ANALYSIS OF PROJECTED DATA AND RAINFALL DISTRIBUTION OF 2010-2018



National Water Research Institute of Malaysia (NAHRIM)

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CHAPTER 1
INTRODUCTION

NAHRIM had previously carried out studies on the climate change projection for Peninsular Malaysia in 2014 (NAHRIM 2014)[1], and for Sabah & Sarawak in 2010 (NAHRIM 2010)[2]; taking into consideration technical information set out in The Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change (IPCC) under greenhouse gas scenarios A1B, A2 and B1 for the projected period of 2010-2100.

1.1 Greenhouse Gas Scenarios and Surface Warming

According to the IPCC (2007)[3], the AR4 is the fourth in a series of reports intended to assess scientific, technical and socio-economic information concerning climate change, its potential effects, and options for adaptation and mitigation. There are six families of scenarios discussed in the AR4, namely; A1FI, A1B, A1T, A2, B1, and B2. Among these scenarios, individual model projections for the 21st century across the A1B, A2 and B1 greenhouse gas scenarios are in agreement, showing greater temperature extremes consistent with a warmer climate. The scenarios are "baseline" scenarios, which meant that they do not take into account any current or future measures to limit greenhouse gas (CO_2) emissions, as shown in Figure 1.1. According to the AR4, the key assumptions for the respective scenarios A1B, A2 and B1 are as follows:

i. A1B:

   A future world of very rapid economic growth, low population growth and rapid introduction of new and more efficient technology. The major underlying themes are economic and cultural convergence and capacity building, with a substantial reduction in regional differences in per capita income. In this world, people pursue personal wealth rather than environmental quality;

[1] NAHRIM, *Final Report on Extension of The Study of The Impact of Climate Change on The Hydrologic Regime and Water Resources of Peninsular Malaysia*, Malaysia, National Hydraulic Research Institute of Malaysia (NAHRIM), 2014.
[2] NAHRIM, *Study of The Impact of Climate Change on Hydrologic Regime and Water Resources of Sabah and Sarawak*, Malaysia, National Hydraulic Research Institute of Malaysia (NAHRIM), 2010.
[3] IPCC, *Climate Change 2007 Synthesis Report: Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Geneva, Intergovernmental Panel on Climate Change (IPCC), 2007.

ii. A2:

A very heterogeneous world. The underlying theme is that of strengthening regional cultural identities, with an emphasis on family values and local traditions, high population growth, and less concern for rapid economic development; and

iii. B1:

A convergent world with the same global population as in the A1 storyline, but with rapid changes in economic structures toward a service and information economy, with reductions in materials intensity, and the introduction of clean and resource-efficient technologies.

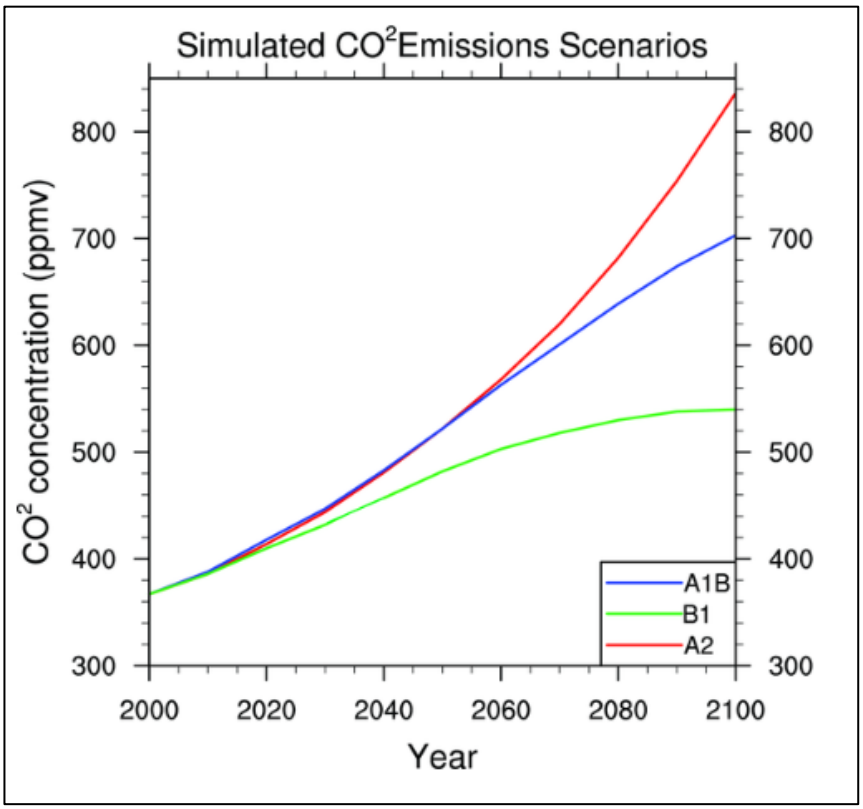


Figure 1.1: Projected CO_2 concentration in the absence of additional climate policies (ESRL n.d.)[1]

Based on the assessment that was carried out by NAHRIM through comparing the estimated average temperature increments up to year 2100 for Peninsular Malaysia, Sabah and Sarawak (Figure 1.2), the average temperature increment of 2.7°C in Peninsular Malaysia is found to be close to the mean global surface warming value (from 1.7°C to 4.4°C) estimated

[1] ESRL, *IPCC AR4 Variable Descriptions*, [website], n.d., https://www.esrl.noaa.gov/psd/ipcc/extremes/scenarios.html, (accessed 22 Jul 2019).

under scenario A1B. The average temperature increments in Sabah (3.5°C) and Sarawak (2.0°C) are close to the mean global surface warming values under scenarios A2 (from 2.0°C to 5.4°C) and B1 (from 1.1°C to 2.9°C), respectively. These indicated that more accurate projections could be expected for Peninsular Malaysia under the A1B scenario, while for Sabah and Sarawak it would be under the A2 and B1 scenario, respectively. However, as shown in Figures 1.1 & 1.2, there is no significant difference in either projected CO_2 concentration or global surface warming, estimated among the three scenarios A1B, A2 and B1 in the study period (2014-2018) of this report. Therefore, any significant difference in the projections under these scenarios for the period of 2014-2018 is not be expected.

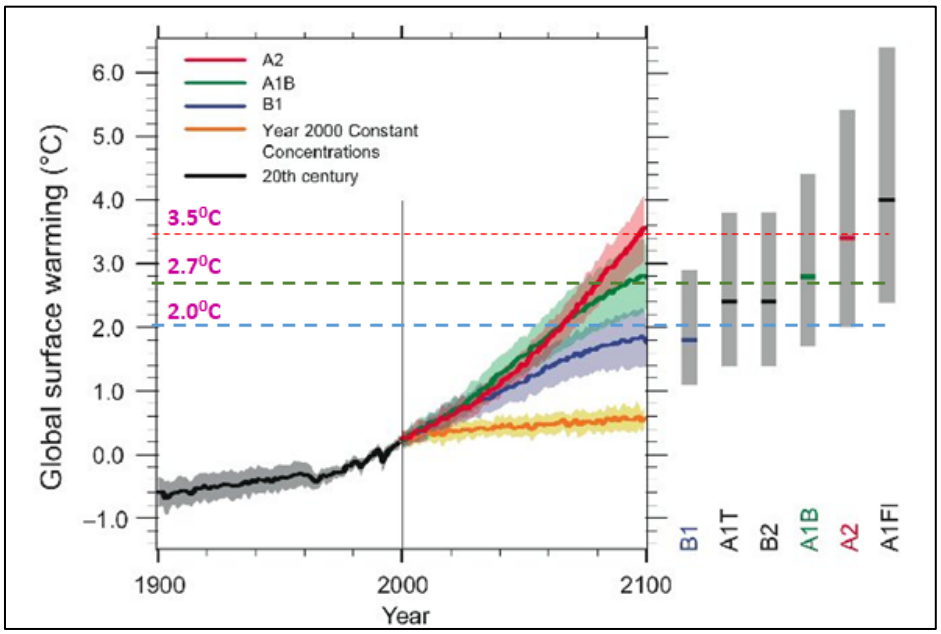


Figure 1.2: Multi-model averages and assessed ranges for surface warming (edited from IPCC 2007)[1]

[1] IPCC, *loc. cit.*

1.2 Climate Projection Models

The available global historical and climate change atmospheric databases produced by the ECHAM5, CCSM3 and MRI-CGCM2.3.2 were downscaled for the region of Peninsular Malaysia at a spatial resolution of 6 km with the Regional Hydro-Climate Model of Peninsular Malaysia (RegHCM-PM) under scenarios A1B, A2 and B1 (NAHRIM 2014)[1]. The time resolution selected for both regional models was on the hour basis.

Over in Sabah & Sarawak, the databases produced by the ECHAM3 and MRI-CGCM2.3.2 were downscaled for the region with the Regional Hydro-Climate Model of Sabah & Sarawak (RegHCM-SS) at a 9 km spatial resolution under scenario A1B (NAHRIM 2010)[2]. The time resolution selected for both regional models was also on the hour basis.

The ECHAM is an atmospheric general circulation model developed at the Max Planck Institute for Meteorology. The ECHAM3 is the third-generation model used for global climate modelling investigations in Germany (Bengtsson et al. 1996)[3], while the ECHAM5 is a newer version (probably the 5th generation) of the ECHAM model with changes made for improvements (Roeckner et al. 2003)[4].

The Community Climate System Model 3 (CCSM3) is a coupled model for simulating past, present, and future climates (William et al. 2006)[5]. Meanwhile, the MRI-CGCM2.3.2 developed by the Meteorological Research Institute (MRI) is the model contributing to the IPCC-AR4 by providing results from numerous experiments for the third phase of the Coupled Model Intercomparison Project (Yukimoto et al. 2006)[6].

[1] NAHRIM, *loc. cit.*
[2] NAHRIM, *loc. cit.*
[3] Bengtsson, L. et al., 'Climate predictability experiments with a general circulation model', *Climate Dynamics*, vol. 12, 1996, pp. 261–278
[4] Roeckner, E. et al., *The atmospheric general circulation model ECHAM5: Part I*, Germany, Max Planck Institute for Meteorology, 2003.
[5] William, D.C. et al., 'The Community Climate System Model Version 3 (CCSM3)', *Journal of Climate*, vol. 19, 2006, pp. 2122-2143.
[6] Yukimoto, S. et al., 'Present-Day Climate and Climate Sensitivity in the Meteorological Research Institute Coupled GCM Version 2.3 (MRI-CGCM2.3)', *Journal of the Meteorological Society of Japan*, vol. 84, no. 2, 2006, pp. 333—363.

When NAHRIM initiated their climate change studies for Peninsular Malaysia and Sabah & Sarawak in 2014 and 2010, respectively, the databases produced by these models were downscaled and used in the RegHCM-PM and RegHCM-SS models. These models were the most advance models available then, embedded with the then most recent AR4's greenhouse gas scenarios, A1B, A2 and B1.

1.3 Scope of Study

The scope of study includes the temporal yearly rainfall pattern projection with the previously mentioned climate models for both Peninsular Malaysia and Sabah & Sarawak. These were done encompassing the various future scenarios for the periods of 2014-2018 and 2018. The results obtained were analysed and discussed on the state basis and also on the station basis. The differences between the projected and observed yearly rainfall were compared to assess the accuracy of the projections. The performances of the climate models were then assessed through estimating the average percentages of the over-projection or under-projection for the 2014-2018 yearly rainfalls.

Spatial distributions of the 2018 yearly rainfall projections and observations, and their respective differences, were also mapped and discussed. Figures 1.3a & 1.3b show the state boundaries for Peninsular Malaysia and division boundaries for Sabah & Sarawak, respectively.



Figure 1.3a: State boundaries of Peninsular Malaysia

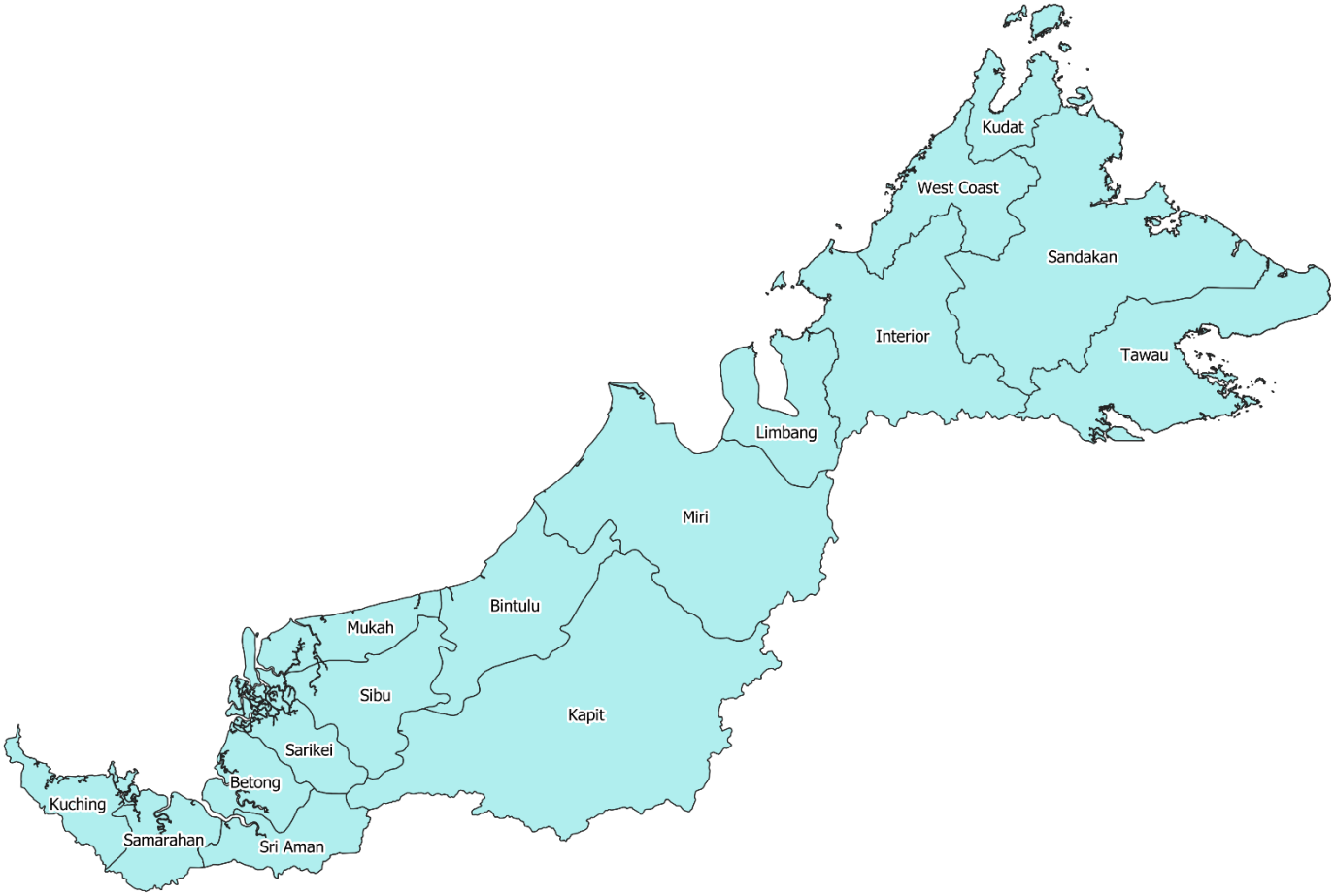


Figure 1.3b: Division boundaries of Sabah & Sarawak

The study continued with detection of the yearly rainfall trend direction. The trends for both the observed and projected 2018 rainfall for all the stations were estimated using the Mann-Kendall test, followed with the comparison of results between the observations and the projections to assess the accuracy of the models. The Mann-Kendall test (Mann 1945[1], Kendall 1975[2]) is to statistically determine whether the normally distributed or linear yearly rainfall series has a monotonic upward or downward trend. A monotonic upward trend would mean that the variable consistently increases with time. Conversely, the monotonic downward trend would indicate that the variable consistently decreases over time.

The changes in the trend slope for both the observed and the projected 2018 yearly rainfall were then quantified for each station using the Sen's slope method (Sen 1968[3]). The Sen's slope method is commonly used to determine the magnitude or significance of the trend slope detected in the Mann-Kendall test.

Lastly, the spatial distributions of these changes were presented with comparison to evaluate the accuracy of model projections.

[1] Mann, H.B., 'Non-parametric tests against trend', *Econometrica*, vol. 13, 1945, pp. 163-171.

[2] Kendall, M.G., *Rank Correlation Methods, 4th edition*, London, Charles Griffin, 1975.

[3] Sen, P.K., 'Estimates of the Regression Coefficient based on Kendall's Tau', *Journal of the American Statistical Association*, vol. 63, 1968, pp. 1379-1389.

CHAPTER 2
ANALYSIS OF YEARLY RAINFALL

2.1 Peninsular Malaysia

2.1.1 Temporal Yearly Rainfall Pattern Analysis for the whole Peninsular Malaysia

The projected 2014-2018 yearly rainfall based on three different climate models namely ECHM5, CCSM3 and MRI, under CO_2 emission scenarios: A1B, A2 and B1 were compared with the observed yearly rainfall for Peninsular Malaysia over the same period. These are shown in Table 2.1 and Figure 2.1. There are no significant differences in the projected yearly rainfall among the scenarios, found for each individual model used. The insignificant differences among these scenarios are actually consistent with the simulated CO_2 emission and global surface warming increment scenarios introduced by the IPCC. In the report the concentrations of CO_2 and the increments of surface warming for these scenarios did not show any significant difference from year 2000 up to year 2020, as shown in Figures 1.1 & 1.2.

Table 2.1: Projected and observed 2014-2018 yearly rainfall for Peninsular Malaysia

Peninsular Malaysia						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	2,352	2,189	2,748	1,901	2,522	2,342
ECHM5_A1B_2	2,227	2,451	2,096	2,283	1,813	2,174
ECHM5_A1B_3	2,835	2,300	2,503	2,110	2,176	2,385
Average_ECHM5_A1B	2,471	2,313	2,449	2,098	2,170	2,300
ECHM5_A2_1	2,329	2,173	2,342	2,324	2,310	2,296
ECHM5_A2_2	2,123	2,665	1,976	2,727	2,144	2,327
ECHM5_A2_3	2,300	2,397	1,932	2,191	2,205	2,205
Average_ECHM5_A2	2,251	2,411	2,083	2,414	2,220	2,276
ECHM5_B1_1	2,424	2,441	2,243	2,184	2,571	2,373
ECHM5_B1_2	2,029	2,279	1,881	2,230	2,526	2,189
ECHM5_B1_3	2,245	2,274	2,223	2,643	2,362	2,349
Average_ECHM5_B1	2,233	2,331	2,115	2,352	2,487	2,304
CCSM3_A1B	2,675	1,626	2,581	2,006	1,715	2,121
CCSM3_A2	2,426	1,830	1,590	1,866	1,643	1,871
CCSM3_B1	2,268	2,073	1,808	1,850	1,974	1,995
MRI_A1B	2,405	1,918	2,260	2,183	1,315	2,016
MRI_B1	2,023	1,978	1,694	2,360	1,937	1,998
Average_A1B	2,499	2,097	2,438	2,097	1,908	2,208
Average_A2	2,294	2,266	1,960	2,277	2,076	2,175
Average_B1	2,198	2,209	1,970	2,253	2,274	2,181
Average_ALL	2,333	2,185	2,134	2,204	2,087	2,189
OBSERVED	2,398	2,117	2,049	2,655	2,362	2,316

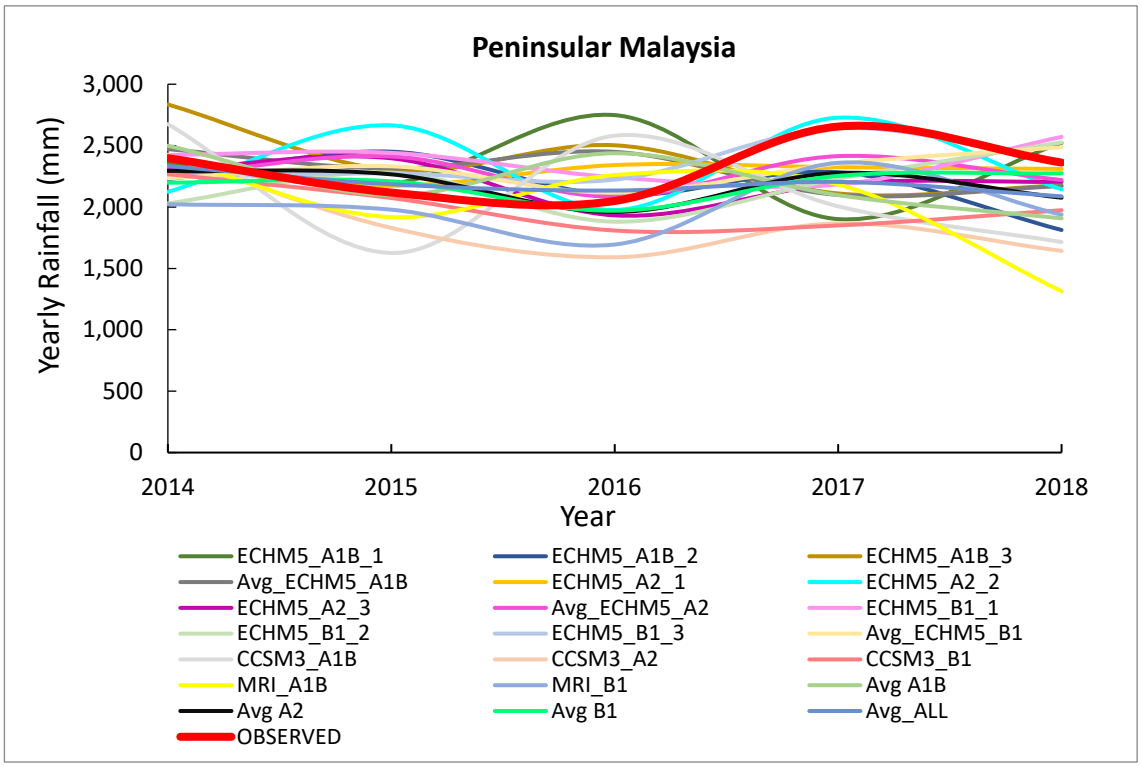


Figure 2.1: Projected and observed 2014-2018 yearly rainfall for Peninsular Malaysia

Among the models, for the average for 2014-2018, the ECHM5 performed better than the CCSM3 and the MRI. The difference between projection and observation of 1% for scenario A1B, -1% for scenario A2 and 0% for scenario B1, are as shown in Table 2.2. For the 2018 yearly rainfall projection, the performance of the ECHM5 in the 2018 (Figure 2.2) was also higher than the other two models for all the scenarios. The differences of -8% for scenario A1B, -6% for scenario A2 and 5% for scenario B1, respectively, are shown in Table 2.2.

Table 2.2: Difference between projected and observed 2014-2018 yearly rainfall for Peninsular Malaysia

Peninsular Malaysia						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-2	3	34	-28	7	3
ECHM5_A1B_2	-7	16	2	-14	-23	-5
ECHM5_A1B_3	18	9	22	-21	-8	4
Average_ECHM5_A1B	3	9	20	-21	-8	1
ECHM5_A2_1	-3	3	14	-12	-2	0
ECHM5_A2_2	-11	26	-4	3	-9	1
ECHM5_A2_3	-4	13	-6	-17	-7	-4
Average_ECHM5_A2	-6	14	2	-9	-6	-1
ECHM5_B1_1	1	15	9	-18	9	3
ECHM5_B1_2	-15	8	-8	-16	7	-5
ECHM5_B1_3	-6	7	8	0	0	2
Average_ECHM5_B1	-7	10	3	-11	5	0
CCSM3_A1B	12	-23	26	-24	-27	-7
CCSM3_A2	1	-14	-22	-30	-30	-19
CCSM3_B1	-5	-2	-12	-30	-16	-13
MRI_A1B	0	-9	10	-18	-44	-12
MRI_B1	-16	-7	-17	-11	-18	-14
Average_A1B	4	-1	19	-21	-19	-4
Average_A2	-4	7	-4	-14	-12	-5
Average_B1	-8	4	-4	-15	-4	-5
Average_ALL	-3	3	4	-17	-12	-5

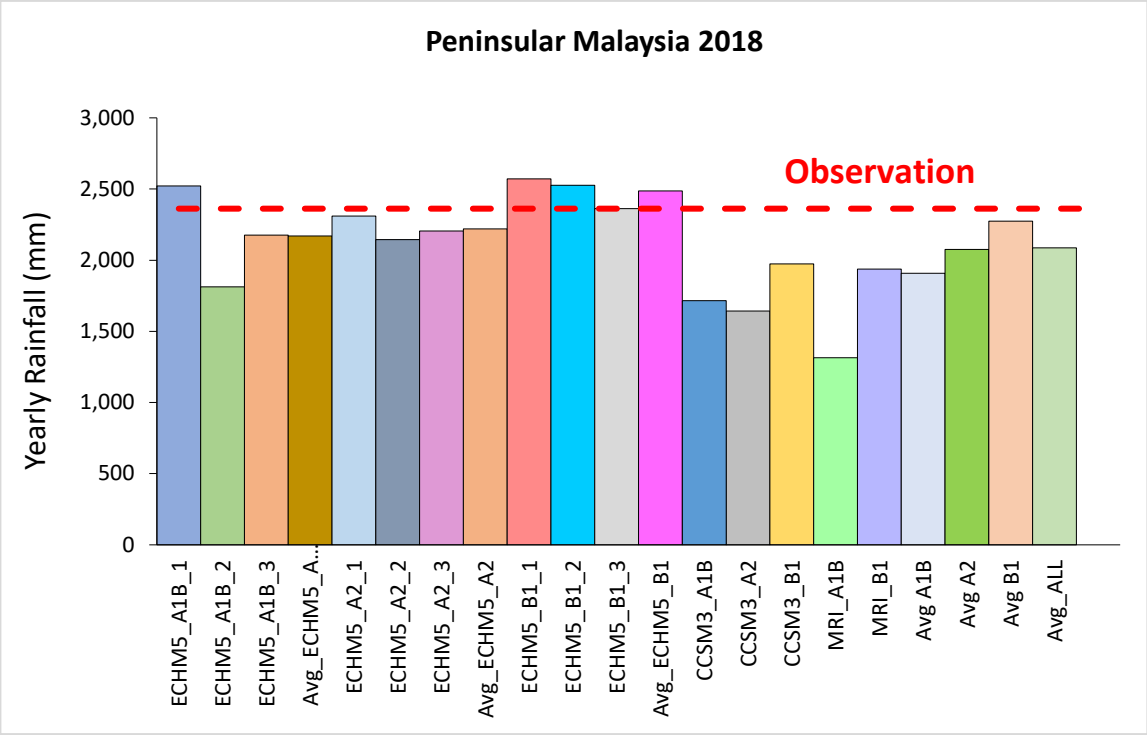


Figure 2.2: Projected and observed 2018 yearly rainfall for Peninsular Malaysia

The performances of models were also assessed through estimating the average percentages for both the over projected and under projected 2014-2018 yearly rainfall. Taken as a group, for the average performance, the three models were found to give 10% of over projection and -13% of under projection, as shown in Table 2.3 and Figure 2.3. Individually, the ECHM5 showed the smallest percentages of 10% over projection and -10% under projection among the three models (Table 2.3).

Table 2.3: Average percentage of over projected and under projected by models for 2014-2018 yearly rainfall for Peninsular Malaysia

Model	Projection	Average Percentage (%)
All	Over Projected	10
	Under Projected	-13
ECHM5	Over Projected	10
	Under Projected	-10
CCSM3	Over Projected	13
	Under Projected	-20
MRI	Over Projected	5
	Under Projected	-18

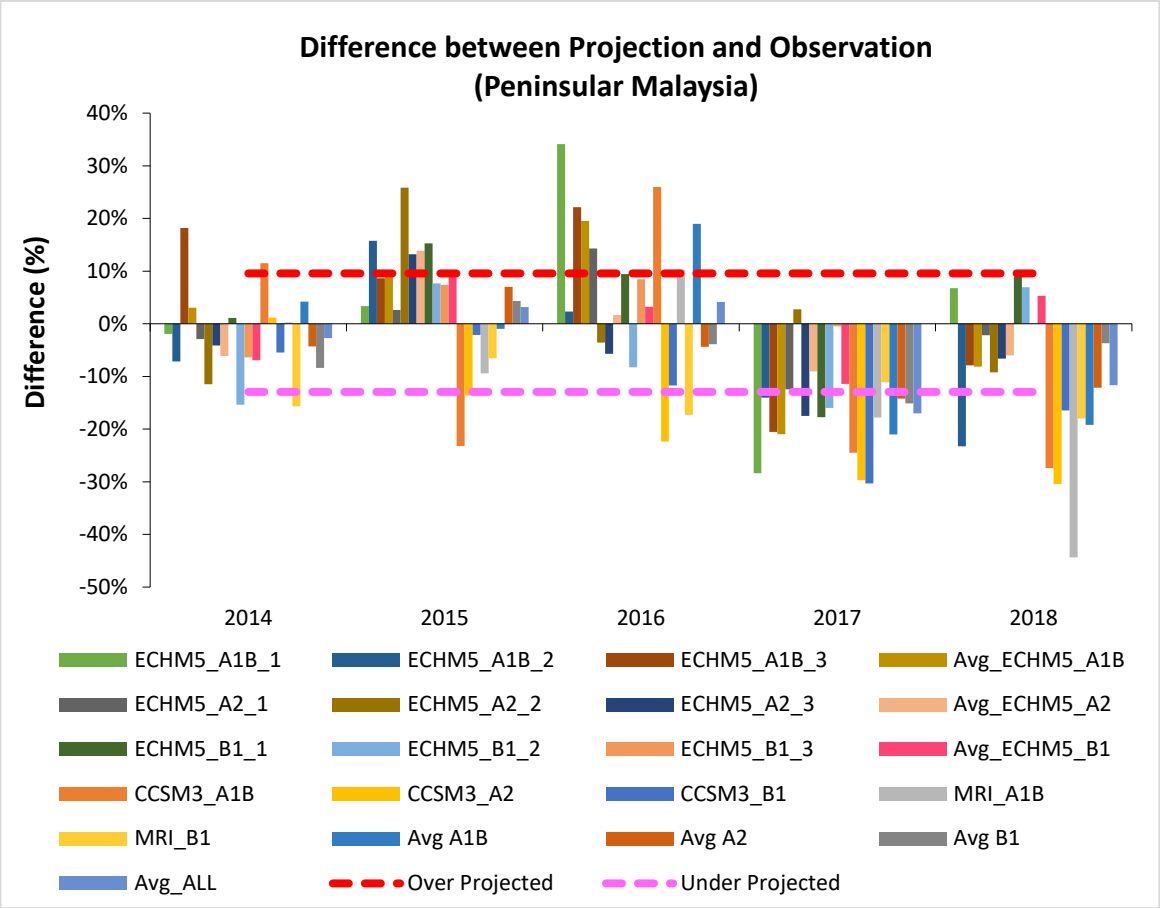


Figure 2.3: Difference between projected and observed 2014-2018 yearly rainfall for Peninsular Malaysia

2.1.2 Temporal Yearly Rainfall Pattern Analysis according to States

The projected 2014-2018 yearly rainfall based on the three different climate models under CO_2 emission scenarios: A1B, A2 and B1 were compared with the observed yearly rainfall. For the respective 11 states namely Selangor & Kuala Lumpur, Negeri Sembilan, Melaka, Johor, Pahang, Terengganu, Kelantan, Perlis, Kedah, Pulau Pinang and Perak, the results are shown in Tables 2.4a-2.4k and Figures 2.4a-2.4k. In general, there is no significant difference in the projected yearly rainfall among the scenarios for each individual model in every state. This is consistent with the concentrations of CO_2 and global surface warming increments simulated by the IPCC for these scenarios from year 2000 to year 2020, where they have similar CO_2 concentration and surface warming increment (Figures 1.1 & 1.2).

Table 2.4a: Projected and observed 2014-2018 yearly rainfall for Selangor & Kuala Lumpur

Selangor & Kuala Lumpur						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	2,967	2,229	2,722	1,686	2,471	2,415
ECHM5_A1B_2	2,066	2,712	2,072	2,118	2,070	2,208
ECHM5_A1B_3	3,022	2,494	2,704	2,224	2,364	2,562
Average_ECHM5_A1B	2,685	2,478	2,499	2,009	2,302	2,395
ECHM5_A2_1	2,093	2,344	2,429	2,212	2,484	2,312
ECHM5_A2_2	1,941	2,425	2,108	2,872	2,520	2,373
ECHM5_A2_3	2,162	2,076	1,887	2,268	2,231	2,125
Average_ECHM5_A2	2,065	2,282	2,141	2,451	2,412	2,270
ECHM5_B1_1	2,231	2,602	2,337	2,194	2,428	2,358
ECHM5_B1_2	1,965	2,131	1,979	2,279	2,521	2,175
ECHM5_B1_3	2,005	2,540	2,144	3,024	2,242	2,391
Average_ECHM5_B1	2,067	2,424	2,153	2,499	2,397	2,308
CCSM3_A1B	2,481	1,511	2,228	1,719	1,730	1,934
CCSM3_A2	2,002	1,227	1,136	1,607	1,495	1,493
CCSM3_B1	2,013	1,575	1,598	1,518	1,667	1,674
MRI_A1B	2,491	1,895	2,244	1,980	1,401	2,002
MRI_B1	1,983	1,929	1,847	2,153	1,965	1,975
Average_A1B	2,605	2,168	2,394	1,945	2,007	2,224
Average_A2	2,049	2,018	1,890	2,240	2,183	2,076
Average_B1	2,040	2,155	1,981	2,233	2,164	2,115
Average_ALL	2,244	2,121	2,102	2,132	2,114	2,143
OBSERVED	2,421	2,465	2,099	2,419	2,371	2,355

Table 2.4b: Projected and observed 2014-2018 yearly rainfall for Negeri Sembilan

Negeri Sembilan						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	2,097	1,840	2,093	1,276	2,098	1,881
ECHM5_A1B_2	1,414	1,923	1,697	1,575	1,640	1,650
ECHM5_A1B_3	2,295	1,689	2,178	1,615	1,732	1,902
Average_ECHM5_A1B	1,935	1,818	1,989	1,488	1,824	1,811
ECHM5_A2_1	1,798	1,833	1,675	1,841	2,062	1,842
ECHM5_A2_2	1,398	1,774	1,530	2,296	2,054	1,810
ECHM5_A2_3	1,841	1,677	1,433	1,759	1,781	1,698
Average_ECHM5_A2	1,679	1,761	1,546	1,965	1,966	1,783
ECHM5_B1_1	1,902	2,113	1,943	1,709	1,967	1,927
ECHM5_B1_2	1,606	1,667	1,406	1,744	1,915	1,668
ECHM5_B1_3	1,571	1,873	1,694	2,429	1,720	1,857
Average_ECHM5_B1	1,693	1,884	1,681	1,961	1,867	1,817
CCSM3_A1B	2,171	1,436	1,912	1,599	1,498	1,723
CCSM3_A2	2,070	1,232	1,228	1,762	1,389	1,536
CCSM3_B1	1,749	1,723	1,603	1,539	1,495	1,622
MRI_A1B	1,866	1,507	1,817	1,553	1,301	1,609
MRI_B1	1,489	1,573	1,714	1,595	1,715	1,617
Average_A1B	1,968	1,679	1,939	1,523	1,654	1,753
Average_A2	1,777	1,629	1,467	1,915	1,822	1,722
Average_B1	1,663	1,790	1,672	1,803	1,762	1,738
Average_ALL	1,805	1,704	1,709	1,735	1,740	1,739
OBSERVED	1,949	1,827	1,612	2,040	1,970	1,880

Table 2.4c: Projected and observed 2014-2018 yearly rainfall for Melaka

Melaka						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,099	2,132	2,279	1,389	1,954	1,971
ECHM5_A1B_2	1,671	2,002	1,683	1,685	1,962	1,801
ECHM5_A1B_3	2,331	1,733	2,475	1,706	1,833	2,016
Average_ECHM5_A1B	2,034	1,956	2,146	1,593	1,916	1,929
ECHM5_A2_1	2,002	1,979	1,998	1,936	2,404	2,064
ECHM5_A2_2	1,795	1,898	1,789	2,672	2,420	2,115
ECHM5_A2_3	1,770	1,837	1,711	2,128	1,840	1,857
Average_ECHM5_A2	1,856	1,905	1,833	2,245	2,221	2,012
ECHM5_B1_1	1,816	2,214	1,919	1,653	1,989	1,918
ECHM5_B1_2	1,465	1,596	1,632	1,932	2,115	1,748
ECHM5_B1_3	1,579	2,070	1,998	3,168	1,779	2,119
Average_ECHM5_B1	1,620	1,960	1,850	2,251	1,961	1,928
CCSM3_A1B	1,721	1,010	1,578	957	1,099	1,273
CCSM3_A2	1,671	938	930	1,921	1,735	1,439
CCSM3_B1	1,452	1,494	1,093	1,083	1,187	1,262
MRI_A1B	1,944	1,694	1,706	1,599	1,252	1,639
MRI_B1	1,531	1,657	1,833	1,834	1,647	1,700
Average_A1B	1,953	1,714	1,944	1,467	1,620	1,740
Average_A2	1,810	1,663	1,607	2,164	2,100	1,869
Average_B1	1,569	1,806	1,695	1,934	1,744	1,750
Average_ALL	1,775	1,732	1,759	1,833	1,801	1,780
OBSERVED	1,546	1,645	1,487	1,942	1,928	1,710

Table 2.4d: Projected and observed 2014-2018 yearly rainfall for Johor

Johor						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,582	2,394	2,993	1,826	2,734	2,506
ECHM5_A1B_2	2,057	2,621	2,176	2,028	1,885	2,153
ECHM5_A1B_3	2,778	2,304	2,395	1,871	2,027	2,275
Average_ECHM5_A1B	2,472	2,440	2,522	1,908	2,215	2,311
ECHM5_A2_1	2,460	2,215	2,299	2,715	2,483	2,434
ECHM5_A2_2	1,859	2,629	1,889	3,039	2,740	2,431
ECHM5_A2_3	2,011	3,032	2,242	2,608	2,115	2,402
Average_ECHM5_A2	2,110	2,625	2,144	2,787	2,446	2,422
ECHM5_B1_1	2,568	2,607	2,431	1,994	2,389	2,398
ECHM5_B1_2	1,833	1,874	1,812	2,141	2,460	2,024
ECHM5_B1_3	1,922	2,357	2,325	3,140	2,219	2,393
Average_ECHM5_B1	2,108	2,279	2,189	2,425	2,356	2,271
CCSM3_A1B	2,711	1,715	1,994	2,106	2,188	2,143
CCSM3_A2	2,443	1,601	1,940	1,818	1,603	1,881
CCSM3_B1	1,832	2,210	1,870	1,994	2,229	2,027
MRI_A1B	2,108	2,120	2,593	1,948	2,033	2,160
MRI_B1	2,057	2,229	2,665	2,061	2,292	2,261
Average_A1B	2,447	2,231	2,430	1,956	2,174	2,248
Average_A2	2,193	2,369	2,093	2,545	2,235	2,287
Average_B1	2,043	2,255	2,221	2,266	2,318	2,221
Average_ALL	2,230	2,279	2,259	2,235	2,243	2,249
OBSERVED	2,113	1,844	1,839	2,585	2,327	2,142

Table 2.4e: Projected and observed 2014-2018 yearly rainfall for Pahang

Pahang						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	2,278	2,097	2,580	1,850	2,617	2,284
ECHM5_A1B_2	1,751	2,085	2,213	2,232	1,596	1,975
ECHM5_A1B_3	2,645	2,165	2,353	1,935	1,904	2,200
Average_ECHM5_A1B	2,224	2,116	2,382	2,005	2,039	2,153
ECHM5_A2_1	2,311	2,010	2,230	2,470	2,291	2,262
ECHM5_A2_2	1,706	2,515	1,800	2,439	2,116	2,115
ECHM5_A2_3	2,257	2,422	1,795	2,119	2,160	2,151
Average_ECHM5_A2	2,091	2,316	1,941	2,343	2,189	2,176
ECHM5_B1_1	2,384	2,391	2,243	2,010	2,491	2,304
ECHM5_B1_2	2,013	2,077	1,788	2,119	2,473	2,094
ECHM5_B1_3	2,016	1,963	2,108	2,631	2,227	2,189
Average_ECHM5_B1	2,138	2,144	2,047	2,253	2,397	2,196
CCSM3_A1B	2,973	2,168	2,444	2,374	2,164	2,425
CCSM3_A2	2,557	1,876	1,896	2,155	1,896	2,076
CCSM3_B1	2,484	2,554	2,014	1,952	2,348	2,270
MRI_A1B	2,341	1,975	2,294	2,134	1,566	2,062
MRI_B1	2,102	1,879	2,002	2,186	2,261	2,086
Average_A1B	2,398	2,098	2,377	2,105	1,969	2,189
Average_A2	2,208	2,206	1,930	2,296	2,116	2,151
Average_B1	2,200	2,173	2,031	2,180	2,360	2,189
Average_ALL	2,273	2,156	2,126	2,186	2,151	2,178
OBSERVED	1,997	1,602	1,453	2,448	1,988	1,898

Table 2.4f: Projected and observed 2014-2018 yearly rainfall for Terengganu

Terengganu						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	2,500	2,599	3,475	3,127	3,237	2,988
ECHM5_A1B_2	2,931	2,690	2,663	3,509	1,807	2,720
ECHM5_A1B_3	3,937	2,959	3,898	2,671	2,192	3,131
Average_ECHM5_A1B	3,123	2,749	3,345	3,102	2,412	2,946
ECHM5_A2_1	3,299	3,106	3,403	3,612	2,805	3,245
ECHM5_A2_2	2,464	4,064	2,413	3,104	2,043	2,818
ECHM5_A2_3	3,148	3,840	2,400	2,665	2,872	2,985
Average_ECHM5_A2	2,970	3,670	2,739	3,127	2,573	3,016
ECHM5_B1_1	3,313	3,544	3,073	2,530	3,814	3,255
ECHM5_B1_2	2,719	3,470	2,575	3,115	3,564	3,089
ECHM5_B1_3	3,062	2,564	3,322	3,184	3,326	3,092
Average_ECHM5_B1	3,031	3,192	2,990	2,943	3,568	3,145
CCSM3_A1B	4,058	2,482	2,906	3,104	2,816	3,073
CCSM3_A2	3,975	2,500	2,293	2,723	2,862	2,871
CCSM3_B1	3,411	2,825	2,892	3,107	3,291	3,105
MRI_A1B	3,933	2,806	3,405	3,341	1,700	3,037
MRI_B1	3,396	3,176	2,303	3,819	3,353	3,209
Average_A1B	3,472	2,707	3,269	3,150	2,350	2,990
Average_A2	3,222	3,377	2,627	3,026	2,646	2,980
Average_B1	3,180	3,116	2,833	3,151	3,469	3,150
Average_ALL	3,296	3,044	2,930	3,115	2,834	3,044
OBSERVED	3,689	2,469	3,005	4,266	3,374	3,361

Table 2.4g: Projected and observed 2014-2018 yearly rainfall for Kelantan

Kelantan						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	2,455	2,251	2,679	2,811	2,842	2,608
ECHM5_A1B_2	2,540	2,713	2,532	2,632	1,750	2,433
ECHM5_A1B_3	3,248	2,547	2,816	2,500	2,128	2,648
Average_ECHM5_A1B	2,748	2,504	2,676	2,647	2,240	2,563
ECHM5_A2_1	2,905	2,589	2,792	2,666	2,474	2,685
ECHM5_A2_2	1,986	3,190	2,323	2,501	2,132	2,426
ECHM5_A2_3	2,594	2,628	2,492	2,408	2,501	2,525
Average_ECHM5_A2	2,495	2,802	2,535	2,525	2,369	2,545
ECHM5_B1_1	2,394	3,229	2,728	2,298	3,211	2,772
ECHM5_B1_2	2,617	2,795	2,108	2,516	2,947	2,597
ECHM5_B1_3	2,805	2,281	2,759	2,878	3,090	2,763
Average_ECHM5_B1	2,606	2,768	2,531	2,564	3,083	2,710
CCSM3_A1B	3,650	2,339	2,960	3,296	2,133	2,876
CCSM3_A2	3,733	2,741	2,385	2,307	2,477	2,729
CCSM3_B1	2,930	2,688	2,904	2,954	2,922	2,880
MRI_A1B	2,910	2,273	2,863	2,507	1,293	2,369
MRI_B1	2,312	2,415	1,618	2,941	2,258	2,309
Average_A1B	2,961	2,425	2,770	2,749	2,029	2,587
Average_A2	2,805	2,787	2,498	2,470	2,396	2,591
Average_B1	2,612	2,682	2,423	2,717	2,886	2,664
Average_ALL	2,791	2,620	2,568	2,658	2,440	2,615
OBSERVED	3,367	2,069	2,229	3,517	2,638	2,764

Table 2.4h: Projected and observed 2014-2018 yearly rainfall for Perlis

Perlis						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,113	1,696	2,351	1,197	1,889	1,849
ECHM5_A1B_2	2,060	1,954	1,572	1,897	1,446	1,786
ECHM5_A1B_3	2,048	1,861	1,840	1,794	2,507	2,010
Average_ECHM5_A1B	2,074	1,837	1,921	1,629	1,948	1,882
ECHM5_A2_1	1,981	1,637	2,062	1,557	1,905	1,828
ECHM5_A2_2	2,004	2,084	1,605	2,782	1,435	1,982
ECHM5_A2_3	2,221	1,911	1,578	1,426	1,712	1,770
Average_ECHM5_A2	2,069	1,877	1,748	1,922	1,684	1,860
ECHM5_B1_1	1,733	1,611	1,343	1,767	2,059	1,703
ECHM5_B1_2	1,558	1,818	1,506	1,835	2,231	1,790
ECHM5_B1_3	2,239	2,231	1,710	1,563	1,749	1,898
Average_ECHM5_B1	1,844	1,887	1,520	1,722	2,013	1,797
CCSM3_A1B	1,660	695	1,821	1,218	1,004	1,280
CCSM3_A2	1,284	1,633	1,037	1,339	464	1,151
CCSM3_B1	1,742	1,061	780	1,113	844	1,108
MRI_A1B	1,828	1,329	1,680	2,005	792	1,527
MRI_B1	1,522	1,198	850	1,905	1,164	1,328
Average_A1B	1,942	1,507	1,853	1,622	1,528	1,690
Average_A2	1,872	1,816	1,571	1,776	1,379	1,683
Average_B1	1,759	1,584	1,238	1,636	1,609	1,565
Average_ALL	1,857	1,623	1,552	1,671	1,514	1,643
OBSERVED	1,778	1,847	1,457	2,472	1,786	1,868

Table 2.4i: Projected and observed 2014-2018 yearly rainfall for Kedah

Kedah						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	2,353	2,164	2,978	1,742	2,473	2,342
ECHM5_A1B_2	2,856	2,599	2,035	2,339	1,993	2,364
ECHM5_A1B_3	2,761	2,273	2,209	2,260	2,494	2,399
Average_ECHM5_A1B	2,657	2,345	2,407	2,114	2,320	2,369
ECHM5_A2_1	2,300	2,034	2,236	2,188	2,149	2,181
ECHM5_A2_2	2,823	2,904	2,000	2,783	1,900	2,482
ECHM5_A2_3	2,333	2,395	1,920	2,131	2,251	2,206
Average_ECHM5_A2	2,485	2,444	2,052	2,367	2,100	2,290
ECHM5_B1_1	2,657	2,041	2,010	2,596	2,650	2,391
ECHM5_B1_2	2,067	2,576	1,897	2,308	2,522	2,274
ECHM5_B1_3	2,543	2,356	2,132	2,128	2,267	2,285
Average_ECHM5_B1	2,422	2,324	2,013	2,344	2,480	2,317
CCSM3_A1B	2,773	1,537	3,825	1,901	1,274	2,262
CCSM3_A2	2,521	2,304	1,766	1,966	1,257	1,963
CCSM3_B1	2,466	2,077	1,655	1,686	1,614	1,900
MRI_A1B	2,210	1,761	1,948	2,427	975	1,864
MRI_B1	1,884	1,620	1,088	2,398	1,412	1,680
Average_A1B	2,590	2,067	2,599	2,134	1,842	2,246
Average_A2	2,494	2,409	1,981	2,267	1,890	2,208
Average_B1	2,323	2,134	1,756	2,223	2,093	2,106
Average_ALL	2,468	2,189	2,121	2,204	1,945	2,185
OBSERVED	2,653	2,439	2,131	2,900	2,265	2,478

Table 2.4j: Projected and observed 2014-2018 yearly rainfall for Pulau Pinang

Pulau Pinang						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	2,061	2,462	3,357	1,811	2,592	2,457
ECHM5_A1B_2	2,695	2,932	2,166	2,769	1,782	2,469
ECHM5_A1B_3	2,961	2,556	2,171	2,340	2,277	2,461
Average_ECHM5_A1B	2,572	2,650	2,565	2,306	2,217	2,462
ECHM5_A2_1	2,113	1,965	2,129	2,153	1,983	2,069
ECHM5_A2_2	3,025	3,084	2,105	2,847	1,869	2,586
ECHM5_A2_3	2,590	2,325	1,641	2,189	2,296	2,208
Average_ECHM5_A2	2,576	2,458	1,959	2,397	2,049	2,288
ECHM5_B1_1	3,160	2,038	2,100	2,773	2,541	2,522
ECHM5_B1_2	2,129	2,557	1,902	2,193	2,417	2,240
ECHM5_B1_3	2,593	2,405	2,110	2,129	2,656	2,379
Average_ECHM5_B1	2,627	2,334	2,037	2,365	2,538	2,380
CCSM3_A1B	2,142	1,088	3,617	1,240	1,276	1,873
CCSM3_A2	1,493	2,126	1,016	886	1,164	1,337
CCSM3_B1	2,331	2,070	1,378	1,412	1,620	1,762
MRI_A1B	2,273	1,705	1,991	2,257	905	1,826
MRI_B1	1,837	1,994	1,164	2,391	1,456	1,768
Average_A1B	2,426	2,149	2,660	2,083	1,767	2,217
Average_A2	2,305	2,375	1,723	2,019	1,828	2,050
Average_B1	2,410	2,213	1,731	2,180	2,138	2,134
Average_ALL	2,386	2,236	2,061	2,099	1,917	2,140
OBSERVED	2,384	2,465	2,477	2,666	2,737	2,546

Table 2.4k: Projected and observed 2014-2018 yearly rainfall for Perak

Perak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,366	2,215	2,724	2,203	2,830	2,468
ECHM5_A1B_2	2,455	2,726	2,252	2,334	2,007	2,355
ECHM5_A1B_3	3,160	2,722	2,489	2,298	2,478	2,629
Average_ECHM5_A1B	2,660	2,554	2,488	2,278	2,439	2,484
ECHM5_A2_1	2,354	2,190	2,503	2,218	2,370	2,327
ECHM5_A2_2	2,352	2,744	2,171	2,665	2,361	2,459
ECHM5_A2_3	2,375	2,220	2,152	2,402	2,496	2,329
Average_ECHM5_A2	2,360	2,385	2,275	2,428	2,409	2,371
ECHM5_B1_1	2,509	2,461	2,542	2,497	2,744	2,551
ECHM5_B1_2	2,348	2,513	2,080	2,353	2,624	2,384
ECHM5_B1_3	2,359	2,371	2,150	2,793	2,708	2,476
Average_ECHM5_B1	2,405	2,448	2,257	2,548	2,692	2,470
CCSM3_A1B	3,083	1,900	3,104	2,548	1,684	2,464
CCSM3_A2	2,937	1,951	1,867	2,047	1,726	2,106
CCSM3_B1	2,536	2,524	2,105	1,992	2,496	2,331
MRI_A1B	2,551	2,032	2,315	2,262	1,243	2,081
MRI_B1	2,136	2,090	1,556	2,674	1,787	2,049
Average_A1B	2,723	2,319	2,577	2,329	2,049	2,399
Average_A2	2,504	2,276	2,173	2,333	2,238	2,305
Average_B1	2,378	2,392	2,087	2,462	2,472	2,358
Average_ALL	2,537	2,333	2,286	2,378	2,254	2,358
OBSERVED	2,485	2,621	2,753	1,952	2,596	2,481

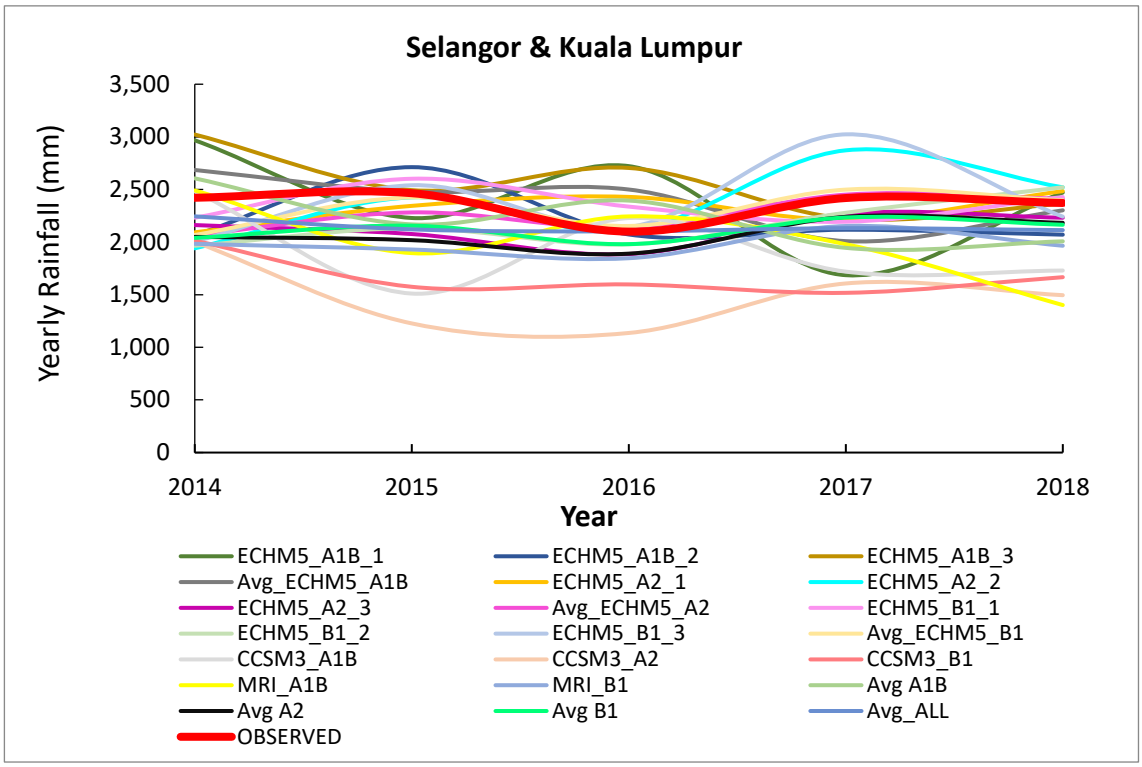


Figure 2.4a: Projected and observed 2014-2018 yearly rainfall for Selangor & Kuala Lumpur

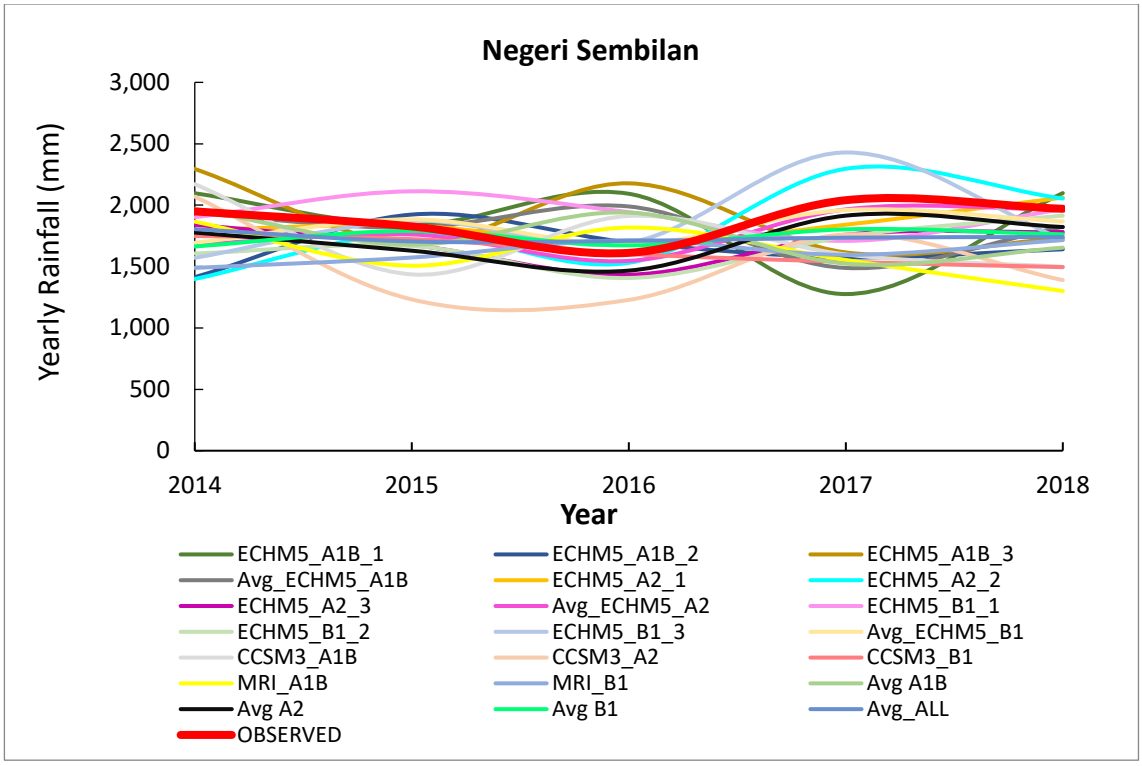


Figure 2.4b: Projected and observed 2014-2018 yearly rainfall for Negeri Sembilan

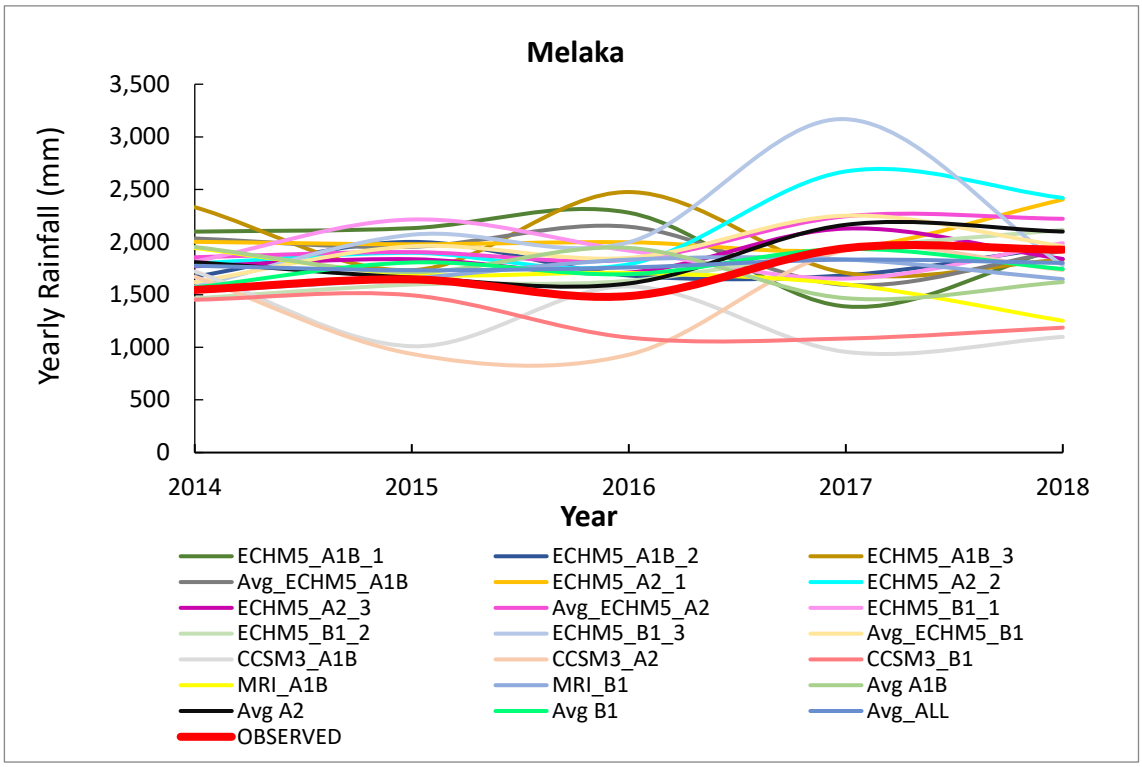


Figure 2.4c: Projected and observed 2014-2018 yearly rainfall for Melaka

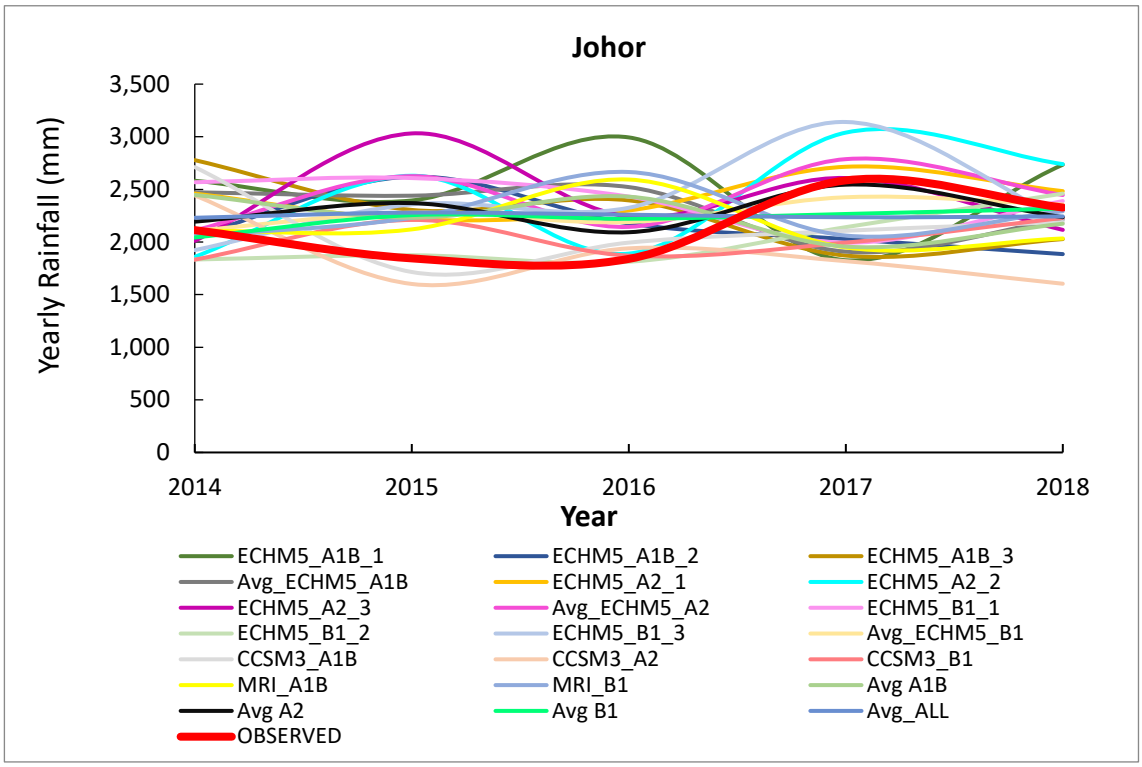


Figure 2.4d: Projected and observed 2014-2018 yearly rainfall for Johor

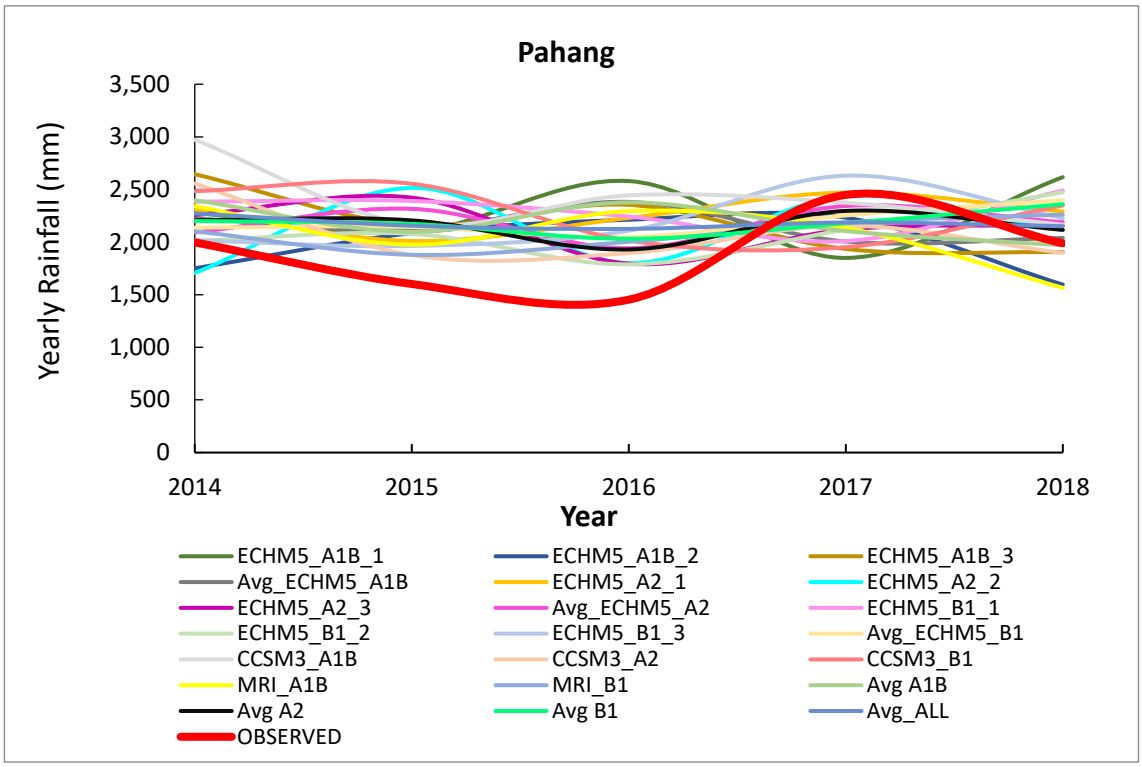


Figure 2.4e: Projected and observed 2014-2018 yearly rainfall for Pahang

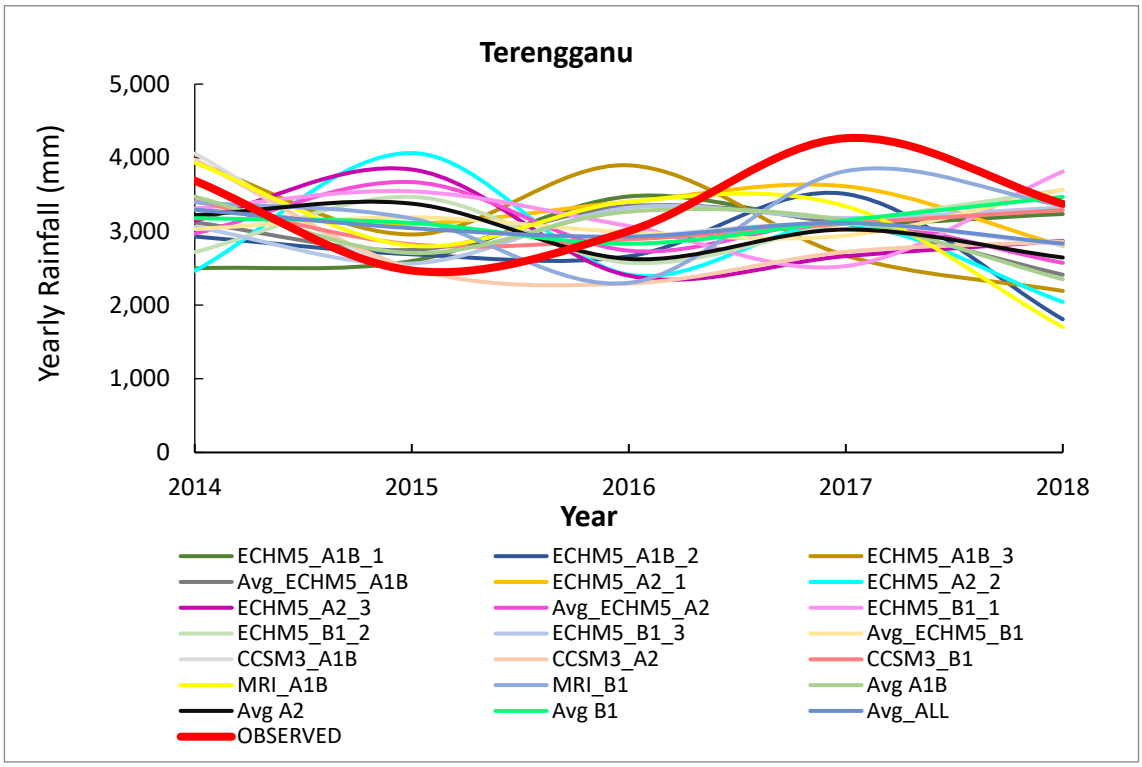


Figure 2.4f: Projected and observed 2014-2018 yearly rainfall for Terengganu

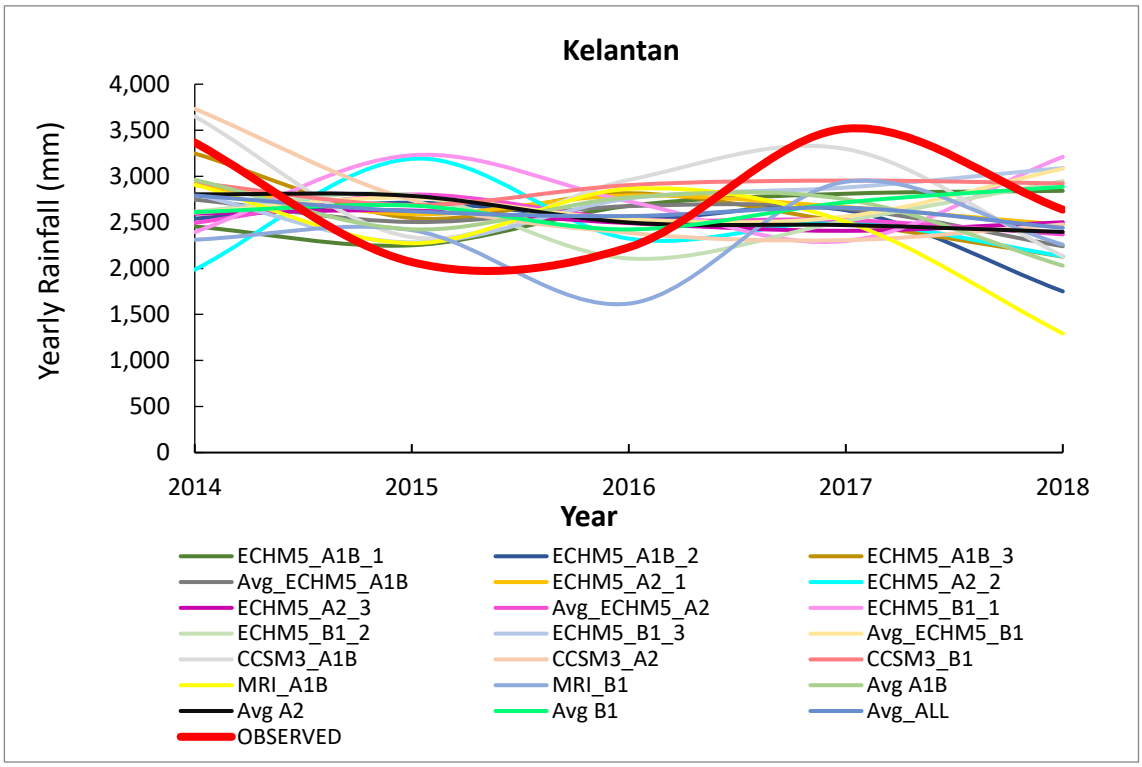


Figure 2.4g: Projected and observed 2014-2018 yearly rainfall for Kelantan

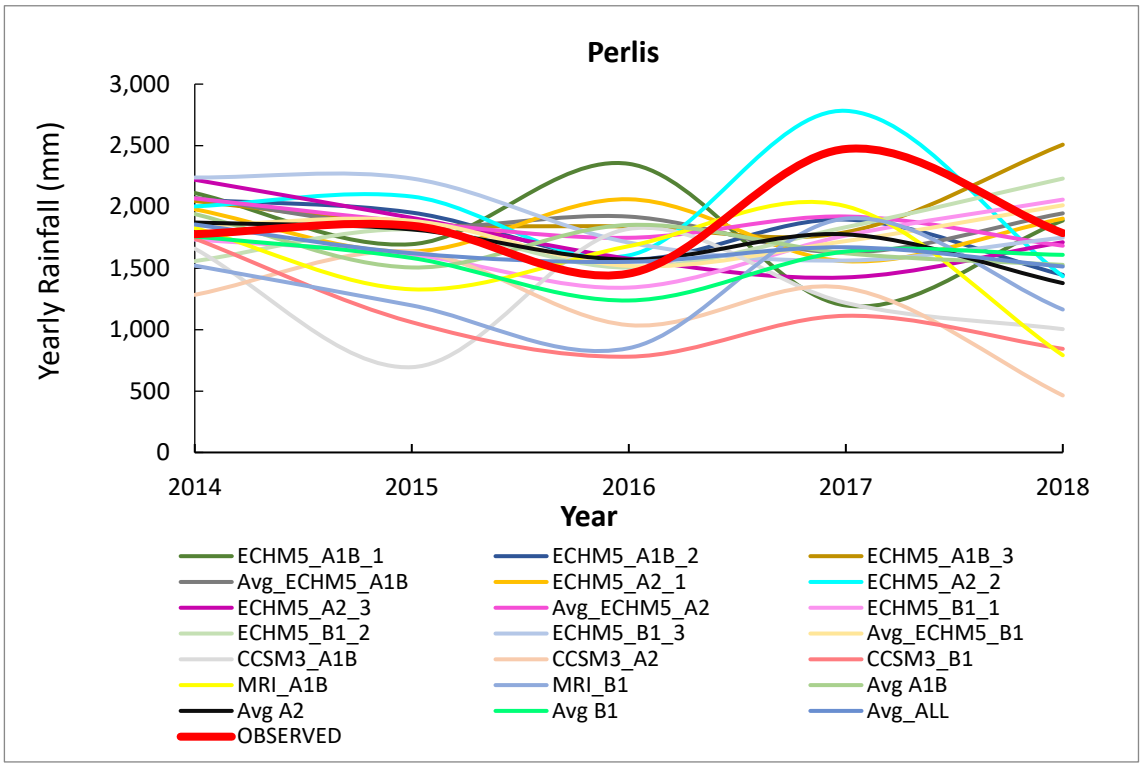


Figure 2.4h: Projected and observed 2014-2018 yearly rainfall for Perlis

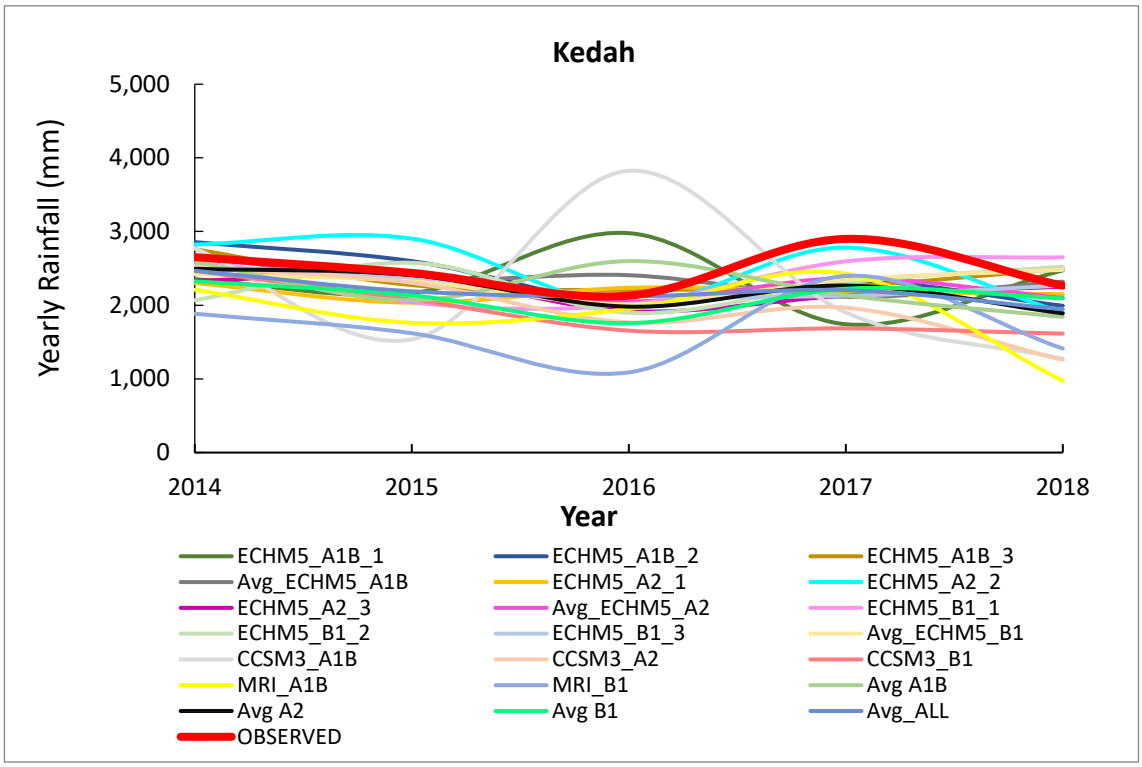


Figure 2.4i: Projected and observed 2014-2018 yearly rainfall for Kedah

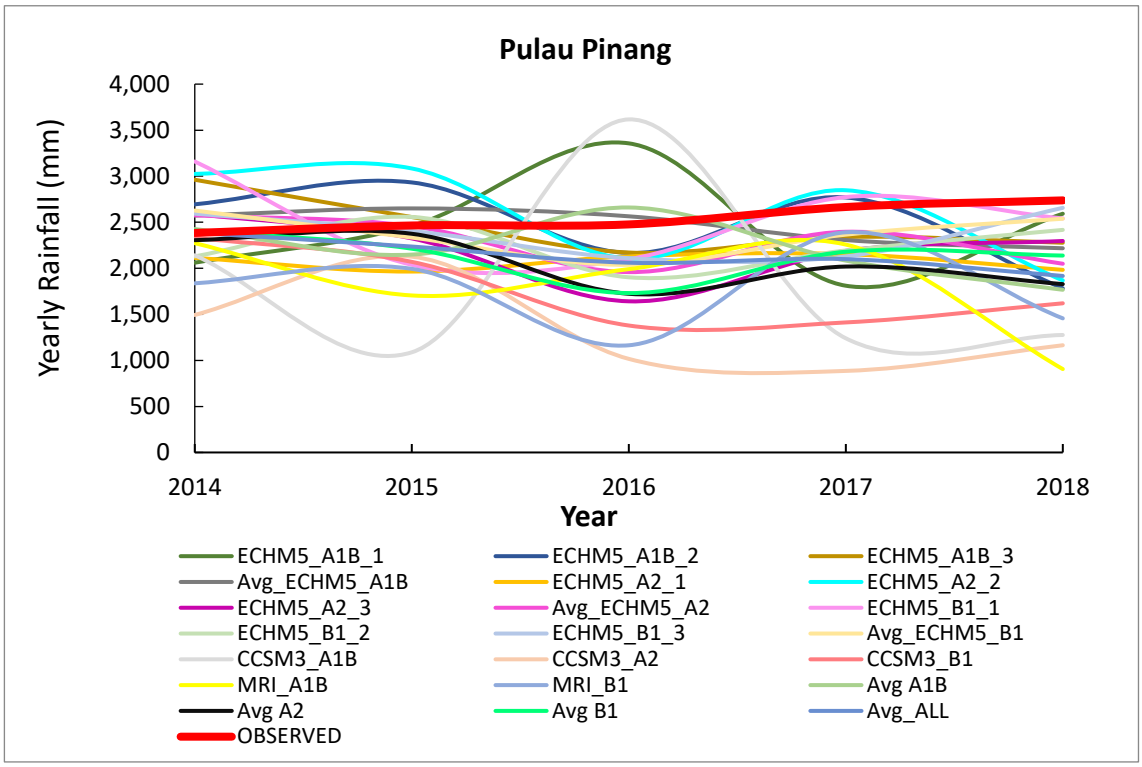


Figure 2.4j: Projected and observed 2014-2018 yearly rainfall for Pulau Pinang

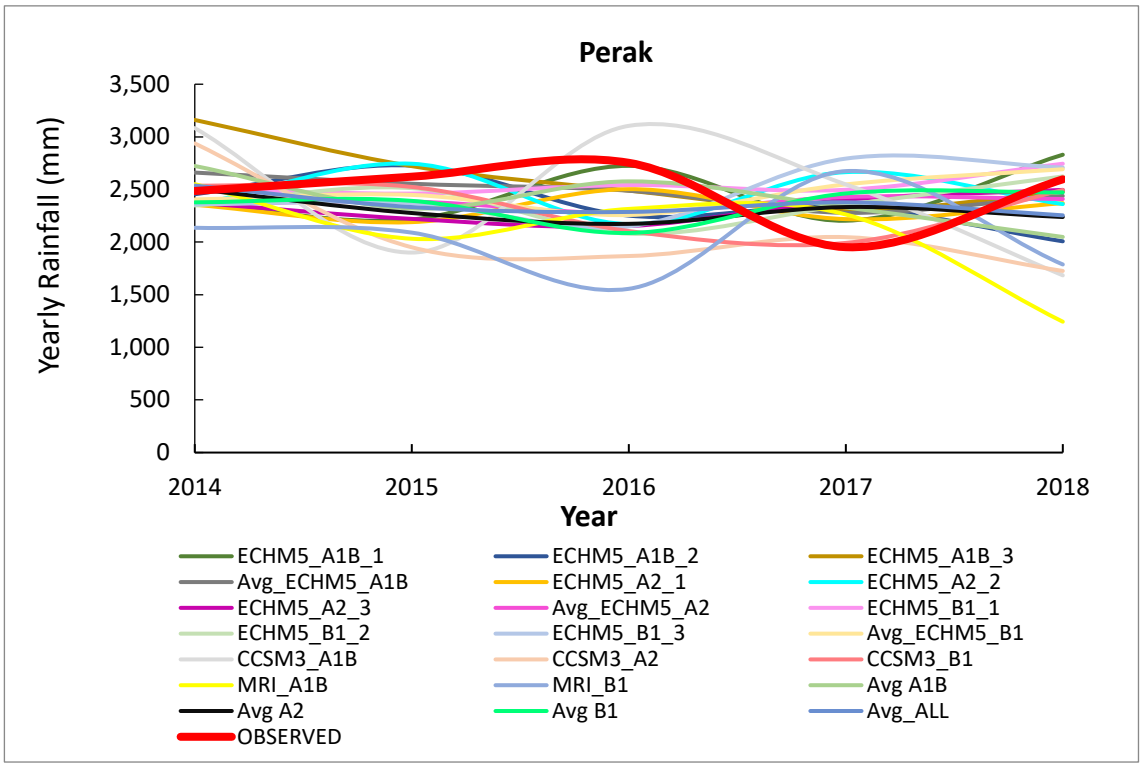


Figure 2.4k: Projected and observed 2014-2018 yearly rainfall for Perak

Generally, on comparing the performance among the models (Tables 2.5a-2.5k), the ECHM5 was found to be outperformed the CCSM3 and the MRI in all the states excepting for Johor, Terengganu and Kelantan. In these three states, the CCSM3 was found to closely commensurate with the performance of the ECHM5. These are shown in Tables 2.5d, 2.5f & 2.5g.

No significant difference between the projected and observed 2014-2018 averages yearly rainfall was shown with the ECHM5 in all the states. The same goes with the CCSM3 in the three states mentioned-above. However, the models did show slightly higher accuracy with:

(a) Scenario A1B for Selangor & Kuala Lumpur (difference of 2% under ECHM5), Negeri Sembilan (difference of -2% under ECHM5), Johor (difference of 1% under CCSM3), Pahang (difference of 18% under ECHM5), Kedah (difference of -3% under ECHM5), Pulau Pinang (difference of -2% under ECHM5) and Perak (difference of 1% under ECHM5), Terengganu (difference of -3% under ECHM5) and Perlis (difference of 1% under ECHM5);

(b) Scenario A2 for Kelantan (difference of 2% under CCSM3), and

(c) Scenario B1 for Melaka (difference of 13% under ECHM5)

The higher accuracies of projections found under scenario A1B for those states mentioned are actually consistent with the projected surface warming increment of 2.7°C (up to year 2100) by NAHRIM for Peninsular Malaysia (NAHRIM 2014)[15]. This is close to the mean value of the global surface warming increments from 1.7°C to 4.4°C estimated by IPCC (2007)[16] for scenario A1B.

[15] NAHRIM, *Final Report on Extension of The Study of The Impact of Climate Change on The Hydrologic Regime and Water Resources of Peninsular Malaysia*, Malaysia, National Hydraulic Research Institute of Malaysia (NAHRIM), 2014

[16] IPCC, *Climate Change 2007 Synthesis Report: Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Geneva, Intergovernmental Panel on Climate Change (IPCC), 2007

Table 2.5a: Difference between projected and observed 2014-2018 yearly rainfall for Selangor & Kuala Lumpur

Selangor & Kuala Lumpur						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	23	-10	30	-30	4	3
ECHM5_A1B_2	-15	10	-1	-12	-13	-6
ECHM5_A1B_3	25	1	29	-8	0	9
Average_ECHM5_A1B	11	1	19	-17	-3	2
ECHM5_A2_1	-14	-5	16	-9	5	-1
ECHM5_A2_2	-20	-2	0	19	6	1
ECHM5_A2_3	-11	-16	-10	-6	-6	-10
Average_ECHM5_A2	-15	-7	2	1	2	-3
ECHM5_B1_1	-8	6	11	-9	2	0
ECHM5_B1_2	-19	-14	-6	-6	6	-8
ECHM5_B1_3	-17	3	2	25	-5	2
Average_ECHM5_B1	-15	-2	3	3	1	-2
CCSM3_A1B	2	-39	6	-29	-27	-17
CCSM3_A2	-17	-50	-46	-34	-37	-37
CCSM3_B1	-17	-36	-24	-37	-30	-29
MRI_A1B	3	-23	7	-18	-41	-14
MRI_B1	-18	-22	-12	-11	-17	-16
Average_A1B	8	-12	14	-20	-15	-5
Average_A2	-15	-18	-10	-7	-8	-12
Average_B1	-16	-13	-6	-8	-9	-10
Average ALL	-7	-14	0	-12	-11	-9

Table 2.5b: Difference between projected and observed 2014-2018 yearly rainfall for Negeri Sembilan

Negeri Sembilan						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	8	1	30	-37	6	2
ECHM5_A1B_2	-27	5	5	-23	-17	-11
ECHM5_A1B_3	18	-8	35	-21	-12	2
Average_ECHM5_A1B	-1	0	23	-27	-7	-2
ECHM5_A2_1	-8	0	4	-10	5	-2
ECHM5_A2_2	-28	-3	-5	13	4	-4
ECHM5_A2_3	-6	-8	-11	-14	-10	-10
Average_ECHM5_A2	-14	-4	-4	-4	0	-5
ECHM5_B1_1	-2	16	21	-16	0	4
ECHM5_B1_2	-18	-9	-13	-15	-3	-12
ECHM5_B1_3	-19	3	5	19	-13	-1
Average_ECHM5_B1	-13	3	4	-4	-5	-3
CCSM3_A1B	11	-21	19	-22	-24	-7
CCSM3_A2	6	-33	-24	-14	-29	-19
CCSM3_B1	-10	-6	-1	-25	-24	-13
MRI_A1B	-4	-18	13	-24	-34	-13
MRI_B1	-24	-14	6	-22	-13	-13
Average_A1B	1	-8	20	-25	-16	-6
Average_A2	-9	-11	-9	-6	-8	-9
Average_B1	-15	-2	4	-12	-11	-7
Average ALL	-7	-7	6	-15	-12	-7

Table 2.5c: Difference between projected and observed 2014-2018 yearly rainfall for Melaka

Melaka						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	36	30	53	-28	1	18
ECHM5_A1B_2	8	22	13	-13	2	6
ECHM5_A1B_3	51	5	66	-12	-5	21
Average_ECHM5_A1B	32	19	44	-18	-1	15
ECHM5_A2_1	30	20	34	0	25	22
ECHM5_A2_2	16	15	20	38	26	23
ECHM5_A2_3	15	12	15	10	-5	9
Average_ECHM5_A2	20	16	23	16	15	18
ECHM5_B1_1	17	35	29	-15	3	14
ECHM5_B1_2	-5	-3	10	0	10	2
ECHM5_B1_3	2	26	34	63	-8	23
Average_ECHM5_B1	5	19	24	16	2	13
CCSM3_A1B	11	-39	6	-51	-43	-23
CCSM3_A2	8	-43	-37	-1	-10	-17
CCSM3_B1	-6	-9	-27	-44	-38	-25
MRI_A1B	26	3	15	-18	-35	-2
MRI_B1	-1	1	23	-6	-15	0
Average_A1B	26	4	31	-24	-16	4
Average_A2	17	1	8	11	9	9
Average_B1	1	10	14	0	-10	3
Average ALL	15	5	18	-6	-7	5

Table 2.5d: Difference between projected and observed 2014-2018 yearly rainfall for Johor

Johor						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	22	30	63	-29	18	21
ECHM5_A1B_2	-3	42	18	-22	-19	3
ECHM5_A1B_3	31	25	30	-28	-13	9
Average_ECHM5_A1B	17	32	37	-26	-5	11
ECHM5_A2_1	16	20	25	5	7	15
ECHM5_A2_2	-12	43	3	18	18	14
ECHM5_A2_3	-5	64	22	1	-9	15
Average_ECHM5_A2	0	42	17	8	5	14
ECHM5_B1_1	22	41	32	-23	3	15
ECHM5_B1_2	-13	2	-1	-17	6	-5
ECHM5_B1_3	-9	28	26	21	-5	12
Average_ECHM5_B1	0	24	19	-6	1	8
CCSM3_A1B	28	-7	8	-19	-6	1
CCSM3_A2	16	-13	5	-30	-31	-11
CCSM3_B1	-13	20	2	-23	-4	-4
MRI_A1B	0	15	41	-25	-13	4
MRI_B1	-3	21	45	-20	-1	8
Average_A1B	16	21	32	-24	-7	8
Average_A2	4	28	14	-2	-4	8
Average_B1	-3	22	21	-12	0	6
Average ALL	6	24	23	-14	-4	7

Table 2.5e: Difference between projected and observed 2014-2018 yearly rainfall for Pahang

Pahang						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	14	31	78	-24	32	26
ECHM5_A1B_2	-12	30	52	-9	-20	8
ECHM5_A1B_3	32	35	62	-21	-4	21
Average_ECHM5_A1B	11	32	64	-18	3	18
ECHM5_A2_1	16	25	53	1	15	22
ECHM5_A2_2	-15	57	24	0	6	14
ECHM5_A2_3	13	51	24	-13	9	17
Average_ECHM5_A2	5	45	34	-4	10	18
ECHM5_B1_1	19	49	54	-18	25	26
ECHM5_B1_2	1	30	23	-13	24	13
ECHM5_B1_3	1	23	45	7	12	18
Average_ECHM5_B1	7	34	41	-8	21	19
CCSM3_A1B	49	35	68	-3	9	32
CCSM3_A2	28	17	30	-12	-5	12
CCSM3_B1	24	59	39	-20	18	24
MRI_A1B	17	23	58	-13	-21	13
MRI_B1	5	17	38	-11	14	13
Average_A1B	20	31	64	-14	-1	20
Average_A2	11	38	33	-6	6	16
Average_B1	10	36	40	-11	19	19
Average ALL	14	35	46	-11	8	18

Table 2.5f: Difference between projected and observed 2014-2018 yearly rainfall for Terengganu

Terengganu						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	-32	5	16	-27	-4	-8
ECHM5_A1B_2	-21	9	-11	-18	-46	-17
ECHM5_A1B_3	7	20	30	-37	-35	-3
Average_ECHM5_A1B	-15	11	11	-27	-29	-10
ECHM5_A2_1	-11	26	13	-15	-17	-1
ECHM5_A2_2	-33	65	-20	-27	-39	-11
ECHM5_A2_3	-15	56	-20	-38	-15	-6
Average_ECHM5_A2	-19	49	-9	-27	-24	-6
ECHM5_B1_1	-10	44	2	-41	13	2
ECHM5_B1_2	-26	41	-14	-27	6	-4
ECHM5_B1_3	-17	4	11	-25	-1	-6
Average_ECHM5_B1	-18	29	0	-31	6	-3
CCSM3_A1B	10	0	-3	-27	-17	-7
CCSM3_A2	8	1	-24	-36	-15	-13
CCSM3_B1	-8	14	-4	-27	-2	-5
MRI_A1B	7	14	13	-22	-50	-8
MRI_B1	-8	29	-23	-10	-1	-3
Average_A1B	-6	10	9	-26	-30	-9
Average_A2	-13	37	-13	-29	-22	-8
Average_B1	-14	26	-6	-26	3	-3
Average ALL	-11	23	-2	-27	-16	-7

Table 2.5g: Difference between projected and observed 2014-2018 yearly rainfall for Kelantan

Kelantan						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-27	9	20	-20	8	-2
ECHM5_A1B_2	-25	31	14	-25	-34	-8
ECHM5_A1B_3	-4	23	26	-29	-19	-1
Average_ECHM5_A1B	-18	21	20	-25	-15	-3
ECHM5_A2_1	-14	25	25	-24	-6	1
ECHM5_A2_2	-41	54	4	-29	-19	-6
ECHM5_A2_3	-23	27	12	-32	-5	-4
Average_ECHM5_A2	-26	35	14	-28	-10	-3
ECHM5_B1_1	-29	56	22	-35	22	7
ECHM5_B1_2	-22	35	-5	-28	12	-2
ECHM5_B1_3	-17	10	24	-18	17	3
Average_ECHM5_B1	-23	34	14	-27	17	3
CCSM3_A1B	8	13	33	-6	-19	6
CCSM3_A2	11	32	7	-34	-6	2
CCSM3_B1	-13	30	30	-16	11	8
MRI_A1B	-14	10	28	-29	-51	-11
MRI_B1	-31	17	-27	-16	-14	-14
Average_A1B	-12	17	24	-22	-23	-3
Average_A2	-17	35	12	-30	-9	-2
Average_B1	-22	30	9	-23	9	1
Average ALL	-17	27	15	-24	-8	-1

Table 2.5h: Difference between projected and observed 2014-2018 yearly rainfall for Perlis

Perlis						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	19	-8	61	-52	6	5
ECHM5_A1B_2	16	6	8	-23	-19	-2
ECHM5_A1B_3	15	1	26	-27	40	11
Average_ECHM5_A1B	17	-1	32	-34	9	5
ECHM5_A2_1	11	-11	42	-37	7	2
ECHM5_A2_2	13	13	10	13	-20	6
ECHM5_A2_3	25	3	8	-42	-4	-2
Average_ECHM5_A2	16	2	20	-22	-6	2
ECHM5_B1_1	-3	-13	-8	-29	15	-8
ECHM5_B1_2	-12	-2	3	-26	25	-2
ECHM5_B1_3	26	21	17	-37	-2	5
Average_ECHM5_B1	4	2	4	-30	13	-1
CCSM3_A1B	-7	-62	25	-51	-44	-28
CCSM3_A2	-28	-12	-29	-46	-74	-38
CCSM3_B1	-2	-43	-46	-55	-53	-40
MRI_A1B	3	-28	15	-19	-56	-17
MRI_B1	-14	-35	-42	-23	-35	-30
Average_A1B	9	-18	27	-34	-14	-6
Average_A2	5	-2	8	-28	-23	-8
Average_B1	-1	-14	-15	-34	-10	-15
Average ALL	4	-12	7	-32	-15	-10

Table 2.5i: Difference between projected and observed 2014-2018 yearly rainfall for Kedah

Kedah						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	-11	-11	40	-40	9	-3
ECHM5_A1B_2	8	7	-4	-19	-12	-4
ECHM5_A1B_3	4	-7	4	-22	10	-2
Average_ECHM5_A1B	0	-4	13	-27	2	-3
ECHM5_A2_1	-13	-17	5	-25	-5	-11
ECHM5_A2_2	6	19	-6	-4	-16	0
ECHM5_A2_3	-12	-2	-10	-27	-1	-10
Average_ECHM5_A2	-6	0	-4	-18	-7	-7
ECHM5_B1_1	0	-16	-6	-11	17	-3
ECHM5_B1_2	-22	6	-11	-20	11	-7
ECHM5_B1_3	-4	-3	0	-27	0	-7
Average_ECHM5_B1	-9	-5	-6	-19	9	-6
CCSM3_A1B	5	-37	79	-34	-44	-6
CCSM3_A2	-5	-6	-17	-32	-44	-21
CCSM3_B1	-7	-15	-22	-42	-29	-23
MRI_A1B	-17	-28	-9	-16	-57	-25
MRI_B1	-29	-34	-49	-17	-38	-33
Average_A1B	-2	-15	22	-26	-19	-8
Average_A2	-6	-1	-7	-22	-17	-11
Average_B1	-12	-12	-18	-23	-8	-15
Average ALL	-7	-10	0	-24	-14	-11

Table 2.5j: Difference between projected and observed 2014-2018 yearly rainfall for Pulau Pinang

Pulau Pinang						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-14	0	36	-32	-5	-3
ECHM5_A1B_2	13	19	-13	4	-35	-2
ECHM5_A1B_3	24	4	-12	-12	-17	-3
Average_ECHM5_A1B	8	8	4	-13	-19	-2
ECHM5_A2_1	-11	-20	-14	-19	-28	-18
ECHM5_A2_2	27	25	-15	7	-32	2
ECHM5_A2_3	9	-6	-34	-18	-16	-13
Average_ECHM5_A2	8	0	-21	-10	-25	-10
ECHM5_B1_1	33	-17	-15	4	-7	0
ECHM5_B1_2	-11	4	-23	-18	-12	-12
ECHM5_B1_3	9	-2	-15	-20	-3	-6
Average_ECHM5_B1	10	-5	-18	-11	-7	-6
CCSM3_A1B	-10	-56	46	-53	-53	-25
CCSM3_A2	-37	-14	-59	-67	-57	-47
CCSM3_B1	-2	-16	-44	-47	-41	-30
MRI_A1B	-5	-31	-20	-15	-67	-28
MRI_B1	-23	-19	-53	-10	-47	-30
Average_A1B	2	-13	7	-22	-35	-12
Average_A2	-3	-4	-30	-24	-33	-19
Average_B1	1	-10	-30	-18	-22	-16
Average ALL	0	-9	-17	-21	-30	-15

Table 2.5k: Difference between projected and observed 2014-2018 yearly rainfall for Perak

Perak						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	-5	-16	-1	13	9	0
ECHM5_A1B_2	-1	4	-18	20	-23	-4
ECHM5_A1B_3	27	4	-10	18	-5	7
Average_ECHM5_A1B	7	-3	-10	17	-6	1
ECHM5_A2_1	-5	-16	-9	14	-9	-5
ECHM5_A2_2	-5	5	-21	37	-9	1
ECHM5_A2_3	-4	-15	-22	23	-4	-4
Average_ECHM5_A2	-5	-9	-17	24	-7	-3
ECHM5_B1_1	1	-6	-8	28	6	4
ECHM5_B1_2	-6	-4	-24	21	1	-2
ECHM5_B1_3	-5	-10	-22	43	4	2
Average_ECHM5_B1	-3	-7	-18	31	4	1
CCSM3_A1B	24	-28	13	31	-35	1
CCSM3_A2	18	-26	-32	5	-34	-14
CCSM3_B1	2	-4	-24	2	-4	-6
MRI_A1B	3	-22	-16	16	-52	-14
MRI_B1	-14	-20	-43	37	-31	-14
Average_A1B	10	-12	-6	19	-21	-2
Average_A2	1	-13	-21	20	-14	-5
Average_B1	-4	-9	-24	26	-5	-3
Average ALL	2	-11	-17	22	-13	-3

For the 2018 yearly rainfall projections, the ECHM5 model again did better than the CCSM3 and MRI models (Tables 2.5a-2.5k & Figures 2.5a-2.5k), for all the states with the exception for Johor, Terengganu and Kelantan, as shown in Tables 2.5d, 2.5f & 2.5g, and Figures 2.5d, 2.5f & 2.5g.

No significant difference between the projected averages and observed 2018 averages of yearly rainfall among the three scenarios was shown by the ECHM5 for all the states, while the CCSM3 model performed better for the exceptional three states mentioned. However, the models did show slightly higher accuracy with:

(a) Scenario B1 for Selangor & Kuala Lumpur (difference of 1% under ECHM5), Johor (difference of 1% under ECHM5), Terengganu (difference of -2% under CCSM3), Pulau Pinang (difference of -7% under ECHM5) and Perak (difference of 4% under ECHM5);

(b) Scenario A1B for Melaka (difference of -1% under ECHM5), Pahang (difference of 3% under ECHM5) and Kedah (difference of 2% under ECHM5), and

(c) Scenario A2 for Negeri Sembilan (no difference under ECHM5), Kelantan (difference of -6% under CCSM3) and Perlis (difference of -6% under ECHM5)

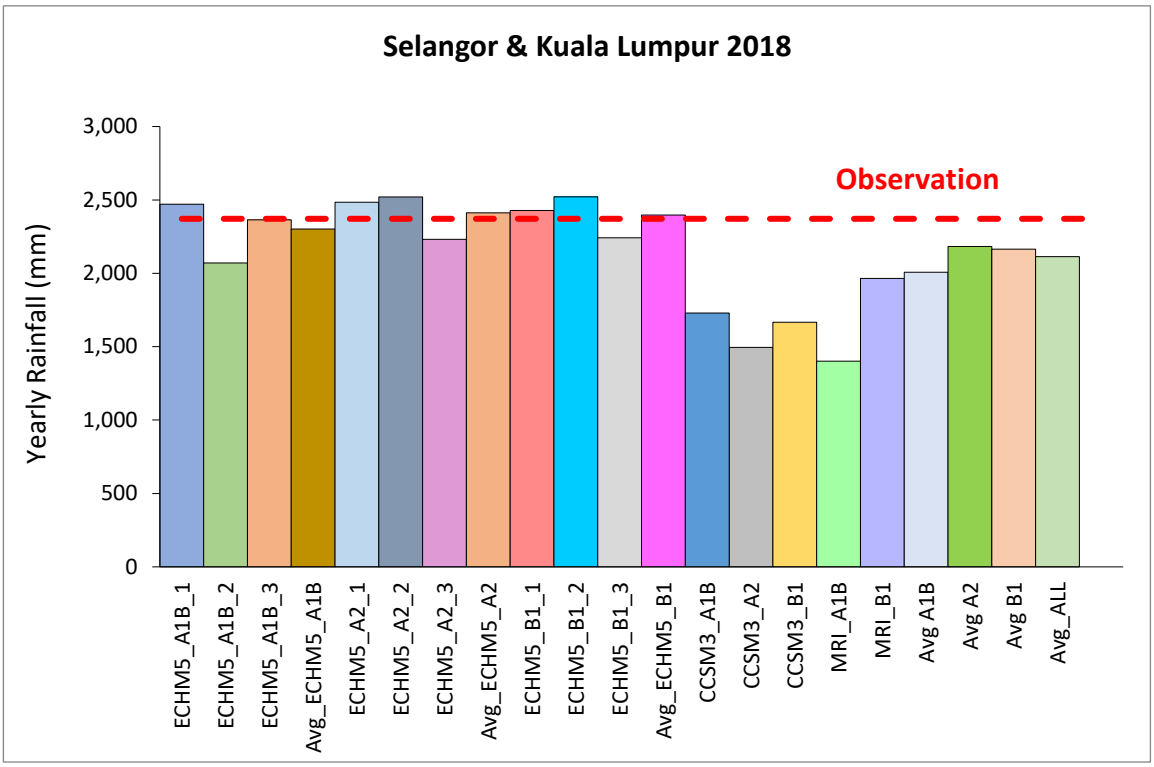


Figure 2.5a: Projected and observed 2018 yearly rainfall for Selangor & Kuala Lumpur

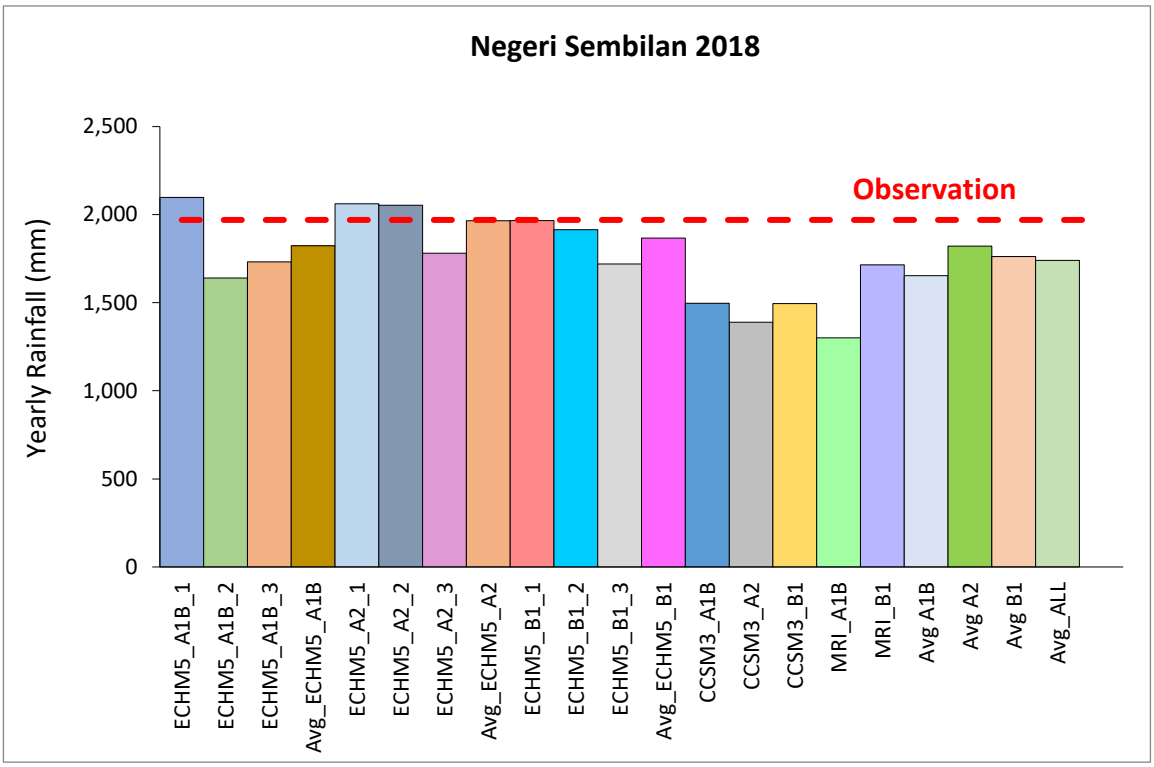


Figure 2.5b: Projected and observed 2018 yearly rainfall for Negeri Sembilan

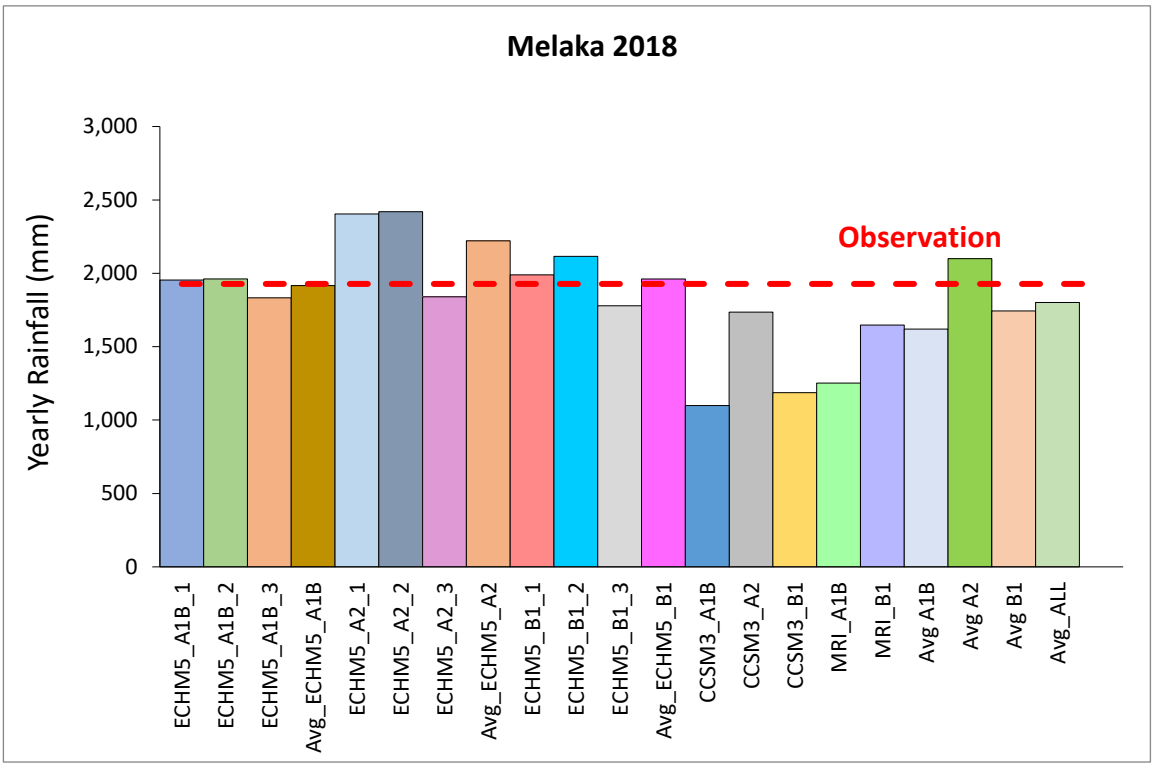


Figure 2.5c: Projected and observed 2018 yearly rainfall for Melaka

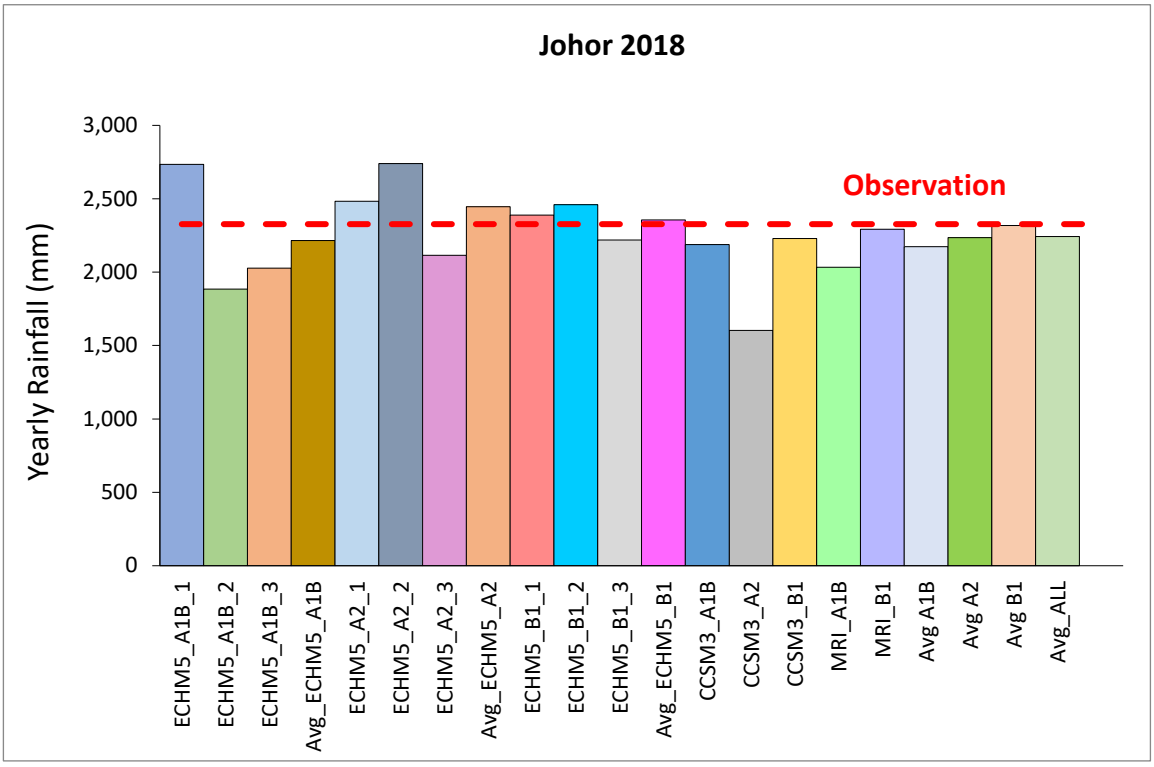


Figure 2.5d: Projected and observed 2018 yearly rainfall for Johor

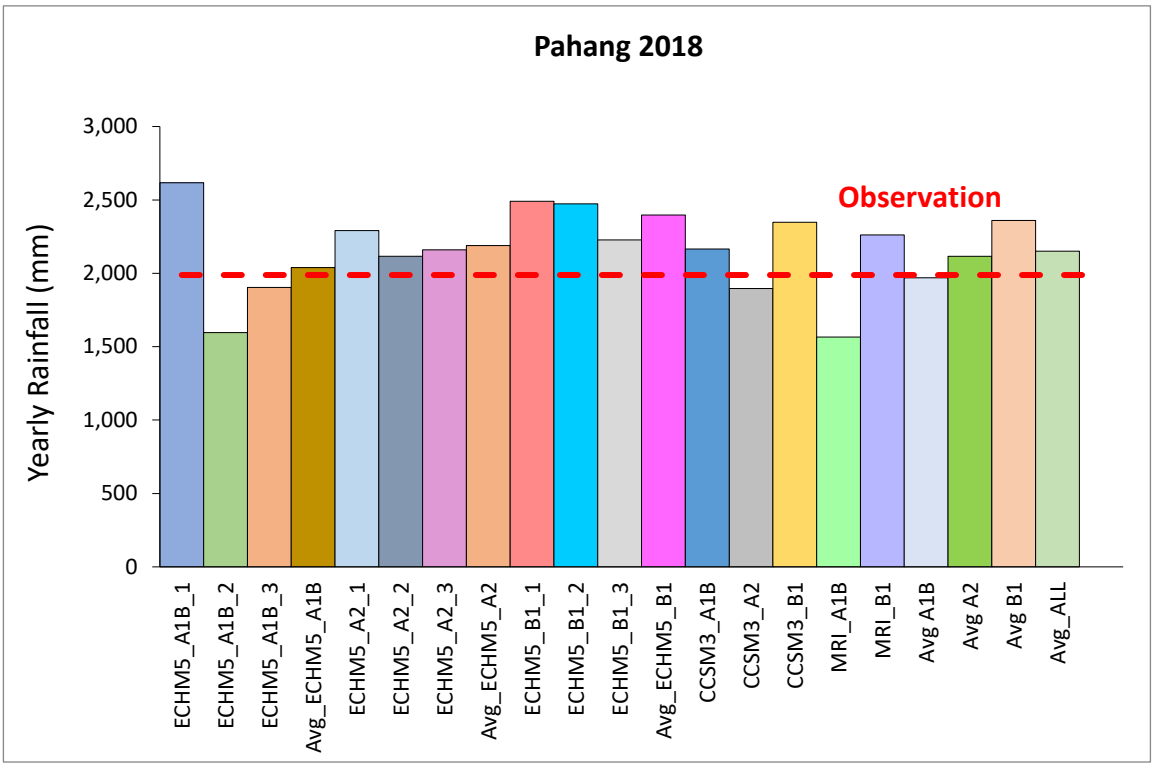


Figure 2.5e: Projected and observed 2018 yearly rainfall for Pahang

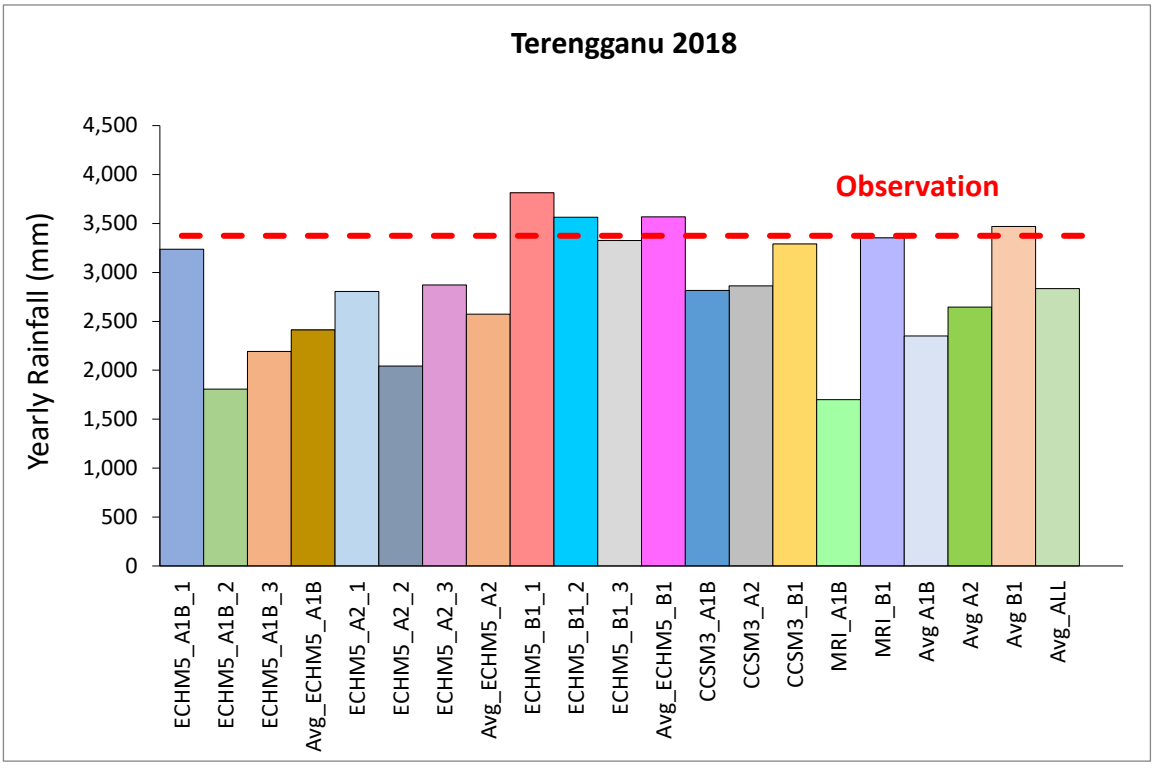


Figure 2.5f: Projected and observed 2018 yearly rainfall for Terengganu

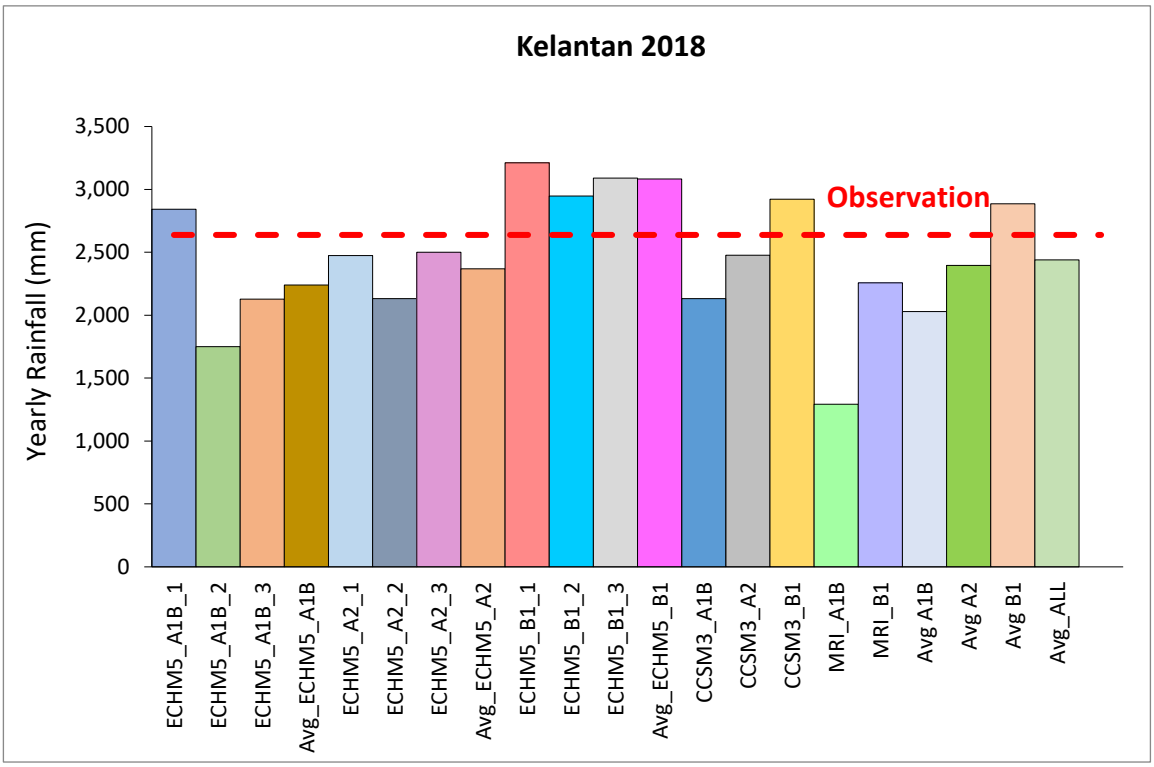


Figure 2.5g: Projected and observed 2018 yearly rainfall for Kelantan

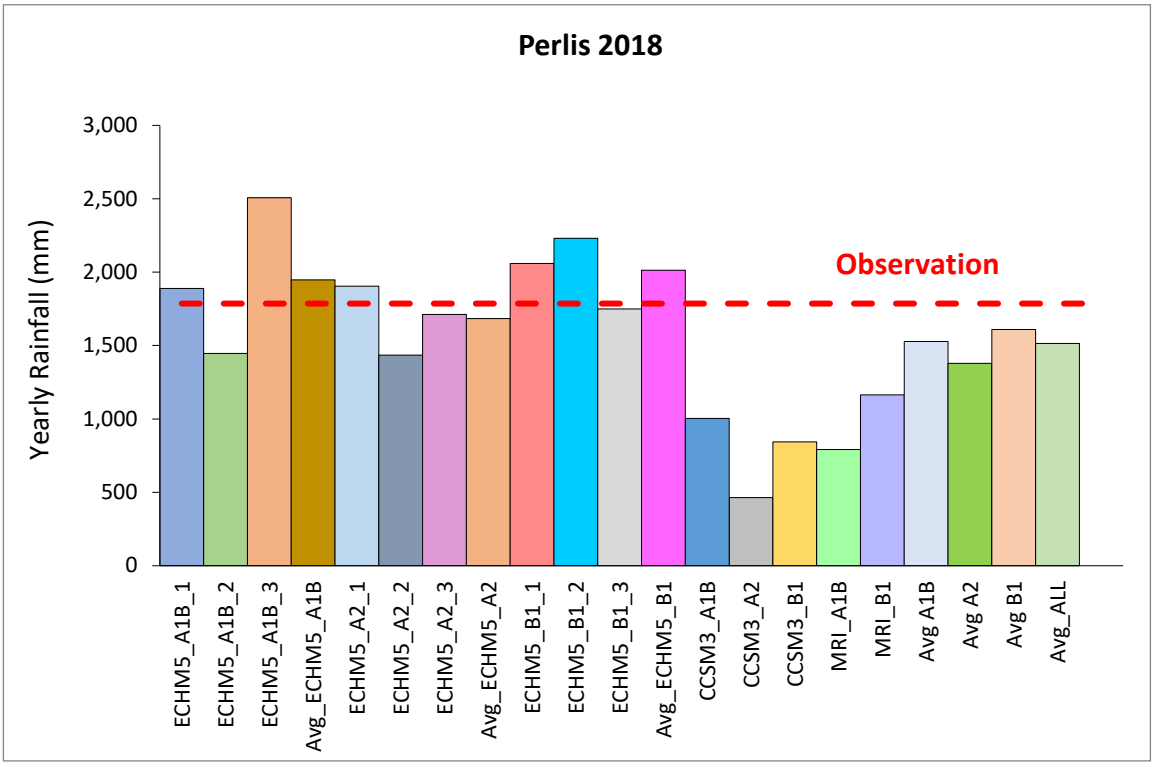


Figure 2.5h: Projected and observed 2018 yearly rainfall for Perlis

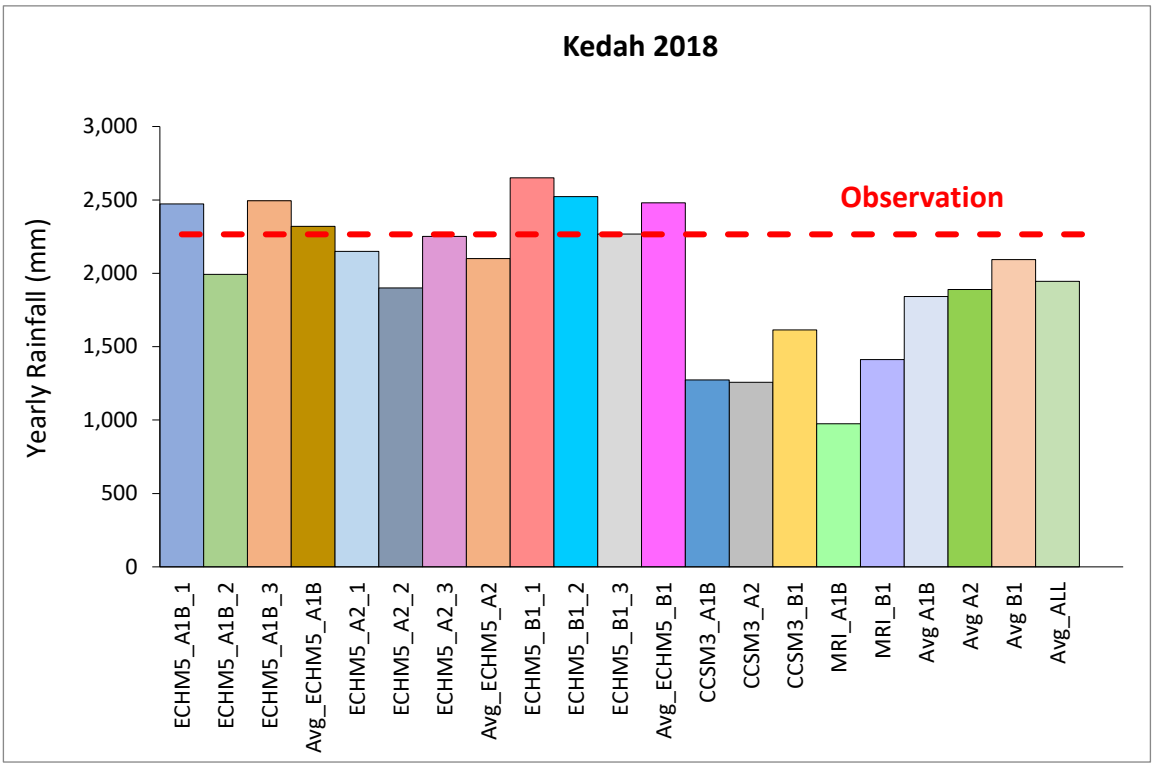


Figure 2.5i: Projected and observed 2018 yearly rainfall for Kedah

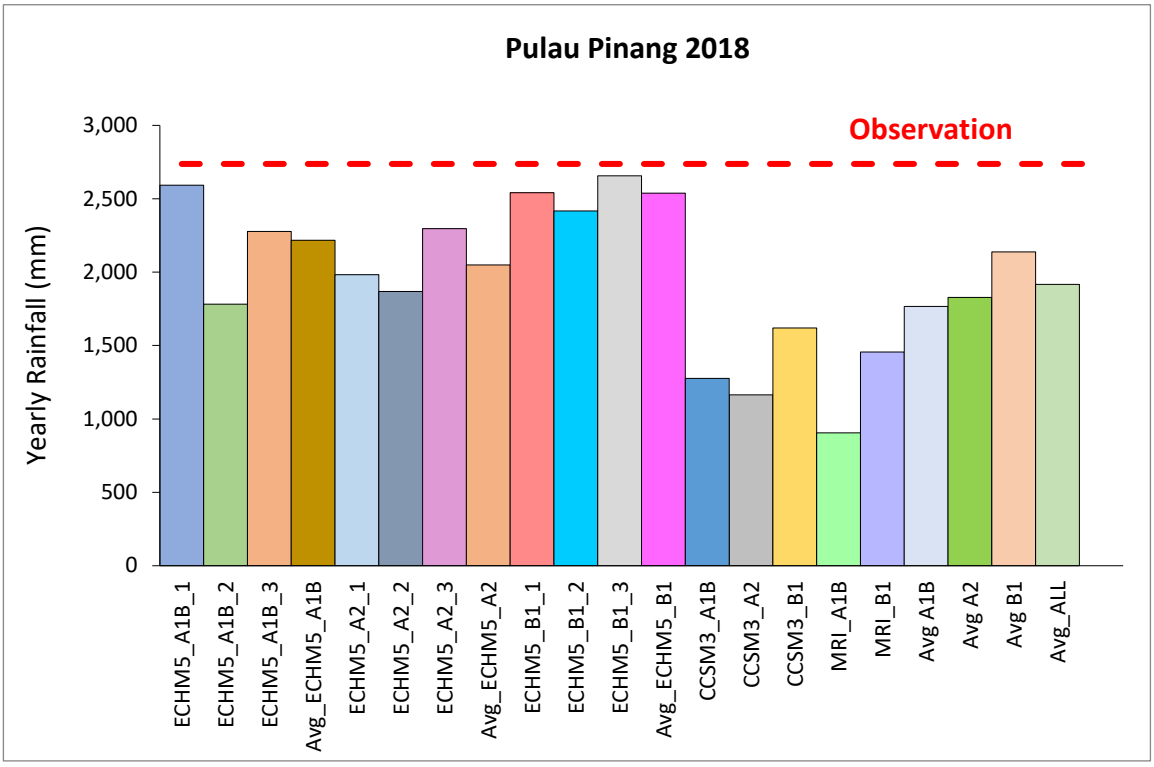


Figure 2.5j: Projected and observed 2018 yearly rainfall for Pulau Pinang

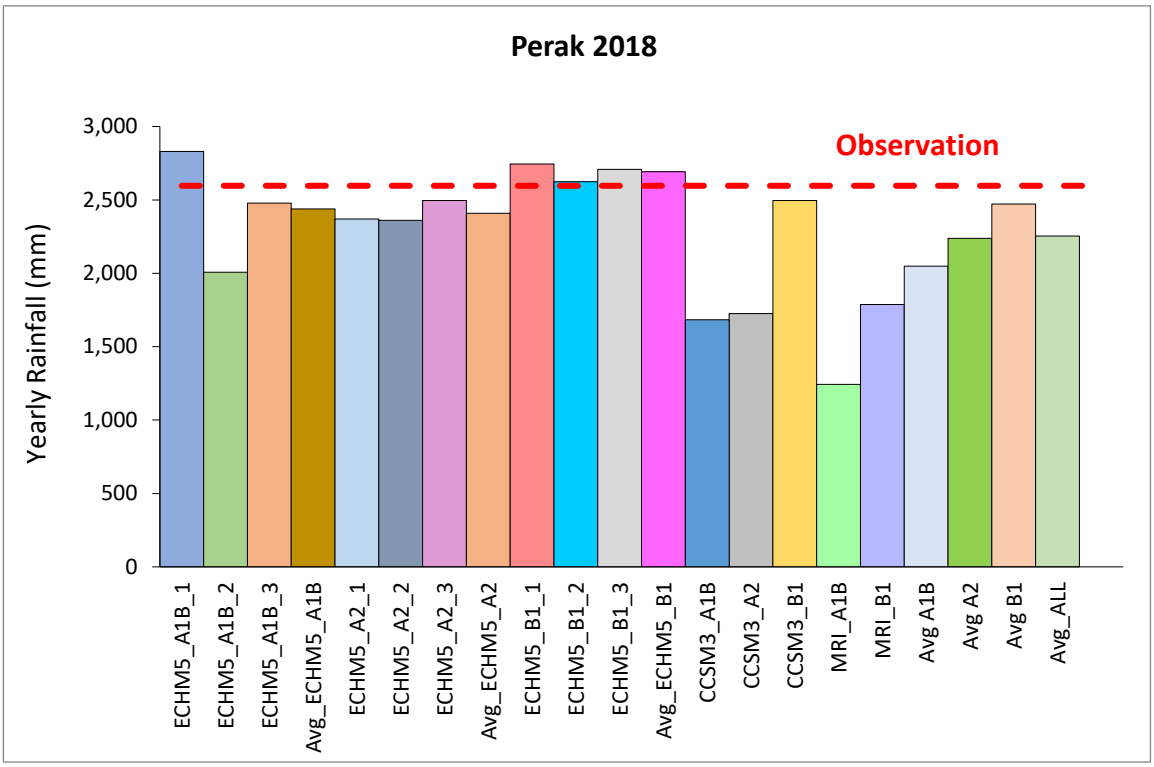


Figure 2.5k: Projected and observed 2018 yearly rainfall for Perak

The performances of the models were also assessed through estimating the average percentages of the over projections and the under projections of the 2014-2018 yearly rainfalls (Table 2.6 and Figures 2.6a-2.6k), where:

(a) The ECHM5 showed the smallest percentages among the models in Selangor & Kuala Lumpur (9% over projection and -9% of under projection), Negeri Sembilan (11% of over projection and -11% of under projection), Melaka (22% of over projection and -9% of under projection), Pahang (28% of over projection and -13% of under projection), Perlis (15% of over projection and -20% of under projection), Kedah (8% of over projection and -12% of under projection), Pulau Pinang (12% of over projection and -15% of under projection) and Perak (16% of over projection -10% of under projection);

(b) The CCSM3 in Johor (13% of over projection and -16% of under projection), Terengganu (7% of over projection and -16% of under projection) and Kelantan (20% of over projection and -16% of under projection)

Overall, the percentages between the over projected yearly rainfalls and the under projected yearly rainfalls of the models that were outperforming were found not to have exceeded 30%.

Table 2.6: Average percentage of over projected and under projected by models for 2014-2018 yearly rainfall for States

Model	Projection	Average Percentage (%)										
		Selangor & Kuala Lumpur	Negeri Sembilan	Melaka	Johor	Pahang	Terengganu	Kelantan	Perlis	Kedah	Pulau Pinang	Perak
All	Over Projected	9	10	19	22	28	18	21	15	12	13	15
	Under Projected	-16	-13	-17	-12	-12	-20	-21	-25	-17	-22	-14
ECHM5	Over Projected	9	11	22	22	28	21	23	15	8	12	16
	Under Projected	-9	-11	-9	-12	-13	-22	-22	-20	-12	-15	-10
CCSM3	Over Projected	4	12	9	13	34	7	20	25	42	46	13
	Under Projected	-32	-19	-29	-16	-10	-16	-16	-39	-26	-40	-23
MRI	Over Projected	5	10	13	30	25	16	18	9	0	0	19
	Under Projected	-20	-19	-15	-10	-15	-19	-26	-31	-29	-29	-29

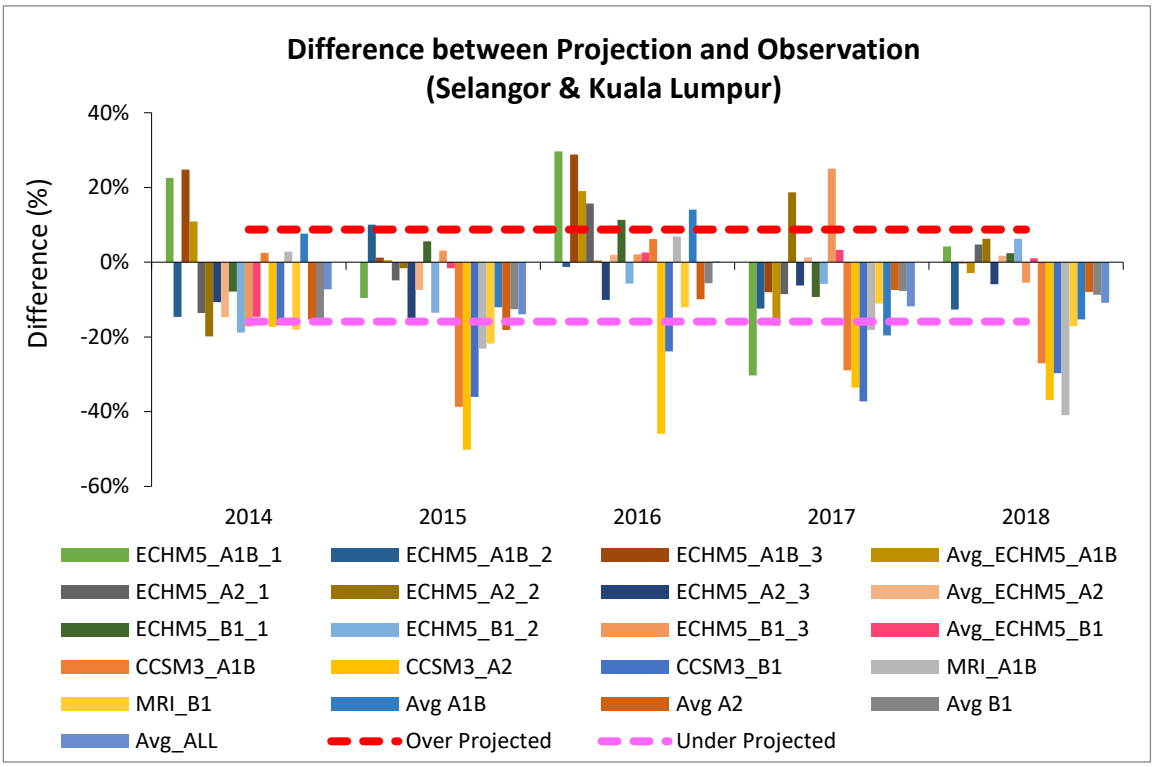


Figure 2.6a: Difference between projected and observed 2014-2018 yearly rainfall for Selangor & Kuala Lumpur

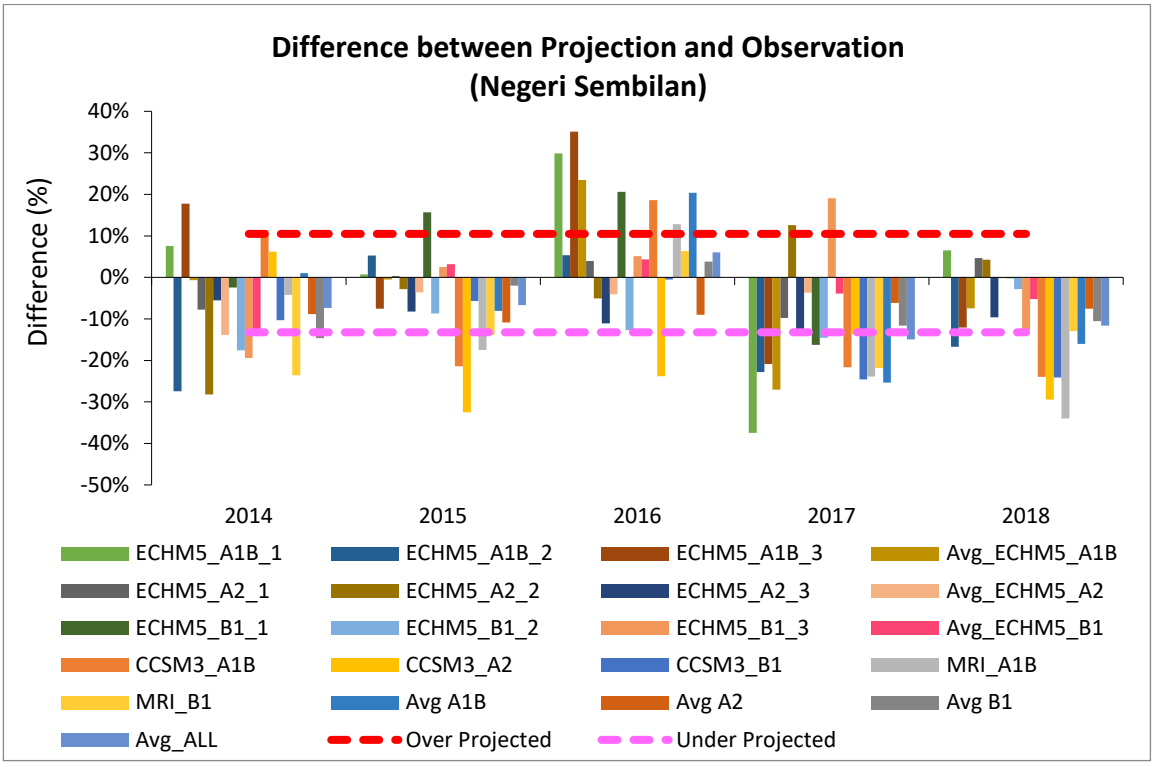


Figure 2.6b: Difference between projected and observed 2014-2018 yearly rainfall for Negeri Sembilan

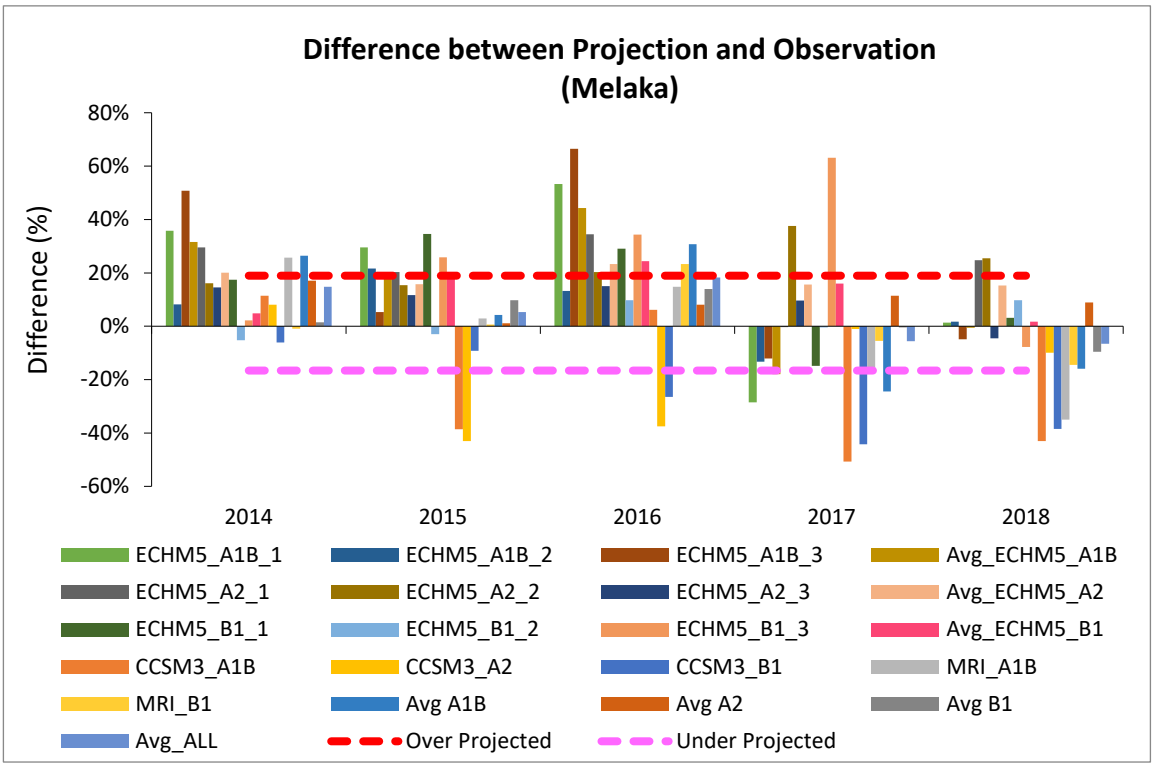


Figure 2.6c: Difference between projected and observed 2014-2018 yearly rainfall for Melaka

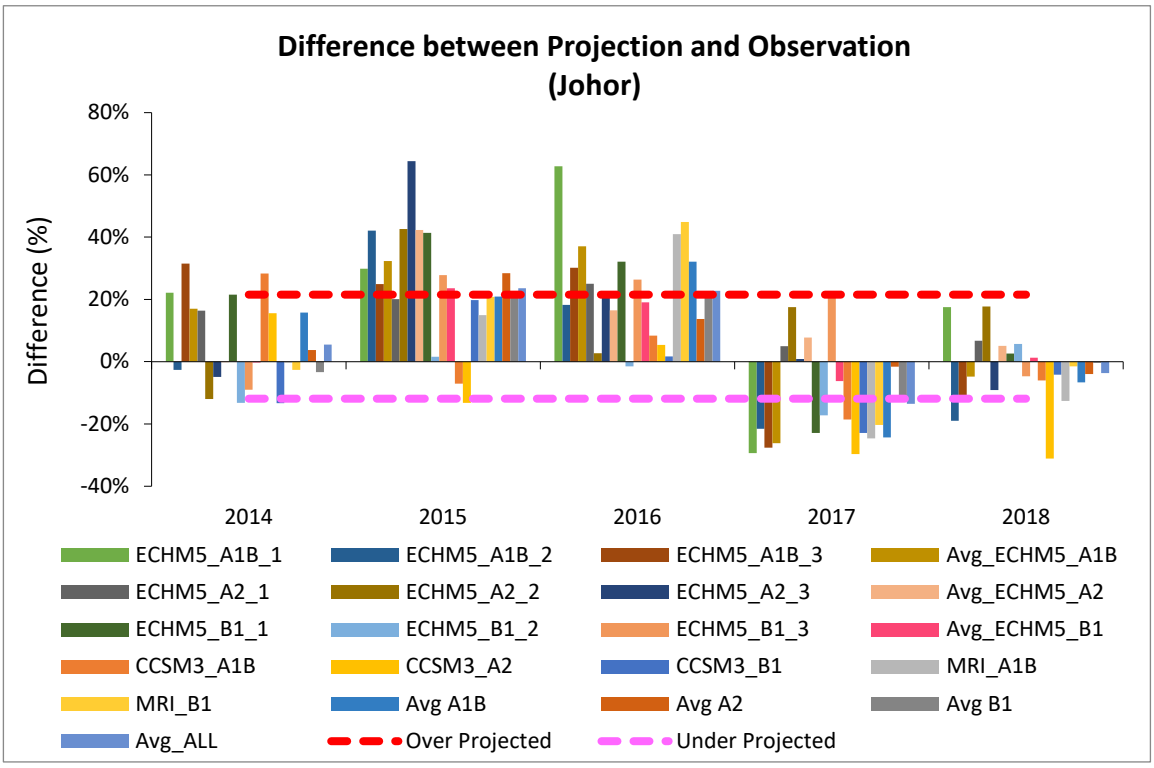


Figure 2.6d: Difference between projected and observed 2014-2018 yearly rainfall for Johor

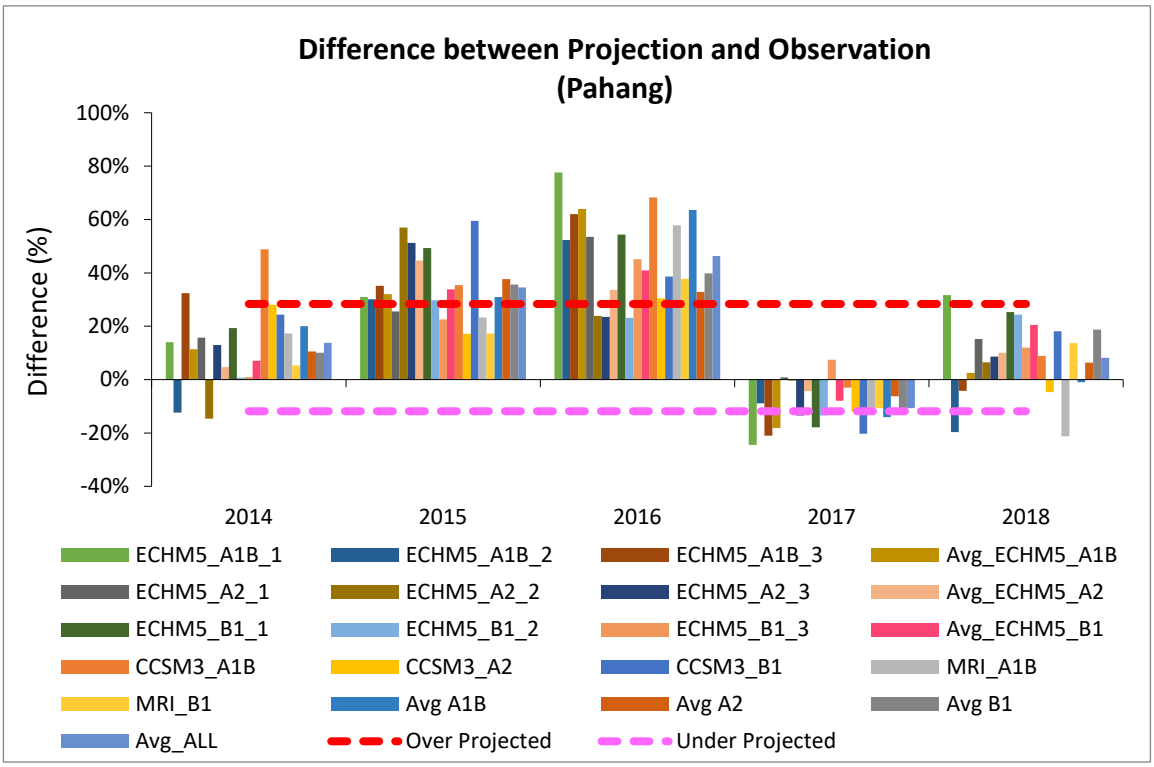


Figure 2.6e: Difference between projected and observed 2014-2018 yearly rainfall for Pahang

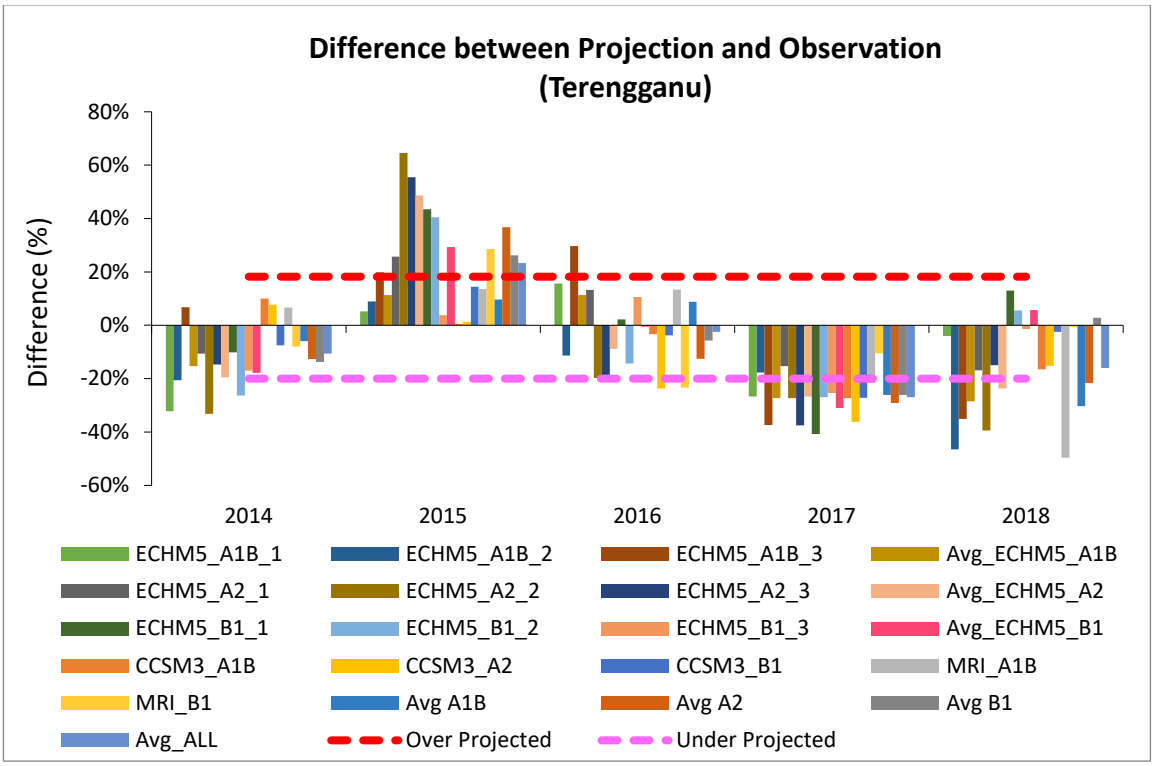


Figure 2.6f: Difference between projected and observed 2014-2018 yearly rainfall for Terengganu

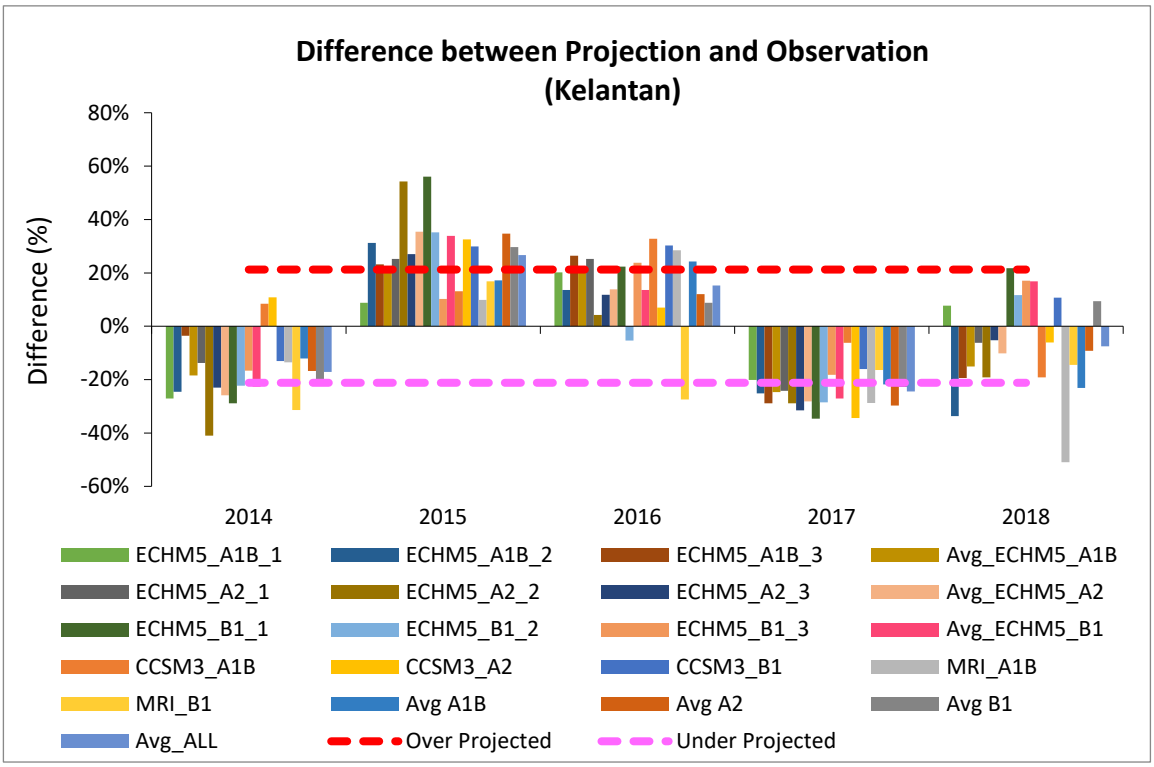


Figure 2.6g: Difference between projected and observed 2014-2018 yearly rainfall for Kelantan

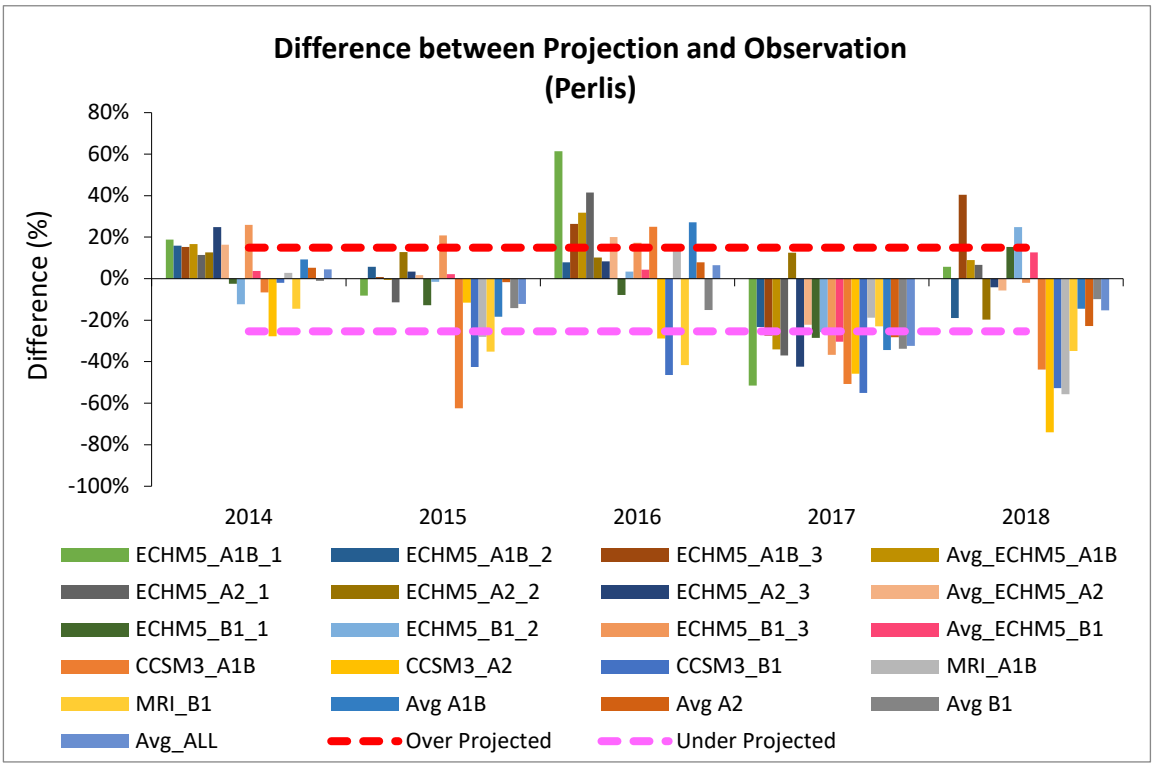


Figure 2.6h: Difference between projected and observed 2014-2018 yearly rainfall for Perlis

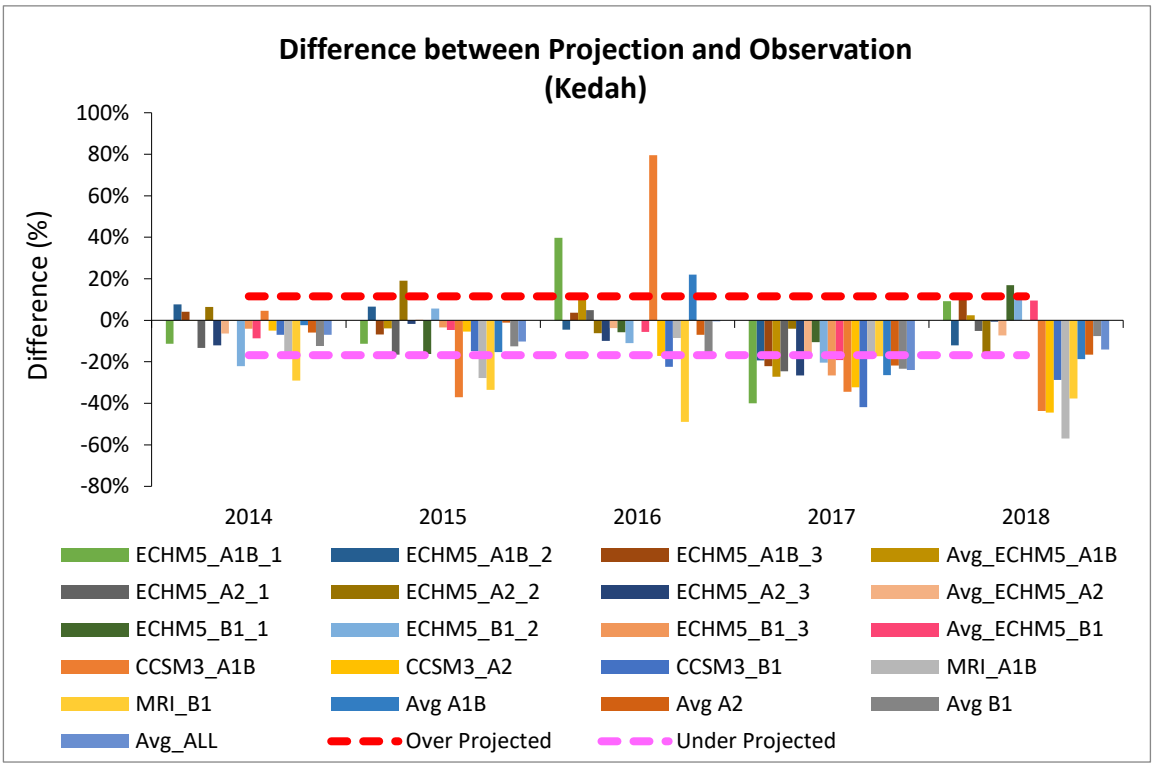


Figure 2.6i: Difference between projected and observed 2014-2018 yearly rainfall for Kedah

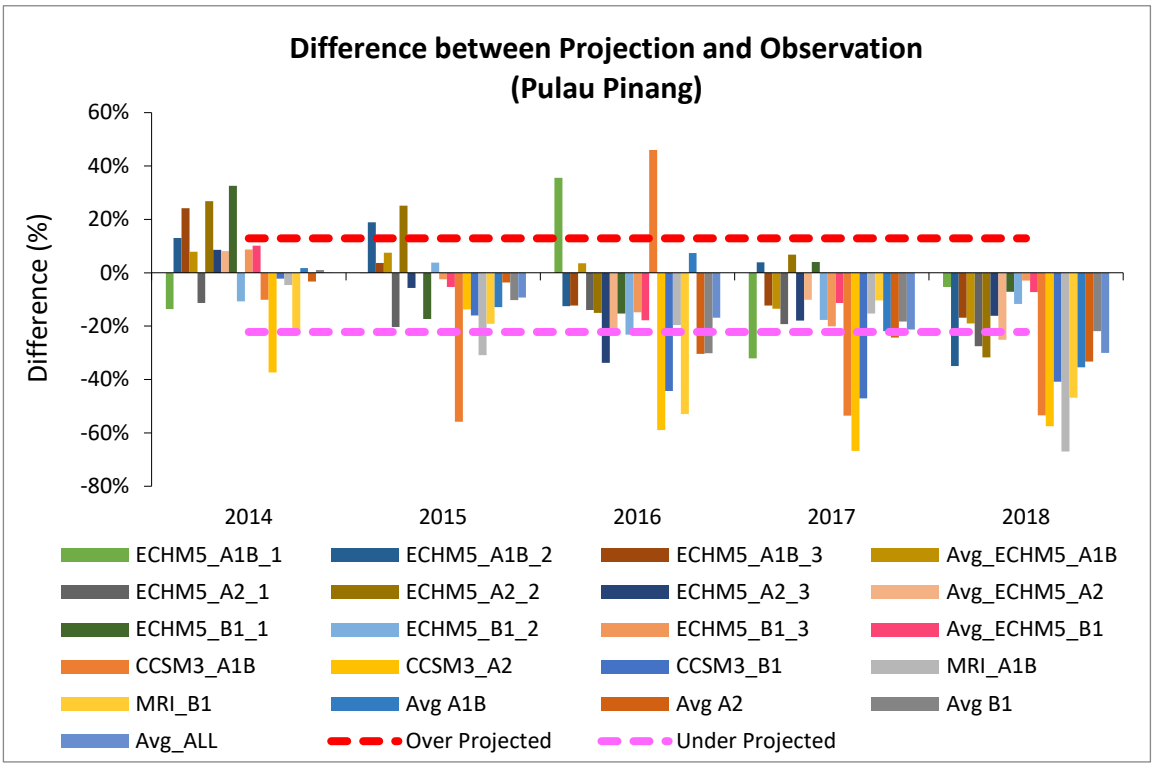


Figure 2.6j: Difference between projected and observed 2014-2018 yearly rainfall for Pinang

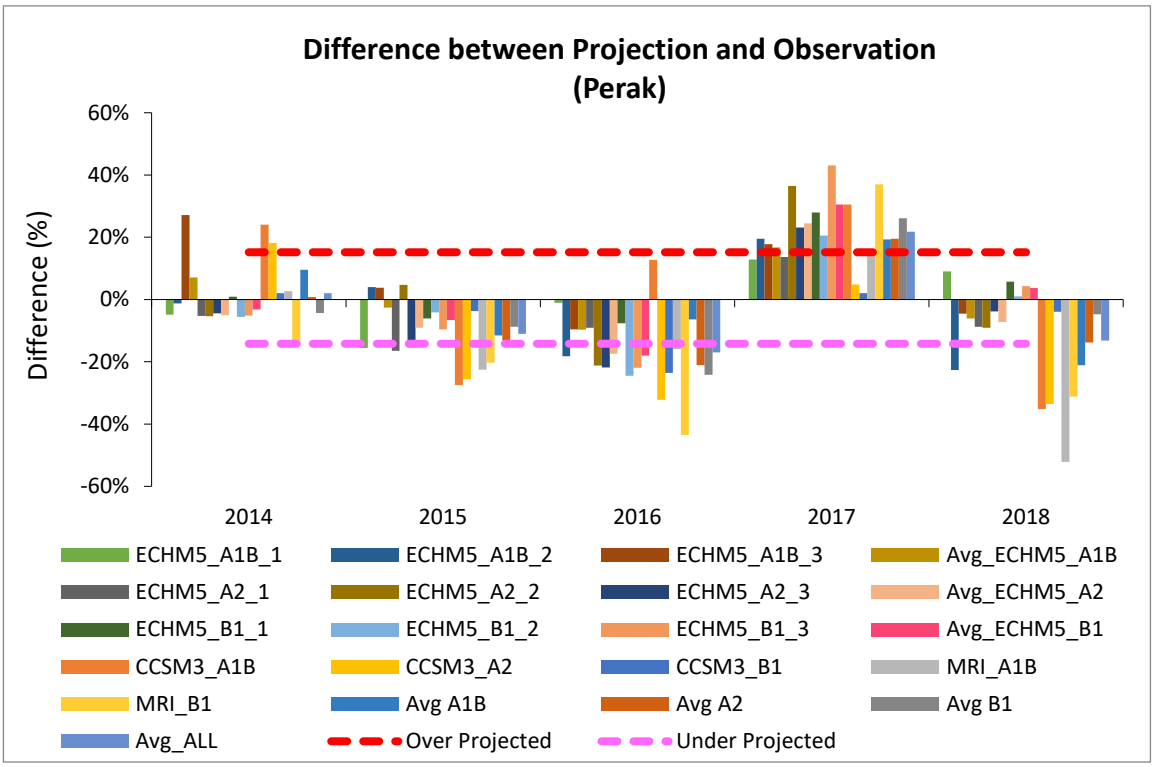


Figure 2.6k: Difference between projected and observed 2014-2018 yearly rainfall for Perak

2.1.3 Analysis of Temporal Yearly Rainfall Pattern according to Stations

The projected and observed 2014-2018 yearly rainfalls were also compared for the selected important stations for each state in Peninsular Malaysia, as summarised in Table 2.7 and shown in Appendix A. Generally, the performance of models for stations is consistent with the performance of models for the state basis, where the ECHM5 was superior to the CCSM3 for the majority of the stations in Selangor & Kuala Lumpur, Negeri Sembilan, Pahang, Perlis, Kedah, Pulau Pinang and Perak; while the CCSM3 model was better than the ECHM5 for the majority of the stations in Johor, Terengganu and Kelantan. However, insignificant differences were found between the averages of projected and of observed 2014-2018 yearly rainfall, among the three scenarios traced by these two models, at the respective stations.

For the 2018 yearly rainfall projection, the ECHM5 still worked better than the CCSM3 for the same stations, and for each state. Again, no significant difference between the 2018 averages of the projections and 2018 averages of the observed yearly rainfall among the three scenarios was shown by these two models at the respective stations.

Table 2.7: Difference between projection and observation by stations for Peninsular Malaysia

State	Station ID	Station Name	Difference (%)											
			ECHM5_A1B		ECHM5_A2		ECHM5_B1		CCSM3_A1B		CCSM3_A2		CCSM3_B1	
			2018	Average 2014 - 2018	2018	Average 2014 - 2018	2018	Average 2014 - 2018	2018	Average 2014 - 2018	2018	Average 2014 - 2018	2018	Average 2014 - 2018
Selangor & Kuala Lumpur	2917001	Setor JPS Kajang	-16	-2	-19	-9	-19	-10	-37	-21	2	-24	-49	-32
	3116004	Ibu Pejabat JPS	-40	-8	-28	-8	0	0	-35	-15	-29	-9	-43	-3
	3117070	JPS Ampang	-7	3	-7	-5	-7	-2	-31	-12	-21	-27	-20	-16
	3217002	Emp Genting Kelang	2	-2	3	-11	4	-8	-28	-18	-26	-31	-12	-22
	3317004	Genting Sempah	-17	-14	-13	-20	-11	-15	-18	-9	-38	-25	-12	-13
	3516022	Loji Air Kuala Kubu Baru	27	2	38	-4	29	-4	0	-9	-15	-25	11	-16
Negeri Sembilan	2719001	Setor JPS Sikamat	-8	-6	-4	-12	-8	-9	-41	-14	-39	-37	-35	-30
	2725083	Ladang New Rompin	8	9	16	10	11	12	3	18	-23	-3	-17	5
Johor	2237164	Jalan Kluang-Mersing	-12	59	-7	62	-7	39	23	59	-29	9	35	47
	2636170	Setor JPS Endau	14	14	-7	28	-7	13	4	24	-24	-1	-11	18
Pahang	3424081	JPS Temerloh	26	25	28	16	49	23	21	38	17	24	48	28
	3818054	Setor JPS Raub	2	46	15	33	23	44	-2	71	-16	42	19	60
	3930012	Sungai Lembing PCC Mill	-19	-10	-19	-6	21	0	-6	-4	-23	-27	-6	-5
	4513033	Gunung Brinchang	-8	-1	-4	-4	0	-2	-36	25	-19	4	1	13
Terengganu	4234109	JPS Kemaman	-18	19	-18	22	40	28	7	3	-24	-14	-14	3
	4734079	SM Sultan Omar Dungun	-35	-8	-30	-3	5	-3	-13	-7	-22	-11	0	-11
	5331048	Setor JPS K Terengganu	-30	5	-20	8	31	18	16	-1	-15	-7	58	11
Kelantan	5522047	JPS Kuala Krai	-12	-10	-1	-9	38	6	11	-2	0	-7	26	7
	5722057	JPS Machang	-28	-15	-18	-15	23	-2	-14	-14	-9	-7	-6	-7
Perlis	6401002	Padang Katong Kangar	9	4	-4	2	12	-4	-43	-29	-84	-48	-69	-38
Kedah	5704055	Kedah Peak	-16	-13	-25	-15	-8	-16	-63	-35	-61	-43	-58	-35
	6103047	Setor JPS Alor Setar	0	-2	-13	-5	9	-9	-58	-50	-82	-63	-72	-48

State	Station ID	Station Name	Difference (%)											
			ECHM5_A1B		ECHM5_A2		ECHM5_B1		CCSM3_A1B		CCSM3_A2		CCSM3_B1	
			2018	Average 2014 - 2018	2018	Average 2014 - 2018	2018	Average 2014 - 2018	2018	Average 2014 - 2018	2018	Average 2014 - 2018	2018	Average 2014 - 2018
	6207032	Ampang Pedu	3	-4	-8	-6	19	-3	-57	-16	-29	9	-22	-27
Pulau Pinang	5303053	Kompleks Prai	-22	-1	-26	-6	-6	-4	-69	-37	-65	-56	-49	-37
	5402001	Klinik Bkt Bendera PP	-18	-14	-35	-21	-5	-16	-71	-60	-67	-64	-61	-55
Perak	4311001	Pejabat Daerah Kampar	-20	-6	-23	-13	-17	-10	-49	-7	-41	-19	-10	-8
	4511111	Politeknik Ungku Umar	-11	5	-18	-1	-5	6	-44	13	-37	-2	-5	12
	4807016	Bukit Larut Taiping	-40	-18	-41	-22	-33	-19	-66	-13	-63	-31	-41	-24

The performance of the models was also assessed through estimating the average percentages for over projected and under projected 2014-2018 yearly rainfall. The ECHM5 showed the smallest percentages among the models for the majority of the stations in Selangor & Kuala Lumpur (except for Loji Air Kuala Kubu Baru), Negeri Sembilan, Johor (except for Jalan Kluang-Mersing), Pahang, Perlis, Kedah, Pulau Pinang and Perak; while the CCSM3 was slightly better than the ECHM5 at all the stations in Terengganu and Kelantan, as shown in Table 2.8.

Overall, the percentages of over projected and under projected yearly rainfall of the overperforming models did not exceed 30%, except for stations at JPS Temerloh, Jalan Kluang-Mersing, Setor JPS Endau, Setor JPS Raub and Bukit Larut Taiping.

Table 2.8: Over projected and under projected by stations for Peninsular Malaysia

State	Station ID	Station Name	Average Percentage (%) for 2014 - 2018			
			ECHM5		CCSM3	
			Over Projected	Under Projected	Over Projected	Under Projected
Selangor & Kuala Lumpur	2917001	Setor JPS Kajang	10	-16	2	-30
	3116004	Ibu Pejabat JPS	14	-16	26	-27
	3117070	JPS Ampang	14	-12	13	-23
	3217002	Emp Genting Kelang	13	-20	9	-29
	3317004	Genting Sempah	9	-20	20	-21
	3516022	Loji Air Kuala Kubu Baru	21	-15	7	-21
Negeri Sembilan	2719001	Setor JPS Sikamat	14	-19	10	-40
	2725083	Ladang New Rompin	18	-10	21	-14
Johor	2237164	Jalan Kluang-Mersing	78	-12	48	-24
	2636170	Setor JPS Endau	39	-17	37	-21
Pahang	3424081	JPS Temerloh	33	-17	37	-15
	3818054	Setor JPS Raub	59	-18	94	-14
	3930012	Sungai Lembing PCC Mill	26	-22	33	-19
	4513033	Gunung Brinchang	15	-13	37	-21
Terengganu	4234109	JPS Kemaman	43	-20	13	-20
	4734079	SM Sultan Omar Dungun	29	-25	24	-22
	5331048	Setor JPS K Terengganu	35	-21	24	-25
Kelantan	5522047	JPS Kuala Krai	21	-23	11	-18
	5722057	JPS Machang	27	-28	22	-20
Perlis	6401002	Padang Katong Kangar	17	-22	37	-44
Kedah	5704055	Kedah Peak	15	-23	6	-41
	6103047	Setor JPS Alor Setar	14	-16	0	-54
	6207032	Ampang Pedu	12	-16	36	-28
Pulau Pinang	5303053	Kompleks Prai	29	-17	55	-50
	5402001	Klinik Bkt Bendera P. Pinang	12	-23	0	-60
Perak	4311001	Pejabat Daerah Kampar	19	-20	17	-26
	4511111	Politeknik Ungku Umar	28	-14	31	-27
	4807016	Bukit Larut Taiping	46	-36	46	-40

2.1.4 Spatial Distribution of 2018 Yearly Rainfall for Peninsular Malaysia

Spatial distributions of the 2018 yearly rainfall projected by the ECHM5 and CCSM3 models, under scenarios A1B, A2 and B1 for the whole Peninsular Malaysia are shown in Figures 2.7a-2.7c and Figures 2.8a-2.8c, respectively. The spatial distributions of yearly rainfall projected by the models are consistent with their temporal patterns for each state, where the ECHM5 outperformed the CCSM3 in all the states except for Terengganu and Kelantan. Based on the temporal pattern analysis (Tables 2.5a-2.5k), the ECHM5 showed:

(a) -3% of difference between projection and observation under scenario A1B, 2% under scenario A2, and 1% under scenario B1 in Selangor - Kuala Lumpur;
(b) -7% of difference between projection and observation under scenario A1B, 0% under scenario A2, and -5% under scenario B1 in Negeri Sembilan;
(c) -1% of difference between projection and observation under scenario A1B, 15% under scenario A2, and 2% under scenario B1 in Melaka;
(d) -5% of difference between projection and observation under scenario A1B, 5% under scenario A2, and 1% under scenario B1 in Johor;
(e) 3% of difference between projection and observation under scenario A1B, 10% under scenario A2, and 21% under scenario B1 in Pahang;
(f) -3% of difference between projection and observation under scenario A1B, 2% under scenario A2, and 1% under scenario B1 in Perlis;
(g) -3% of difference between projection and observation under scenario A1B, 2% under scenario A2, and 1% under scenario B1 in Kedah;
(h) -3% of difference between projection and observation under scenario A1B, 2% under scenario A2, and 1% under scenario B1 in Pulau Pinang, and
(i) -3% of difference between projection and observation under scenario A1B, 2% under scenario A2, and 1% under scenario B1 in Perak

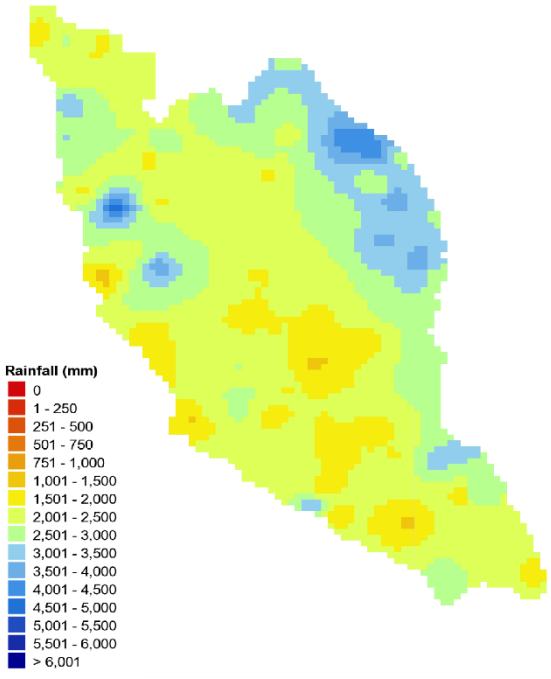
The differences between projected and observed yearly rainfall magnitude (majority around -500 mm to 500 mm) presented in the spatial maps in Figures 2.7a-2.7c are consistent with the state average percentage of differences obtained in the temporal pattern analysis as discussed in the earlier sections. However, under projections from -1,000 mm to -1,500 mm were found in some areas in Pulau Pinang and Melaka. It was found that the yearly rainfall difference maps of the three scenarios showed insignificant differences among each other, for

all these states. Over at the east coast (Tables 2.5a-2.5k), the CCSM3 performed better than the ECHM5 with:

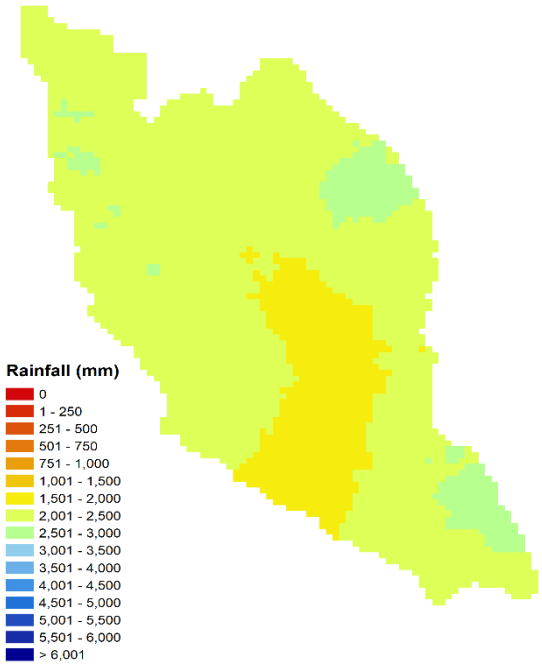
(a) -17% of difference under scenario A1B, -15% under scenario A2, and -2% under scenario B1 in Terengganu, and

(b) -19% of difference under scenario A1B, -6% under scenario A2, and 11% under scenario B1 in Kelantan

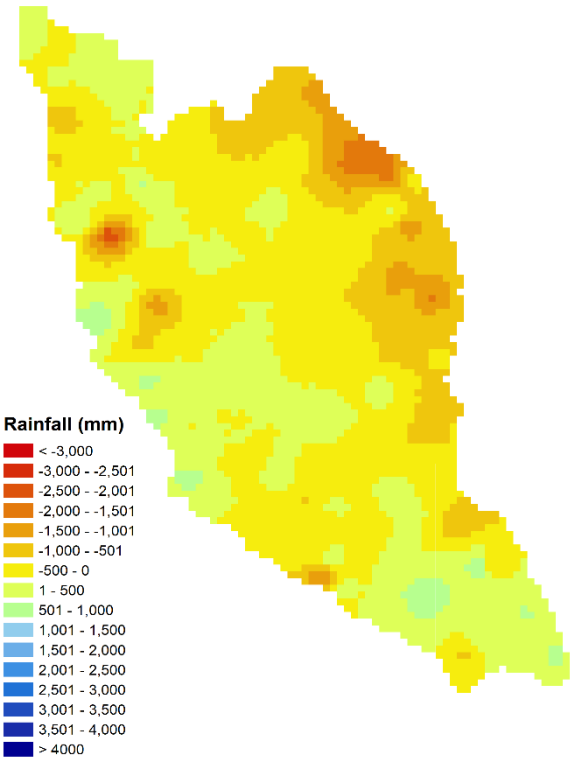
The differences between projected and observed yearly rainfall magnitudes (majority under projections of more than 0 mm to -1,500 mm) presented in the spatial maps in Figure 2.8a-c are consistent with these percentages of difference as in the temporal pattern analysis. However, over projections of 500 mm to 1,500 mm were found in some areas located in south Kelantan and north Terengganu, especially with scenarios of A2 and B1. Other areas, however, showed insignificant difference among the three scenarios.



Observation

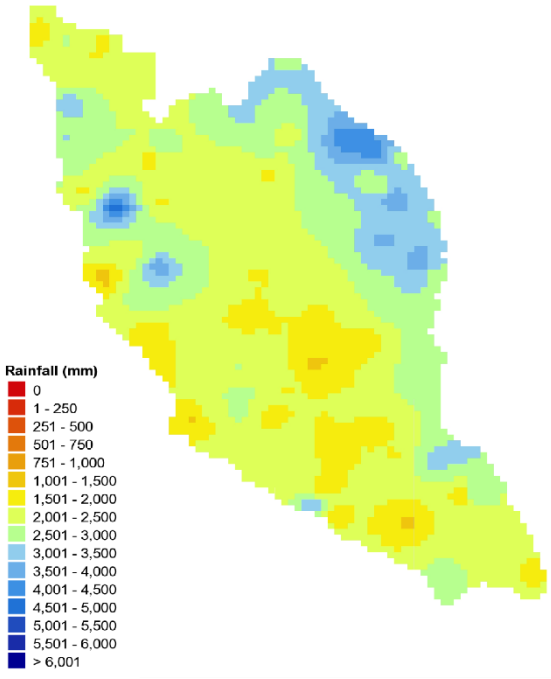


Projection (Average_ECHM5_A1B)

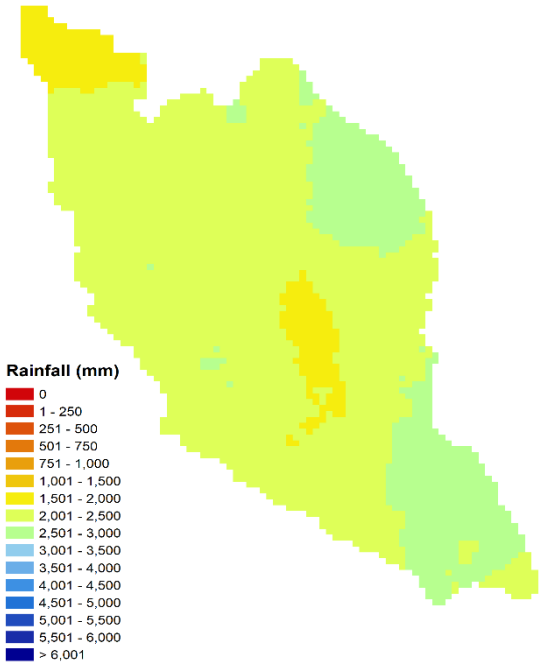


Difference

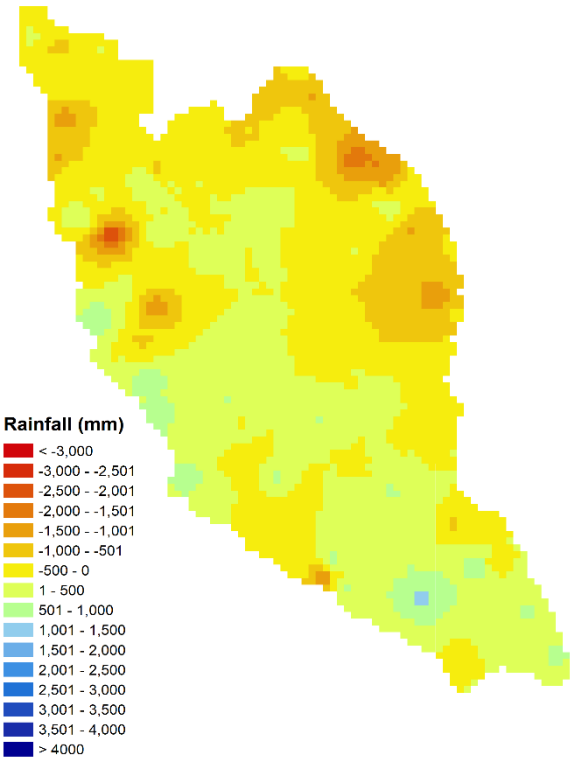
Figure 2.7a: Spatial distribution of 2018 yearly rainfall by ECHM5 under Scenario A1B for Peninsular Malaysia



Observation

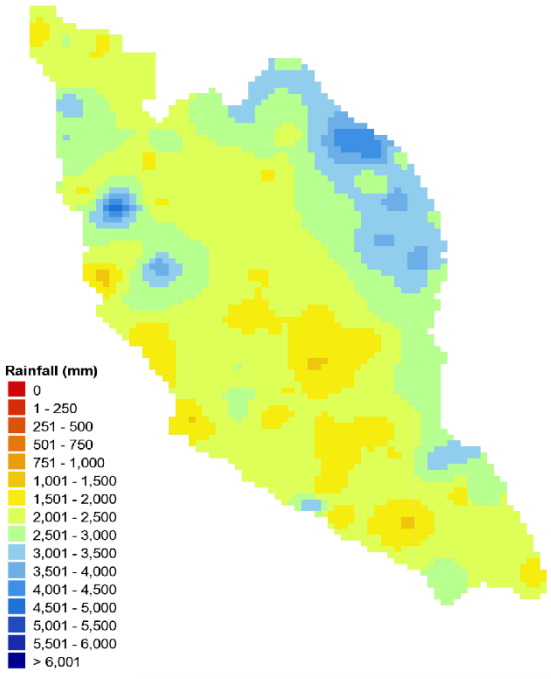


Projection (Average_ECHM5_A2)

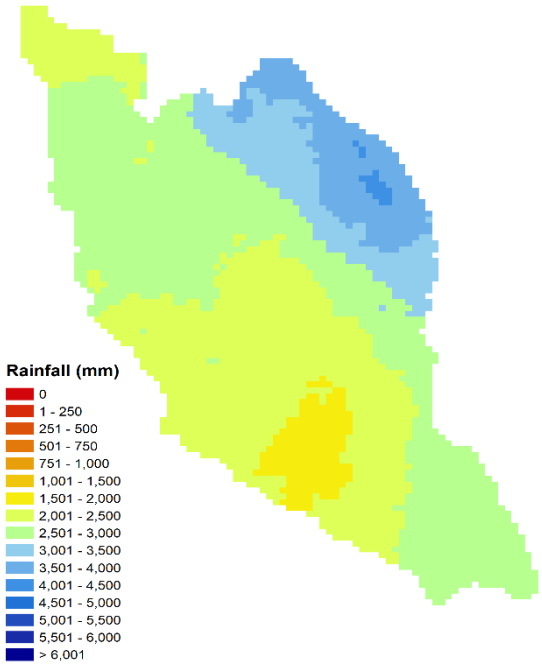


Difference

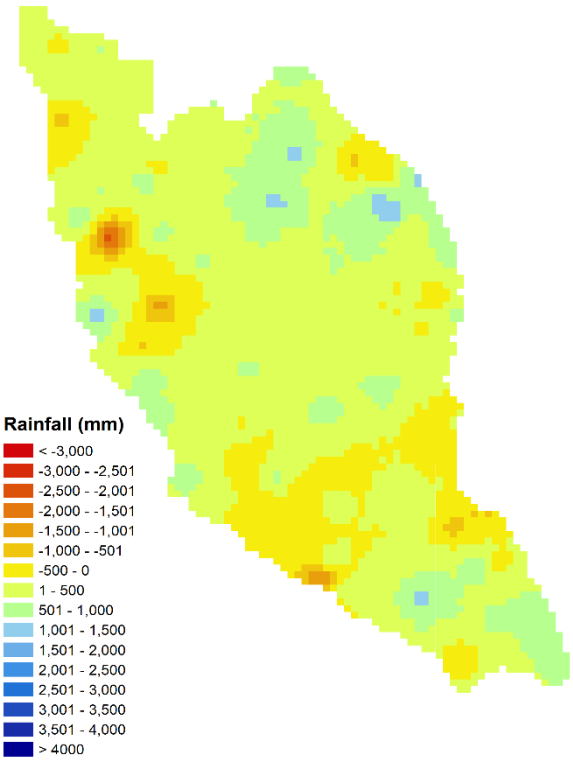
Figure 2.7b: Spatial distribution of 2018 yearly rainfall by ECHM5 under Scenario A2 for Peninsular Malaysia



Observation

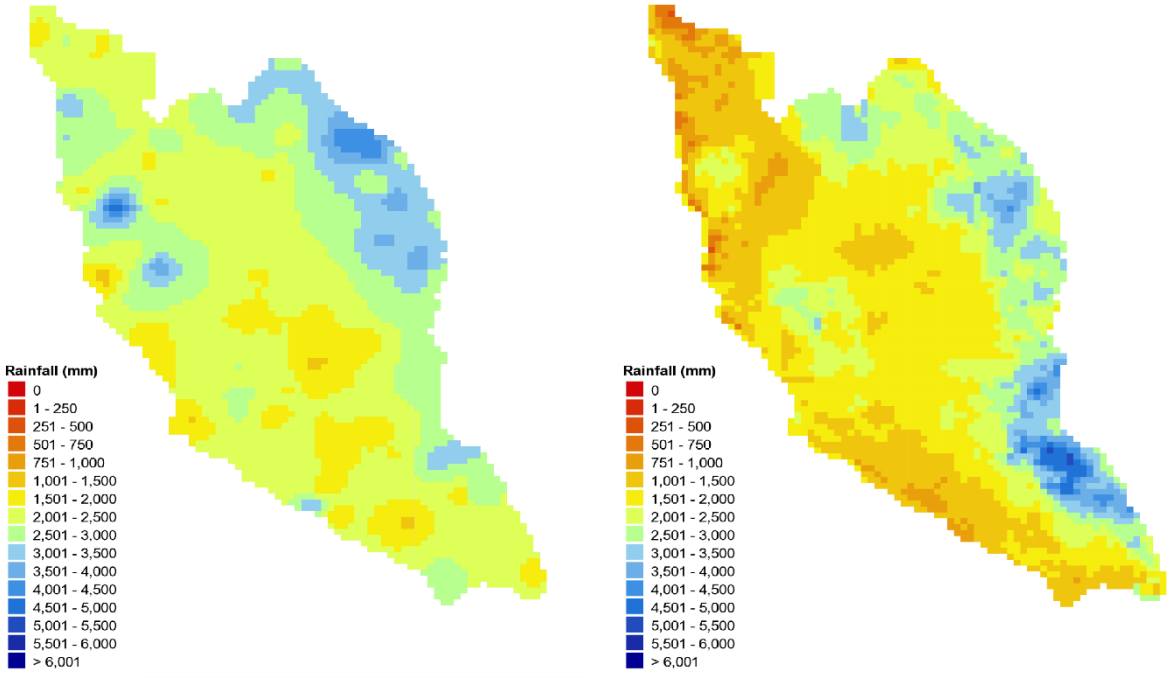


Projection (Average_ECHM5_B1)



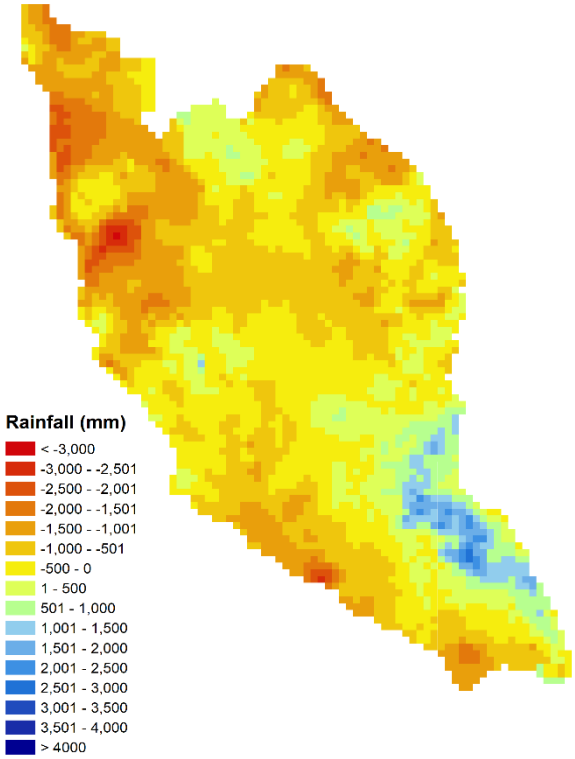
Difference

Figure 2.7c: Spatial distribution of 2018 yearly rainfall by ECHM5 under Scenario B1 for Peninsular Malaysia



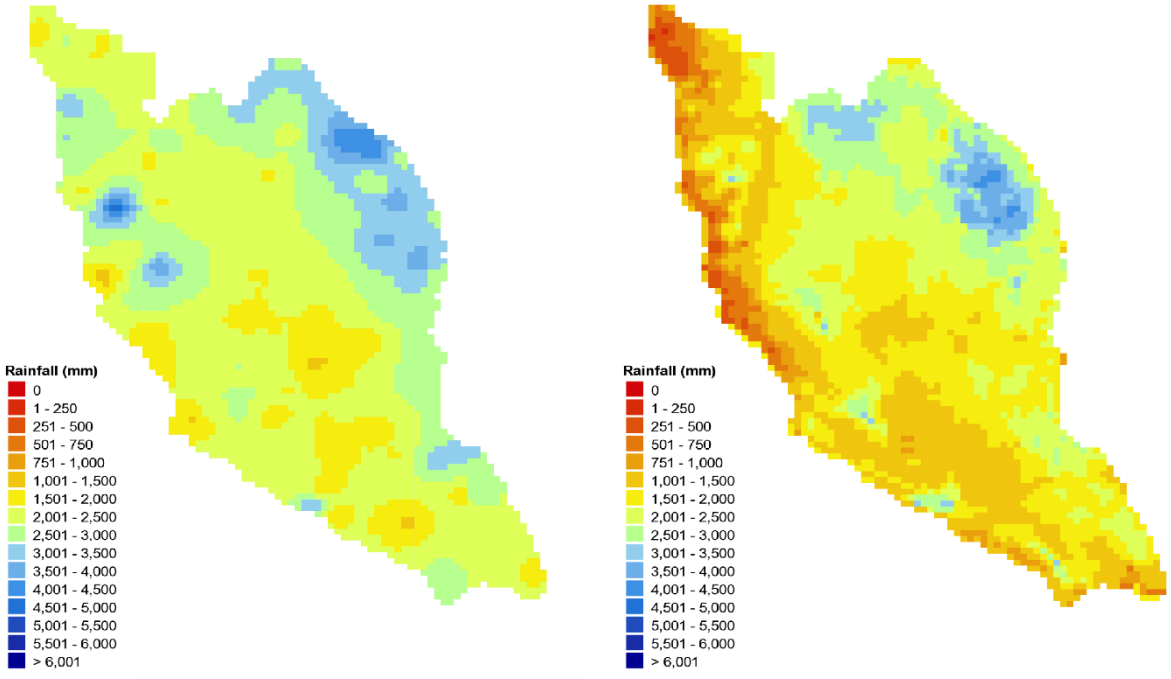
Observation

Projection (CCSM3_A1B)



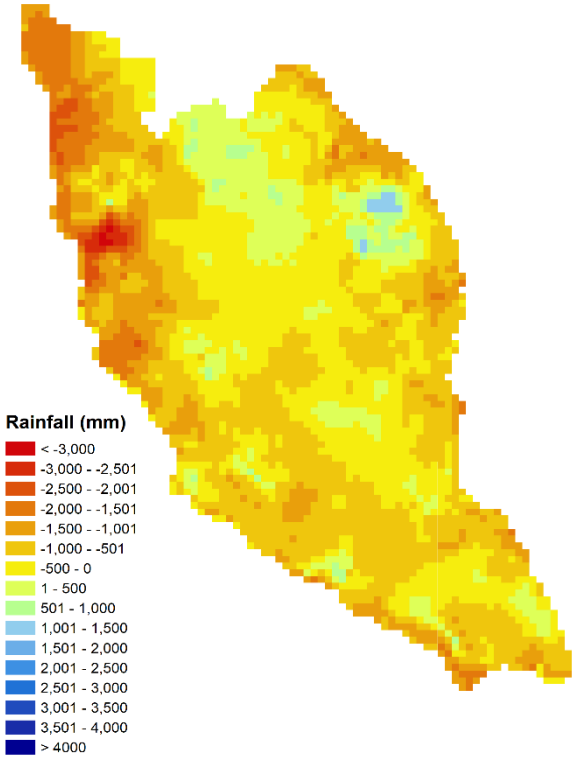
Difference

Figure 2.8a: Spatial distribution of 2018 yearly rainfall by CCSM3 under Scenario A1B for Peninsular Malaysia



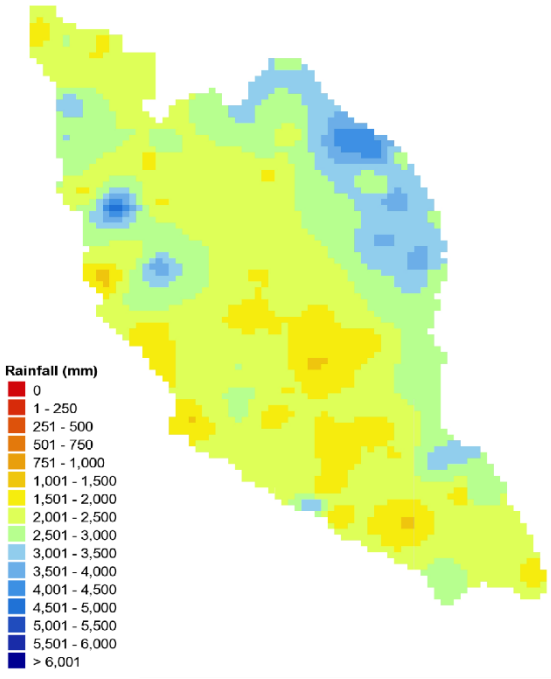
Observation

Projection (CCSM3_A2)

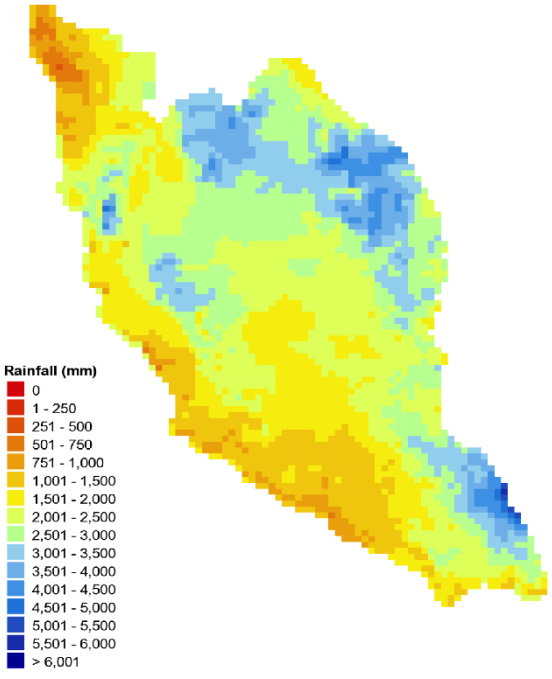


Difference

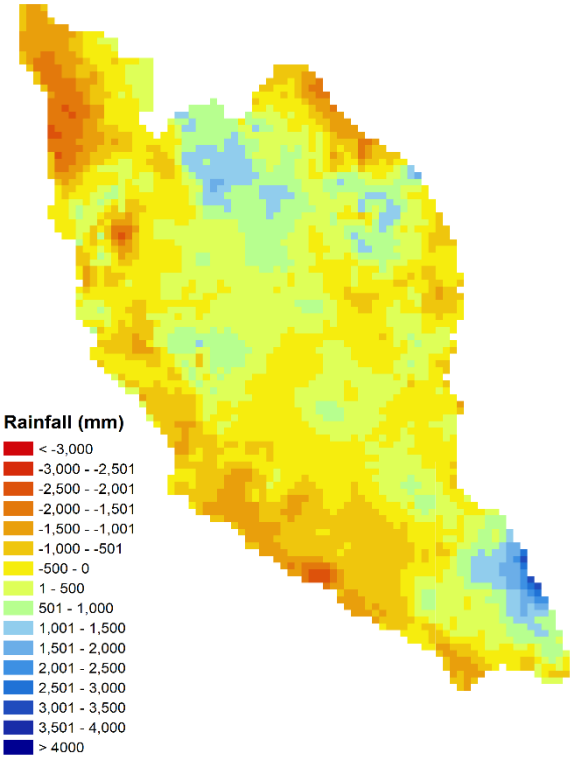
Figure 2.8b: Spatial distribution of 2018 yearly rainfall by CCSM3 under Scenario A2 for Peninsular Malaysia



Observation



Projection (CCSM3_B1)



Difference

Figure 2.8c: Spatial distribution of 2018 yearly rainfall by CCSM3 under Scenario B1 for Peninsular Malaysia

2.2 Sabah & Sarawak

2.2.1 Temporal Yearly Rainfall Pattern Analysis according to States

Similarly, for Sabah and Sarawak, the projected 2014-2018 yearly rainfalls based on different climate models and CO_2 emission scenarios were compared with the corresponding observed yearly rainfall, as shown in Tables 2.9a & 2.9b and Figures 2.9a & 2.9b. Overall, the MRI over-performed the ECHM3 for the two states in scenario A1B, as shown in Tables 2.9a & 2.9b.

The difference between the projection and the observation by MRI in Sabah was only -6%, while that for the ECHM3 was 21%. In Sarawak, there was no difference between projection and observation found for MRI, while a 15% of difference was accounted for with the ECHM3 model.

Table 2.9a: Projected and Observed 2014-2018 Yearly Rainfall for Sabah

Sabah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	3,440	3,240	3,426	2,739	2,703	3,110
ECHM3_A1B_2	3,211	3,125	2,847	2,825	3,094	3,020
ECHM3_A1B_3	2,915	3,638	3,255	3,529	2,693	3,206
Average_ECHM3	3,189	3,334	3,176	3,031	2,830	3,112
MRI_A1B	2,313	2,332	2,559	2,901	2,142	2,449
Average_ALL	2,970	3,084	3,022	2,998	2,658	2,946
OBSERVED	2,718	2,227	2,339	3,249	2,559	2,618

Table 2.9b: Projected and Observed 2014-2018 Yearly Rainfall for Sarawak

Sarawak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	4,207	4,133	4,100	4,297	3,251	3,998
ECHM3_A1B_2	4,047	4,376	3,489	3,456	3,417	3,757
ECHM3_A1B_3	3,511	4,078	4,378	3,984	4,297	4,050
Average_ECHM3	3,922	4,195	3,989	3,912	3,655	3,935
MRI_A1B	3,323	3,532	3,575	3,509	3,214	3,431
Average_ALL	3,772	4,029	3,885	3,811	3,545	3,808
OBSERVED	2,969	3,434	3,504	3,785	3,517	3,442

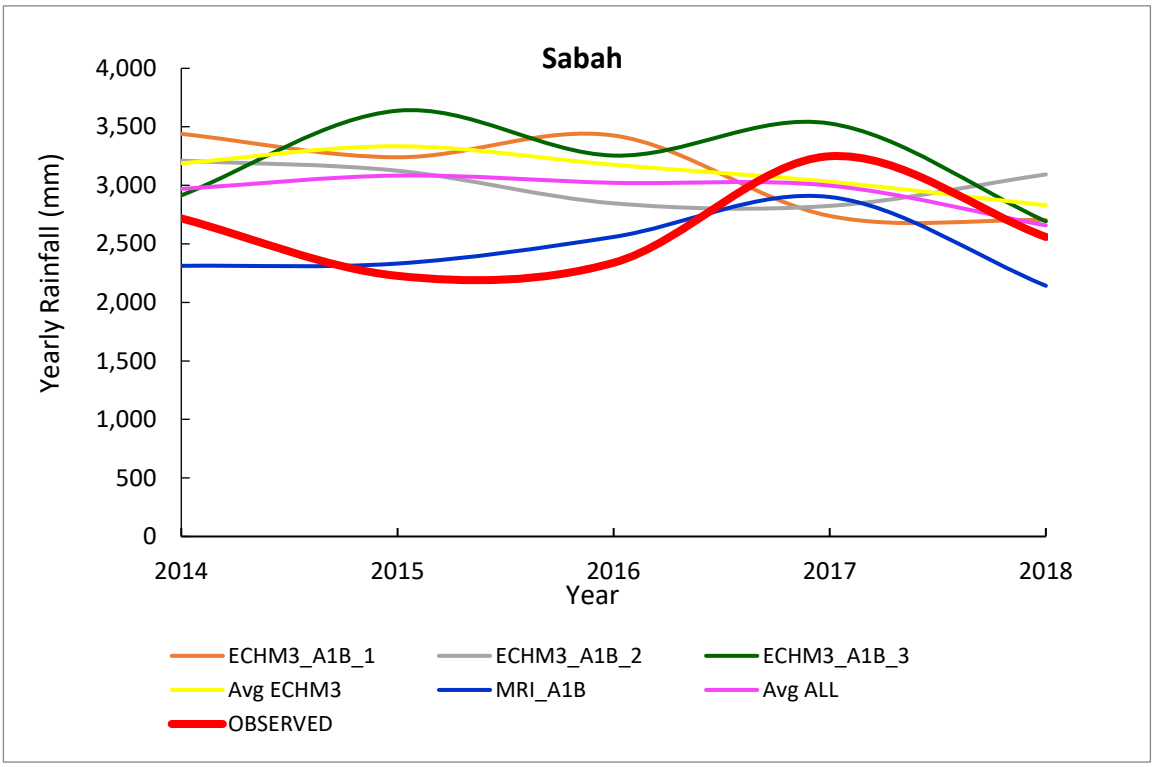


Figure 2.9a: Projected and observed 2014-2018 yearly rainfall for Sabah

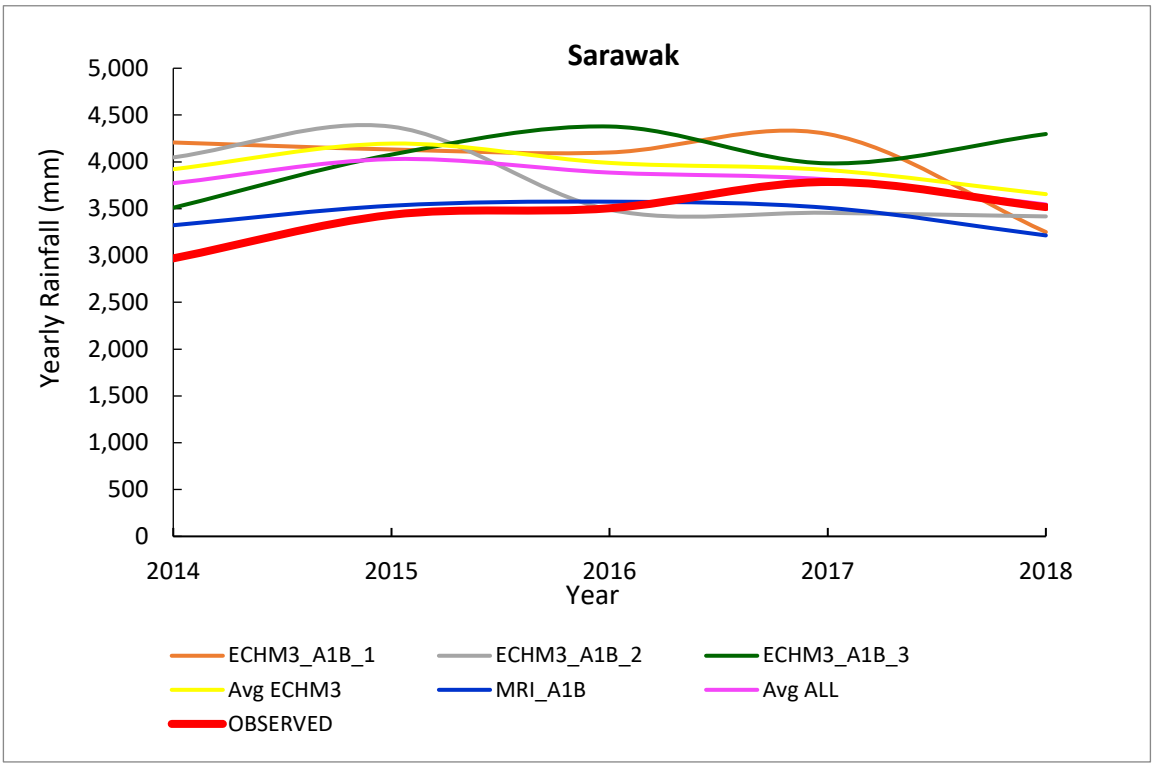


Figure 2.9b: Projected and observed 2014-2018 yearly rainfall for Sarawak

Table 2.10a: Difference between projected and observed 2014-2018 yearly rainfall for Sabah

Sabah						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	27	45	46	-16	6	22
ECHM3_A1B_2	18	40	22	-13	21	18
ECHM3_A1B_3	7	63	39	9	5	25
Average_ECHM3	17	50	36	-7	11	21
MRI_A1B	-15	5	9	-11	-16	-6
Average_ALL	9	38	29	-8	4	14

Table 2.10b: Difference between projected and observed 2014-2018 yearly rainfall for Sarawak

Sarawak						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	42	20	17	14	-8	17
ECHM3_A1B_2	36	27	0	-9	-3	10
ECHM3_A1B_3	18	19	25	5	22	18
Average_ECHM3	32	22	14	3	4	15
MRI_A1B	12	3	2	-7	-9	0
Average_ALL	27	17	11	1	1	11

For the 2018 yearly rainfall projection, the ECHM3 outperformed the MRI for Sabah and Sarawak, as shown in Tables 2.10a & 2.10b and Figures 2.10a & 2.10b. The ECHM3 showed slightly higher performance for the two states with difference between projected and observed yearly rainfall of 11% for Sabah and 4% for Sarawak, as compared to -16% and -9%, respectively, by the MRI.

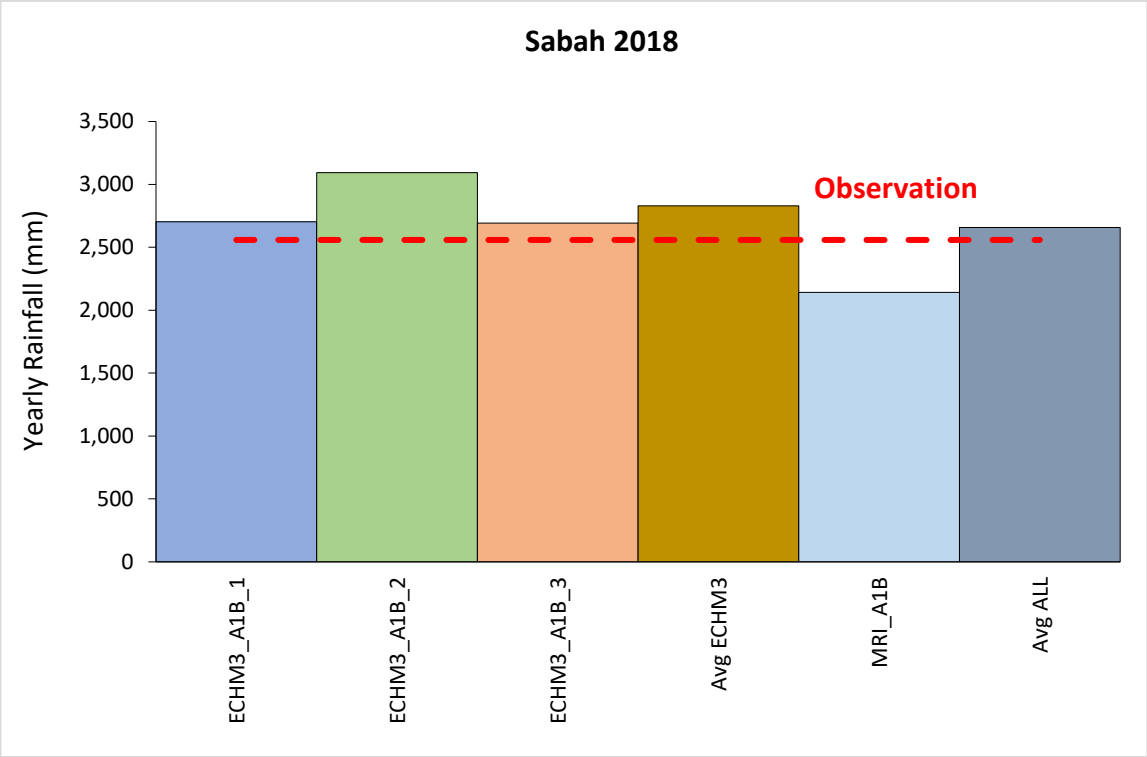


Figure 2.10a: Projected and observed 2018 yearly rainfall for Sabah

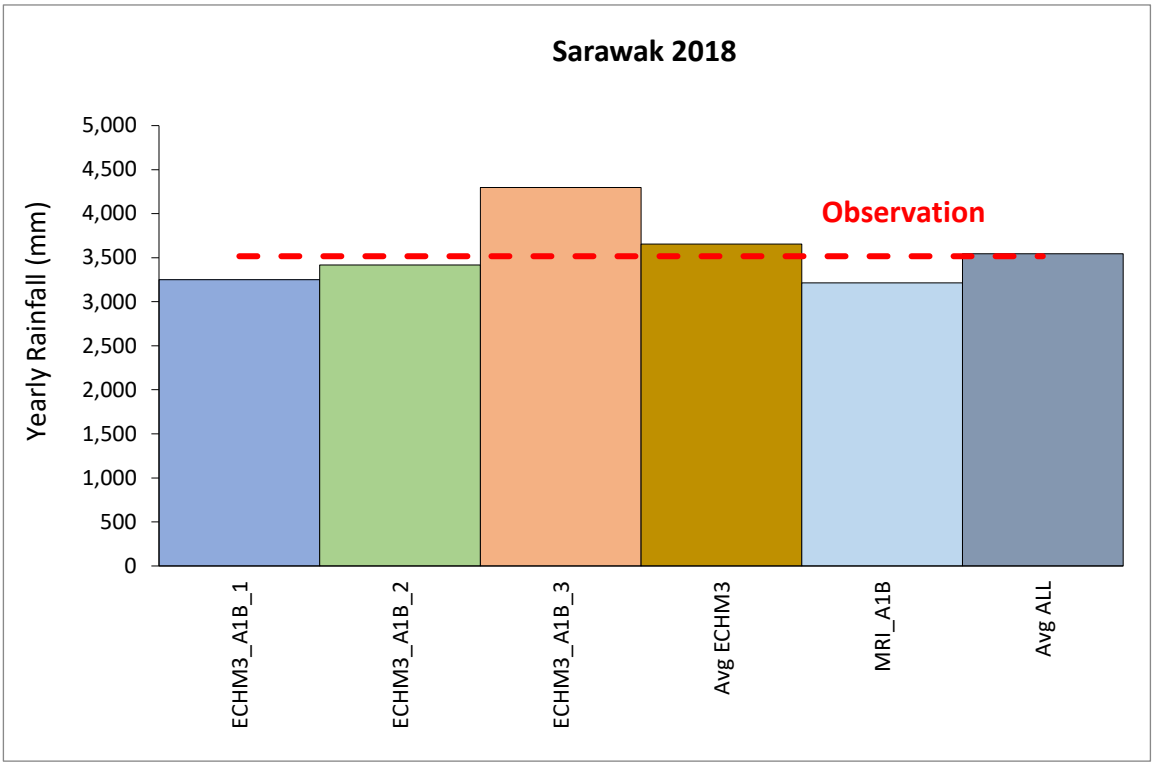


Figure 2.10b: Projected and observed 2018 yearly rainfall for Sarawak

The performances of models were also assessed through estimating the average percentages of the over projected and the under projected 2014-2018 yearly rainfall. The MRI showed the smaller percentages of 7% over projection and -14% under projection for Sabah; while 6% over projection and -8% under projection for Sarawak, as shown in Tables 2.11a & 2.11b and Figures 2.11a & 2.11b.

Table 2.11a: Average percentage of over projected and under projected by models for 2014-2018 yearly rainfall for Sabah

Model	Projection	Average Percentage
All	Over Projected	21
	Under Projected	-12
ECHM3	Over Projected	28
	Under Projected	-7
MRI	Over Projected	7
	Under Projected	-14

Table 2.11b: Average percentage of over projected and under projected by models for 2014-2018 yearly rainfall for Sarawak

Model	Projection	Average Percentage
All	Over Projected	12
	Under Projected	-8
ECHM3	Over Projected	15
	Under Projected	0
MRI	Over Projected	6
	Under Projected	-8

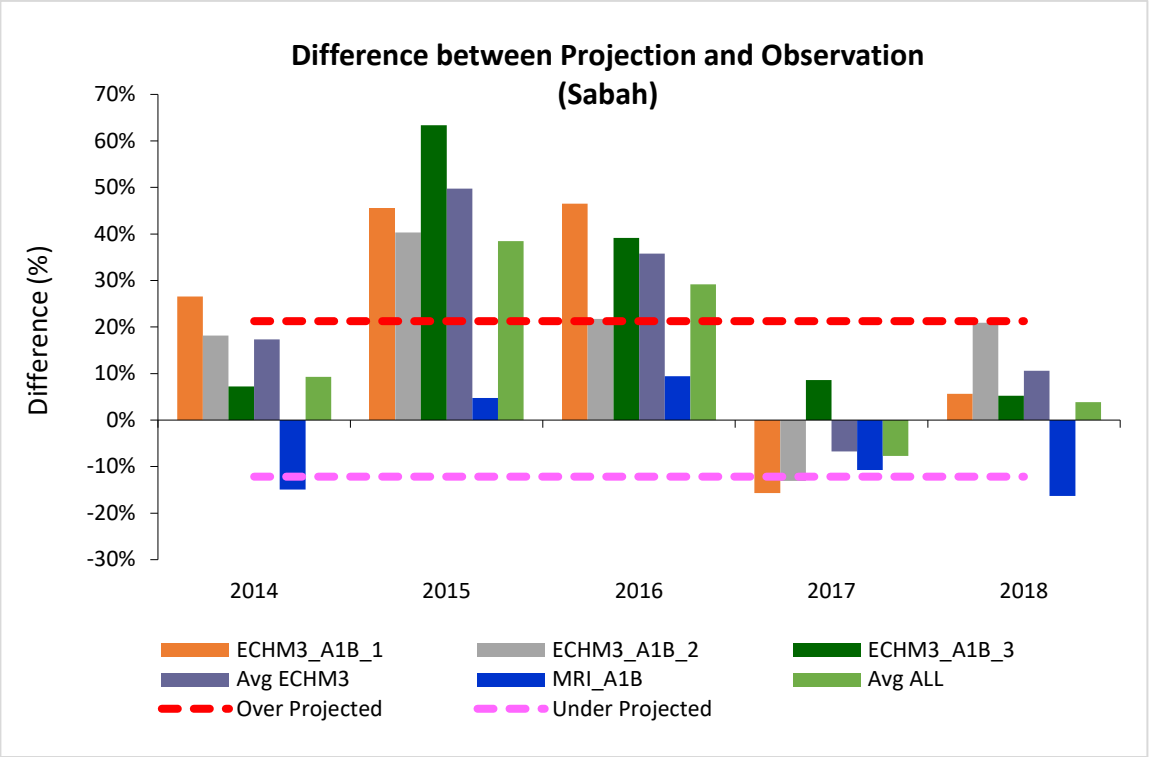


Figure 2.11a: Difference between projected and observed 2014-2018 yearly rainfall for Sabah

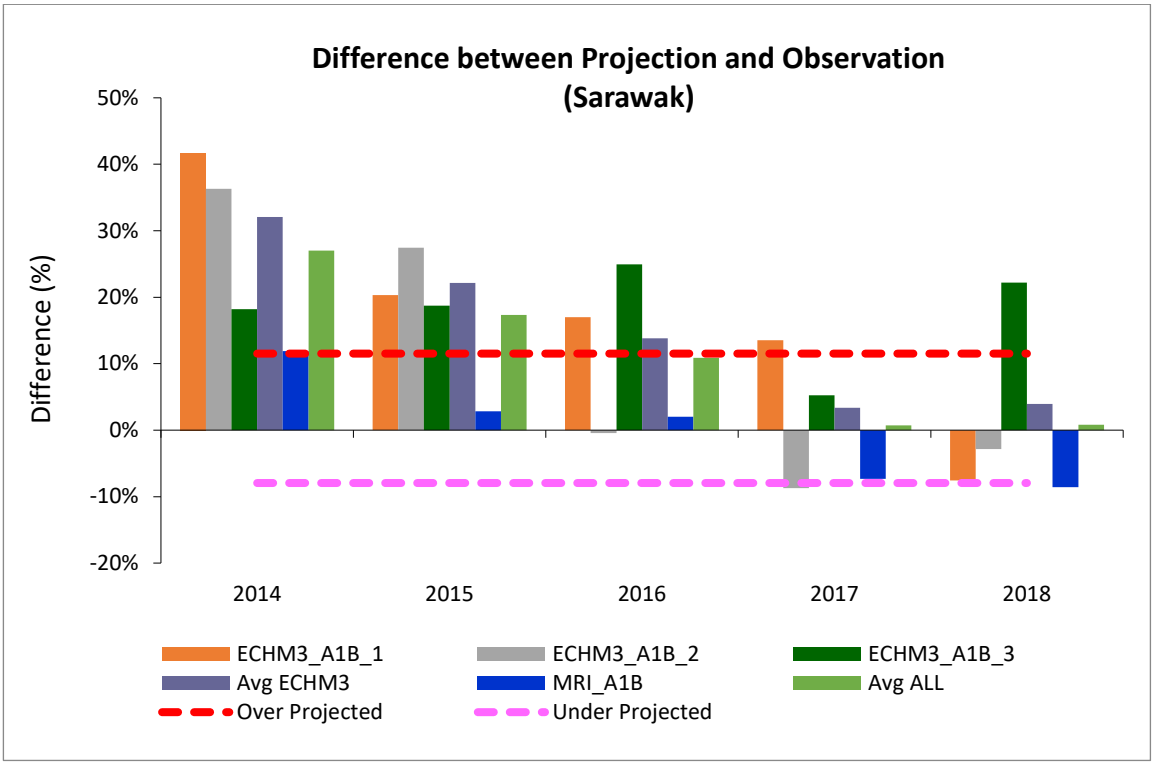


Figure 2.11b: Difference between projected and observed 2014-2018 yearly rainfall for Sarawak

2.2.2 Analysis of Temporal Yearly Rainfall Pattern according to Stations

The projected 2014-2018 yearly rainfalls were also compared with the same period of observed yearly rainfall for the selected important stations in Sabah and Sarawak, as summarised in Table 2.12 and shown in Appendix B. Generally, the performance of models for the selected stations in Sarawak is consistent with the performance of models for the state basis, where the MRI outperformed the ECHM3 for the majority of stations in the state; except for the stations at Belaga, Kanowit Water Works, Lawas Airfield, Nanga Mujan and Sibu New Airport. However, in Sabah, ECHM3 was found to be better than the MRI in most of the selected stations.

For the 2018 yearly rainfall projection, the ECHM3 outperformed MRI for most of the selected stations in Sabah, as shown in Table 2.12, which is consistent with the average performance of models for the whole state basis. In Sarawak, however, the MRI had performed better than the ECHM3 at most of the selected stations, for the 2018 yearly rainfall.

Overall, the differences between projected and observed yearly rainfall were found to be less than 50%, except for stations at Kuamut Met Stn and Semporna Airport in Sabah, and stations at Limbang DID and Nanga Mujan in Sarawak.

Table 2.12: Difference between projection and observation by stations for Sabah & Sarawak

State	Station ID	Station Name	Difference (%)			
			ECHM3_A1B		MRI_A1B	
			2018	Average 2014 - 2018	2018	Average 2014 - 2018
Sabah	4486001	Semporna Airport	41	60	70	95
	5274001	Kuamut Met Stn	-57	-51	-63	-58
	5357003	Beaufort JPS	-40	-15	-40	-38
	5361002	Keningau Met Stn	-62	-58	-37	-35
	5862002	Ulu Moyog	-35	-33	-32	-37
	5961002	Inanam	-40	8	90	117
	5973001	Trusan Sapi Met Stn	-26	-16	-63	-54
	6264001	Tamu Darat Agr Stn	-44	-46	-47	-46
	6868001	Kudat JPS	-23	22	-7	-1
Sarawak	1105027	Serian	39	41	-11	13
	1302078	Kampung Git	8	6	-10	2
	1321001	Nanga Mujan	-51	-48	-64	-58
	1403001	Kuching Airport	15	6	-6	0
	1506034	Asa Jaya	-21	-23	-22	-8
	2021036	Kanowit Water Works	-5	-7	-27	-13
	2115008	Sarikei DID	-10	-11	-19	-11
	2219001	Sibu New Airport	19	-3	-1	-7
	2737103	Belaga	21	5	-14	-15
	3541033	Long Jegan	-48	-38	-35	-25
	3956001	Ba Kelalan	73	83	-5	24
	4339005	Miri Airport	-72	-62	-43	-23
	4749001	Limbang DID	-55	-40	-52	-35
	4854009	Lawas Airfield	-36	-6	-55	-37

The models' performances were also assessed through estimating the average percentages of over projected and under projected values for the 2014-2018 yearly rainfalls, as shown in Table 2.13. The MRI showed the smaller range for most of the stations in Sabah and Sarawak when compared to the ECHM3. In general, the percentages of over projection and under projection were found to be less than 35% and 50%, respectively, for the majority of the stations in the states except for the stations at Inanam, Kuamut Met Stn, Semporna Airport and Trusan Sapi Met Stn in Sabah, and the stations at Nanga Mujan and Ba Kelalan in Sarawak.

Table 2.13: Over projected and under projected by stations for Sabah & Sarawak

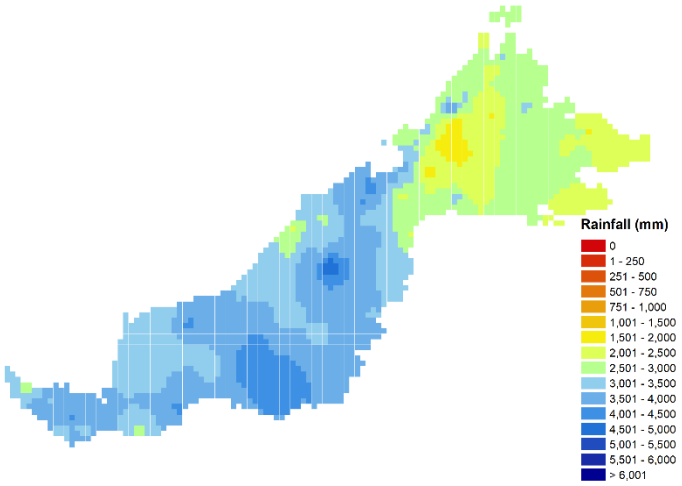
State	Station ID	Station Name	Average Percentage (%) for 2014 - 2018			
			ECHM3_A1B		MRI_A1B	
			Over Projected	Under Projected	Over Projected	Under Projected
Sabah	4486001	Semporna Airport	60	0	95	0
	5274001	Kuamut Met Stn	0	-51	0	-58
	5357003	Beaufort JPS	15	-36	0	-38
	5361002	Keningau Met Stn	0	-58	0	-35
	5862002	Ulu Moyog	0	-33	0	-37
	5961002	Inanam	70	-34	117	0
	5973001	Trusan Sapi Met Stn	27	-27	0	-54
	6264001	Tamu Darat Agr Stn	0	-46	0	-46
	6868001	Kudat JPS	45	-14	19	-15
Sarawak	1105027	Serian	41	0	31	-14
	1302078	Kampung Git	9	-4	20	-10
	1321001	Nanga Mujan	0	-48	0	-58
	1403001	Kuching Airport	10	-9	13	-9
	1506034	Asa Jaya	0	-23	15	-23
	2021036	Kanowit Water Works	1	-10	0	-13
	2115008	Sarikei DID	2	-14	1	-15
	2219001	Sibu New Airport	15	-31	11	-19
	2737103	Belaga	15	-10	0	-15
	3541033	Long Jegan	0	-38	0	-25
	3956001	Ba Kelalan	83	0	45	-6
	4339005	Miri Airport	0	-62	0	-23
	4749001	Limbang DID	0	-40	0	-35
	4854009	Lawas Airfield	29	-30	0	-37

2.2.3 Spatial Distribution of 2018 Yearly Rainfall for Sabah & Sarawak

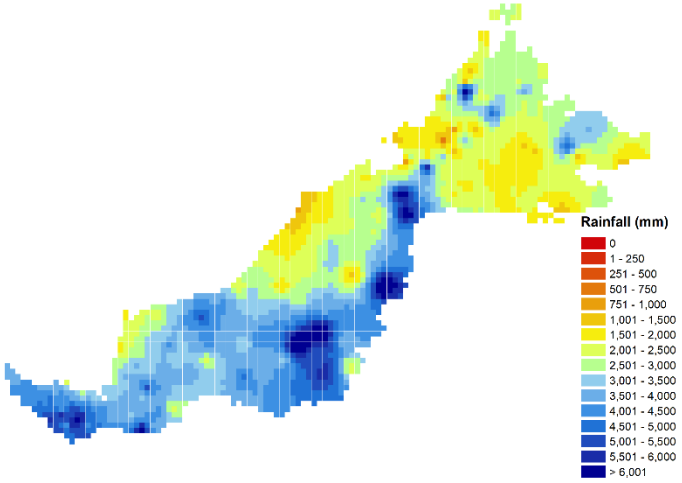
Spatial distributions of the 2018 yearly rainfall projections by the ECHM3 and MRI models under scenario A1B for Sabah and Sarawak are shown in Figure 2.12 and Figure 2.13, respectively. The spatial distributions of the yearly rainfall projected by the models are deemed consistent with their temporal patterns for the states, where the ECHM3 gave slightly better performances than the MRI. Based on the temporal pattern analysis, the ECHM3 showed 11% of difference between projections and observations in Sabah and 4% in Sarawak, whereas the MRI showed -16% in Sabah and -9% in Sarawak (Tables 2.10a & 2.10b).

The differences between the projections by the ECHM3 and the observed yearly rainfall magnitudes in the region are of a majority around -1,000 mm to 500 mm, as presented in the spatial map of the two states in Figure 2.12. These are consistent with the state average percentage of differences from the temporal pattern analysis. However, there were over projections of up to 3,000 mm found in the east of Limbang and Miri, and the central of Kapit, in Sarawak. Over projections were also found for some small areas in the south of Samarahan and Sri Aman in Sarawak, and the central of west coast and east of Sandakan in Sabah. Nevertheless, under projections of up to -2,500 mm were identified in the west coast and central areas of Limbang and Miri.

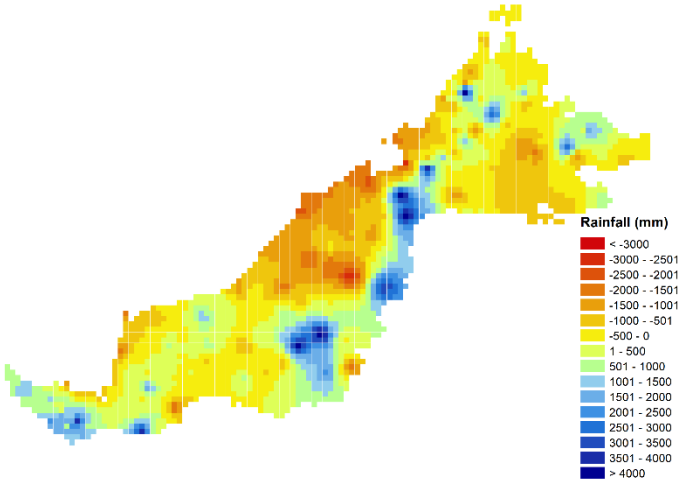
On the other hand, based on the projections by the MRI, the majority of the areas in Sabah and Sarawak were under projected (around > 0 mm to -1,500 mm), as shown in Figure 2.13. Again, this was in line with the temporal pattern analysis, where -16% of difference between projection and observation in Sabah and -9% in Sarawak were identified.



Observation

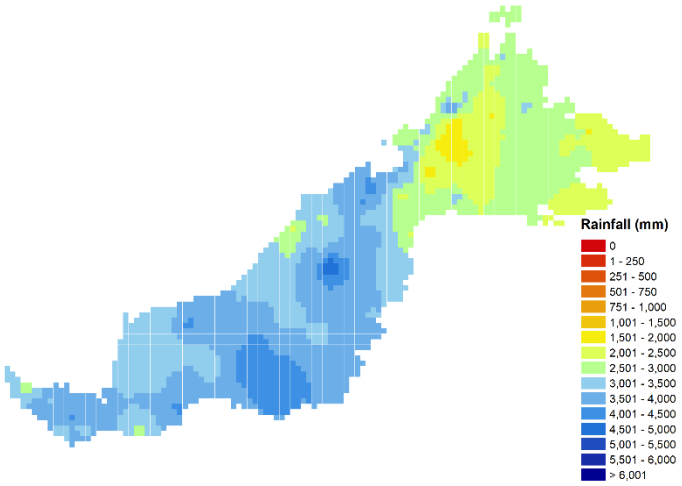


Projection (Average_ECHM3_A1B)

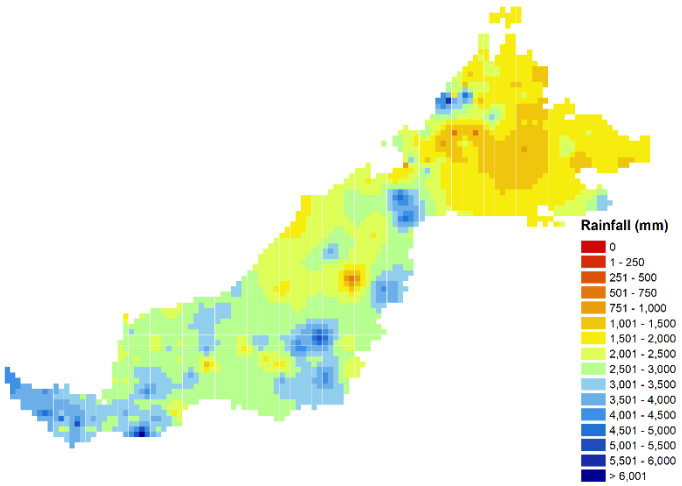


Difference

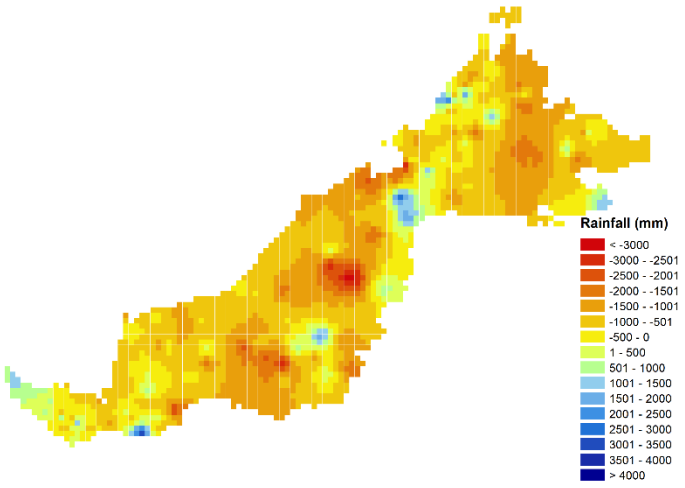
Figure 2.12: Spatial distribution of 2018 yearly rainfall by ECHM3 under Scenario A1B for Sabah & Sarawak



Observation



Projection (MRI_A1B)



Difference

Figure 2.13: Spatial distribution of 2018 yearly rainfall by MRI under Scenario A1B for Sabah & Sarawak

CHAPTER 3
TREND ANALYSIS FOR 2018 YEARLY RAINFALL

3.1 Peninsular Malaysia

3.1.1 Analysis of Trend Direction Change for 2018 Yearly Rainfall

In order to assess the changes of 2018 yearly rainfall trend direction at each station, their trends for the periods of 2010-2017 and 2010-2018 were first estimated using the Mann-Kendall test. The differences in trend between these two periods were then determined to represent the trend direction changes in 2018 at the stations. The changes of trend direction based on the observed and projected yearly rainfall of the two periods were also determined and compared to assess the accuracy of projections.

As shown in Table 3.1, between the projections made with the two models and the observations, there is no significant difference in the number of stations showing changes of trend direction in 2018, under the three scenarios. However, for Kelantan under scenarios A1B and B1 as projected by the ECHM5, and Kedah under scenario A1B as projected by the CCSM3, five stations were found for each scenario. The results are consistent with the findings in the previous chapter where the CCSM3 was found to outperform the ECHM5 in Kelantan, while in reverse, the ECHM5 outperformed the CCSM3 in Kedah. Other states showed not more than three stations with differences between the observation and projections. In fact, most of the states showed either no difference, or to only one station.

Table 3.1: Number of stations showing changes of trend direction in 2018 for Peninsular Malaysia

State	Total Number of Station	Scenario A1B											Scenario A2										Scenario B1										
		2010-2017				2010-2018				Change of trend direction in 2018			2010-2017				2010-2018				Change of trend direction in 2018			2010-2017				2010-2018				Change of trend direction in 2018		
		Observation		Projection		Observation		Projection					Observation		Projection		Observation		Projection					Observation		Projection		Observation		Projection				
		Positive Trend	Negative Trend	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Observation	Projection	Difference	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Observation	Projection	Difference	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Observation	Projection	Difference
Selangor & Kuala	16	6	10	16	0	6	10	15	1	2	1	1	6	15	10	1	6	15	10	1	2	0	2	6	9	10	7	6	10	10	6	2	2	0
		6	10	14	2	6	10	12	4	2	2	0	6	9	10	7	6	11	10	5	2	4	2	6	5	10	11	6	7	10	9	2	3	1
Negeri Sembilan	3	1	2	3	0	1	2	3	0	0	0	0	1	3	2	0	1	3	2	0	0	0	0	1	3	2	0	1	3	2	0	0	1	1
		1	2	2	1	1	2	2	1	0	1	1	1	3	2	0	1	2	2	1	0	2	2	1	0	2	3	1	0	2	3	0	0	0
Melaka	2	0	2	2	0	1	1	1	1	1	1	0	0	2	2	0	1	2	1	0	1	0	1	0	2	2	0	1	1	1	1	1	2	1
		0	2	1	1	1	1	1	1	1	0	1	0	2	2	0	1	2	1	0	1	0	1	0	0	2	2	1	1	1	1	1	1	0
Johor	11	7	4	9	2	6	5	6	5	1	3	2	7	10	4	1	6	9	5	2	1	1	0	7	2	4	9	6	2	5	9	1	3	2
		7	4	5	6	6	5	6	5	1	3	2	7	10	4	1	6	7	5	4	1	3	2	7	5	4	6	6	6	5	5	1	1	0
Pahang	15	5	10	15	0	6	9	12	3	3	5	2	5	13	10	2	6	12	9	3	3	5	2	5	4	10	11	6	9	9	6	3	6	3
		5	10	9	6	6	9	10	5	3	3	0	5	15	10	0	6	13	9	2	3	2	1	5	6	10	9	6	7	9	8	3	2	1
Terengganu	12	2	10	12	0	2	10	8	4	2	4	2	2	12	10	0	2	10	10	2	2	3	1	2	0	10	12	2	3	10	9	2	2	0
		2	10	1	11	2	10	2	10	2	1	1	2	10	10	2	2	10	10	2	2	0	2	2	5	10	7	2	7	10	5	2	3	1
Kelantan	11	8	3	10	1	7	4	6	5	1	6	5	8	11	3	0	7	7	4	4	1	4	3	8	2	3	9	7	9	4	2	1	6	5
		8	3	8	3	7	4	3	8	1	4	3	8	4	3	7	7	4	4	7	1	2	1	8	9	3	2	7	9	4	2	1	2	1
Kedah	7	4	3	4	3	4	3	4	3	0	0	0	4	3	3	4	4	0	3	7	0	0	0	4	1	3	6	4	3	3	4	0	3	3
		4	3	6	1	4	3	2	5	0	5	5	4	6	3	1	4	4	3	3	0	3	3	4	7	3	0	4	7	3	0	0	0	0
Pulau Pinang	5	3	2	4	1	4	1	2	3	1	3	2	3	2	2	3	4	1	1	4	1	1	0	3	0	2	5	4	1	1	4	1	0	1
		3	2	3	2	4	1	3	2	1	0	1	3	5	2	0	4	5	1	0	1	1	0	3	5	2	0	4	5	1	0	1	0	1
Perak	10	2	8	6	4	1	9	6	4	2	4	2	2	4	8	6	1	6	9	4	2	5	3	2	5	8	5	1	7	9	3	2	1	1
		2	8	10	0	1	9	10	0	2	0	2	2	7	8	3	1	1	9	9	2	5	3	2	7	8	3	1	8	9	2	2	2	0

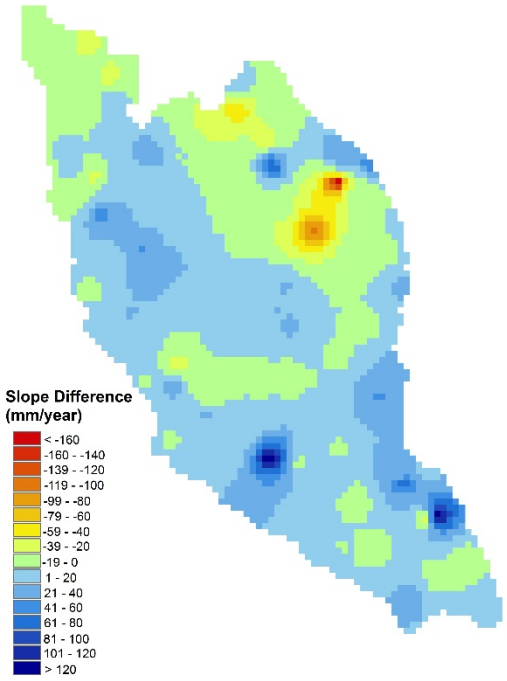
Notes: Upper row of each state represents ECHM5, while lower row represents CCSM3

3.1.2 Analysis of Trend Slope Change for 2018 Yearly Rainfall

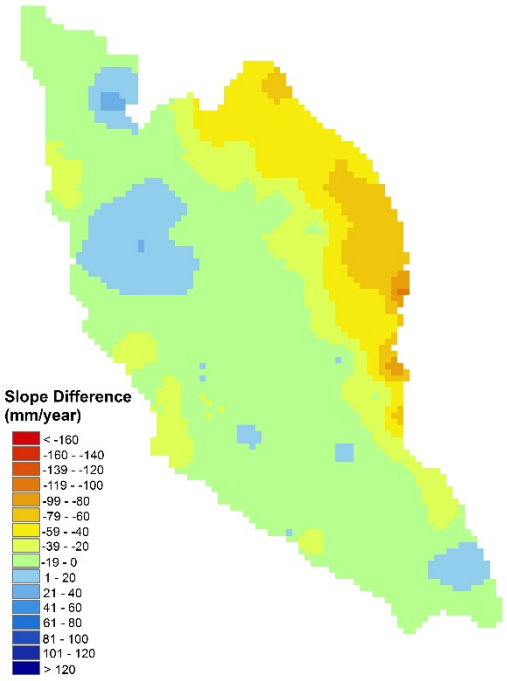
The changes in trend slope were estimated using the Sen's slope method. These were carried out for the 2018 yearly rainfall and are quantified for each station by calculating their trend slope differences between the 2010-2018 yearly rainfall and the 2010-2017 yearly rainfall. The majority of the areas in the northern region (except Perlis and north Kedah), the central region, the southern region and Pahang, are observed to have positive slope difference of up to 20 mm per year in 2018 yearly rainfall. The majority of the areas in Terengganu, Kelantan, Perlis and north Kedah on the other hand showed negative slope difference of up to -20 mm per year. Some areas in north Terengganu and south Kelantan had even more significant negative slope difference of as much as up to -100 mm per year.

Based on the slope trend difference projected by the ECHM5 in Figure 3.1, the projection under the scenario B1 showed the most similar positive slope difference (up to 40 mm per year) to the observed slope difference for northern region (except Perlis and north Kedah), central region, southern region and Pahang; while in scenarios A1B and A2 (up to -40 mm per year) for both, Perlis and north Kedah. All these projected slope differences (up to 40 or -40 mm per year) were found to have similar difference of 20 mm per year as compared to the observed slope difference (up to 20 or -20 mm per year).

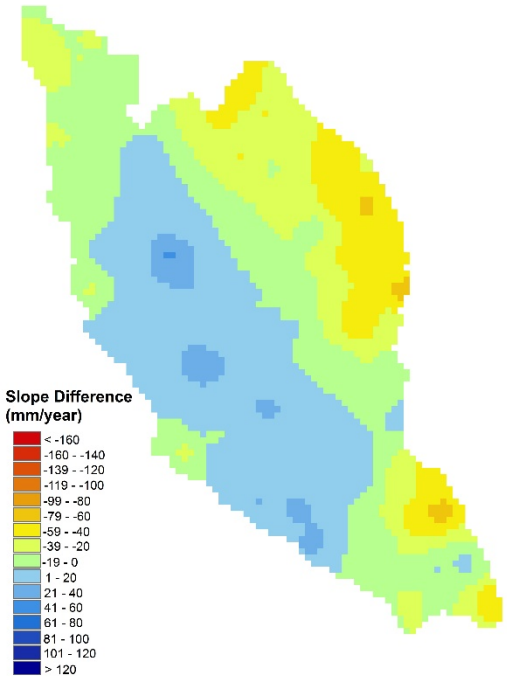
Over in Terengganu and Kelantan, as shown in Figure 3.2, the CCSM3 performed better than the ECHM5 in projecting yearly rainfall slope difference for 2018 under scenario A1B (up to -80 mm per year as compared to -100 mm per year under observation).



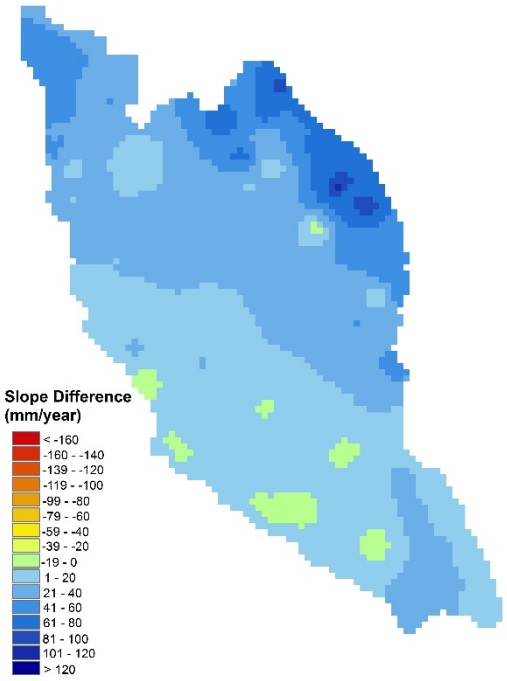
Observation



Average_ECHM5_A1B

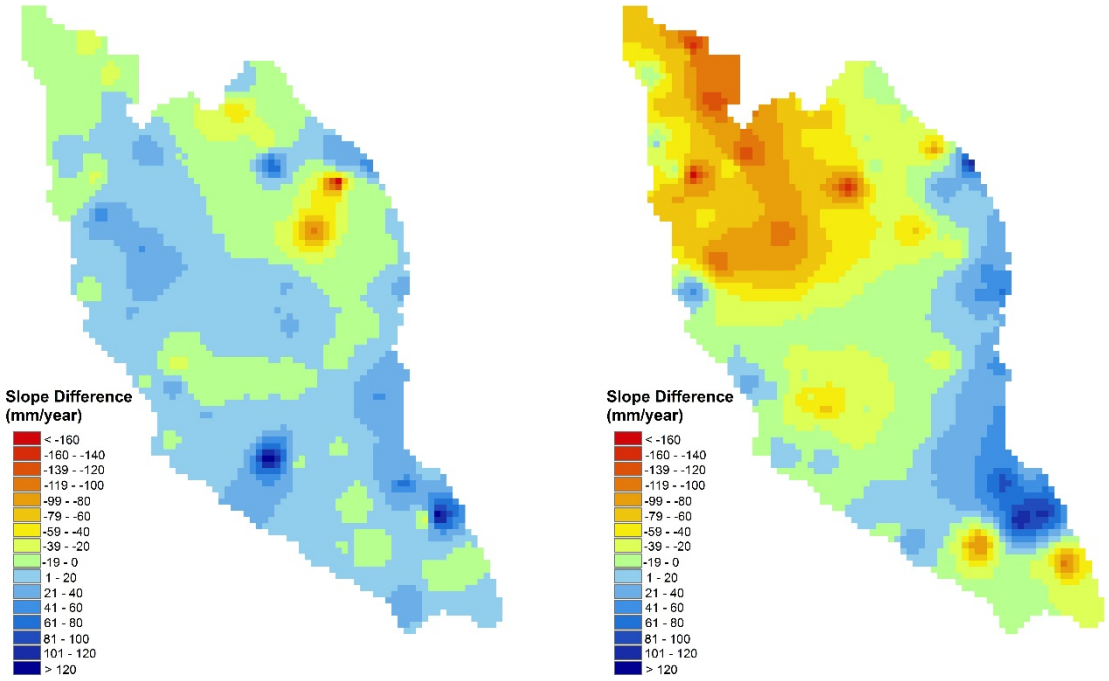


Average_ECHM5_A2



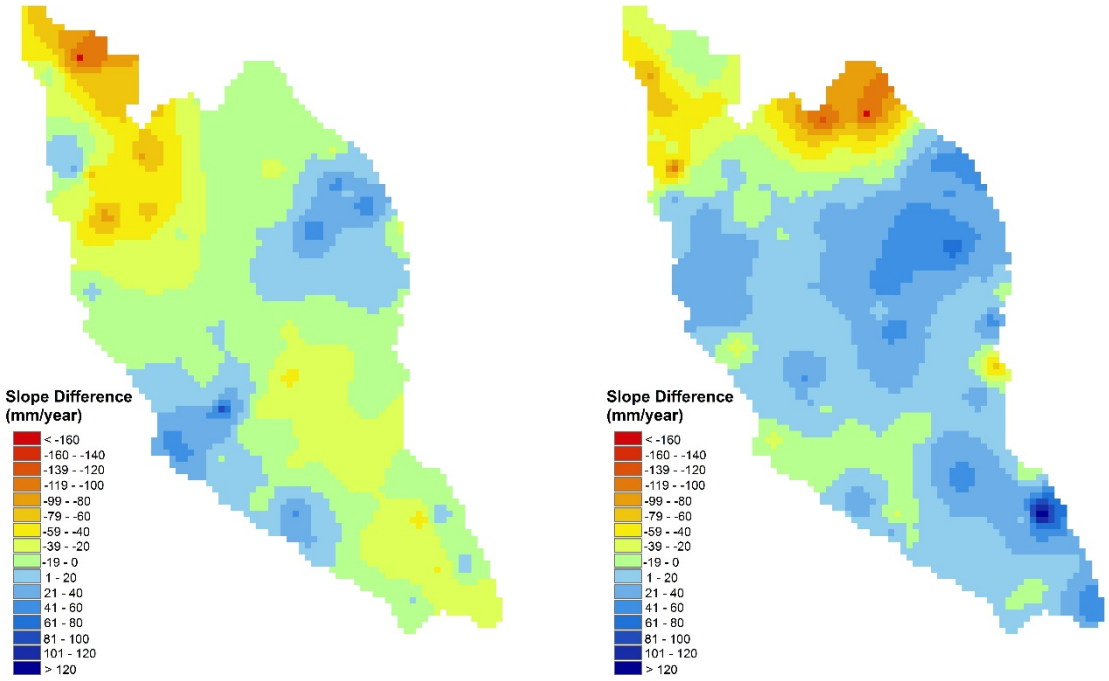
Average_ECHM5_B1

Figure 3.1: Spatial distribution of 2018 yearly rainfall trend slope change projected by ECHM5 under Scenarios A1B, A2 and B1 for Peninsular Malaysia



Observation

CCSM3_A1B



CCSM3_A2

CCSM3_B1

Figure 3.2: Spatial distribution of 2018 yearly rainfall trend slope change projected by CCSM3 under Scenarios A1B, A2 and B1 for Peninsular Malaysia

3.2 Sabah & Sarawak

3.2.1 Analysis of Trend Direction Change for 2018 Yearly Rainfall

For the case of Sabah & Sarawak, the same analysis was carried out to detect the changes in trend direction of each station for 2018 yearly rainfall. The changes of trend direction based on the observed and projected yearly rainfall of 2010-2017 and 2010-2018 periods were determined and compared to assess the accuracy of projections under scenario A1B by ECHM3 and MRI.

As shown in Table 3.2, there is no significant difference in the number of stations showing changes of trend direction in 2018 between the projections by ECHM3 and the observations, for the two states. However, a significant difference of 10 stations was found in Sarawak under the MRI projection. Again, the results are consistent with the findings in the previous chapter where the ECHM3 was found to be outperformed MRI in the two states for 2018 yearly rainfall projections.

Table 3.2: Number of stations showing changes of trend direction in 2018 for Sabah & Sarawak

State	Total Number of Station	Scenario A1B										
		2010-2017				2010-2018				Change of trend direction in 2018		
		Observation		Projection		Observation		Projection				
		Positive Trend	Negative Trend	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Positive Trend	Negative Trend	Observation	Projection	Difference
Sabah	24	5	19	24	0	5	19	21	3	4	3	1
		5	19	3	21	5	19	1	23	4	3	1
Sarawak	64	16	48	61	3	18	46	59	5	8	10	2
		16	48	19	45	18	46	2	62	8	18	10

Notes: Upper row of each state represents ECHM3, while lower row represents MRI

3.2.2 Analysis of Trend Slope Change for 2018 Yearly Rainfall

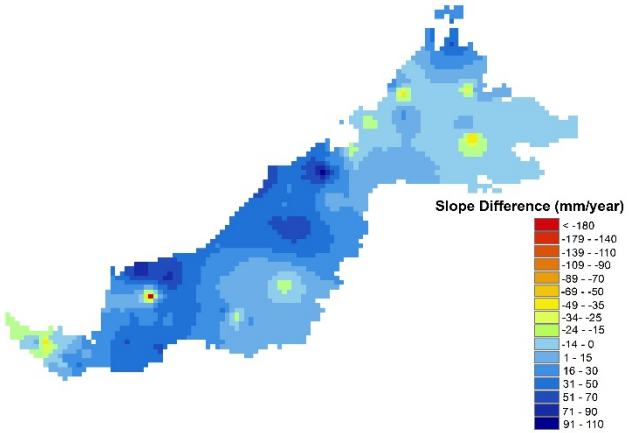
In Sabah, as shown in Figure 3.3, a negative slope difference up to -15 mm per year was observed in the majority of the areas for the 2018 yearly rainfall, while some small areas in the west coast, inland, Tawau and Sandakan even achieved -50 mm per year. However, the majority of the areas in the coastal areas of west coast, the east and south of inland, and the north of Sandakan, showed positive slope difference up to 15 mm per year. An increment of up to 50 mm per year was even observed at Kudat.

Based on the yearly rainfall trend projected by the MRI under scenario A1B, a negative slope difference around -15 mm per year to -35 mm per year (which is slightly higher than the observed -15 mm per year) is expected for the majority of the areas in the state. This projection has a consistent trend with the observation. On the other hand, the projection for the coastal areas of the west coast is also consistent with the observation, even though over projection up to 30 mm per year was found for the coastal areas of inland. However, areas such as the east and south of inland, the north of Sandakan, and Kudat, were not projected to have positive slope difference as had been observed. To the contrary, negative slope differences of -25 mm per year to -50 mm per year were mostly projected for these areas.

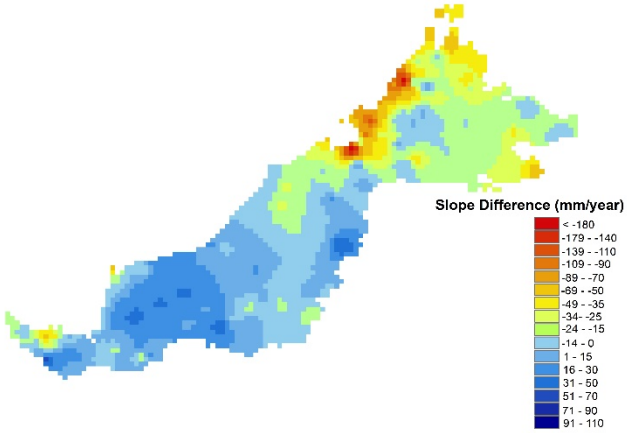
In Sarawak, a positive slope difference up to 50 mm per year was observed in most areas for the 2018 yearly rainfall. Some areas such as the central and coastal areas of Miri showed up to 70 mm per year, while Mukah and the central of Limbang even showed up to 90 mm per year. However, negative slope differences are observed in the majority areas of Kuching (up to -50 mm per year) and same areas in the central of Sibu (up to -90 mm per year) and north-east of Kapit (up to -25 mm per year).

Based on the yearly rainfall trend projected by the ECHM3 under scenario A1B as shown in Figure 3.3, the majority of the areas in the state (except Miri) showed positive slope difference of up to 30 mm per year, which is close to the observed trend. In Kuching, a negative slope difference up to -50 mm per year was projected. This projected value is similar with the observation. However, Mukah was not projected to have a positive slope difference as high as the observed value (up to 90 mm per year); while the central of Sibu and the north-east of Kapit were also not projected to have negative slope difference as shown by the observations. Over

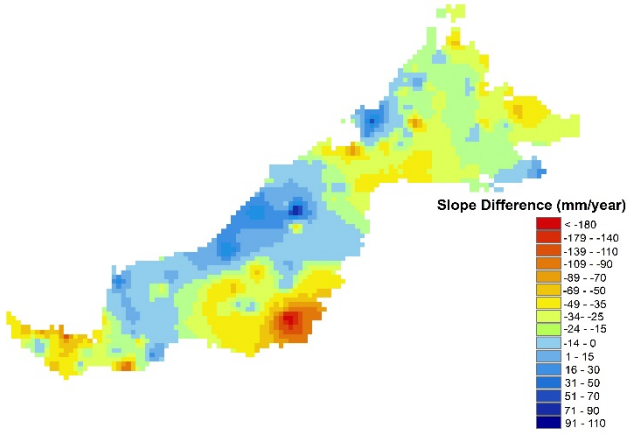
in Miri, the MRI showed more accurate projection with the positive slope difference similar to the observation.



Observation



Average_ECHM3_A1B



MRI_A1B

Figure 3.3: Spatial distribution of 2018 yearly rainfall trend slope change projected by ECHM3 and MRI under Scenario A1B for Sabah & Sarawak

CHAPTER 4
ASSESSMENT OF MODEL PROJECTIONS FOR 2014 & 2019 FLOOD EVENTS AND 2014-2016 DRY SPELL

4.1 Flood 2014 in Kelantan and Terengganu

From 14 December until 25 December 2014, continuous rainfall over the Kelantan River Basin had caused tremendous floods, specifically at Gua Musang, Kuala Krai, Tanah Merah, Jeli, Machang, Pasir Mas and at Kota Bharu. According to the meteorology survey, the north east monsoon surge that brought cold winds from the Siberia highlands and North China to the east coast of Peninsular Malaysia, began on 14 December 2014. Strong winds blew from the Pacific Ocean towards the South China Sea. The broad zonal easterly winds merged with cold monsoon surge on 14 to 17 December 2014. A total rainfall of 900 mm was received over the Kelantan River Basin from 14 to 24 December 2014. The highest daily rainfall record of 479 mm (62 years of ARI) and 507 mm (80 years of ARI) were received at Site 4726001 at Gunung Gagau on 22 December 2014 and 23 December 2014, respectively.

The projected rainfall presented at a 2-week interval for the five study rainfall stations namely Site 4726001 at Gunung Gagau, Site 4819027 at Gua Musang, Site 5521044 at Kuala Krai, Site 5721042 at Kusial and Site 5130007 at Emp Kenyir (as shown in Figure 4.1) under the CO_2 emission scenarios A1B, A2 and B1 from the three different climate models, namely the ECHM5, CCSM3 and MRI, were assessed through the comparison with the observed rainfall. The results are shown in Tables 4.1a-4.1e and Figures 4.2a-4.2e.



Figure 4.1: Location of study rainfall stations in Kelantan and Terengganu for flood events in 2014

Table 4.1a: Projected and observed 2-week rainfall and the cumulative rainfall for Site 4726001 at Gunung Gagau, Kelantan

Station		Site 4726001 at Gunung Gagau, Kelantan						
Interval (Unit)		2-week Rainfall (mm)						
Period		01/10/2014 - 14/10/2014	15/10/2014 - 28/10/2014	29/10/2014 - 11/11/2014	12/11/2014 - 25/11/2014	26/11/2014 - 09/12/2014	10/12/2014 - 23/12/2014	24/12/2014 - 06/01/2015
Model Projection	Average_ECHM5_A1B	116	100	128	306	104	310	397
	Average_ECHM5_A2	108	165	251	282	121	219	359
	Average_ECHM5_B1	269	150	278	232	132	169	138
	CCSM3_A1B	71	276	189	239	269	280	57
	CCSM3_A2	299	14	424	193	405	565	160
	CCSM3_B1	221	159	514	113	76	33	483
	MRI_A1B	117	235	491	561	608	348	268
	MRI_B1	166	139	469	701	406	265	206
	Average_ALL	171	155	343	328	265	274	258
OBSERVED		106	110	179	354	93	1,128	714
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		215	343	650	753	1,063	1,460
	Average_ECHM5_A2		273	525	806	927	1,147	1,505
	Average_ECHM5_B1		419	697	929	1,061	1,231	1,369
	CCSM3_A1B		347	535	774	1,043	1,323	1,380
	CCSM3_A2		314	737	930	1,335	1,900	2,060
	CCSM3_B1		380	894	1,007	1,083	1,116	1,599
	MRI_A1B		351	842	1,404	2,011	2,360	2,628
	MRI_B1		305	774	1,475	1,882	2,147	2,353
	Average_ALL		326	669	997	1,262	1,536	1,794
OBSERVED			216	395	749	842	1,970	2,684

Table 4.1b: Projected and observed 2-week rainfall and the cumulative rainfall for Site 4819027 at Gua Musang, Kelantan

Station		Site 4819027 at Gua Musang, Kelantan						
Interval (Unit)		2-week Rainfall (mm)						
Period		01/10/2014 - 14/10/2014	15/10/2014 - 28/10/2014	29/10/2014 - 11/11/2014	12/11/2014 - 25/11/2014	26/11/2014 - 09/12/2014	10/12/2014 - 23/12/2014	24/12/2014 - 06/01/2015
Model Projection	Average_ECHM5_A1B	70	93	93	124	82	116	169
	Average_ECHM5_A2	136	62	170	77	44	85	126
	Average_ECHM5_B1	133	70	137	161	96	123	75
	CCSM3_A1B	110	274	214	185	155	120	17
	CCSM3_A2	194	92	273	87	125	175	130
	CCSM3_B1	157	298	533	133	30	43	272
	MRI_A1B	76	130	201	69	380	453	47
	MRI_B1	77	77	76	158	141	80	57
	Average_ALL	119	137	212	124	132	149	112
OBSERVED		89	181	62	35	47	657	182
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		163	256	380	462	578	747
	Average_ECHM5_A2		198	368	445	489	574	700
	Average_ECHM5_B1		203	340	501	597	720	795
	CCSM3_A1B		384	598	783	938	1,058	1,075
	CCSM3_A2		286	559	646	771	946	1,076
	CCSM3_B1		455	988	1,121	1,151	1,194	1,466
	MRI_A1B		206	407	476	856	1,309	1,356
	MRI_B1		154	230	388	529	609	666
	Average_ALL		256	468	593	724	874	985
OBSERVED			270	332	367	414	1,071	1,253

Table 4.1c: Projected and observed 2-week rainfall and the cumulative rainfall for Site 5521044 at Kuala Krai, Kelantan

Station		Site 5521044 at Kuala Krai, Kelantan						
Interval (Unit)		2-week Rainfall (mm)						
Period		01/10/2014 - 14/10/2014	15/10/2014 - 28/10/2014	29/10/2014 - 11/11/2014	12/11/2014 - 25/11/2014	26/11/2014 - 09/12/2014	10/12/2014 - 23/12/2014	24/12/2014 - 06/01/2015
Model Projection	Average_ECHM5_A1B	114	164	166	294	136	214	288
	Average_ECHM5_A2	115	78	144	136	160	146	345
	Average_ECHM5_B1	126	62	107	456	341	240	133
	CCSM3_A1B	86	65	57	410	451	165	24
	CCSM3_A2	232	1	263	168	337	590	147
	CCSM3_B1	24	188	841	23	62	16	499
	MRI_A1B	31	102	261	71	384	225	84
	MRI_B1	8	29	76	164	193	190	146
	Average_ALL	92	86	239	215	258	223	208
OBSERVED		105	73	148	231	189	581	490
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		278	444	738	874	1,088	1,376
	Average_ECHM5_A2		193	337	473	633	779	1,124
	Average_ECHM5_B1		188	295	751	1,092	1,332	1,465
	CCSM3_A1B		151	208	618	1,069	1,234	1,258
	CCSM3_A2		233	496	664	1,001	1,591	1,738
	CCSM3_B1		212	1,053	1,076	1,138	1,154	1,653
	MRI_A1B		133	394	465	849	1,074	1,158
	MRI_B1		37	113	277	470	660	806
	Average_ALL		178	418	633	891	1,114	1,322
OBSERVED			178	326	557	746	1,327	1,817

Table 4.1d: Projected and observed 2-week rainfall and the cumulative rainfall for Site 5721042 at Kusial, Kelantan

Station		Site 5721042 at Kusial, Kelantan						
Interval (Unit)		2-week Rainfall (mm)						
Period		01/10/2014 - 14/10/2014	15/10/2014 - 28/10/2014	29/10/2014 - 11/11/2014	12/11/2014 - 25/11/2014	26/11/2014 - 09/12/2014	10/12/2014 - 23/12/2014	24/12/2014 - 06/01/2015
Model Projection	Average_ECHM5_A1B	119	249	179	352	139	241	282
	Average_ECHM5_A2	147	92	188	156	171	174	314
	Average_ECHM5_B1	132	86	105	434	287	269	129
	CCSM3_A1B	93	51	80	354	471	184	21
	CCSM3_A2	194	1	264	165	503	656	151
	CCSM3_B1	13	191	804	7	62	22	500
	MRI_A1B	38	141	220	91	333	250	79
	MRI_B1	11	86	54	206	180	231	165
	Average_ALL	93	112	237	221	268	253	205
OBSERVED		78	198	131	372	81	730	609
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		368	547	899	1,038	1,279	1,561
	Average_ECHM5_A2		239	427	583	754	928	1,242
	Average_ECHM5_B1		218	323	757	1,044	1,313	1,442
	CCSM3_A1B		144	224	578	1,049	1,233	1,254
	CCSM3_A2		195	459	624	1,127	1,783	1,934
	CCSM3_B1		204	1,008	1,015	1,077	1,099	1,599
	MRI_A1B		179	399	490	823	1,073	1,152
	MRI_B1		97	151	357	537	768	933
	Average_ALL		206	442	663	931	1,185	1,390
OBSERVED			276	407	779	860	1,590	2,199

Table 4.1e: Projected and observed 2-week rainfall and the cumulative rainfall for Site 5130007 at Emp Kenyir, Terengganu

Station		Site 5130007 at Emp Kenyir, Terengganu						
Interval (Unit)		2-week Rainfall (mm)						
Period		01/10/2014 - 14/10/2014	15/10/2014 - 28/10/2014	29/10/2014 - 11/11/2014	12/11/2014 - 25/11/2014	26/11/2014 - 09/12/2014	10/12/2014 - 23/12/2014	24/12/2014 - 06/01/2015
Model Projection	Average_ECHM5_A1B	78	189	209	299	217	393	365
	Average_ECHM5_A2	148	123	216	165	117	129	324
	Average_ECHM5_B1	222	100	187	414	232	238	175
	CCSM3_A1B	167	292	151	664	449	316	33
	CCSM3_A2	287	6	491	109	431	463	257
	CCSM3_B1	187	478	829	55	65	42	621
	MRI_A1B	34	252	521	236	773	799	163
	MRI_B1	124	123	128	328	343	304	206
	Average_ALL	156	195	342	284	328	335	268
OBSERVED		146	123	97	538	115	1,263	459
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		267	476	775	992	1,385	1,750
	Average_ECHM5_A2		271	487	652	769	898	1,221
	Average_ECHM5_B1		321	508	922	1,154	1,392	1,568
	CCSM3_A1B		459	610	1,274	1,722	2,038	2,071
	CCSM3_A2		293	784	893	1,324	1,787	2,044
	CCSM3_B1		664	1,493	1,548	1,613	1,655	2,275
	MRI_A1B		286	807	1,043	1,816	2,615	2,778
	MRI_B1		247	375	703	1,046	1,349	1,556
	Average_ALL		351	692	976	1,304	1,640	1,908
OBSERVED			269	366	904	1,019	2,282	2,741

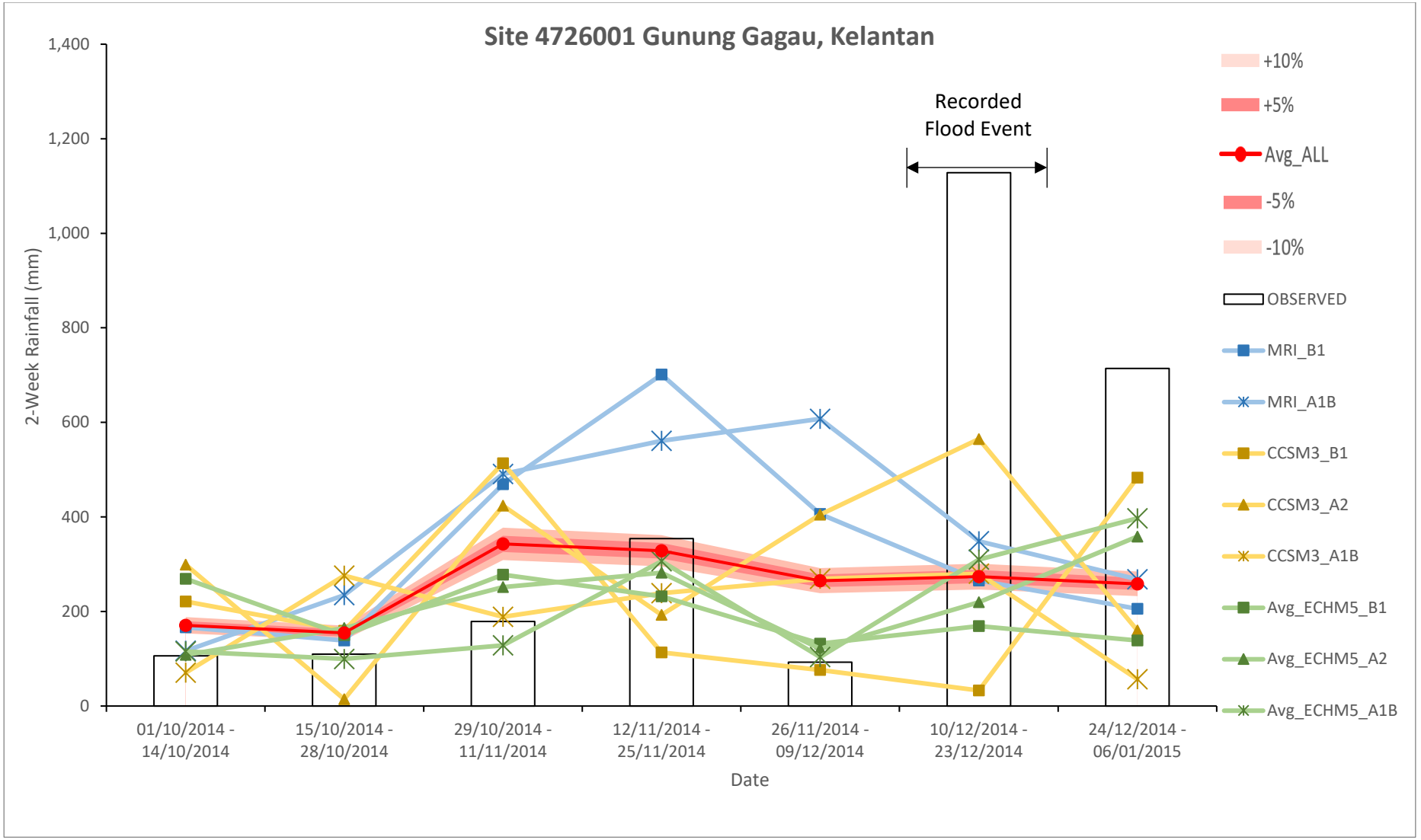


Figure 4.2a: Projected and observed 2-week rainfall for Site 4726001 at Gunung Gagau, Kelantan

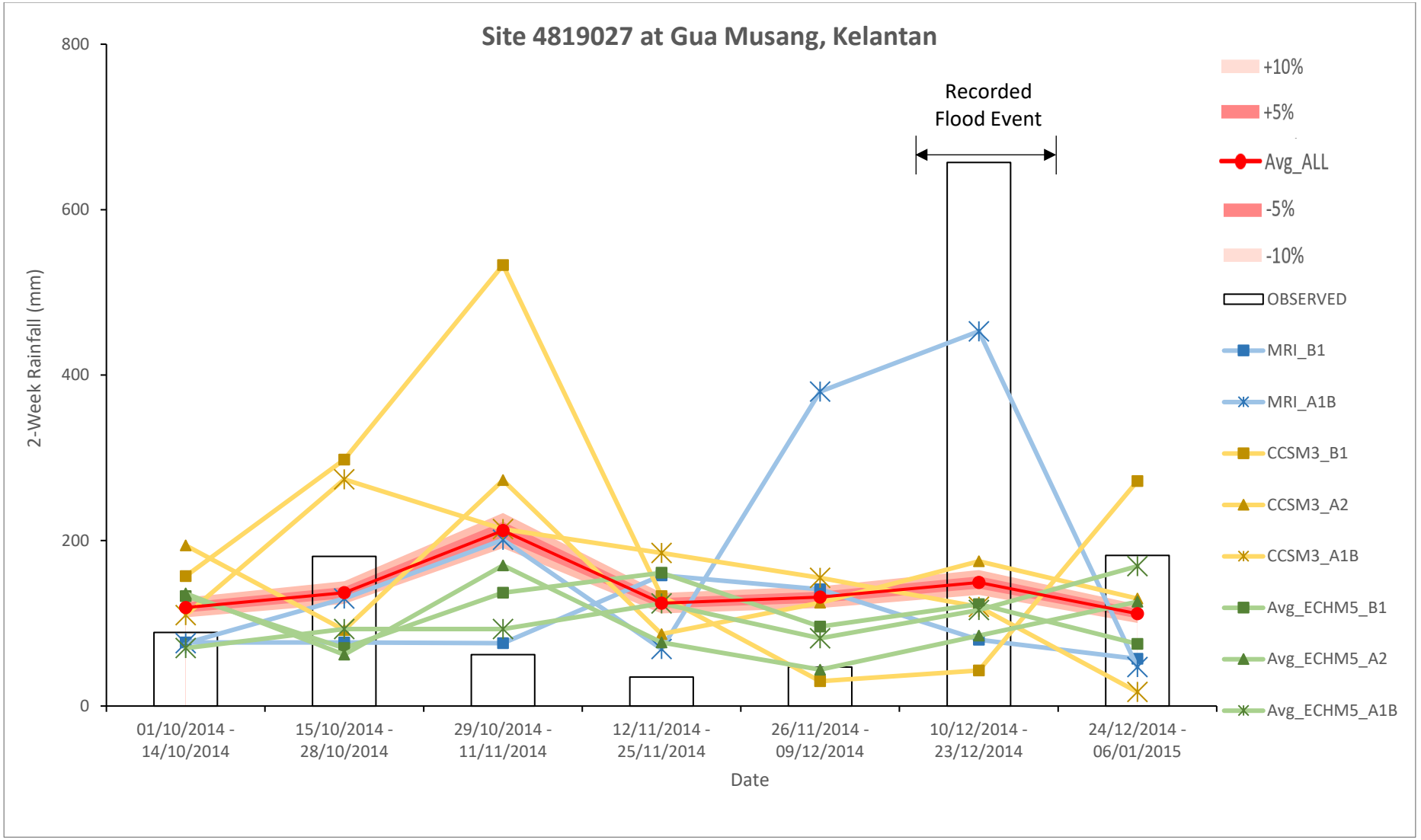


Figure 4.2b: Projected and observed 2-week rainfall for Site 4819027 at Gua Musang, Kelantan

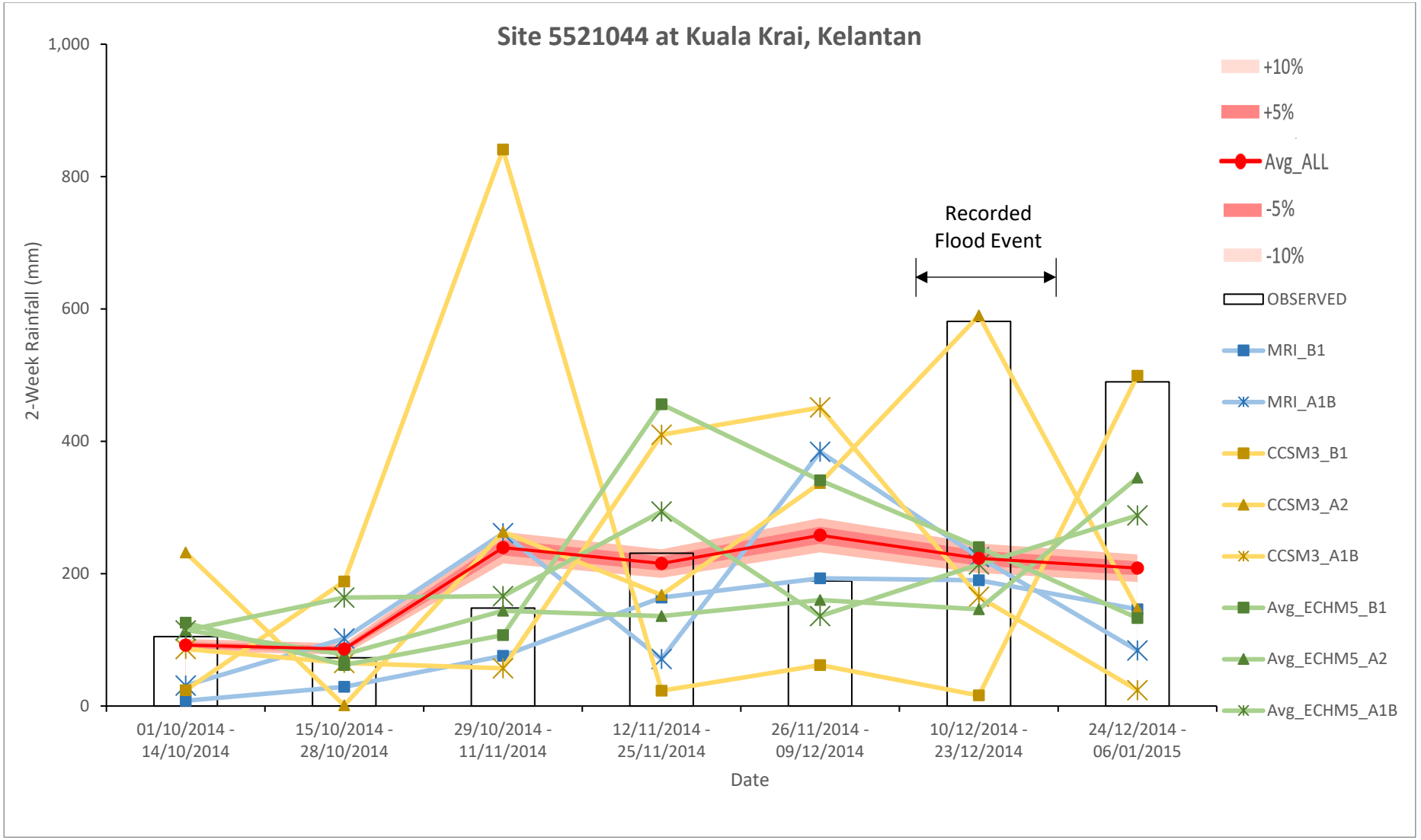


Figure 4.2c: Projected and observed 2-week rainfall for Site 5521044 at Kuala Krai, Kelantan

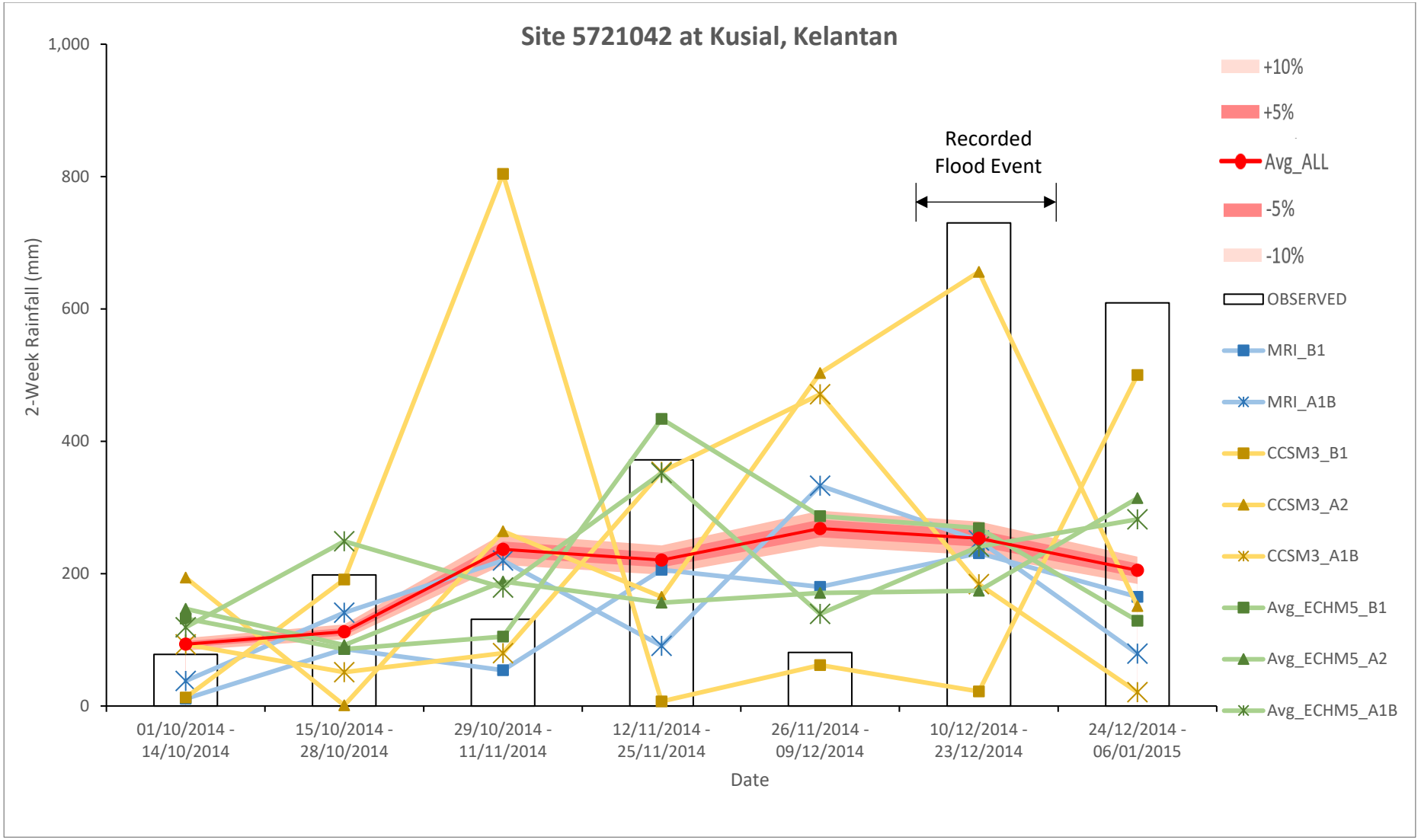


Figure 4.2d: Projected and observed 2-week rainfall for Site 5721042 at Kusial, Kelantan

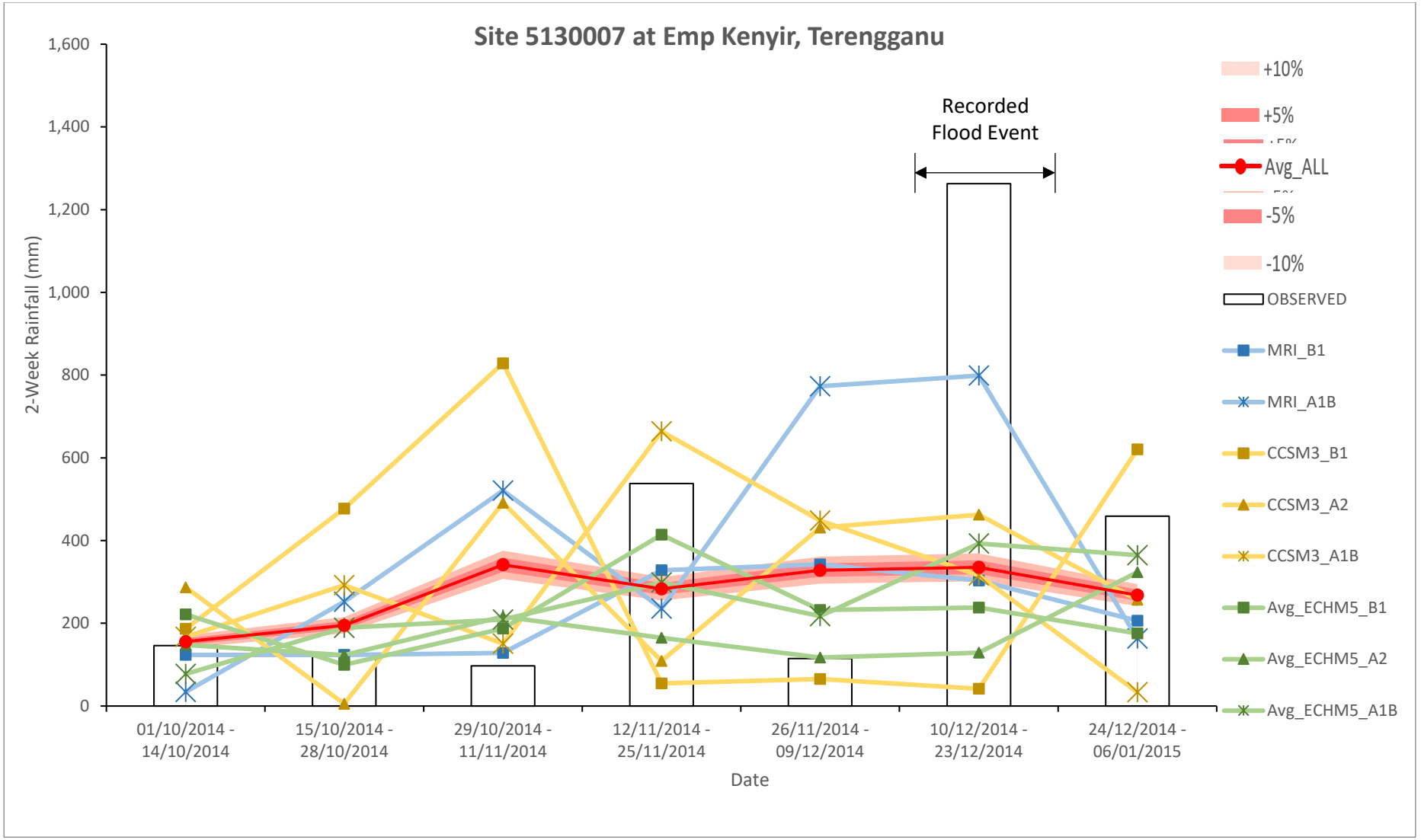


Figure 4.2e: Projected and observed 2-week rainfall for Site 5130007 at Emp Kenyir, Terengganu

In general, at all the stations under the various scenarios, it can be observed that all the models projected heavier rainfall than the observed values for the October-November period (which were one to two months earlier than the actual flood event on 14-24 December 2014). It was also observed that the projected 2-week rainfall (26 November 2014 - 09 December 2014) at all the stations a priori to the flood event, were much higher than those observed values, except for those projections by the CCSM3 under scenario B1. However, during the flood event, most of the models projected rainfall much lower than the observed values, except for the CCSM3. The CCSM3 model was able to project the 2-week rainfall close to the observed values at Site 5521044 at Kuala Krai (Table 4.1c & Figure 4.2c) and at Site 5721042 at Kusial (Table 4.1d & Figure 4.2d) under scenario A2. The high 2-week rainfall amount prior to the flood event had made the total rainfall during the four weeks (26 November 2014 - 09 December 2014 and 10 December 2014 - 23 December 2014) close to the total observed rainfall received during the flood event. This indicated that the models projected high rainfall (2 weeks earlier) prior to the flood event, and continued with high projections during the event period.

The cumulative rainfalls over a 2-week period are presented in Tables 4.1a-4.1e and illustrated in Figures 4.3a-4.3e. The CCSM3 model was found to be more accurate in projecting cumulative rainfall than the ECHM5 and MRI models. However, the MRI outperformed the CCSM3 under scenario A1B at Site 4726001 at Gunung Gagau, Site 4819027 at Gua Musang and Site 5130007 at Emp Kenyir. Some of the important findings on projected cumulative rainfall according to stations during the flood event include:

(a) Site 4726001 at Gunung Gagau (Table 4.1a & Figure 4.3a):
The CCSM3 gave good results albeit only for the scenario A2, where 1,900 mm of cumulative rainfall was projected as compared to 1,970 mm of observed value;
The MRI has higher projections than the observed values under scenarios A1B and B1. However, a higher projected rainfall is always advantageously on the safer side for flood monitoring and mitigation purposes

(b) Site 4819027 at Gua Musang (Table 4.1b and Figure 4.3b):
A cumulative rainfall of 1,058 mm was projected by the CCSM3 under scenario A1B compared to the observed value of 1,071 mm;
The cumulative rainfalls projected by the CCSM3 and MRI were found to be slightly higher than the observed rainfall under scenario B1 and scenario A1B, respectively

(c) Site 5521044 at Kuala Krai (Table 4.1c & Figure 4.3c):

The ECHM5 under scenario B1 showed the most accurate projection, where a cumulative rainfall of 1,332 mm was projected as compared to the 1,327 mm of observation;

The CCSM3 projected accurate estimations under scenarios B1, A2 and A1B, where higher estimations were obtained in scenario A2

(d) Site 5721042 at Kusial (Table 4.1d & Figure 4.3d):

The CCSM3 under scenario A2, has resulted in more accurate projections. A cumulative rainfall of 1,783 mm was projected compared to the observed 1,590 mm

(e) Site 5130007 at Emp Kenyir (Table 4.1e & Figure 4.3e):

The performances of the CCSM3 and MRI under scenario A1B were better than others. However, the MRI has higher projection (2,615 mm) compared to the observed value (2,282 mm);

The CCSM3 gave an accumulative 2,038 mm under scenario A1B

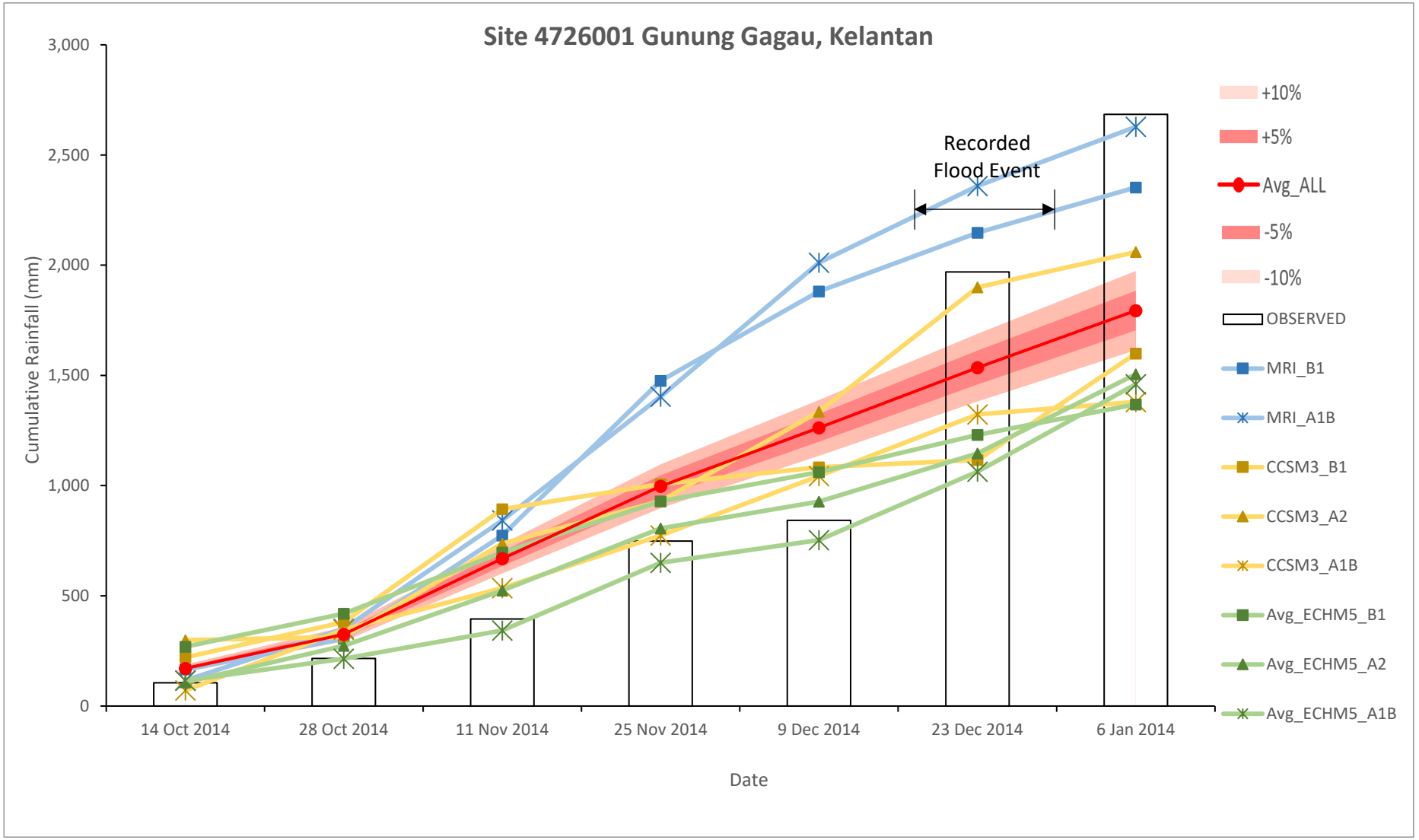


Figure 4.3a: Cumulative rainfall for Site 4726001 at Gunung Gagau, Kelantan

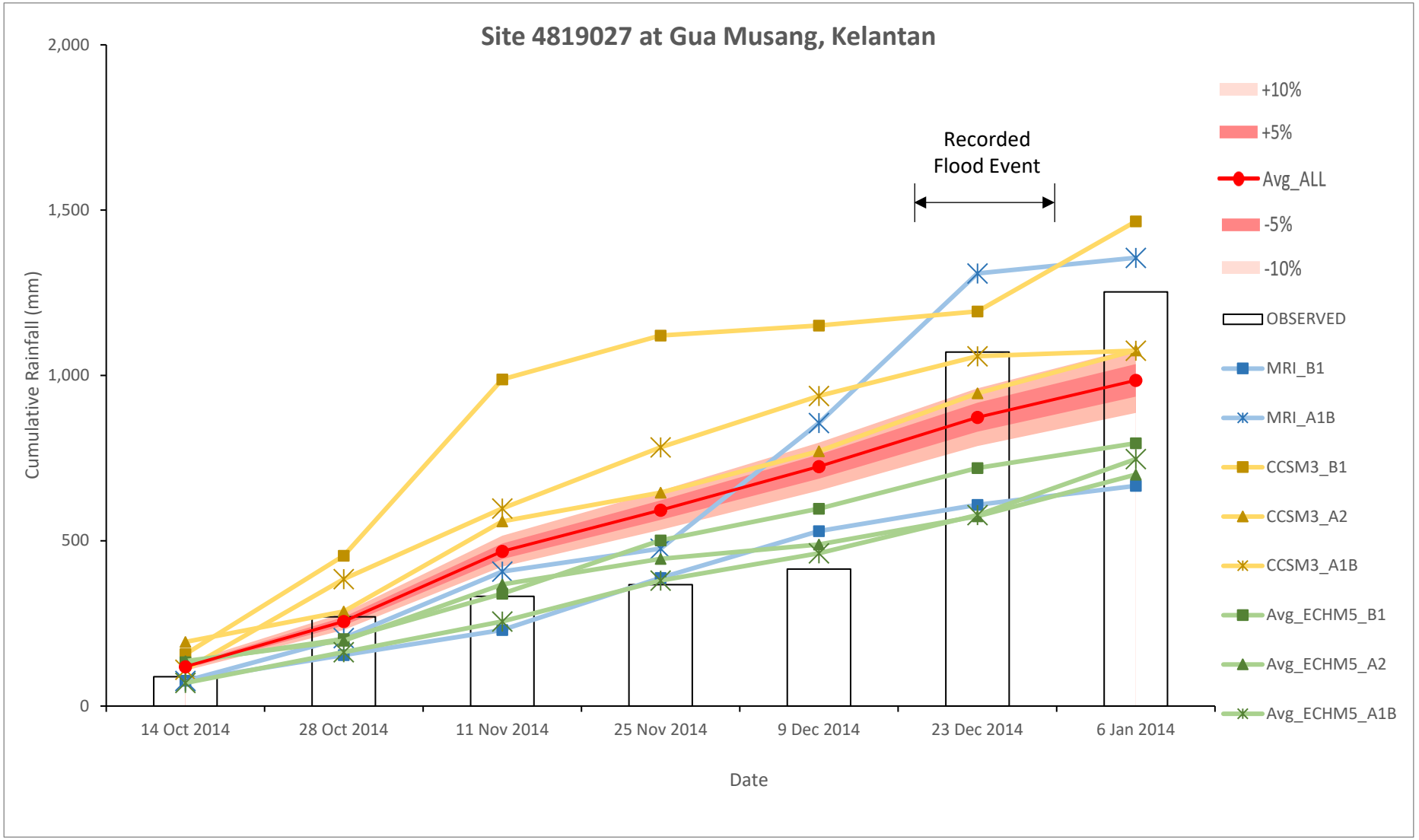


Figure 4.3b: Cumulative rainfall for Site 4819027 at Gua Musang, Kelantan

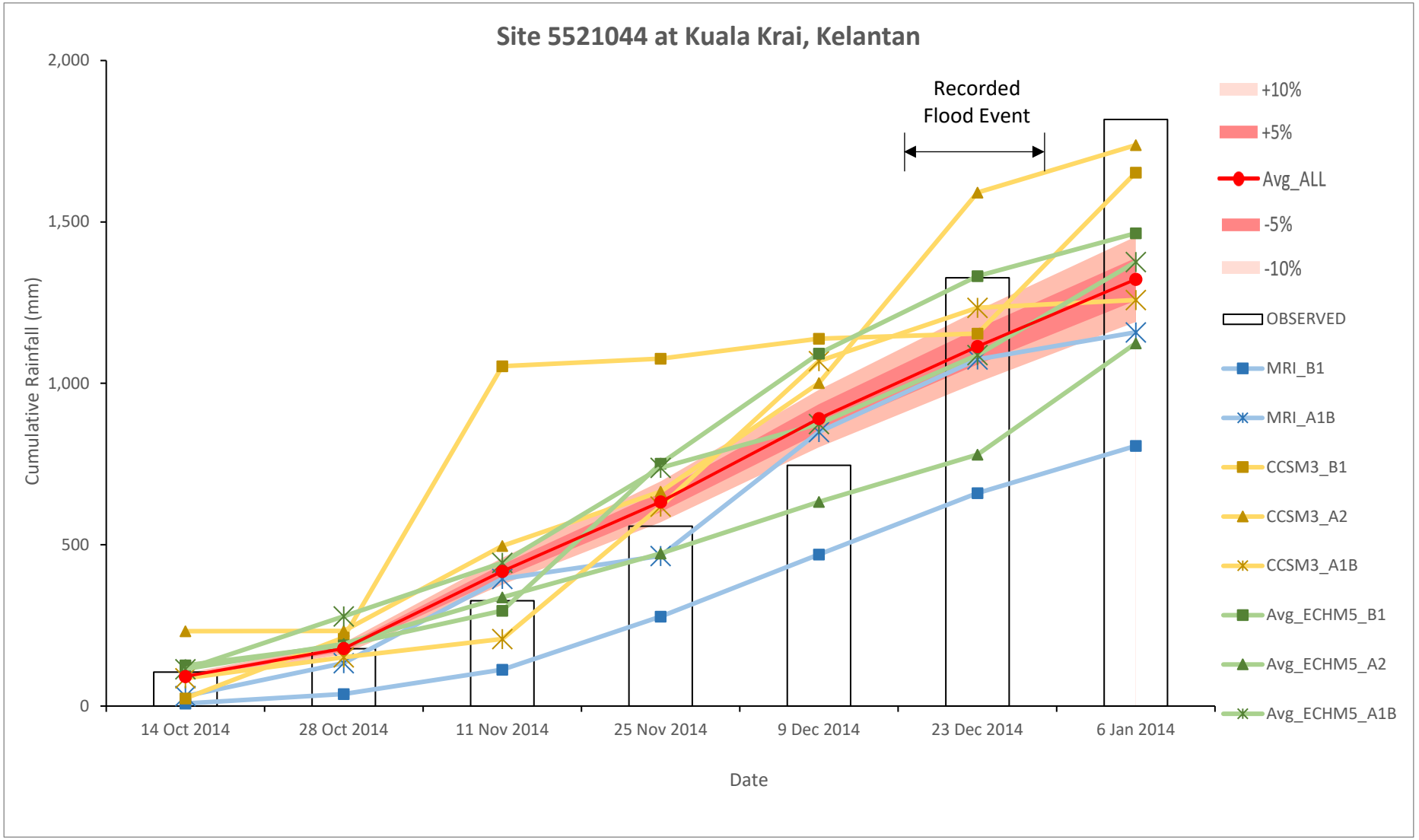


Figure 4.3c: Cumulative rainfall for Site 5521044 at Kuala Krai, Kelantan

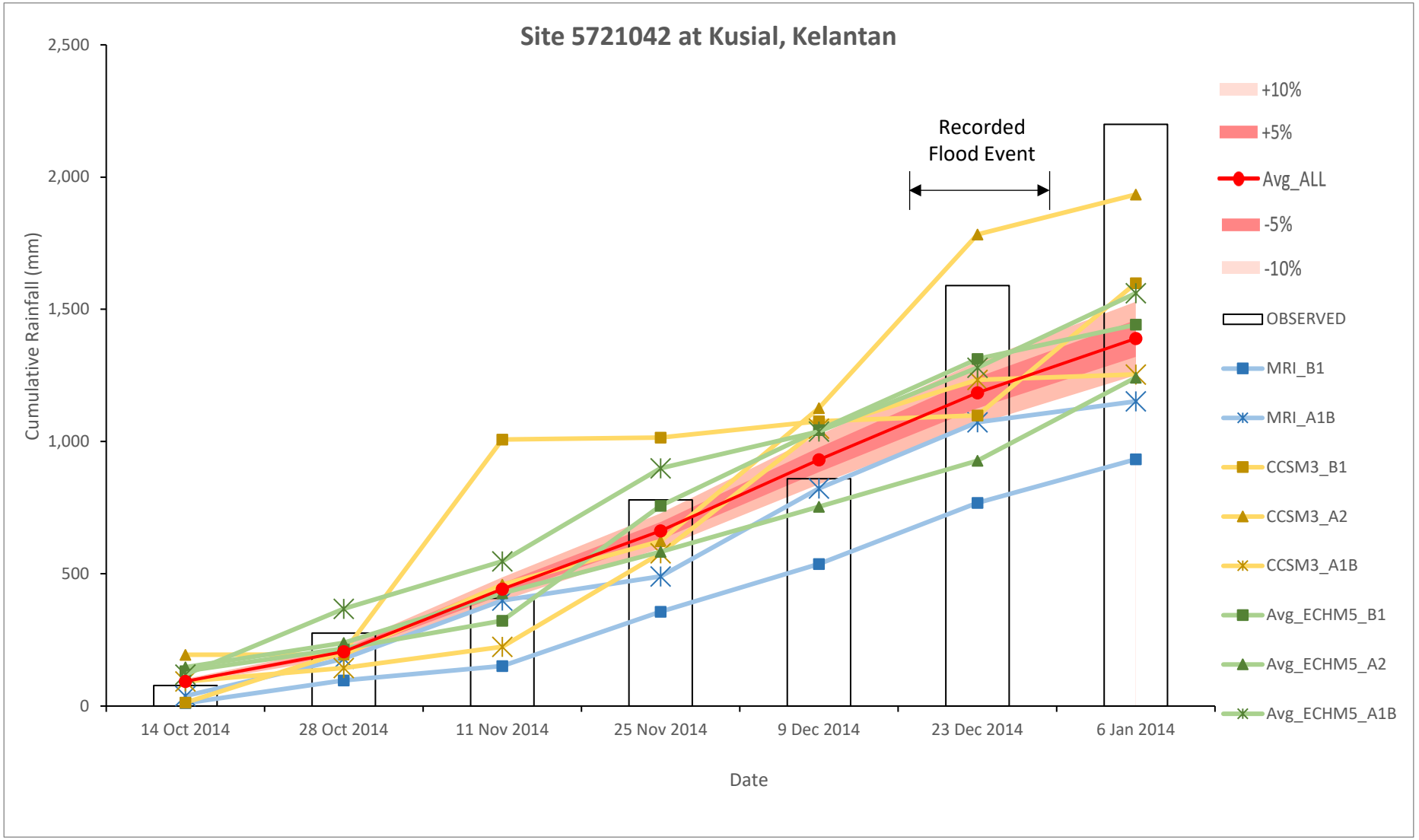


Figure 4.3d: Cumulative rainfall for Site 5721042 at Kusial, Kelantan

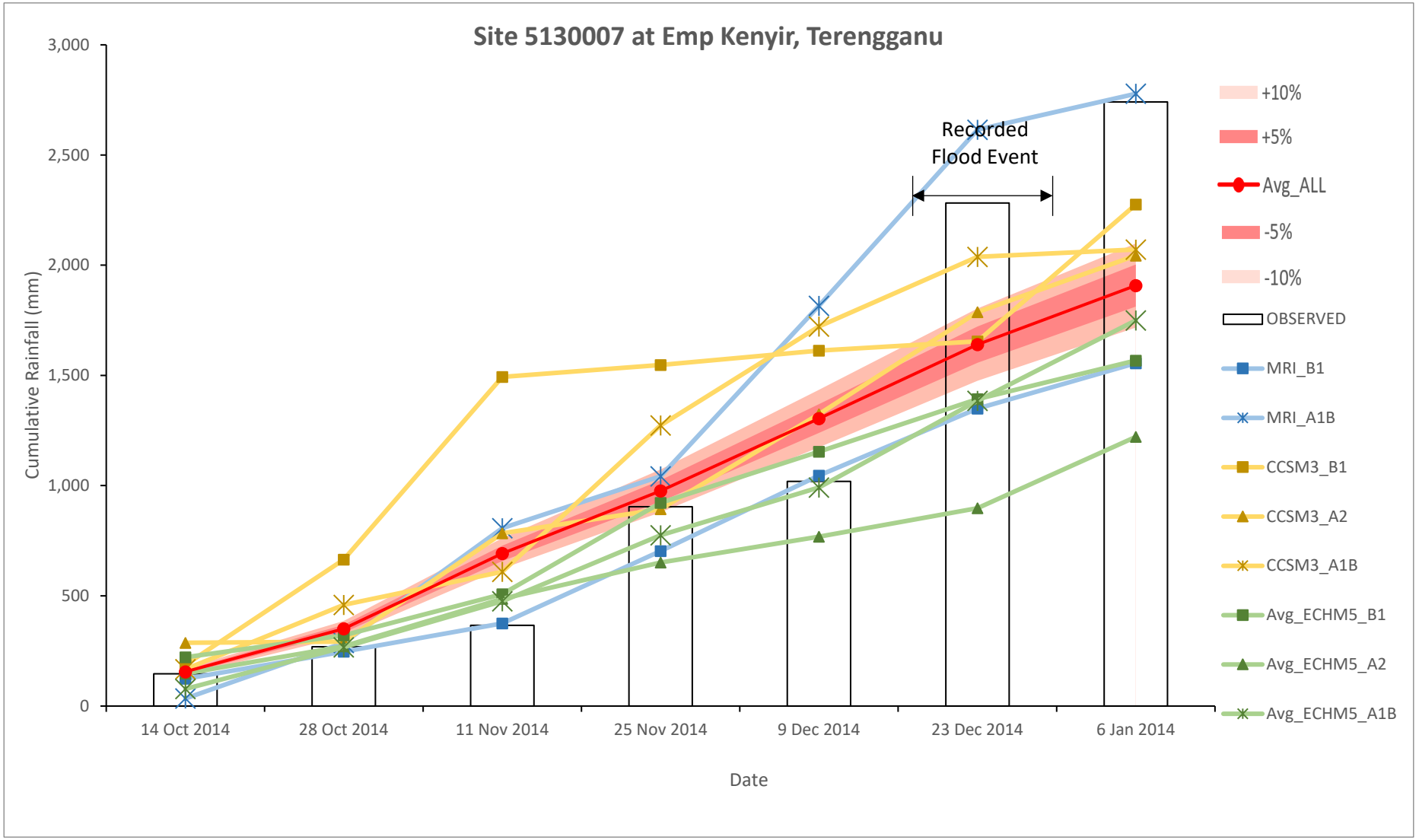


Figure 4.3e: Cumulative rainfall for Site 5130007 at Emp Kenyir, Terengganu

4.2 Flood 2019 in Johor and Kelantan

In Johor, the downpour started at about 6 am on 9 December 2019 and had continued since. The water level from the nearby Sungai Ara has risen and had flooded Jalan Kota Tinggi-Mersing. The Malaysian Meteorological Department had by then issued a bad weather announcement, stating that heavy rains would be affect the areas of Mersing and Kota Tinggi. On the same day, the Malaysia's National Disaster Command Centre (NDCC) reported that more than 700 people had evacuated their homes following the flooding in Johor State. All those displaced were from the Kota Tinggi District. Some areas of the district were under flood water up to 1 metre deep. Nearby, it was noted that in Mersing a recorded 141 mm of rain in 24 hours had fallen till 09 December 2019.

As of 14 December 2019, following heavy rainfall, a total of 171 people from 45 families in the Mersing and Kota Tinggi districts were evacuated to temporary relief centres. Areas inundated in Mersing were Kampung Tenglu, Kampung Sri Lumpur, Kampung Air Papan, Kampung Sungai Padang and Kampung Air Tawar. In Kota Tinggi, residents of Kampung Bukit and Kampung Tengah were affected. *The MetMalaysia* had upgraded its weather warning alert for Mersing and Kota Tinggi from yellow to red (danger level), with continuous heavy rainfall expected in both districts until 15 December 2019. On 16 December 2019, road access to the coastal town of Mersing was restricted, and by then the number of displaced persons rose beyond 9,000. According to figures from the local authorities, the worst hit region was Kota Tinggi, where more than 2,600 people were evacuated.

In the state of Kelantan, on 16 December 2019 morning, *The MetMalaysia* released a thunderstorm warning for heavy rain and strong winds expected over Kelantan's Bachok, Machang (where Batu 13 is located), Pasir Puteh, Kuala Krai and Gua Musang districts. On 18 December 2019, a second wave of flood had hit Kelantan early in the morning following heavy rain since 17 December 2019. This calamity resulted in the three districts of Tanah Merah, Machang and Jeli being under flood waters thus and forcing the evacuation of 1,141 people to pre-prepared safe places.

As of 18 December 2019 morning, there were 440 flood relief centres were opened for evacuees. Jeli was the worst district affected with 1,030 being forced to evacuate, followed by Tanah Merah and Machang. Four rivers rose above their alert marks. These are the Golok River

in Rantau Panjang (7.91m); the Kelantan River in Kusial (13.01m); the Lebir River (29.23m) and the Pergau River (71.69m). Tanah Merah and Jeli were the worst affected districts with villages affected included Kampung Rahmat, Kampung Legeh, Kampung Sungai Satan, Kampung Gemang and Kampung Lakota. Flood levels at these districts had exceeded the 1 m to 1.5 m danger levels.

From 21 December 2019, the flood situation in Kelantan had gradually improved with a further drop in the number of evacuees. Nevertheless, at that stage, Kelantan still had the most evacuees at 1,332 people from 490 families. Nonetheless, this was a big drop from the high of 2,029 people from 715 families recorded. However though, the *ebanjir.kelantan.gov.my website* showed that the Golok River at Rantau Panjang, Pasir Mas, was still above the danger level with a reading of 9.98 m (danger mark 9 m), while Golok River at Kuala Jambu, Tumpat was 2.40 m, breaching the warning level of 2.15 m.

Figure 4.4 shows the locations of the study rainfall stations located in Johor and Kelantan. The rainfall stations within Kota Tinggi District include Site 1738001 at Kota Tinggi, Site 1836001 at Ulu Sebol and Site 1737001 at Bukit Besar. In the Mersing Distrcit the stations are at Stor JPS Mersing, Pengkalan Batu, Site 2636170 at Endau Mersing and Site 2536168 at Empangan Labong. In Kelantan, the study rainfall stations included are at Site 5718005 at Air Bol, Site 5718033 at Kampung Jeli and Site 5621071 at Batu 13.

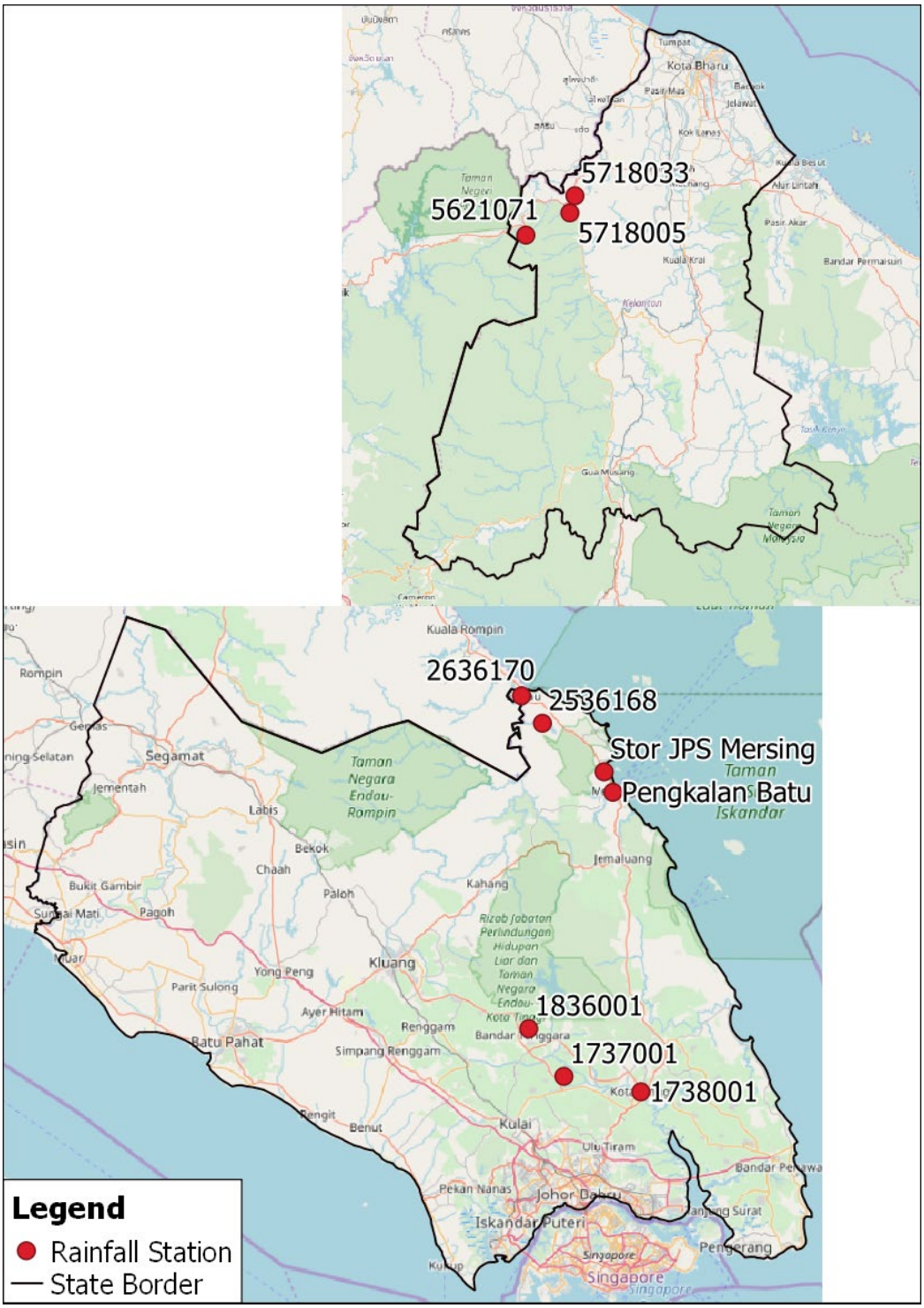


Figure 4.4: Location of study rainfall stations in Kelantan and Johor for flood events in 2019

4.2.1 Kota Tinggi, Johor

The projected daily rainfall under the CO_2 emission scenario B1, with the two different climate models namely the ECHM5 and MRI, were assessed through their comparison with the corresponding observed rainfall. The three rainfall stations in this study are namely Site 1738001 at Kota Tinggi, Site 1836001 at Ulu Sebol and Site 1737001 at Bukit Besar in Kota Tinggi District. The results are shown in Tables 4.2a-4.2c, Figures 4.5a-4.5c and Figures 4.6a-4.6c.

The ECHM5 and the MRI had projected heavy rainfalls during the period before the observed heavy rainfall day on 9 December 2019. It was noted that at Site 1836001 at Ulu Sebol, the MRI projected cumulative rainfall from 1 December 2019 - 9 December 2019 was similar to the observed value, which are 98 mm and 95 mm, respectively. At Site 1737001 at Bukit Besar, for the same period, the ECHM5 projected cumulative rainfall and the observed value are 61 mm and 70 mm, respectively.

The second heavy rainfall event to fall onto the district started on 11 December 2019 until 15 December 2019. At Site 1738001 at Kota Tinggi, the MRI projection was 422 mm of cumulative rainfall, while the observed value was 472 mm. The ECHM5 again showed higher projection accuracy at Site 1737001 at Bukit Besar with 201 mm of cumulative rainfall to the 257 mm observed value.

On 14 December 2019, the MRI was found to be performing better than the ECHM5 in projecting daily rainfall at Site 1738001 at Kota Tinggi. The model projected 93 mm of daily rainfall to the observed value of 95 mm. However, the ECHM5 had higher projection accuracies than the MRI on the same day at Site 1836001 at Ulu Sebol (110 mm of projected daily rainfall to the 93 mm of observed daily rainfall) and at Site 1737001 at Bukit Besar (97 mm of projected daily rainfall to the 73 mm of observed daily rainfall). Similarly, for 1 December 2019 up to 14 December 2019, the ECHM5 was more accurate at Site 1836001 at Ulu Sebol. This was when 210 mm of cumulative rainfall was projected for the 233 mm of cumulative rainfall observed. Again, at Site 1737001 at Bukit Besar, the 196 mm of projected cumulative rainfall accounted for the 199 mm of observed cumulative rainfall.

Table 4.2a: Projected and observed daily rainfall and the cumulative rainfall for Site 1738001 at Kota Tinggi, Johor

Station		Site 1738001 at Kota Tinggi, Johor																														
Interval (Unit)		Daily Rainfall (mm)																														
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019	22/12/2019	23/12/2019	24/12/2019	25/12/2019	26/12/2019	27/12/2019	28/12/2019	29/12/2019	30/12/2019	31/12/2019
Model Projection	ECHM5_B1_3	5	3	8	3	7	7	0	12	1	19	2	13	1	143	2	15	0	7	0	18	18	1	0	16	1	1	1	0	1	12	8
	MRI_B1	8	10	20	9	23	23	33	7	4	2	2	11	20	93	158	163	1	2	7	4	17	49	5	60	7	25	61	32	3	1	1
	Average ALL	6	6	14	6	15	15	17	10	2	10	2	12	10	118	80	89	1	5	4	11	17	25	3	38	4	13	31	16	2	6	5
Observed		1	1	0	0	0	0	0	0	160	0	49	9	49	95	108	5	4	3	2	0	0	0	0	0	0	0	0	0	0	0	0
		Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_B1_3	8	16	19	26	33	33	45	46	64	66	79	80	223	225	240	240	247	247	265	283	284	284	301	301	302	303	304	305	316	324	
	MRI_B1	17	38	46	69	93	126	133	137	139	141	152	171	265	422	586	586	589	596	600	617	666	671	731	738	763	823	855	858	859	861	
	Average ALL	13	27	33	47	63	80	89	92	102	103	115	126	244	324	413	413	418	422	432	450	475	478	516	520	532	563	580	581	588	592	
Observed		2	2	2	2	2	2	2	162	162	211	220	269	364	472	477	481	484	486	486	486	486	486	486	486	486	486	486	486	486	486	

Table 4.2b: Projected and observed daily rainfall and the cumulative rainfall for Site 1836001 at Ulu Sebol, Johor

Station		Site 1836001 at Ulu Sebol, Johor																														
Interval (Unit)		Daily Rainfall (mm)																														
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019	22/12/2019	23/12/2019	24/12/2019	25/12/2019	26/12/2019	27/12/2019	28/12/2019	29/12/2019	30/12/2019	31/12/2019
Model Projection	ECHM5_B1_3	0	0	0	39	7	7	0	11	8	25	0	1	1	110	6	18	1	5	0	0	22	0	0	11	0	1	2	1	0	11	9
	MRI_B1	1	5	9	1	5	20	48	5	3	2	19	15	11	196	324	165	1	0	1	3	15	28	10	33	1	16	42	18	0	0	3
	Average ALL	1	3	5	20	6	13	24	8	6	13	10	8	6	153	165	92	1	3	0	2	19	14	5	22	1	8	22	9	0	6	6
Observed		6	1	1	0	0	0	0	4	83	0	13	6	26	93	106	1	2	4	0	4	13	0	0	0	0	0	0	0	0	0	0
		Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_B1_3	0	1	39	46	53	53	64	73	98	98	99	101	210	216	234	235	240	241	241	263	263	263	274	274	275	277	278	278	290	298	
	MRI_B1	6	15	17	22	41	90	95	98	100	119	134	145	341	665	831	832	832	833	835	851	879	889	921	922	938	980	998	998	998	1001	
	Average ALL	3	8	28	34	47	71	80	85	99	108	117	123	276	441	532	533	536	537	538	557	571	576	598	598	606	629	638	638	644	649	
Observed		7	8	8	8	8	8	12	95	95	108	114	140	233	339	340	342	346	346	350	363	363	363	363	363	363	363	363	363	363	363	

Table 4.2c: Projected and observed daily rainfall and the cumulative rainfall for Site 1737001 at Bukit Besar, Johor

Station		Site 1737001 at Bukit Besar, Johor																														
Interval (Unit)		Daily Rainfall (mm)																														
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019	22/12/2019	23/12/2019	24/12/2019	25/12/2019	26/12/2019	27/12/2019	28/12/2019	29/12/2019	30/12/2019	31/12/2019
Model Projection	ECHM5_B1_3	13	0	0	22	5	8	1	13	0	17	2	14	4	97	4	5	1	5	1	5	8	0	0	9	2	1	3	0	1	5	5
	MRI_B1	5	6	10	0	3	2	71	10	3	1	14	21	14	106	184	149	2	0	1	9	19	41	13	55	0	42	61	40	0	4	2
	Average ALL	9	3	5	11	4	5	36	11	2	9	8	17	9	102	94	77	1	2	1	7	13	21	7	32	1	21	32	20	0	4	3
Observed		10	1	2	0	0	0	0	13	44	0	25	3	28	73	58	5	4	36	0	0	2	0	0	0	0	0	0	0	0	0	0
		Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_B1_3	13	13	35	40	48	49	61	61	78	81	94	99	196	201	206	206	211	212	217	225	225	226	235	237	237	240	241	241	246	251	
	MRI_B1	12	21	22	25	27	98	108	111	112	126	147	161	267	451	600	602	602	603	613	631	672	685	740	741	782	843	883	883	887	888	
	Average ALL	12	17	28	32	37	73	85	86	95	103	121	130	231	326	403	404	407	407	415	428	449	456	487	489	510	542	562	562	566	570	
Observed		11	13	13	13	13	13	26	70	70	95	98	126	199	257	262	266	302	302	302	304	304	304	304	304	304	304	304	304	304	304	

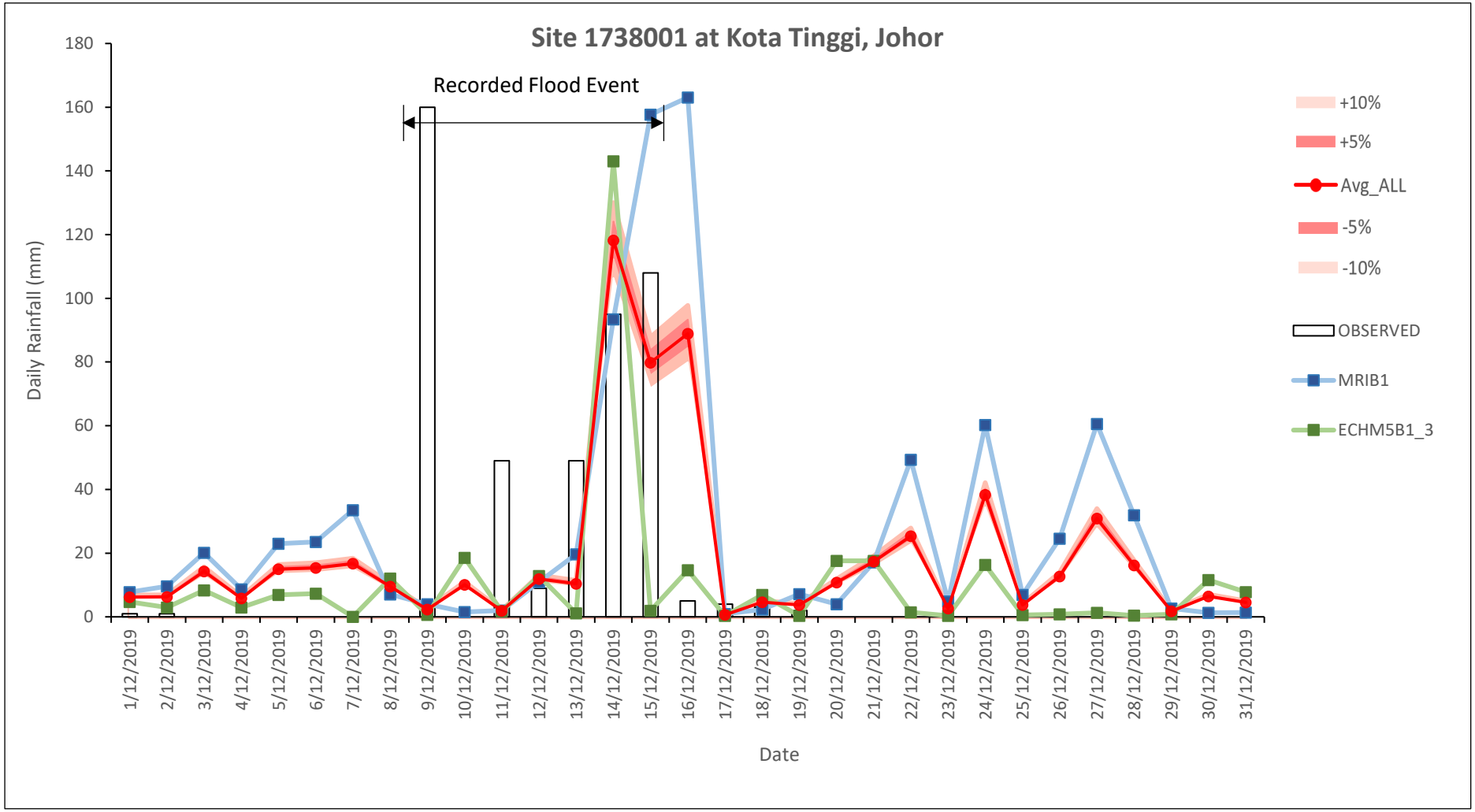


Figure 4.5a: Projected and observed daily rainfall for Site 1738001 at Kota Tinggi, Johor

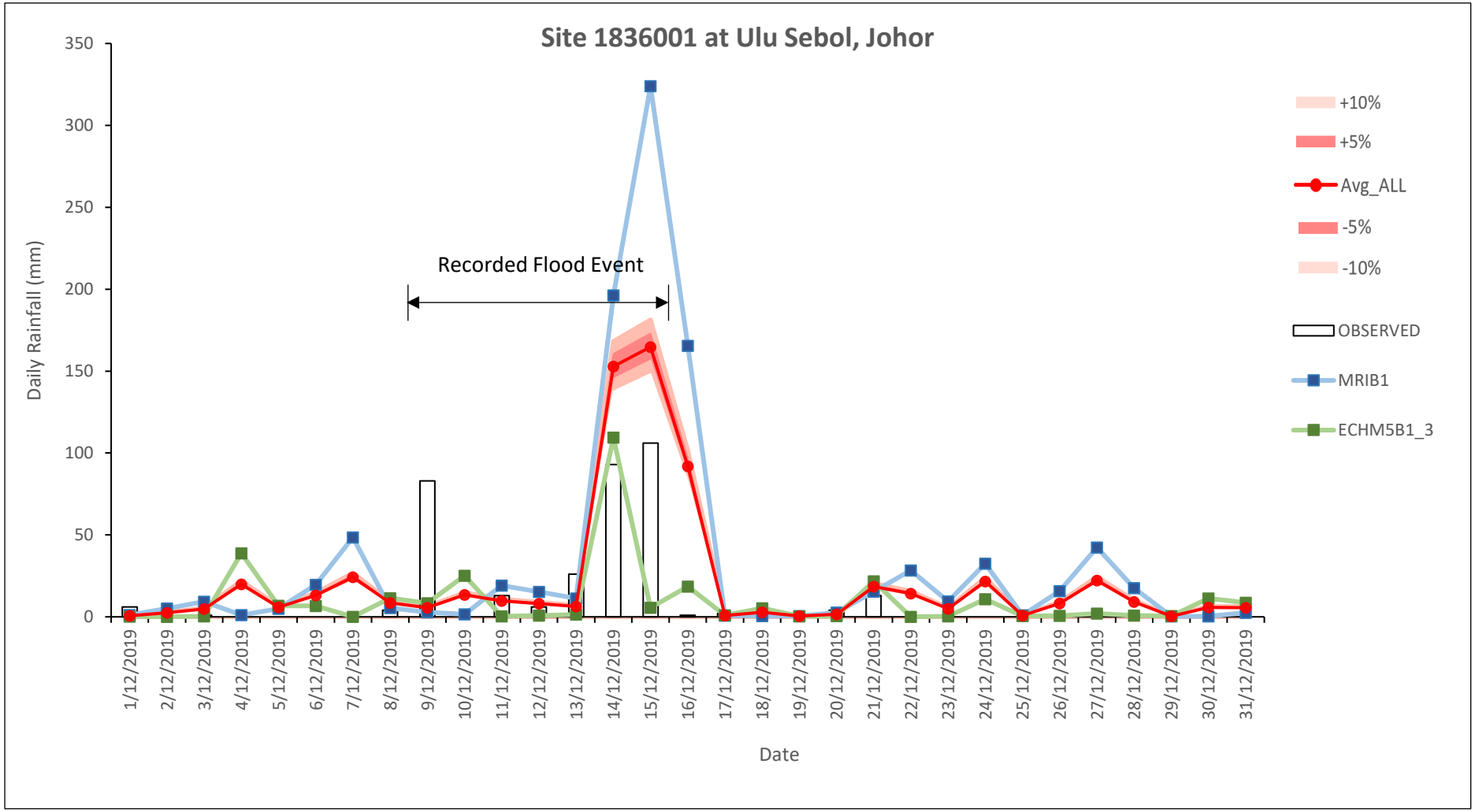


Figure 4.5b: Projected and observed daily rainfall for Site 1836001 at Ulu Sebol, Johor

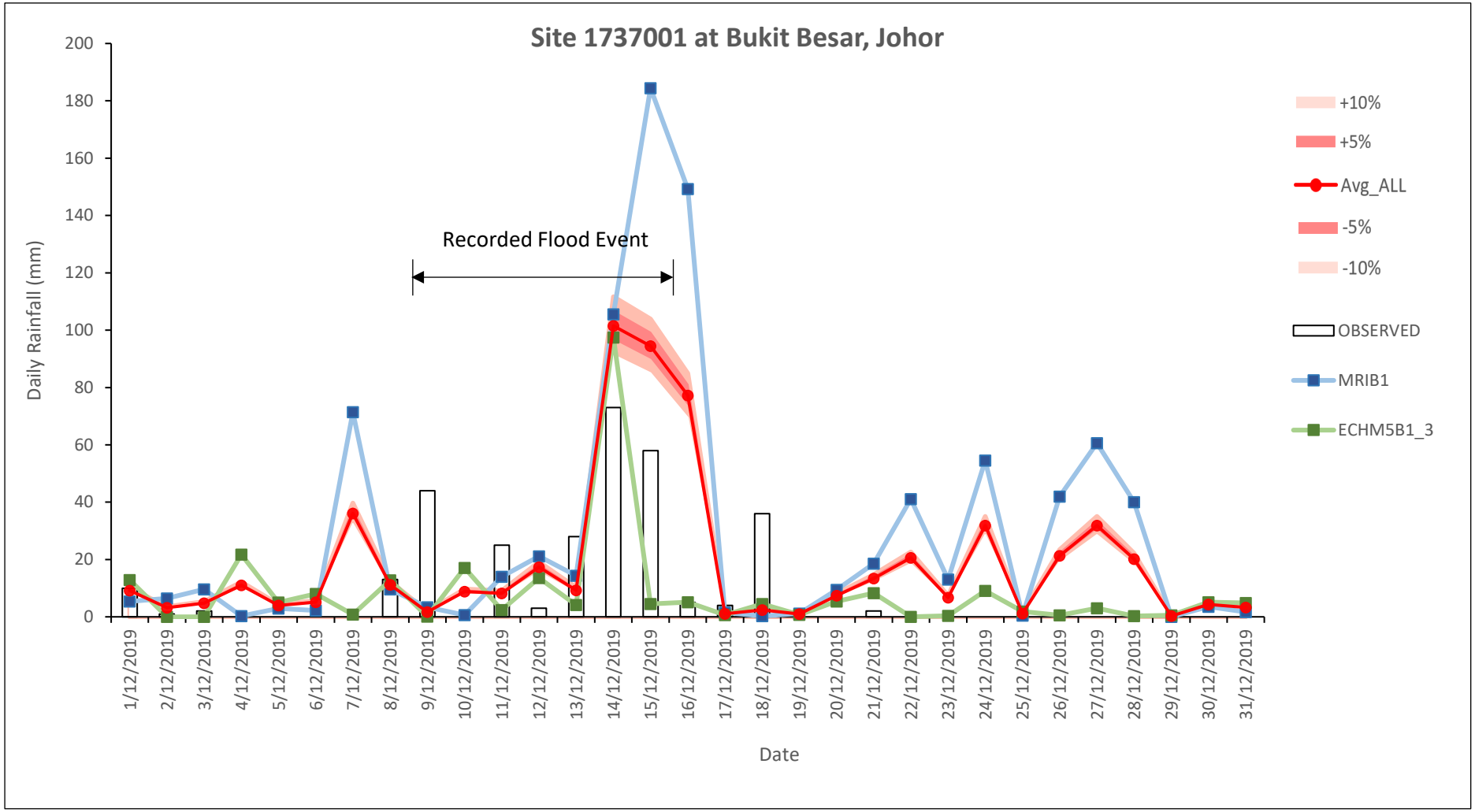


Figure 4.5c: Projected and observed daily rainfall for Site 1737001 at Bukit Besar, Johor

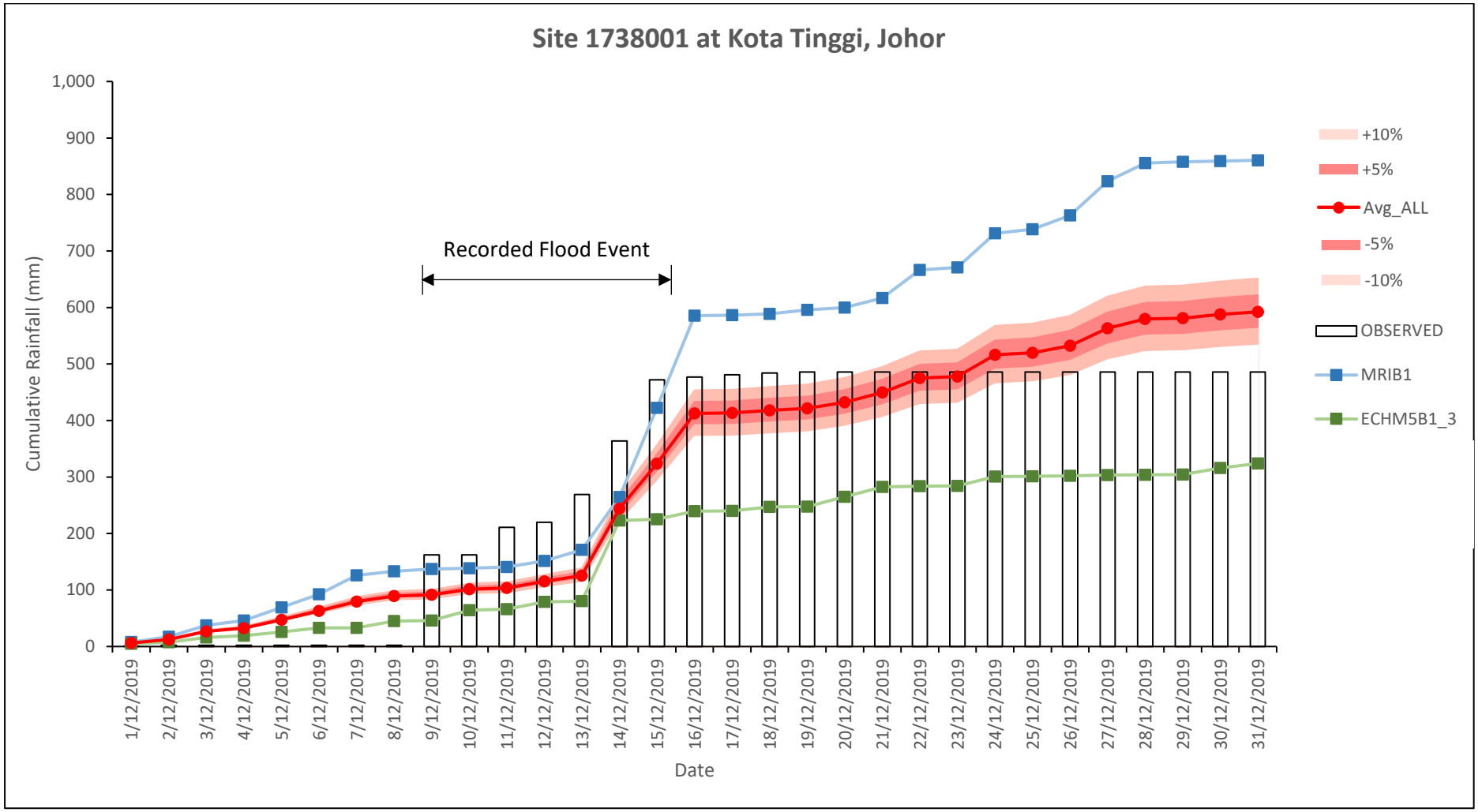


Figure 4.6a: Cumulative rainfall for Site 1738001 at Kota Tinggi, Johor

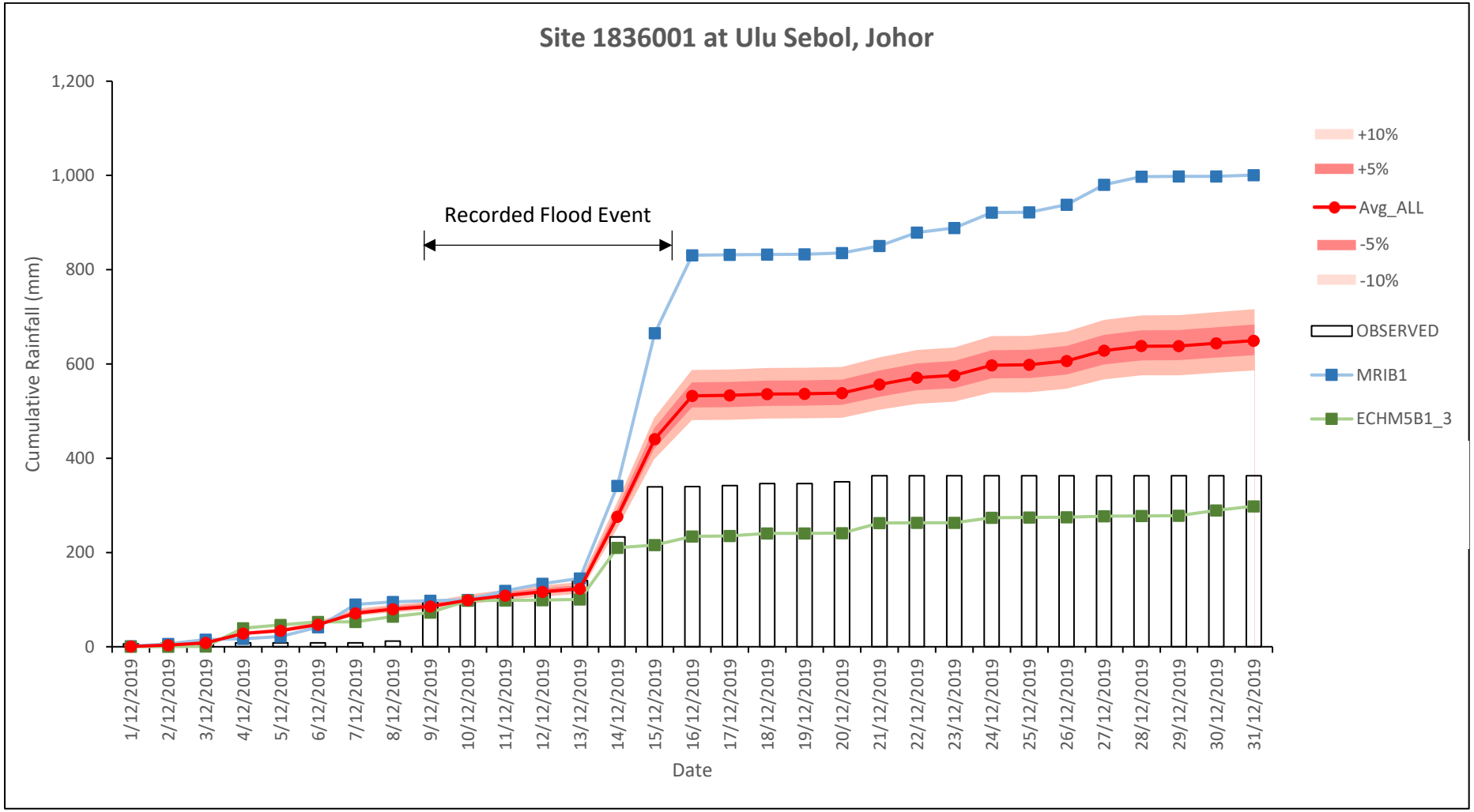


Figure 4.6b: Cumulative rainfall for Site 1836001 at Ulu Sebol, Johor

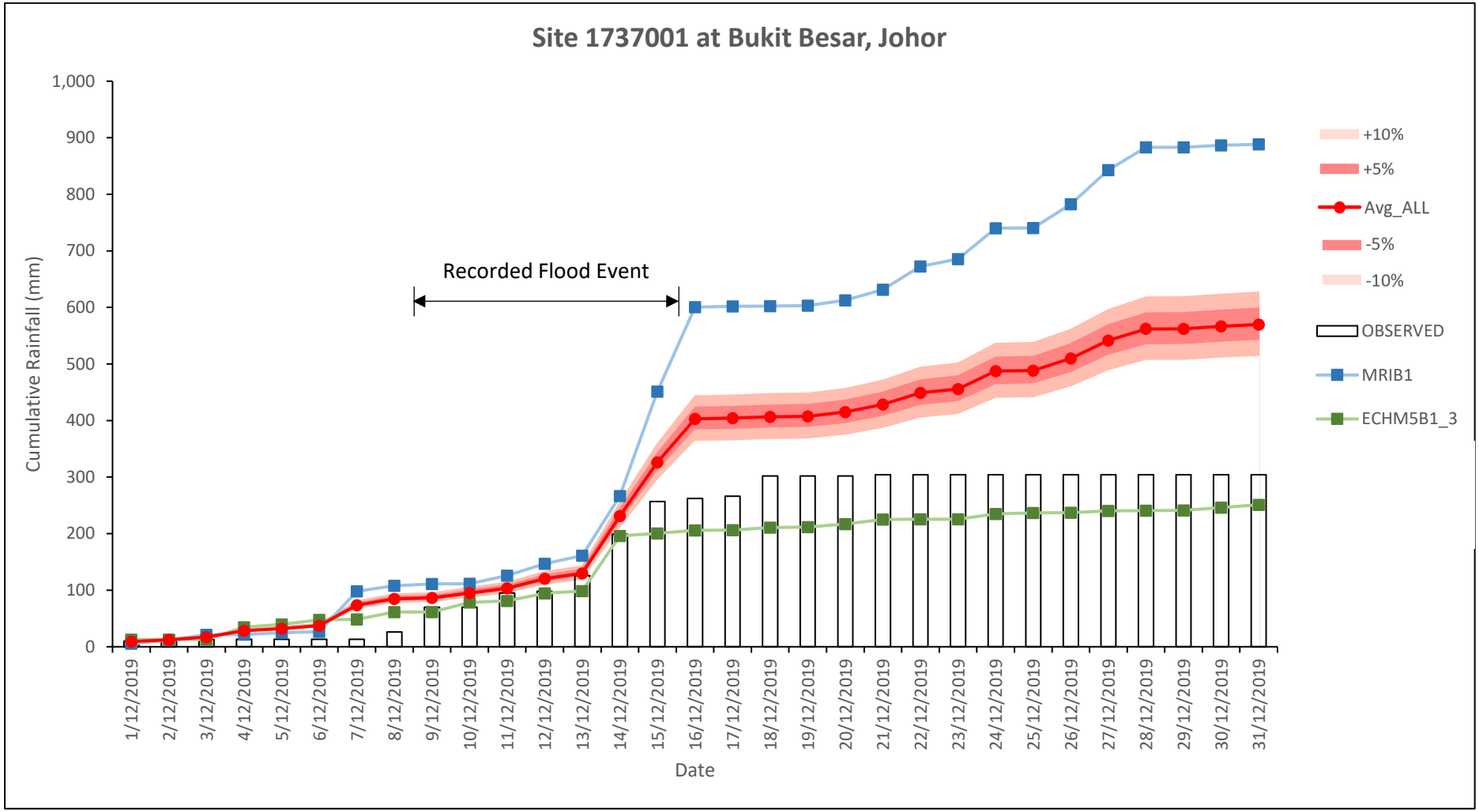


Figure 4.6c: Cumulative rainfall for Site 1737001 at Bukit Besar, Johor

4.2.2 Mersing, Johor

The projected daily rainfall for the four study rainfall stations namely Stor JPS Mersing, Pengkalan Batu, Site 2636170 at Endau Mersing and Site 2536168 at Empangan Labong in Mersing District, under the CO_2 emission scenario B1 from the two different climate models, namely the ECHM5 and MRI, were assessed through the comparison with the observed rainfall. The results are shown in Tables 4.3a-4.3d, Figures 4.7a-4.7d and Figures 4.8a-4.8d.

A similar situation of the projected heavy rainfalls in the Kota Tinggi District was observed in the Mersing District. The ECHM5 and the MRI projected heavy rainfalls at the four stations in the Mersing District, during the period before the observed heavy rainfall day on 9 December 2019. The projected cumulative rainfall from 1 December 2019 to 9 December 2019 at Stor JPS Mersing and Pengkalan Batu by the ECHM5 were found to be similar to their observed values. These are the 207 mm cumulative rainfall to the observed 222 mm at Stor JPS Mersing, and the 176 mm cumulative rainfall to the observed 199 mm at Pengkalan Batu.

The ECHM5 was again found to be better performing than the MRI in projecting cumulative rainfall during the second heavy rainfall event that fell onto the district from 11 December 2019 to 15 December 2019. The performance of the ECHM5 at the four stations are as follows:

(i) Stor JPS Mersing:

ECHM5 projected 535 mm of cumulative rainfall from 1 December 2019 to 14 December 2019; while the observation was 600 mm

(ii) Pengkalan Batu:

ECHM5 projected 476 mm of cumulative rainfall from 1 December 2019 to 14 December 2019; while the observation was 464 mm

(iii) Site 2636170 at Endau Mersing:

ECHM5 projected 650 mm of cumulative rainfall from 1 December 2019 to 14 December 2019; while the observation was 643 mm;

ECHM5 also projected 370 mm of daily rainfall on 14 December 2019; while the observation was 396 mm

(iv) Site 2536168 at Empangan Labong:

ECHM5 projected 653 mm of cumulative rainfall from 1 December 2019 to 14 December 2019; while the observation was 677 mm;

ECHM5 also projected 361 mm of daily rainfall on 14 December 2019; while the observation was 376 mm

Table 4.3a: Projected and observed daily rainfall and the cumulative rainfall for Stor JPS Mersing, Johor

Station		Stor JPS Mersing, Johor																														
Interval (Unit)		Daily Rainfall (mm)																														
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019	22/12/2019	23/12/2019	24/12/2019	25/12/2019	26/12/2019	27/12/2019	28/12/2019	29/12/2019	30/12/2019	31/12/2019
Model Projection	ECHM5_B1_3	10	144	53	0	0	0	0	0	1	0	3	1	17	307	34	30	14	0	0	0	61	15	4	0	7	51	0	0	0	6	0
	MRI_B1	70	13	24	54	102	97	10	48	59	59	52	94	100	89	113	7	0	0	0	77	104	42	20	13	0	48	0	47	0	24	55
	Average ALL	40	78	39	27	51	48	5	24	30	29	28	47	58	198	73	18	7	0	0	38	83	28	12	7	4	50	0	23	0	15	27
Observed		16	36	3	0	0	0	1	6	160	0	0	0	217	161	73	29	13	45	1	22	18	7	0	2	0	0	0	0	0	0	0
		Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_B1_3	154	207	207	207	207	207	207	207	207	210	211	228	535	569	599	613	613	613	613	674	689	692	692	699	750	751	751	751	757	757	
	MRI_B1	84	108	162	264	361	370	419	478	536	589	683	783	872	984	991	991	991	991	1068	1172	1213	1233	1246	1246	1295	1295	1341	1341	1365	1420	
	Average ALL	119	157	184	235	284	288	313	343	372	399	447	505	704	777	795	802	802	802	840	923	951	963	969	973	1022	1023	1046	1046	1061	1088	
Observed		52	55	55	55	55	56	62	222	222	222	222	439	600	673	702	715	760	761	783	801	808	808	810	810	810	810	810	810	810	810	

Table 4.3b: Projected and observed daily rainfall and the cumulative rainfall for Pengkalan Batu, Johor

Station		Pengkalan Batu, Johor																														
Interval (Unit)		Daily Rainfall (mm)																														
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019	22/12/2019	23/12/2019	24/12/2019	25/12/2019	26/12/2019	27/12/2019	28/12/2019	29/12/2019	30/12/2019	31/12/2019
Model Projection	ECHM5_B1_3	0	157	18	0	0	0	0	0	1	0	5	2	23	270	35	34	0	0	0	0	51	6	0	0	5	86	9	0	0	10	0
	MRI_B1	55	63	60	53	67	64	41	41	40	43	58	61	71	86	94	67	54	7	0	48	74	56	56	8	40	66	52	61	49	0	35
	Average ALL	27	110	39	26	34	32	21	21	21	21	32	31	47	178	64	50	27	4	0	24	62	31	28	4	23	76	31	30	24	5	17
Observed		4	54	1	0	0	0	1	15	124	0	1	0	131	133	66	22	1	39	1	21	17	6	0	0	0	0	0	0	0	0	1
		Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_B1_3	157	175	175	175	175	175	175	176	176	182	183	206	476	510	544	544	544	544	544	595	601	601	601	606	692	701	701	701	711	711	
	MRI_B1	117	177	230	297	361	403	444	483	526	584	645	716	801	896	963	1017	1024	1024	1072	1146	1202	1258	1266	1306	1372	1424	1484	1533	1533	1568	
	Average ALL	137	176	202	236	268	289	309	330	351	383	414	461	639	703	753	780	784	784	808	870	901	929	933	956	1032	1062	1093	1117	1122	1139	
Observed		58	59	59	59	59	60	75	199	199	200	200	331	464	530	552	553	592	593	614	631	637	637	637	637	637	637	637	637	637	638	

Table 4.3c: Projected and observed daily rainfall and the cumulative rainfall for Site 2636170 at Endau Mersing, Johor

Station		Site 2636170 at Endau Mersing, Johor																														
Interval (Unit)		Daily Rainfall (mm)																														
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019	22/12/2019	23/12/2019	24/12/2019	25/12/2019	26/12/2019	27/12/2019	28/12/2019	29/12/2019	30/12/2019	31/12/2019
Model Projection	ECHM5_B1_3	96	76	57	0	0	0	0	0	0	0	12	0	39	370	26	42	0	0	0	0	14	0	0	0	8	95	1	0	0	0	0
	MRI_B1	46	59	54	42	68	46	41	58	37	73	48	77	54	38	15	32	14	58	59	77	41	18	2	13	59	86	45	45	57	63	52
	Average ALL	71	68	55	21	34	23	20	29	19	36	30	38	46	204	21	37	7	29	30	38	27	9	1	7	33	90	23	23	28	32	26
Observed		14	3	0	0	0	0	19	0	120	0	0	2	89	396	171	23	25	9	0	16	13	44	0	3	0	0	0	0	0	0	3
		Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_B1_3	172	229	229	229	229	229	229	229	229	229	240	240	279	650	676	719	719	719	719	719	732	732	732	732	740	835	835	835	835	835	835
	MRI_B1	105	159	201	268	314	355	413	450	522	570	647	701	739	754	786	799	857	917	993	1035	1053	1054	1068	1126	1212	1256	1301	1358	1421	1473
	Average_ALL	139	194	215	248	271	292	321	339	375	405	444	490	694	715	752	759	788	818	856	883	892	893	900	933	1023	1046	1068	1097	1128	1154
Observed		17	17	17	17	17	36	36	156	156	156	158	247	643	814	837	862	871	871	887	900	944	944	947	947	947	947	947	947	947	947	950

Table 4.3d: Projected and observed daily rainfall and the cumulative rainfall for Site 2536168 at Empangan Labong, Johor

Station		Site 2536168 at Empangan Labong, Johor																														
Interval (Unit)		Daily Rainfall (mm)																														
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019	22/12/2019	23/12/2019	24/12/2019	25/12/2019	26/12/2019	27/12/2019	28/12/2019	29/12/2019	30/12/2019	31/12/2019
Model Projection	ECHM5_B1_3	64	26	163	0	2	0	0	0	0	0	10	1	27	361	41	35	0	9	0	0	20	0	0	0	30	93	5	0	0	0	0
	MRI_B1	19	15	0	3	75	83	70	71	5	131	66	87	105	141	59	2	18	90	104	121	17	24	2	20	79	127	0	0	48	1	97
	Average_ALL	41	20	81	2	39	42	35	36	2	65	38	44	66	251	50	18	9	50	52	60	18	12	1	10	55	110	2	0	24	0	48
Observed		14	10	12	13	0	0	2	1	121	0	4	0	124	376	279	17	70	4	0	16	5	43	0	2	0	0	0	0	0	0	1
		Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_B1_3	89	252	252	254	254	254	254	254	254	264	265	292	653	694	729	729	738	738	738	757	757	757	757	787	880	885	885	885	885	885	
	MRI_B1	35	35	38	113	196	266	338	343	473	539	627	731	872	931	933	951	1041	1145	1266	1283	1307	1308	1328	1408	1534	1534	1534	1582	1583	1680	
	Average ALL	62	143	145	184	225	260	296	298	364	402	446	512	763	812	831	840	889	941	1002	1020	1032	1033	1043	1097	1207	1209	1209	1233	1234	1282	
Observed		24	36	49	49	49	51	52	173	173	177	177	301	677	956	973	1043	1047	1047	1063	1068	1111	1111	1113	1113	1113	1113	1113	1113	1113	1114	

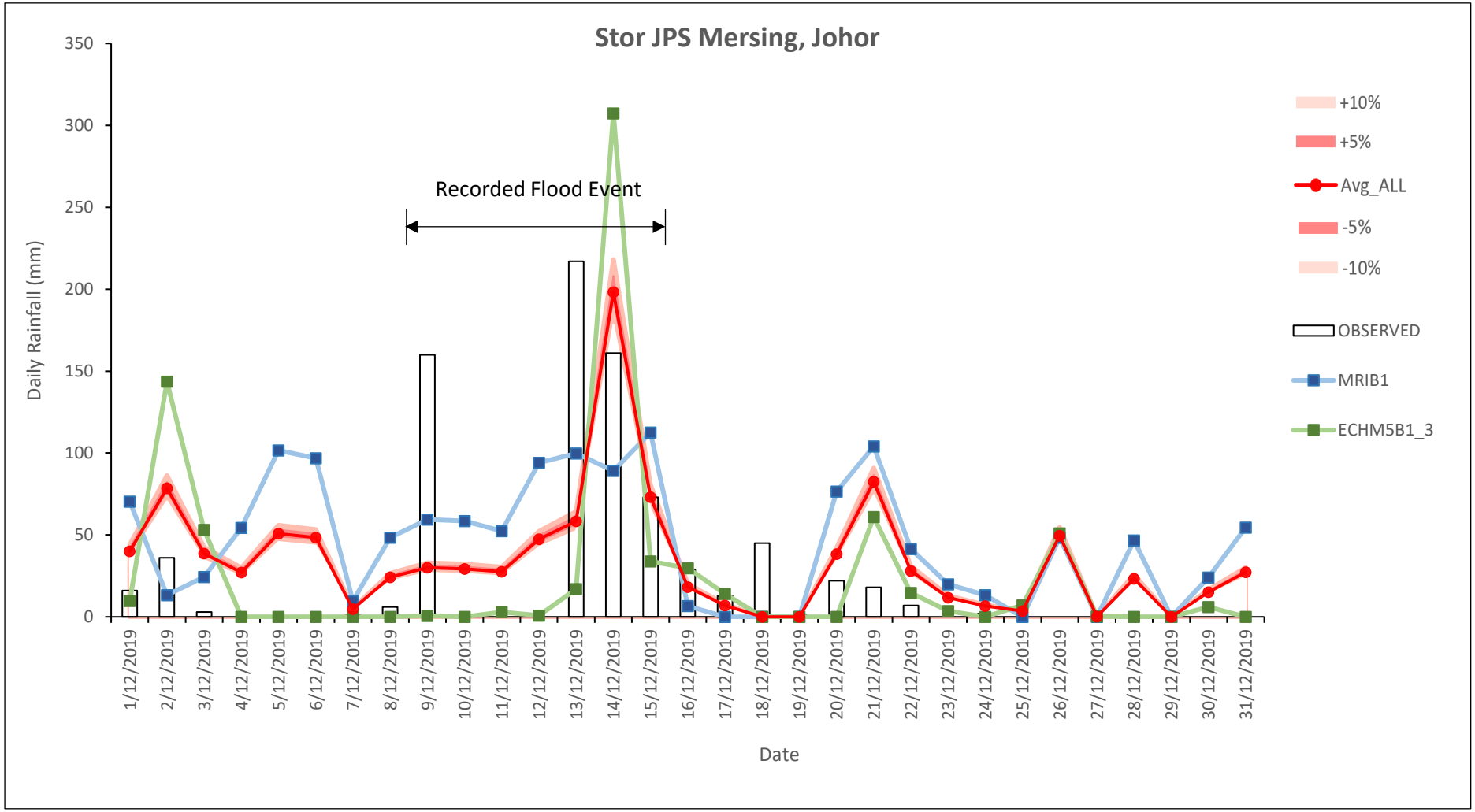


Figure 4.7a: Projected and observed daily rainfall for Stor JPS Mersing, Johor

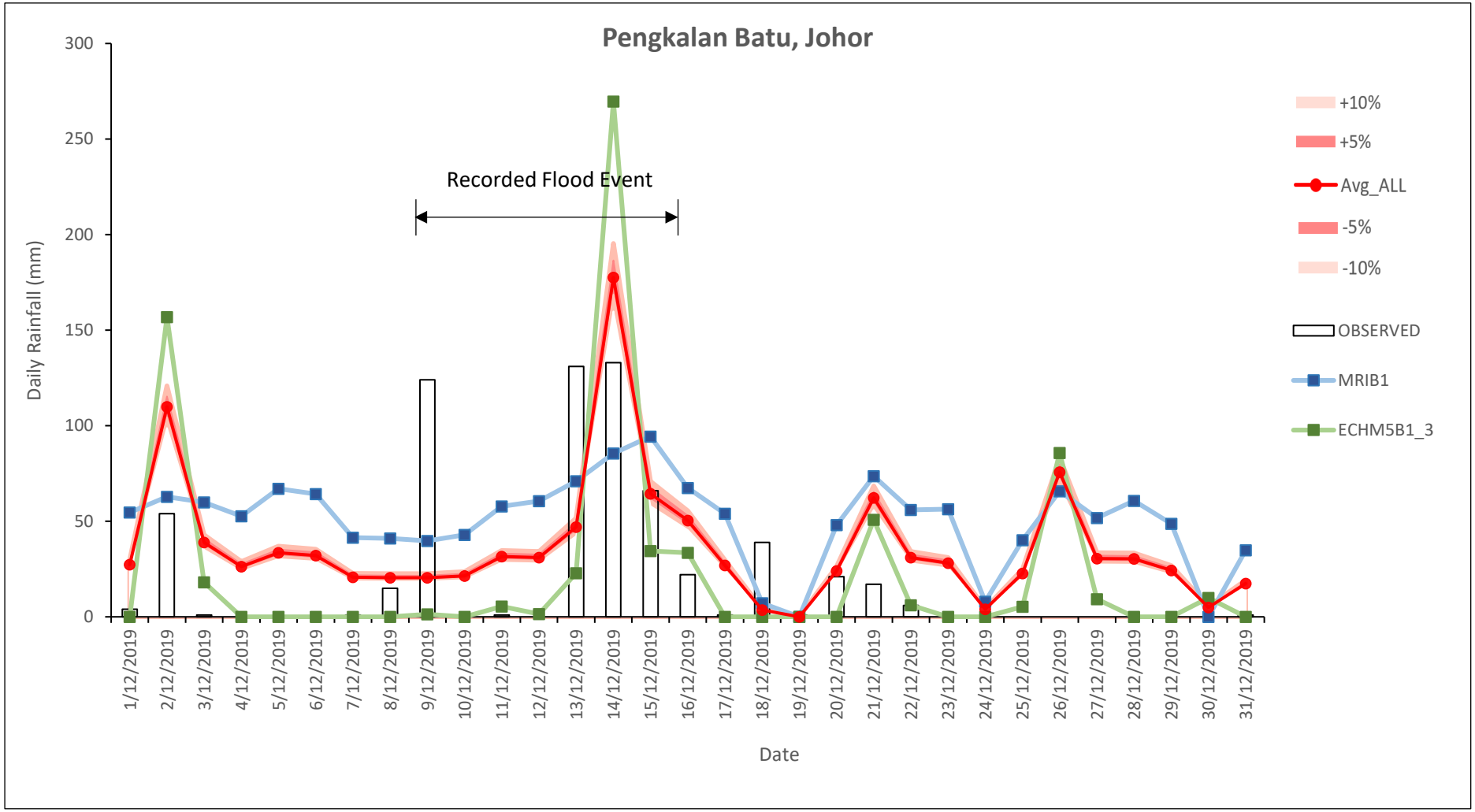


Figure 4.7b: Projected and observed daily rainfall for Pengkalan Batu, Johor

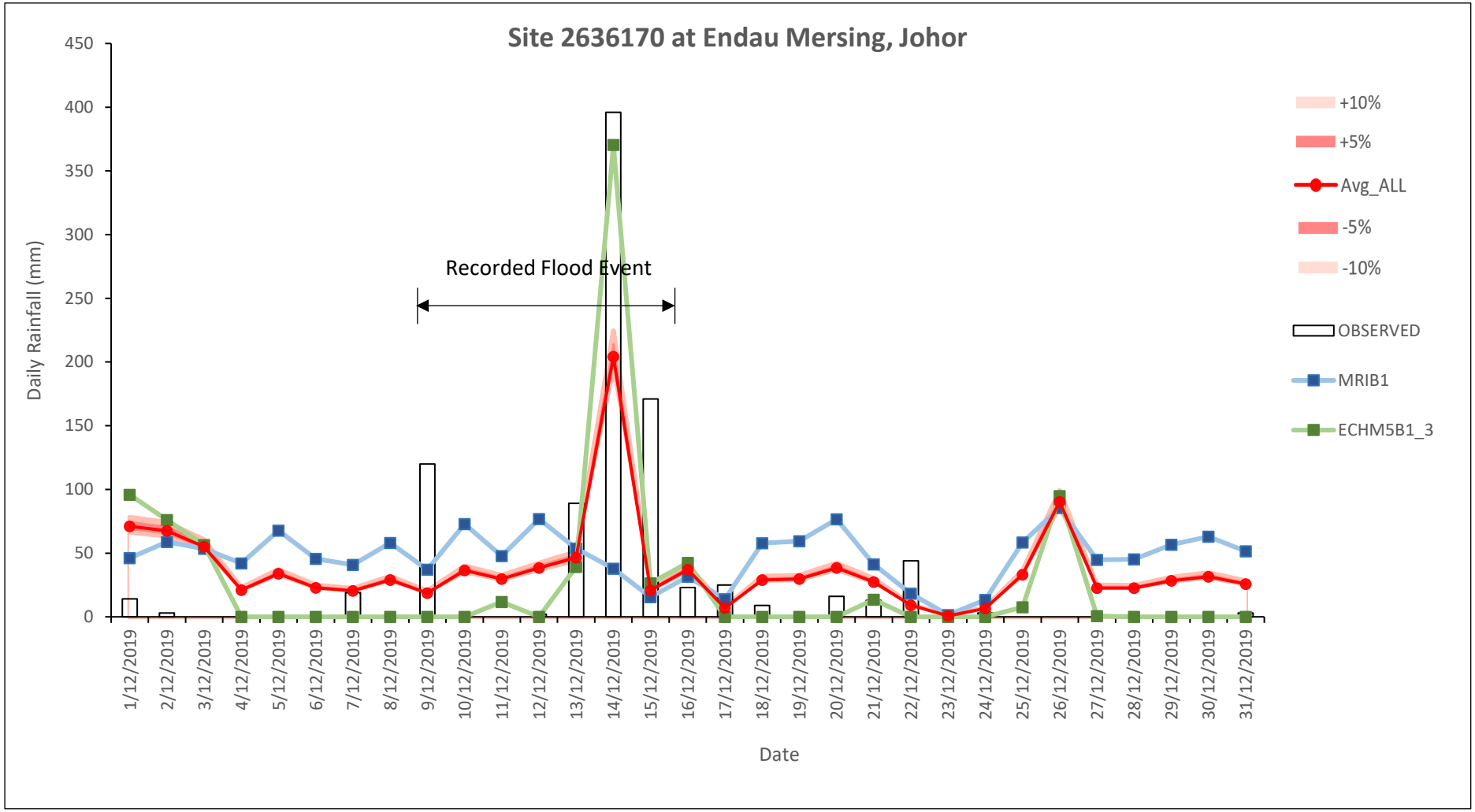


Figure 4.7c: Projected and observed daily rainfall for Site 2636170 at Endau Mersing, Johor

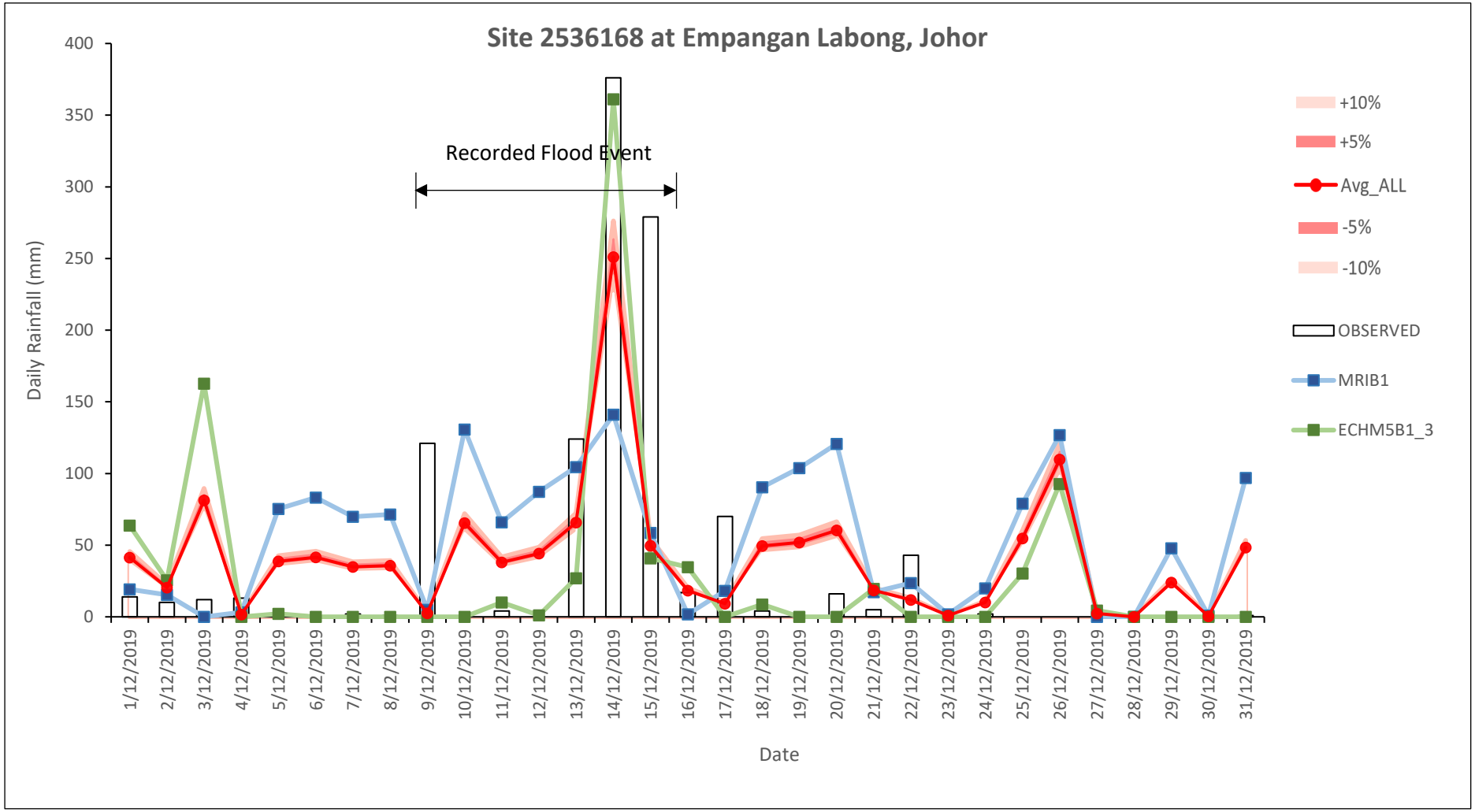


Figure 4.7d: Projected and observed daily rainfall for Site 2536168 at Empangan Labong, Johor

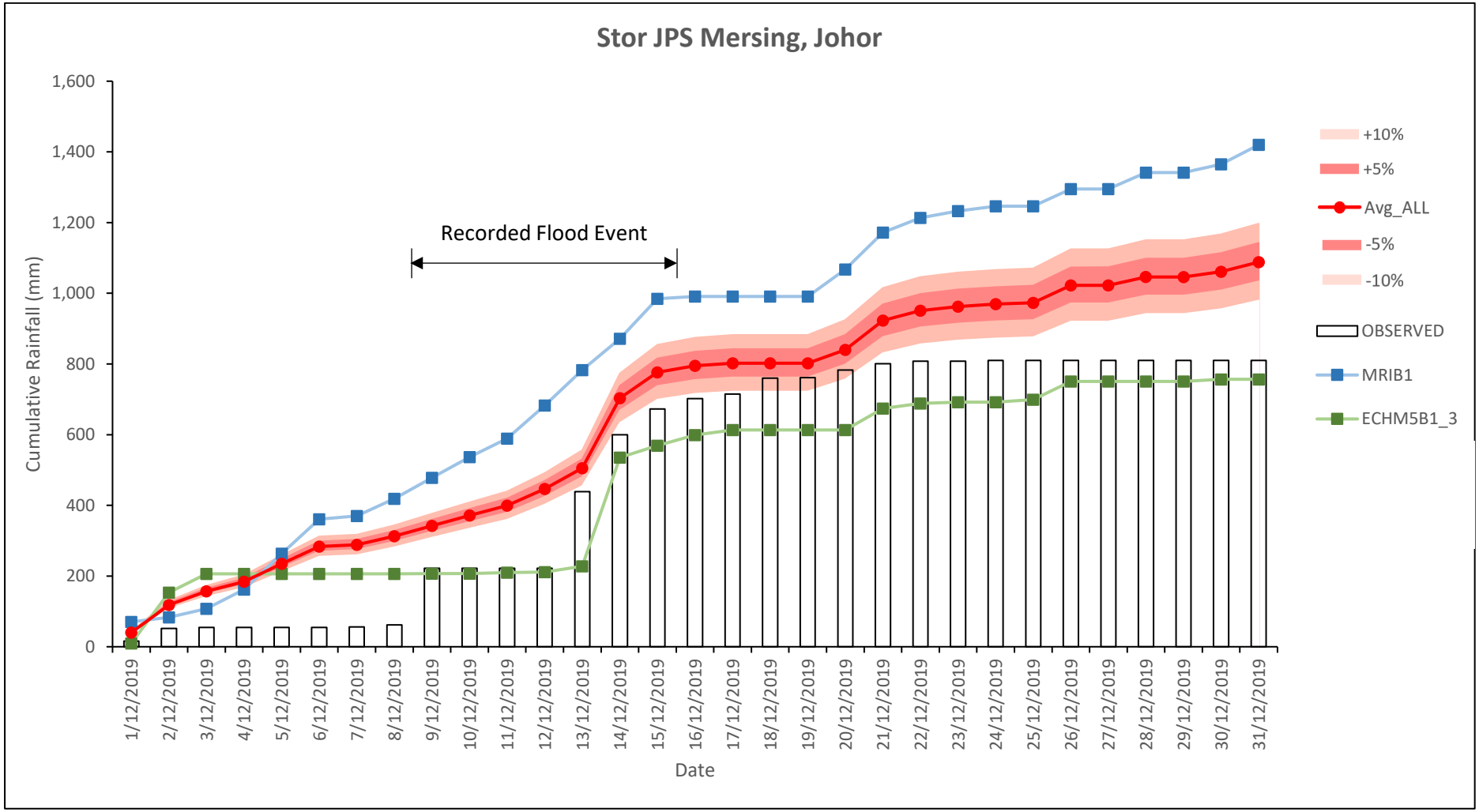


Figure 4.8a: Cumulative rainfall for Stor JPS Mersing, Johor

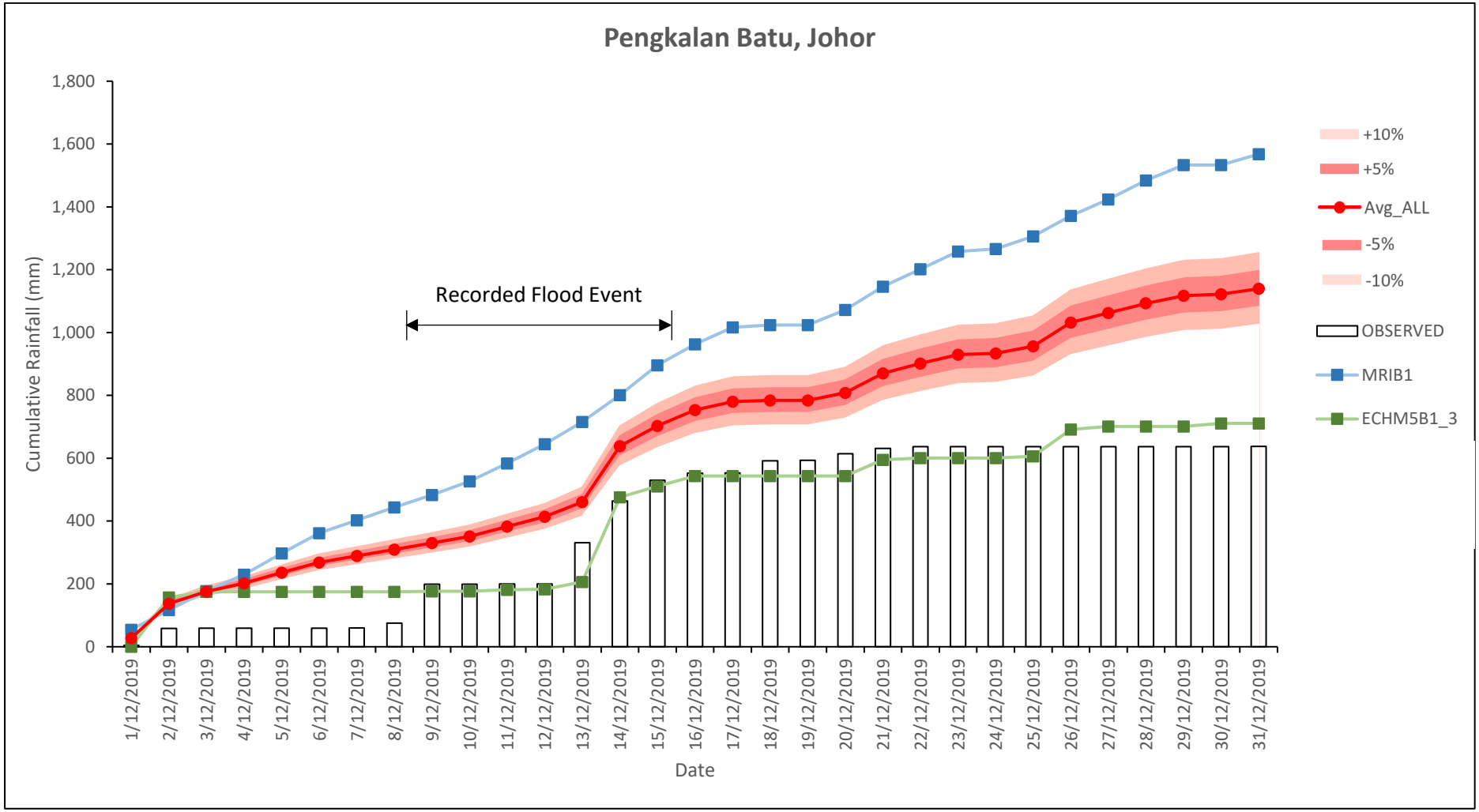


Figure 4.8b: Cumulative rainfall for Pengkalan Batu, Johor

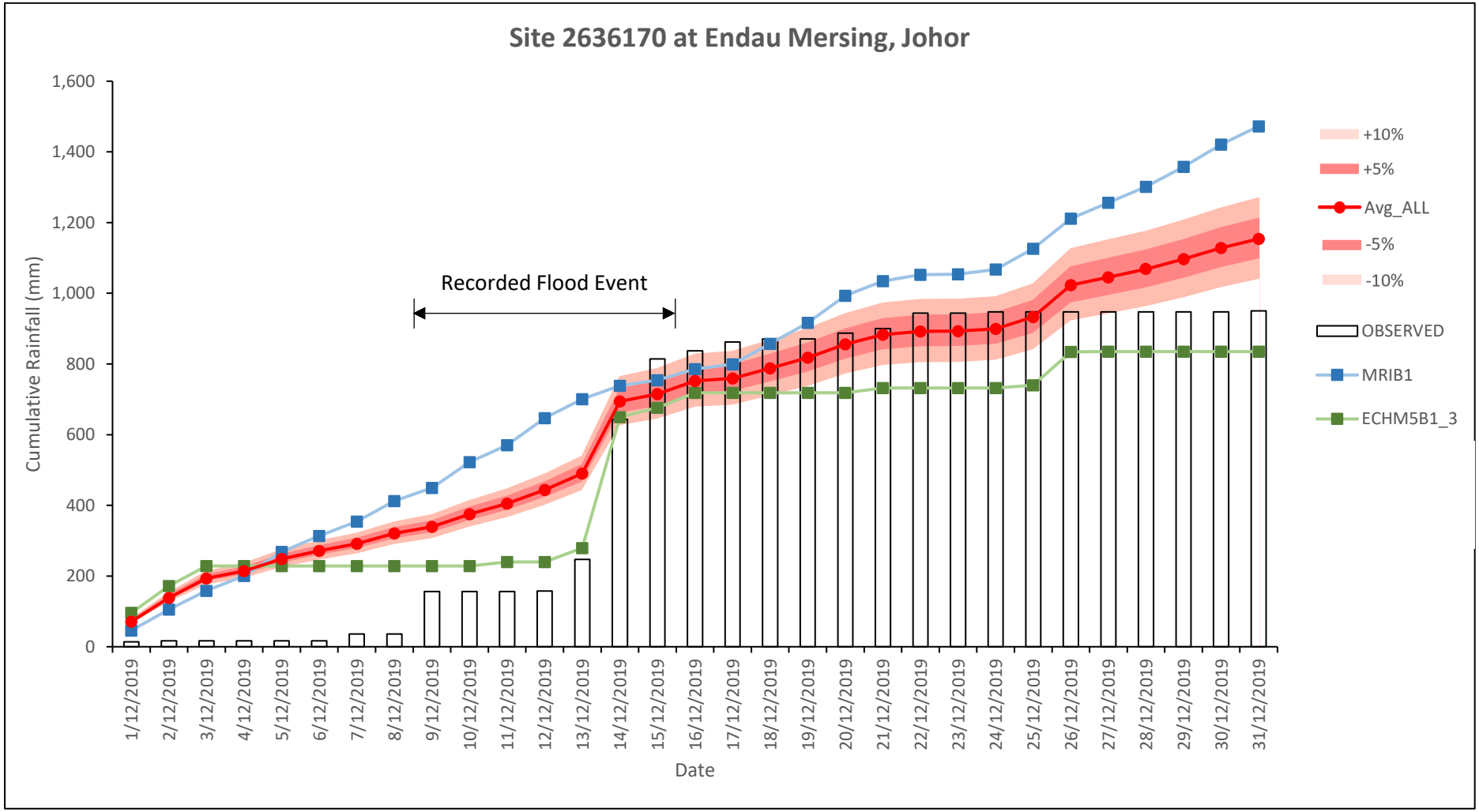


Figure 4.8c: Cumulative rainfall for Site 2636170 at Endau Mersing, Johor

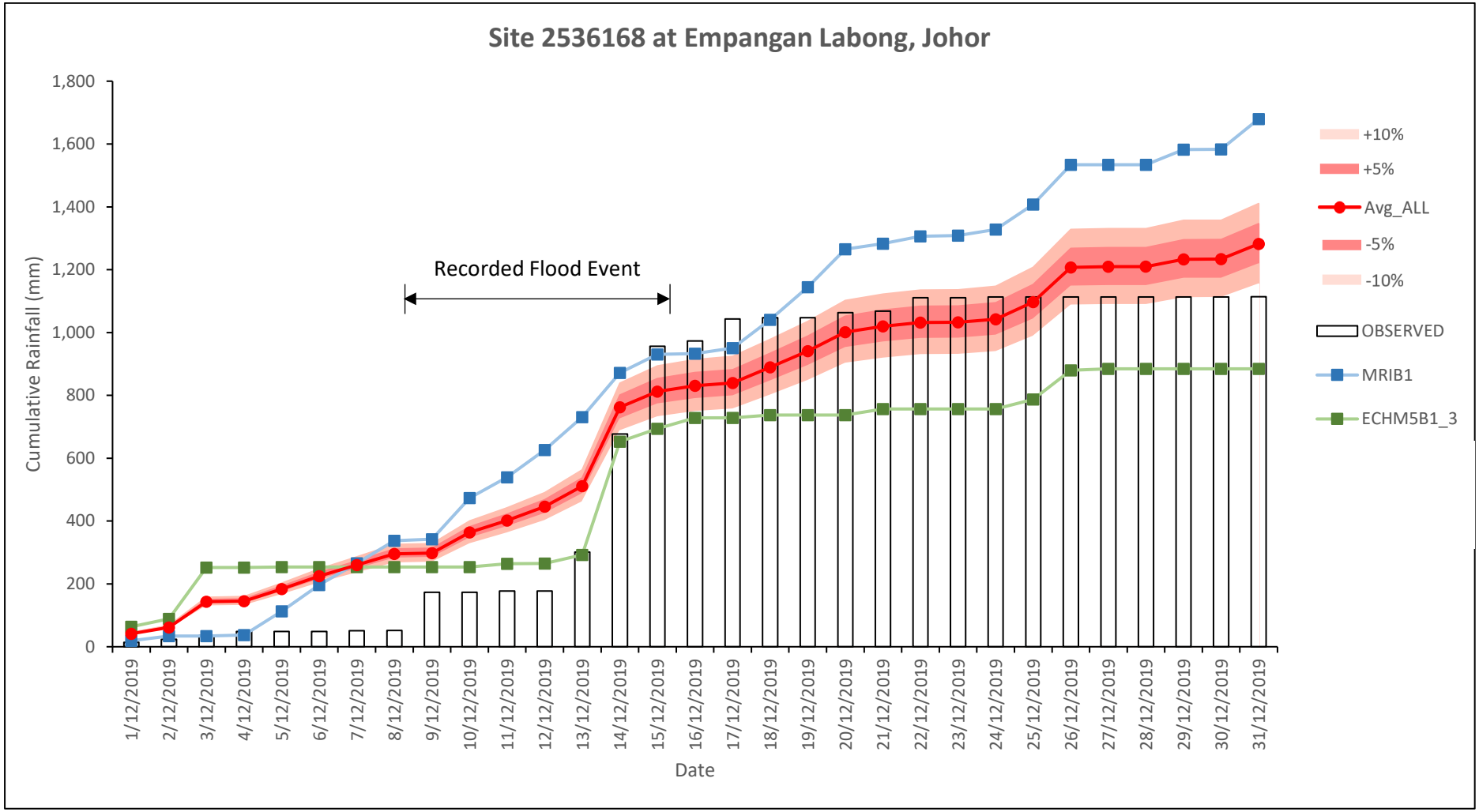


Figure 4.8d: Cumulative rainfall for Site 2536168 at Empangan Labong, Johor

4.2.3 Jeli, Kelantan

The projected daily rainfall for the three study rainfall stations namely Site 5718005 at Air Bol, Site 5718033 at Kampung Jeli and Site 5621071 at Batu 13 in Jeli District, Kelantan, under the CO_2 emission scenarios A1B and A2 from the two different climate models, namely the ECHM5 and MRI, were assessed through the comparison with the observed rainfall. The results are shown in Tables 4.4a-4.4c, Figures 4.9a-4.9c and Figures 4.10a-4.10c.

Heavy rainfall was observed on 16-18 December 2019 at Site 5718005 at Air Bol and at Site 5718033 at Kampung Jeli. On 14-19 December 2019 heavy rainfall was recorded at Site 5621071 at Batu 13. In general, the ECHM5 performed better than the MRI in Jeli District. The performance of the ECHM5 at the three stations are as follows:

(i) Site 5718005 at Air Bol:

ECHM5 under scenario A1B projected 91 mm of daily rainfall on 16 December 2019; while the observation was 83 mm;

ECHM5 under scenario A1B projected 486 mm of cumulative rainfall from 1 December 2019 to 17 December 2019; while the observation was 518 mm

(ii) Site 5718033 at Kampung Jeli:

ECHM5 under scenario A1B projected 91 mm of daily rainfall on 16 December 2019; while the observation was 75 mm;

ECHM5 under scenario A2 projected 113 mm of daily rainfall on 17 December 2019; while the observation was 121 mm;

ECHM5 under scenario A2 projected 120 mm of daily rainfall on 18 December 2019; while the observation was 126 mm;

ECHM5 under scenario A1B projected 500 mm of cumulative rainfall from 1 December 2019 to 18 December 2019; while the observation was 521 mm

(iii) Site 5621071 at Batu 13:

ECHM5 under scenario A2 projected 81 mm of daily rainfall on 17 December 2019; while the observation was 94 mm;

ECHM5 under scenario A2 projected 122 mm of daily rainfall on 18 December 2019; while the observation was 117 mm;

ECHM5 under scenario A1B projected 463 mm of cumulative rainfall from 1 December 2019 to 16 December 2019; while the observation was 483 mm

Nevertheless, the MRI gave better cumulative rainfall projections than the ECHM5 at Site 5621071 at Batu 13 under scenario A1B for the periods of 1-17 December 2019 and 1-18 December 2019. Respectively, the MRI projected 540 mm for the 577 mm of observed cumulative rainfall during 1-17 December, and 565 mm for the 694 mm of observed cumulative rainfall during 1-18 December.

Table 4.4a: Projected and observed daily rainfall and the cumulative rainfall for Site 5718005 at Air Bol, Kelantan

Station		Site 5718005 at Air Bol, Kelantan																			
Interval (Unit)		Daily Rainfall (mm)																			
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019
Model Projection	ECHM5_A1B1	2	2	25	11	43	11	10	59	23	18	21	2	15	44	90	**91**	20	14	73	54	4
	ECHM5_A2_1	4	0	7	16	0	0	0	43	51	1	6	10	13	30	20	19	25	7	2	18	229
	ECHM5_A2_3	0	16	2	2	0	0	0	34	42	1	0	0	1	28	489	268	113	120	50	54	78
	MRI_A1B	29	19	47	65	75	47	13	4	39	41	28	59	48	36	13	1	17	19	24	20	14
	Average ALL	9	9	20	23	29	14	6	35	38	15	14	18	19	34	153	95	44	40	37	37	81
Observed		75	124	20	3	0	4	15	3	28	4	8	3	0	2	29	29	**83**	163	186	9	21
		Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_A1B1	4	29	39	82	93	103	162	185	203	224	226	241	285	375	466	**486**	500	573	627	631	
	ECHM5_A2_1	4	11	27	27	27	27	69	120	121	127	137	150	180	199	218	244	250	252	270	500	
	ECHM5_A2_3	16	18	20	20	20	20	54	96	97	97	97	98	126	615	883	996	1116	1166	1221	1299	
	MRI_A1B	48	94	159	233	281	294	298	337	378	406	464	512	548	562	563	580	598	622	641	655	
	Average ALL	18	38	61	90	105	111	146	184	200	213	231	250	285	438	532	576	616	653	690	771	
Observed		80	144	147	147	151	166	169	197	201	209	212	212	214	243	272	355	**518**	704	713	734	

Table 4.4b: Projected and observed daily rainfall and the cumulative rainfall for Site 5718033 at Kampung Jeli, Kelantan

Station		Site 5718033 at Kampung Jeli, Kelantan																			
Interval (Unit)		Daily Rainfall (mm)																			
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019
Model Projection	ECHM5_A1B1	2	2	25	11	43	11	10	59	23	18	21	2	15	44	90	**91**	20	14	73	54	4
	ECHM5_A2_1	4	0	7	16	0	0	0	43	51	1	6	10	13	30	20	19	25	7	2	18	229
	ECHM5_A2_3	0	16	2	2	0	0	0	34	42	1	0	0	1	28	489	268	**113**	**120**	50	54	78
	MRI_A1B	29	19	47	65	75	47	13	4	39	41	28	59	48	36	13	1	17	19	24	20	14
	Average ALL	9	9	20	23	29	14	6	35	38	15	14	18	19	34	153	95	44	40	37	37	81
Observed		75	5	11	1	2	9	5	27	6	11	4	1	1	21	20	**75**	**121**	**126**	11	20	0
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_A1B1		4	29	39	82	93	103	162	185	203	224	226	241	285	375	466	486	**500**	573	627	631
	ECHM5_A2_1		4	11	27	27	27	27	69	120	121	127	137	150	180	199	218	244	250	252	270	500
	ECHM5_A2_3		16	18	20	20	20	20	54	96	97	97	97	98	126	615	883	996	1116	1166	1221	1299
	MRI_A1B		48	94	159	233	281	294	298	337	378	406	464	512	548	562	563	580	598	622	641	655
	Average ALL		18	38	61	90	105	111	146	184	200	213	231	250	285	438	532	576	616	653	690	771
Observed			80	91	92	94	103	108	135	141	152	156	157	158	179	199	274	395	**521**	532	552	552

Table 4.4c: Projected and observed daily rainfall and the cumulative rainfall for Site 5621071 at Batu 13, Kelantan

Station		Site 5621071 at Batu 13, Kelantan																			
Interval (Unit)		Daily Rainfall (mm)																			
Period		1/12/2019	2/12/2019	3/12/2019	4/12/2019	5/12/2019	6/12/2019	7/12/2019	8/12/2019	9/12/2019	10/12/2019	11/12/2019	12/12/2019	13/12/2019	14/12/2019	15/12/2019	16/12/2019	17/12/2019	18/12/2019	19/12/2019	20/12/2019	21/12/2019
Model Projection	ECHM5_A1B1	7	3	23	8	56	20	13	28	40	24	23	2	6	22	58	130	29	16	45	30	13
	ECHM5_A2_1	72	21	22	8	1	1	1	4	68	2	5	12	18	31	17	27	24	55	29	3	202
	ECHM5_A2_3	3	11	9	1	1	2	2	12	54	11	2	1	2	6	287	255	**81**	**122**	103	47	54
	MRI_A1B	25	20	37	38	91	44	17	5	32	36	34	37	44	29	21	12	15	25	26	23	14
	Average ALL	27	14	23	14	37	17	8	12	48	18	16	13	17	22	96	106	37	55	51	26	71
Observed		75	106	14	3	2	3	13	15	51	22	11	2	13	12	65	96	55	**94**	**117**	14	22
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	ECHM5_A1B1		10	33	41	97	117	130	158	197	221	244	247	252	275	333	**463**	492	508	553	582	596
	ECHM5_A2_1		92	114	123	123	124	125	130	197	199	204	217	234	265	282	309	333	388	417	420	622
	ECHM5_A2_3		14	23	25	25	27	29	41	95	106	108	109	111	117	403	658	740	862	965	1012	1066
	MRI_A1B		46	83	121	212	256	274	279	311	348	382	419	463	492	513	525	**540**	**565**	591	614	628
	Average ALL		41	63	77	114	131	139	152	200	219	235	248	265	287	383	489	526	581	631	657	728
Observed			80	120	123	125	128	141	156	207	229	240	242	255	267	332	428	**483**	**577**	**694**	708	730

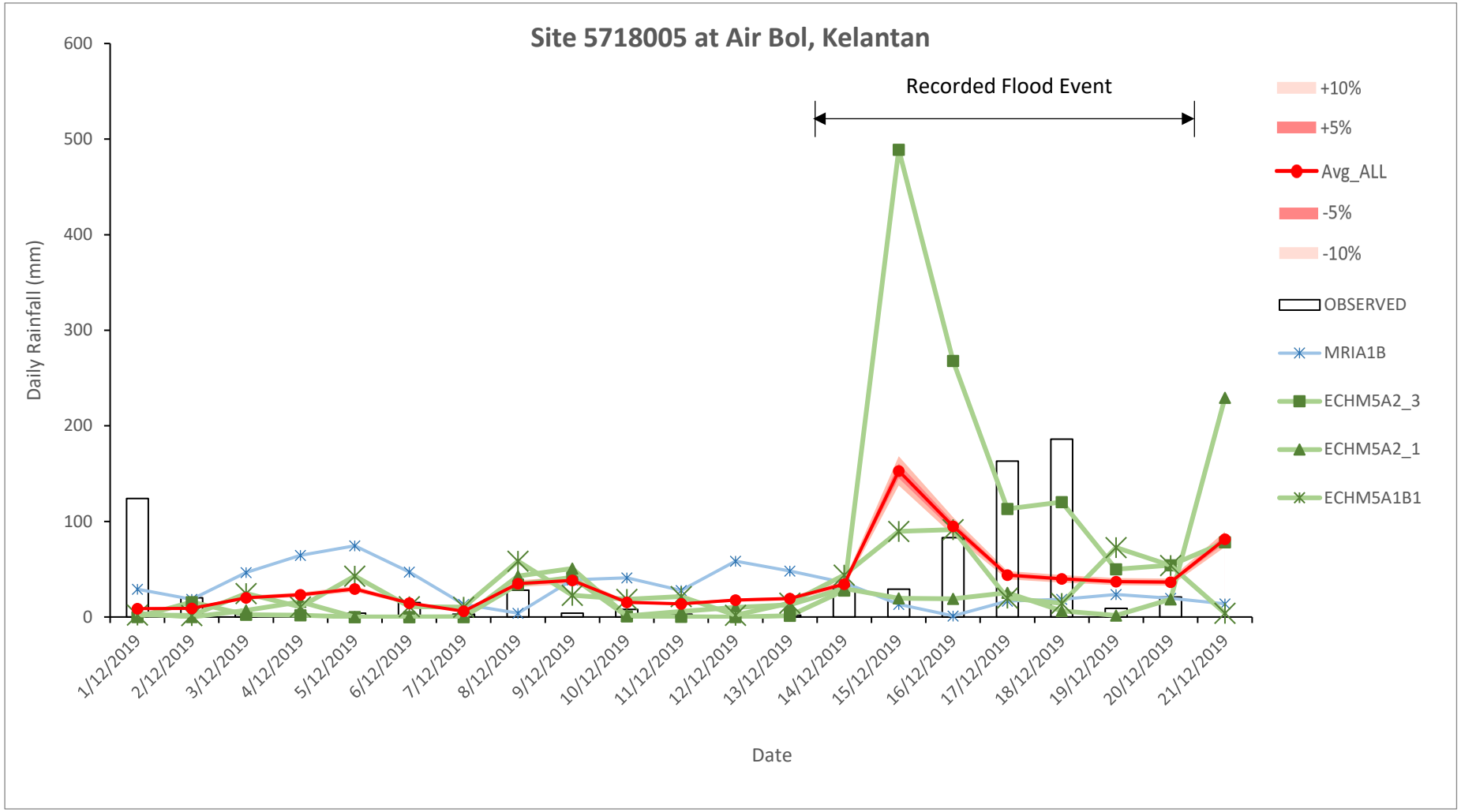


Figure 4.9a: Projected and observed daily rainfall for Site 5718005 at Air Bol, Kelantan

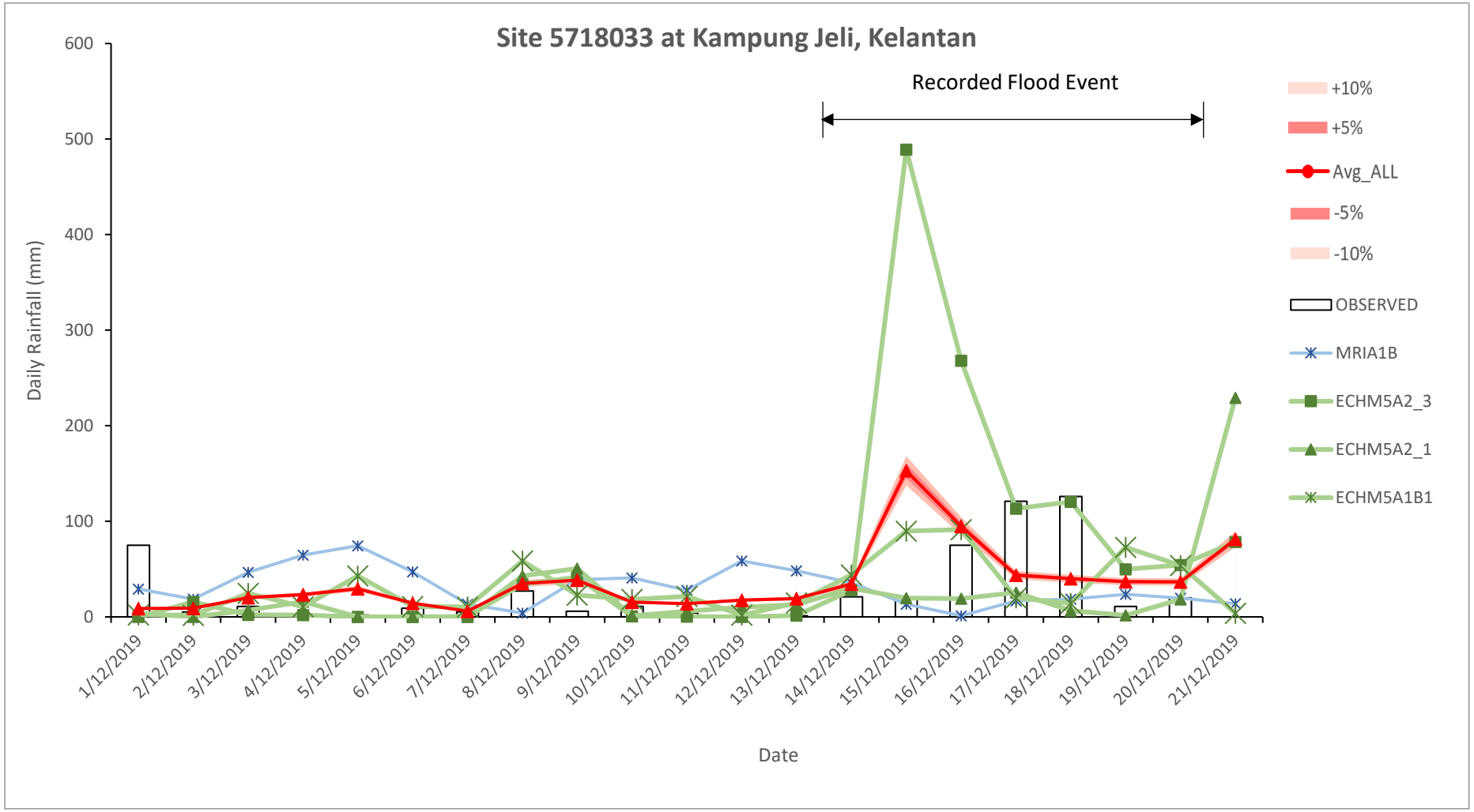


Figure 4.9b: Projected and observed daily rainfall for Site 5718033 at Kampung Jeli, Kelantan

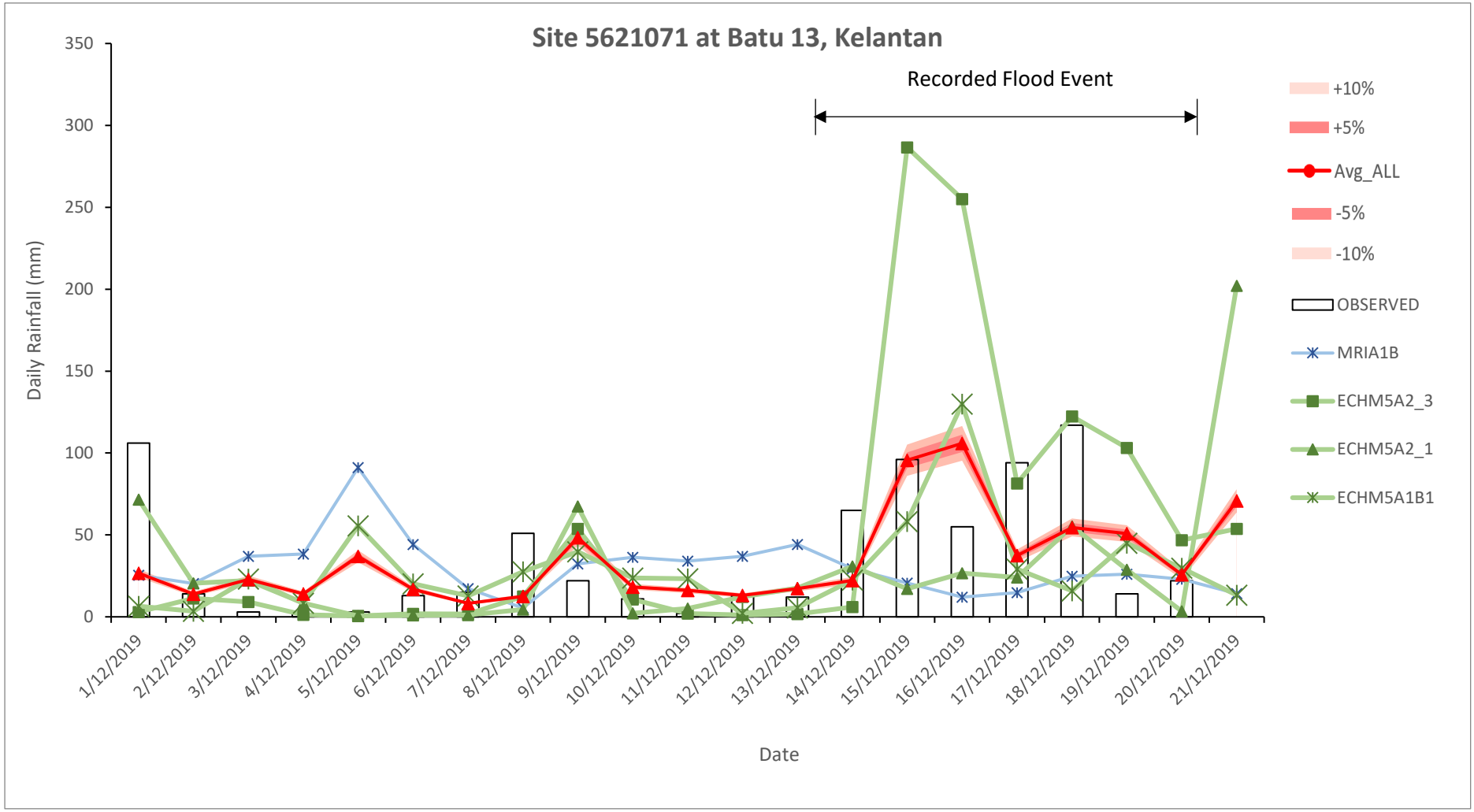


Figure 4.9c: Projected and observed daily rainfall for Site 5621071 at Batu 13, Kelantan

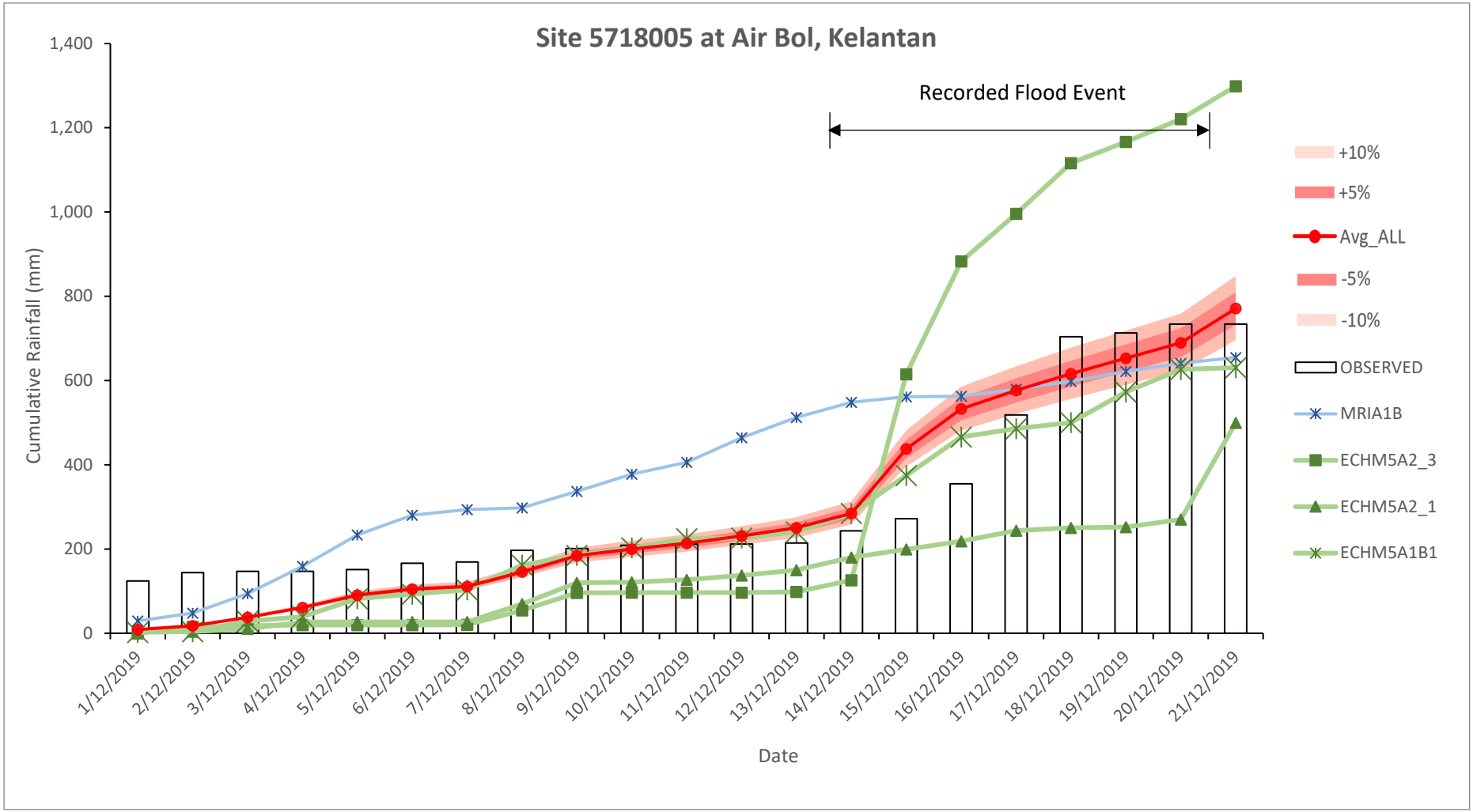


Figure 4.10a: Cumulative rainfall for Site 5718005 at Air Bol, Kelantan

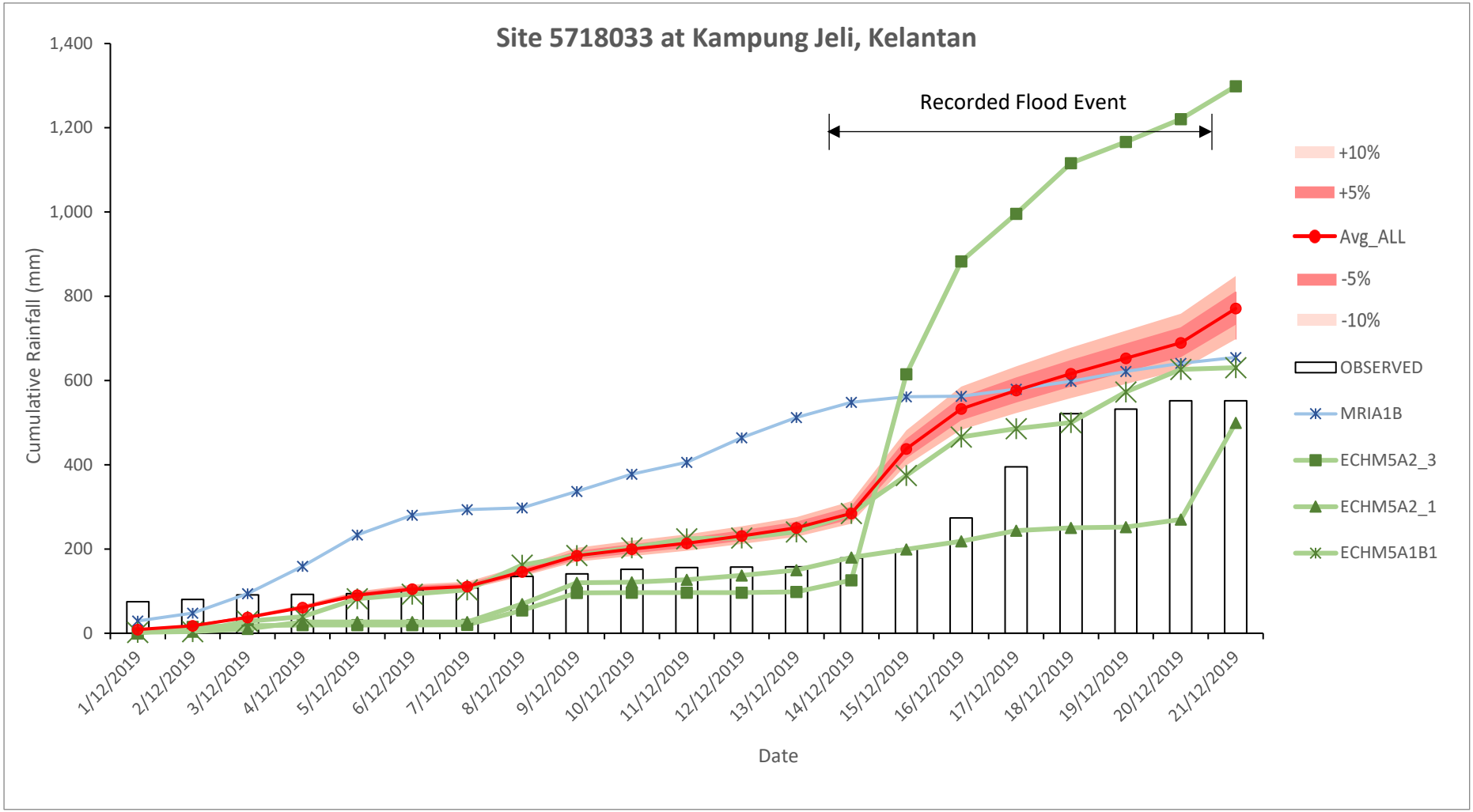


Figure 4.10b: Cumulative rainfall for Site 5718033 at Kampung Jeli, Kelantan

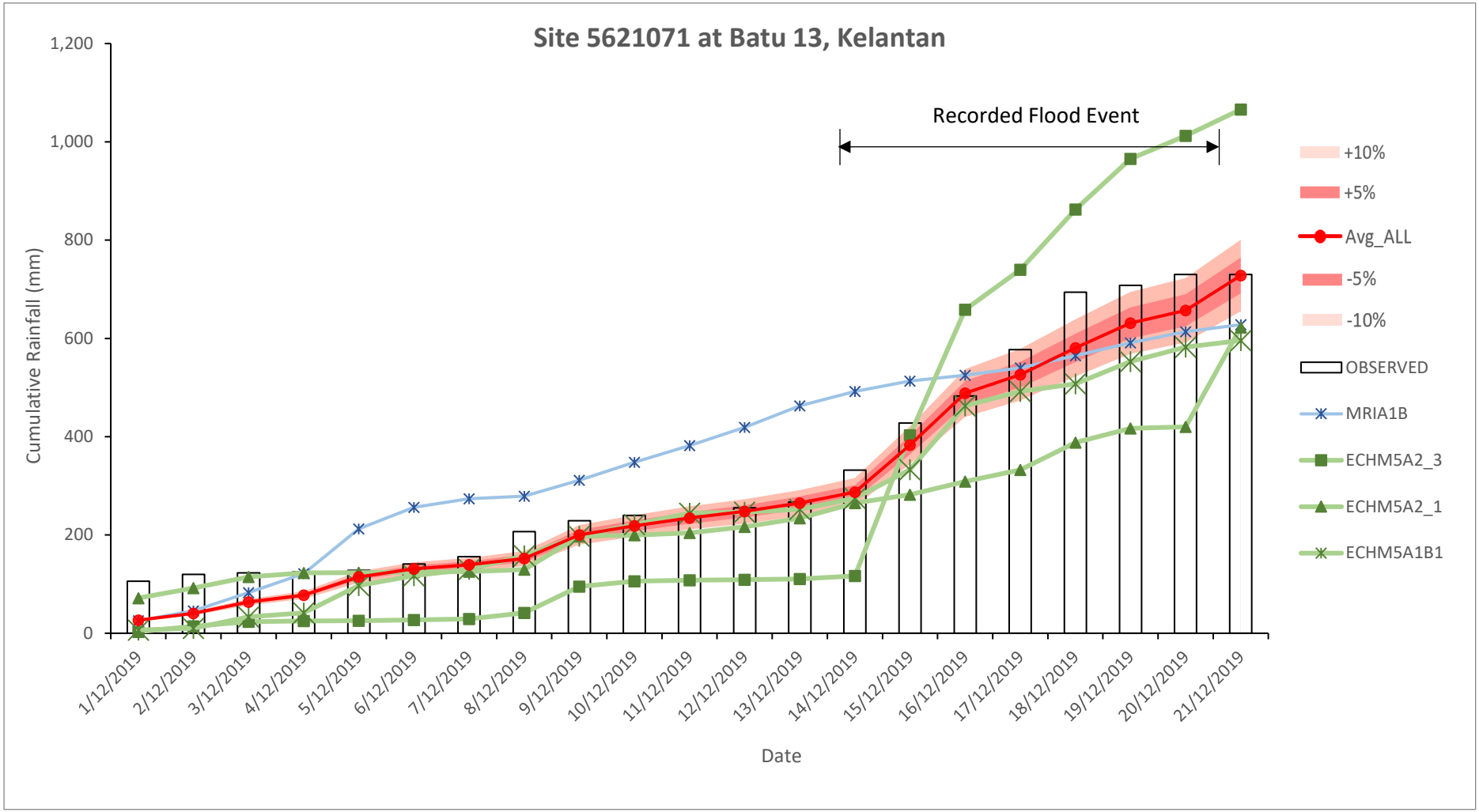


Figure 4.10c: Cumulative rainfall for Site 5621071 at Batu 13, Kelantan

4.3 Dry Spell 2014-2016 in Johor

Starting from 2014, some places in Johor faced reductions in monthly rainfall. This is indicated by the rainfall records at the rainfall stations monitored by DID Malaysia namely; Site 2526001 at Ldg. Sungai Gemas, Site 2033002 at Stn. Telemetri Bandar Kluang, Site 1437116 at Stor JPS Johor Bahru, Site 1829001 at Sek. Men. Munshi Sulaiman, Site 2528002 Stn. Telemetri di Bandar Segamat, Site 2536168 at Empangan Labong_Endau and Site 2527004 at Ldg. Paya Lang_Segamat, as shown in Figure 4.11.

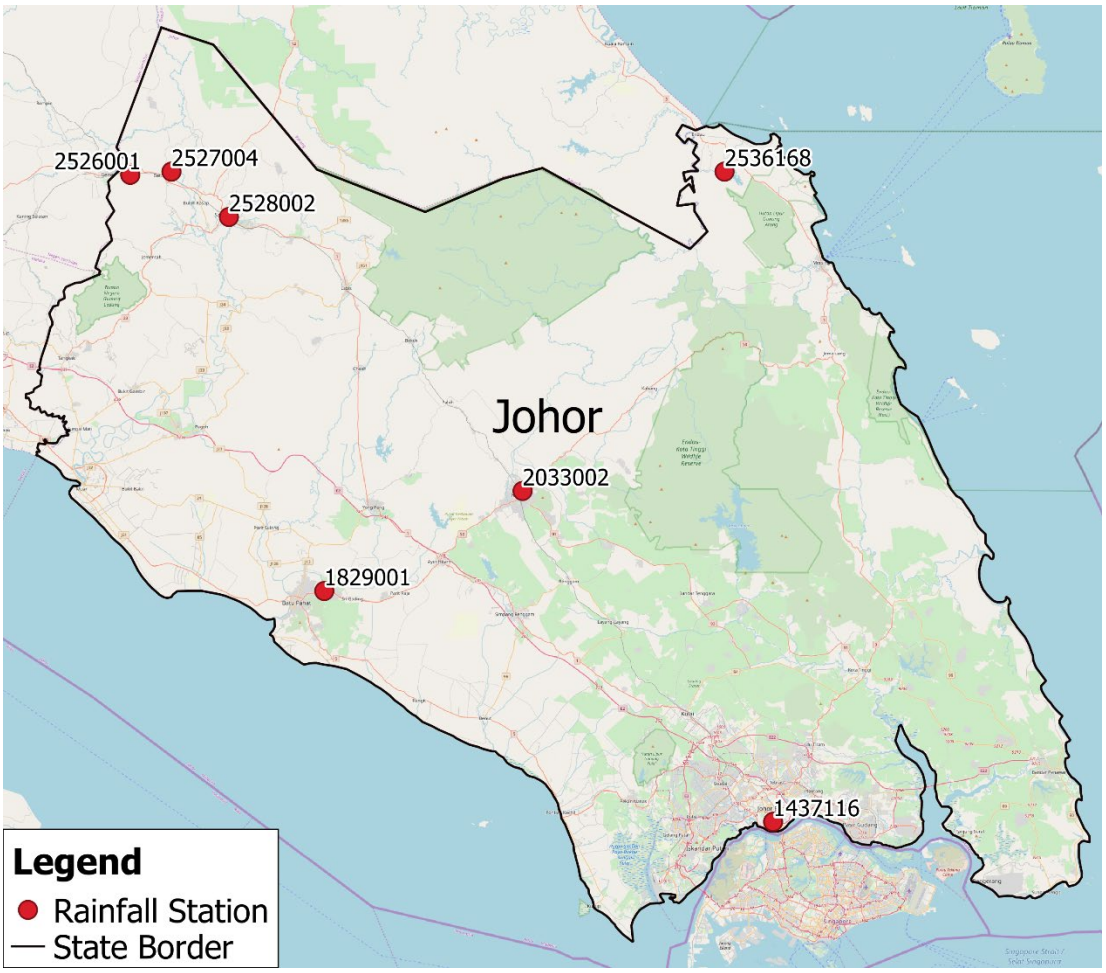


Figure 4.11: Location of study rainfall stations in Johor

The conditions worsen in 2016 when some of the monthly rainfall for these stations showed deficits of more than 35% on comparing with their normal monthly rainfall. These are as shown in Table 4.5. It was reported that the long periods of dry spells in the State had resulted in severe water shortages at several reservoirs. The worst condition was observed in August 2016, where all the stations showed deficits more than 35%. Other severe dry months included January, March, April, June and October. At almost all the stations, long dry periods up to five to six months were observed. The exceptions were at Site 1437116 at Stor JPS at Johor Bahru and at Site 2527004 at Ldg at Paya Lang_Segamat where only two discontinuous dry months had occurred.

Table 4.5: Comparison between the recorded monthly rainfall in 2016 with their normal monthly rainfall

Rainfall Station	Remarks	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
Site 2526001 at Ldg. Sungai Gemas	**Monthly Rainfall (Normal Monthly Rainfall) in mm**	62 (124)	253 (98)	0 (159)	61 (156)	165 (138)	43 (99)	121 (97)	60 (109)	96 (140)	179 (178)	179 (207)
	Difference in mm (%)	-62 (-50.1)	155 (158.7)	-159 (-100)	-95 (-60.8)	27 (19.2)	-56 (-56.4)	24 (24.5)	-49 (-45.2)	-44 (-31.6)	1 (0.6)	-28 (-13.6)
Site 2033002 at Stn. Telemetri Bandar Kluang	**Monthly Rainfall (Normal Monthly Rainfall) in mm**	148 (177)	107 (105)	31 (183)	294 (236)	298 (170)	119 (146)	55 (139)	54 (137)	69 (150)	117.5 (201)	207 (238)
	Difference in mm (%)	-29 (-16.5)	2 (1.6)	-152 (-83.1)	57 (24.3)	128 (75.4)	-27 (-18.7)	-84 (-60.4)	-83 (-60.7)	-81 (-54.1)	-84 (-41.6)	-31 (-13.1)
Site 1437116 at Stor JPS Johor Bahru	**Monthly Rainfall (Normal Monthly Rainfall) in mm**	112 (196)	239 (138)	249 (240)	183 (251)	185 (224)	110 (145)	182 (171)	92 (192)	159 (199)	308 (208)	216 (265)
	Difference in mm (%)	-84 (-43.1)	101 (72.9)	9 (3.5)	-68 (-27.2)	-39 (-17.3)	-35 (-24.2)	11 (6.5)	-100 (-52)	-40 (-20)	100 (48.3)	-49 (-18.6)
Site 1829001 at Sek. Men. Munshi Sulaiman	**Monthly Rainfall (Normal Monthly Rainfall) in mm**	55 (156)	129 (162)	133 (203)	54 (205)	238 (168)	43 (159)	47.5 (177)	104 (170)	181.5 (178)	158.5 (193)	230 (248)
	Difference in mm (%)	-101 (-64.7)	-33 (-20.5)	-70 (-34.6)	-152 (-73.9)	70 (41.6)	-117 (-73.3)	-130 (-73.2)	-66 (-38.8)	3 (1.8)	-35 (-17.9)	-18 (-7.4)
Site 2528002 Stn. Telemetri di Bandar Segamat	**Monthly Rainfall (Normal Monthly Rainfall) in mm**	200 (173)	140 (93)	5 (179)	96 (148)	356 (123)	40 (85)	87 (104)	50 (112)	75.5 (142)	86 (145)	86 (191)
	Difference in mm (%)	27 (15.5)	47 (50.8)	-175 (-97.5)	-53 (-35.5)	233 (190.3)	-45 (-52.7)	-17 (-16.3)	-62 (-55.3)	-67 (-47)	-59 (-40.7)	-105 (-55)
Site 2536168 at Empangan Labong_Endau	**Monthly Rainfall (Normal Monthly Rainfall) in mm**	359 (458)	274 (223)	15 (208)	39 (151)	66 (197)	261 (166)	133 (166)	100.5 (175)	182.5 (191)	140 (248)	300.5 (437)
	Difference in mm (%)	-99 (-21.6)	51 (22.8)	-194 (-93)	-113 (-74.5)	-131 (-66.5)	96 (57.7)	-33 (-20)	-75 (-42.6)	-8 (-4.3)	-108 (-43.4)	-136 (-31.2)
Site 2527004 at Ldg. Paya Lang_Segamat	**Monthly Rainfall (Normal Monthly Rainfall) in mm**	186 (149)	146 (118)	0 (166)	118 (154)	276 (161)	153 (117)	70 (103)	42.5 (110)	213.5 (142)	216.5 (166)	193 (212)
	Difference in mm (%)	36 (24.2)	28 (23.7)	-166 (-100)	-36 (-23.2)	114 (70.7)	36 (30.9)	-33 (-32.2)	-68 (-61.4)	72 (50.5)	50 (30.2)	-19 (-9)

In this study, the projected rainfall based on three different climate models namely the ECHM5, CCSM3 and MRI under three different CO_2 emission scenarios A1B, A2 and B1 for the seven study rainfall stations located in the affected dry spell areas in Johor were compared with the respective corresponding observed rainfall over a 3-month interval, as shown in Tables 4.9a-4.9g and Figures 4.12a-4.12g. In general, the projected rainfall of the three models followed the seasonal trend in each year, wherein lower rainfall was always detected in the middle of the years, while higher rainfall happened at the end of the years. This reflects the natural seasonal monsoonal patterns. It can be observed that for most of the time throughout the three study years, the individual models and the model average showed rainfall either closer to or lower than the observed values at all the stations with the exceptions at Site 2033002 at Stn Telemetri Bandar Kluang and at Linggiu Dam. During the dry spell monitoring practices, the lower projected rainfall is always on the safer side. This is because early warning and preparation can be carried out based on the low rainfall projections.

No significant differences were found amongst the performance of the three models, although the MRI seems likely to have lower projections during the first quadrants of 2014 and 2015 under the scenario B1 for most of the stations, except at Site 2033002 at Stn Telemetri Bandar Kluang and at Linggiu Dam. The performance of the MRI under scenario B1 was also found to be outstanding at:

(a) Site 2526001 at Ldg Sungai Gemas (Table 4.6a & Figure 4.12a):
During the third quadrants in 2014 and 2015; and the second and fourth quadrants in 2016

(b) Site 1437116 at Stor JPS Johor Bahru (Table 4.6c & Figure 4.12c):
During the third quadrant in 2014; the fourth quadrant in 2015; and the first and second quadrants in 2016

(c) Site 1829001 at Sek Men Munshi Sulaiman (Table 4.6d & Figure 4.12d):
During the second, third and fourth quadrants in 2015 and 2016

(d) Site 2536168 at Empangan Labong_Endau (Table 4.6e & Figure 4.12e):
During the second and third quadrants in 2014; the second quadrant in 2015; and the first, second and third quadrants in 2016

(e) Site 2527004 at Ldg Paya Lang_Segamat (Table 4.6f & Figure 4.12f):
During the second quadrant in 2014; the third quadrant in 2015; and the second and third quadrants in 2016

Table 4.6a: Projected and observed 3-month rainfall and the cumulative rainfall at Site 2526001 at Ldg. Sungai Gemas, Johor

Station		Site 2526001 at Ldg. Sungai Gemas, Johor											
Interval (Unit)		3-Month Rainfall (mm)											
Period		Jan 2014 - Mar 2014	Apr 2014 - Jun 2014	Jul 2014 - Sep 2014	Oct 2014 - Dec 2014	Jan 2015 - Mar 2015	Apr 2015 - Jun 2015	Jul 2015 - Sep 2015	Oct 2015 - Dec 2015	Jan 2016 - Mar 2016	Apr 2016 - Jun 2016	Jul 2016 - Sep 2016	Oct 2016 - Dec 2016
Model Projection	Average_ECHM5_A1B	375	424	323	775	477	331	312	571	495	266	425	665
	Average_ECHM5_A2	566	264	250	510	481	341	323	760	332	383	449	429
	Average_ECHM5_B1	549	229	295	489	283	431	359	708	441	224	310	638
	CCSM3_A1B	1,265	213	376	532	643	271	254	618	695	178	467	389
	CCSM3_A2	748	310	762	639	231	142	338	446	99	233	290	648
	CCSM3_B1	630	243	306	644	388	379	379	567	590	316	272	600
	MRI_A1B	389	425	239	460	313	210	280	466	261	327	476	599
	MRI_B1	97	215	357	404	109	282	256	618	701	168	286	564
	Average ALL	577	290	364	557	366	298	312	594	452	262	372	566
OBSERVED		174	437	303	673	114	320	351	388	372	232	240	569
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		799	1,121	1,896	2,373	2,704	3,016	3,587	4,082	4,348	4,773	5,438
	Average_ECHM5_A2		830	1,080	1,590	2,071	2,412	3,016	3,495	3,827	4,210	4,659	5,088
	Average_ECHM5_B1		777	1,073	1,561	1,845	2,275	3,016	3,342	3,783	4,008	4,317	4,955
	CCSM3_A1B		1,478	1,854	2,385	3,028	3,300	3,553	4,171	4,865	5,043	5,510	5,899
	CCSM3_A2		1,058	1,821	2,460	2,691	2,834	3,171	3,618	3,717	3,950	4,240	4,889
	CCSM3_B1		874	1,180	1,823	2,211	2,591	2,970	3,537	4,127	4,442	4,715	5,315
	MRI_A1B		814	1,053	1,513	1,825	2,035	2,315	2,781	3,042	3,369	3,845	4,444
	MRI_B1		312	668	1,073	1,182	1,464	1,719	2,337	3,038	3,206	3,492	4,056
	Average ALL		868	1,231	1,788	2,153	2,452	2,847	3,358	3,810	4,072	4,444	5,010
OBSERVED			611	914	1,587	1,701	2,021	2,372	2,760	3,132	3,364	3,604	4,173

Table 4.6b: Projected and observed 3-month rainfall and the cumulative rainfall at Site 2033002 at Stn Telemetri Bandar Kluang, Johor

Station		Site 2033002 at Stn. Telemetri Bandar Kluang , Johor											
Interval (Unit)		3-Month Rainfall (mm)											
Period		Jan 2014 - Mar 2014	Apr 2014 - Jun 2014	Jul 2014 - Sep 2014	Oct 2014 - Dec 2014	Jan 2015 - Mar 2015	Apr 2015 - Jun 2015	Jul 2015 - Sep 2015	Oct 2015 - Dec 2015	Jan 2016 - Mar 2016	Apr 2016 - Jun 2016	Jul 2016 - Sep 2016	Oct 2016 - Dec 2016
Model Projection	Average_ECHM5_A1B	460	587	456	954	703	591	603	762	592	503	648	769
	Average_ECHM5_A2	589	420	432	757	673	552	504	912	288	537	805	558
	Average_ECHM5_B1	609	444	466	665	417	641	543	802	530	493	481	774
	CCSM3_A1B	1,041	442	541	747	383	290	533	776	803	307	625	503
	CCSM3_A2	571	603	962	932	375	413	479	586	354	545	522	715
	CCSM3_B1	678	238	264	767	640	629	555	831	553	371	395	815
	MRI_A1B	396	569	412	426	354	272	421	693	787	636	774	992
	MRI_B1	616	271	563	628	403	366	647	816	848	348	313	795
	Average ALL	620	447	512	734	493	469	535	772	594	468	570	740
OBSERVED		230	852	507	533	164	312	101	621	373	665	166	377
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		1,048	1,504	2,458	3,161	3,752	4,355	5,116	5,708	6,211	6,859	7,629
	Average_ECHM5_A2		1,009	1,441	2,198	2,870	3,422	4,355	4,838	5,126	5,663	6,468	7,026
	Average_ECHM5_B1		1,052	1,518	2,183	2,600	3,241	4,355	4,586	5,115	5,608	6,089	6,863
	CCSM3_A1B		1,483	2,024	2,771	3,154	3,443	3,976	4,752	5,555	5,862	6,487	6,990
	CCSM3_A2		1,174	2,136	3,067	3,442	3,855	4,334	4,920	5,274	5,819	6,341	7,056
	CCSM3_B1		916	1,180	1,948	2,587	3,216	3,771	4,602	5,155	5,526	5,921	6,736
	MRI_A1B		965	1,378	1,804	2,158	2,430	2,851	3,544	4,330	4,966	5,740	6,732
	MRI_B1		887	1,450	2,077	2,480	2,846	3,492	4,309	5,157	5,505	5,819	6,614
	Average ALL		1,067	1,579	2,313	2,806	3,276	3,936	4,583	5,178	5,645	6,215	6,956
OBSERVED			1,082	1,589	2,122	2,286	2,598	2,699	3,320	3,693	4,358	4,524	4,901

Table 4.6c: Projected and observed 3-month rainfall and the cumulative rainfall at Site 1437116 at Stor JPS Johor Bahru, Johor

Station		Site 1437116 at Stor JPS Johor Bahru, Johor											
Interval (Unit)		3-Month Rainfall (mm)											
Period		Jan 2014 - Mar 2014	Apr 2014 - Jun 2014	Jul 2014 - Sep 2014	Oct 2014 - Dec 2014	Jan 2015 - Mar 2015	Apr 2015 - Jun 2015	Jul 2015 - Sep 2015	Oct 2015 - Dec 2015	Jan 2016 - Mar 2016	Apr 2016 - Jun 2016	Jul 2016 - Sep 2016	Oct 2016 - Dec 2016
Model Projection	Average_ECHM5_A1B	446	531	461	846	668	504	567	593	657	432	605	749
	Average_ECHM5_A2	450	360	396	626	587	430	456	928	344	413	560	588
	Average_ECHM5_B1	480	409	423	602	388	510	401	773	657	442	391	682
	CCSM3_A1B	1,144	333	524	567	407	120	262	729	767	190	360	586
	CCSM3_A2	597	240	953	831	415	376	428	515	119	284	717	742
	CCSM3_B1	487	233	357	618	594	328	640	726	575	151	362	810
	MRI_A1B	532	407	329	478	506	280	482	761	591	249	818	764
	MRI_B1	234	322	556	698	321	300	583	822	665	505	525	854
	Average ALL	546	354	500	658	486	356	477	731	547	333	542	722
OBSERVED		313	717	629	979	316	669	333	786	640	462	363	673
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		978	1,438	2,284	2,952	3,456	4,022	4,615	5,272	5,704	6,309	7,058
	Average_ECHM5_A2		810	1,206	1,832	2,419	2,849	4,022	4,232	4,577	4,990	5,549	6,138
	Average_ECHM5_B1		889	1,312	1,914	2,302	2,812	4,022	3,986	4,643	5,085	5,476	6,158
	CCSM3_A1B		1,477	2,000	2,567	2,974	3,094	3,356	4,085	4,852	5,042	5,402	5,988
	CCSM3_A2		837	1,790	2,622	3,037	3,413	3,840	4,355	4,474	4,758	5,475	6,217
	CCSM3_B1		719	1,076	1,694	2,288	2,616	3,256	3,982	4,557	4,707	5,069	5,879
	MRI_A1B		939	1,268	1,745	2,251	2,531	3,013	3,774	4,365	4,614	5,431	6,195
	MRI_B1		555	1,111	1,809	2,130	2,430	3,013	3,835	4,501	5,006	5,531	6,385
	Average ALL		901	1,400	2,059	2,544	2,900	3,568	4,108	4,655	4,988	5,530	6,252
OBSERVED			1,030	1,659	2,638	2,954	3,623	3,956	4,742	5,382	5,844	6,207	6,880

Table 4.6d: Projected and observed 3-month rainfall and the cumulative rainfall at Site 1829001 at Sek Men Munshi Sulaiman, Johor

Station		Site 1829001 at Sek. Men. Munshi Sulaiman, Johor											
Interval (Unit)		3-Month Rainfall (mm)											
Period		Jan 2014 - Mar 2014	Apr 2014 - Jun 2014	Jul 2014 - Sep 2014	Oct 2014 - Dec 2014	Jan 2015 - Mar 2015	Apr 2015 - Jun 2015	Jul 2015 - Sep 2015	Oct 2015 - Dec 2015	Jan 2016 - Mar 2016	Apr 2016 - Jun 2016	Jul 2016 - Sep 2016	Oct 2016 - Dec 2016
Model Projection	Average_ECHM5_A1B	414	480	425	734	624	417	493	547	530	386	590	665
	Average_ECHM5_A2	473	339	355	553	539	340	441	720	276	396	487	533
	Average_ECHM5_B1	446	348	371	509	423	466	463	658	581	410	433	637
	CCSM3_A1B	1,001	164	613	626	337	121	244	575	738	207	253	417
	CCSM3_A2	551	156	981	753	366	267	304	368	107	177	706	860
	CCSM3_B1	440	328	365	617	524	409	278	750	397	157	179	713
	MRI_A1B	372	472	449	597	442	389	347	679	693	275	656	429
	MRI_B1	163	403	576	590	218	362	488	755	734	377	383	547
	Average ALL	482	336	517	622	434	346	382	631	507	298	461	600
OBSERVED		399	761	808	942	348	438	347	586	623	312	319	550
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		895	1,320	2,054	2,678	3,095	3,588	4,135	4,665	5,051	5,641	6,307
	Average_ECHM5_A2		812	1,167	1,720	2,259	2,599	3,588	3,760	4,037	4,432	4,919	5,452
	Average_ECHM5_B1		794	1,166	1,675	2,098	2,564	3,588	3,685	4,266	4,676	5,109	5,746
	CCSM3_A1B		1,165	1,778	2,404	2,740	2,861	3,105	3,680	4,419	4,625	4,878	5,295
	CCSM3_A2		706	1,687	2,440	2,806	3,073	3,376	3,744	3,851	4,028	4,735	5,595
	CCSM3_B1		768	1,133	1,751	2,275	2,683	2,962	3,712	4,109	4,266	4,445	5,158
	MRI_A1B		844	1,293	1,890	2,332	2,721	3,067	3,746	4,440	4,715	5,371	5,800
	MRI_B1		566	1,142	1,732	1,949	2,311	2,799	3,554	4,288	4,666	5,048	5,596
	Average ALL		819	1,336	1,958	2,392	2,738	3,259	3,752	4,259	4,557	5,018	5,618
OBSERVED			1,160	1,968	2,910	3,258	3,696	4,043	4,629	5,252	5,564	5,883	6,433

Table 4.6e: Projected and observed 3-month rainfall and the cumulative rainfall at Site 2536168 at Empangan Labong_Endau, Johor

Station		Site 2536168 at Empangan Labong_Endau, Johor											
Interval (Unit)		3-Month Rainfall (mm)											
Period		Jan 2014 - Mar 2014	Apr 2014 - Jun 2014	Jul 2014 - Sep 2014	Oct 2014 - Dec 2014	Jan 2015 - Mar 2015	Apr 2015 - Jun 2015	Jul 2015 - Sep 2015	Oct 2015 - Dec 2015	Jan 2016 - Mar 2016	Apr 2016 - Jun 2016	Jul 2016 - Sep 2016	Oct 2016 - Dec 2016
Model Projection	Average_ECHM5_A1B	775	524	662	1,599	1,064	560	456	1,241	1,219	363	531	1,371
	Average_ECHM5_A2	946	396	428	1,326	931	386	570	2,107	513	469	731	1,610
	Average_ECHM5_B1	844	331	427	1,438	565	621	437	1,415	808	343	460	1,347
	CCSM3_A1B	2,144	135	379	1,200	940	36	711	1,331	1,018	19	286	1,690
	CCSM3_A2	720	119	642	1,353	908	132	391	1,002	258	95	556	1,638
	CCSM3_B1	734	157	309	1,307	1,253	59	430	2,076	1,235	5	264	1,438
	MRI_A1B	668	529	352	1,277	416	459	563	1,110	680	356	567	2,438
	MRI_B1	354	634	587	1,073	206	413	773	1,235	677	625	686	2,001
	Average ALL	898	353	473	1,321	785	333	541	1,440	801	284	510	1,692
OBSERVED		527	469	525	1,526	556	357	429	837	542	365	433	847
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		1,298	1,960	3,559	4,623	5,183	5,639	6,880	8,100	8,463	8,994	10,365
	Average_ECHM5_A2		1,342	1,770	3,096	4,027	4,414	5,639	7,091	7,604	8,073	8,804	10,414
	Average_ECHM5_B1		1,176	1,603	3,041	3,606	4,227	5,639	6,079	6,887	7,229	7,689	9,036
	CCSM3_A1B		2,279	2,658	3,858	4,797	4,833	5,544	6,875	7,893	7,912	8,199	9,889
	CCSM3_A2		839	1,481	2,834	3,742	3,874	4,265	5,268	5,525	5,621	6,177	7,814
	CCSM3_B1		891	1,199	2,506	3,759	3,818	4,248	6,324	7,559	7,564	7,828	9,266
	MRI_A1B		1,197	1,549	2,827	3,242	3,702	4,264	5,374	6,054	6,410	6,977	9,414
	MRI_B1		987	1,574	2,647	2,853	3,266	4,040	5,275	5,951	6,576	7,263	9,264
	Average ALL		1,251	1,724	3,046	3,831	4,165	4,910	6,146	6,947	7,231	7,741	9,433
OBSERVED			997	1,522	3,048	3,604	3,961	4,390	5,227	5,769	6,134	6,566	7,413

Table 4.6f: Projected and observed 3-month rainfall and the cumulative rainfall at Site 2527004 at Ldg Paya Lang_Segamat, Johor

Station		Site 2527004 at Ldg. Paya Lang_Segamat , Johor											
Interval (Unit)		3-Month Rainfall (mm)											
Period		Jan 2014 - Mar 2014	Apr 2014 - Jun 2014	Jul 2014 - Sep 2014	Oct 2014 - Dec 2014	Jan 2015 - Mar 2015	Apr 2015 - Jun 2015	Jul 2015 - Sep 2015	Oct 2015 - Dec 2015	Jan 2016 - Mar 2016	Apr 2016 - Jun 2016	Jul 2016 - Sep 2016	Oct 2016 - Dec 2016
Model Projection	Average_ECHM5_A1B	393	416	326	694	524	351	346	523	501	267	467	588
	Average_ECHM5_A2	533	258	293	524	480	343	337	714	401	368	499	428
	Average_ECHM5_B1	532	233	308	470	317	458	346	654	398	241	348	598
	CCSM3_A1B	978	198	347	538	493	277	293	574	947	236	505	379
	CCSM3_A2	483	390	615	634	257	304	338	431	125	274	294	572
	CCSM3_B1	507	259	179	564	441	381	415	594	551	219	258	509
	MRI_A1B	345	363	231	471	331	240	292	455	301	310	449	593
	MRI_B1	117	274	329	417	95	293	260	626	676	209	278	536
	Average ALL	486	299	328	539	367	331	328	571	488	265	387	525
OBSERVED		157	305	224	644	113	254	275	338	257	229	311	393
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		809	1,135	1,829	2,353	2,704	3,050	3,573	4,075	4,341	4,808	5,395
	Average_ECHM5_A2		791	1,084	1,608	2,088	2,431	3,050	3,482	3,883	4,251	4,750	5,178
	Average_ECHM5_B1		766	1,073	1,543	1,860	2,319	3,050	3,318	3,716	3,956	4,304	4,903
	CCSM3_A1B		1,176	1,523	2,062	2,554	2,831	3,124	3,698	4,645	4,881	5,387	5,766
	CCSM3_A2		873	1,488	2,122	2,379	2,684	3,021	3,452	3,577	3,851	4,145	4,717
	CCSM3_B1		766	945	1,509	1,950	2,331	2,746	3,340	3,891	4,110	4,368	4,877
	MRI_A1B		709	939	1,410	1,741	1,982	2,273	2,729	3,030	3,340	3,789	4,382
	MRI_B1		391	721	1,138	1,233	1,527	1,786	2,412	3,088	3,297	3,576	4,112
	Average ALL		785	1,114	1,653	2,020	2,351	2,763	3,251	3,738	4,003	4,391	4,916
OBSERVED			463	686	1,330	1,444	1,698	1,973	2,310	2,567	2,795	3,106	3,499

Table 4.6g: Projected and observed 3-month rainfall and the cumulative rainfall at Linggiu Dam, Johor

Station		Linggiu Dam, Johor											
Interval (Unit)		3-Month Rainfall (mm)											
Period		Jan 2014 - Mar 2014	Apr 2014 - Jun 2014	Jul 2014 - Sep 2014	Oct 2014 - Dec 2014	Jan 2015 - Mar 2015	Apr 2015 - Jun 2015	Jul 2015 - Sep 2015	Oct 2015 - Dec 2015	Jan 2016 - Mar 2016	Apr 2016 - Jun 2016	Jul 2016 - Sep 2016	Oct 2016 - Dec 2016
Model Projection	Average_ECHM5_A1B	482	572	618	1,029	754	570	600	738	731	431	648	834
	Average_ECHM5_A2	702	437	455	750	634	495	533	1,226	388	485	774	677
	Average_ECHM5_B1	675	457	466	777	451	563	513	857	562	455	482	731
	CCSM3_A1B	1,273	434	534	857	506	135	547	909	547	128	523	639
	CCSM3_A2	527	644	732	920	492	420	429	656	288	538	496	914
	CCSM3_B1	608	161	321	996	722	365	534	980	543	393	359	908
	MRI_A1B	742	479	440	660	433	321	552	937	839	324	754	1,101
	MRI_B1	443	466	688	939	376	377	694	1,056	903	630	649	927
	Average ALL	682	456	532	866	546	406	550	920	600	423	586	841
OBSERVED		283	731	512	675	186	569	314	676	358	455	465	619
			Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall	Cumulative Rainfall
Model Projection	Average_ECHM5_A1B		1,054	1,673	2,701	3,456	4,026	4,626	5,365	6,096	6,527	7,175	8,010
	Average_ECHM5_A2		1,139	1,594	2,344	2,979	3,474	4,626	5,233	5,622	6,106	6,880	7,557
	Average_ECHM5_B1		1,132	1,598	2,375	2,826	3,390	4,626	4,760	5,322	5,776	6,258	6,989
	CCSM3_A1B		1,707	2,241	3,098	3,604	3,739	4,287	5,196	5,743	5,871	6,394	7,033
	CCSM3_A2		1,171	1,903	2,822	3,315	3,735	4,163	4,819	5,107	5,645	6,141	7,055
	CCSM3_B1		768	1,089	2,085	2,807	3,172	3,706	4,685	5,229	5,622	5,981	6,889
	MRI_A1B		1,221	1,661	2,321	2,754	3,075	3,627	4,564	5,403	5,727	6,481	7,581
	MRI_B1		909	1,597	2,536	2,913	3,290	3,983	5,040	5,943	6,573	7,222	8,149
	Average ALL		1,138	1,670	2,536	3,082	3,487	4,206	4,958	5,558	5,981	6,566	7,408
OBSERVED			1,014	1,526	2,201	2,387	2,956	3,270	3,947	4,304	4,759	5,224	5,843

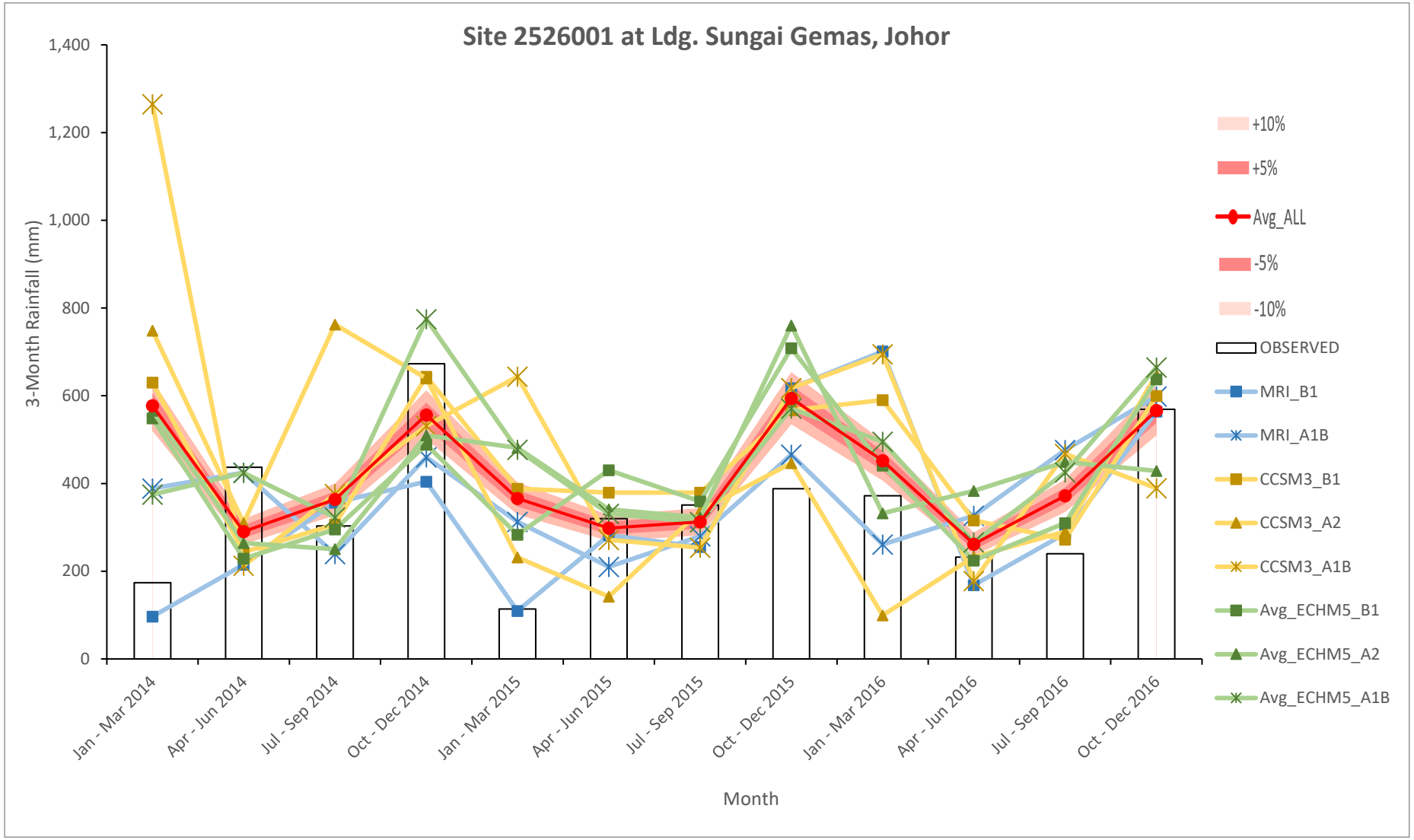


Figure 4.12a: Projected and observed 3-month rainfall at Site 2526001 at Ldg Sungai Gemas, Johor

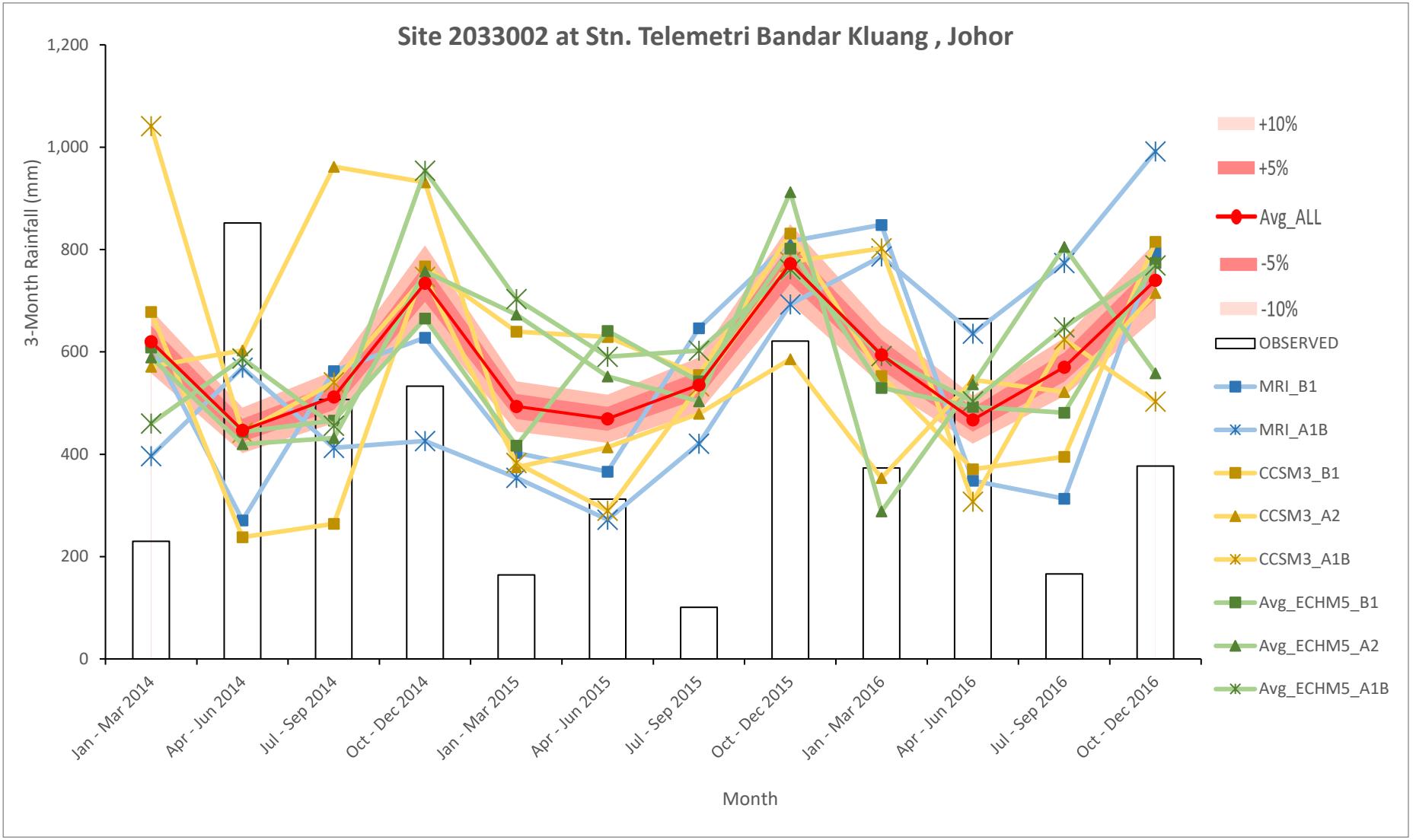


Figure 4.12b: Projected and observed 3-month rainfall at Site 2033002 at Stn Telemetri Bandar Kluang, Johor

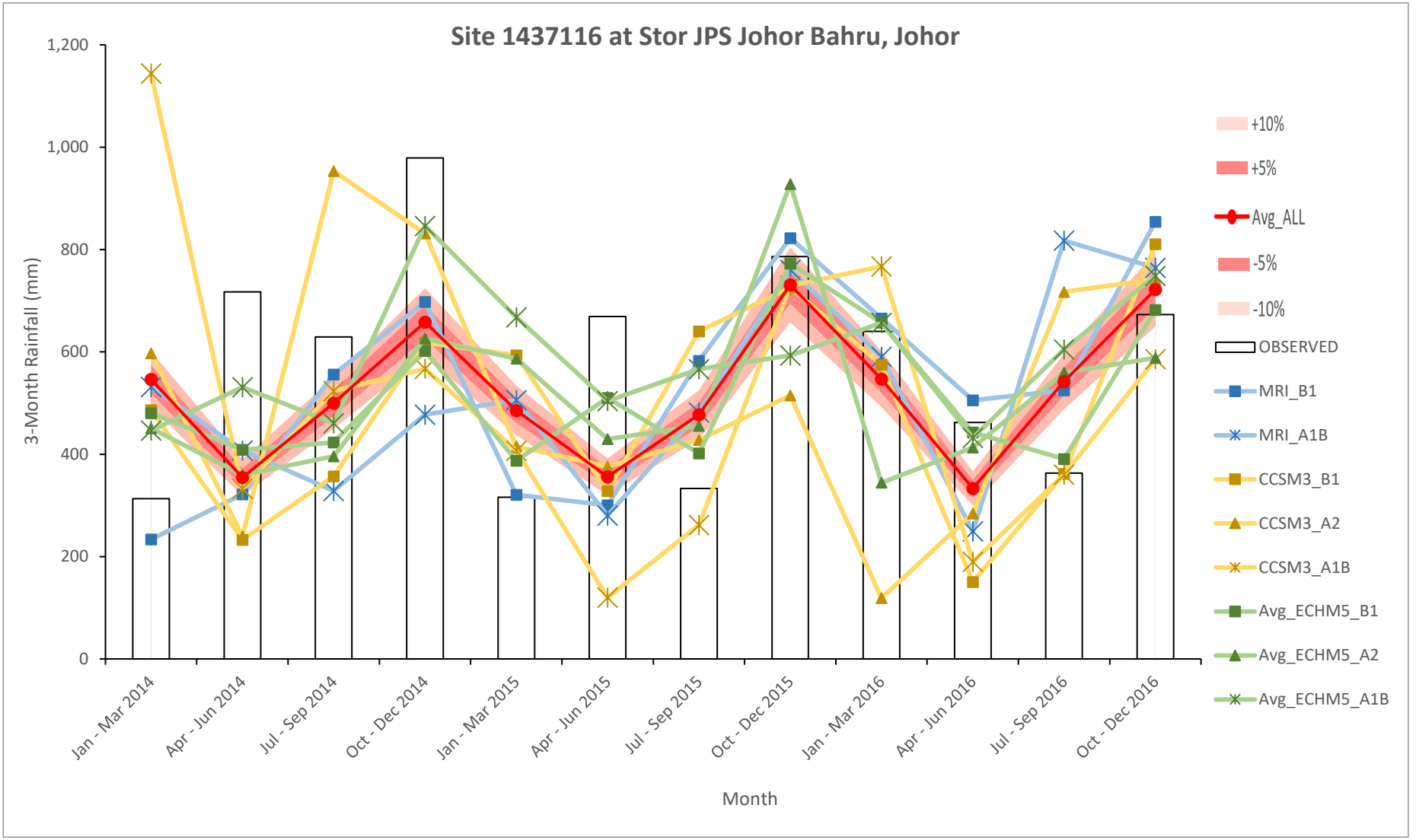


Figure 4.12c: Projected and observed 3-month rainfall at Site 1437116 at Stor JPS Johor Bahru, Johor

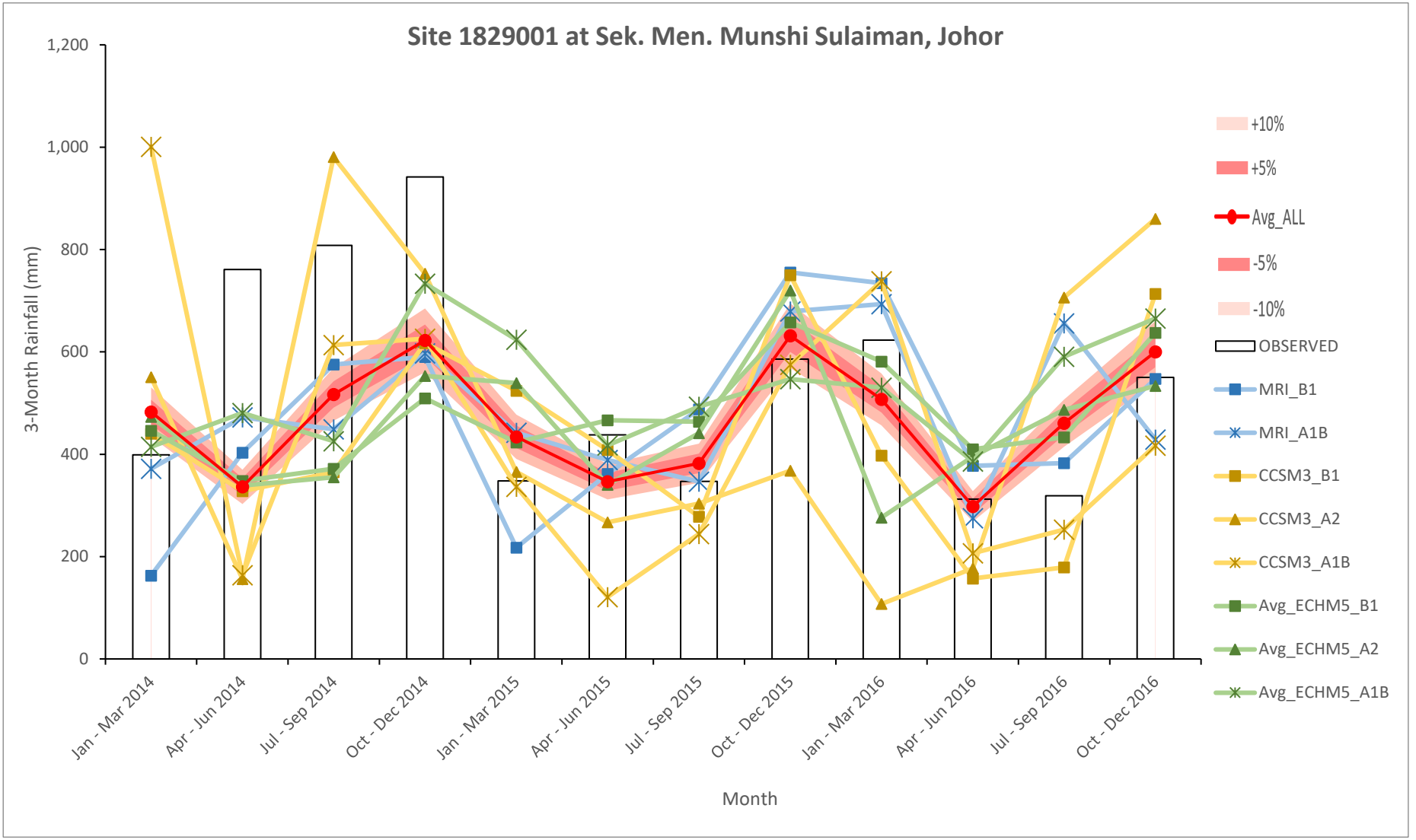


Figure 4.12d: Projected and observed 3-month rainfall at Site 1829001 at Sek Men Munshi Sulaiman, Johor

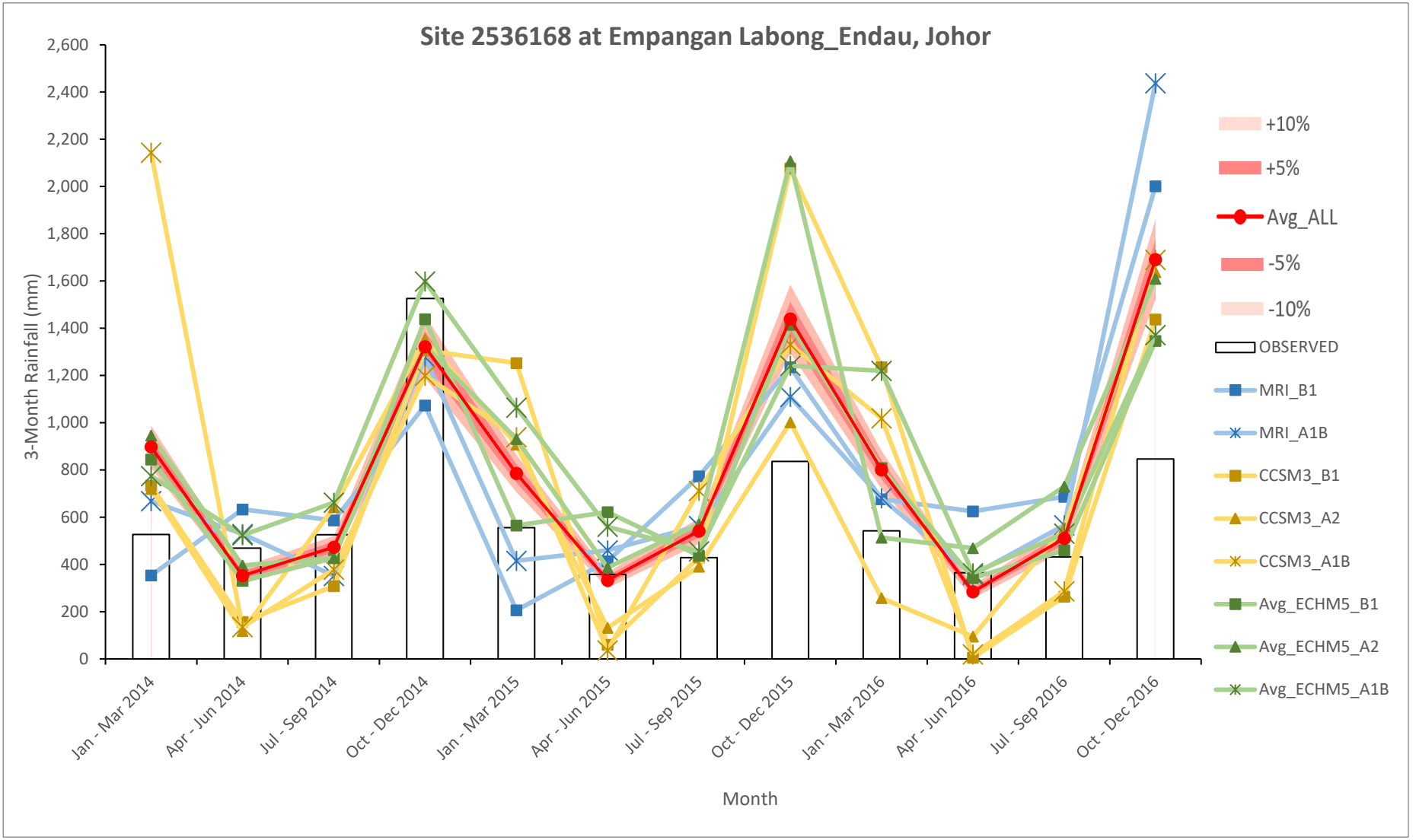


Figure 4.12e: Projected and observed 3-month rainfall at Site 2536168 at Empangan Labong_Endau, Johor

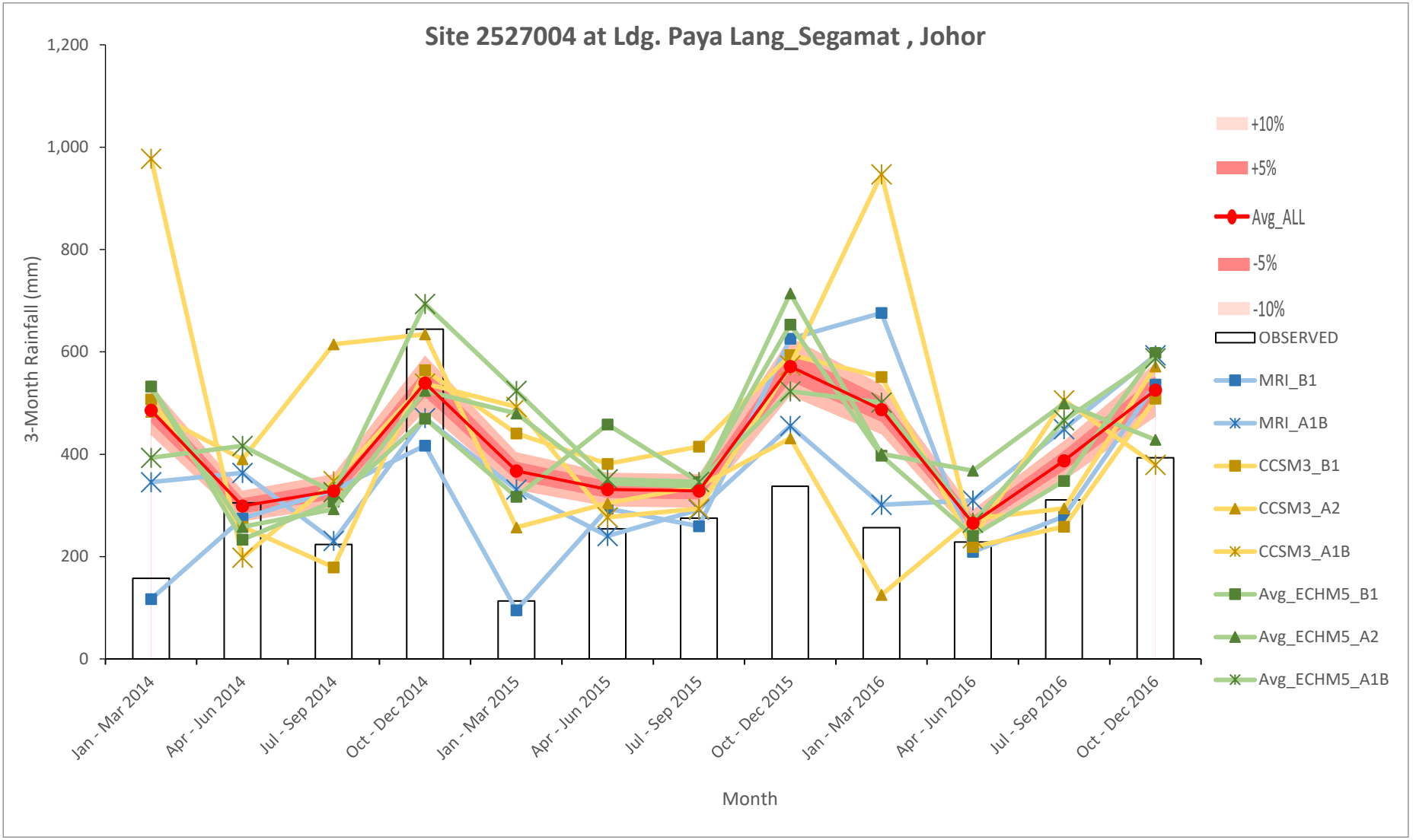


Figure 4.12f: Projected and observed 3-month rainfall at Site 2527004 at Ldg Paya Lang_Segamat, Johor

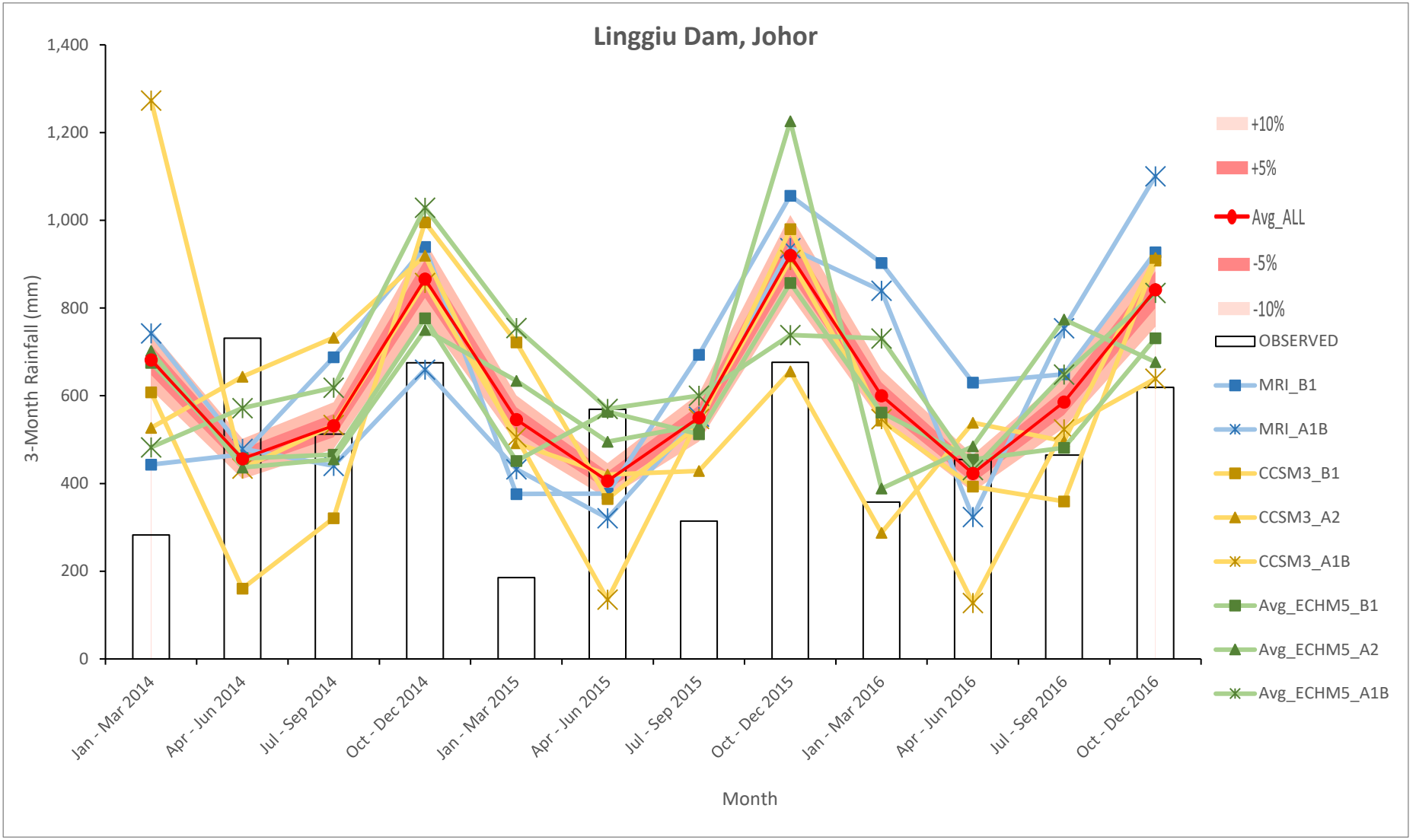


Figure 4.12g: Projected and observed 3-month rainfall at Linggiu Dam, Johor

The cumulative rainfalls over a 3-month period are presented in Tables 4.9a-4.9g and illustrated through Figures 4.13a-4.13g. Among the models, the MRI under scenario B1 was found to be able to project similar or lower cumulative rainfall compared to the observed cumulative rainfall at all the stations throughout the three years. It is noted that a lower projected cumulative rainfall is always advantageously on the safer side for dry spell monitoring and mitigation works. However, the exceptions are at Site 2033002 at Stn Telemetri Bandar Kluang (Table 4.6b & Figure 4.13b); Site 2527004 at Ldg Paya Lang_Segamat (Table 4.6f & Figure 4.13f), where higher cumulative rainfall was projected in 2016; and at Linggiu Dam (Table 4.6g & Figure 4.13g).

On the other hand, throughout the three years, the ECHM5 and CCSM3 models have also shown higher accuracy at Site 1437116 at Stor JPS Johor Bahru (Table 4.6c & Figure 4.13c) and at Site 1829001 at Sek Men Munshi Sulaiman (Table 4.6d & Figure 4.13d). It was also noticed that the model projections under scenario A1B were always higher than those under scenario B1, with scenario A2 being the moderate in between.

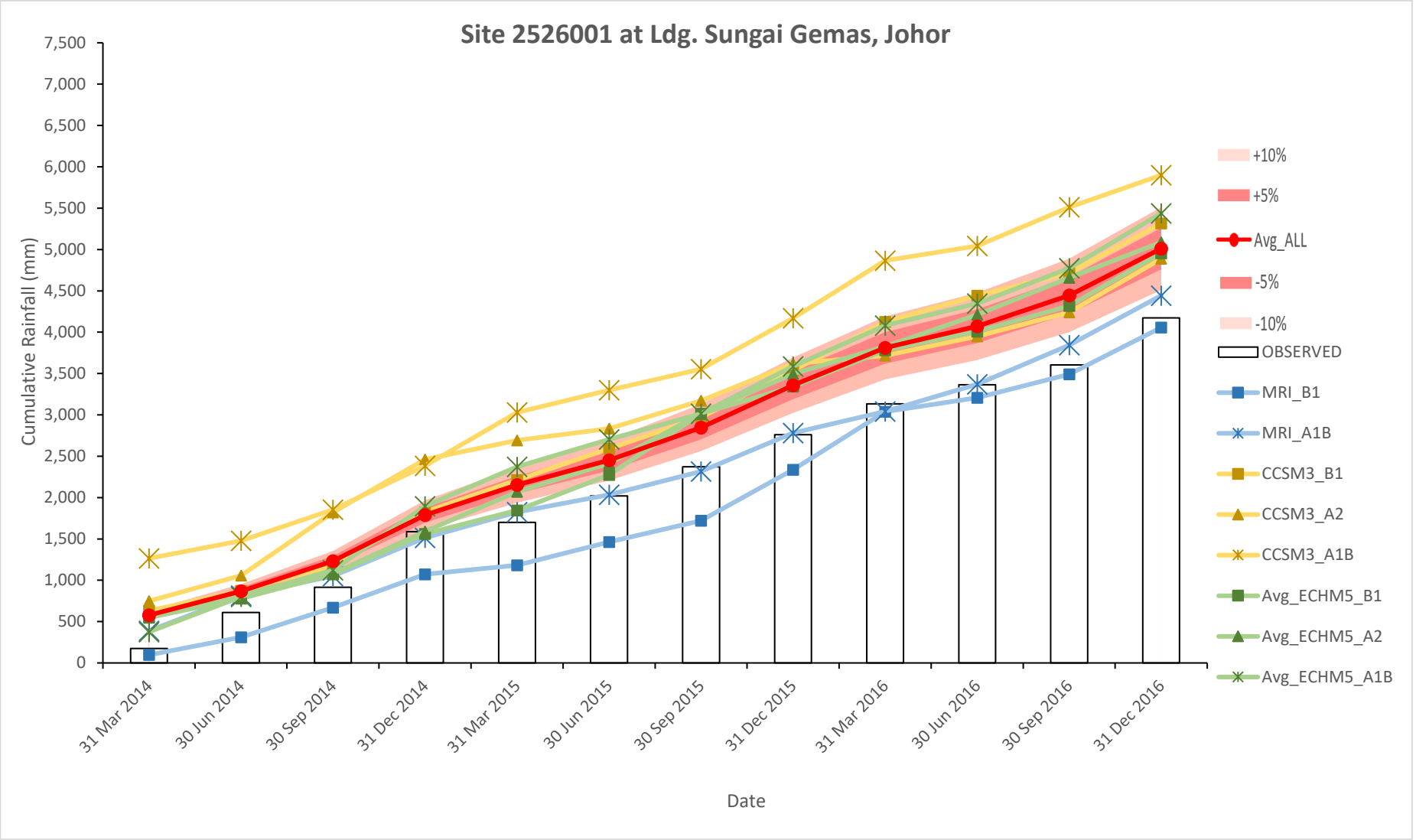


Figure 4.13a: Cumulative rainfall at Site 2526001 at Ldg Sungai Gemas, Johor

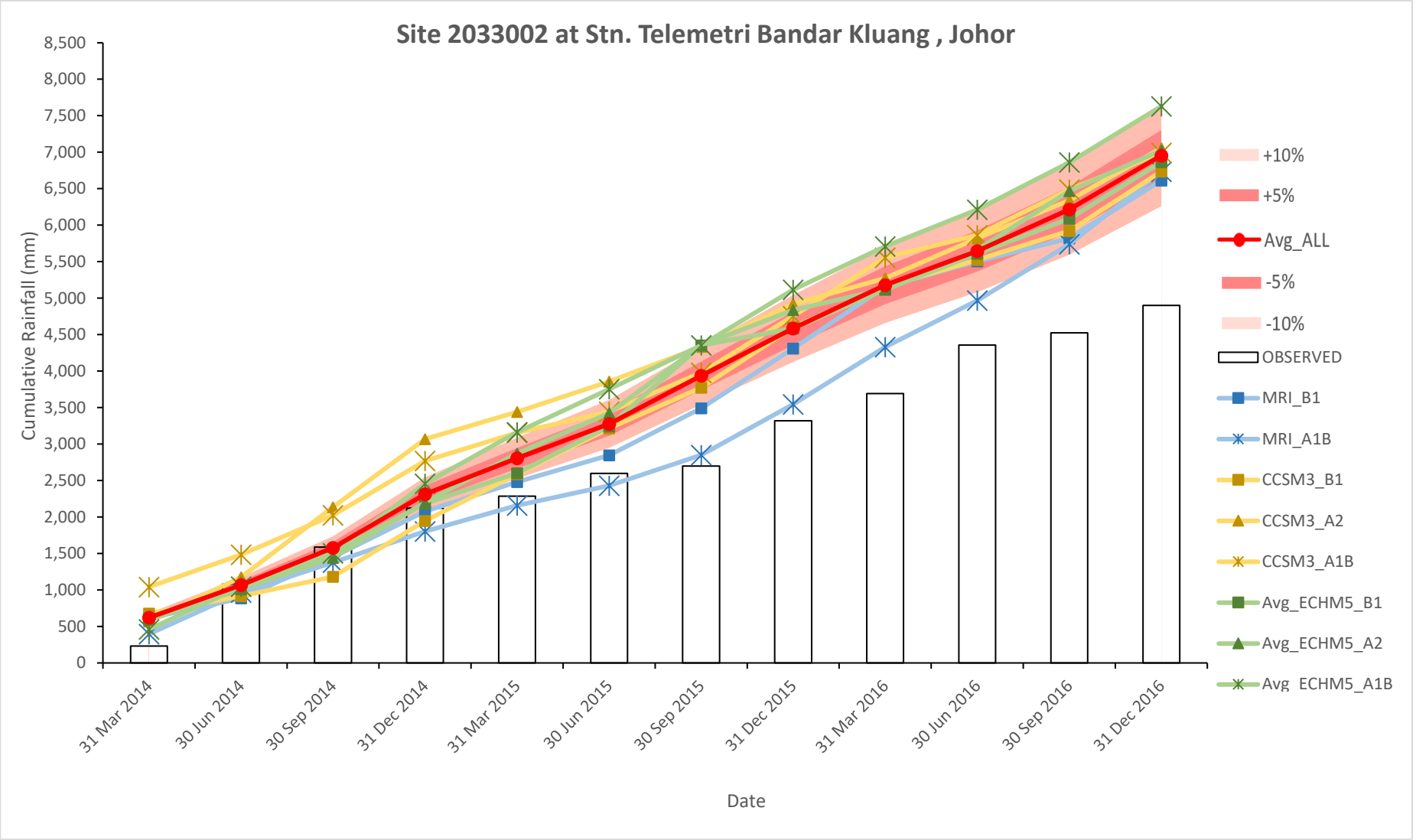


Figure 4.13b: Cumulative rainfall at Site 2033002 at Stn Telemetri Bandar Kluang , Johor

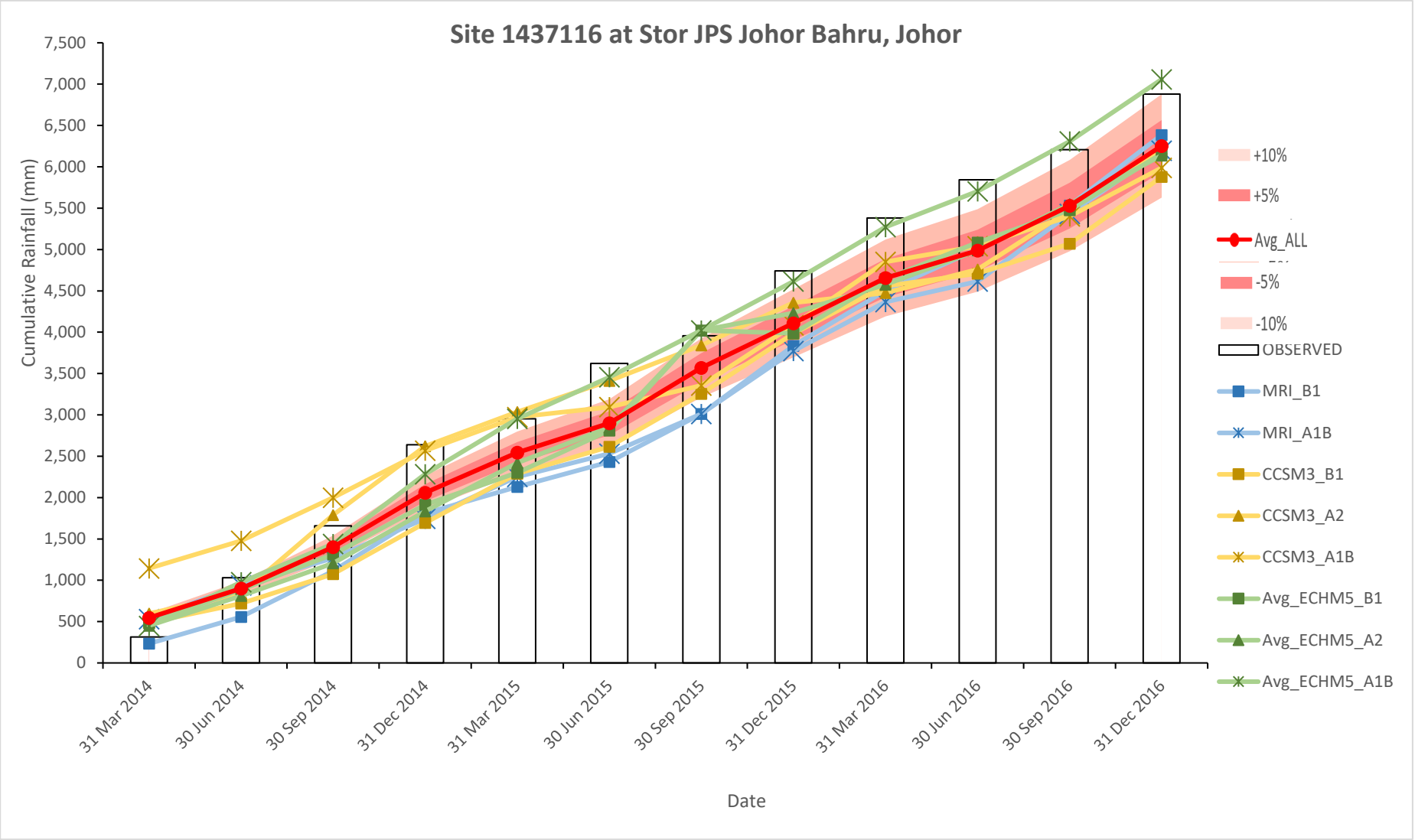


Figure 4.13c: Cumulative rainfall at Site 1437116 at Stor JPS Johor Bahru, Johor

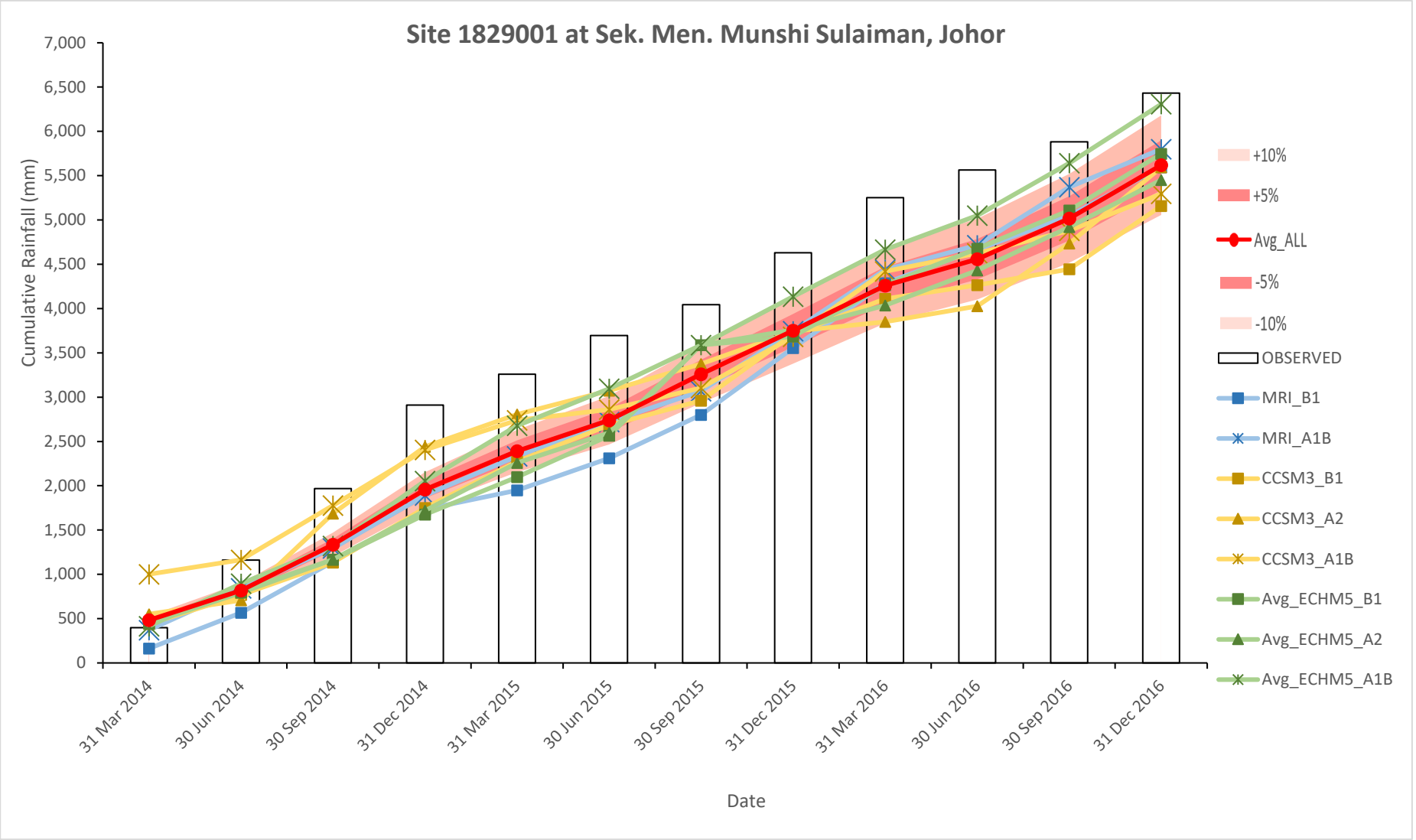


Figure 4.13d: Cumulative rainfall at Site 1829001 at Sek Men Munshi Sulaiman, Johor

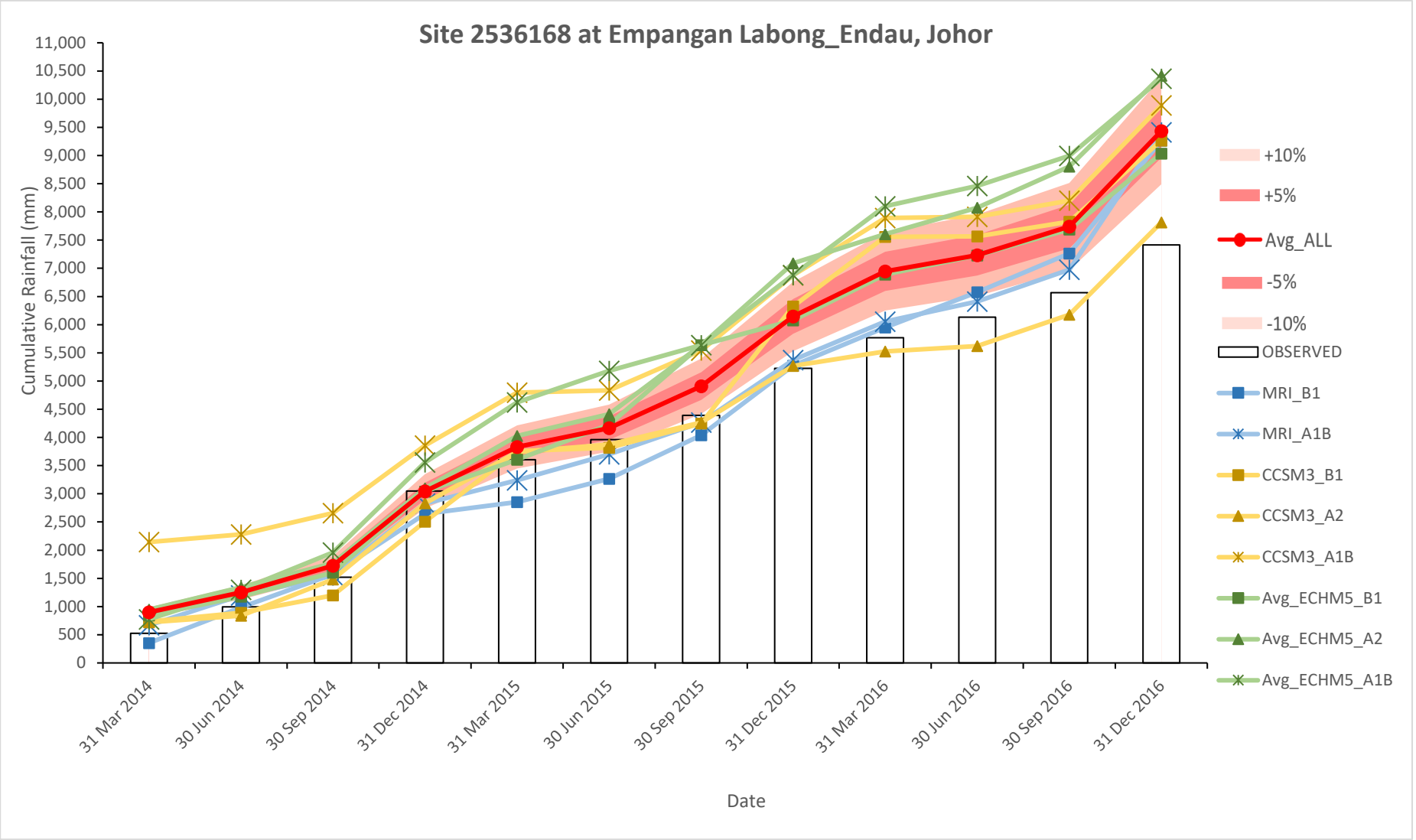


Figure 4.13e: Cumulative rainfall at Site 2536168 at Empangan Labong_Endau, Johor

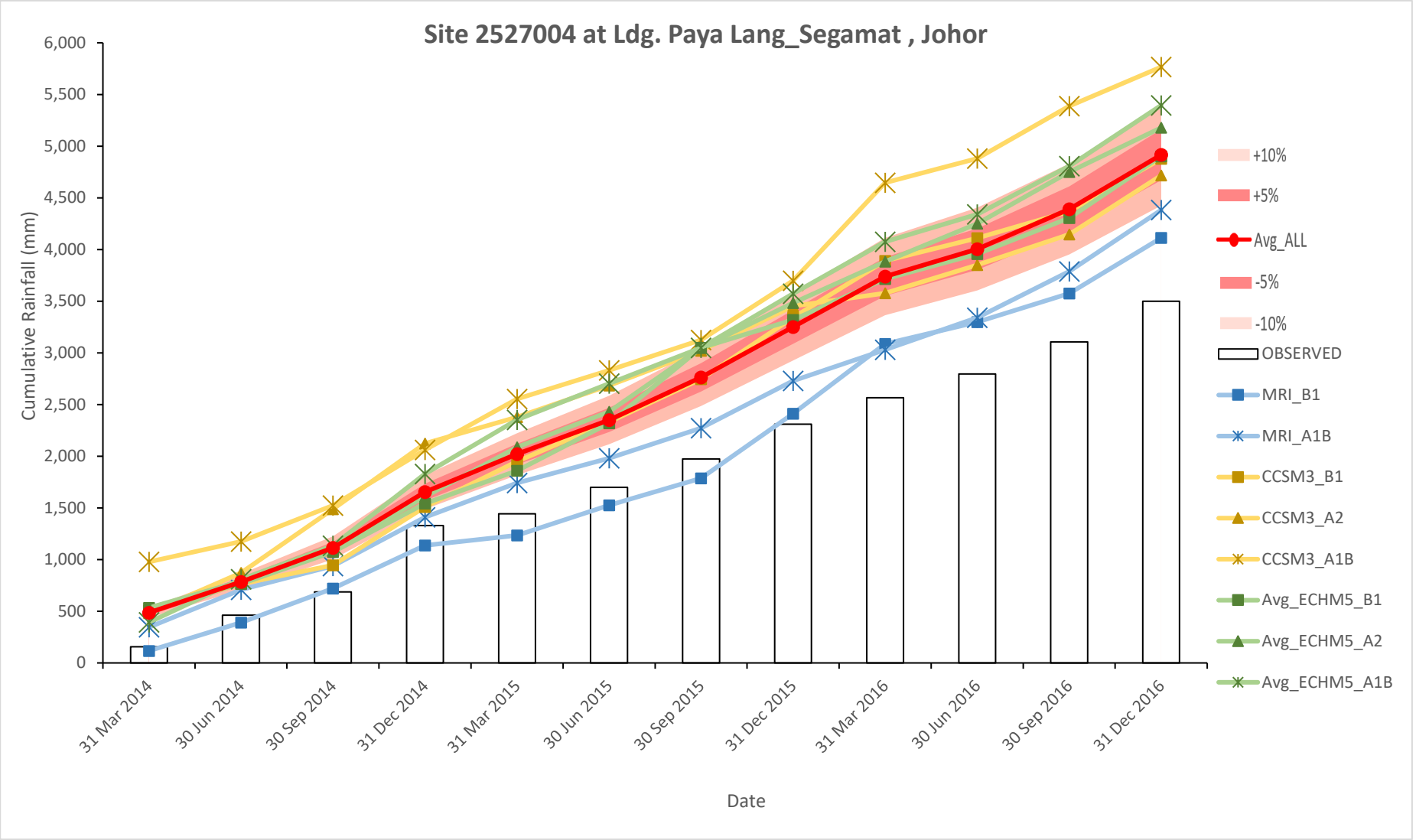


Figure 4.13f: Cumulative rainfall at Site 2527004 at Ldg. Paya Lang_Segamat , Johor

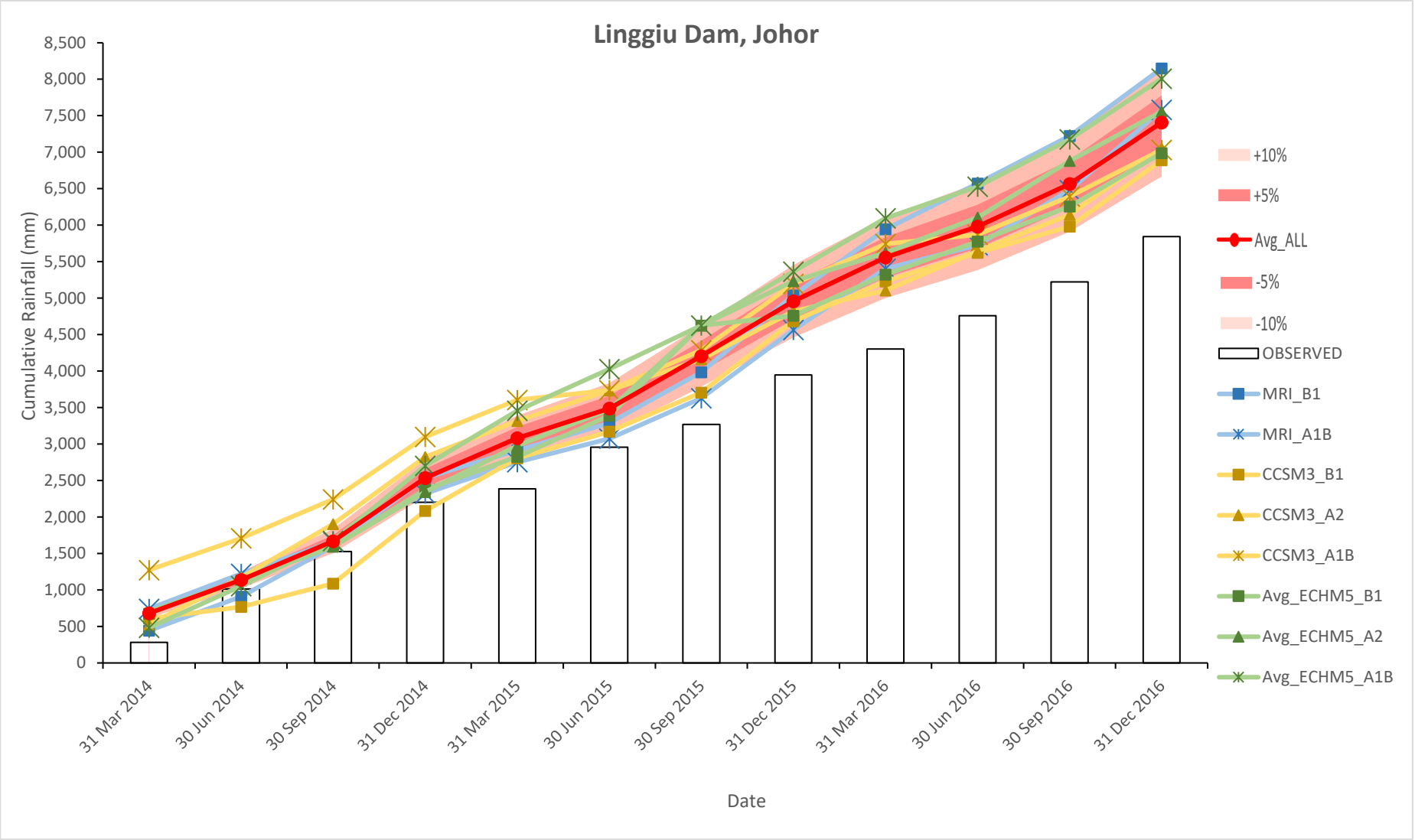


Figure 4.13g: Cumulative rainfall at Linggiu Dam, Johor

CHAPTER 5
CONCLUSIONS

5.1 Temporal Yearly Rainfall Pattern Analysis

From the analyses of the projected 2014-2018 yearly rainfall, based on the different climate models and the three climate scenarios, it was shown that the ECHM5 performed better than the CCSM3 and the MRI; with differences of 1% for scenario A1B, -1% for scenario A2 and 0% for scenario B1, for the whole Peninsular Malaysia, as shown in Table 5.1. The results are deemed consistent with the simulated CO_2 emission scenarios by the IPCC; where there was no significant difference of concentrations of CO_2 from year 2000 up to year 2020, for the three scenarios. Similar performances were also found for the 2018 yearly rainfall, where the ECHM5 again showed the most insignificant differences of -8% for scenario A1B, -6% for scenario A2 and 5% for scenario B1, respectively.

Table 5.1: Difference between projected and observed 2014-2018 yearly rainfall for Malaysia

State	Difference (%)					
	ECHM5_A1B		ECHM5_A2		ECHM5_B1	
	Average 2014-2018	2018	Average 2014-2018	2018	Average 2014-2018	2018
Peninsular Malaysia	1	-8	-1	-6	0	5
Selangor & Kuala Lumpur	2	-3	-3	2	-2	1
Negeri Sembilan	-2	-7	-5	0	-3	-5
Melaka	15	-1	18	15	13	2
Johor	11	-5	14	5	8	1
Pahang	18	3	18	10	19	21
Perlis	5	9	2	-6	-1	13
Kedah	-3	2	-7	-7	-6	9
Pulau Pinang	-2	-19	-10	-25	-6	-7
Perak	1	-6	-3	-7	1	4
	CCSM3_A1B		CCSM3_A2		CCSM3_B1	
	Average 2014-2018	2018	Average 2014-2018	2018	Average 2014-2018	2018
Terengganu	-7	-17	-13	-15	-5	-2
Kelantan	6	-19	2	-6	8	11
	ECHM3_A1B		MRI_A1B			
	Average 2014-2018	2018	Average 2014-2018	2018		
Sabah	21	11	-6	-16		
Sarawak	15	4	0	-9		

Meanwhile, the results on a state basis showed that in general, the ECHM5 outperformed the CCSM3 and MRI for all the states excepting for Terengganu and Kelantan, where the CCSM3 slightly overtook the ECHM5. No significant difference between the averages projected and the observed 2014-2018 yearly rainfall, and the 2018 yearly rainfall, was shown by both the ECHM5 and CCSM3 among the three scenarios, except for:

(a) Scenario B1: The models showed slightly higher accuracy for most of the states (with maximum difference of 13% in Melaka for the average 2014-2018 yearly rainfall, and -7% in Pulau Pinang for the 2018 yearly rainfall); except for Negeri Sembilan, Kelantan and Perlis;

(b) Scenario A2: Higher accuracy was found for Negeri Sembilan, Kelantan and Perlis with maximum difference of -5% in Negeri Sembilan for the average 2014-2018 yearly rainfall, and -6% in Kelantan and Perlis for the 2018 yearly rainfall;

(c) Scenario A1B: Maximum differences of 18% and 3% were found for Pahang and Kedah, respectively.

Over in Sabah and Sarawak, in general, the MRI was performing more effectively than the ECHM3, for the average 2014-2018 yearly rainfall (Table 5.1). The difference between the projection by MRI and the observations in Sabah was only -6%, while that for the ECHM3 was 21%. In Sarawak, there was no difference between projections for the MRI and observation were found, whereas a 15% of difference was accounted for with the ECHM3 model. For the 2018 yearly rainfall, the ECHM3 outperformed the MRI by showing slightly higher performance; with lesser magnitudes of differences between projected and observed yearly rainfall of 11% for Sabah and 4% for Sarawak, as compared to -16% and -9%, respectively.

On the other hand, based on the assessments of model performance through estimating the average percentages for the over projected and under projected 2014-2018 yearly rainfall, the ECHM5 showed the smallest range of 20% (average 10% of over projected and -10% of under projected) for the whole Peninsular Malaysia (Table 5.2).

Table 5.2: Average percentage of over projected and under projected by the best models for 2014-2018 yearly rainfall for Malaysia

State	Average Percentage (%) for 2014 - 2018	
	Over Projected	Under Projected
	ECHM5	
Peninsular Malaysia	10	-10
Selangor & Kuala Lumpur	9	-9
Negeri Sembilan	11	-11
Melaka	22	-9
Johor	22	-12
Pahang	28	-13
Perlis	15	-20
Kedah	8	-12
Pulau Pinang	12	-15
Perak	16	-10
	CCSM3	
Terengganu	7	-16
Kelantan	20	-16
	MRI	
Sabah	7	-14
Sarawak	6	-8

The ECHM5, in general, also showed the smallest range among the models for Selangor - Kuala Lumpur, Negeri Sembilan, Melaka (MRI showed slightly smaller range of 28% as compared to 31% by ECHM5), Johor (MRI showed slightly smaller range of 29% as compared to 34% by ECHM5), Pahang (MRI showed slightly smaller range of 40% as compared to 41% by ECHM5), Perlis, Kedah, Pulau Pinang and Perak; while the CCSM3 works better for Terengganu and Kelantan. Overall, for Peninsular Malaysia, the ranges between the over projected and the under projected yearly rainfall of the models that were better performing, did not exceed 50%.

In Sabah & Sarawak, it was found that the MRI was better than the ECHM3, where the results of smaller ranges of 21% for Sabah and 14% for Sarawak were obtained, compared to 35% and 15%, respectively.

5.2 Analysis of Temporal Yearly Rainfall Pattern according to Stations

From the basis of the analyses at stations in Peninsular Malaysia, generally, the performance of the models was found to be consistent with the performance of models on the state basis. Insignificant difference was found between the averages of projected and of observed 2014-2018 yearly rainfall among the three scenarios traced by these two models, at the respective stations and states. The ECHM5 still worked better than the CCSM3 for the same stations, and for each state, for the 2018 yearly rainfall.

Over in Sabah, for the 2014-2018 yearly rainfall, inconsistent results with the state basis analysis were obtained, where ECHM3, in general, showed better results than the MRI in most of the selected stations. A consistent result however, was found for the 2018 yearly rainfall.

In Sarawak, the performance of models for the 2014-2018 yearly rainfall is consistent with the state basis, while inconsistent result was found for the 2018 yearly rainfall. Overall, the differences between projected and observed yearly rainfall at most of the stations in Sabah & Sarawak were less than 50%.

On the other hand, the performance of the models assessed through estimating the average percentages for over projected and under projected 2014-2018 yearly rainfall revealed that the ECHM5 gave the smallest range difference among the models for the stations in all the states in Peninsular Malaysia, with the exception of Terengganu and Kelantan. The CCSM3 performed slightly better in these two states. Over in Sabah & Sarawak, the MRI showed the smaller range for most of the stations in Sabah and Sarawak when compared to the ECHM3. Overall, the ranges between over projected and under projected yearly rainfall of the better performing models did not exceed 50% for most of the stations.

5.3 Spatial Distribution of 2018 Yearly Rainfall

Spatial distributions of 2018 yearly rainfall projected with the ECHM5 under the three A1B, A2 and B1 scenarios for Peninsular Malaysia showed that the differences between projected and observed yearly rainfall magnitude (majority around -500 mm to 500 mm) are consistent with the state average percentage of differences obtained in the temporal pattern analysis for most of the states, except for some areas in Pulau Pinang and Melaka.

Over in Terengganu and Kelantan, however, the CCSM3 performed better with the majority areas under projections of more than 0 mm to -1,500 mm that is consistent with the temporal pattern analysis. In general, it was found that the yearly rainfall difference maps of scenarios A1B, A2 and B1 showed insignificant differences among each other for all these states

In Sabah and Sarawak, the projected spatial distributions of the yearly rainfall again are deemed consistent with their temporal patterns for the states. The ECHM3 showed slightly better performances with difference between projected and observed yearly rainfall magnitudes for the majority areas at around -1,000 mm to 500 mm, except for some areas in Limbang, Miri, the central of Kapit, the south of Samarahan and Sri Aman, in Sarawak; and the central of west coast and east of Sandakan in Sabah.

5.4 Changes of Trend Direction and Trend Slope for 2018 Yearly Rainfall

The differences in trend between the periods of 2010-2017 and 2010-2018 were determined to present the trend direction changes in 2018 at all the stations in Peninsular Malaysia. It was found that no significant difference in the number of stations showing changes of trend direction in 2018 between the projections and the observations, the exception being for Kelantan under scenarios A1B and B1 as projected by the ECHM5, and Kedah under scenario A1B as projected by the CCSM3, where five stations were found for each scenario. In the other states, not more than three stations were with differences between the observation and projections.

In Sabah & Sarawak, there were insignificant differences in the number of stations showing changes of trend direction in 2018 for the projections by ECHM3. However, under the MRI projection, a significant difference of some 10 stations was found for Sarawak.

The changes in trend slope projected by the ECHM5 for the 2018 yearly rainfall in Peninsular Malaysia, had it that the scenario B1 showed 20 mm per year of over projection for the northern region (except for Perlis and north Kedah), central region, southern region and Pahang. In fact, a -20 mm per year of under projection for scenarios A1B and A2 were the order of the day for Perlis and north Kedah. Over in Terengganu and Kelantan, the CCSM3 performed better than the ECHM5 in scenario A1B with -20 mm per year of difference as compared to the observation.

In Sabah, the 2018 yearly rainfall trend projected by the MRI under scenario A1B was close (slightly higher) to the observed trend for the majority of the areas. However, the east and south of inland, the north of Sandakan, and Kudat, were not projected to have increasing trend as had been observed. Over projection was also found in the coastal areas of inland. However, it must be mentioned that the projections for coastal areas of west coast was consistent with the observations.

In Sarawak, the majority of the areas (except Miri where MRI showed more accurate projection) projected by the ECHM3 under scenario A1B was found to have close increasing trend of up to 30 mm per year with the observations. High accuracy of projection was also found in Kuching, where the projected decreasing trend up to -50 mm per year was found to be similar with the observation. However, areas such as Mukah, the central of Sibu, and the north-east of Kapit, did not show projections that were consistent with their observations.

5.5 Model Assessment for 2014 & 2019 Flood Events and 2014-2016 Dry Spell

From the results of the model assessments under the various scenarios at all the stations in the study, and based on the 14-24 December 2014 flood event in Kelantan and Terengganu, all the models generally projected heavier rainfall than the observed values during October-November (one to two months earlier than the actual flood event). However, the total rainfall projected by these models during the four-week period (two weeks before the event: 26 November 2014 - 09 December 2014; and two weeks during the event: 10 December 2014 - 23 December 2014) are close to the total observed rainfall received during the flood event (10 December 2014 - 23 December 2014). This indicated that the models projected high rainfall (2

weeks earlier) prior to the flood event, and continued with high projections during the event period. During the October-December 2014 period, it was found that in general, the CCSM3 model was more accurate in projecting cumulative rainfall at all the stations when compared to the ECHM5 and MRI models. However, the MRI performed better than the CCSM3 under the scenario A1B at Site 4726001 at Gunung Gagau, Site 4819027 at Gua Musang and Site 5130007 at Emp Kenyir.

During the December 2019 flood in Bukit Tinggi district, Johor, in general, it was found that the MRI performed better than the ECHM5 at Site 1738001 at Kota Tinggi in rainfall projections, while the ECHM5 outperformed the MRI at Site 1836001 at Ulu Sebol and Site 1737001 at Bukit Besar, under the CO_2 emission scenario B1. Meanwhile, in Mersing district, the ECHM5 had showed outstanding projections under the same emission scenario at all the four study stations: Stor JPS Mersing, Pengkalan Batu, Site 2636170 at Endau Mersing and Site 2536168 at Empangan Labong.

Over in Jeli district, Kelantan, in general, the ECHM5 outperformed the MRI at all the three study stations: Site 5718005 at Air Bol, Site 5718033 at Kampung Jeli and Site 5621071 at Batu 13, under the CO_2 emission scenarios A1B and A2. However, it was found that the MRI overperformed the ECHM5 under the CO_2 emission scenarios A1B at Site 5621071 at Batu 13.

For the dry spell event model assessments during the period of 2014-2016 in Johor, the projected rainfall was found to follow the seasonal trend in each year, wherein lower rainfall was always detected in the middle of the years, while higher rainfall happened at the end of the years. For most of the time, the individual models and the model average showed that rainfall was either closer to or lower than the observed values throughout the three study years at all the stations except at Site 2033002 at Stn Telemetri Bandar Kluang and at Linggiu Dam. No significant differences were found amongst the performance of the three models. The MRI was likely to give lower projections during the first quadrants of 2014 and 2015 under the scenario B1 for most of the stations, except at Site 2033002 at Stn Telemetri Bandar Kluang and at Linggiu Dam.

It was found that the MRI under scenario B1 was able to project similar or lower cumulative rainfall compared to the observed cumulative rainfall at all the stations throughout the three years, with the exceptions at Site 2033002 at Stn Telemetri Bandar Kluang, Site

2527004 at Ldg Paya Lang_Segamat (where higher cumulative rainfall was projected in 2016) and at Linggiu Dam. Nevertheless, the ECHM5 and CCSM3 models showed accuracy as high as those of the MRI at Site 1437116 at Stor JPS Johor Bahru and Site 1829001 at Sek Men Munshi Sulaiman. It was also noticed that the model projections under scenario A1B is always higher than those under scenario B1, with scenario A2 being rated as the moderate.

APPENDIX A

A1: Site 2917001 at Setor JPS Kajang, Selangor

Table A1-1: Projected and observed 2014-2018 yearly rainfall for Site 2917001 at Setor JPS Kajang, Selangor

Site 2917001 at Setor JPS Kajang, Selangor						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,936	2,292	2,732	1,597	2,359	2,383
ECHM5_A1B_2	2,110	2,489	1,949	1,952	2,047	2,109
ECHM5_A1B_3	3,115	2,483	2,865	2,255	2,555	2,655
Average_ECHM5_A1B	2,720	2,421	2,515	1,935	2,320	2,382
ECHM5_A2_1	2,047	2,307	2,209	2,290	2,283	2,227
ECHM5_A2_2	1,958	2,202	2,092	2,812	2,423	2,297
ECHM5_A2_3	2,082	2,295	1,824	2,111	2,041	2,071
Average_ECHM5_A2	2,029	2,268	2,042	2,404	2,249	2,198
ECHM5_B1_1	2,045	2,810	2,234	2,072	2,310	2,294
ECHM5_B1_2	1,843	1,996	1,832	2,291	2,407	2,074
ECHM5_B1_3	2,048	2,153	2,068	2,691	2,041	2,200
Average_ECHM5_B1	1,979	2,320	2,045	2,351	2,253	2,189
CCSM3_A1B	2,397	2,248	1,996	1,276	1,750	1,933
CCSM3_A2	2,221	1,341	1,439	1,690	2,826	1,903
CCSM3_B1	1,880	1,563	2,003	1,432	1,405	1,656
MRI_A1B	2,410	1,967	2,279	1,880	1,727	2,053
MRI_B1	2,035	2,014	1,988	2,115	2,096	2,050
Average_A1B	2,594	2,296	2,364	1,792	2,087	2,227
Average_A2	2,077	2,036	1,891	2,226	2,087	2,063
Average_B1	1,970	2,107	2,025	2,120	2,393	2,123
Average_ALL	2,223	2,154	2,108	2,033	2,162	2,136
OBSERVED	2,661	2,188	2,354	2,268	2,772	2,449

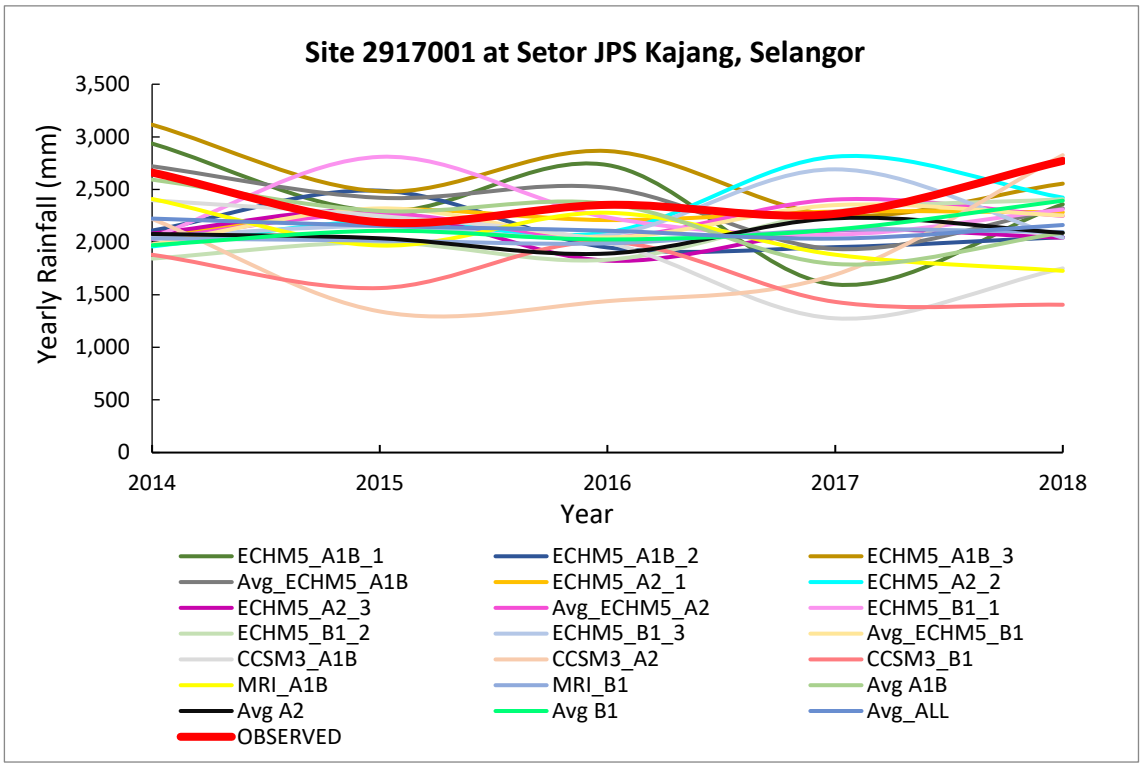


Figure A1-1: Projected and observed 2014-2018 yearly rainfall for Site 2917001 at Setor JPS Kajang, Selangor

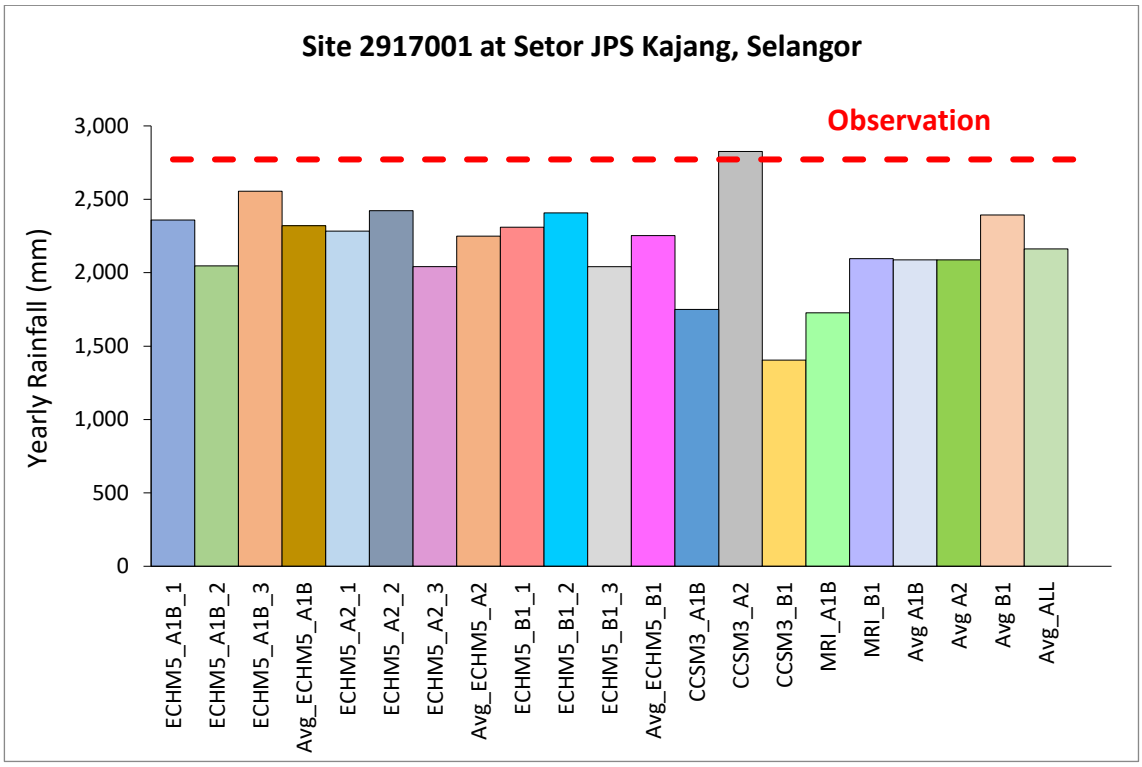


Figure A1-2: Projected and observed 2018 yearly rainfall for Site 2917001 at Setor JPS Kajang, Selangor

Table A1-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2917001 at Setor JPS Kajang, Selangor

Site 2917001 at Setor JPS Kajang, Selangor						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	10	5	16	-30	-15	-3
ECHM5_A1B_2	-21	14	-17	-14	-26	-13
ECHM5_A1B_3	17	13	22	-1	-8	9
Average_ECHM5_A1B	2	11	7	-15	-16	-2
ECHM5_A2_1	-23	5	-6	1	-18	-8
ECHM5_A2_2	-26	1	-11	24	-13	-5
ECHM5_A2_3	-22	5	-23	-7	-26	-15
Average_ECHM5_A2	-24	4	-13	6	-19	-9
ECHM5_B1_1	-23	28	-5	-9	-17	-5
ECHM5_B1_2	-31	-9	-22	1	-13	-15
ECHM5_B1_3	-23	-2	-12	19	-26	-9
Average_ECHM5_B1	-26	6	-13	4	-19	-10
CCSM3_A1B	-10	3	-15	-44	-37	-21
CCSM3_A2	-17	-39	-39	-25	2	-24
CCSM3_B1	-29	-29	-15	-37	-49	-32
MRI_A1B	-9	-10	-3	-17	-38	-16
MRI_B1	-24	-8	-16	-7	-24	-16
Average_A1B	-3	5	0	-21	-25	-9
Average_A2	-22	-7	-20	-2	-25	-15
Average_B1	-26	-4	-14	-7	-14	-13
Average_ALL	-16	-2	-10	-10	-22	-12

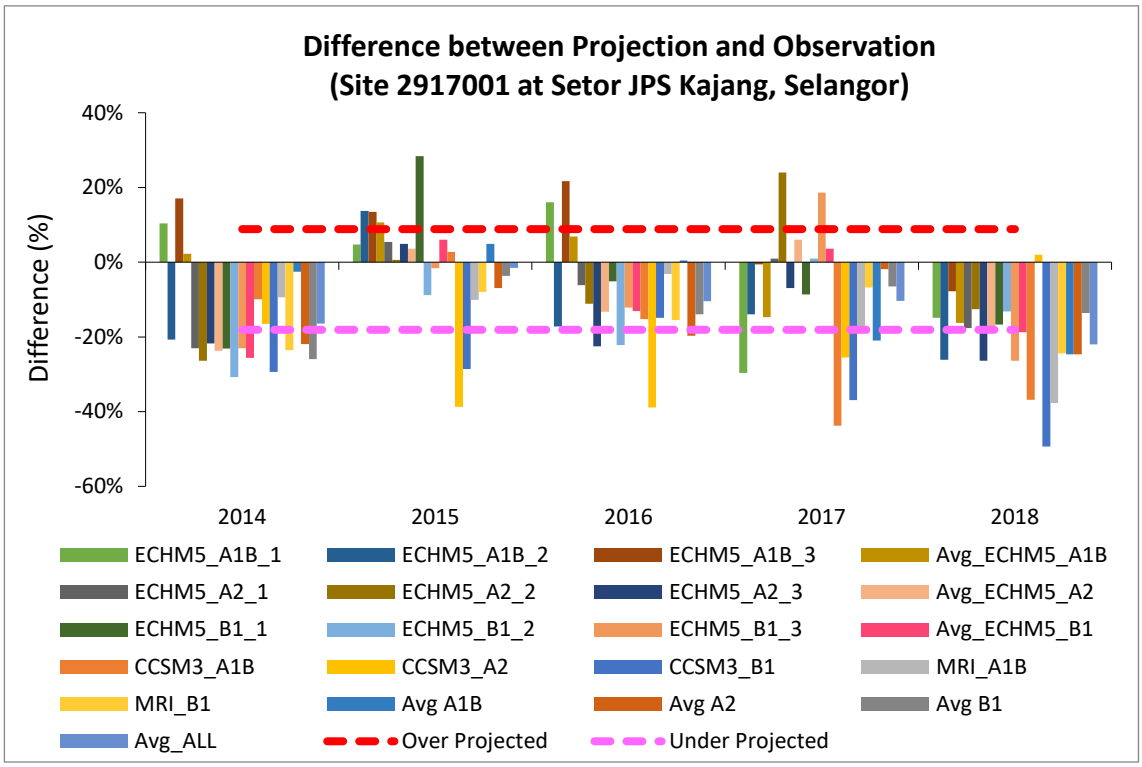


Figure A1-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2917001 at Setor JPS Kajang, Selangor

A2: Site 3116004 at Ibu Pejabat JPS, Kuala Lumpur

Table A2-1: Projected and observed 2014-2018 yearly rainfall for Site 3116004 at Ibu Pejabat JPS, Kuala Lumpur

Site 3116004 at Ibu Pejabat JPS, Kuala Lumpur						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,483	2,169	3,024	2,622	2,605	2,581
ECHM5_A1B_2	2,651	3,161	2,463	3,033	1,658	2,593
ECHM5_A1B_3	4,000	3,111	3,402	2,784	2,024	3,064
Average_ECHM5_A1B	3,045	2,813	2,963	2,813	2,096	2,746
ECHM5_A2_1	3,075	3,088	4,095	2,576	2,741	3,115
ECHM5_A2_2	2,075	3,274	2,478	2,817	2,138	2,556
ECHM5_A2_3	2,723	2,688	2,627	2,283	2,711	2,606
Average_ECHM5_A2	2,624	3,016	3,066	2,558	2,530	2,759
ECHM5_B1_1	2,442	4,163	2,398	2,472	3,753	3,046
ECHM5_B1_2	2,604	3,398	2,221	3,103	3,030	2,871
ECHM5_B1_3	3,459	2,598	3,198	2,819	3,734	3,162
Average_ECHM5_B1	2,835	3,386	2,605	2,798	3,506	3,026
CCSM3_A1B	3,344	1,903	2,352	2,909	2,259	2,554
CCSM3_A2	3,255	4,381	1,863	1,579	2,485	2,713
CCSM3_B1	2,689	2,455	3,083	4,322	1,988	2,907
MRI_A1B	2,319	1,703	2,625	2,307	1,189	2,028
MRI_B1	1,971	2,044	1,426	2,969	2,144	2,111
Average_A1B	2,959	2,409	2,773	2,731	1,947	2,564
Average_A2	2,782	3,358	2,766	2,314	1,947	2,633
Average_B1	2,633	2,932	2,465	3,137	2,519	2,737
Average_ALL	2,792	2,867	2,661	2,757	2,461	2,708
OBSERVED	2,919	2,827	2,846	3,112	3,498	3,040

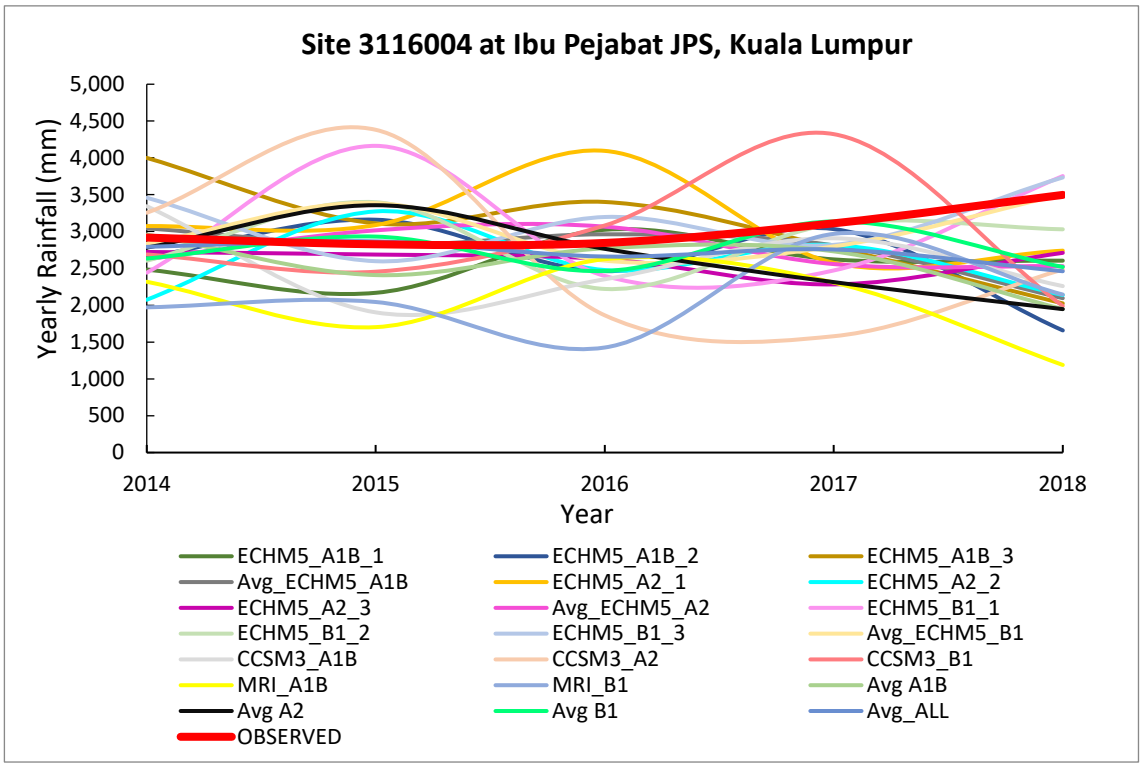


Figure A2-1: Projected and observed 2014-2018 yearly rainfall for Site 3116004 at Ibu Pejabat JPS, Kuala Lumpur

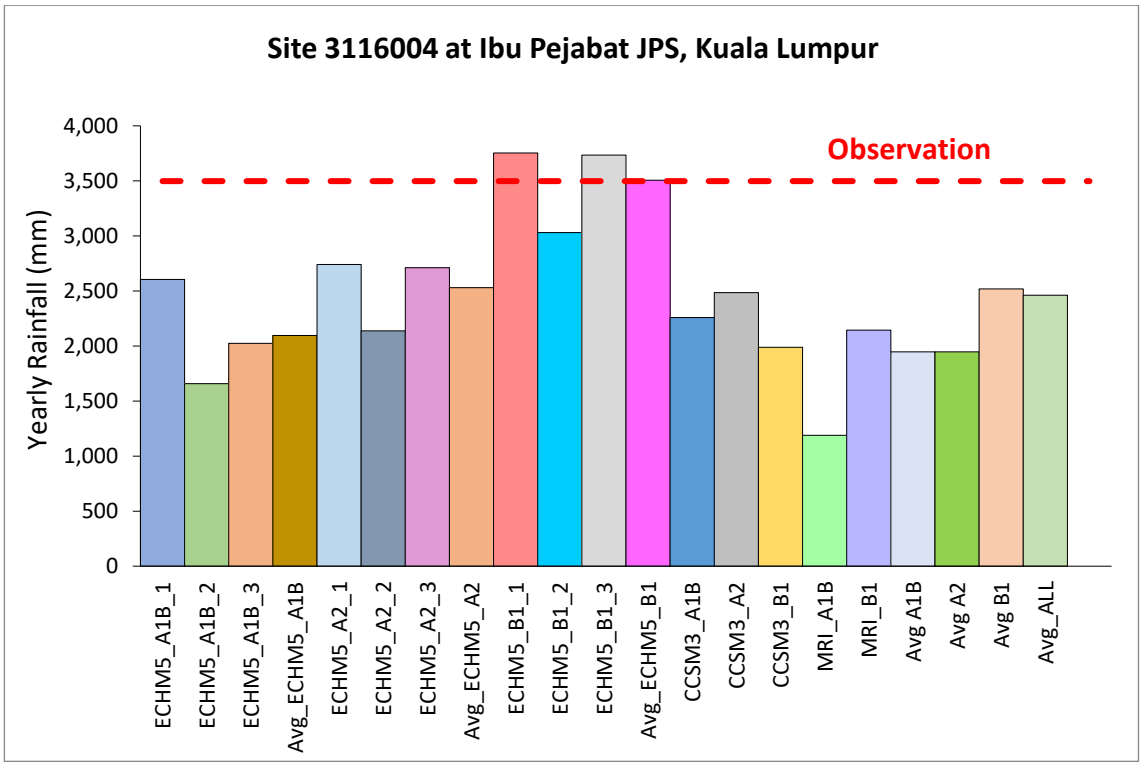


Figure A2-2: Projected and observed 2018 yearly rainfall for Site 3116004 at Ibu Pejabat JPS, Kuala Lumpur

Table A2-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3116004 at Ibu Pejabat JPS, Kuala Lumpur

Site 3116004 at Ibu Pejabat JPS, Kuala Lumpur						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-15	-23	6	-16	-26	-15
ECHM5_A1B_2	-9	12	-13	-3	-53	-13
ECHM5_A1B_3	37	10	20	-11	-42	3
Average_ECHM5_A1B	4	0	4	-10	-40	-8
ECHM5_A2_1	5	9	44	-17	-22	4
ECHM5_A2_2	-29	16	-13	-9	-39	-15
ECHM5_A2_3	-7	-5	-8	-27	-22	-14
Average_ECHM5_A2	-10	7	8	-18	-28	-8
ECHM5_B1_1	-16	47	-16	-21	7	0
ECHM5_B1_2	-11	20	-22	0	-13	-5
ECHM5_B1_3	19	-8	12	-9	7	4
Average_ECHM5_B1	-3	20	-8	-10	0	0
CCSM3_A1B	15	-33	-17	-7	-35	-15
CCSM3_A2	12	55	-35	-49	-29	-9
CCSM3_B1	-8	-13	8	39	-43	-3
MRI_A1B	-21	-40	-8	-26	-66	-32
MRI_B1	-32	-28	-50	-5	-39	-31
Average_A1B	1	-15	-3	-12	-44	-15
Average_A2	-5	19	-3	-26	-44	-12
Average_B1	-10	4	-13	1	-28	-9
Average_ALL	-4	1	-6	-11	-30	-10

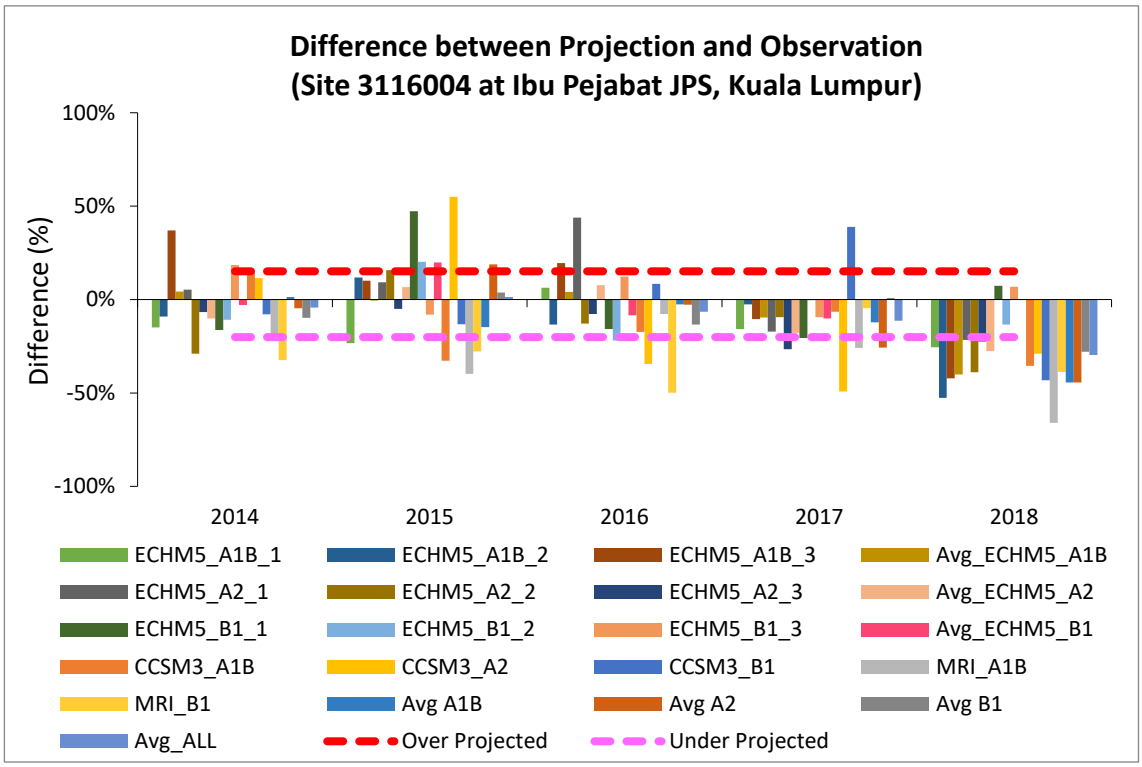


Figure A2-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3116004 at Ibu Pejabat JPS, Kuala Lumpur

A3: Site 3117070 at JPS Ampang, Kuala Lumpur

Table A3-1: Projected and observed 2014-2018 yearly rainfall for Site 3117070 at JPS Ampang, Kuala Lumpur

Site 3117070 at JPS Ampang, Kuala Lumpur						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	3,044	2,538	3,059	1,653	2,665	2,592
ECHM5_A1B_2	2,469	3,022	2,262	2,247	2,376	2,475
ECHM5_A1B_3	3,361	2,859	2,952	2,271	2,726	2,834
Average_ECHM5_A1B	2,958	2,806	2,758	2,057	2,589	2,634
ECHM5_A2_1	2,338	2,570	2,502	2,301	2,713	2,485
ECHM5_A2_2	2,115	2,251	2,344	3,046	2,742	2,500
ECHM5_A2_3	2,141	2,327	1,948	2,503	2,279	2,240
Average_ECHM5_A2	2,198	2,382	2,265	2,617	2,578	2,408
ECHM5_B1_1	2,370	2,843	2,731	2,248	2,716	2,582
ECHM5_B1_2	2,075	2,162	2,250	2,582	2,632	2,340
ECHM5_B1_3	2,209	2,687	2,212	3,313	2,423	2,569
Average_ECHM5_B1	2,218	2,564	2,397	2,714	2,590	2,497
CCSM3_A1B	2,246	1,724	2,586	2,633	1,907	2,219
CCSM3_A2	2,415	1,450	1,528	1,920	2,184	1,899
CCSM3_B1	2,405	2,197	2,288	1,661	2,223	2,155
MRI_A1B	2,725	1,846	2,262	1,952	1,529	2,063
MRI_B1	1,892	2,004	1,933	2,238	2,003	2,014
Average_A1B	2,769	2,398	2,624	2,151	2,241	2,437
Average_A2	2,252	2,149	2,080	2,443	2,241	2,233
Average_B1	2,190	2,378	2,282	2,408	2,480	2,348
Average_ALL	2,415	2,320	2,347	2,326	2,366	2,355
OBSERVED	3,055	2,448	2,354	2,268	2,772	2,579

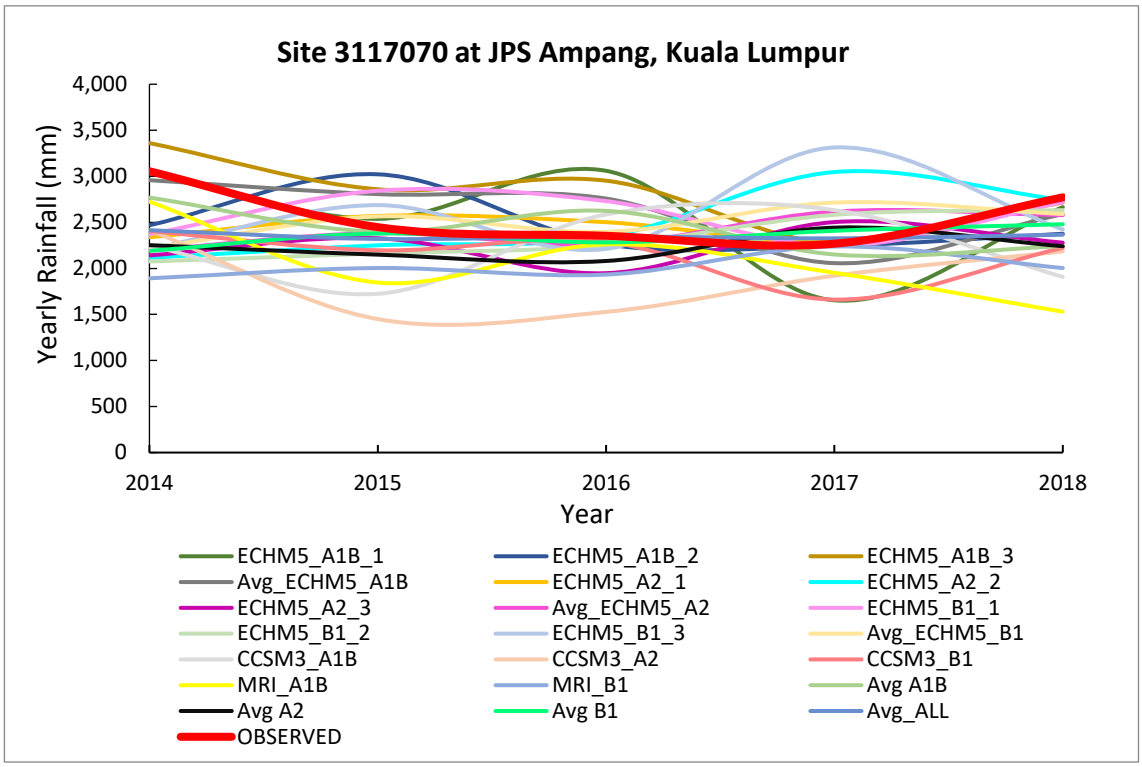


Figure A3-1: Projected and observed 2014-2018 yearly rainfall for Site 3117070 at JPS Ampang, Kuala Lumpur

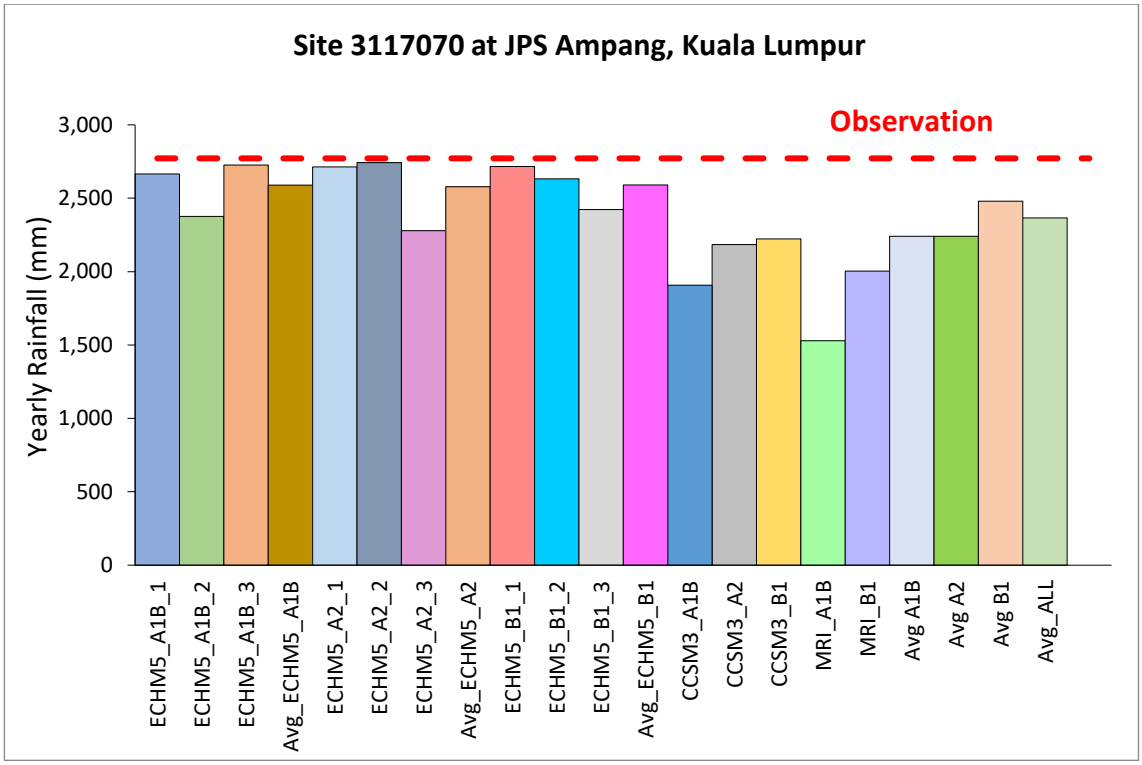


Figure A3-2: Projected and observed 2018 yearly rainfall for Site 3117070 at JPS Ampang, Kuala Lumpur

Table A3-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3117070 at JPS Ampang, Kuala Lumpur

Site 3117070 at JPS Ampang, Kuala Lumpur						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	0	4	30	-27	-4	0
ECHM5_A1B_2	-19	23	-4	-1	-14	-3
ECHM5_A1B_3	10	17	25	0	-2	10
Average_ECHM5_A1B	-3	15	17	-9	-7	3
ECHM5_A2_1	-23	5	6	1	-2	-3
ECHM5_A2_2	-31	-8	0	34	-1	-1
ECHM5_A2_3	-30	-5	-17	10	-18	-12
Average_ECHM5_A2	-28	-3	-4	15	-7	-5
ECHM5_B1_1	-22	16	16	-1	-2	1
ECHM5_B1_2	-32	-12	-4	14	-5	-8
ECHM5_B1_3	-28	10	-6	46	-13	2
Average_ECHM5_B1	-27	5	2	20	-7	-2
CCSM3_A1B	-26	-30	10	16	-31	-12
CCSM3_A2	-21	-41	-35	-15	-21	-27
CCSM3_B1	-21	-10	-3	-27	-20	-16
MRI_A1B	-11	-25	-4	-14	-45	-20
MRI_B1	-38	-18	-18	-1	-28	-21
Average_A1B	-9	-2	12	-5	-19	-5
Average_A2	-26	-12	-12	8	-19	-12
Average_B1	-28	-3	-3	6	-11	-8
Average_ALL	-21	-5	0	3	-15	-8

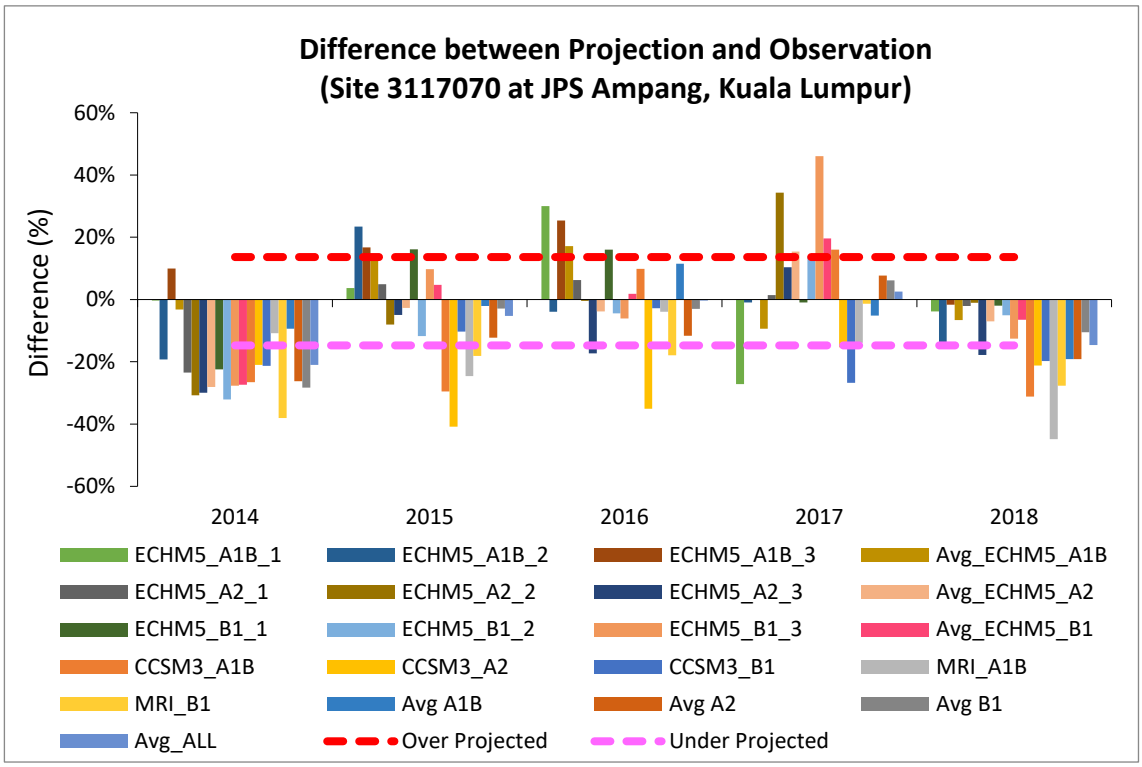


Figure A3-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3117070 at JPS Ampang, Kuala Lumpur

A4: Site 3217002 at Emp Genting Kelang, Kuala Lumpur

Table A4-1: Projected and observed 2014-2018 yearly rainfall for Site 3217002 at Emp Genting Kelang, Kuala Lumpur

Site 3217002 at Emp Genting Kelang, Kuala Lumpur						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	3,092	2,239	2,634	1,537	2,546	2,409
ECHM5_A1B_2	2,026	2,899	2,338	2,079	2,220	2,312
ECHM5_A1B_3	3,157	2,627	2,800	1,951	2,343	2,575
Average_ECHM5_A1B	2,758	2,588	2,590	1,856	2,369	2,432
ECHM5_A2_1	2,274	2,241	2,384	2,056	2,551	2,301
ECHM5_A2_2	1,998	2,199	2,043	2,829	2,493	2,313
ECHM5_A2_3	2,084	1,967	1,810	2,431	2,087	2,076
Average_ECHM5_A2	2,119	2,136	2,079	2,439	2,377	2,230
ECHM5_B1_1	2,111	2,545	2,817	2,150	2,467	2,418
ECHM5_B1_2	2,217	2,088	2,044	2,436	2,394	2,236
ECHM5_B1_3	2,014	2,450	1,867	2,922	2,383	2,327
Average_ECHM5_B1	2,114	2,361	2,243	2,503	2,414	2,327
CCSM3_A1B	2,205	1,527	2,247	2,578	1,673	2,046
CCSM3_A2	2,216	1,536	1,523	1,703	1,719	1,739
CCSM3_B1	2,067	1,865	2,121	1,553	2,037	1,929
MRI_A1B	2,399	1,895	2,082	2,137	1,597	2,022
MRI_B1	1,806	1,904	1,827	2,290	1,828	1,931
Average_A1B	2,576	2,237	2,420	2,056	2,076	2,273
Average_A2	2,143	1,986	1,940	2,255	2,076	2,080
Average_B1	2,043	2,170	2,135	2,270	2,213	2,166
Average_ALL	2,262	2,142	2,181	2,189	2,167	2,188
OBSERVED	2,495	3,121	2,011	2,932	2,316	2,575

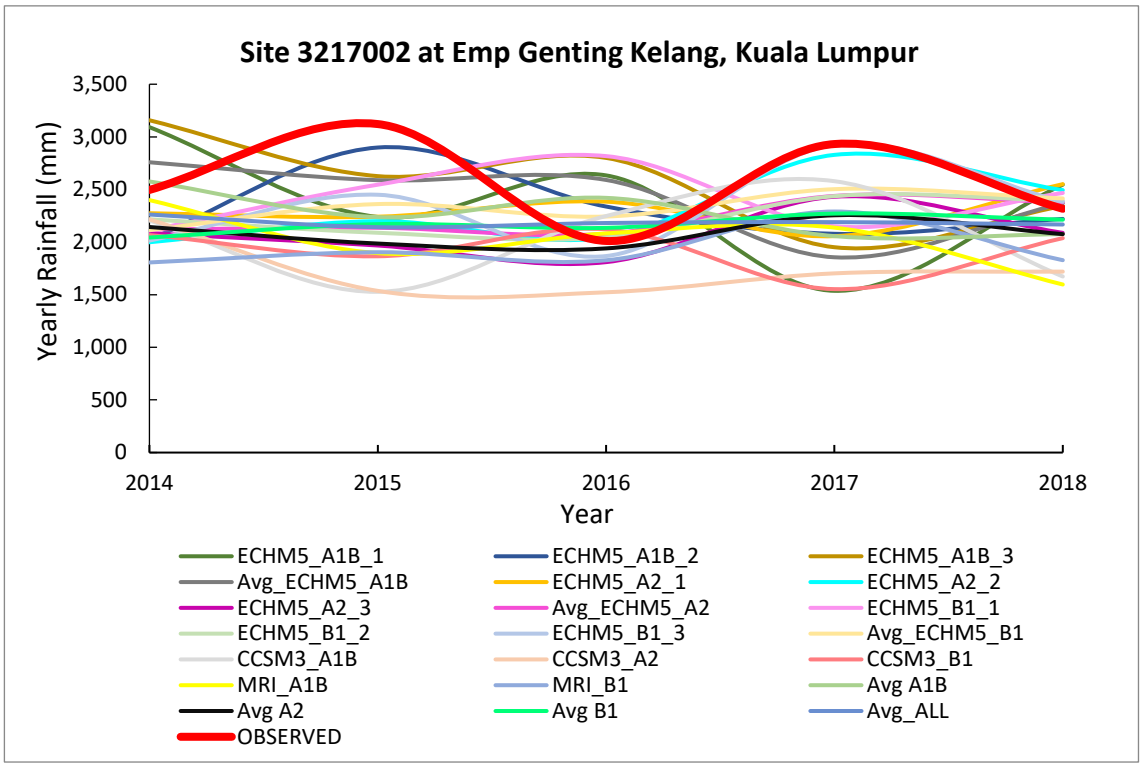


Figure A4-1: Projected and observed 2014-2018 yearly rainfall for Site 3217002 at Emp Genting Kelang, Kuala Lumpur

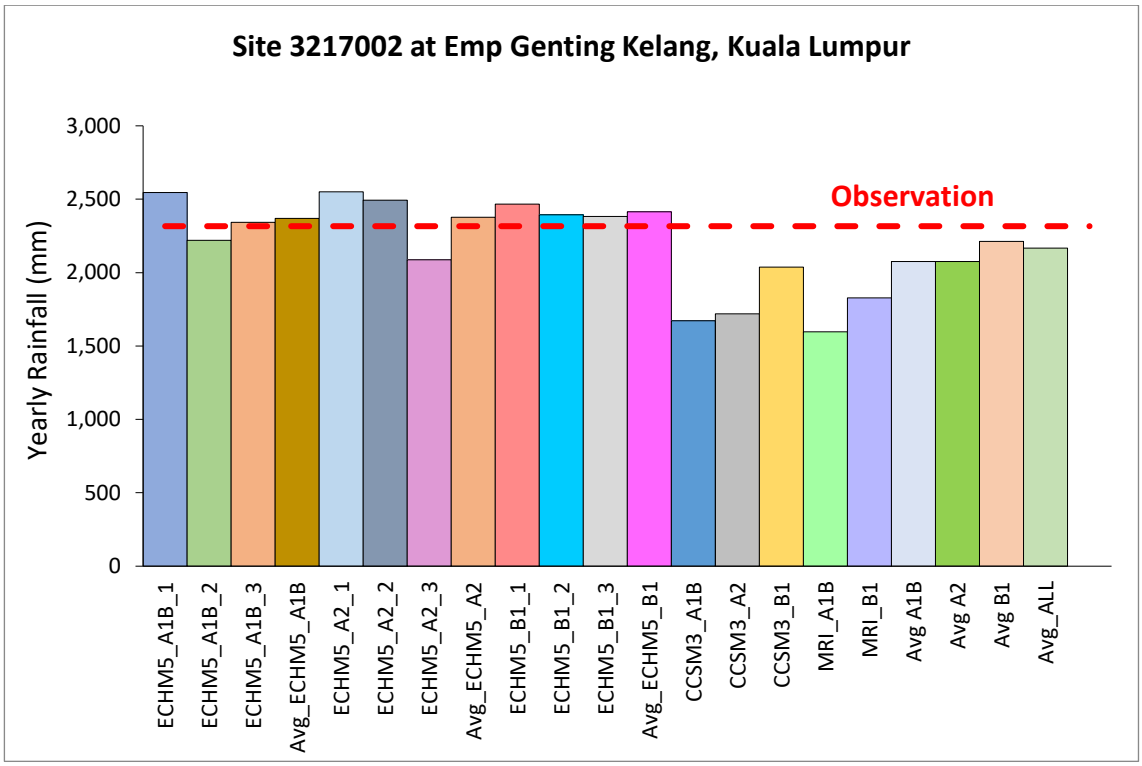


Figure A4-2: Projected and observed 2018 yearly rainfall for Site 3217002 at Emp Genting Kelang, Kuala Lumpur

Table A4-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3217002 at Emp Genting Kelang, Kuala Lumpur

Site 3217002 at Emp Genting Kelang, Kuala Lumpur						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	24	-28	31	-48	10	-2
ECHM5_A1B_2	-19	-7	16	-29	-4	-9
ECHM5_A1B_3	27	-16	39	-33	1	4
Average_ECHM5_A1B	11	-17	29	-37	2	-2
ECHM5_A2_1	-9	-28	19	-30	10	-8
ECHM5_A2_2	-20	-30	2	-4	8	-9
ECHM5_A2_3	-16	-37	-10	-17	-10	-18
Average_ECHM5_A2	-15	-32	3	-17	3	-11
ECHM5_B1_1	-15	-18	40	-27	6	-3
ECHM5_B1_2	-11	-33	2	-17	3	-11
ECHM5_B1_3	-19	-22	-7	0	3	-9
Average_ECHM5_B1	-15	-24	12	-15	4	-8
CCSM3_A1B	-12	-51	12	-12	-28	-18
CCSM3_A2	-11	-51	-24	-42	-26	-31
CCSM3_B1	-17	-40	5	-47	-12	-22
MRI_A1B	-4	-39	4	-27	-31	-20
MRI_B1	-28	-39	-9	-22	-21	-24
Average_A1B	3	-28	20	-30	-10	-9
Average_A2	-14	-36	-4	-23	-10	-17
Average_B1	-18	-30	6	-23	-4	-14
Average_ALL	-9	-31	8	-25	-6	-13

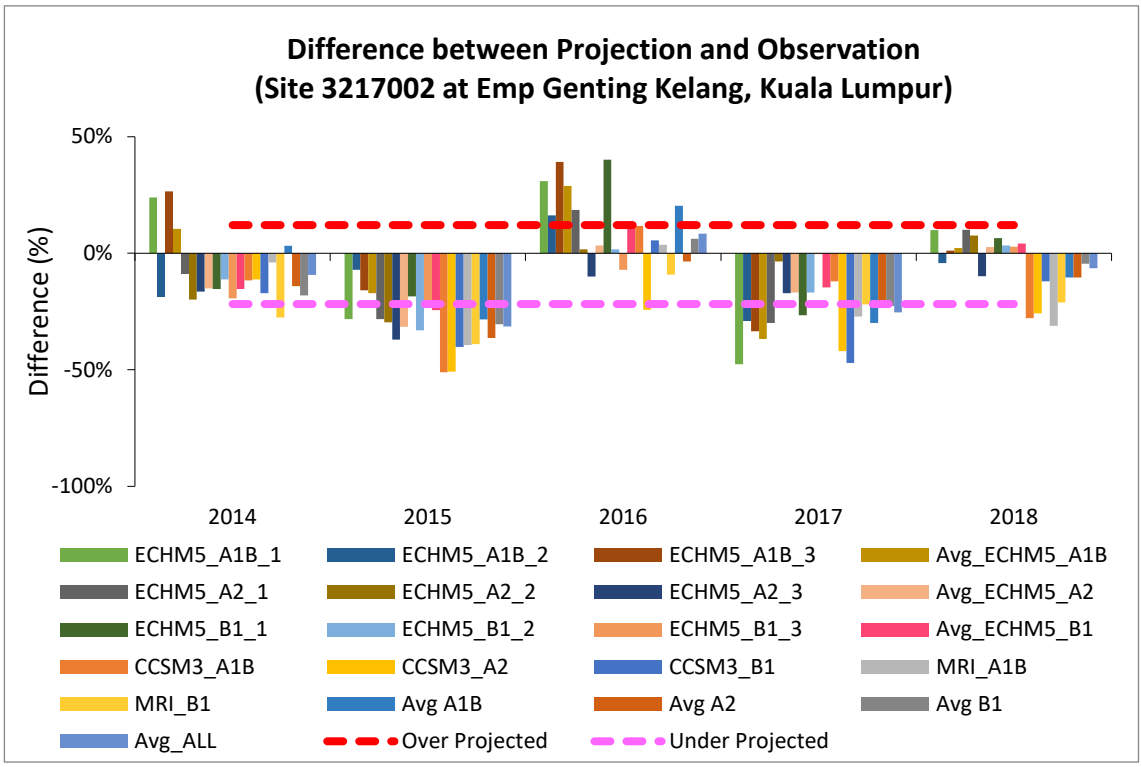


Figure A4-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3217002 at Emp Genting Kelang, Kuala Lumpur

A5: Site 3317004 at Genting Sempah, Kuala Lumpur

Table A5-1: Projected and observed 2014-2018 yearly rainfall for Site 3317004 at Genting Sempah, Kuala Lumpur

Site 3317004 at Genting Sempah, Kuala Lumpur						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,612	2,067	2,197	1,727	2,381	2,197
ECHM5_A1B_2	1,612	2,306	2,170	1,935	1,858	1,976
ECHM5_A1B_3	2,542	2,208	2,398	1,980	2,143	2,254
Average_ECHM5_A1B	2,255	2,194	2,255	1,881	2,128	2,142
ECHM5_A2_1	2,080	2,060	2,017	2,035	2,289	2,096
ECHM5_A2_2	1,580	2,116	1,992	2,152	2,285	2,025
ECHM5_A2_3	2,137	1,726	1,721	1,995	2,122	1,940
Average_ECHM5_A2	1,932	1,967	1,910	2,061	2,232	2,020
ECHM5_B1_1	1,951	2,195	2,315	2,124	2,190	2,155
ECHM5_B1_2	2,183	1,985	1,972	1,960	2,347	2,089
ECHM5_B1_3	1,982	2,131	1,848	2,548	2,282	2,158
Average_ECHM5_B1	2,039	2,104	2,045	2,211	2,273	2,134
CCSM3_A1B	2,343	2,012	2,441	2,496	2,114	2,281
CCSM3_A2	2,474	1,821	1,611	2,087	1,593	1,917
CCSM3_B1	2,159	2,844	1,900	1,653	2,263	2,164
MRI_A1B	2,710	2,083	2,359	2,400	1,804	2,271
MRI_B1	2,369	2,153	1,963	2,088	2,140	2,142
Average_A1B	2,364	2,135	2,313	2,108	2,060	2,196
Average_A2	2,068	1,931	1,835	2,067	2,072	1,995
Average_B1	2,129	2,262	1,999	2,075	2,244	2,142
Average_ALL	2,195	2,122	2,064	2,084	2,129	2,119
OBSERVED	2,745	2,398	2,007	3,079	2,565	2,559

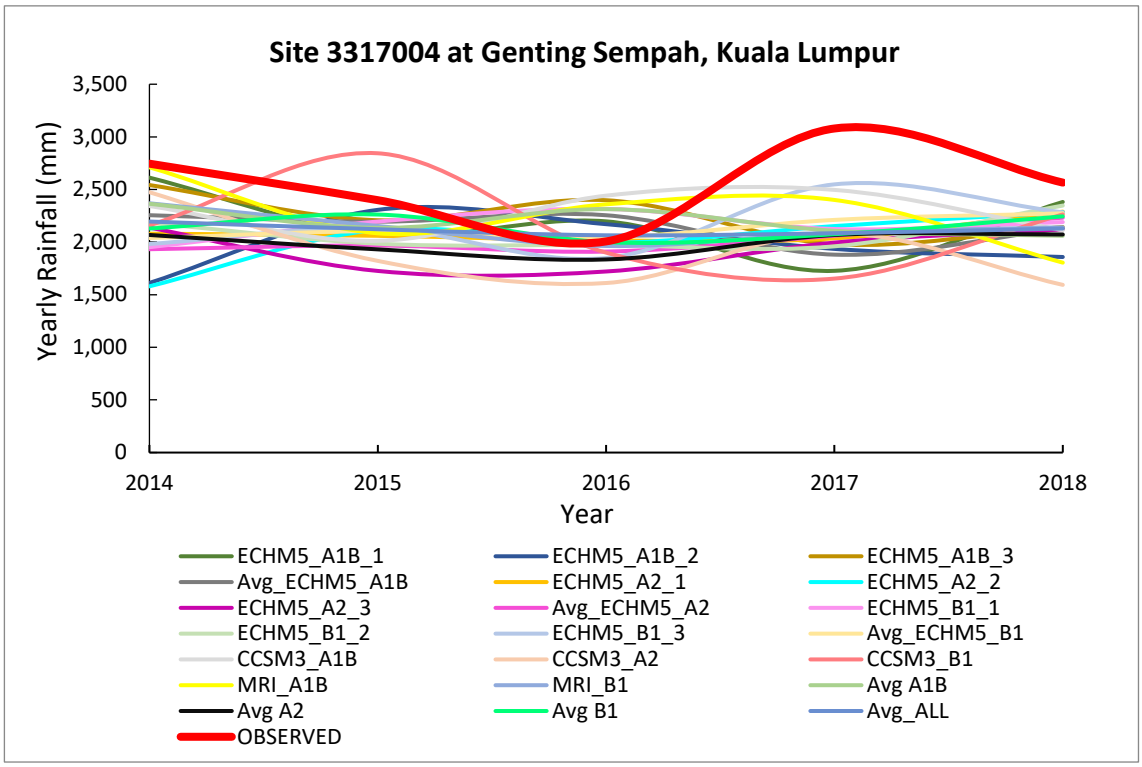


Figure A5-1: Projected and observed 2014-2018 yearly rainfall for Site 3317004 at Genting Sempah, Kuala Lumpur

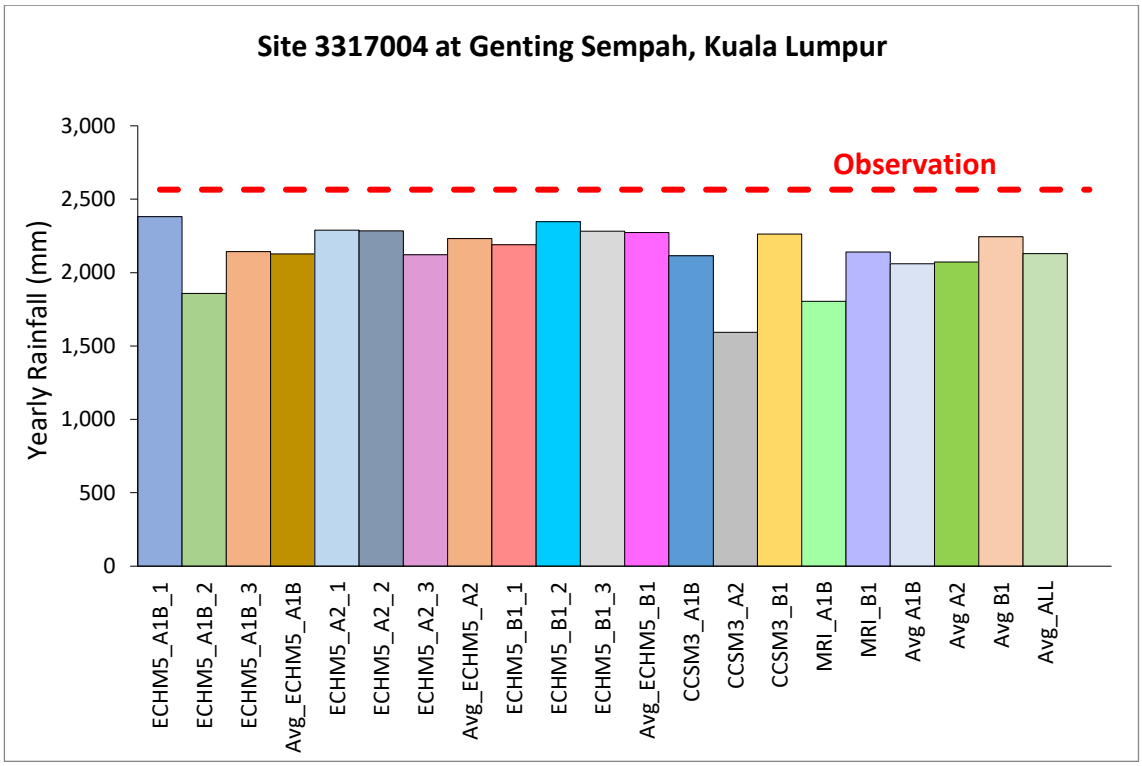


Figure A5-2: Projected and observed 2018 yearly rainfall for Site 3317004 at Genting Sempah, Kuala Lumpur

Table A5-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3317004 at Genting Sempah, Kuala Lumpur

Site 3317004 at Genting Sempah, Kuala Lumpur						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-5	-14	9	-44	-7	-12
ECHM5_A1B_2	-41	-4	8	-37	-28	-20
ECHM5_A1B_3	-7	-8	20	-36	-16	-10
Average_ECHM5_A1B	-18	-9	12	-39	-17	-14
ECHM5_A2_1	-24	-14	1	-34	-11	-17
ECHM5_A2_2	-42	-12	-1	-30	-11	-19
ECHM5_A2_3	-22	-28	-14	-35	-17	-23
Average_ECHM5_A2	-30	-18	-5	-33	-13	-20
ECHM5_B1_1	-29	-8	15	-31	-15	-14
ECHM5_B1_2	-20	-17	-2	-36	-9	-17
ECHM5_B1_3	-28	-11	-8	-17	-11	-15
Average_ECHM5_B1	-26	-12	2	-28	-11	-15
CCSM3_A1B	-15	-16	22	-19	-18	-9
CCSM3_A2	-10	-24	-20	-32	-38	-25
CCSM3_B1	-21	19	-5	-46	-12	-13
MRI_A1B	-1	-13	18	-22	-30	-10
MRI_B1	-14	-10	-2	-32	-17	-15
Average_A1B	-14	-11	15	-32	-20	-12
Average_A2	-25	-19	-9	-33	-19	-21
Average_B1	-22	-6	0	-33	-13	-15
Average_ALL	-20	-12	3	-32	-17	-16

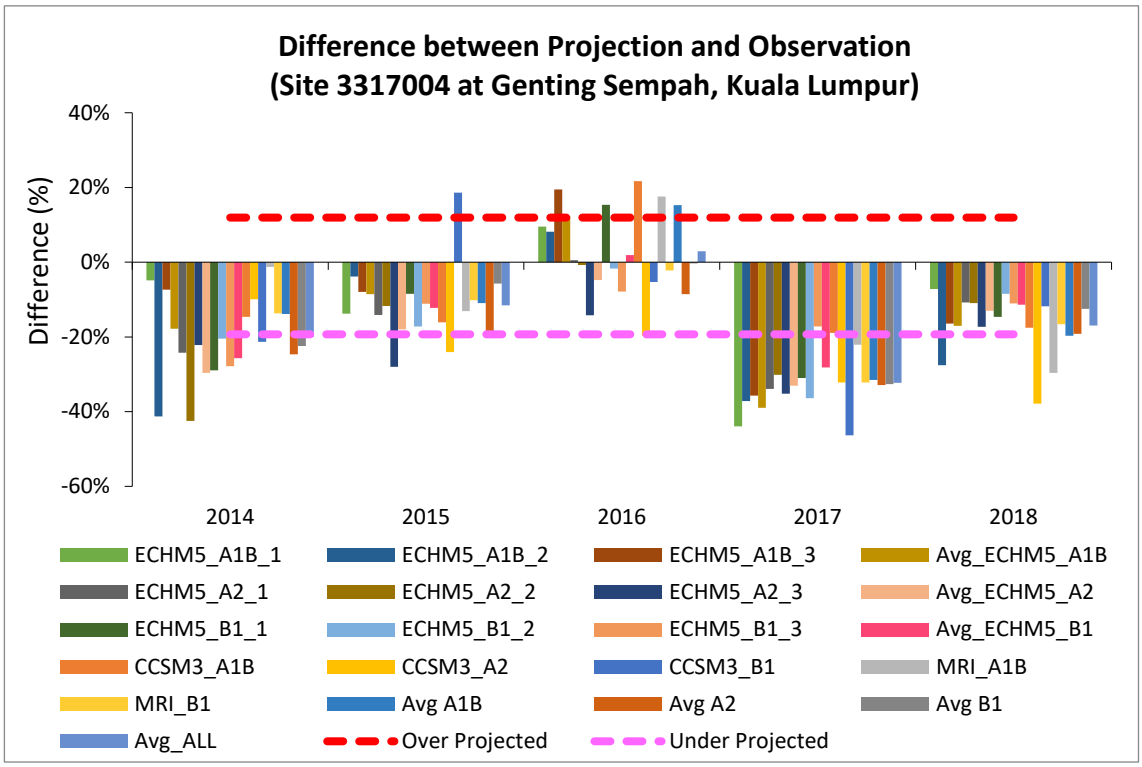


Figure A5-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3317004 at Genting Sempah, Kuala Lumpur

A6: Site 3516022 at Loji Air Kuala Kubu Baru, Selangor

Table A6-1: Projected and observed 2014-2018 yearly rainfall for Site 3516022 at Loji Air Kuala Kubu Baru, Selangor

Site 3516022 at Loji Air Kuala Kubu Baru, Selangor						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,866	2,312	2,562	1,847	2,808	2,479
ECHM5_A1B_2	1,898	2,811	2,297	2,101	2,236	2,269
ECHM5_A1B_3	3,099	2,944	2,548	2,257	2,496	2,669
Average_ECHM5_A1B	2,621	2,689	2,469	2,068	2,514	2,472
ECHM5_A2_1	2,281	2,364	2,395	2,198	2,790	2,405
ECHM5_A2_2	2,066	2,109	2,282	2,405	2,890	2,351
ECHM5_A2_3	2,478	1,978	2,017	2,149	2,551	2,235
Average_ECHM5_A2	2,275	2,151	2,232	2,251	2,743	2,330
ECHM5_B1_1	2,050	2,454	2,274	2,435	2,634	2,369
ECHM5_B1_2	2,488	2,204	2,084	2,217	2,594	2,317
ECHM5_B1_3	2,081	2,287	1,882	3,058	2,446	2,351
Average_ECHM5_B1	2,206	2,315	2,080	2,570	2,558	2,346
CCSM3_A1B	2,133	1,960	2,596	2,466	1,980	2,227
CCSM3_A2	2,310	1,580	1,641	1,985	1,679	1,839
CCSM3_B1	2,075	2,420	1,916	1,523	2,197	2,026
MRI_A1B	2,422	2,252	2,181	2,137	1,704	2,139
MRI_B1	2,136	1,949	2,137	2,113	2,108	2,088
Average_A1B	2,484	2,456	2,437	2,162	2,245	2,357
Average_A2	2,284	2,008	2,084	2,184	2,245	2,161
Average_B1	2,166	2,263	2,059	2,269	2,477	2,247
Average_ALL	2,313	2,259	2,201	2,206	2,365	2,269
OBSERVED	2,485	2,574	2,518	2,809	1,984	2,474

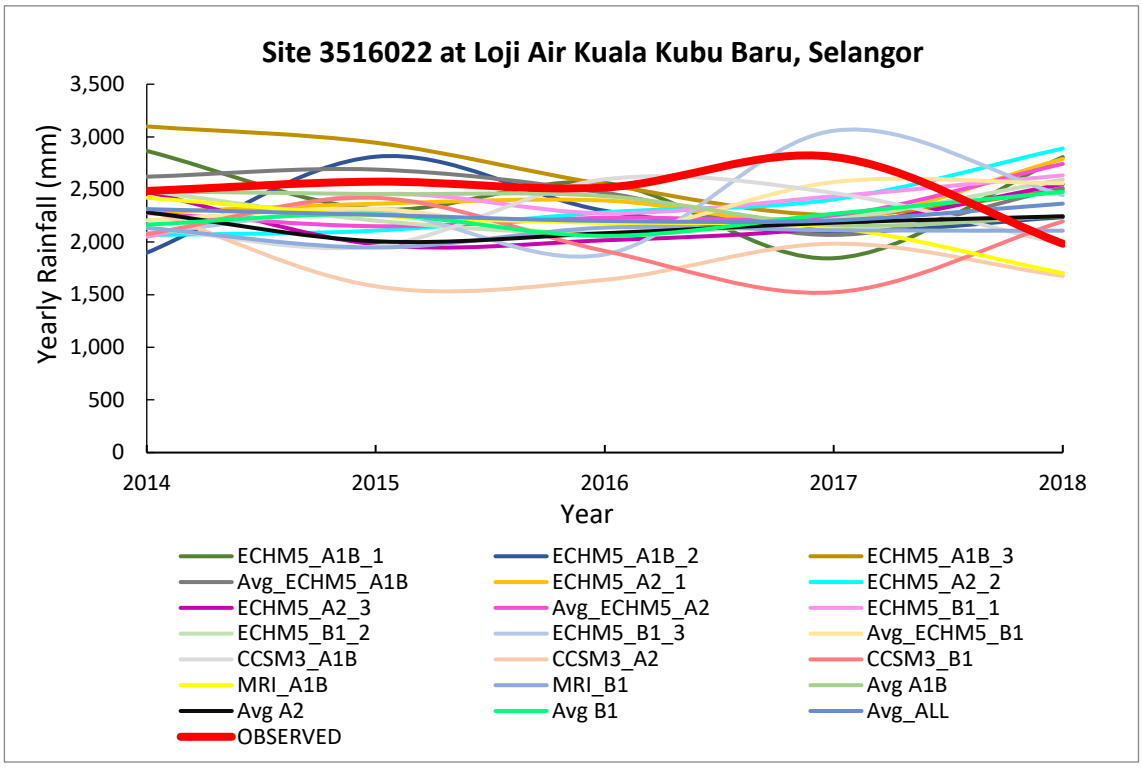


Figure A6-1: Projected and observed 2014-2018 yearly rainfall for Site 3516022 at Loji Air Kuala Kubu Baru, Selangor

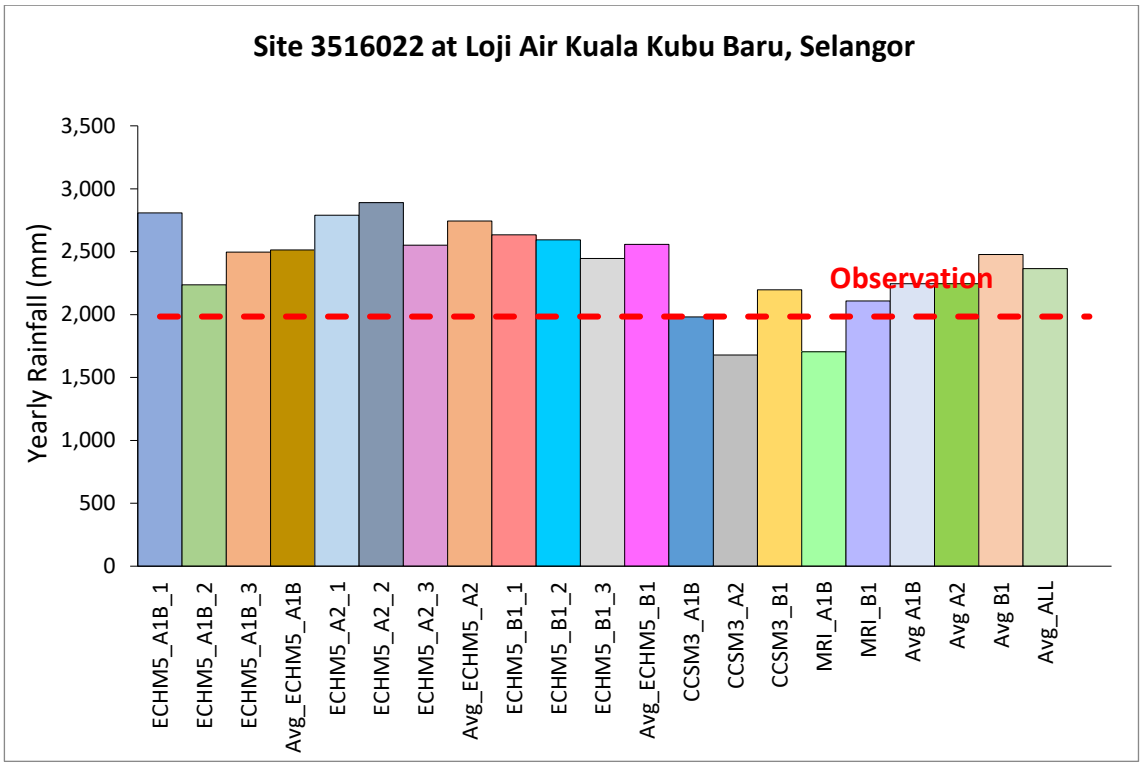


Figure A6-2: Projected and observed 2018 yearly rainfall for Site 3516022 at Loji Air Kuala Kubu Baru, Selangor

Table A6-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3516022 at Loji Air Kuala Kubu Baru, Selangor

Site 3516022 at Loji Air Kuala Kubu Baru, Selangor						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	15	-10	2	-34	42	3
ECHM5_A1B_2	-24	9	-9	-25	13	-7
ECHM5_A1B_3	25	14	1	-20	26	9
Average_ECHM5_A1B	5	4	-2	-26	27	2
ECHM5_A2_1	-8	-8	-5	-22	41	0
ECHM5_A2_2	-17	-18	-9	-14	46	-3
ECHM5_A2_3	0	-23	-20	-24	29	-8
Average_ECHM5_A2	-8	-16	-11	-20	38	-4
ECHM5_B1_1	-18	-5	-10	-13	33	-2
ECHM5_B1_2	0	-14	-17	-21	31	-4
ECHM5_B1_3	-16	-11	-25	9	23	-4
Average_ECHM5_B1	-11	-10	-17	-9	29	-4
CCSM3_A1B	-14	-24	3	-12	0	-9
CCSM3_A2	-7	-39	-35	-29	-15	-25
CCSM3_B1	-17	-6	-24	-46	11	-16
MRI_A1B	-3	-13	-13	-24	-14	-13
MRI_B1	-14	-24	-15	-25	6	-14
Average_A1B	0	-5	-3	-23	13	-4
Average_A2	-8	-22	-17	-22	13	-11
Average_B1	-13	-12	-18	-19	25	-8
Average_ALL	-7	-12	-13	-21	19	-7

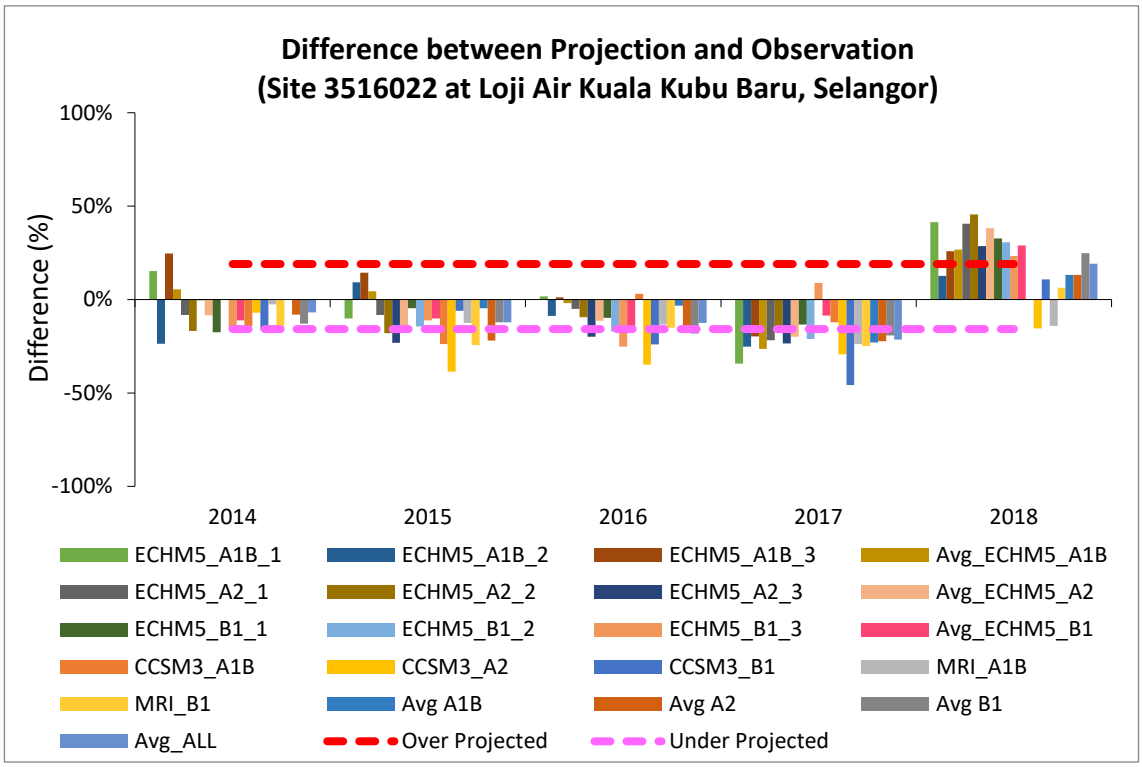


Figure A6-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3516022 at Loji Air Kuala Kubu Baru, Selangor

A7: Site 2719001 at Setor JPS Sikamat, Negeri Sembilan

Table A7-1: Projected and observed 2014-2018 yearly rainfall for Site 2719001 at Setor JPS Sikamat, Negeri Sembilan

Site 2719001 at Setor JPS Sikamat, Negeri Sembilan						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,391	2,059	2,564	1,414	2,397	2,165
ECHM5_A1B_2	1,786	2,445	1,933	1,810	1,781	1,951
ECHM5_A1B_3	2,874	2,249	2,647	1,999	2,315	2,417
Average_ECHM5_A1B	2,351	2,251	2,381	1,741	2,165	2,178
ECHM5_A2_1	1,739	2,196	1,997	2,123	2,245	2,060
ECHM5_A2_2	1,882	2,014	2,074	2,757	2,463	2,238
ECHM5_A2_3	1,885	1,961	1,796	2,123	2,032	1,959
Average_ECHM5_A2	1,835	2,057	1,956	2,334	2,247	2,086
ECHM5_B1_1	2,122	2,574	2,541	1,941	2,190	2,273
ECHM5_B1_2	1,797	1,963	1,749	2,200	2,271	1,996
ECHM5_B1_3	1,655	2,174	1,921	2,921	2,035	2,141
Average_ECHM5_B1	1,858	2,237	2,071	2,354	2,165	2,137
CCSM3_A1B	3,184	2,394	2,085	1,009	1,390	2,013
CCSM3_A2	2,300	1,272	1,057	1,691	1,421	1,548
CCSM3_B1	1,709	1,433	1,925	1,610	1,527	1,641
MRI_A1B	2,386	1,831	1,971	1,704	1,198	1,818
MRI_B1	1,584	1,722	1,756	2,133	1,772	1,794
Average_A1B	2,524	2,196	2,240	1,587	1,816	2,073
Average_A2	1,952	1,861	1,731	2,173	1,816	1,907
Average_B1	1,773	1,973	1,978	2,161	2,040	1,985
Average_ALL	2,092	2,021	2,001	1,960	1,931	2,001
OBSERVED	2,855	2,237	1,826	2,811	2,344	2,414

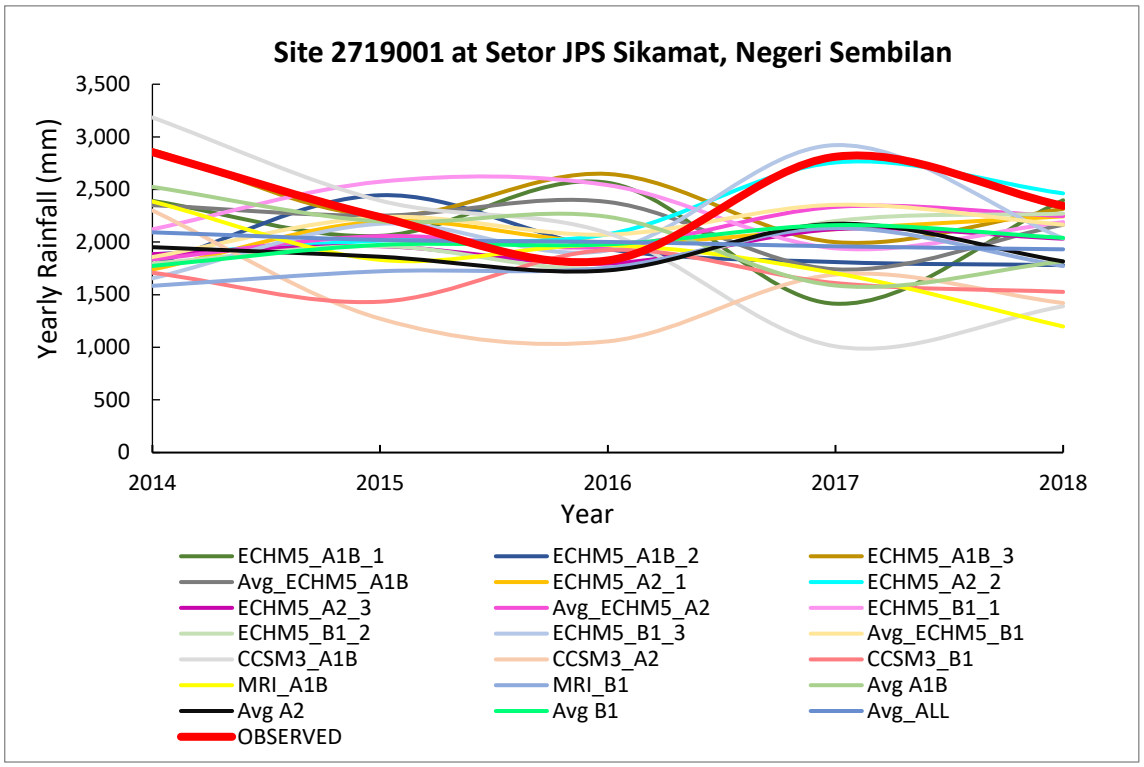


Figure A7-1: Projected and observed 2014-2018 yearly rainfall for Site 2719001 at Setor JPS Sikamat, Negeri Sembilan

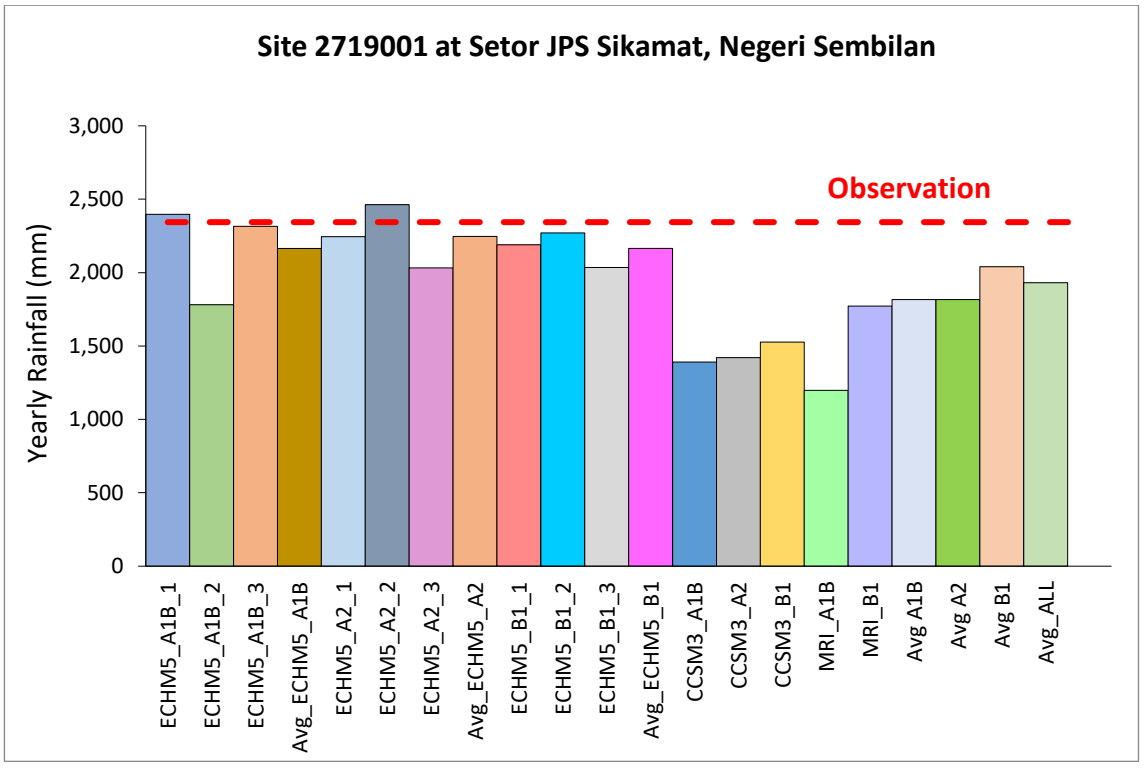


Figure A7-2: Projected and observed 2018 yearly rainfall for Site 2719001 at Setor JPS Sikamat, Negeri Sembilan

Table A7-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2719001 at Setor JPS Sikamat, Negeri Sembilan

Site 2719001 at Setor JPS Sikamat, Negeri Sembilan						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-16	-8	40	-50	2	-6
ECHM5_A1B_2	-37	9	6	-36	-24	-16
ECHM5_A1B_3	1	1	45	-29	-1	3
Average_ECHM5_A1B	-18	1	30	-38	-8	-6
ECHM5_A2_1	-39	-2	9	-24	-4	-12
ECHM5_A2_2	-34	-10	14	-2	5	-5
ECHM5_A2_3	-34	-12	-2	-24	-13	-17
Average_ECHM5_A2	-36	-8	7	-17	-4	-12
ECHM5_B1_1	-26	15	39	-31	-7	-2
ECHM5_B1_2	-37	-12	-4	-22	-3	-16
ECHM5_B1_3	-42	-3	5	4	-13	-10
Average_ECHM5_B1	-35	0	13	-16	-8	-9
CCSM3_A1B	12	7	14	-64	-41	-14
CCSM3_A2	-19	-43	-42	-40	-39	-37
CCSM3_B1	-40	-36	5	-43	-35	-30
MRI_A1B	-16	-18	8	-39	-49	-23
MRI_B1	-45	-23	-4	-24	-24	-24
Average_A1B	-12	-2	23	-44	-23	-11
Average_A2	-32	-17	-5	-23	-23	-20
Average_B1	-38	-12	8	-23	-13	-15
Average_ALL	-27	-10	10	-30	-18	-15

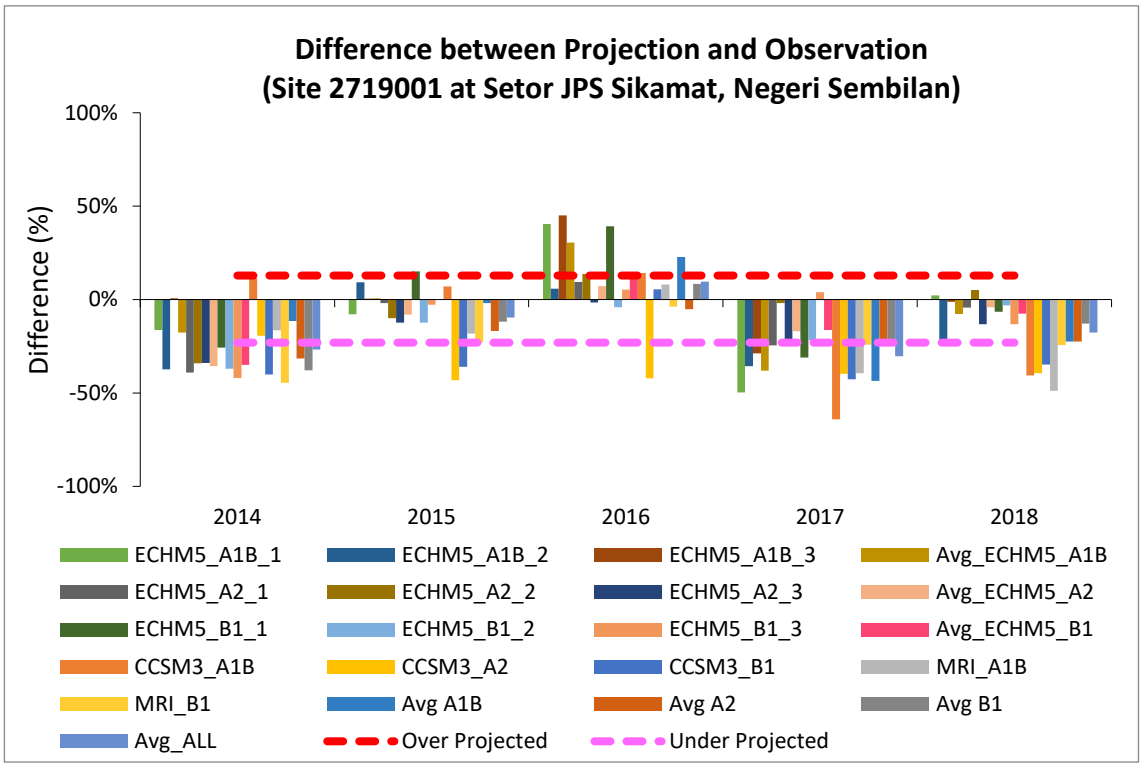


Figure A7-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2719001 at Setor JPS Sikamat, Negeri Sembilan

A8: Site 2725083 at Ladang New Rompin, Negeri Sembilan

Table A8-1: Projected and observed 2014-2018 yearly rainfall for Site 2725083 at Ladang New Rompin, Negeri Sembilan

Site 2725083 at Ladang New Rompin, Negeri Sembilan						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,015	1,813	2,117	1,188	2,352	1,897
ECHM5_A1B_2	1,284	1,749	1,611	1,513	1,584	1,548
ECHM5_A1B_3	2,459	1,528	2,068	1,554	1,534	1,829
Average_ECHM5_A1B	1,920	1,697	1,932	1,418	1,823	1,758
ECHM5_A2_1	1,847	1,930	1,574	2,078	2,192	1,924
ECHM5_A2_2	1,123	2,007	1,394	2,529	1,859	1,782
ECHM5_A2_3	1,876	1,670	1,353	1,631	1,839	1,674
Average_ECHM5_A2	1,615	1,869	1,440	2,079	1,963	1,793
ECHM5_B1_1	2,193	2,310	1,822	1,662	2,030	2,003
ECHM5_B1_2	1,688	1,751	1,224	1,671	1,790	1,625
ECHM5_B1_3	1,542	1,960	1,586	2,375	1,794	1,852
Average_ECHM5_B1	1,808	2,007	1,544	1,903	1,871	1,827
CCSM3_A1B	2,242	1,415	1,981	2,146	1,741	1,905
CCSM3_A2	2,196	1,283	1,386	1,706	1,299	1,574
CCSM3_B1	1,753	1,830	1,831	1,676	1,399	1,698
MRI_A1B	1,775	1,388	1,803	1,323	1,159	1,490
MRI_B1	1,186	1,368	1,593	1,287	1,620	1,411
Average_A1B	1,955	1,579	1,916	1,545	1,674	1,734
Average_A2	1,761	1,722	1,427	1,986	1,674	1,714
Average_B1	1,672	1,844	1,611	1,734	1,797	1,732
Average_ALL	1,799	1,714	1,667	1,739	1,728	1,729
OBSERVED	1,606	1,695	1,445	1,677	1,688	1,622

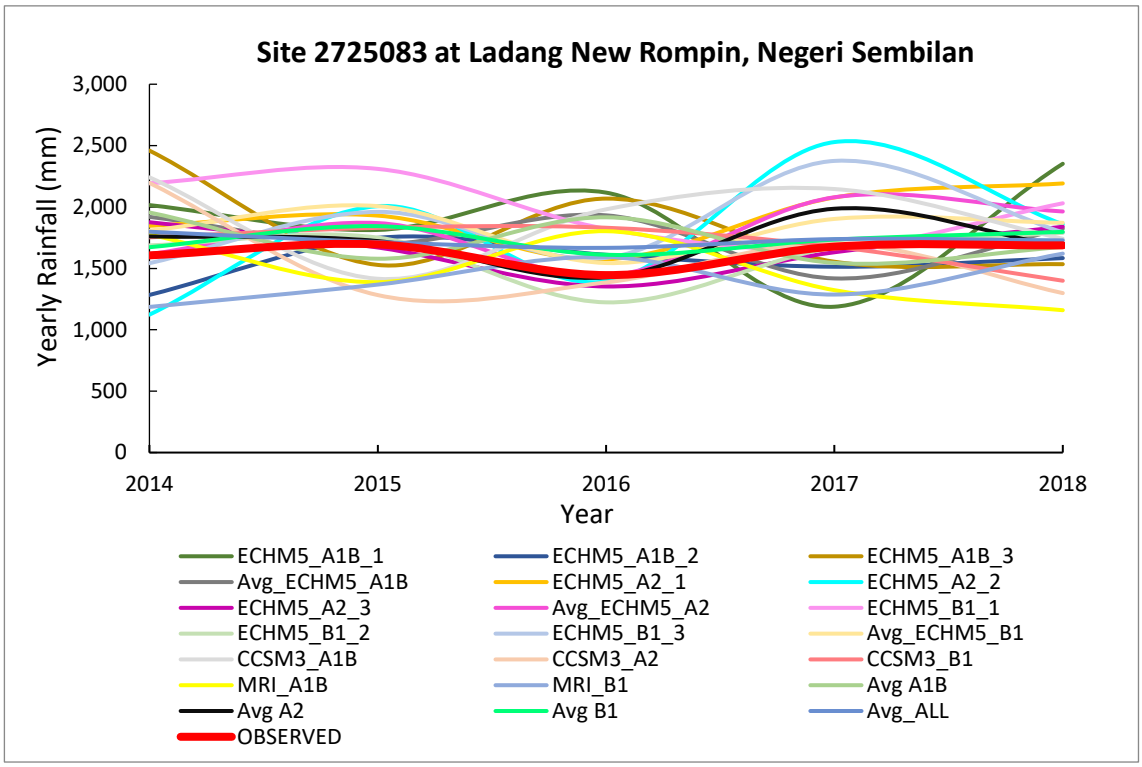


Figure A8-1: Projected and observed 2014-2018 yearly rainfall for Site 2725083 at Ladang New Rompin, Negeri Sembilan

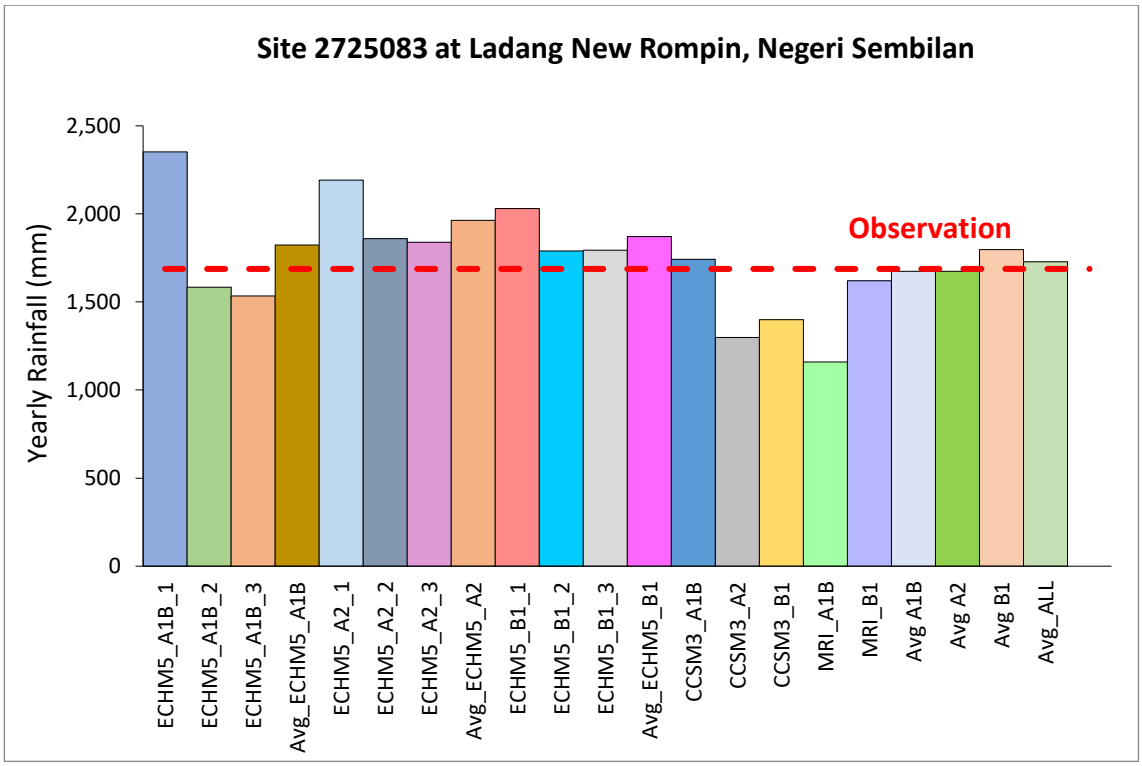


Figure A8-2: Projected and observed 2018 yearly rainfall for Site 2725083 at Ladang New Rompin, Negeri Sembilan

Table A8-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2725083 at Ladang New Rompin, Negeri Sembilan

Site 2725083 at Ladang New Rompin, Negeri Sembilan						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	25	7	46	-29	39	18
ECHM5_A1B_2	-20	3	11	-10	-6	-4
ECHM5_A1B_3	53	-10	43	-7	-9	14
Average_ECHM5_A1B	20	0	34	-15	8	9
ECHM5_A2_1	15	14	9	24	30	18
ECHM5_A2_2	-30	18	-4	51	10	9
ECHM5_A2_3	17	-1	-6	-3	9	3
Average_ECHM5_A2	1	10	0	24	16	10
ECHM5_B1_1	37	36	26	-1	20	24
ECHM5_B1_2	5	3	-15	0	6	0
ECHM5_B1_3	-4	16	10	42	6	14
Average_ECHM5_B1	13	18	7	13	11	12
CCSM3_A1B	40	-16	37	28	3	18
CCSM3_A2	37	-24	-4	2	-23	-3
CCSM3_B1	9	8	27	0	-17	5
MRI_A1B	11	-18	25	-21	-31	-7
MRI_B1	-26	-19	10	-23	-4	-13
Average_A1B	22	-7	33	-8	-1	8
Average_A2	10	2	-1	18	-1	6
Average_B1	4	9	11	3	6	7
Average_ALL	12	1	15	4	2	7

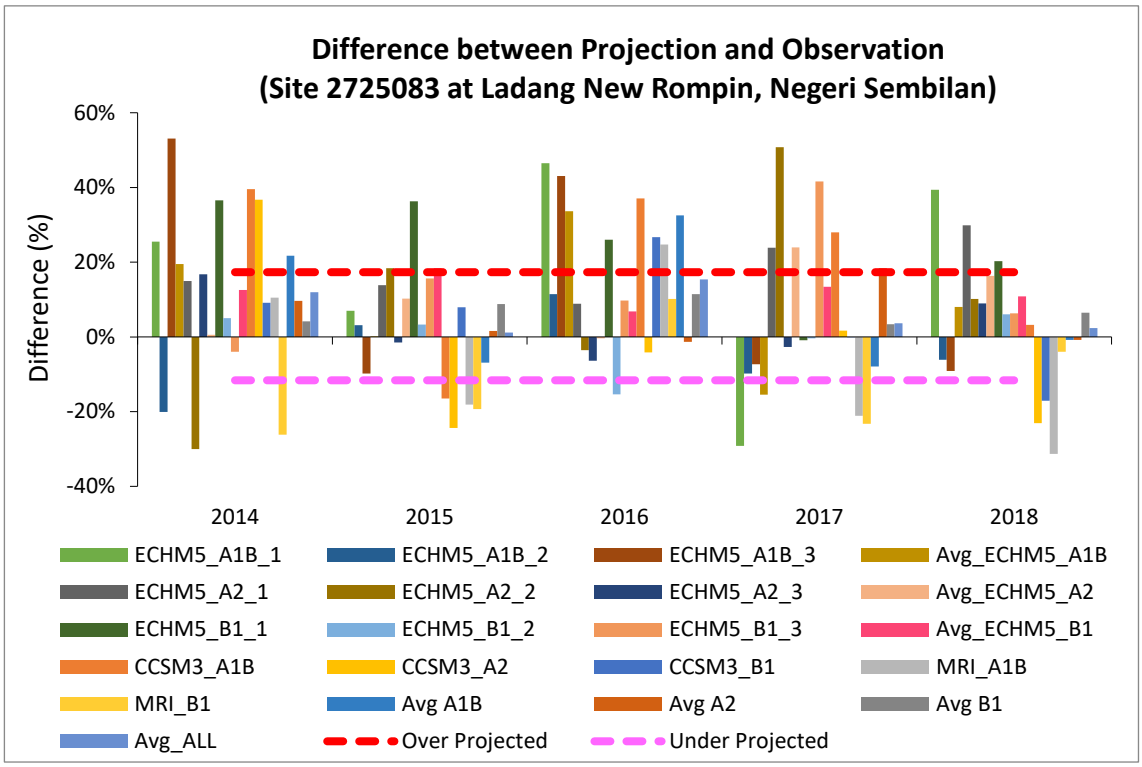


Figure A8-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2725083 at Ladang New Rompin, Negeri Sembilan

A9: Site 2237164 at Jalan Kluang-Mersing, Johor

Table A9-1: Projected and observed 2014-2018 yearly rainfall for Site 2237164 at Jalan Kluang-Mersing, Johor

Site 2237164 at Jalan Kluang-Mersing, Johor						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	3,981	3,604	3,854	2,268	3,651	3,471
ECHM5_A1B_2	2,930	3,032	3,048	2,536	1,914	2,692
ECHM5_A1B_3	3,553	2,856	2,670	2,221	2,300	2,720
Average_ECHM5_A1B	3,488	3,164	3,191	2,341	2,622	2,961
ECHM5_A2_1	3,411	2,912	3,110	4,704	2,769	3,381
ECHM5_A2_2	2,018	3,585	2,012	3,713	3,264	2,919
ECHM5_A2_3	2,794	4,538	3,226	2,687	2,262	3,101
Average_ECHM5_A2	2,741	3,678	2,783	3,701	2,765	3,134
ECHM5_B1_1	3,750	3,298	2,381	2,464	2,579	2,894
ECHM5_B1_2	2,015	2,791	1,920	2,548	2,884	2,432
ECHM5_B1_3	2,253	2,946	2,618	3,523	2,800	2,828
Average_ECHM5_B1	2,673	3,012	2,306	2,845	2,754	2,718
CCSM3_A1B	3,905	2,658	2,492	3,097	3,642	3,159
CCSM3_A2	2,671	1,749	1,867	2,219	2,104	2,122
CCSM3_B1	2,202	3,704	1,976	3,103	4,013	3,000
MRI_A1B	2,531	2,888	3,651	1,941	2,214	2,645
MRI_B1	2,748	3,315	4,081	2,500	2,966	3,122
Average_A1B	3,380	3,008	3,143	2,412	2,744	2,937
Average_A2	2,724	3,196	2,554	3,331	2,744	2,910
Average_B1	2,594	3,211	2,595	2,828	2,600	2,765
Average_ALL	2,912	3,134	2,779	2,823	2,812	2,892
OBSERVED	1,935	1,739	1,233	2,704	2,969	2,116

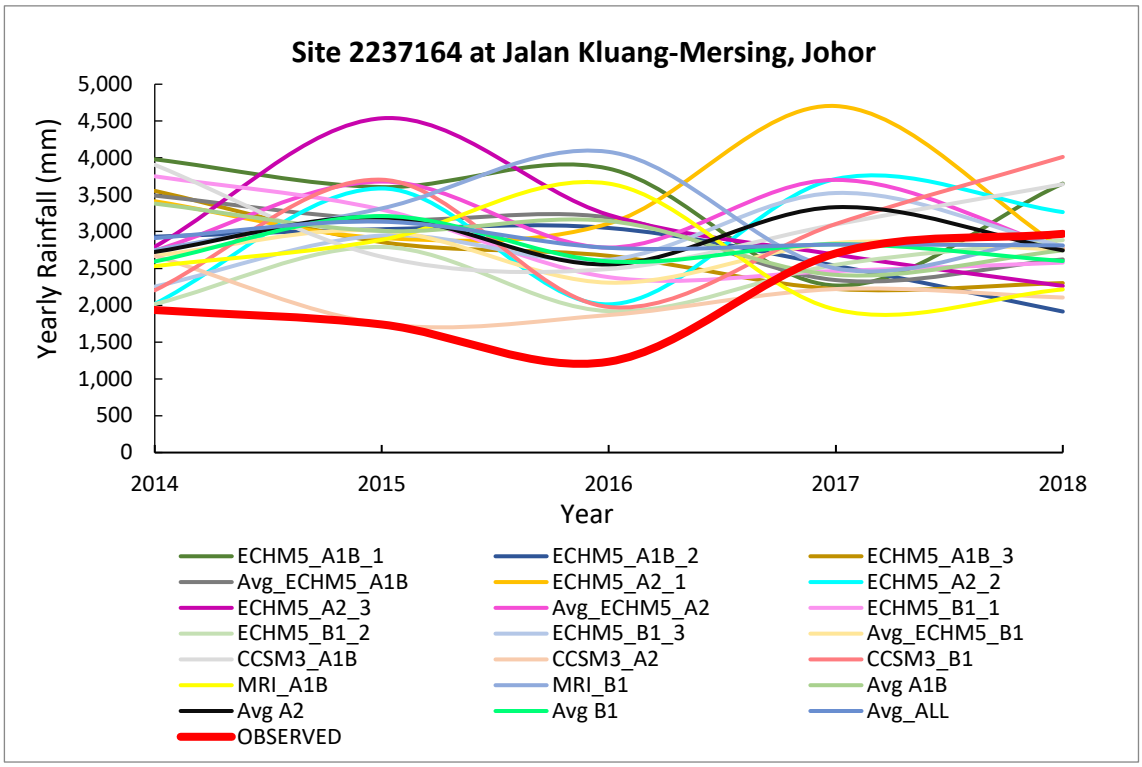


Figure A9-1: Projected and observed 2014-2018 yearly rainfall for Site 2237164 at Jalan Kluang-Mersing, Johor

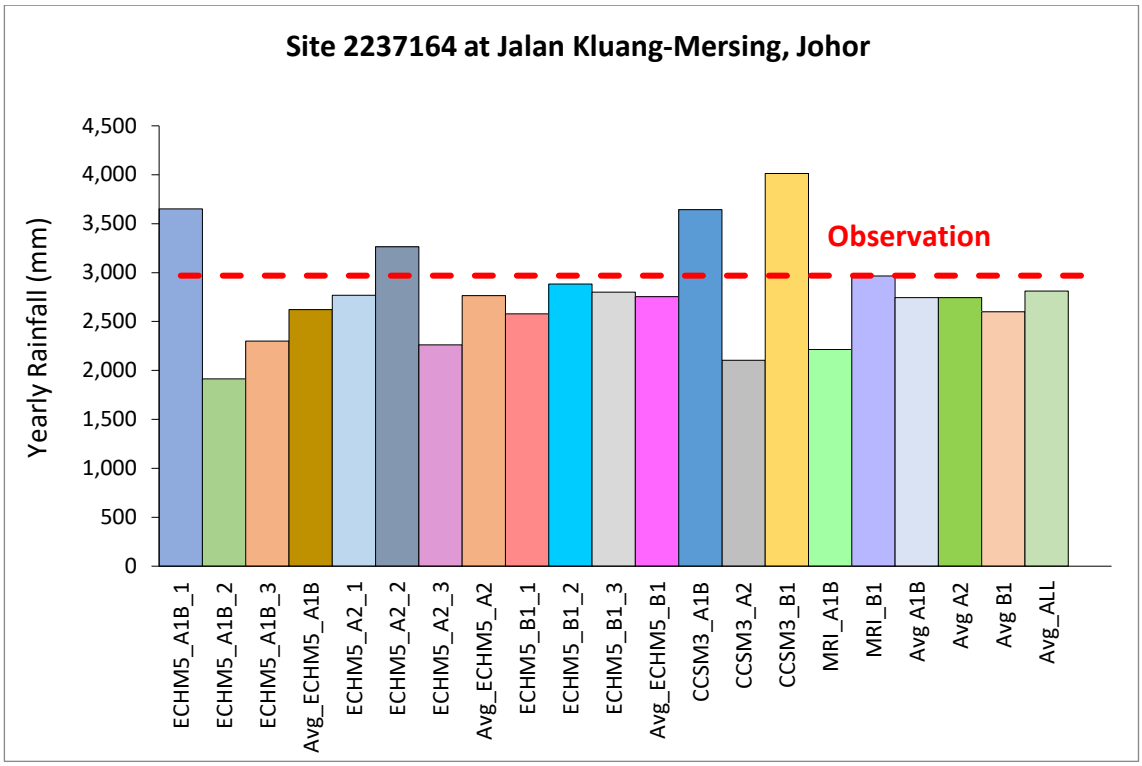


Figure A9-2: Projected and observed 2018 yearly rainfall for Site 2237164 at Jalan Kluang-Mersing, Johor

Table A9-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2237164 at Jalan Kluang-Mersing, Johor

Site 2237164 at Jalan Kluang-Mersing, Johor						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	106	107	212	-16	23	86
ECHM5_A1B_2	51	74	147	-6	-36	46
ECHM5_A1B_3	84	64	116	-18	-23	45
Average_ECHM5_A1B	80	82	159	-13	-12	59
ECHM5_A2_1	76	67	152	74	-7	73
ECHM5_A2_2	4	106	63	37	10	44
ECHM5_A2_3	44	161	162	-1	-24	68
Average_ECHM5_A2	42	112	126	37	-7	62
ECHM5_B1_1	94	90	93	-9	-13	51
ECHM5_B1_2	4	61	56	-6	-3	22
ECHM5_B1_3	16	69	112	30	-6	45
Average_ECHM5_B1	38	73	87	5	-7	39
CCSM3_A1B	102	53	102	15	23	59
CCSM3_A2	38	1	51	-18	-29	9
CCSM3_B1	14	113	60	15	35	47
MRI_A1B	31	66	196	-28	-25	48
MRI_B1	42	91	231	-8	0	71
Average_A1B	75	73	155	-11	-8	57
Average_A2	41	84	107	23	-8	49
Average_B1	34	85	110	5	-12	44
Average_ALL	50	80	125	4	-5	51

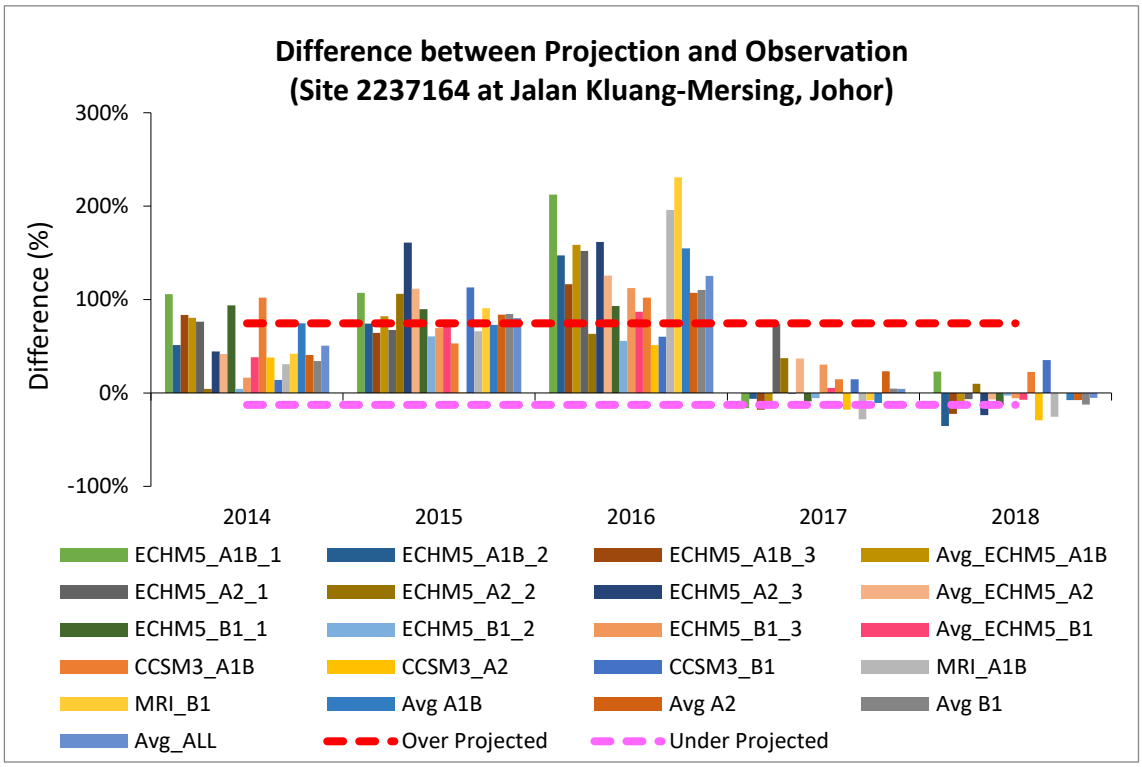


Figure A9-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2237164 at Jalan Kluang-Mersing, Johor

A10: Site 2636170 at Setor JPS Endau, Johor

Table A10-1: Projected and observed 2014-2018 yearly rainfall for Site 2636170 at Setor JPS Endau, Johor

Site 2636170 at Setor JPS Endau, Johor						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	3,552	3,249	4,659	2,720	4,053	3,647
ECHM5_A1B_2	2,819	2,354	2,613	3,395	1,906	2,618
ECHM5_A1B_3	3,410	3,116	2,682	2,211	2,625	2,809
Average_ECHM5_A1B	3,260	2,906	3,318	2,775	2,861	3,024
ECHM5_A2_1	3,258	2,496	3,443	4,291	3,360	3,370
ECHM5_A2_2	2,458	3,986	1,998	4,180	3,080	3,140
ECHM5_A2_3	2,818	4,329	3,101	3,132	2,771	3,230
Average_ECHM5_A2	2,845	3,604	2,847	3,868	3,070	3,247
ECHM5_B1_1	3,930	3,505	2,512	2,270	2,877	3,019
ECHM5_B1_2	1,647	2,124	2,507	2,782	3,593	2,531
ECHM5_B1_3	2,596	3,005	2,985	3,584	2,808	2,996
Average_ECHM5_B1	2,724	2,878	2,668	2,878	3,093	2,848
CCSM3_A1B	3,577	3,346	2,640	2,579	3,448	3,118
CCSM3_A2	2,822	1,995	2,789	2,177	2,509	2,458
CCSM3_B1	2,537	3,589	2,783	2,887	2,952	2,949
MRI_A1B	3,659	2,599	4,221	1,704	3,045	3,046
MRI_B1	2,518	2,587	3,102	2,309	3,589	2,821
Average_A1B	3,403	2,933	3,363	2,522	3,015	3,047
Average_A2	2,839	3,202	2,833	3,445	3,015	3,067
Average_B1	2,646	2,962	2,778	2,766	2,930	2,816
Average_ALL	2,971	3,020	3,002	2,873	3,044	2,982
OBSERVED	2,392	2,205	1,849	3,494	3,316	2,651

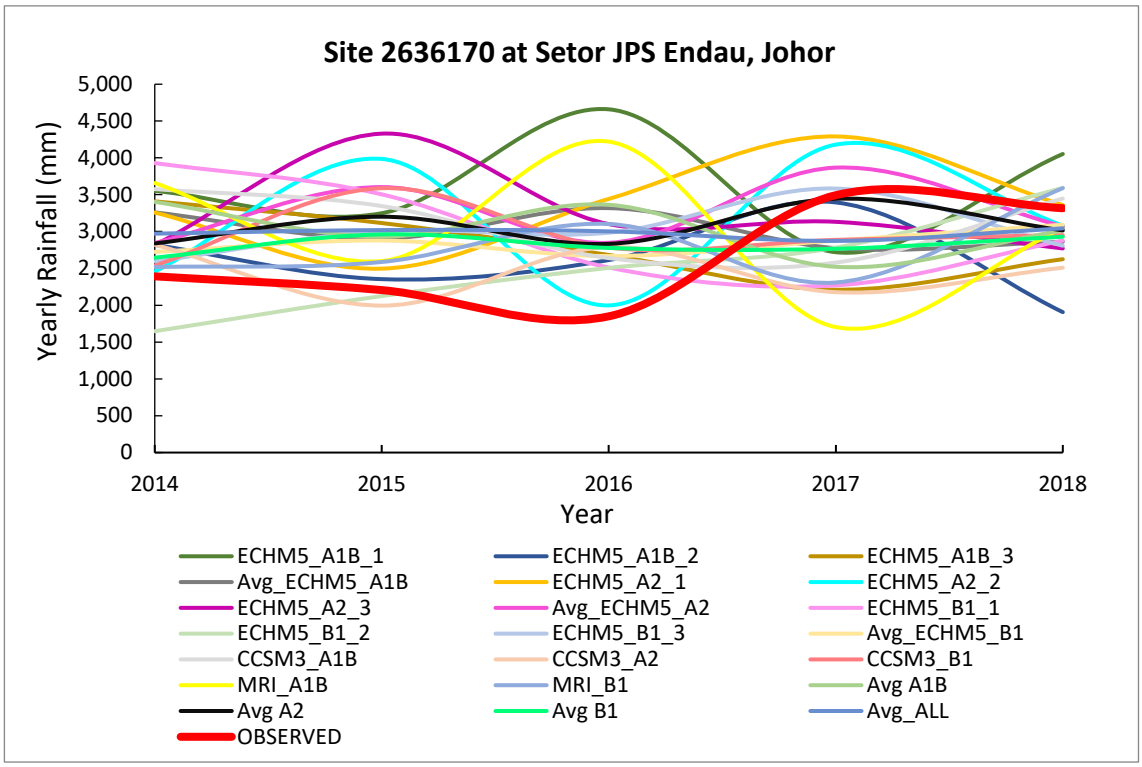


Figure A10-1: Projected and observed 2014-2018 yearly rainfall for Site 2636170 at Setor JPS Endau, Johor

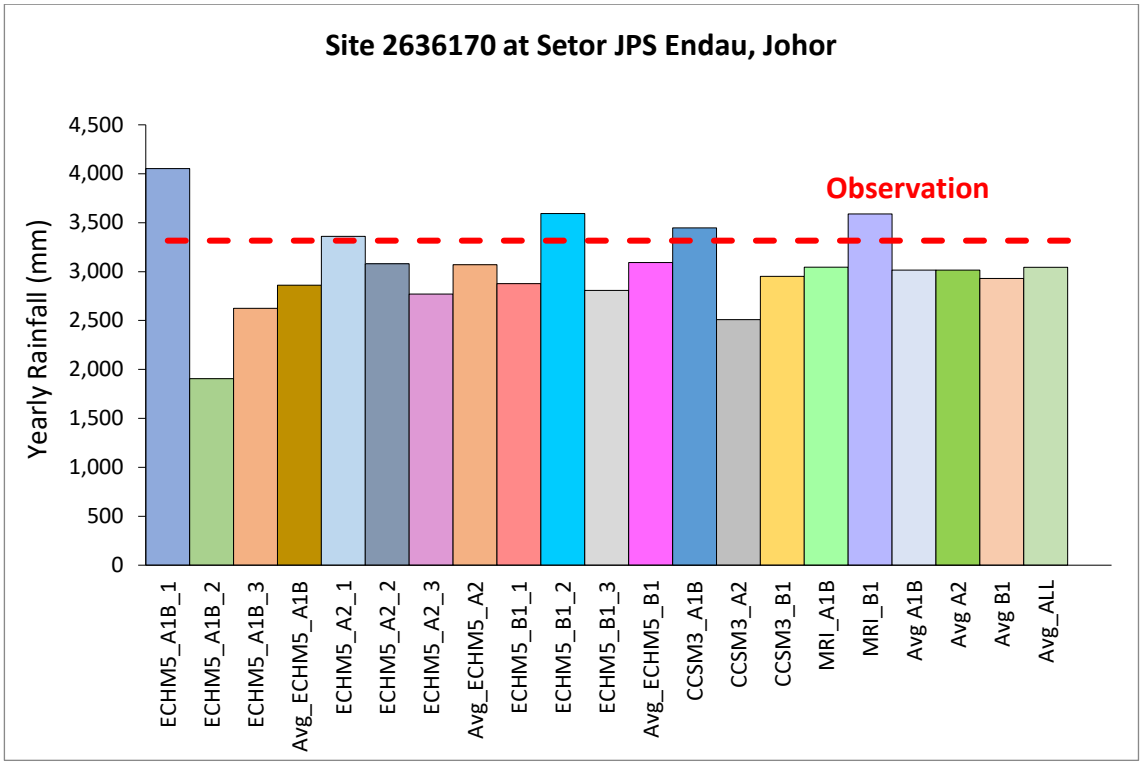


Figure A10-2: Projected and observed 2018 yearly rainfall for Site 2636170 at Setor JPS Endau, Johor

Table A10-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2636170 at Setor JPS Endau, Johor

Site 2636170 at Setor JPS Endau, Johor						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	49	47	152	-22	22	50
ECHM5_A1B_2	18	7	41	-3	-43	4
ECHM5_A1B_3	43	41	45	-37	-21	14
Average_ECHM5_A1B	36	32	79	-21	-14	23
ECHM5_A2_1	36	13	86	23	1	32
ECHM5_A2_2	3	81	8	20	-7	21
ECHM5_A2_3	18	96	68	-10	-16	31
Average_ECHM5_A2	19	63	54	11	-7	28
ECHM5_B1_1	64	59	36	-35	-13	22
ECHM5_B1_2	-31	-4	36	-20	8	-2
ECHM5_B1_3	9	36	61	3	-15	19
Average_ECHM5_B1	14	31	44	-18	-7	13
CCSM3_A1B	50	52	43	-26	4	24
CCSM3_A2	18	-10	51	-38	-24	-1
CCSM3_B1	6	63	50	-17	-11	18
MRI_A1B	53	18	128	-51	-8	28
MRI_B1	5	17	68	-34	8	13
Average_A1B	42	33	82	-28	-9	24
Average_A2	19	45	53	-1	-9	21
Average_B1	11	34	50	-21	-12	13
Average_ALL	24	37	62	-18	-8	20

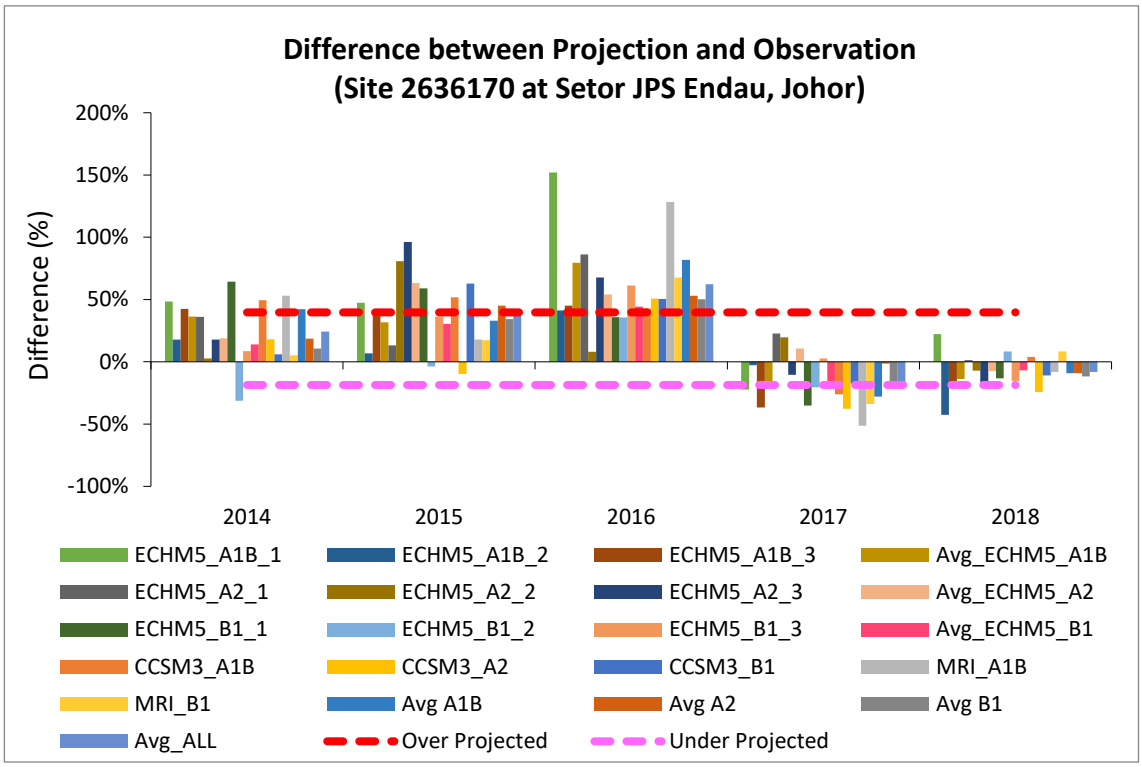


Figure A10-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2636170 at Setor JPS Endau, Johor

A11: Site 3424081 at JPS Temerloh, Pahang

Table A11-1: Projected and observed 2014-2018 yearly rainfall for Site 3424081 at JPS Temerloh, Pahang

Site 3424081 at JPS Temerloh, Pahang						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,129	1,595	2,042	1,421	2,198	1,877
ECHM5_A1B_2	1,346	1,954	1,953	1,765	1,389	1,681
ECHM5_A1B_3	2,305	1,754	2,180	1,606	1,676	1,904
Average_ECHM5_A1B	1,927	1,768	2,058	1,597	1,754	1,821
ECHM5_A2_1	1,824	1,642	1,827	2,208	1,736	1,848
ECHM5_A2_2	1,269	1,904	1,599	1,897	1,758	1,685
ECHM5_A2_3	1,744	1,636	1,393	1,716	1,851	1,668
Average_ECHM5_A2	1,612	1,728	1,606	1,941	1,782	1,734
ECHM5_B1_1	1,879	1,910	1,817	1,614	2,155	1,875
ECHM5_B1_2	1,765	1,702	1,408	1,696	2,092	1,733
ECHM5_B1_3	1,831	1,792	1,683	2,279	1,938	1,905
Average_ECHM5_B1	1,825	1,801	1,636	1,863	2,062	1,837
CCSM3_A1B	2,479	2,025	2,109	1,973	1,674	2,052
CCSM3_A2	2,046	1,644	1,800	2,155	1,628	1,855
CCSM3_B1	2,038	2,414	1,472	1,609	2,047	1,916
MRI_A1B	1,856	1,647	1,783	1,693	1,301	1,656
MRI_B1	1,964	1,282	1,407	1,710	1,720	1,617
Average_A1B	2,023	1,795	2,013	1,691	1,648	1,834
Average_A2	1,721	1,707	1,655	1,994	1,648	1,745
Average_B1	1,895	1,820	1,557	1,782	1,743	1,759
Average_ALL	1,891	1,779	1,748	1,810	1,797	1,805
OBSERVED	1,645	1,603	1,050	2,114	1,387	1,560

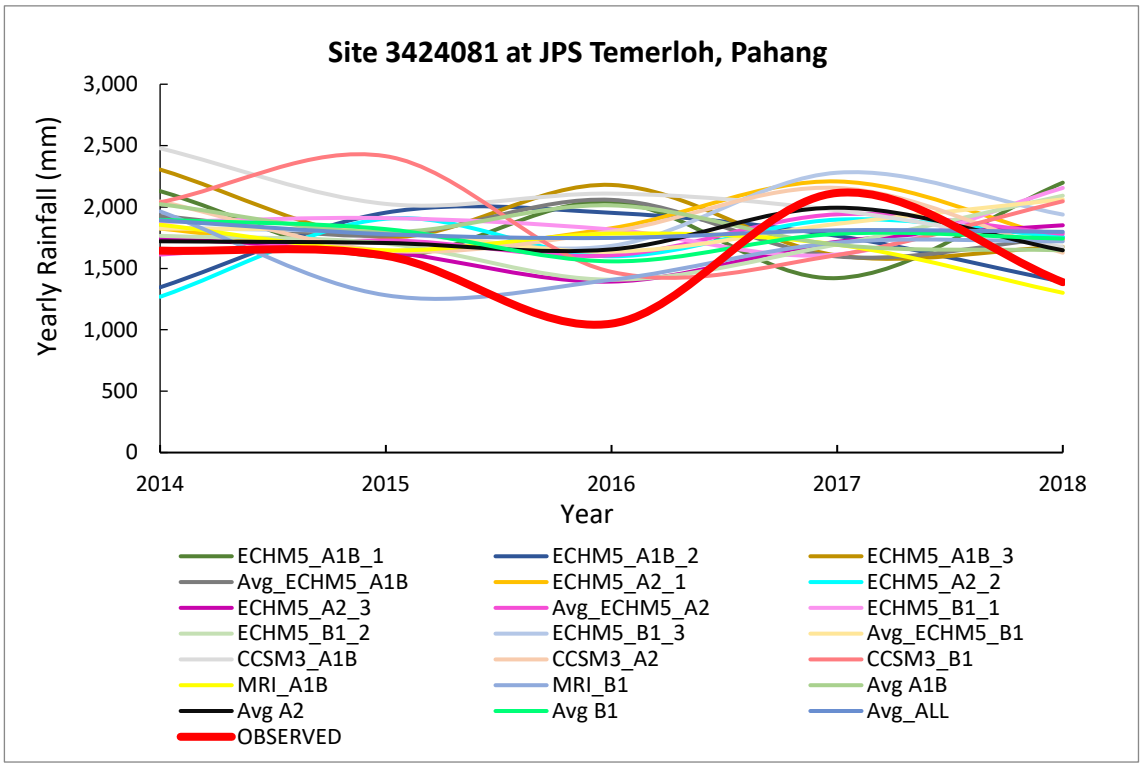


Figure A11-1: Projected and observed 2014-2018 yearly rainfall for Site 3424081 at JPS Temerloh, Pahang

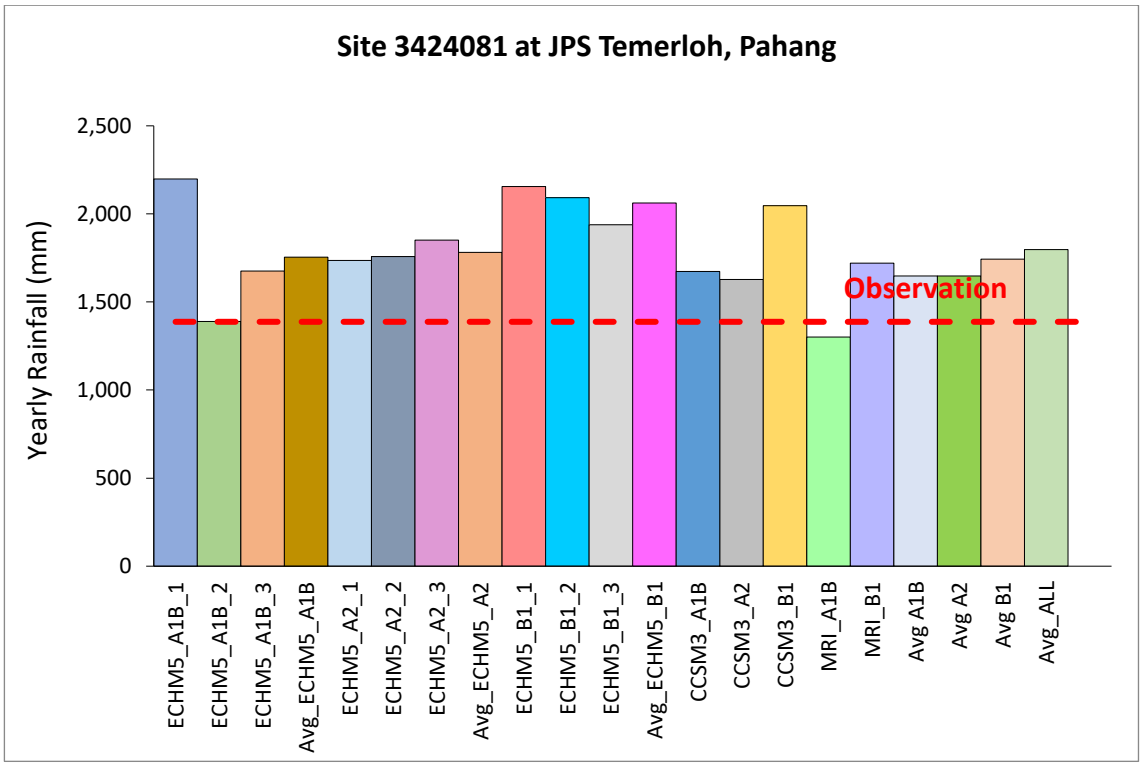


Figure A11-2: Projected and observed 2018 yearly rainfall for Site 3424081 at JPS Temerloh, Pahang

Table A11-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3424081 at JPS Temerloh, Pahang

Site 3424081 at JPS Temerloh, Pahang						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	29	0	94	-33	58	30
ECHM5_A1B_2	-18	22	86	-17	0	15
ECHM5_A1B_3	40	9	108	-24	21	31
Average_ECHM5_A1B	17	10	96	-24	26	25
ECHM5_A2_1	11	2	74	4	25	23
ECHM5_A2_2	-23	19	52	-10	27	13
ECHM5_A2_3	6	2	33	-19	33	11
Average_ECHM5_A2	-2	8	53	-8	28	16
ECHM5_B1_1	14	19	73	-24	55	28
ECHM5_B1_2	7	6	34	-20	51	16
ECHM5_B1_3	11	12	60	8	40	26
Average_ECHM5_B1	11	12	56	-12	49	23
CCSM3_A1B	51	26	101	-7	21	38
CCSM3_A2	24	3	71	2	17	24
CCSM3_B1	24	51	40	-24	48	28
MRI_A1B	13	3	70	-20	-6	12
MRI_B1	19	-20	34	-19	24	8
Average_A1B	23	12	92	-20	19	25
Average_A2	5	6	58	-6	19	16
Average_B1	15	14	48	-16	26	17
Average_ALL	15	11	66	-14	30	22

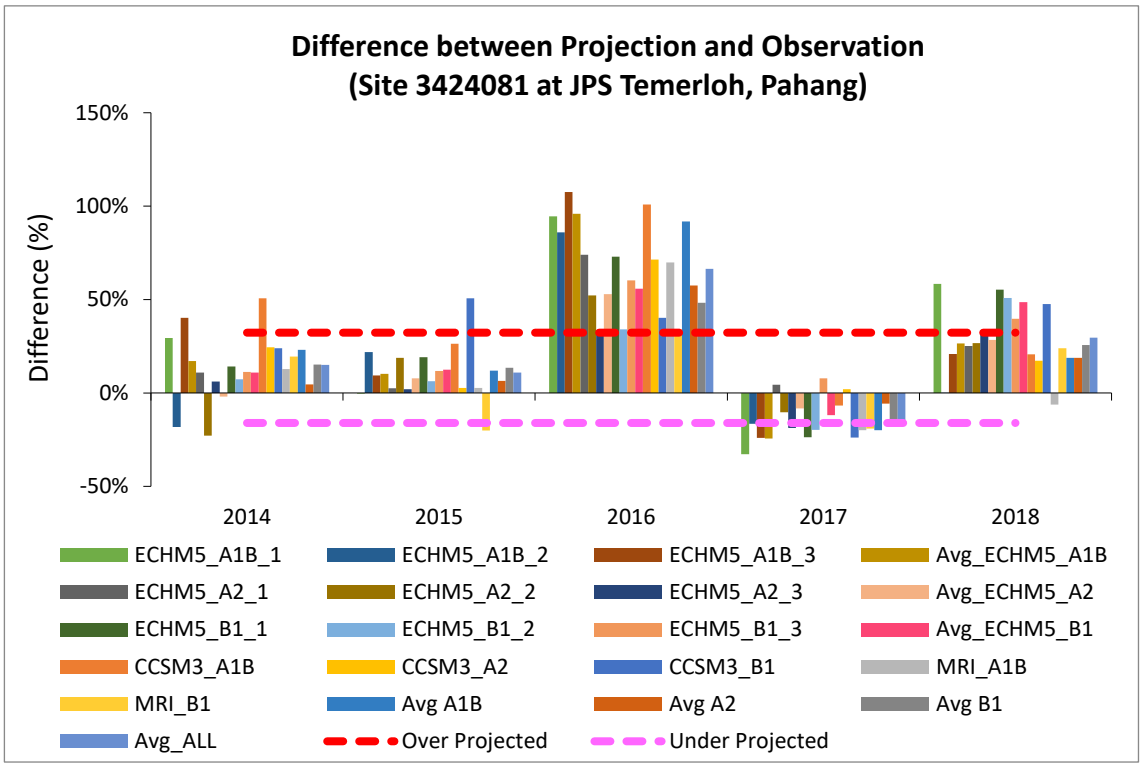


Figure A11-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3424081 at JPS Temerloh, Pahang

A12: Site 3818054 at Setor JPS Raub, Pahang

Table A12-1: Projected and observed 2014-2018 yearly rainfall for Site 3818054 at Setor JPS Raub, Pahang

Site 3818054 at Setor JPS Raub, Pahang						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,334	1,728	2,309	1,571	2,421	2,072
ECHM5_A1B_2	1,458	1,954	1,861	1,610	1,357	1,648
ECHM5_A1B_3	2,622	1,921	1,915	1,814	1,655	1,985
Average_ECHM5_A1B	2,138	1,868	2,028	1,665	1,811	1,902
ECHM5_A2_1	1,747	1,646	1,906	2,082	1,974	1,871
ECHM5_A2_2	1,246	1,878	1,634	1,894	2,295	1,789
ECHM5_A2_3	1,955	1,804	1,413	1,944	1,852	1,794
Average_ECHM5_A2	1,650	1,776	1,651	1,973	2,040	1,818
ECHM5_B1_1	1,749	1,963	2,379	1,734	2,138	1,993
ECHM5_B1_2	1,989	1,674	1,639	1,715	2,403	1,884
ECHM5_B1_3	1,810	1,821	1,674	2,292	2,005	1,920
Average_ECHM5_B1	1,849	1,820	1,897	1,914	2,182	1,932
CCSM3_A1B	2,520	2,274	2,405	2,162	1,744	2,221
CCSM3_A2	2,573	1,811	1,689	1,873	1,484	1,886
CCSM3_B1	2,485	2,397	1,964	1,540	2,104	2,098
MRI_A1B	2,378	1,634	2,027	1,797	1,151	1,798
MRI_B1	1,969	1,577	1,590	1,842	1,882	1,772
Average_A1B	2,262	1,902	2,103	1,791	1,666	1,945
Average_A2	1,880	1,785	1,661	1,948	1,666	1,788
Average_B1	2,000	1,887	1,849	1,824	1,901	1,892
Average_ALL	2,060	1,863	1,886	1,848	1,890	1,909
OBSERVED	1,277	1,301	833	2,244	1,775	1,486

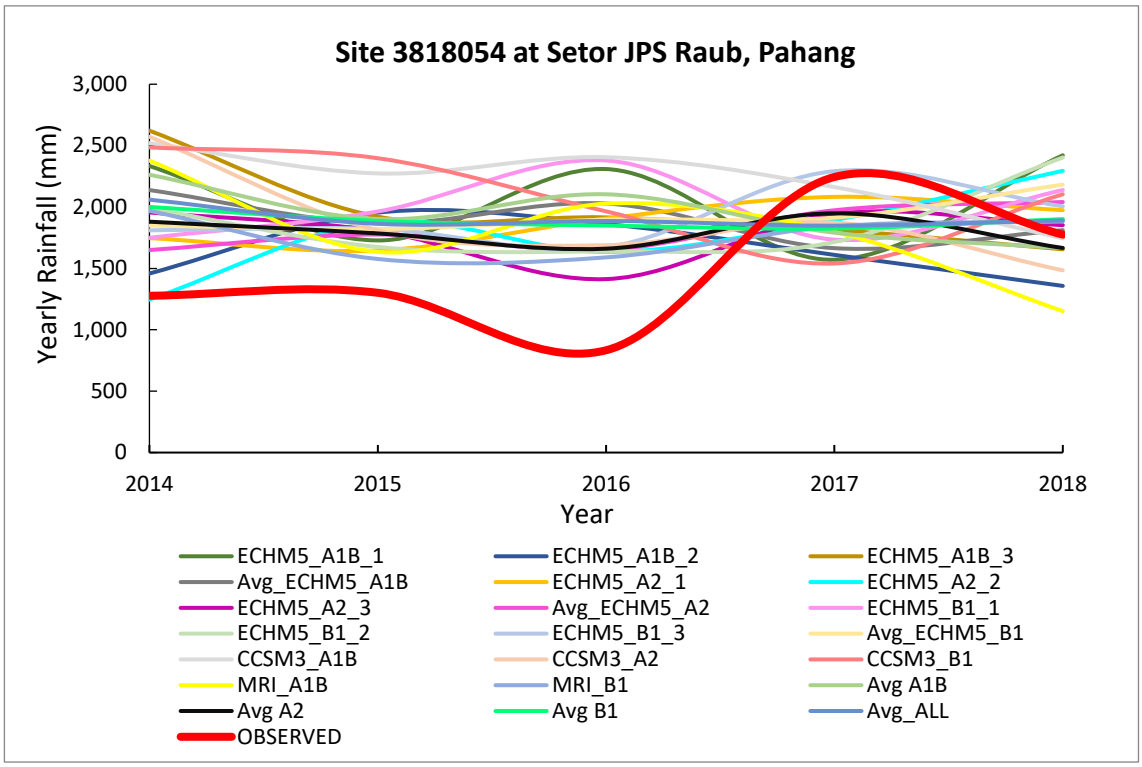


Figure A12-1: Projected and observed 2014-2018 yearly rainfall for Site 3818054 at Setor JPS Raub, Pahang

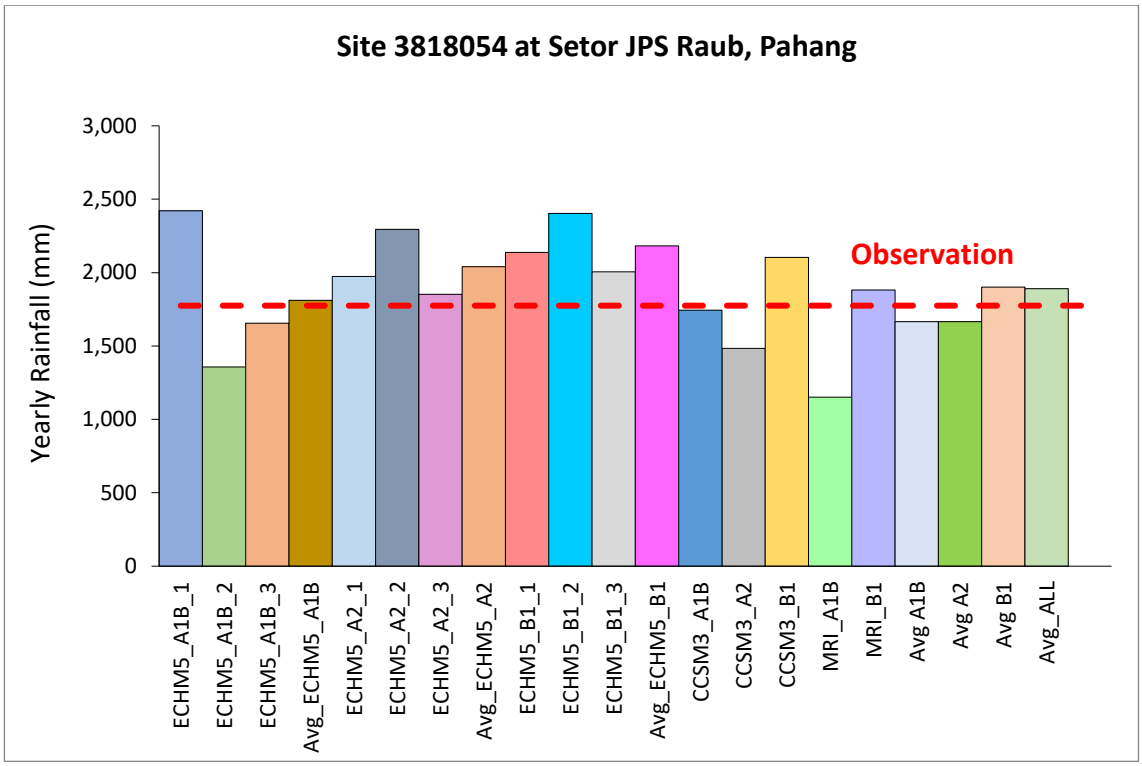


Figure A12-2: Projected and observed 2018 yearly rainfall for Site 3818054 at Setor JPS Raub, Pahang

Table A12-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3818054 at Setor JPS Raub, Pahang

Site 3818054 at Setor JPS Raub, Pahang						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	83	33	177	-30	36	60
ECHM5_A1B_2	14	50	123	-28	-24	27
ECHM5_A1B_3	105	48	130	-19	-7	51
Average_ECHM5_A1B	67	44	143	-26	2	46
ECHM5_A2_1	37	26	129	-7	11	39
ECHM5_A2_2	-2	44	96	-16	29	30
ECHM5_A2_3	53	39	70	-13	4	30
Average_ECHM5_A2	29	36	98	-12	15	33
ECHM5_B1_1	37	51	185	-23	20	54
ECHM5_B1_2	56	29	97	-24	35	39
ECHM5_B1_3	42	40	101	2	13	40
Average_ECHM5_B1	45	40	128	-15	23	44
CCSM3_A1B	97	75	189	-4	-2	71
CCSM3_A2	101	39	103	-17	-16	42
CCSM3_B1	95	84	136	-31	19	60
MRI_A1B	86	26	143	-20	-35	40
MRI_B1	54	21	91	-18	6	31
Average_A1B	77	46	152	-20	-6	50
Average_A2	47	37	99	-13	-6	33
Average_B1	57	45	122	-19	7	42
Average_ALL	61	43	126	-18	7	44

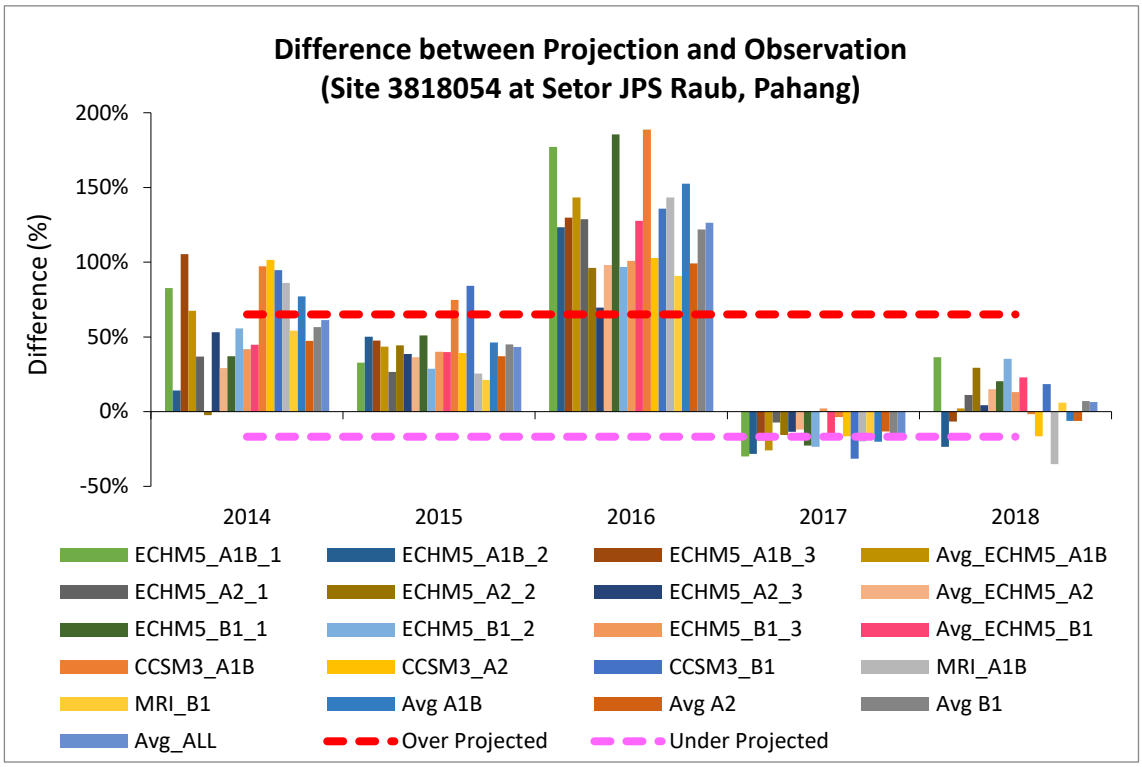


Figure A12-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3818054 at Setor JPS Raub, Pahang

A13: Site 3930012 at Sungai Lembing PCC Mill, Pahang

Table A13-1: Projected and observed 2014-2018 yearly rainfall for Site 3930012 at Sungai Lembing PCC Mill, Pahang

Site 3930012 at Sungai Lembing PCC Mill, Pahang						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,305	2,355	3,709	1,957	3,045	2,674
ECHM5_A1B_2	2,351	2,032	2,396	3,336	1,410	2,305
ECHM5_A1B_3	3,242	2,379	2,732	2,284	1,887	2,505
Average_ECHM5_A1B	2,632	2,255	2,946	2,525	2,114	2,495
ECHM5_A2_1	2,583	2,331	2,893	3,240	2,265	2,662
ECHM5_A2_2	2,321	3,514	1,899	2,880	1,850	2,493
ECHM5_A2_3	2,872	3,141	2,187	2,477	2,286	2,592
Average_ECHM5_A2	2,592	2,995	2,326	2,866	2,133	2,582
ECHM5_B1_1	3,169	3,475	2,392	2,170	3,284	2,898
ECHM5_B1_2	2,048	2,508	2,125	2,406	3,631	2,544
ECHM5_B1_3	2,450	2,503	2,869	3,147	2,649	2,724
Average_ECHM5_B1	2,555	2,829	2,462	2,574	3,188	2,722
CCSM3_A1B	3,403	2,555	2,662	2,249	2,455	2,665
CCSM3_A2	2,831	1,746	1,562	2,176	2,016	2,066
CCSM3_B1	3,146	2,809	2,354	2,299	2,478	2,617
MRI_A1B	3,557	2,625	2,774	2,848	2,538	2,868
MRI_B1	3,482	2,492	2,455	2,761	2,921	2,822
Average_A1B	2,972	2,389	2,855	2,535	2,267	2,603
Average_A2	2,652	2,683	2,135	2,693	2,267	2,486
Average_B1	2,859	2,758	2,439	2,557	2,104	2,543
Average_ALL	2,840	2,605	2,501	2,588	2,480	2,602
OBSERVED	3,470	2,021	2,792	3,390	2,625	2,860

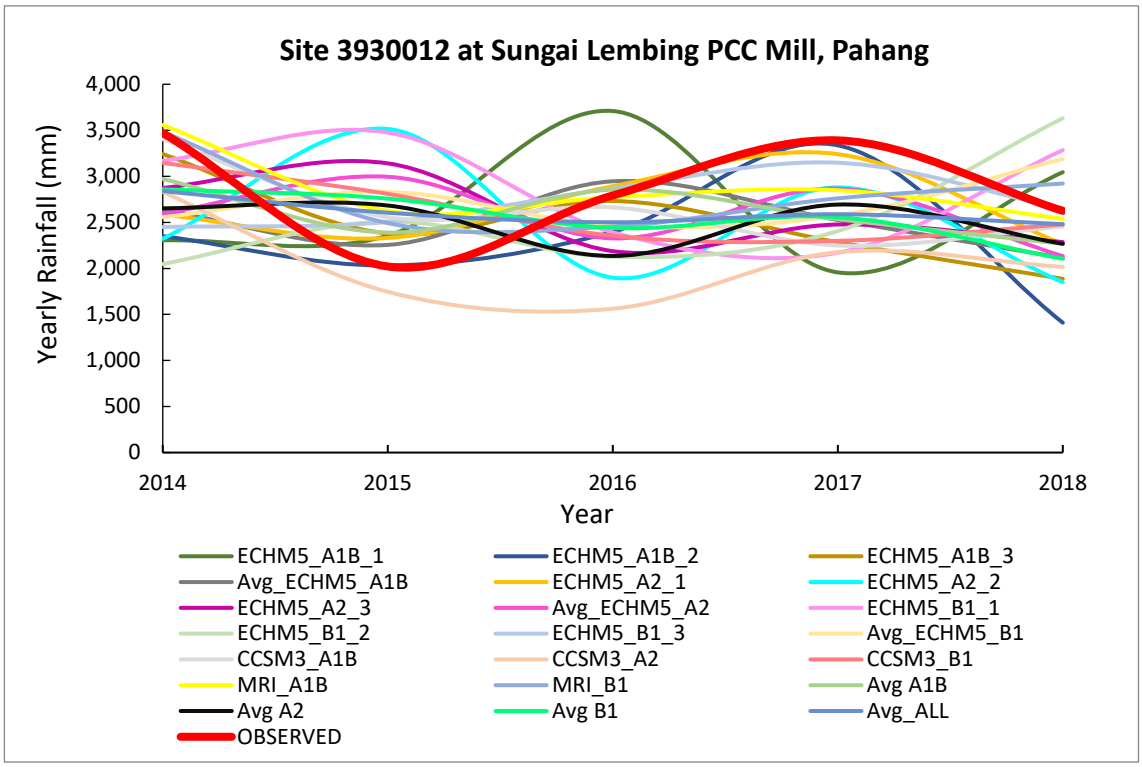


Figure A13-1: Projected and observed 2014-2018 yearly rainfall for Site 3930012 at Sungai Lembing PCC Mill, Pahang

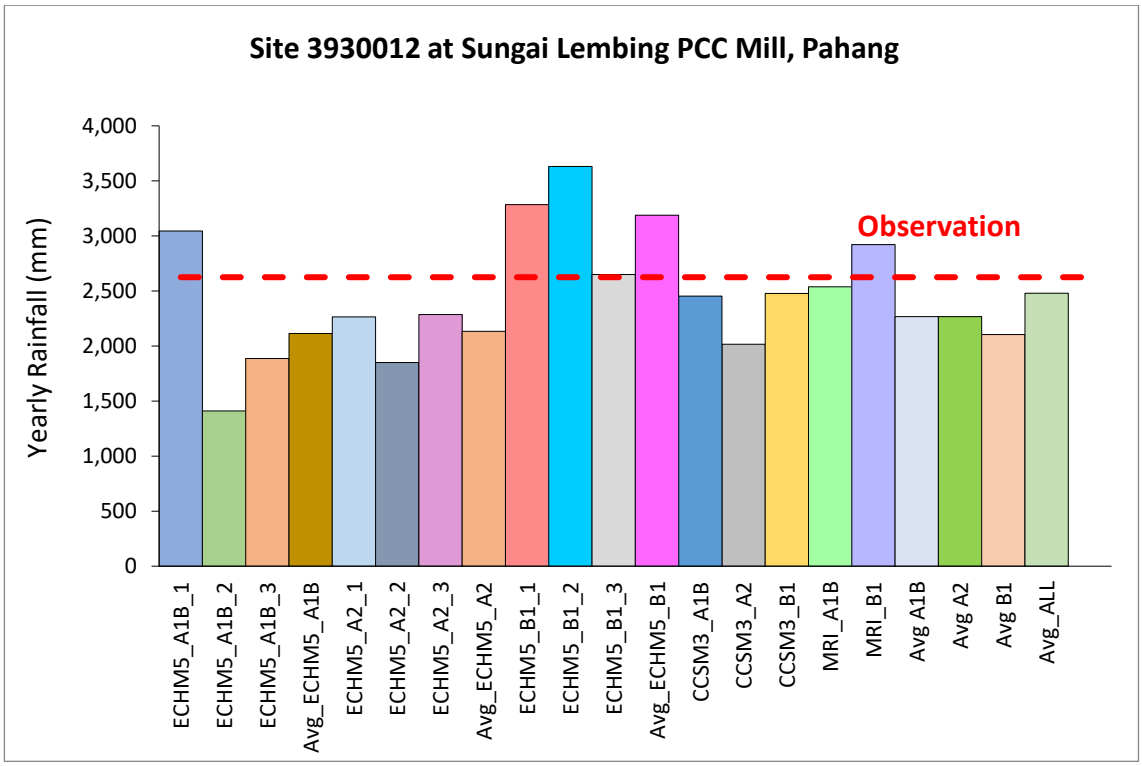


Figure A13-2: Projected and observed 2018 yearly rainfall for Site 3930012 at Sungai Lembing PCC Mill, Pahang

Table A13-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3930012 at Sungai Lembing PCC Mill, Pahang

Site 3930012 at Sungai Lembing PCC Mill, Pahang						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-34	17	33	-42	16	-2
ECHM5_A1B_2	-32	1	-14	-2	-46	-19
ECHM5_A1B_3	-7	18	-2	-33	-28	-10
Average_ECHM5_A1B	-24	12	6	-26	-19	-10
ECHM5_A2_1	-26	15	4	-4	-14	-5
ECHM5_A2_2	-33	74	-32	-15	-30	-7
ECHM5_A2_3	-17	55	-22	-27	-13	-5
Average_ECHM5_A2	-25	48	-17	-15	-19	-6
ECHM5_B1_1	-9	72	-14	-36	25	8
ECHM5_B1_2	-41	24	-24	-29	38	-6
ECHM5_B1_3	-29	24	3	-7	1	-2
Average_ECHM5_B1	-26	40	-12	-24	21	0
CCSM3_A1B	-2	26	-5	-34	-6	-4
CCSM3_A2	-18	-14	-44	-36	-23	-27
CCSM3_B1	-9	39	-16	-32	-6	-5
MRI_A1B	3	30	-1	-16	-3	2
MRI_B1	0	23	-12	-19	11	1
Average_A1B	-14	18	2	-25	-14	-7
Average_A2	-24	33	-24	-21	-14	-10
Average_B1	-18	36	-13	-25	-20	-8
Average_ALL	-18	29	-10	-24	-6	-6

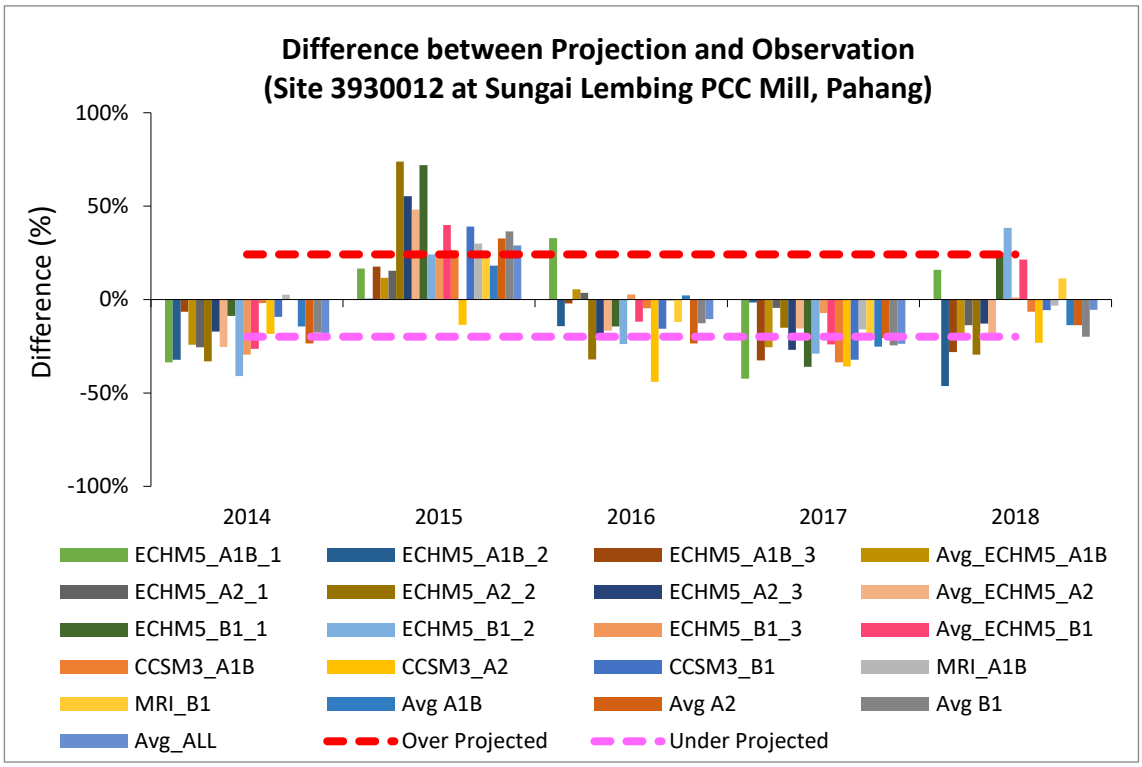


Figure A13-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3930012 at Sungai Lembing PCC Mill, Pahang

A14: Site 4513033 at Gunung Brinchang, Pahang

Table A14-1: Projected and observed 2014-2018 yearly rainfall for Site 4513033 at Gunung Brinchang, Pahang

Site 4513033 at Gunung Brinchang, Pahang						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,336	2,325	2,567	2,175	2,960	2,473
ECHM5_A1B_2	1,855	2,543	2,528	2,056	2,254	2,247
ECHM5_A1B_3	2,857	2,314	2,292	2,275	2,159	2,379
Average_ECHM5_A1B	2,349	2,394	2,463	2,169	2,458	2,366
ECHM5_A2_1	2,706	2,031	2,289	2,252	2,674	2,391
ECHM5_A2_2	1,898	2,760	2,042	2,201	2,625	2,305
ECHM5_A2_3	2,195	2,041	2,242	2,074	2,360	2,182
Average_ECHM5_A2	2,266	2,277	2,191	2,176	2,553	2,293
ECHM5_B1_1	2,058	2,438	2,567	2,443	2,612	2,424
ECHM5_B1_2	2,794	2,109	2,006	2,029	2,727	2,333
ECHM5_B1_3	2,134	2,146	1,990	2,678	2,642	2,318
Average_ECHM5_B1	2,329	2,231	2,188	2,383	2,660	2,358
CCSM3_A1B	4,062	2,702	3,197	2,824	1,693	2,896
CCSM3_A2	3,125	2,336	2,194	2,463	2,159	2,455
CCSM3_B1	3,316	3,122	2,441	1,629	2,683	2,638
MRI_A1B	2,990	2,247	2,731	2,553	1,427	2,390
MRI_B1	2,536	2,290	1,981	3,025	2,427	2,452
Average_A1B	2,820	2,426	2,663	2,377	2,099	2,477
Average_A2	2,481	2,292	2,192	2,247	2,099	2,262
Average_B1	2,568	2,421	2,197	2,361	2,454	2,400
Average_ALL	2,633	2,386	2,362	2,334	2,386	2,420
OBSERVED	1,972	2,560	2,114	2,873	2,664	2,437

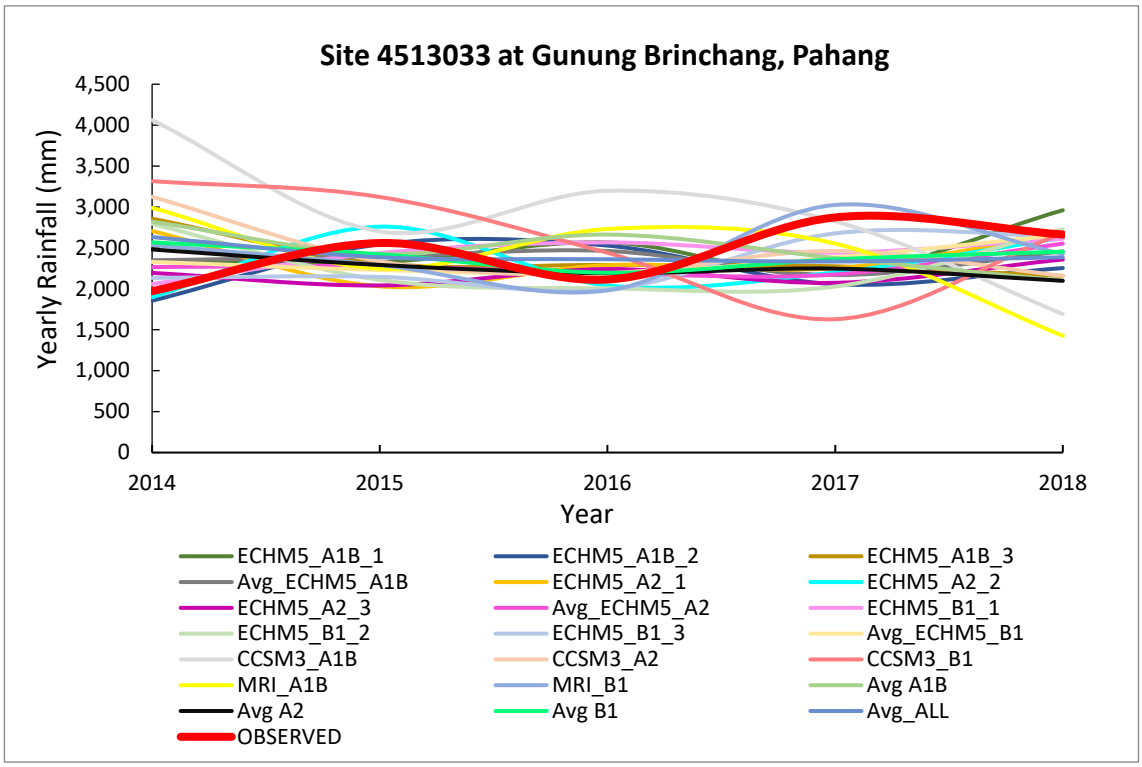


Figure A14-1: Projected and observed 2014-2018 yearly rainfall for Site 4513033 at Gunung Brinchang, Pahang

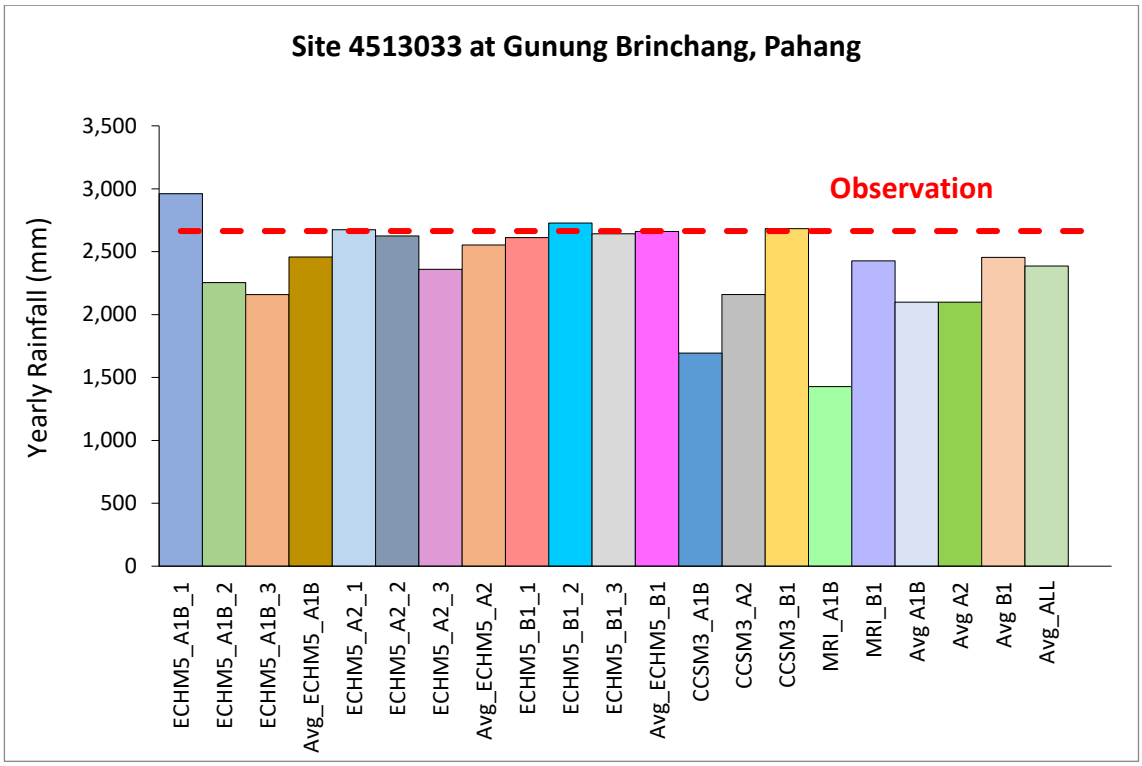


Figure A14-2: Projected and observed 2018 yearly rainfall for Site 4513033 at Gunung Brinchang, Pahang

Table A14-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4513033 at Gunung Brinchang, Pahang

Site 4513033 at Gunung Brinchang, Pahang						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	18	-9	21	-24	11	4
ECHM5_A1B_2	-6	-1	20	-28	-15	-6
ECHM5_A1B_3	45	-10	8	-21	-19	1
Average_ECHM5_A1B	19	-6	16	-25	-8	-1
ECHM5_A2_1	37	-21	8	-22	0	1
ECHM5_A2_2	-4	8	-3	-23	-1	-5
ECHM5_A2_3	11	-20	6	-28	-11	-8
Average_ECHM5_A2	15	-11	4	-24	-4	-4
ECHM5_B1_1	4	-5	21	-15	-2	1
ECHM5_B1_2	42	-18	-5	-29	2	-2
ECHM5_B1_3	8	-16	-6	-7	-1	-4
Average_ECHM5_B1	18	-13	3	-17	0	-2
CCSM3_A1B	106	6	51	-2	-36	25
CCSM3_A2	58	-9	4	-14	-19	4
CCSM3_B1	68	22	15	-43	1	13
MRI_A1B	52	-12	29	-11	-46	2
MRI_B1	29	-11	-6	5	-9	2
Average_A1B	43	-5	26	-17	-21	5
Average_A2	26	-10	4	-22	-21	-5
Average_B1	30	-5	4	-18	-8	1
Average_ALL	34	-7	12	-19	-10	2

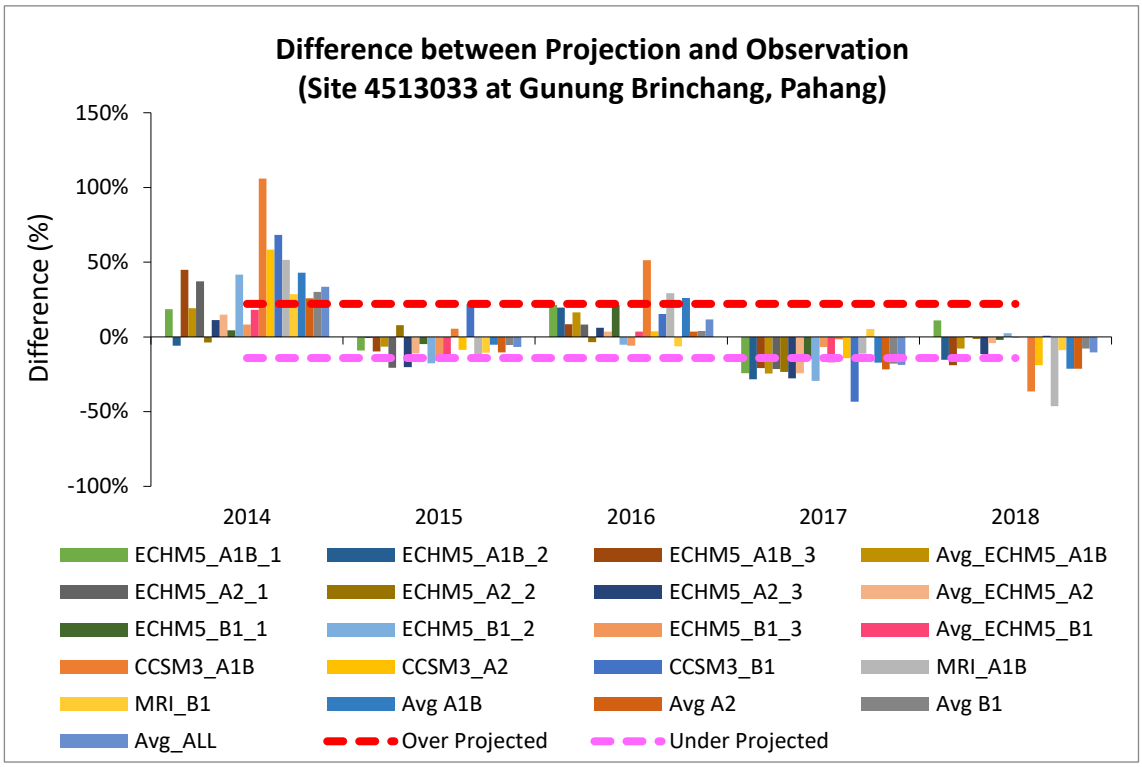


Figure A14-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4513033 at Gunung Brinchang, Pahang

A15: Site 4234109 at JPS Kemaman, Terengganu

Table A15-1: Projected and observed 2014-2018 yearly rainfall for Site 4234109 at JPS Kemaman, Terengganu

Site 4234109 at JPS Kemaman, Terengganu						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,305	2,842	4,421	3,391	3,340	3,260
ECHM5_A1B_2	2,706	2,300	2,365	3,952	1,486	2,561
ECHM5_A1B_3	2,955	3,330	5,192	2,217	2,094	3,158
Average_ECHM5_A1B	2,655	2,824	3,993	3,187	2,307	2,993
ECHM5_A2_1	3,229	2,796	3,376	4,335	2,992	3,346
ECHM5_A2_2	2,550	3,761	2,215	3,717	1,809	2,810
ECHM5_A2_3	3,486	4,646	2,366	2,501	2,080	3,016
Average_ECHM5_A2	3,088	3,734	2,652	3,517	2,294	3,057
ECHM5_B1_1	3,648	3,878	2,423	2,422	4,539	3,382
ECHM5_B1_2	1,998	3,189	2,606	3,344	4,490	3,125
ECHM5_B1_3	2,306	3,194	3,857	3,837	2,717	3,182
Average_ECHM5_B1	2,650	3,421	2,962	3,201	3,915	3,230
CCSM3_A1B	3,240	2,251	2,995	1,798	2,996	2,656
CCSM3_A2	3,418	2,083	1,579	2,102	2,118	2,260
CCSM3_B1	3,177	2,639	2,112	2,985	2,407	2,664
MRI_A1B	3,830	2,485	2,511	3,146	2,461	2,887
MRI_B1	3,416	2,305	2,594	2,983	3,479	2,955
Average_A1B	3,007	2,642	3,497	2,901	2,475	2,904
Average_A2	3,171	3,321	2,384	3,163	2,475	2,903
Average_B1	2,909	3,041	2,718	3,114	2,250	2,806
Average_ALL	3,019	2,979	2,901	3,052	2,786	2,947
OBSERVED	3,220	1,954	2,277	2,859	2,801	2,622

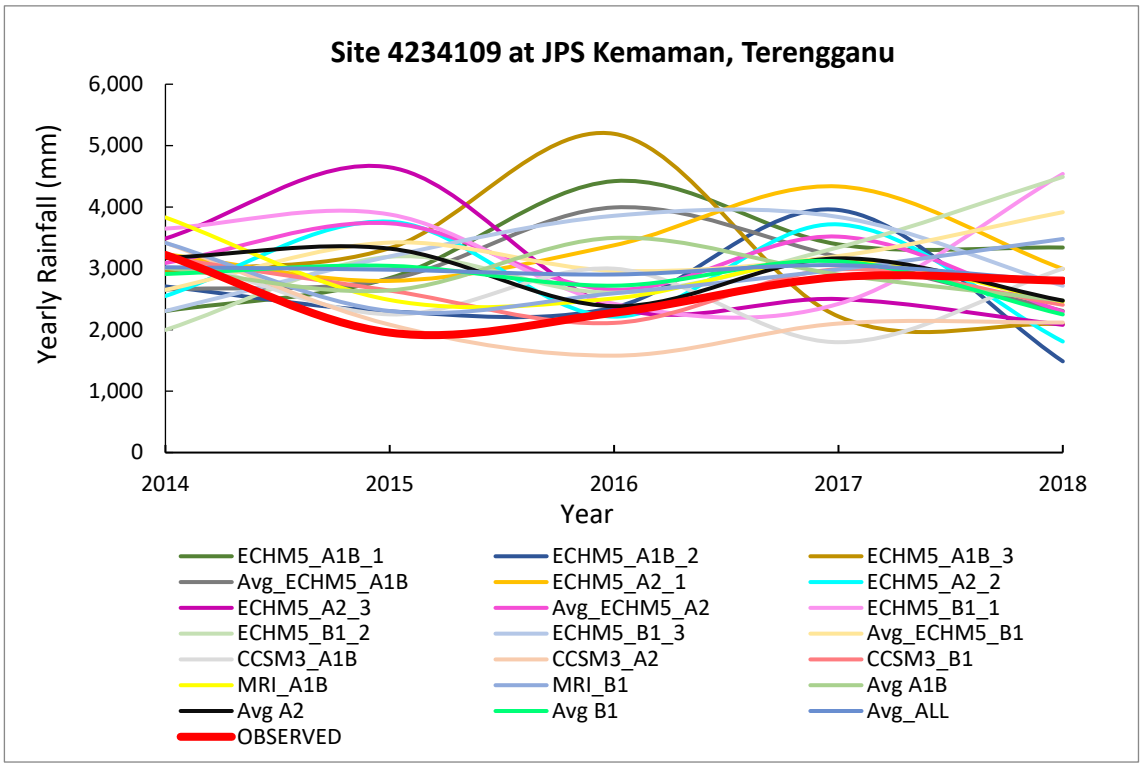


Figure A15-1: Projected and observed 2014-2018 yearly rainfall for Site 4234109 at JPS Kemaman, Terengganu

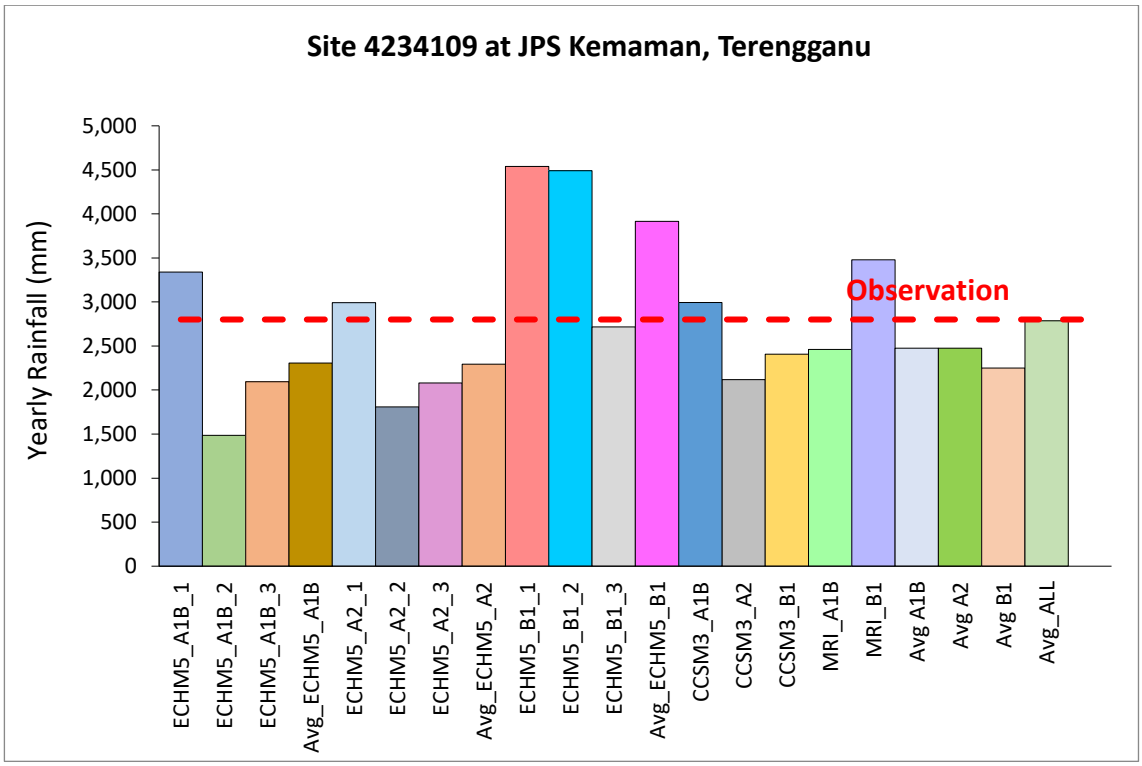


Figure A15-2: Projected and observed 2018 yearly rainfall for Site 4234109 at JPS Kemaman, Terengganu

Table A15-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4234109 at JPS Kemaman, Terengganu

Site 4234109 at JPS Kemaman, Terengganu						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-28	45	94	19	19	30
ECHM5_A1B_2	-16	18	4	38	-47	-1
ECHM5_A1B_3	-8	70	128	-22	-25	29
Average_ECHM5_A1B	-18	45	75	11	-18	19
ECHM5_A2_1	0	43	48	52	7	30
ECHM5_A2_2	-21	92	-3	30	-35	13
ECHM5_A2_3	8	138	4	-13	-26	22
Average_ECHM5_A2	-4	91	16	23	-18	22
ECHM5_B1_1	13	99	6	-15	62	33
ECHM5_B1_2	-38	63	14	17	60	23
ECHM5_B1_3	-28	64	69	34	-3	27
Average_ECHM5_B1	-18	75	30	12	40	28
CCSM3_A1B	1	15	32	-37	7	3
CCSM3_A2	6	7	-31	-26	-24	-14
CCSM3_B1	-1	35	-7	4	-14	3
MRI_A1B	19	27	10	10	-12	11
MRI_B1	6	18	14	4	24	13
Average_A1B	-7	35	54	1	-12	14
Average_A2	-2	70	5	11	-12	14
Average_B1	-10	56	19	9	-20	11
Average_ALL	-6	52	27	7	-1	16

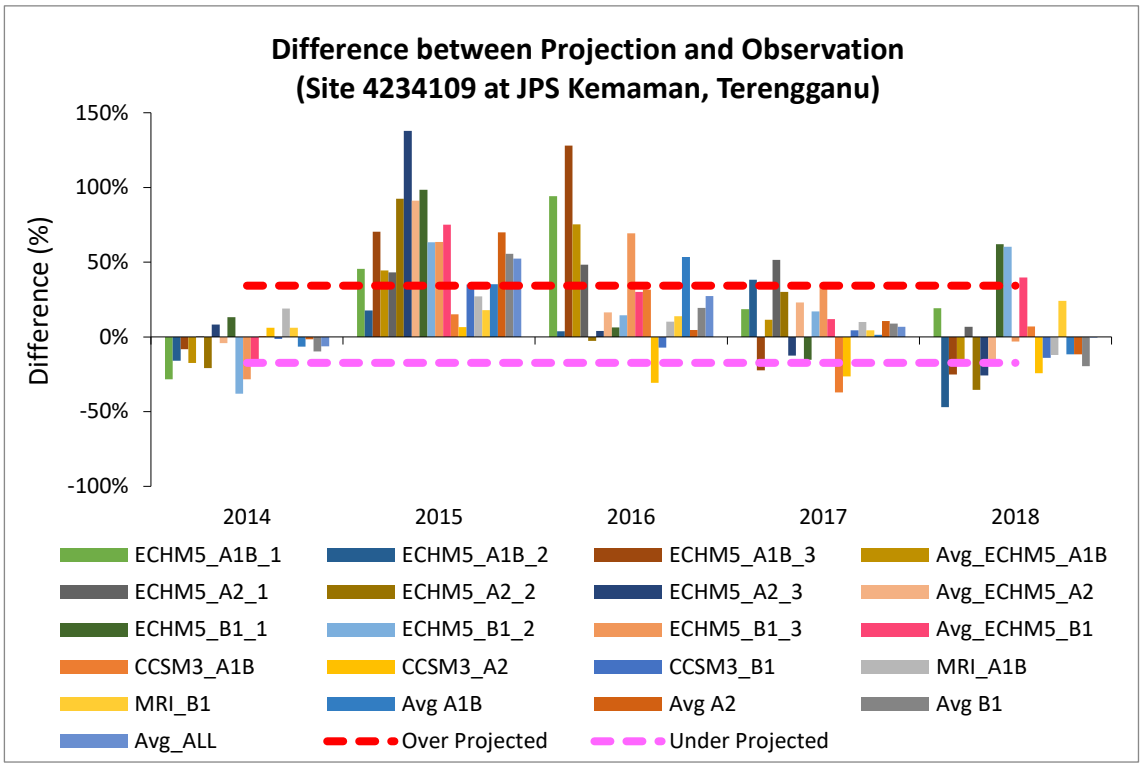


Figure A15-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4234109 at JPS Kemaman, Terengganu

A16: Site 4734079 at SM Sultan Omar Dungun, Terengganu

Table A16-1: Projected and observed 2014-2018 yearly rainfall for Site 4734079 at SM Sultan Omar Dungun, Terengganu

Site 4734079 at SM Sultan Omar Dungun, Terengganu						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,191	2,581	3,652	2,413	2,511	2,670
ECHM5_A1B_2	2,638	2,139	2,028	3,114	1,451	2,274
ECHM5_A1B_3	3,554	2,289	3,631	2,538	1,657	2,734
Average_ECHM5_A1B	2,794	2,337	3,104	2,688	1,873	2,559
ECHM5_A2_1	2,964	2,971	3,310	3,422	2,111	2,956
ECHM5_A2_2	2,136	3,731	1,743	3,001	1,453	2,413
ECHM5_A2_3	2,768	3,619	2,054	2,002	2,461	2,581
Average_ECHM5_A2	2,623	3,440	2,369	2,808	2,008	2,650
ECHM5_B1_1	3,166	3,555	2,174	1,769	3,105	2,754
ECHM5_B1_2	2,144	3,044	2,020	2,870	3,330	2,682
ECHM5_B1_3	1,997	2,613	2,747	2,759	2,636	2,550
Average_ECHM5_B1	2,436	3,071	2,313	2,466	3,024	2,662
CCSM3_A1B	3,276	2,108	2,960	1,975	2,498	2,563
CCSM3_A2	4,306	2,030	1,350	2,688	2,249	2,525
CCSM3_B1	2,735	2,471	1,991	2,253	2,857	2,462
MRI_A1B	4,180	3,137	3,004	3,609	1,527	3,091
MRI_B1	3,963	3,354	2,336	3,828	3,927	3,481
Average_A1B	3,168	2,451	3,055	2,730	1,929	2,666
Average_A2	3,044	3,088	2,114	2,778	1,929	2,590
Average_B1	2,801	3,007	2,253	2,696	2,069	2,565
Average_ALL	3,001	2,832	2,500	2,731	2,412	2,695
OBSERVED	2,851	2,124	2,630	3,973	2,869	2,889

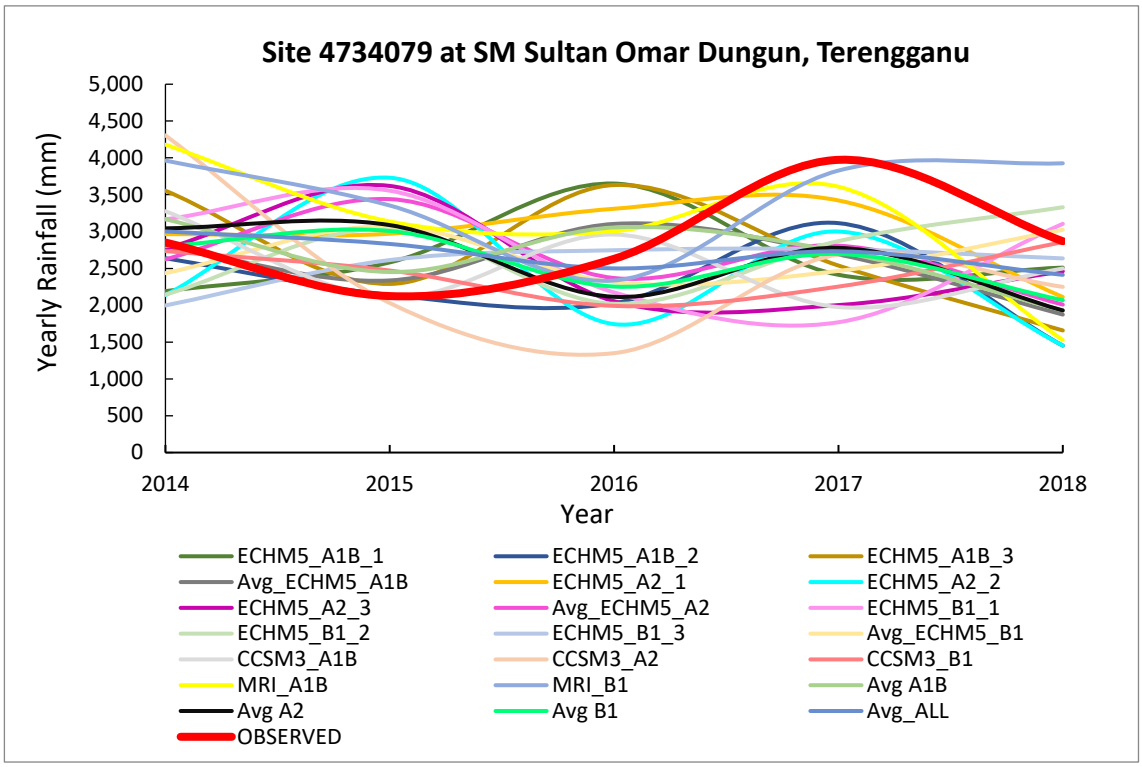


Figure A16-1: Projected and observed 2014-2018 yearly rainfall for Site 4734079 at SM Sultan Omar Dungun, Terengganu

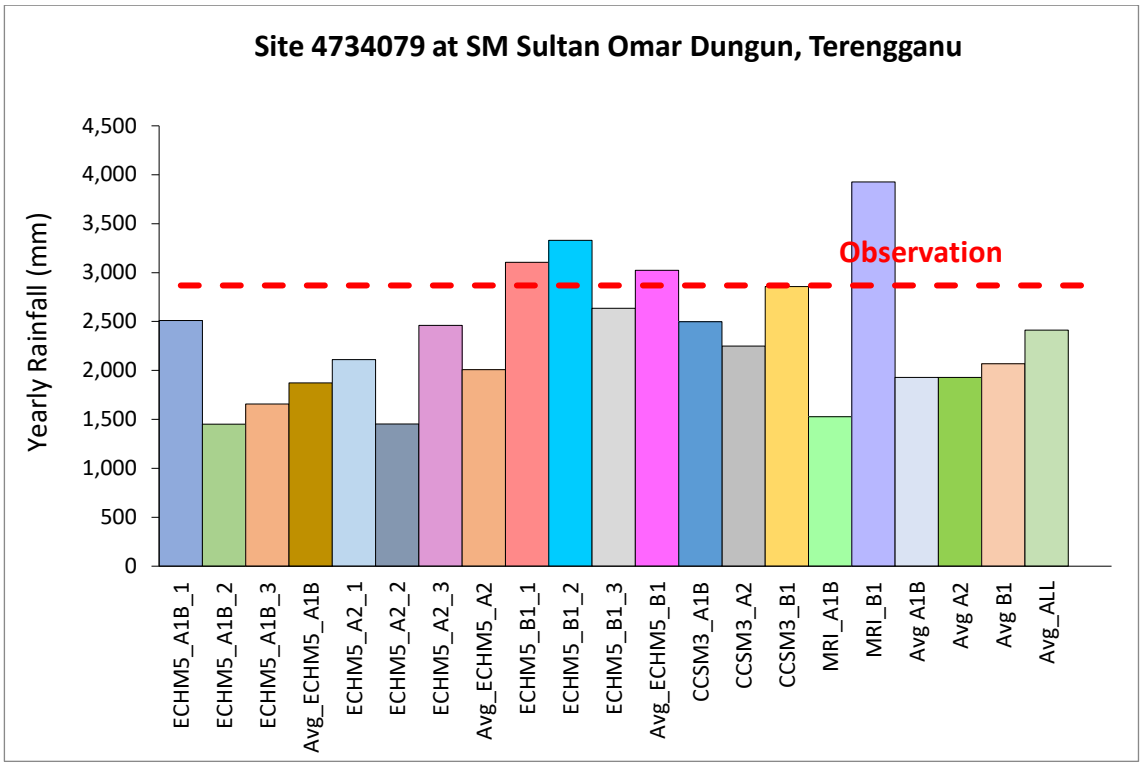


Figure A16-2: Projected and observed 2018 yearly rainfall for Site 4734079 at SM Sultan Omar Dungun, Terengganu

Table A16-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4734079 at SM Sultan Omar Dungun, Terengganu

Site 4734079 at SM Sultan Omar Dungun, Terengganu						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-23	22	39	-39	-12	-3
ECHM5_A1B_2	-7	1	-23	-22	-49	-20
ECHM5_A1B_3	25	8	38	-36	-42	-2
Average_ECHM5_A1B	-2	10	18	-32	-35	-8
ECHM5_A2_1	4	40	26	-14	-26	6
ECHM5_A2_2	-25	76	-34	-24	-49	-11
ECHM5_A2_3	-3	70	-22	-50	-14	-4
Average_ECHM5_A2	-8	62	-10	-29	-30	-3
ECHM5_B1_1	11	67	-17	-55	8	3
ECHM5_B1_2	-25	43	-23	-28	16	-3
ECHM5_B1_3	-30	23	4	-31	-8	-8
Average_ECHM5_B1	-15	45	-12	-38	5	-3
CCSM3_A1B	15	-1	13	-50	-13	-7
CCSM3_A2	51	-4	-49	-32	-22	-11
CCSM3_B1	-4	16	-24	-43	0	-11
MRI_A1B	47	48	14	-9	-47	11
MRI_B1	39	58	-11	-4	37	24
Average_A1B	11	15	16	-31	-33	-4
Average_A2	7	45	-20	-30	-33	-6
Average_B1	-2	42	-14	-32	-28	-7
Average_ALL	5	33	-5	-31	-16	-3

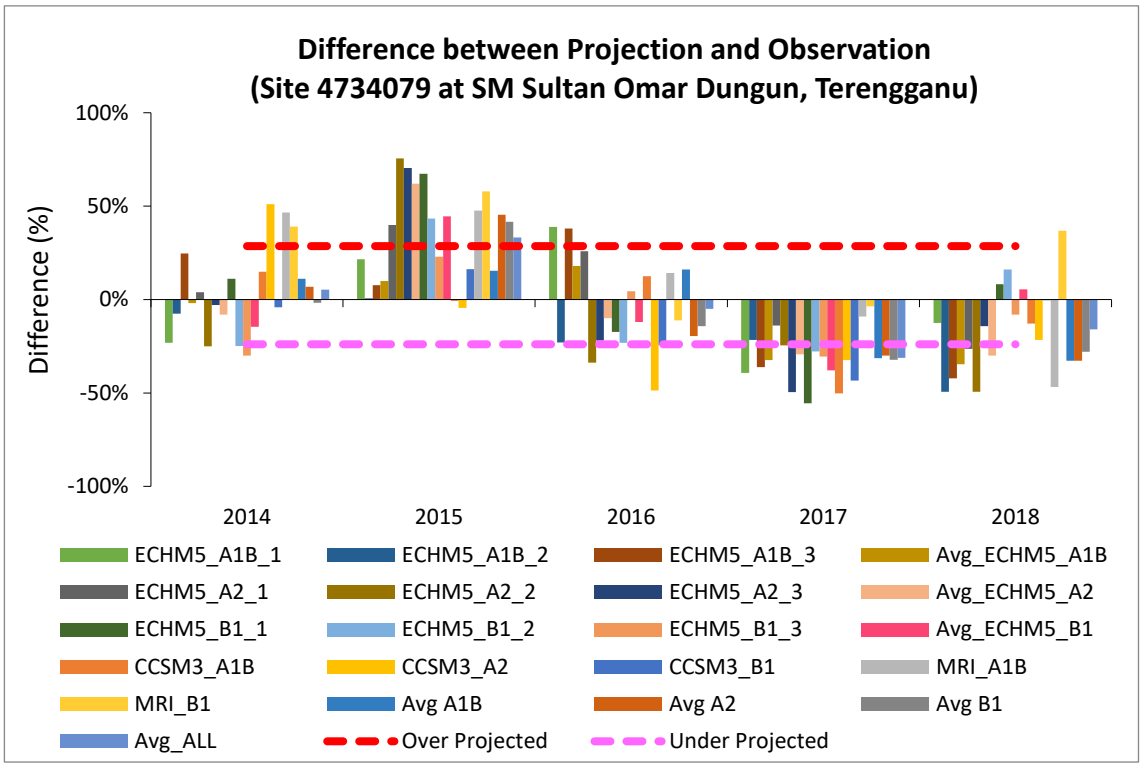


Figure A16-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4734079 at SM Sultan Omar Dungun, Terengganu

A17: Site 5331048 at Setor JPS K Terengganu, Terengganu

Table A17-1: Projected and observed 2014-2018 yearly rainfall for Site 5331048 at Setor JPS K Terengganu, Terengganu

Site 5331048 at Setor JPS K Terengganu, Terengganu						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	1,891	2,192	3,685	2,253	2,480	2,500
ECHM5_A1B_2	2,555	2,167	2,065	2,944	1,472	2,241
ECHM5_A1B_3	4,811	3,227	3,262	2,194	1,820	3,063
Average_ECHM5_A1B	3,086	2,529	3,004	2,464	1,924	2,601
ECHM5_A2_1	2,747	3,122	3,567	2,810	2,468	2,943
ECHM5_A2_2	2,286	3,541	2,117	3,182	1,575	2,540
ECHM5_A2_3	2,294	3,311	1,864	2,122	2,601	2,438
Average_ECHM5_A2	2,442	3,324	2,516	2,705	2,215	2,640
ECHM5_B1_1	2,754	3,156	3,026	2,074	4,198	3,042
ECHM5_B1_2	2,454	3,771	2,545	2,602	3,320	2,938
ECHM5_B1_3	2,398	2,496	3,268	2,756	3,305	2,844
Average_ECHM5_B1	2,535	3,141	2,946	2,477	3,608	2,941
CCSM3_A1B	2,700	2,275	1,965	2,178	3,212	2,466
CCSM3_A2	3,201	1,995	1,635	2,418	2,345	2,319
CCSM3_B1	2,639	2,071	2,655	2,513	4,355	2,846
MRI_A1B	3,812	2,604	3,088	3,189	968	2,732
MRI_B1	2,531	3,037	1,751	4,254	2,797	2,874
Average_A1B	3,154	2,493	2,813	2,552	1,990	2,600
Average_A2	2,632	2,992	2,296	2,633	1,990	2,509
Average_B1	2,555	2,906	2,649	2,840	2,247	2,639
Average_ALL	2,791	2,783	2,607	2,678	2,637	2,699
OBSERVED	2,270	1,835	2,966	3,120	2,764	2,591

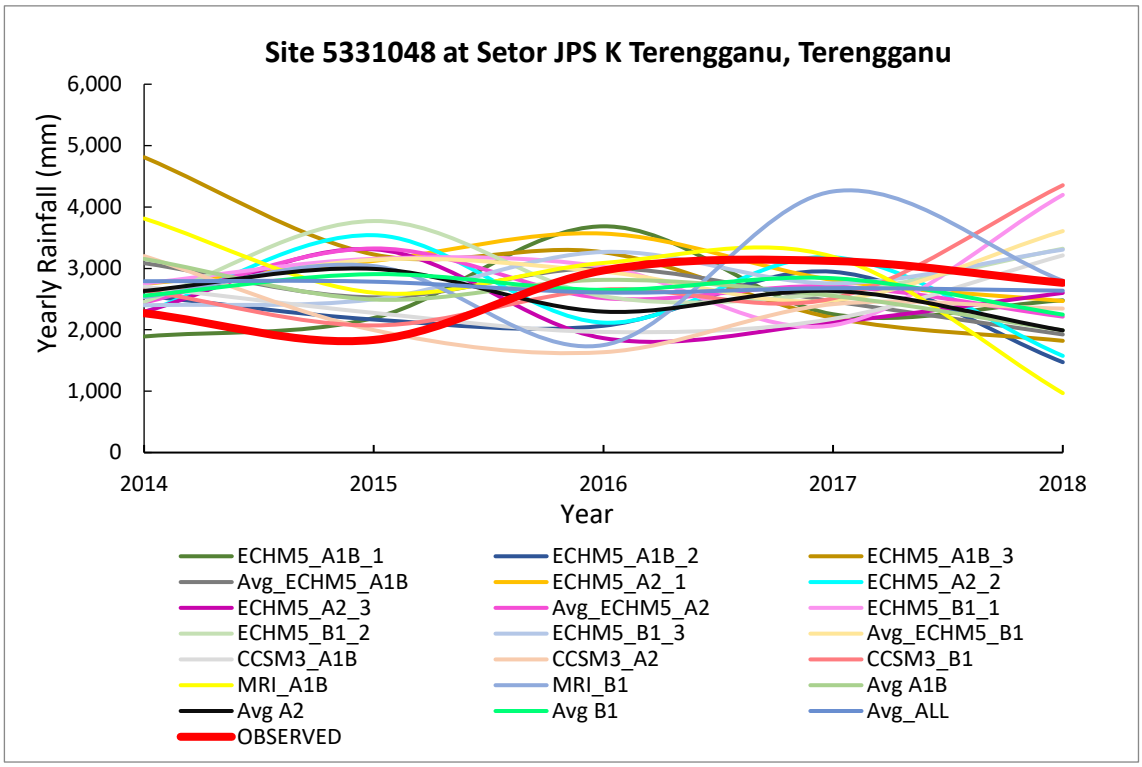


Figure A17-1: Projected and observed 2014-2018 yearly rainfall for Site 5331048 at Setor JPS K Terengganu, Terengganu

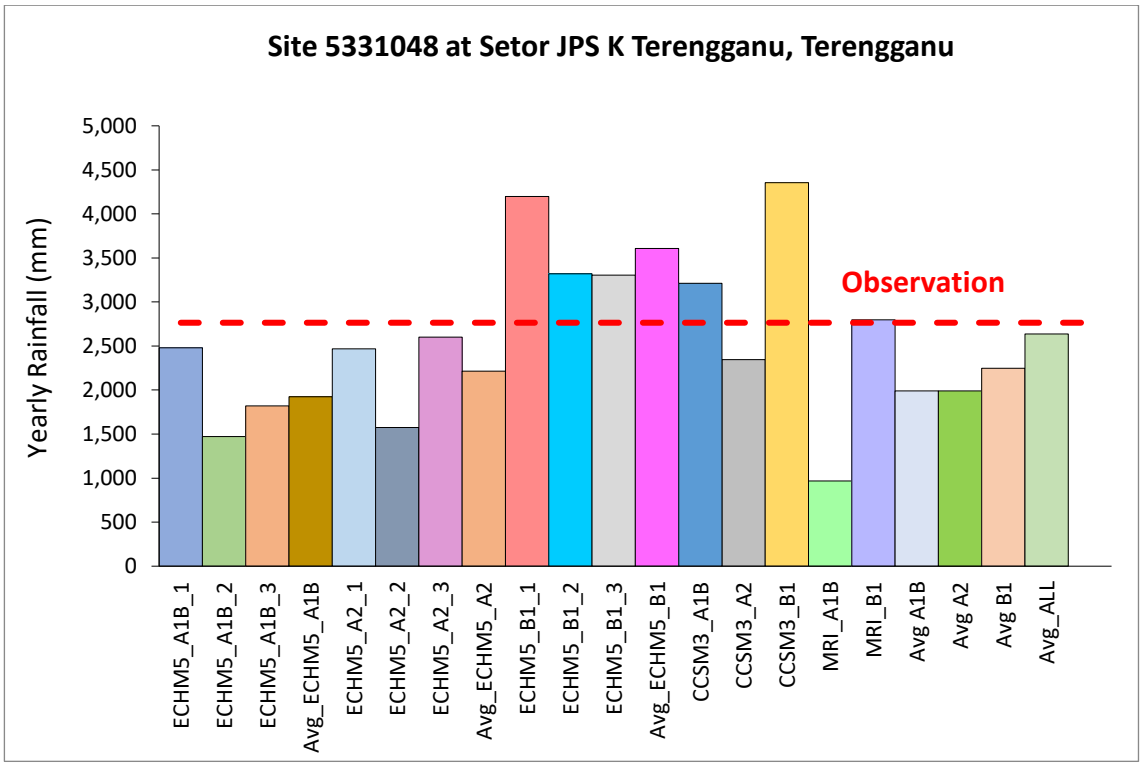


Figure A17-2: Projected and observed 2018 yearly rainfall for Site 5331048 at Setor JPS K Terengganu, Terengganu

Table A17-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5331048 at Setor JPS K Terengganu, Terengganu

Site 5331048 at Setor JPS K Terengganu, Terengganu						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-17	19	24	-28	-10	-2
ECHM5_A1B_2	13	18	-30	-6	-47	-10
ECHM5_A1B_3	112	76	10	-30	-34	27
Average_ECHM5_A1B	36	38	1	-21	-30	5
ECHM5_A2_1	21	70	20	-10	-11	18
ECHM5_A2_2	1	93	-29	2	-43	5
ECHM5_A2_3	1	80	-37	-32	-6	1
Average_ECHM5_A2	8	81	-15	-13	-20	8
ECHM5_B1_1	21	72	2	-34	52	23
ECHM5_B1_2	8	106	-14	-17	20	21
ECHM5_B1_3	6	36	10	-12	20	12
Average_ECHM5_B1	12	71	-1	-21	31	18
CCSM3_A1B	19	24	-34	-30	16	-1
CCSM3_A2	41	9	-45	-23	-15	-7
CCSM3_B1	16	13	-10	-19	58	11
MRI_A1B	68	42	4	2	-65	10
MRI_B1	12	66	-41	36	1	15
Average_A1B	39	36	-5	-18	-28	5
Average_A2	16	63	-23	-16	-28	3
Average_B1	13	58	-11	-9	-19	7
Average_ALL	23	52	-12	-14	-5	9

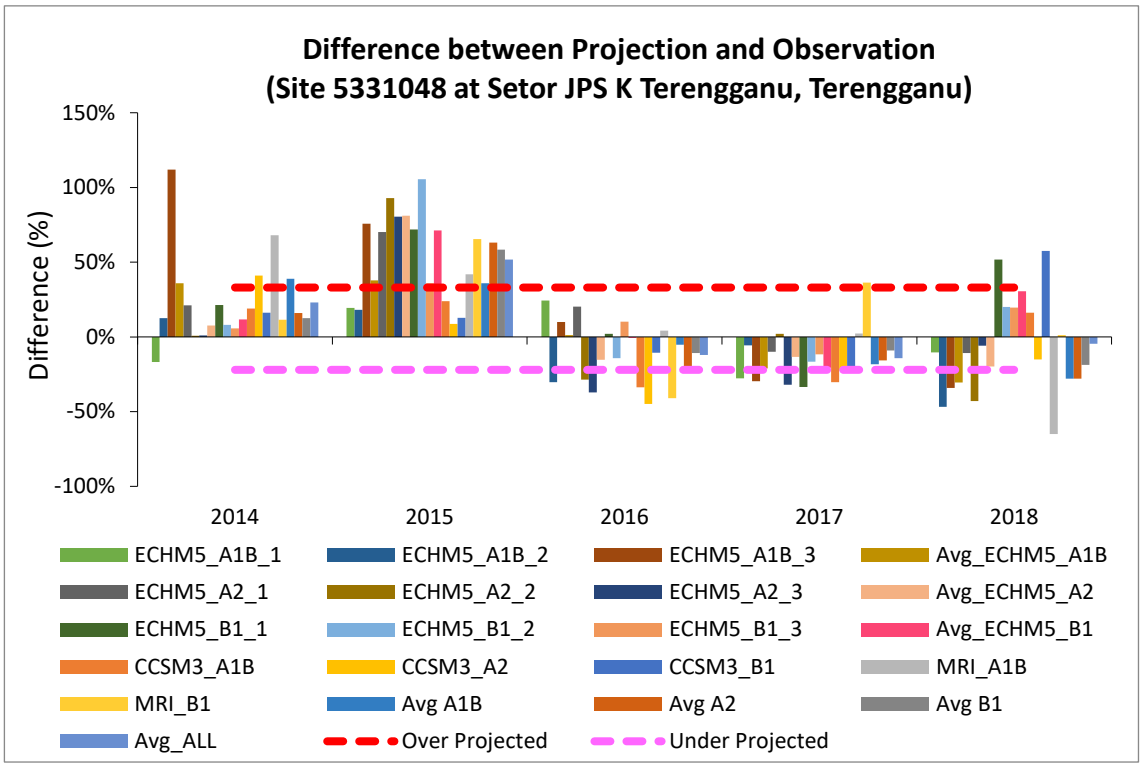


Figure A17-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5331048 at Setor JPS K Terengganu, Terengganu

A18: Site 5522047 at JPS Kuala Krai, Kelantan

Table A18-1: Projected and observed 2014-2018 yearly rainfall for Site 5522047 at JPS Kuala Krai, Kelantan

Site 5522047 at JPS Kuala Krai, Kelantan						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,322	2,182	2,431	2,559	2,470	2,393
ECHM5_A1B_2	2,601	2,873	2,122	2,714	1,501	2,362
ECHM5_A1B_3	3,265	2,551	3,309	2,464	1,762	2,670
Average_ECHM5_A1B	2,729	2,536	2,621	2,579	1,911	2,475
ECHM5_A2_1	3,124	3,068	2,850	2,524	2,386	2,790
ECHM5_A2_2	1,990	3,160	1,962	2,299	1,633	2,209
ECHM5_A2_3	2,486	2,360	2,180	2,240	2,431	2,339
Average_ECHM5_A2	2,533	2,863	2,331	2,354	2,150	2,446
ECHM5_B1_1	2,477	3,546	2,688	2,272	3,484	2,893
ECHM5_B1_2	2,474	3,157	2,152	2,901	2,414	2,619
ECHM5_B1_3	3,869	2,017	3,349	2,729	3,099	3,012
Average_ECHM5_B1	2,940	2,906	2,730	2,634	2,999	2,842
CCSM3_A1B	3,509	2,185	2,664	2,869	2,425	2,731
CCSM3_A2	4,072	2,573	1,956	2,142	2,188	2,586
CCSM3_B1	2,856	2,508	2,962	3,660	2,736	2,945
MRI_A1B	2,737	2,144	2,899	2,436	1,226	2,288
MRI_B1	1,997	1,993	1,195	2,925	1,782	1,978
Average_A1B	2,887	2,387	2,685	2,609	1,877	2,489
Average_A2	2,918	2,790	2,237	2,301	1,877	2,425
Average_B1	2,735	2,644	2,469	2,897	2,159	2,581
Average_ALL	2,841	2,594	2,480	2,624	2,253	2,558
OBSERVED	3,645	2,314	2,500	3,463	2,179	2,820

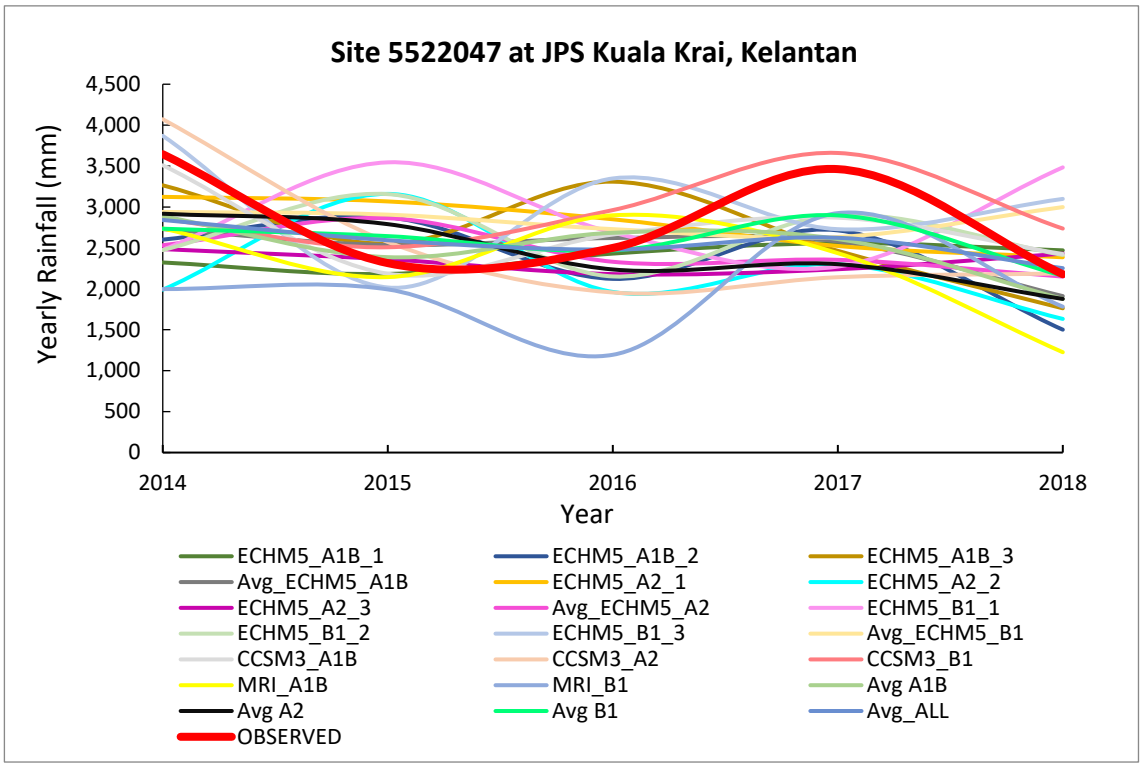


Figure A18-1: Projected and observed 2014-2018 yearly rainfall for Site 5522047 at JPS Kuala Krai, Kelantan

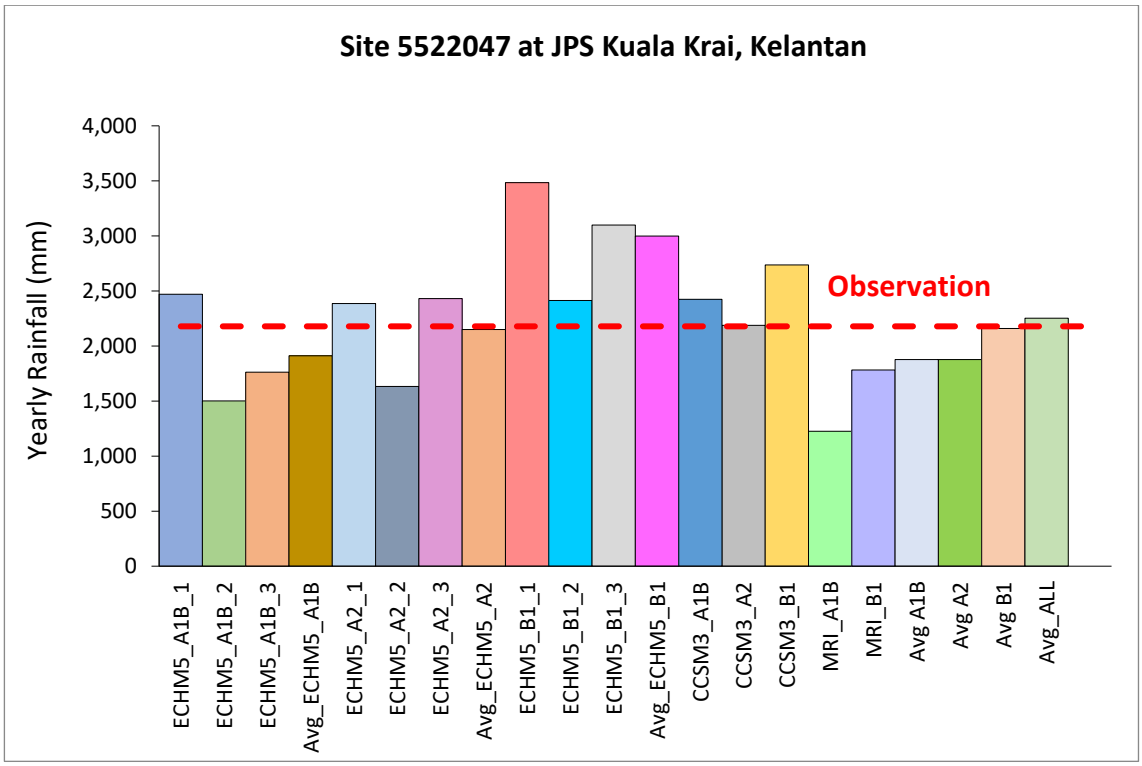


Figure A18-2: Projected and observed 2018 yearly rainfall for for Site 5522047 at JPS Kuala Krai, Kelantan

Table A18-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5522047 at JPS Kuala Krai, Kelantan

Site 5522047 at JPS Kuala Krai, Kelantan						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-36	-6	-3	-26	13	-12
ECHM5_A1B_2	-29	24	-15	-22	-31	-14
ECHM5_A1B_3	-10	10	32	-29	-19	-3
Average_ECHM5_A1B	-25	10	5	-26	-12	-10
ECHM5_A2_1	-14	33	14	-27	10	3
ECHM5_A2_2	-45	37	-22	-34	-25	-18
ECHM5_A2_3	-32	2	-13	-35	12	-13
Average_ECHM5_A2	-31	24	-7	-32	-1	-9
ECHM5_B1_1	-32	53	8	-34	60	11
ECHM5_B1_2	-32	36	-14	-16	11	-3
ECHM5_B1_3	6	-13	34	-21	42	10
Average_ECHM5_B1	-19	26	9	-24	38	6
CCSM3_A1B	-4	-6	7	-17	11	-2
CCSM3_A2	12	11	-22	-38	0	-7
CCSM3_B1	-22	8	18	6	26	7
MRI_A1B	-25	-7	16	-30	-44	-18
MRI_B1	-45	-14	-52	-16	-18	-29
Average_A1B	-21	3	7	-25	-14	-10
Average_A2	-20	21	-11	-34	-14	-11
Average_B1	-25	14	-1	-16	-1	-6
Average_ALL	-22	12	-1	-24	3	-6

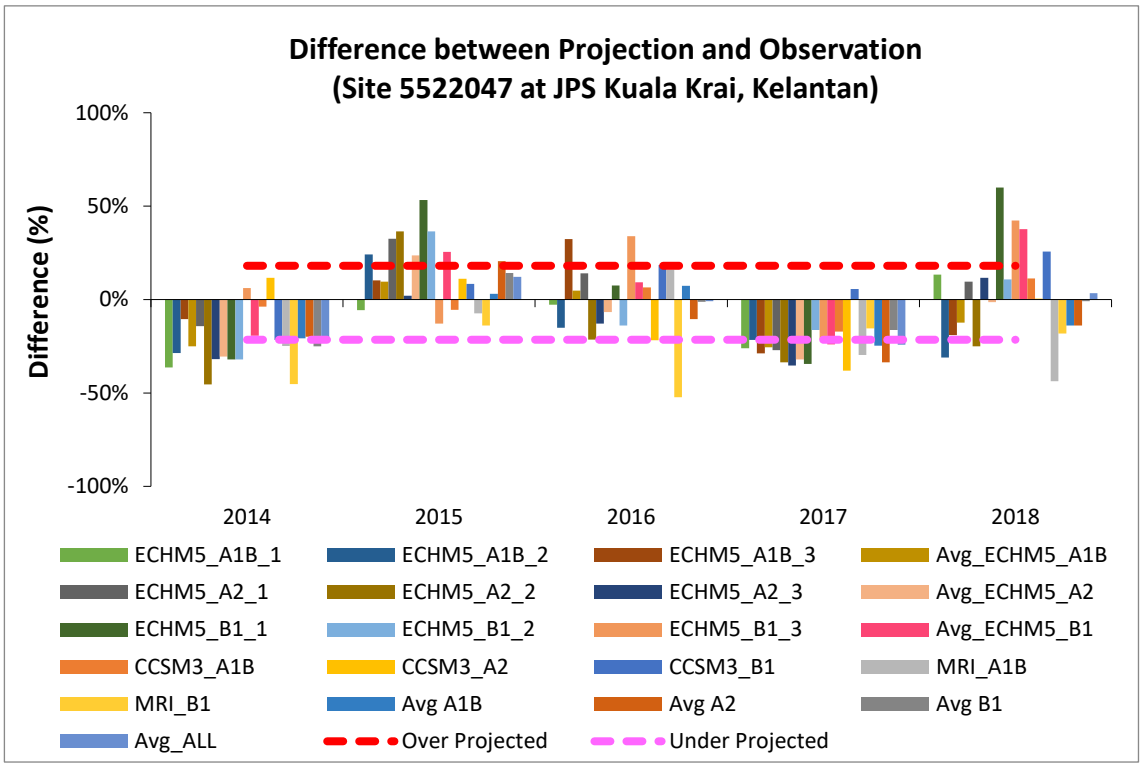


Figure A18-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5522047 at JPS Kuala Krai, Kelantan

A19: Site 5722057 at JPS Machang, Kelantan

Table A19-1: Projected and observed 2014-2018 yearly rainfall for Site 5722057 at JPS Machang, Kelantan

Site 5722057 at JPS Machang, Kelantan						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,377	2,266	2,544	2,622	2,403	2,442
ECHM5_A1B_2	2,872	3,332	2,227	2,775	1,610	2,563
ECHM5_A1B_3	3,579	2,811	3,159	2,586	1,846	2,796
Average_ECHM5_A1B	2,943	2,803	2,644	2,661	1,953	2,601
ECHM5_A2_1	3,095	2,989	3,624	2,460	2,290	2,891
ECHM5_A2_2	2,025	3,191	2,183	2,345	1,875	2,324
ECHM5_A2_3	2,594	2,355	2,230	2,293	2,471	2,388
Average_ECHM5_A2	2,571	2,845	2,679	2,366	2,212	2,535
ECHM5_B1_1	2,352	4,248	2,396	2,321	3,766	3,017
ECHM5_B1_2	2,525	3,236	2,067	2,881	2,640	2,670
ECHM5_B1_3	3,338	2,346	3,329	2,721	3,593	3,065
Average_ECHM5_B1	2,738	3,277	2,598	2,641	3,333	2,917
CCSM3_A1B	3,390	2,013	2,706	3,070	2,321	2,700
CCSM3_A2	4,253	3,614	1,945	1,821	2,465	2,820
CCSM3_B1	2,653	2,404	2,924	4,043	2,542	2,913
MRI_A1B	2,420	1,865	2,854	2,319	1,215	2,134
MRI_B1	1,969	1,832	1,448	2,835	1,778	1,973
Average_A1B	2,928	2,457	2,698	2,674	1,879	2,527
Average_A2	2,992	3,037	2,495	2,230	1,879	2,527
Average_B1	2,568	2,813	2,433	2,960	2,275	2,610
Average_ALL	2,817	2,750	2,545	2,649	2,344	2,621
OBSERVED	4,082	2,427	2,409	4,630	2,701	3,250

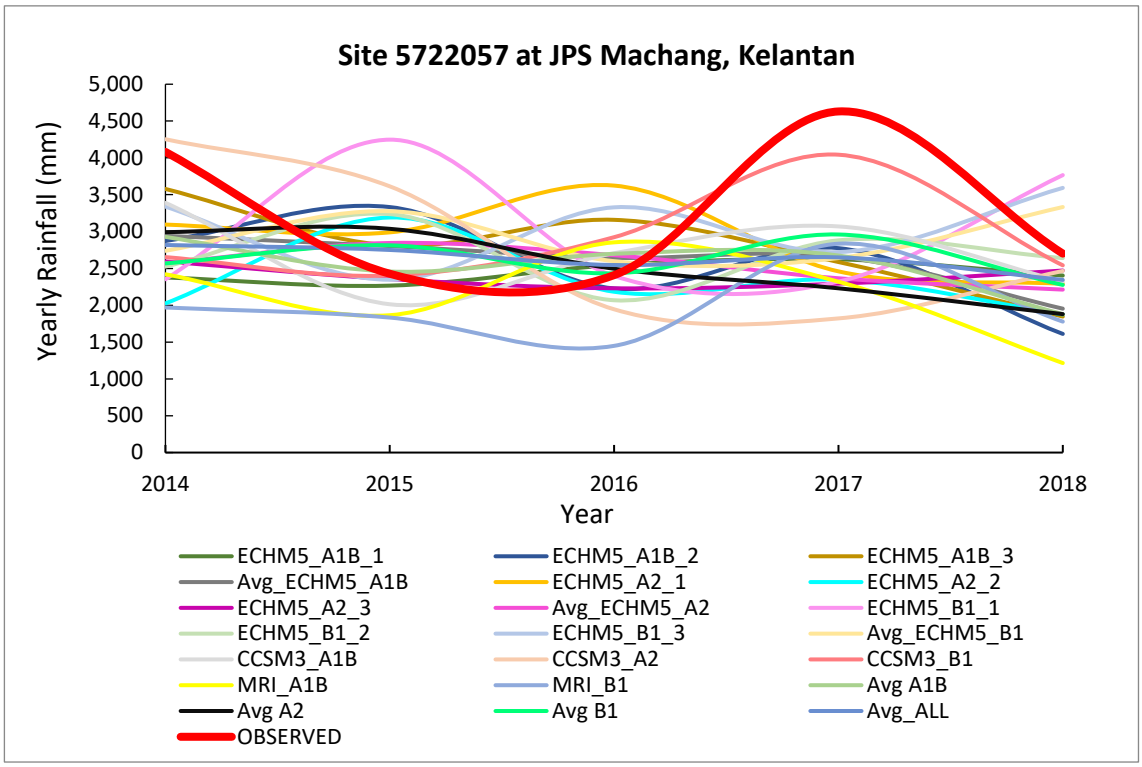


Figure A19-1: Projected and observed 2014-2018 yearly rainfall for Site 5722057 at JPS Machang, Kelantan

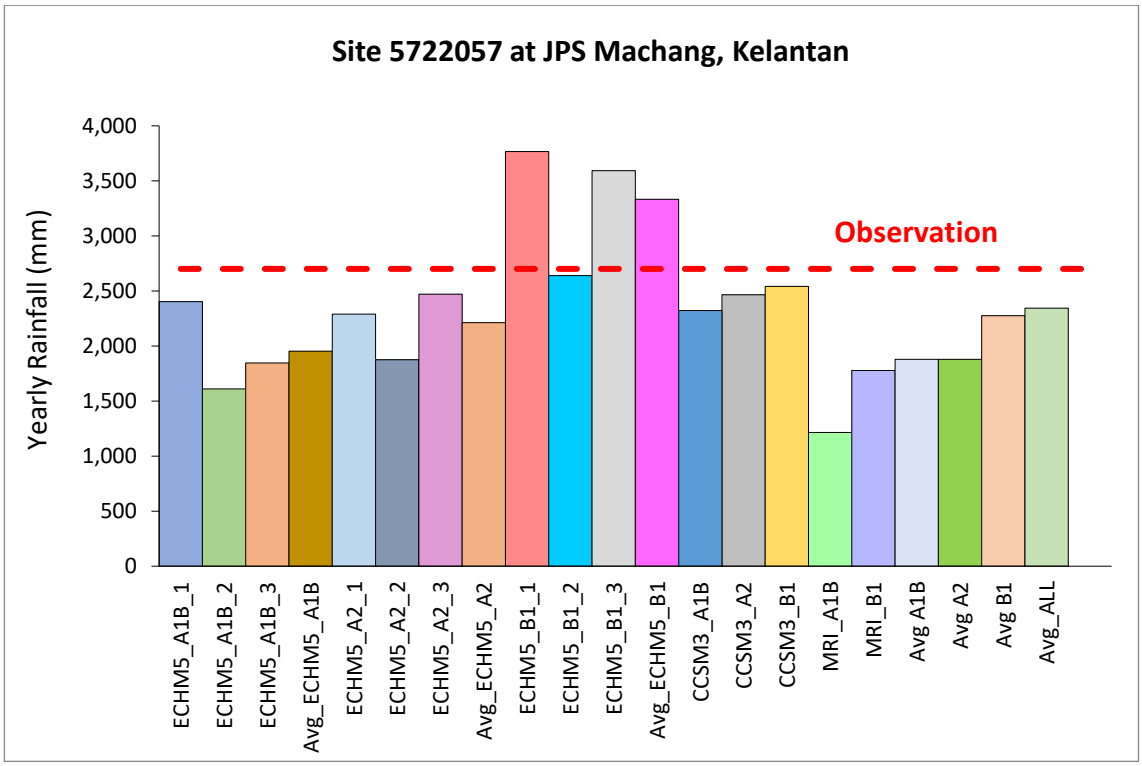


Figure A19-2: Projected and observed 2018 yearly rainfall for Site 5722057 at JPS Machang, Kelantan

Table A19-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5722057 at JPS Machang, Kelantan

Site 5722057 at JPS Machang, Kelantan						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-42	-7	6	-43	-11	-19
ECHM5_A1B_2	-30	37	-8	-40	-40	-16
ECHM5_A1B_3	-12	16	31	-44	-32	-8
Average_ECHM5_A1B	-28	15	10	-43	-28	-15
ECHM5_A2_1	-24	23	50	-47	-15	-3
ECHM5_A2_2	-50	31	-9	-49	-31	-22
ECHM5_A2_3	-36	-3	-7	-50	-9	-21
Average_ECHM5_A2	-37	17	11	-49	-18	-15
ECHM5_B1_1	-42	75	-1	-50	39	4
ECHM5_B1_2	-38	33	-14	-38	-2	-12
ECHM5_B1_3	-18	-3	38	-41	33	2
Average_ECHM5_B1	-33	35	8	-43	23	-2
CCSM3_A1B	-17	-17	12	-34	-14	-14
CCSM3_A2	4	49	-19	-61	-9	-7
CCSM3_B1	-35	-1	21	-13	-6	-7
MRI_A1B	-41	-23	18	-50	-55	-30
MRI_B1	-52	-25	-40	-39	-34	-38
Average_A1B	-28	1	12	-42	-30	-18
Average_A2	-27	25	4	-52	-30	-16
Average_B1	-37	16	1	-36	-16	-14
Average_ALL	-31	13	6	-43	-13	-14

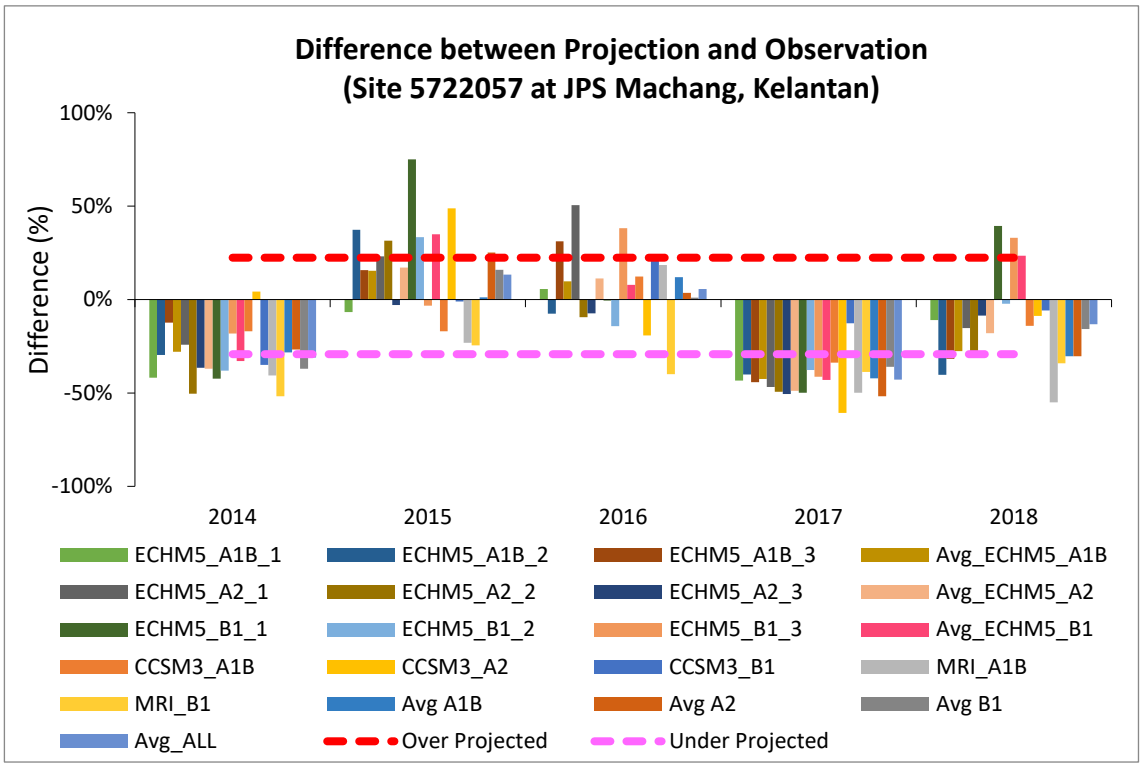


Figure A19-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5722057 at JPS Machang, Kelantan

A20: Site 6401002 at Padang Katong Kangar, Perlis

Table A20-1: Projected and observed 2014-2018 yearly rainfall for Site 6401002 at Padang Katong Kangar, Perlis

Site 6401002 at Padang Katong Kangar, Perlis						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,112	1,603	2,454	1,075	1,865	1,822
ECHM5_A1B_2	2,146	1,851	1,562	1,861	1,399	1,764
ECHM5_A1B_3	2,094	1,914	1,708	1,769	2,574	2,012
Average_ECHM5_A1B	2,117	1,789	1,908	1,568	1,946	1,866
ECHM5_A2_1	2,041	1,513	2,037	1,493	1,976	1,812
ECHM5_A2_2	1,979	2,152	1,593	2,900	1,475	2,020
ECHM5_A2_3	2,269	1,938	1,684	1,129	1,667	1,737
Average_ECHM5_A2	2,097	1,868	1,771	1,840	1,706	1,856
ECHM5_B1_1	1,660	1,586	1,247	1,601	2,049	1,629
ECHM5_B1_2	1,486	1,626	1,451	1,857	2,240	1,732
ECHM5_B1_3	2,251	2,416	1,701	1,494	1,696	1,911
Average_ECHM5_B1	1,799	1,876	1,466	1,651	1,995	1,757
CCSM3_A1B	1,667	530	1,448	1,834	1,010	1,298
CCSM3_A2	831	1,744	974	874	290	942
CCSM3_B1	2,434	755	813	1,113	561	1,135
MRI_A1B	1,875	1,312	1,728	1,986	786	1,537
MRI_B1	1,481	1,224	850	1,896	1,152	1,320
Average_A1B	1,979	1,442	1,780	1,705	1,527	1,686
Average_A2	1,780	1,837	1,572	1,599	1,527	1,663
Average_B1	1,862	1,521	1,212	1,592	1,352	1,508
Average_ALL	1,881	1,583	1,518	1,634	1,481	1,619
OBSERVED	1,778	1,847	1,457	2,472	1,786	1,868

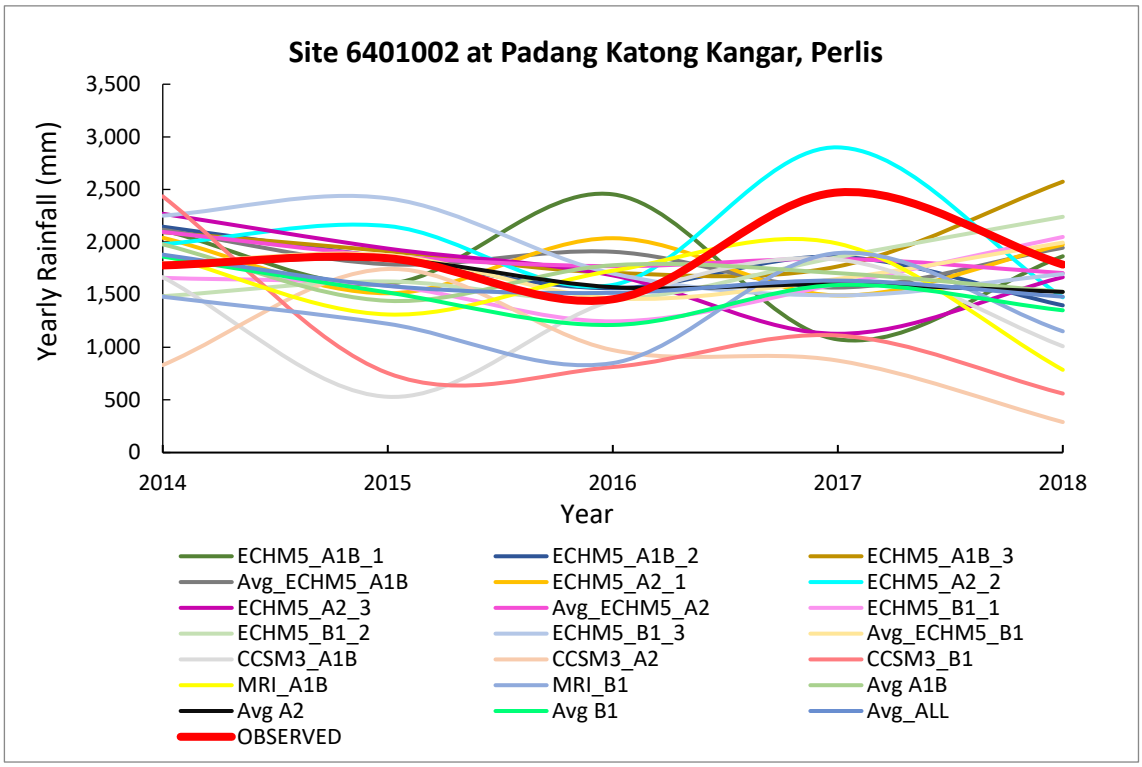


Figure A20-1: Projected and observed 2014-2018 yearly rainfall for Site 6401002 at Padang Katong Kangar, Perlis

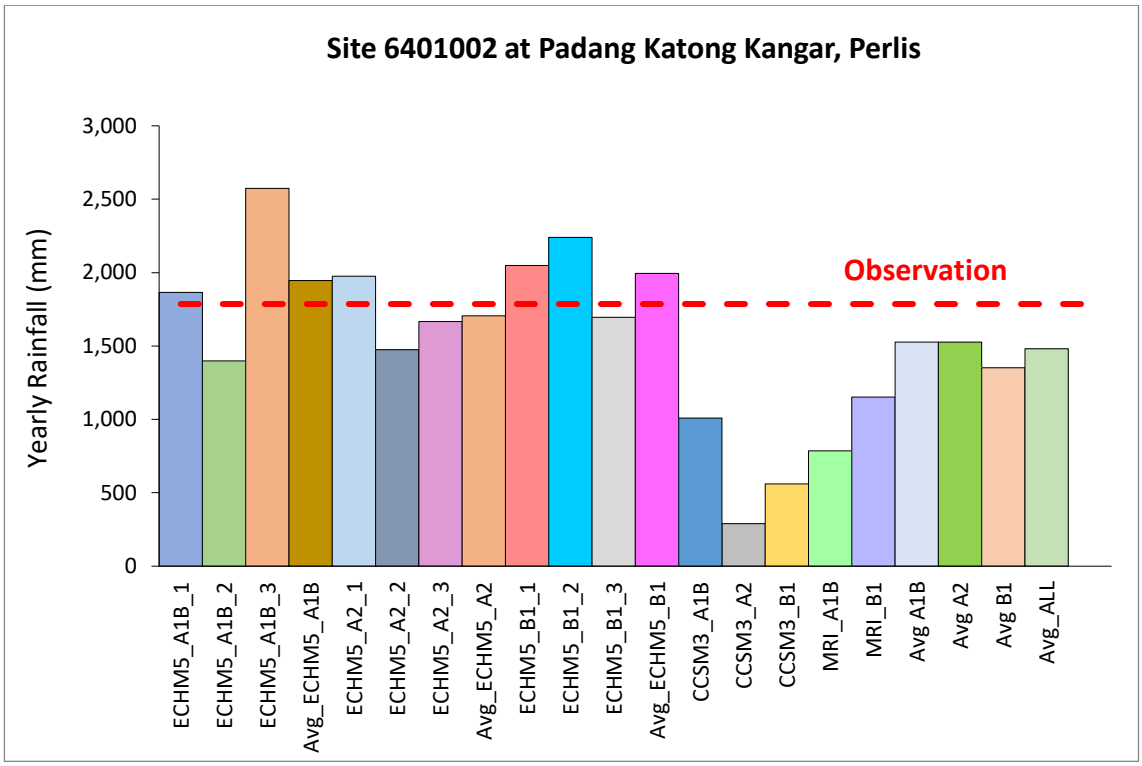


Figure A20-2: Projected and observed 2018 yearly rainfall for Site 6401002 at Padang Katong Kangar, Perlis

Table A20-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 6401002 at Padang Katong Kangar, Perlis

Site 6401002 at Padang Katong Kangar, Perlis						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	19	-13	68	-56	4	4
ECHM5_A1B_2	21	0	7	-25	-22	-4
ECHM5_A1B_3	18	4	17	-28	44	11
Average_ECHM5_A1B	19	-3	31	-37	9	4
ECHM5_A2_1	15	-18	40	-40	11	2
ECHM5_A2_2	11	17	9	17	-17	7
ECHM5_A2_3	28	5	16	-54	-7	-3
Average_ECHM5_A2	18	1	22	-26	-4	2
ECHM5_B1_1	-7	-14	-14	-35	15	-11
ECHM5_B1_2	-16	-12	0	-25	25	-6
ECHM5_B1_3	27	31	17	-40	-5	6
Average_ECHM5_B1	1	2	1	-33	12	-4
CCSM3_A1B	-6	-71	-1	-26	-43	-29
CCSM3_A2	-53	-6	-33	-65	-84	-48
CCSM3_B1	37	-59	-44	-55	-69	-38
MRI_A1B	5	-29	19	-20	-56	-16
MRI_B1	-17	-34	-42	-23	-35	-30
Average_A1B	11	-22	22	-31	-15	-7
Average_A2	0	-1	8	-35	-15	-8
Average_B1	5	-18	-17	-36	-24	-18
Average_ALL	6	-14	4	-34	-17	-11

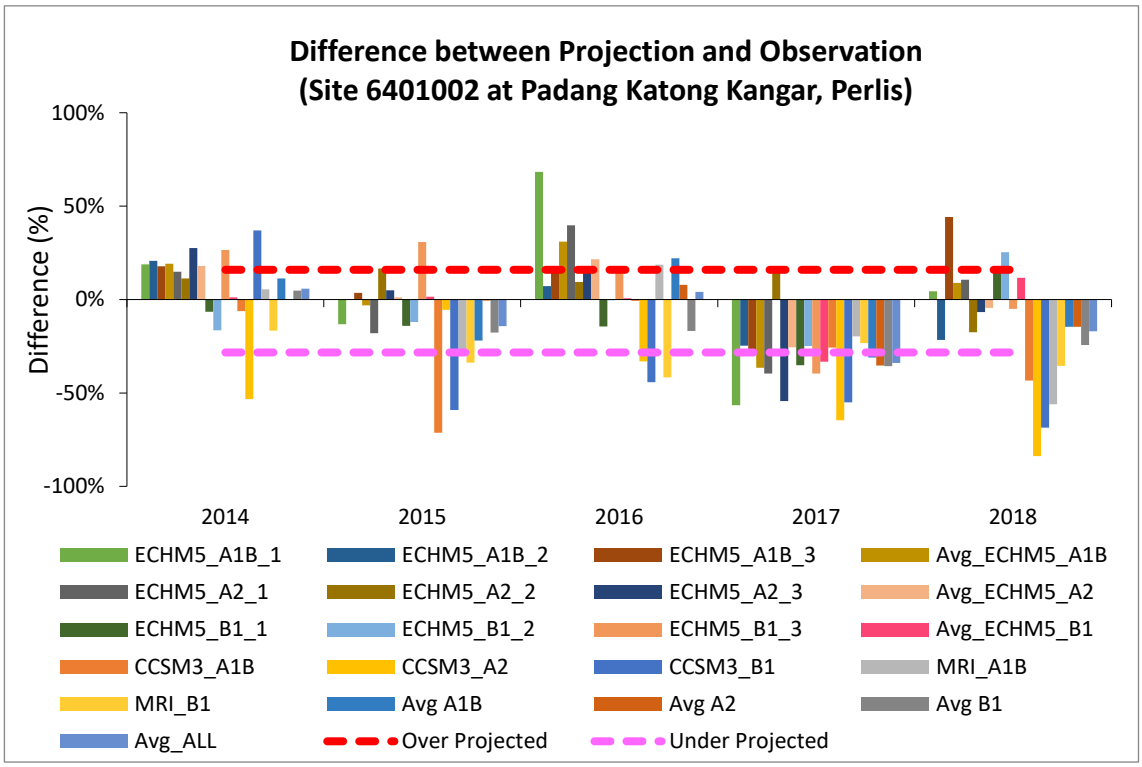


Figure A20-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 6401002 at Padang Katong Kangar, Perlis

A21: Site 5704055 at Kedah Peak, Kedah

Table A21-1: Projected and observed 2014-2018 yearly rainfall for Site 5704055 at Kedah Peak, Kedah

Site 5704055 at Kedah Peak, Kedah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	3,164	2,429	3,706	1,933	2,718	2,790
ECHM5_A1B_2	3,599	3,785	2,399	2,866	2,711	3,072
ECHM5_A1B_3	3,493	2,600	2,507	2,709	3,195	2,901
Average_ECHM5_A1B	3,418	2,938	2,871	2,502	2,875	2,921
ECHM5_A2_1	2,836	2,457	2,472	2,498	2,805	2,613
ECHM5_A2_2	3,560	4,464	2,602	3,935	2,004	3,313
ECHM5_A2_3	2,260	2,706	2,033	2,604	2,845	2,490
Average_ECHM5_A2	2,886	3,209	2,369	3,012	2,551	2,805
ECHM5_B1_1	3,817	2,572	2,136	2,965	3,553	3,009
ECHM5_B1_2	2,213	2,659	2,200	3,092	3,040	2,641
ECHM5_B1_3	3,005	3,028	2,831	2,315	2,758	2,787
Average_ECHM5_B1	3,012	2,753	2,389	2,790	3,117	2,812
CCSM3_A1B	2,519	1,857	3,811	1,473	1,271	2,186
CCSM3_A2	2,339	2,200	2,208	1,281	1,325	1,871
CCSM3_B1	3,147	2,549	1,675	1,900	1,434	2,141
MRI_A1B	2,569	1,944	2,183	3,015	752	2,093
MRI_B1	2,245	1,964	1,232	2,997	1,877	2,063
Average_A1B	3,069	2,523	2,921	2,399	2,129	2,608
Average_A2	2,749	2,957	2,329	2,580	2,129	2,549
Average_B1	2,885	2,554	2,015	2,654	2,245	2,471
Average_ALL	2,912	2,658	2,428	2,542	2,306	2,569
OBSERVED	3,697	2,571	3,587	3,795	3,403	3,411

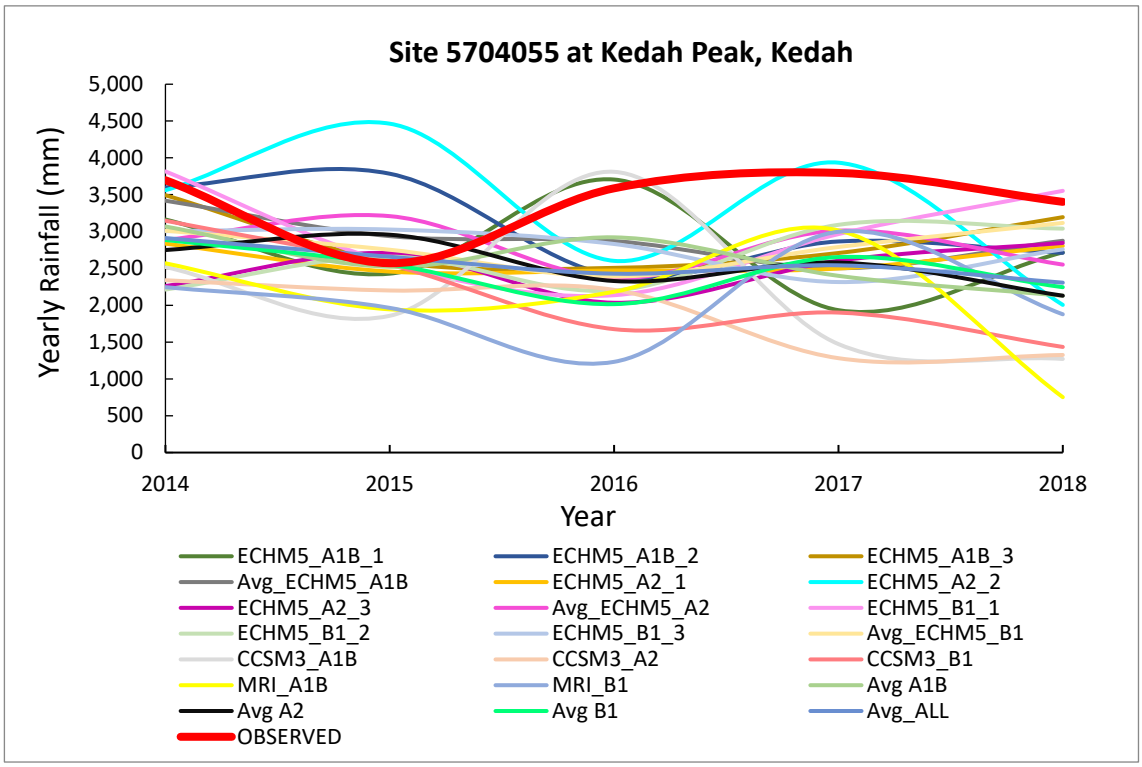


Figure A21-1: Projected and observed 2014-2018 yearly rainfall for Site 5704055 at Kedah Peak, Kedah

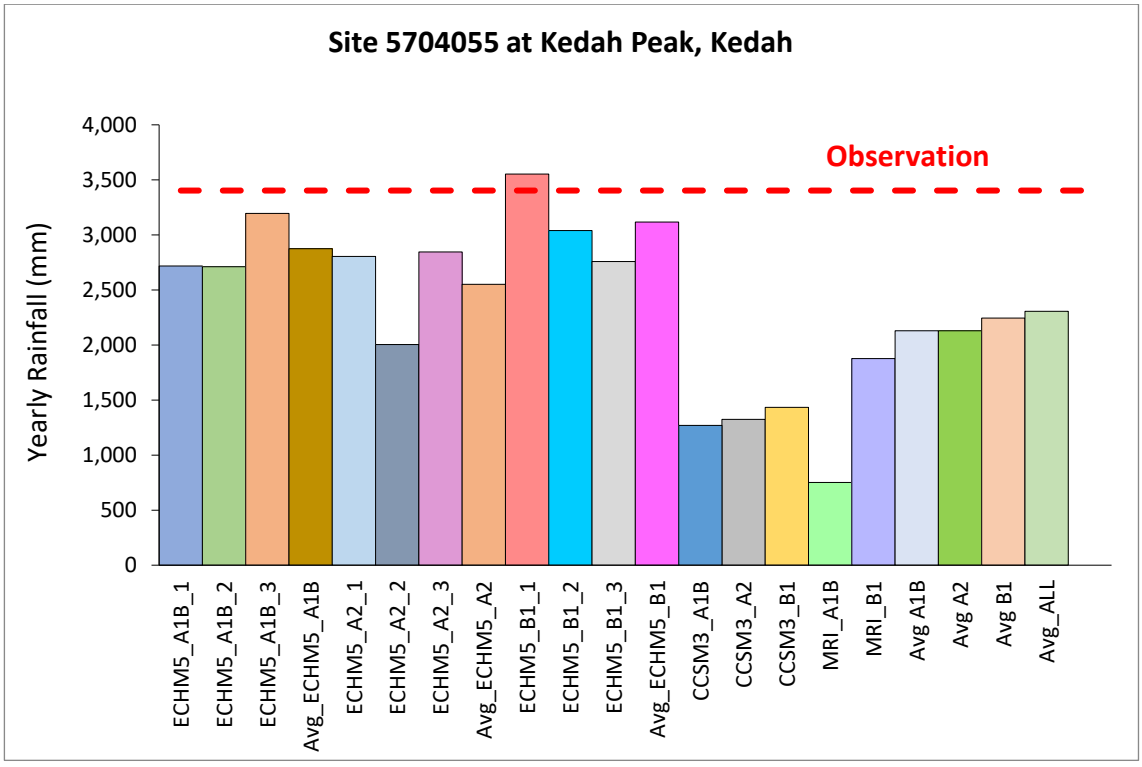


Figure A21-2: Projected and observed 2018 yearly rainfall for Site 5704055 at Kedah Peak, Kedah

Table A21-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5704055 at Kedah Peak, Kedah

Site 5704055 at Kedah Peak, Kedah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-14	-6	3	-49	-20	-17
ECHM5_A1B_2	-3	47	-33	-25	-20	-7
ECHM5_A1B_3	-6	1	-30	-29	-6	-14
Average_ECHM5_A1B	-8	14	-20	-34	-16	-13
ECHM5_A2_1	-23	-4	-31	-34	-18	-22
ECHM5_A2_2	-4	74	-27	4	-41	1
ECHM5_A2_3	-39	5	-43	-31	-16	-25
Average_ECHM5_A2	-22	25	-34	-21	-25	-15
ECHM5_B1_1	3	0	-40	-22	4	-11
ECHM5_B1_2	-40	3	-39	-19	-11	-21
ECHM5_B1_3	-19	18	-21	-39	-19	-16
Average_ECHM5_B1	-19	7	-33	-26	-8	-16
CCSM3_A1B	-32	-28	6	-61	-63	-35
CCSM3_A2	-37	-14	-38	-66	-61	-43
CCSM3_B1	-15	-1	-53	-50	-58	-35
MRI_A1B	-31	-24	-39	-21	-78	-39
MRI_B1	-39	-24	-66	-21	-45	-39
Average_A1B	-17	-2	-19	-37	-37	-22
Average_A2	-26	15	-35	-32	-37	-23
Average_B1	-22	-1	-44	-30	-34	-26
Average_ALL	-21	3	-32	-33	-32	-23

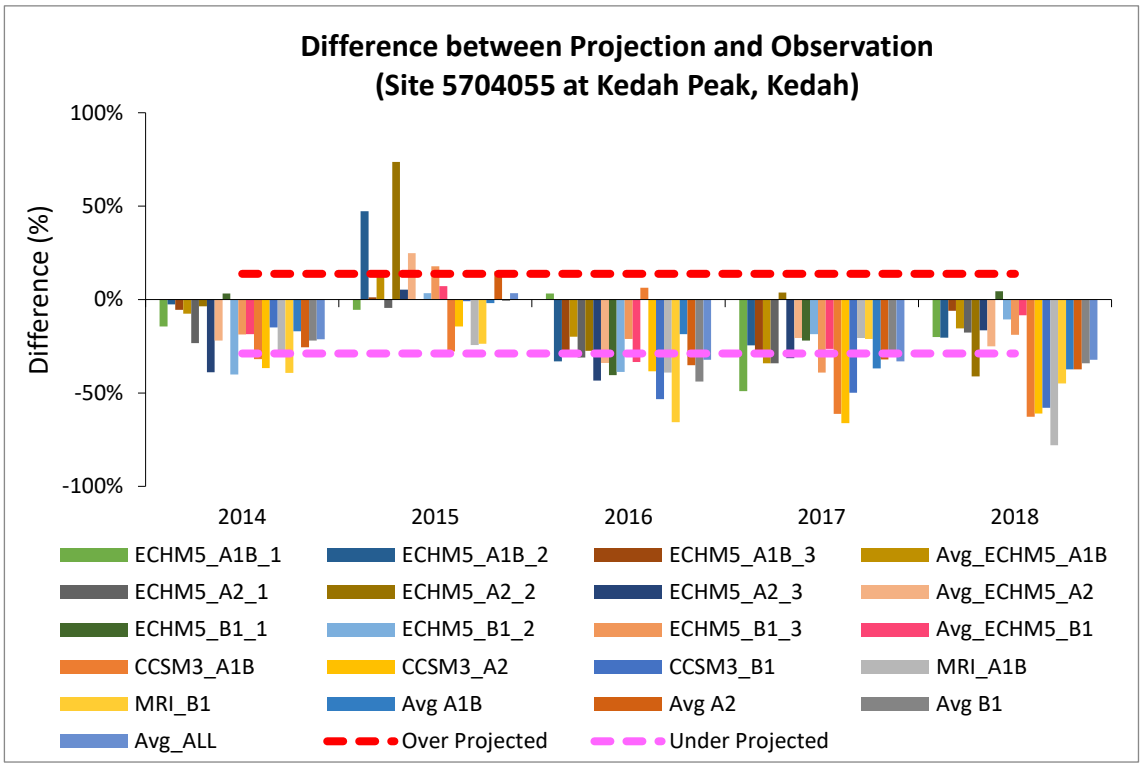


Figure A21-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5704055 at Kedah Peak, Kedah

A22: Site 6103047 at Setor JPS Alor Setar, Kedah

Table A22-1: Projected and observed 2014-2018 yearly rainfall for Site 6103047 at Setor JPS Alor Setar, Kedah

Site 6103047 at Setor JPS Alor Setar, Kedah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,478	1,789	2,872	1,336	1,937	2,083
ECHM5_A1B_2	2,431	2,402	1,906	2,750	1,719	2,242
ECHM5_A1B_3	2,689	2,022	2,220	2,279	2,783	2,398
Average_ECHM5_A1B	2,532	2,071	2,333	2,121	2,146	2,241
ECHM5_A2_1	2,233	1,979	2,311	2,062	2,072	2,131
ECHM5_A2_2	2,831	2,816	1,886	3,609	1,651	2,559
ECHM5_A2_3	1,826	2,556	1,511	1,778	1,899	1,914
Average_ECHM5_A2	2,296	2,450	1,903	2,483	1,874	2,201
ECHM5_B1_1	2,581	1,772	1,528	2,116	2,566	2,113
ECHM5_B1_2	1,856	1,987	1,642	2,129	2,517	2,026
ECHM5_B1_3	2,955	2,528	1,935	1,612	1,911	2,188
Average_ECHM5_B1	2,464	2,096	1,702	1,952	2,331	2,109
CCSM3_A1B	1,845	1,077	1,354	526	904	1,141
CCSM3_A2	1,041	1,179	1,064	617	382	856
CCSM3_B1	1,958	1,638	769	1,295	599	1,252
MRI_A1B	2,155	1,589	1,775	2,289	784	1,719
MRI_B1	1,652	1,332	941	2,321	1,369	1,523
Average_A1B	2,320	1,776	2,025	1,836	1,626	1,916
Average_A2	1,982	2,133	1,693	2,016	1,626	1,890
Average_B1	2,200	1,851	1,363	1,895	1,501	1,762
Average_ALL	2,181	1,905	1,694	1,908	1,650	1,867
OBSERVED	2,408	2,718	1,916	2,472	2,147	2,332

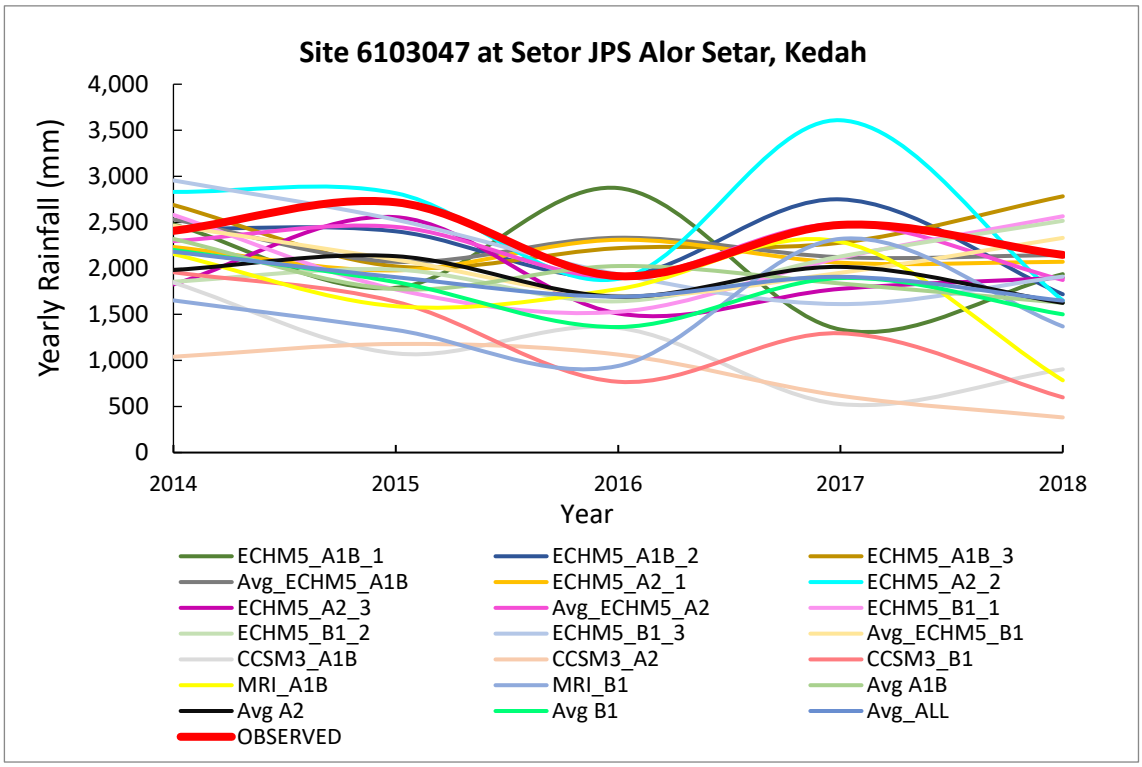


Figure A22-1: Projected and observed 2014-2018 yearly rainfall for Site 6103047 at Setor JPS Alor Setar, Kedah

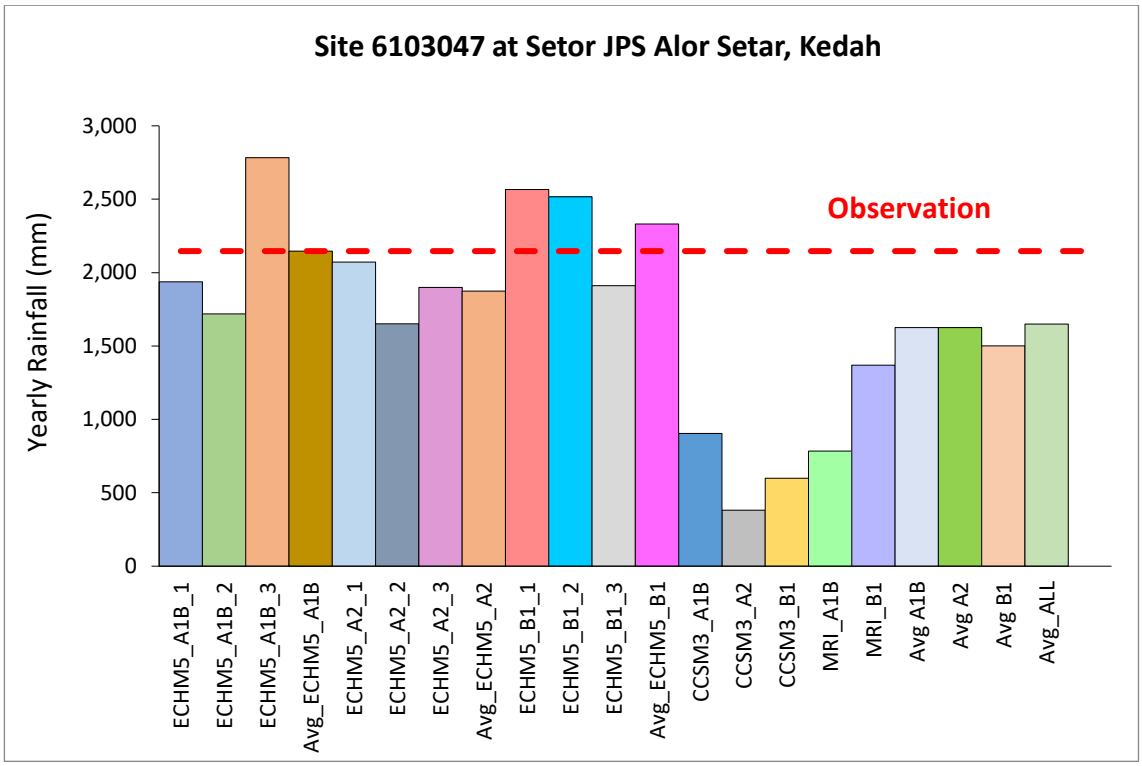


Figure A22-2: Projected and observed 2018 yearly rainfall for Site 6103047 at Setor JPS Alor Setar, Kedah

Table A22-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 6103047 at Setor JPS Alor Setar, Kedah

Site 6103047 at Setor JPS Alor Setar, Kedah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	3	-34	50	-46	-10	-7
ECHM5_A1B_2	1	-12	-1	11	-20	-4
ECHM5_A1B_3	12	-26	16	-8	30	5
Average_ECHM5_A1B	5	-24	22	-14	0	-2
ECHM5_A2_1	-7	-27	21	-17	-3	-7
ECHM5_A2_2	18	4	-2	46	-23	9
ECHM5_A2_3	-24	-6	-21	-28	-12	-18
Average_ECHM5_A2	-5	-10	-1	0	-13	-5
ECHM5_B1_1	7	-35	-20	-14	20	-9
ECHM5_B1_2	-23	-27	-14	-14	17	-12
ECHM5_B1_3	23	-7	1	-35	-11	-6
Average_ECHM5_B1	2	-23	-11	-21	9	-9
CCSM3_A1B	-23	-60	-29	-79	-58	-50
CCSM3_A2	-57	-57	-44	-75	-82	-63
CCSM3_B1	-19	-40	-60	-48	-72	-48
MRI_A1B	-10	-42	-7	-7	-63	-26
MRI_B1	-31	-51	-51	-6	-36	-35
Average_A1B	-4	-35	6	-26	-24	-17
Average_A2	-18	-22	-12	-18	-24	-19
Average_B1	-9	-32	-29	-23	-30	-25
Average_ALL	-9	-30	-12	-23	-23	-19

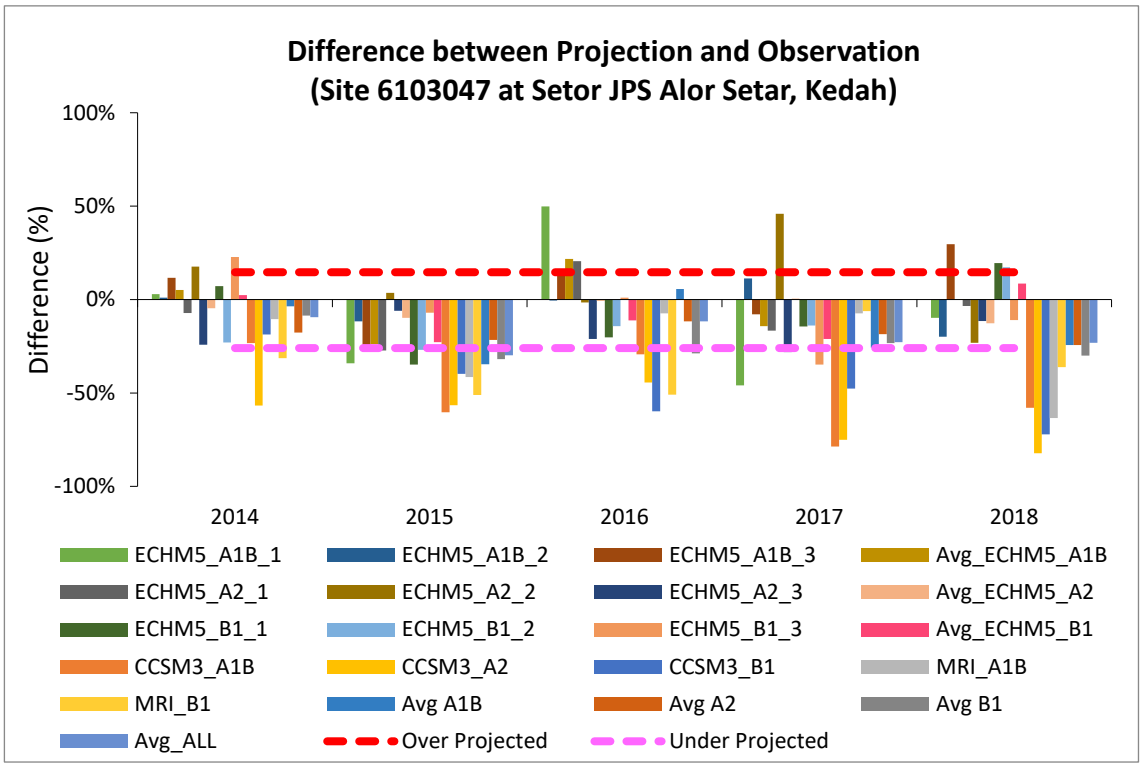


Figure A22-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 6103047 at Setor JPS Alor Setar, Kedah

A23: Site 6207032 at Ampang Pedu, Kedah

Table A23-1: Projected and observed 2014-2018 yearly rainfall for Site 6207032 at Ampang Pedu, Kedah

Site 6207032 at Ampang Pedu, Kedah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,265	2,195	3,005	1,489	2,164	2,224
ECHM5_A1B_2	2,919	2,137	1,767	2,123	1,862	2,162
ECHM5_A1B_3	2,381	1,935	2,044	2,133	2,295	2,158
Average_ECHM5_A1B	2,522	2,089	2,272	1,915	2,107	2,181
ECHM5_A2_1	2,303	1,893	2,052	2,106	2,090	2,089
ECHM5_A2_2	2,963	2,787	1,749	2,351	1,684	2,307
ECHM5_A2_3	2,353	2,424	1,808	2,186	1,866	2,127
Average_ECHM5_A2	2,539	2,368	1,870	2,214	1,880	2,174
ECHM5_B1_1	2,180	1,698	1,801	2,589	2,444	2,143
ECHM5_B1_2	2,051	2,783	1,897	2,316	2,744	2,358
ECHM5_B1_3	2,602	2,434	1,701	2,001	2,143	2,176
Average_ECHM5_B1	2,278	2,305	1,800	2,302	2,444	2,226
CCSM3_A1B	2,371	1,151	3,177	1,965	882	1,909
CCSM3_A2	2,495	2,736	2,654	3,494	1,463	2,569
CCSM3_B1	1,954	1,463	1,542	1,861	1,607	1,685
MRI_A1B	1,990	1,603	1,734	2,291	927	1,709
MRI_B1	1,845	1,062	990	2,459	1,371	1,545
Average_A1B	2,385	1,804	2,345	2,000	1,626	2,032
Average_A2	2,528	2,460	2,066	2,534	1,626	2,243
Average_B1	2,126	1,888	1,586	2,245	1,776	1,924
Average_ALL	2,334	2,022	1,994	2,240	1,824	2,083
OBSERVED	2,514	2,241	1,915	3,017	2,053	2,348

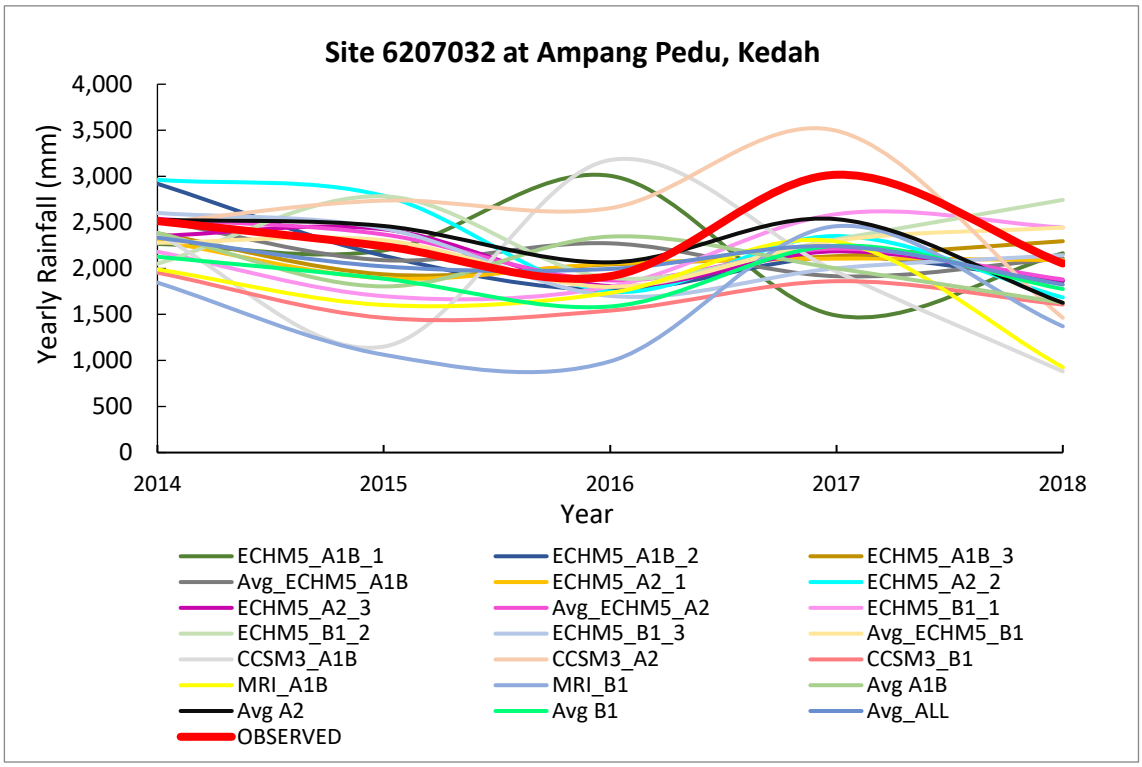


Figure A23-1: Projected and observed 2014-2018 yearly rainfall for Site 6207032 at Ampang Pedu, Kedah

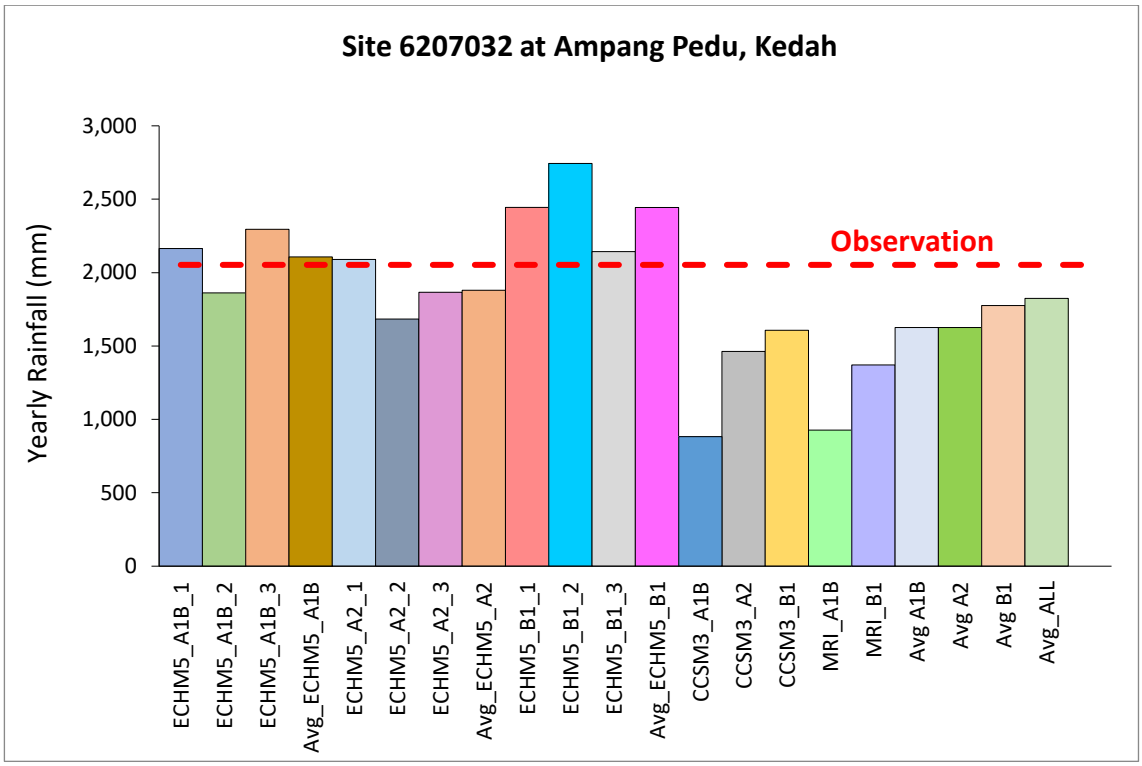


Figure A23-2: Projected and observed 2018 yearly rainfall for Site 6207032 at Ampang Pedu, Kedah

Table A23-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 6207032 at Ampang Pedu, Kedah

Site 6207032 at Ampang Pedu, Kedah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-10	-2	57	-51	5	0
ECHM5_A1B_2	16	-5	-8	-30	-9	-7
ECHM5_A1B_3	-5	-14	7	-29	12	-6
Average_ECHM5_A1B	0	-7	19	-37	3	-4
ECHM5_A2_1	-8	-16	7	-30	2	-9
ECHM5_A2_2	18	24	-9	-22	-18	-1
ECHM5_A2_3	-6	8	-6	-28	-9	-8
Average_ECHM5_A2	1	6	-2	-27	-8	-6
ECHM5_B1_1	-13	-24	-6	-14	19	-8
ECHM5_B1_2	-18	24	-1	-23	34	3
ECHM5_B1_3	4	9	-11	-34	4	-6
Average_ECHM5_B1	-9	3	-6	-24	19	-3
CCSM3_A1B	-6	-49	66	-35	-57	-16
CCSM3_A2	-1	22	39	16	-29	9
CCSM3_B1	-22	-35	-20	-38	-22	-27
MRI_A1B	-21	-28	-9	-24	-55	-28
MRI_B1	-27	-53	-48	-19	-33	-36
Average_A1B	-5	-19	22	-34	-21	-11
Average_A2	1	10	8	-16	-21	-4
Average_B1	-15	-16	-17	-26	-14	-17
Average_ALL	-7	-10	4	-26	-11	-10

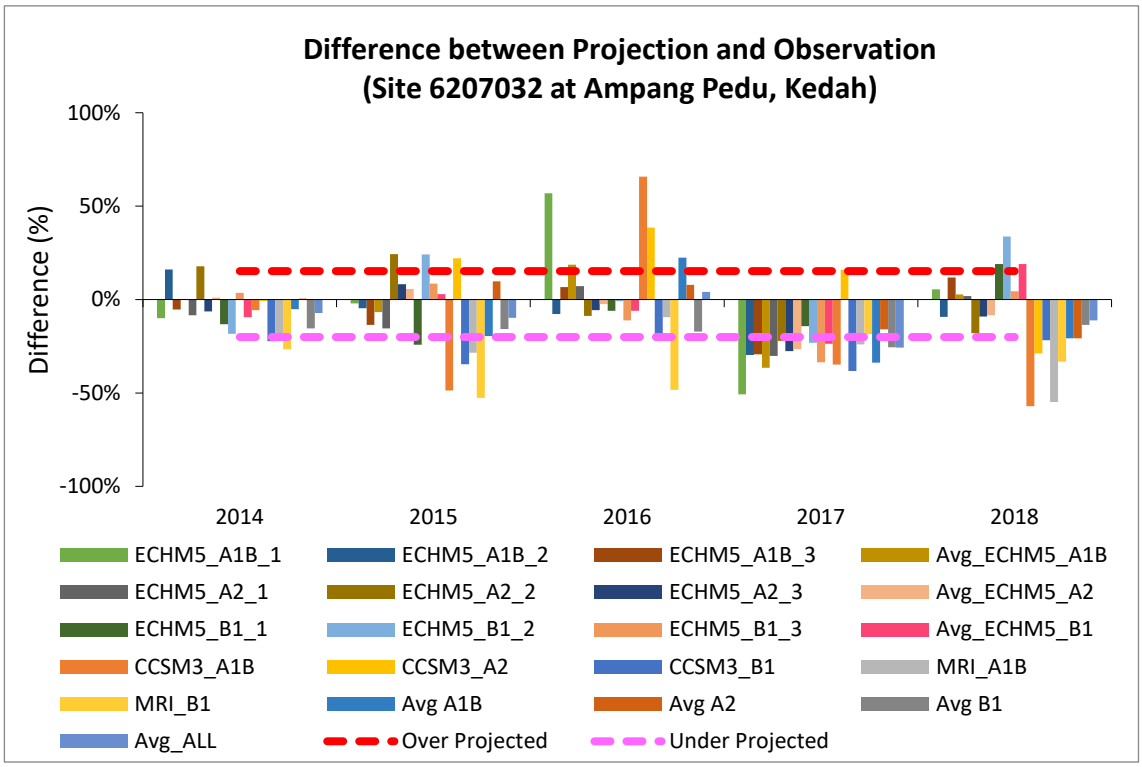


Figure A23-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 6207032 at Ampang Pedu, Kedah

A24: Site 5303053 at Kompleks Prai, Pulau Pinang

Table A24-1: Projected and observed 2014-2018 yearly rainfall for Site 5303053 at Kompleks Prai, Pulau Pinang

Site 5303053 at Kompleks Prai, Pulau Pinang						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	1,959	2,424	3,248	1,702	2,303	2,327
ECHM5_A1B_2	2,704	2,727	2,034	2,948	1,481	2,379
ECHM5_A1B_3	2,758	2,259	2,014	2,336	2,214	2,316
Average_ECHM5_A1B	2,474	2,470	2,432	2,329	1,999	2,341
ECHM5_A2_1	1,913	1,839	1,974	2,152	1,979	1,971
ECHM5_A2_2	3,216	2,874	2,136	2,898	1,732	2,571
ECHM5_A2_3	2,919	2,408	1,399	1,965	1,954	2,129
Average_ECHM5_A2	2,683	2,374	1,836	2,339	1,889	2,224
ECHM5_B1_1	3,306	1,696	1,901	2,699	2,375	2,395
ECHM5_B1_2	2,032	2,534	1,703	2,011	2,441	2,144
ECHM5_B1_3	2,696	2,357	2,071	1,842	2,390	2,271
Average_ECHM5_B1	2,678	2,195	1,892	2,184	2,402	2,270
CCSM3_A1B	1,277	1,014	3,566	605	788	1,450
CCSM3_A2	870	2,523	576	529	891	1,078
CCSM3_B1	1,755	1,634	1,346	1,467	1,294	1,499
MRI_A1B	2,334	1,656	2,034	2,145	852	1,804
MRI_B1	1,594	1,812	1,088	2,401	1,492	1,677
Average_A1B	2,206	2,016	2,579	1,947	1,528	2,055
Average_A2	2,229	2,411	1,521	1,886	1,639	1,937
Average_B1	2,276	2,006	1,622	2,084	1,999	1,997
Average_ALL	2,238	2,125	1,935	1,979	1,728	2,001
OBSERVED	1,933	2,701	2,297	2,583	2,554	2,413

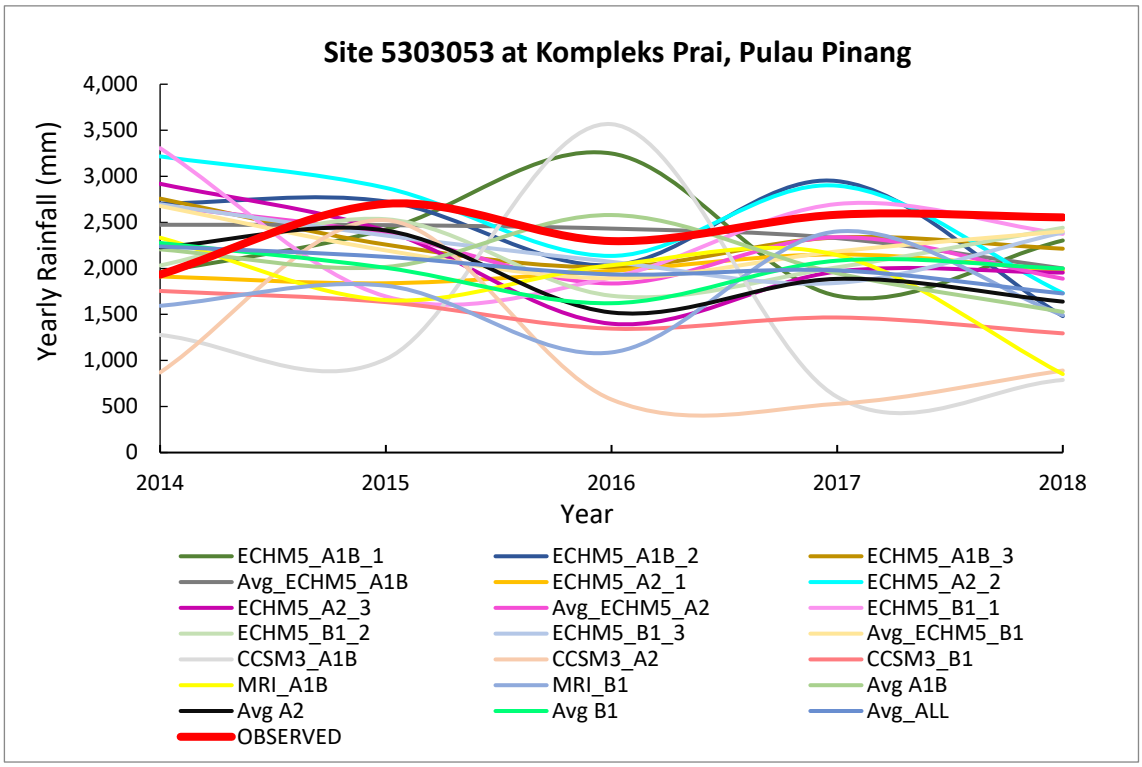


Figure A24-1: Projected and observed 2014-2018 yearly rainfall for Site 5303053 at Kompleks Prai, Pulau Pinang

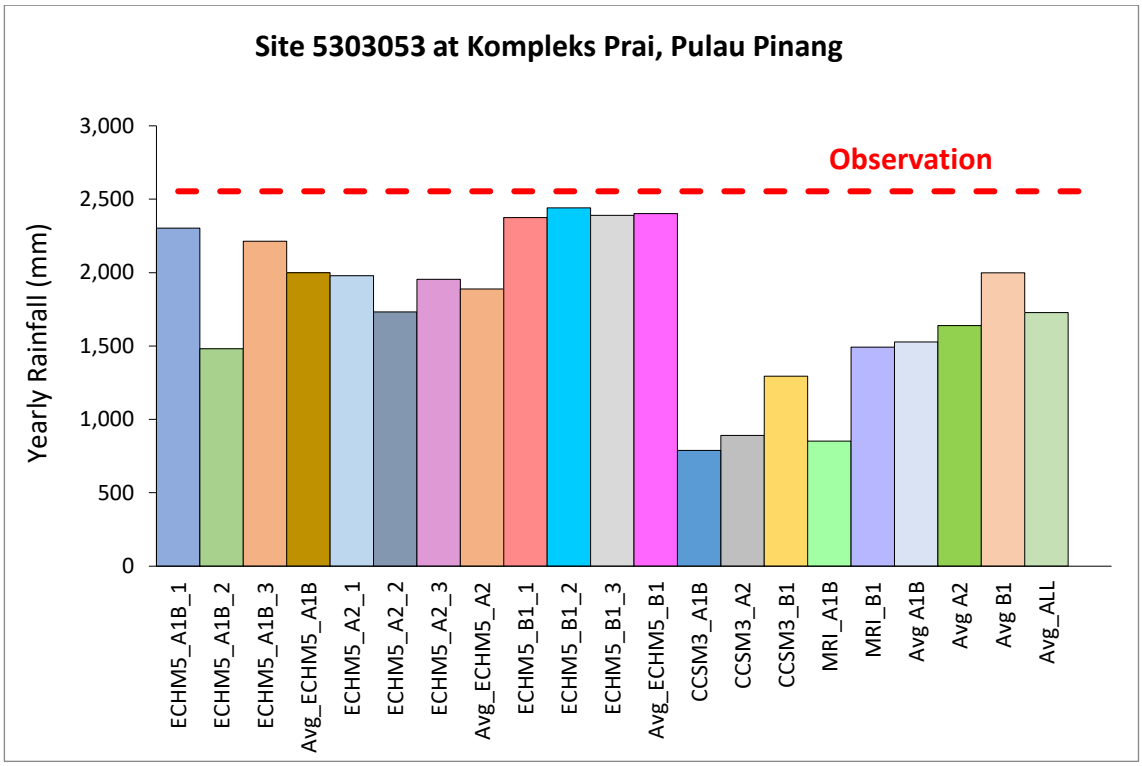


Figure A24-2: Projected and observed 2018 yearly rainfall for Site 5303053 at Kompleks Prai, Pulau Pinang

Table A24-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5303053 at Kompleks Prai, Pulau Pinang

Site 5303053 at Kompleks Prai, Pulau Pinang						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	1	-10	41	-34	-10	-2
ECHM5_A1B_2	40	1	-11	14	-42	0
ECHM5_A1B_3	43	-16	-12	-10	-13	-2
Average_ECHM5_A1B	28	-9	6	-10	-22	-1
ECHM5_A2_1	-1	-32	-14	-17	-23	-17
ECHM5_A2_2	66	6	-7	12	-32	9
ECHM5_A2_3	51	-11	-39	-24	-23	-9
Average_ECHM5_A2	39	-12	-20	-9	-26	-6
ECHM5_B1_1	71	-37	-17	5	-7	3
ECHM5_B1_2	5	-6	-26	-22	-4	-11
ECHM5_B1_3	39	-13	-10	-29	-6	-4
Average_ECHM5_B1	39	-19	-18	-15	-6	-4
CCSM3_A1B	-34	-62	55	-77	-69	-37
CCSM3_A2	-55	-7	-75	-80	-65	-56
CCSM3_B1	-9	-40	-41	-43	-49	-37
MRI_A1B	21	-39	-11	-17	-67	-23
MRI_B1	-18	-33	-53	-7	-42	-30
Average_A1B	14	-25	12	-25	-40	-13
Average_A2	15	-11	-34	-27	-36	-18
Average_B1	18	-26	-29	-19	-22	-16
Average_ALL	16	-21	-16	-23	-32	-15

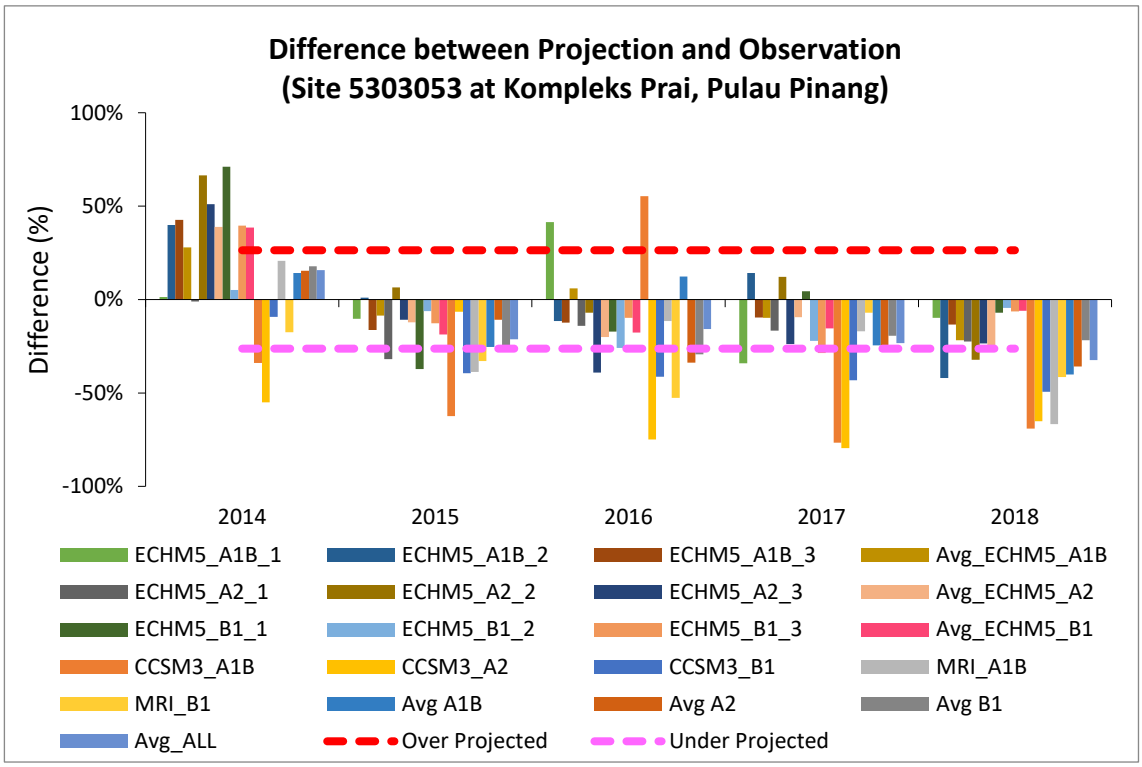


Figure A24-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5303053 at Kompleks Prai, Pulau Pinang

A25: Site 5402001 at Klinik Bkt Bendera P. Pinang, Pulau Pinang

Table A25-1: Projected and observed 2014-2018 yearly rainfall for Site 5402001 at Klinik Bkt Bendera P. Pinang, Pulau Pinang

Site 5402001 at Klinik Bkt Bendera P. Pinang, Pulau Pinang						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	1,926	2,260	3,430	1,674	2,643	2,387
ECHM5_A1B_2	2,814	3,137	1,902	2,679	1,715	2,449
ECHM5_A1B_3	3,046	2,234	2,185	2,312	2,475	2,450
Average_ECHM5_A1B	2,595	2,544	2,506	2,222	2,278	2,429
ECHM5_A2_1	2,230	1,886	1,898	1,934	1,974	1,985
ECHM5_A2_2	3,337	3,146	2,015	3,211	1,375	2,617
ECHM5_A2_3	2,355	2,557	1,393	2,048	2,099	2,090
Average_ECHM5_A2	2,641	2,530	1,769	2,397	1,816	2,231
ECHM5_B1_1	3,487	1,804	1,806	2,355	2,560	2,402
ECHM5_B1_2	2,405	2,544	1,814	2,363	2,535	2,332
ECHM5_B1_3	2,577	2,548	2,441	1,694	2,787	2,409
Average_ECHM5_B1	2,823	2,299	2,020	2,137	2,627	2,381
CCSM3_A1B	1,287	987	1,857	704	801	1,127
CCSM3_A2	1,358	1,209	844	758	903	1,014
CCSM3_B1	1,476	1,367	1,527	980	1,075	1,285
MRI_A1B	1,958	1,549	1,920	2,241	697	1,673
MRI_B1	1,795	1,801	928	2,295	1,289	1,622
Average_A1B	2,206	2,033	2,259	1,922	1,666	2,017
Average_A2	2,320	2,200	1,537	1,988	1,666	1,942
Average_B1	2,348	2,013	1,703	1,937	1,588	1,918
Average_ALL	2,289	2,074	1,854	1,946	1,781	1,989
OBSERVED	2,669	2,689	3,023	3,090	2,776	2,849

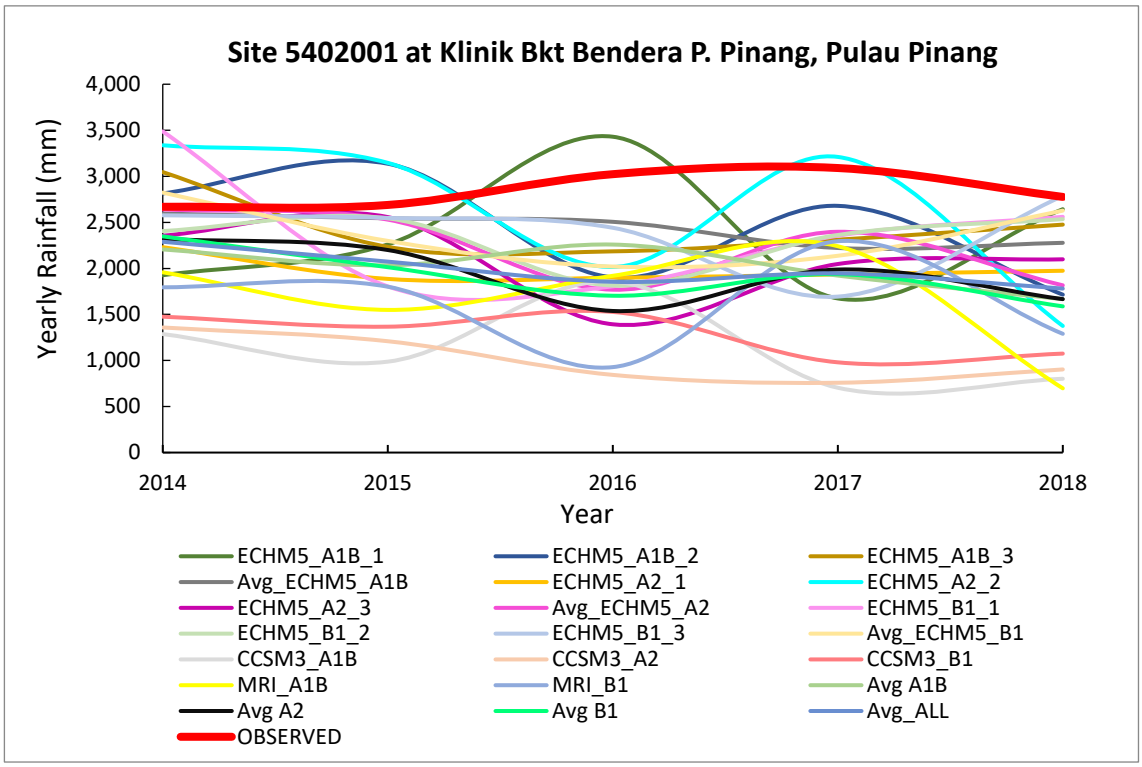


Figure A25-1: Projected and observed 2014-2018 yearly rainfall for Site 5402001 at Klinik Bkt Bendera P. Pinang, Pulau Pinang

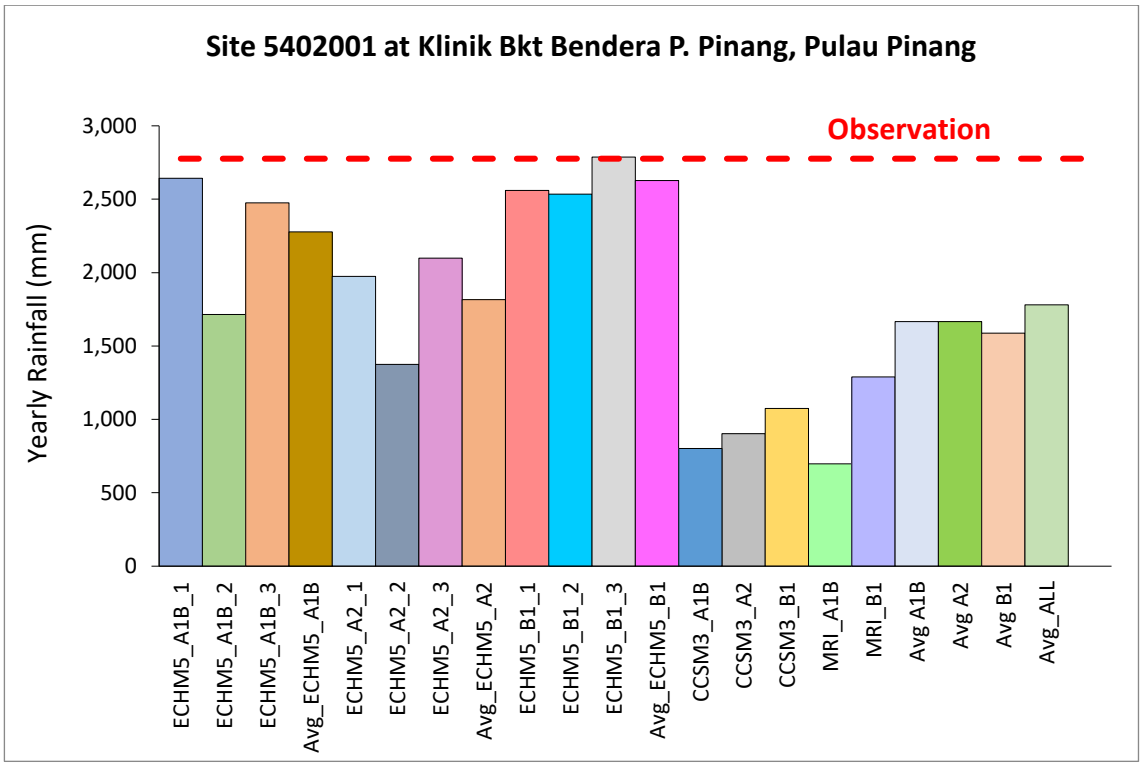


Figure A25-2: Projected and observed 2018 yearly rainfall for Site 5402001 at Klinik Bkt Bendera P. Pinang, Pulau Pinang

Table A25-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5402001 at Klinik Bkt Bendera P. Pinang, Pulau Pinang

Site 5402001 at Klinik Bkt Bendera P. Pinang, Pulau Pinang						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-28	-16	13	-46	-5	-16
ECHM5_A1B_2	5	17	-37	-13	-38	-13
ECHM5_A1B_3	14	-17	-28	-25	-11	-13
Average_ECHM5_A1B	-3	-5	-17	-28	-18	-14
ECHM5_A2_1	-16	-30	-37	-37	-29	-30
ECHM5_A2_2	25	17	-33	4	-50	-8
ECHM5_A2_3	-12	-5	-54	-34	-24	-26
Average_ECHM5_A2	-1	-6	-41	-22	-35	-21
ECHM5_B1_1	31	-33	-40	-24	-8	-15
ECHM5_B1_2	-10	-5	-40	-24	-9	-18
ECHM5_B1_3	-3	-5	-19	-45	0	-15
Average_ECHM5_B1	6	-15	-33	-31	-5	-16
CCSM3_A1B	-52	-63	-39	-77	-71	-60
CCSM3_A2	-49	-55	-72	-75	-67	-64
CCSM3_B1	-45	-49	-49	-68	-61	-55
MRI_A1B	-27	-42	-37	-27	-75	-42
MRI_B1	-33	-33	-69	-26	-54	-43
Average_A1B	-17	-24	-25	-38	-40	-29
Average_A2	-13	-18	-49	-36	-40	-31
Average_B1	-12	-25	-44	-37	-43	-32
Average_ALL	-14	-23	-39	-37	-36	-30

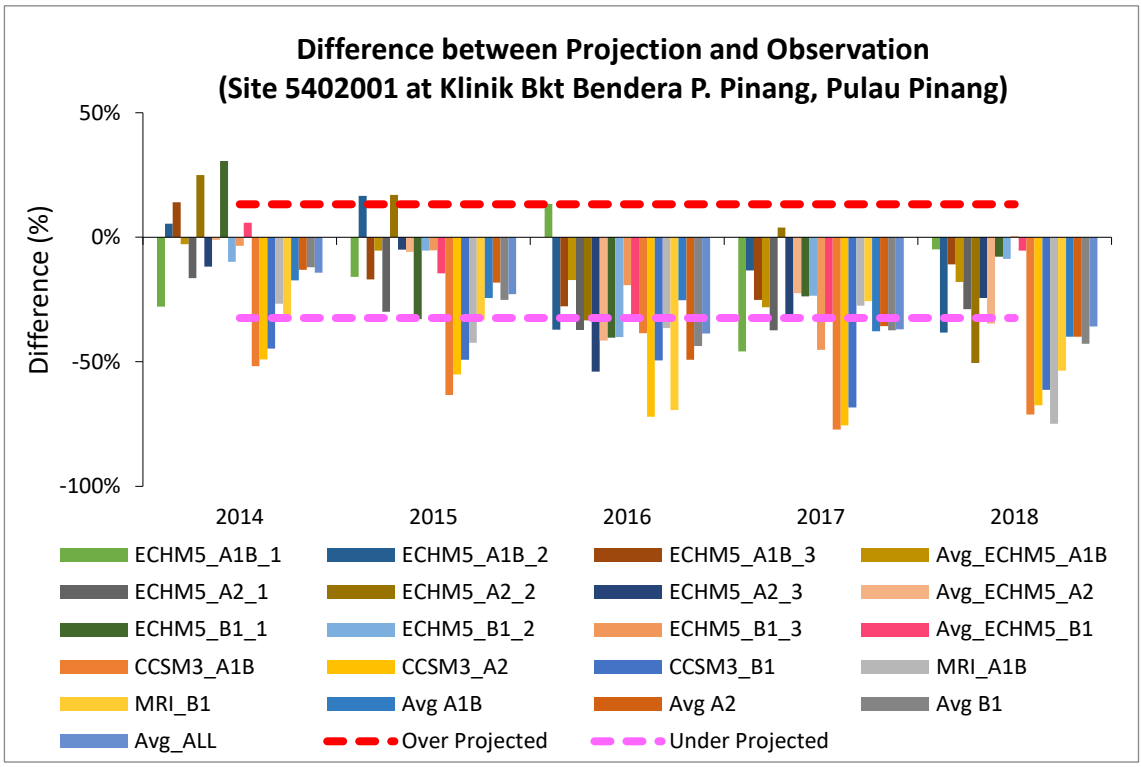


Figure A25-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5402001 at Klinik Bkt Bendera P. Pinang, Pulau Pinang

A26: Site 4311001 at Pejabat Daerah Kampar, Perak

Table A26-1: Projected and observed 2014-2018 yearly rainfall for Site 4311001 at Pejabat Daerah Kampar, Perak

Site 4311001 at Pejabat Daerah Kampar, Perak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,835	2,444	3,185	2,142	3,658	2,853
ECHM5_A1B_2	2,899	3,097	2,489	2,627	2,832	2,789
ECHM5_A1B_3	4,092	3,325	3,060	2,376	2,855	3,142
Average_ECHM5_A1B	3,275	2,955	2,911	2,382	3,115	2,928
ECHM5_A2_1	2,811	2,244	2,884	2,394	2,998	2,666
ECHM5_A2_2	2,610	2,925	2,426	3,297	3,025	2,857
ECHM5_A2_3	2,552	2,423	2,643	2,605	2,945	2,634
Average_ECHM5_A2	2,658	2,531	2,651	2,765	2,989	2,719
ECHM5_B1_1	2,437	2,989	2,782	2,740	2,995	2,789
ECHM5_B1_2	2,888	2,498	2,412	2,832	3,286	2,783
ECHM5_B1_3	2,568	2,852	2,452	3,401	3,380	2,931
Average_ECHM5_B1	2,631	2,780	2,549	2,991	3,220	2,834
CCSM3_A1B	3,510	2,529	3,071	2,989	1,983	2,816
CCSM3_A2	3,283	2,003	2,373	2,553	2,312	2,505
CCSM3_B1	3,157	2,951	2,919	1,927	3,511	2,893
MRI_A1B	2,981	2,402	2,629	2,553	1,402	2,394
MRI_B1	2,409	2,485	1,958	3,438	2,193	2,497
Average_A1B	3,264	2,759	2,887	2,537	2,546	2,799
Average_A2	2,814	2,399	2,581	2,712	2,546	2,611
Average_B1	2,692	2,755	2,505	2,868	2,820	2,728
Average_ALL	2,931	2,655	2,663	2,705	2,813	2,753
OBSERVED	3,163	3,824	2,252	3,033	3,893	3,233

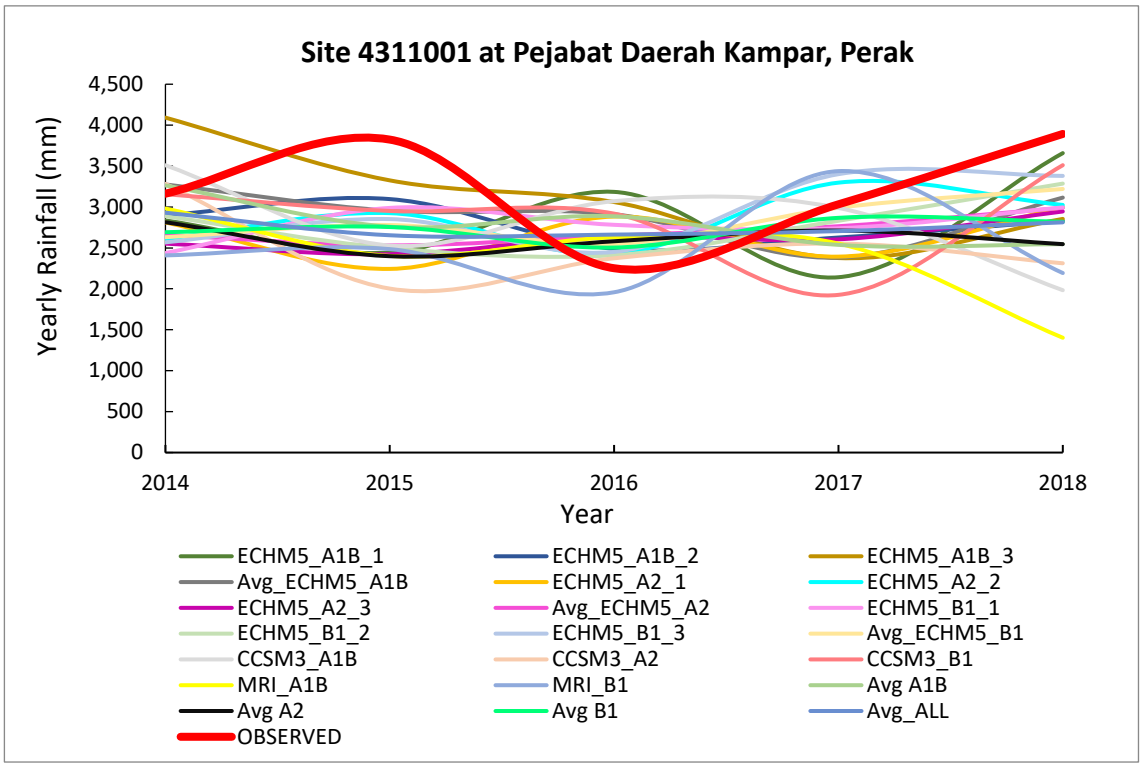


Figure A26-1: Projected and observed 2014-2018 yearly rainfall for Site 4311001 at Pejabat Daerah Kampar, Perak

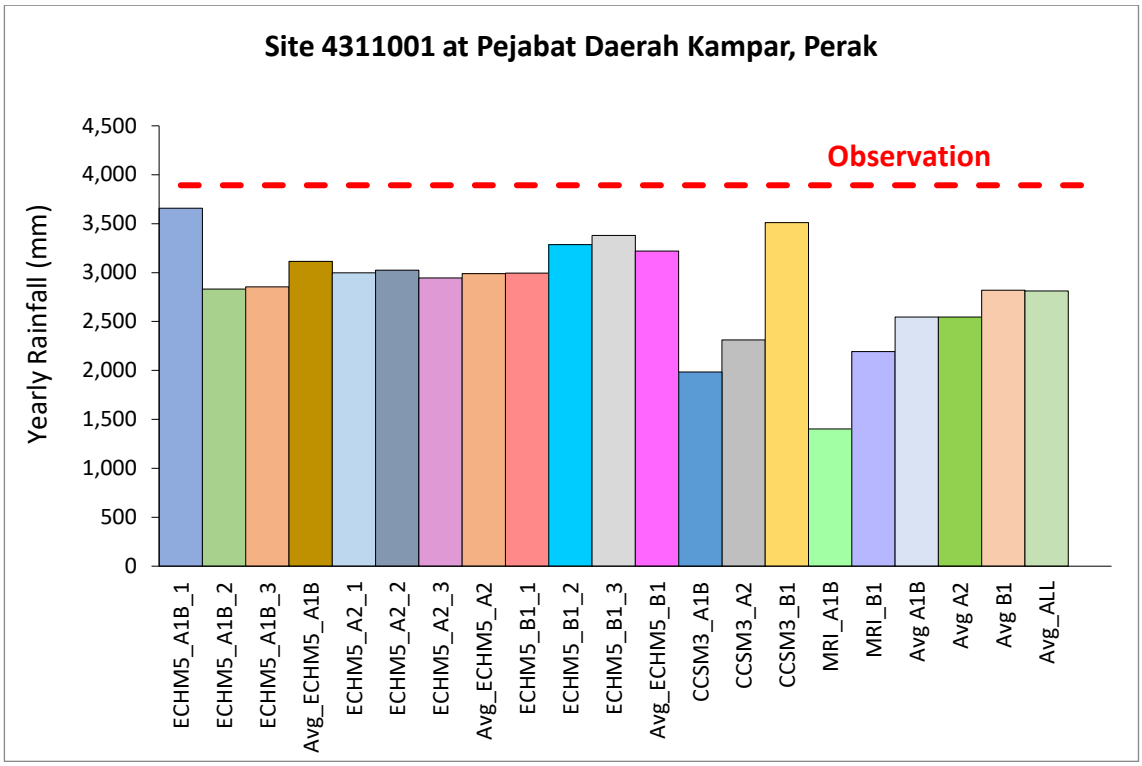


Figure A26-2: Projected and observed 2018 yearly rainfall for Site 4311001 at Pejabat Daerah Kampar, Perak

Table A26-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4311001 at Pejabat Daerah Kampar, Perak

Site 4311001 at Pejabat Daerah Kampar, Perak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-10	-36	41	-29	-6	-8
ECHM5_A1B_2	-8	-19	11	-13	-27	-11
ECHM5_A1B_3	29	-13	36	-22	-27	1
Average_ECHM5_A1B	4	-23	29	-21	-20	-6
ECHM5_A2_1	-11	-41	28	-21	-23	-14
ECHM5_A2_2	-17	-24	8	9	-22	-9
ECHM5_A2_3	-19	-37	17	-14	-24	-15
Average_ECHM5_A2	-16	-34	18	-9	-23	-13
ECHM5_B1_1	-23	-22	24	-10	-23	-11
ECHM5_B1_2	-9	-35	7	-7	-16	-12
ECHM5_B1_3	-19	-25	9	12	-13	-7
Average_ECHM5_B1	-17	-27	13	-1	-17	-10
CCSM3_A1B	11	-34	36	-1	-49	-7
CCSM3_A2	4	-48	5	-16	-41	-19
CCSM3_B1	0	-23	30	-36	-10	-8
MRI_A1B	-6	-37	17	-16	-64	-21
MRI_B1	-24	-35	-13	13	-44	-20
Average_A1B	3	-28	28	-16	-35	-9
Average_A2	-11	-37	15	-11	-35	-16
Average_B1	-15	-28	11	-5	-28	-13
Average_ALL	-7	-31	18	-11	-28	-12

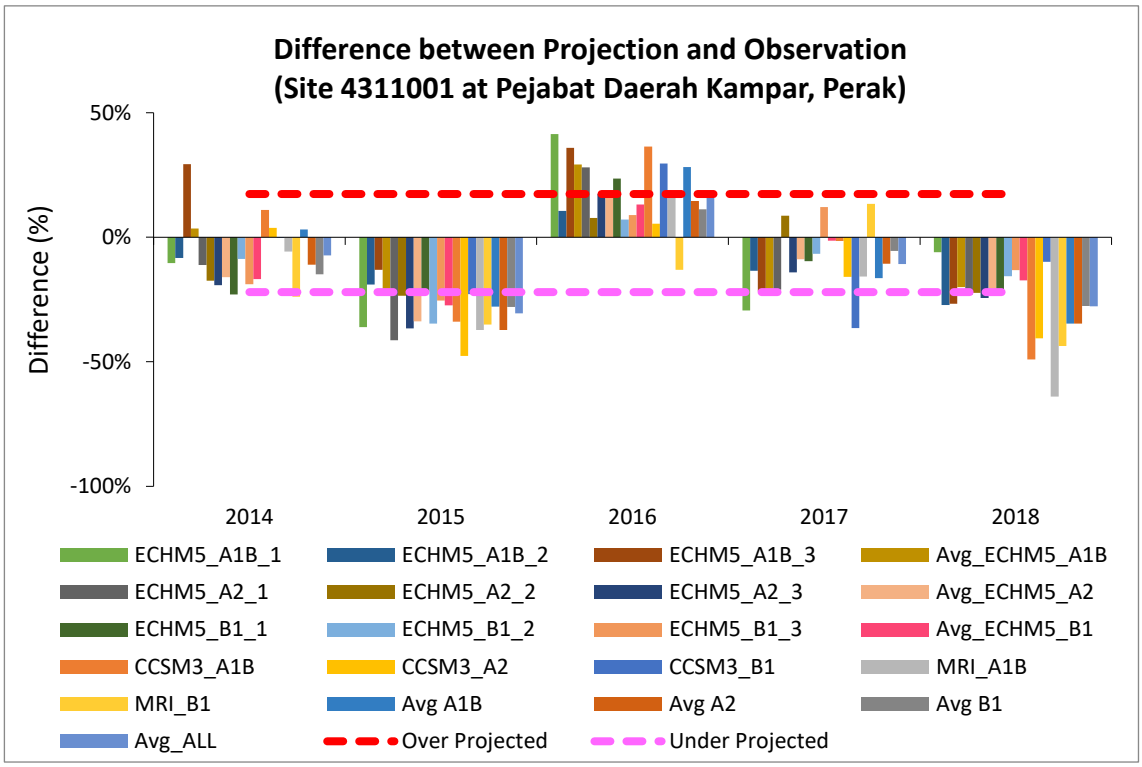


Figure A26-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4311001 at Pejabat Daerah Kampar, Perak

A27: Site 4511111 at Politeknik Ungku Umar, Perak

Table A27-1: Projected and observed 2014-2018 yearly rainfall for Site 4511111 at Politeknik Ungku Umar, Perak

Site 4511111 at Politeknik Ungku Umar, Perak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,055	2,027	2,441	1,717	2,909	2,230
ECHM5_A1B_2	2,445	2,410	2,018	2,159	2,076	2,221
ECHM5_A1B_3	3,038	2,620	2,360	2,167	2,509	2,539
Average_ECHM5_A1B	2,512	2,352	2,273	2,014	2,498	2,330
ECHM5_A2_1	2,183	1,864	2,219	2,007	2,195	2,094
ECHM5_A2_2	2,115	2,445	1,982	2,394	2,271	2,241
ECHM5_A2_3	2,140	1,912	2,265	2,153	2,420	2,178
Average_ECHM5_A2	2,146	2,074	2,155	2,185	2,295	2,171
ECHM5_B1_1	2,308	2,230	2,665	2,522	2,547	2,454
ECHM5_B1_2	2,245	2,147	1,985	2,153	2,673	2,241
ECHM5_B1_3	2,215	2,140	2,018	2,603	2,762	2,348
Average_ECHM5_B1	2,256	2,172	2,223	2,426	2,661	2,348
CCSM3_A1B	3,146	2,057	2,857	2,365	1,577	2,401
CCSM3_A2	3,134	1,683	1,909	2,275	1,761	2,152
CCSM3_B1	3,067	2,828	2,226	1,811	2,649	2,516
MRI_A1B	2,475	2,049	2,141	2,183	1,011	1,972
MRI_B1	2,141	1,847	1,586	3,086	1,741	2,080
Average_A1B	2,632	2,232	2,363	2,118	2,016	2,272
Average_A2	2,393	1,976	2,094	2,207	2,016	2,137
Average_B1	2,395	2,239	2,096	2,435	2,162	2,265
Average_ALL	2,479	2,161	2,191	2,257	2,221	2,262
OBSERVED	2,417	2,792	1,532	2,016	2,802	2,312

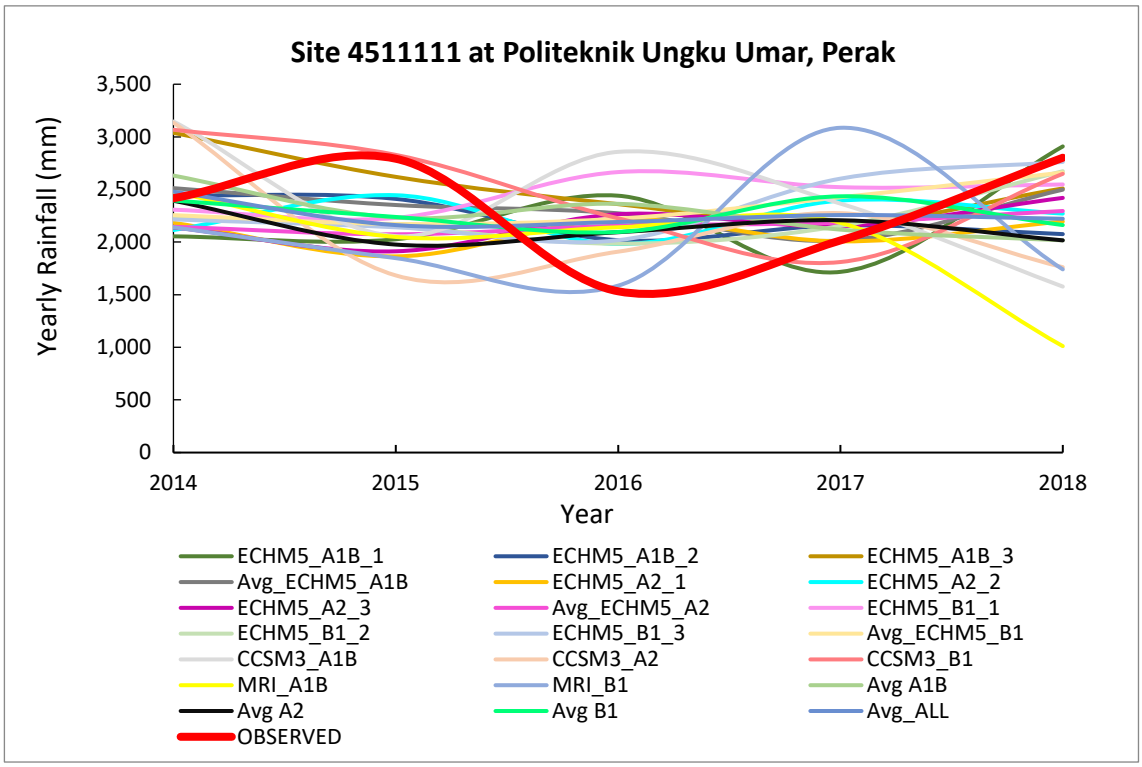


Figure A27-1: Projected and observed 2014-2018 yearly rainfall for Site 4511111 at Politeknik Ungku Umar, Perak

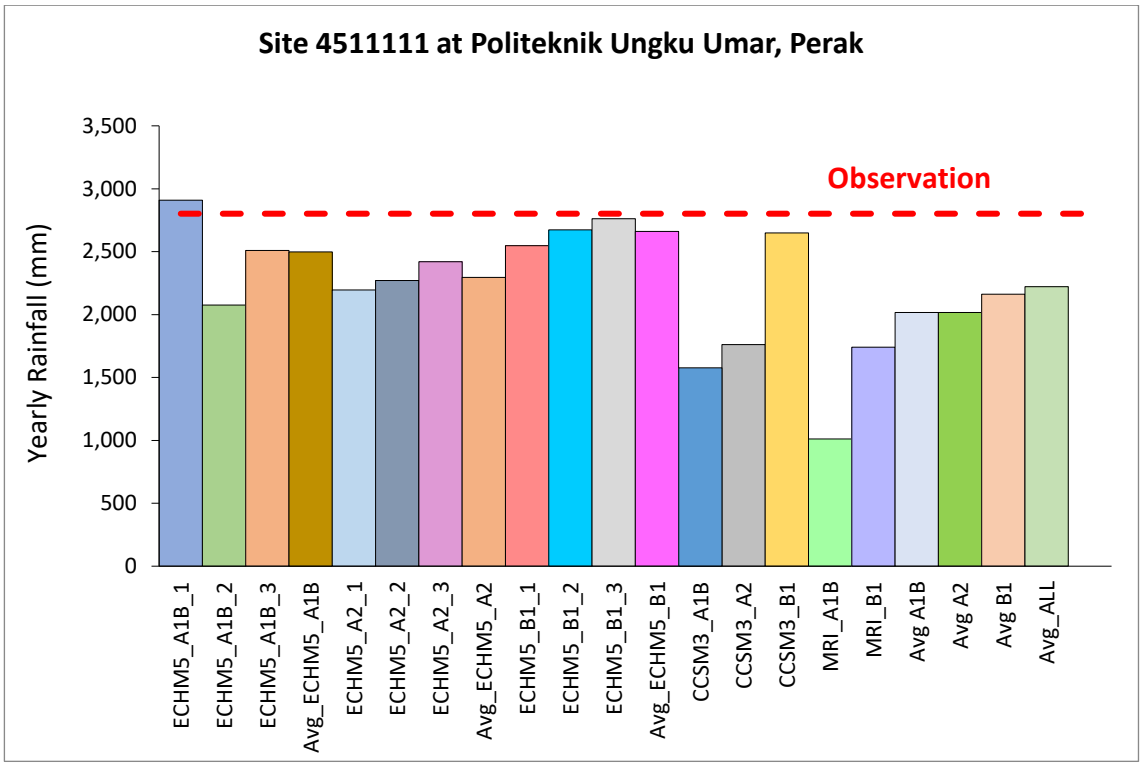


Figure A27-2: Projected and observed 2018 yearly rainfall for Site 4511111 at Politeknik Ungku Umar, Perak

Table A27-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4511111 at Politeknik Ungku Umar, Perak

Site 4511111 at Politeknik Ungku Umar, Perak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-15	-27	59	-15	4	1
ECHM5_A1B_2	1	-14	32	7	-26	0
ECHM5_A1B_3	26	-6	54	8	-10	14
Average_ECHM5_A1B	4	-16	48	0	-11	5
ECHM5_A2_1	-10	-33	45	0	-22	-4
ECHM5_A2_2	-12	-12	29	19	-19	1
ECHM5_A2_3	-11	-32	48	7	-14	0
Average_ECHM5_A2	-11	-26	41	8	-18	-1
ECHM5_B1_1	-5	-20	74	25	-9	13
ECHM5_B1_2	-7	-23	30	7	-5	0
ECHM5_B1_3	-8	-23	32	29	-1	6
Average_ECHM5_B1	-7	-22	45	20	-5	6
CCSM3_A1B	30	-26	86	17	-44	13
CCSM3_A2	30	-40	25	13	-37	-2
CCSM3_B1	27	1	45	-10	-5	12
MRI_A1B	2	-27	40	8	-64	-8
MRI_B1	-11	-34	4	53	-38	-5
Average_A1B	9	-20	54	5	-28	4
Average_A2	-1	-29	37	10	-28	-2
Average_B1	-1	-20	37	21	-23	3
Average_ALL	3	-23	43	12	-21	3

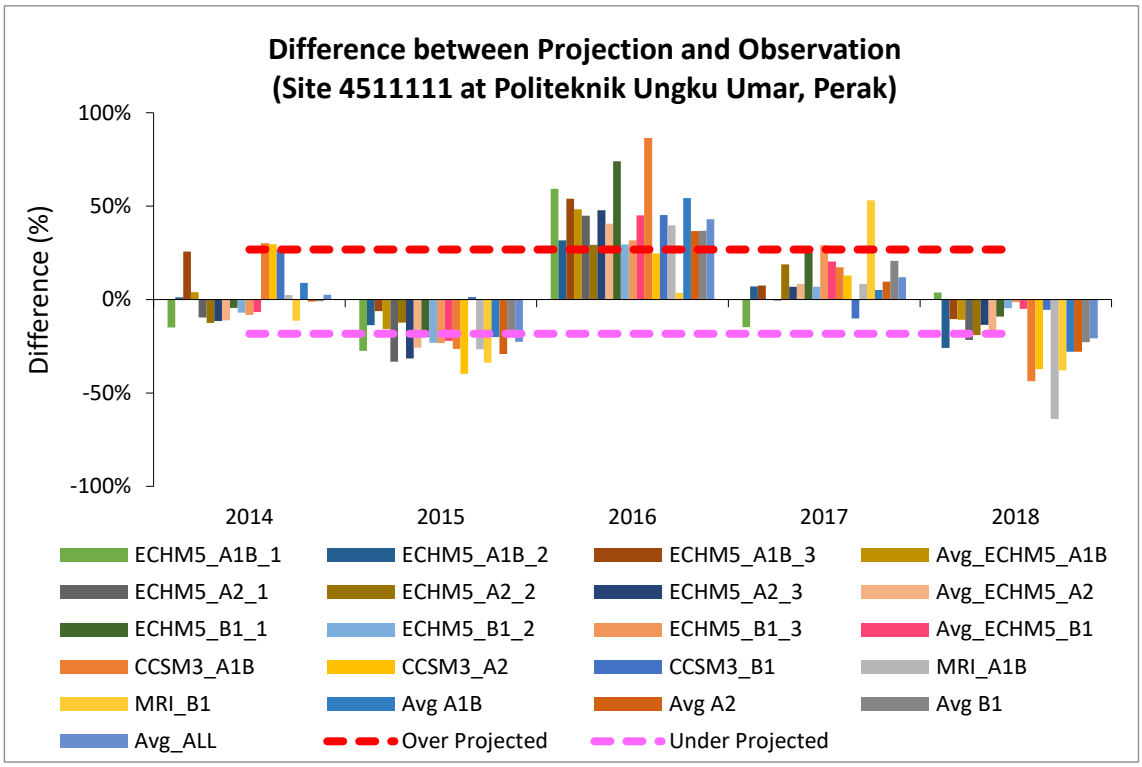


Figure A27-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4511111 at Politeknik Ungku Umar, Perak

A28: Site 4807016 at Bukit Larut Taiping, Perak

Table A28-1: Projected and observed 2014-2018 yearly rainfall for Site 4807016 at Bukit Larut Taiping, Perak

Site 4807016 at Bukit Larut Taiping, Perak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM5_A1B_1	2,897	2,438	3,017	2,499	3,156	2,801
ECHM5_A1B_2	2,883	3,012	2,756	2,697	2,481	2,766
ECHM5_A1B_3	3,565	3,152	3,194	2,672	3,135	3,143
Average_ECHM5_A1B	3,115	2,867	2,989	2,623	2,924	2,904
ECHM5_A2_1	2,723	2,604	2,900	2,792	2,920	2,788
ECHM5_A2_2	2,516	3,685	2,599	3,412	2,952	3,033
ECHM5_A2_3	2,593	2,436	2,493	2,902	2,745	2,634
Average_ECHM5_A2	2,611	2,908	2,664	3,035	2,872	2,818
ECHM5_B1_1	2,835	3,278	2,826	2,846	3,035	2,964
ECHM5_B1_2	2,578	2,782	2,548	2,587	3,180	2,735
ECHM5_B1_3	2,797	2,879	2,792	3,204	3,548	3,044
Average_ECHM5_B1	2,737	2,980	2,722	2,879	3,255	2,914
CCSM3_A1B	3,404	2,199	3,871	3,186	1,645	2,861
CCSM3_A2	3,467	2,483	2,101	2,721	1,812	2,517
CCSM3_B1	2,929	3,263	2,395	2,383	2,860	2,766
MRI_A1B	2,786	2,071	2,493	2,498	1,195	2,209
MRI_B1	2,315	2,478	1,535	3,085	1,791	2,241
Average_A1B	3,107	2,574	3,066	2,710	2,322	2,756
Average_A2	2,825	2,802	2,523	2,957	2,322	2,686
Average_B1	2,691	2,936	2,419	2,821	2,607	2,695
Average_ALL	2,878	2,768	2,680	2,820	2,604	2,750
OBSERVED	4,183	4,563	1,915	4,470	4,882	4,002

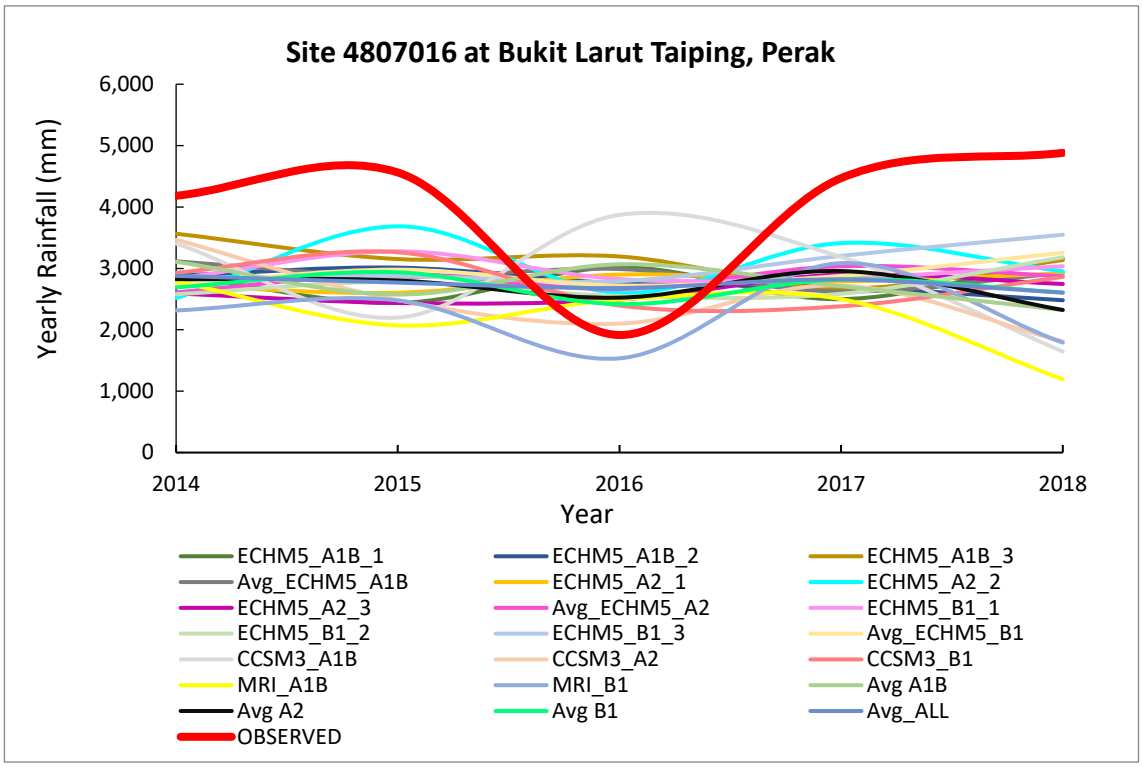


Figure A28-1: Projected and observed 2014-2018 yearly rainfall for Site 4807016 at Bukit Larut Taiping, Perak

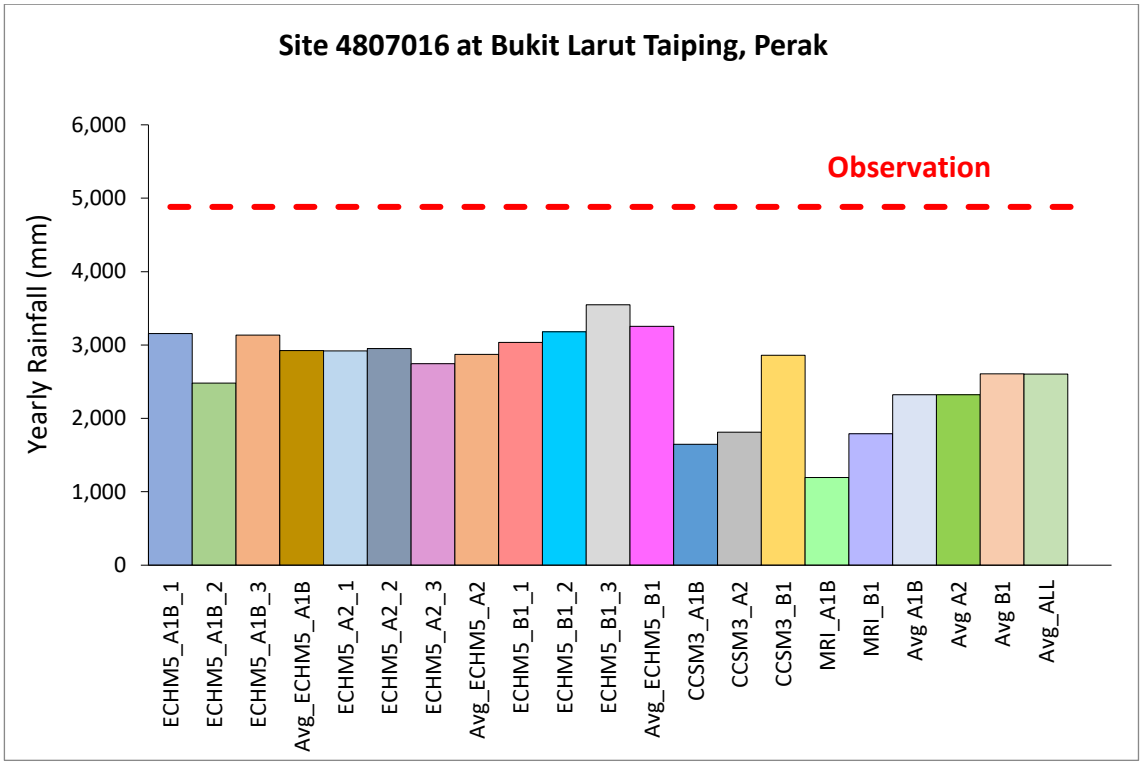


Figure A28-2: Projected and observed 2018 yearly rainfall for Site 4807016 at Bukit Larut Taiping, Perak

Table A28-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4807016 at Bukit Larut Taiping, Perak

Site 4807016 at Bukit Larut Taiping, Perak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM5_A1B_1	-31	-47	58	-44	-35	-20
ECHM5_A1B_2	-31	-34	44	-40	-49	-22
ECHM5_A1B_3	-15	-31	67	-40	-36	-11
Average_ECHM5_A1B	-26	-37	56	-41	-40	-18
ECHM5_A2_1	-35	-43	51	-38	-40	-21
ECHM5_A2_2	-40	-19	36	-24	-40	-17
ECHM5_A2_3	-38	-47	30	-35	-44	-27
Average_ECHM5_A2	-38	-36	39	-32	-41	-22
ECHM5_B1_1	-32	-28	48	-36	-38	-17
ECHM5_B1_2	-38	-39	33	-42	-35	-24
ECHM5_B1_3	-33	-37	46	-28	-27	-16
Average_ECHM5_B1	-35	-35	42	-36	-33	-19
CCSM3_A1B	-19	-52	102	-29	-66	-13
CCSM3_A2	-17	-46	10	-39	-63	-31
CCSM3_B1	-30	-28	25	-47	-41	-24
MRI_A1B	-33	-55	30	-44	-76	-35
MRI_B1	-45	-46	-20	-31	-63	-41
Average_A1B	-26	-44	60	-39	-52	-20
Average_A2	-32	-39	32	-34	-52	-25
Average_B1	-36	-36	26	-37	-47	-26
Average_ALL	-31	-39	40	-37	-47	-23

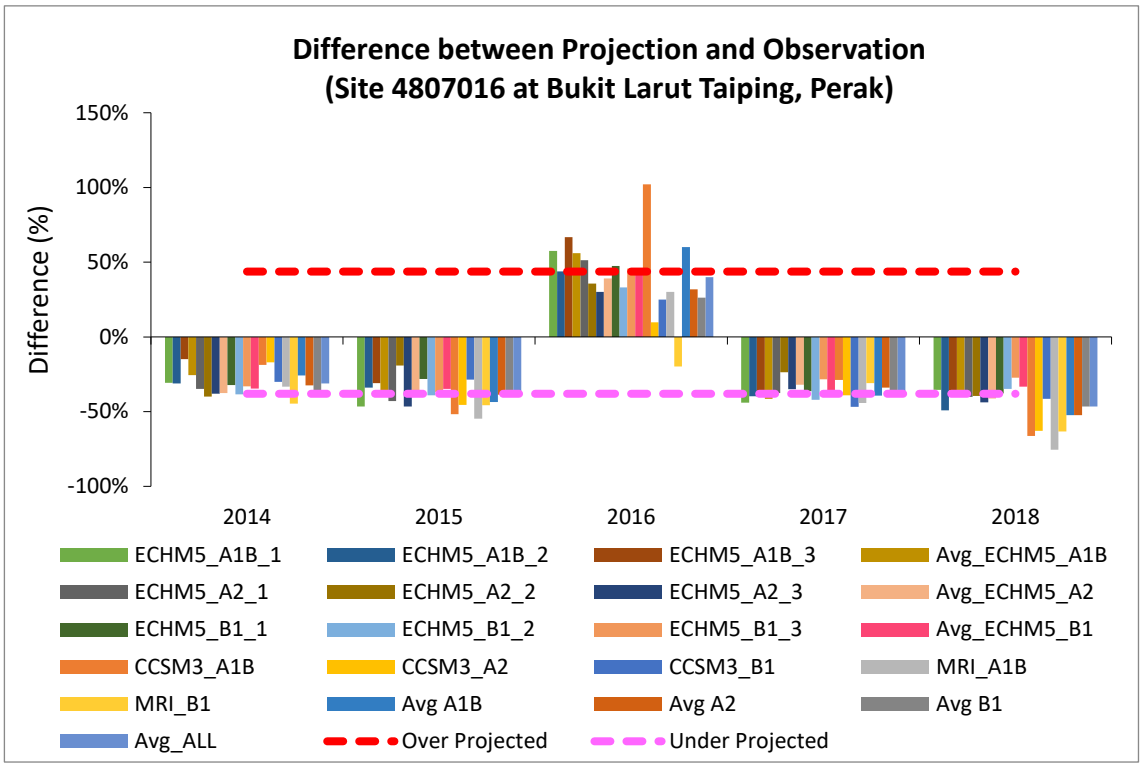


Figure A28-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4807016 at Bukit Larut Taiping, Perak

APPENDIX B

B1: Site 4486001 at Semporna Airport, Sabah

Table B1-1: Projected and observed 2014-2018 yearly rainfall for Site 4486001 at Semporna Airport, Sabah

Site 4486001 at Semporna Airport, Sabah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	2,084	3,787	3,860	4,469	2,689	3,378
ECHM3_A1B_2	3,195	2,718	2,198	2,999	3,038	2,830
ECHM3_A1B_3	1,901	3,435	3,538	4,296	2,794	3,193
Average_ECHM3	2,393	3,313	3,199	3,921	2,840	3,133
MRI_A1B	4,624	3,426	3,940	4,044	3,417	3,890
Average_ALL	2,951	3,341	3,384	3,952	2,985	3,323
OBSERVED	2,294	1,315	2,133	2,556	2,013	2,062

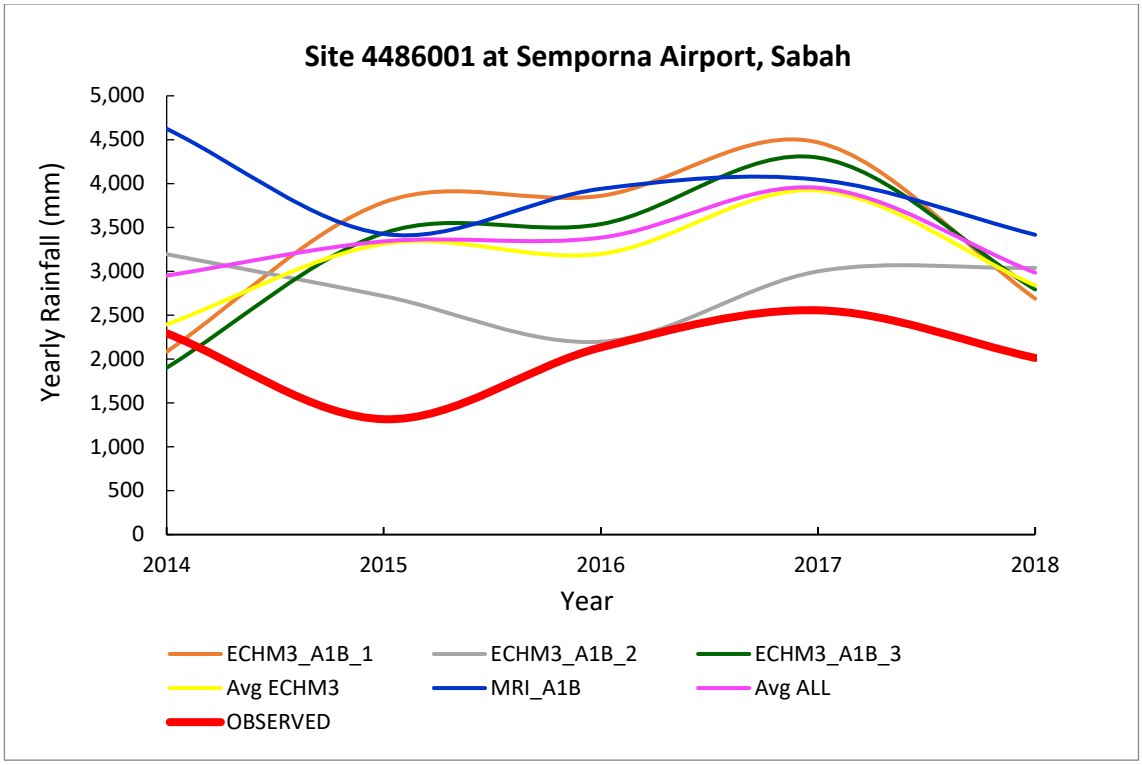


Figure B1-1: Projected and observed 2014-2018 yearly rainfall for Site 4486001 at Semporna Airport, Sabah

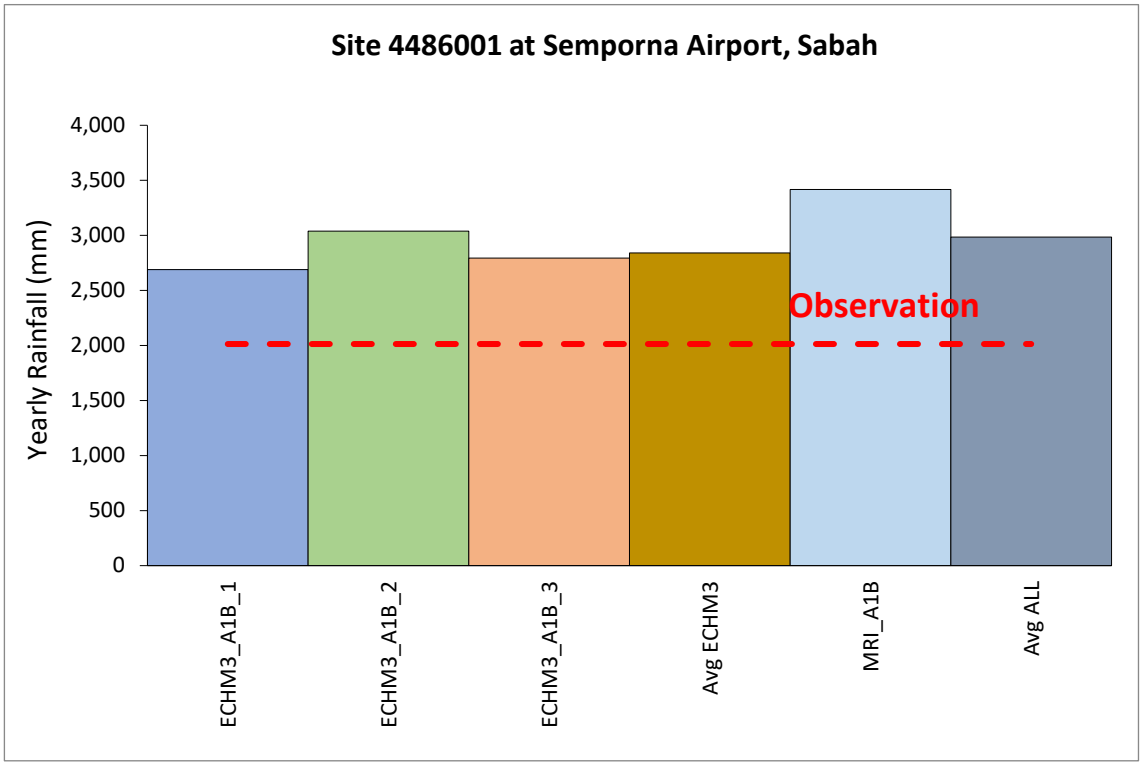


Figure B1-2: Projected and observed 2018 yearly rainfall for Site 4486001 at Semporna Airport, Sabah

Table B1-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4486001 at Semporna Airport, Sabah

Site 4486001 at Semporna Airport, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-9	188	81	75	34	74
ECHM3_A1B_2	39	107	3	17	51	43
ECHM3_A1B_3	-17	161	66	68	39	63
Average_ECHM3	4	152	50	53	41	60
MRI_A1B	102	161	85	58	70	95
Average_ALL	29	154	59	55	48	69

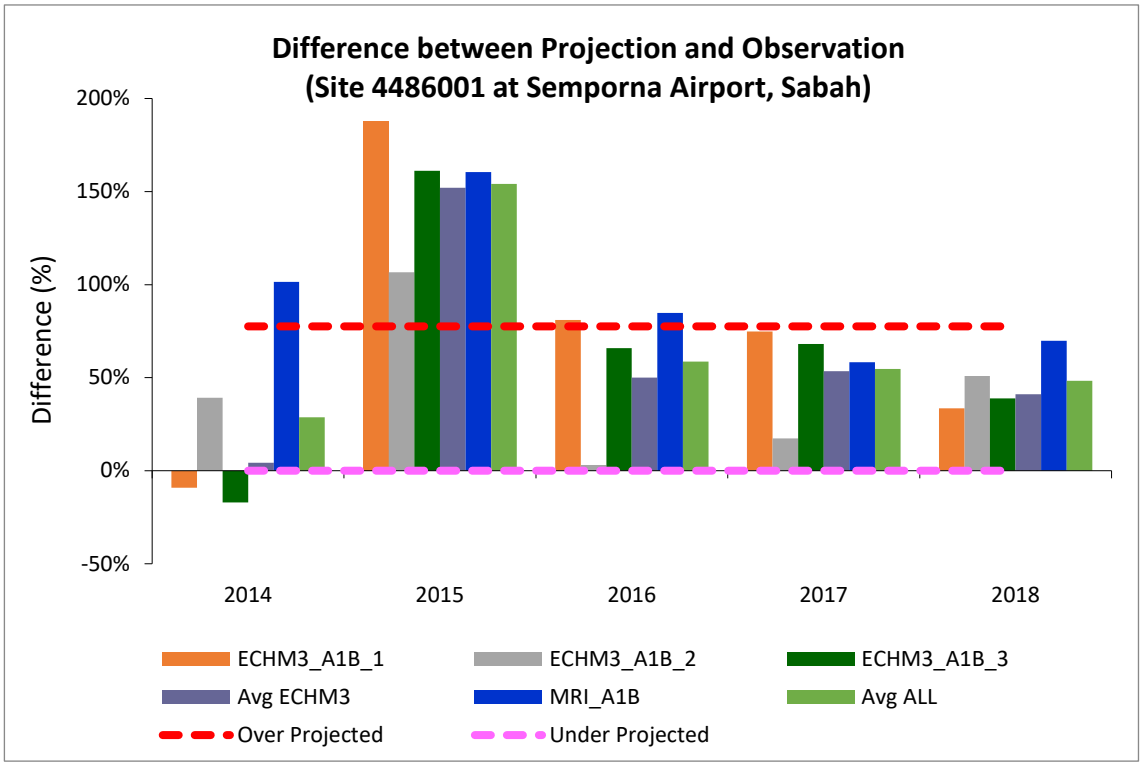


Figure B1-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4486001 at Semporna Airport, Sabah

B2: Site 5274001 at Kuamut Met Stn, Sabah

Table B2-1: Projected and observed 2014-2018 yearly rainfall for Site 5274001 at Kuamut Met Stn, Sabah

Site 5274001 at Kuamut Met Stn, Sabah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	1,613	1,442	1,726	1,387	1,090	1,452
ECHM3_A1B_2	1,801	1,404	844	1,695	1,683	1,485
ECHM3_A1B_3	1,840	1,466	1,685	1,556	1,040	1,517
Average_ECHM3	1,751	1,438	1,418	1,546	1,271	1,485
MRI_A1B	1,252	958	1,411	1,891	1,097	1,322
Average_ALL	1,627	1,318	1,416	1,632	1,227	1,444
OBSERVED	2,960	2,510	3,671	3,448	2,975	3,113

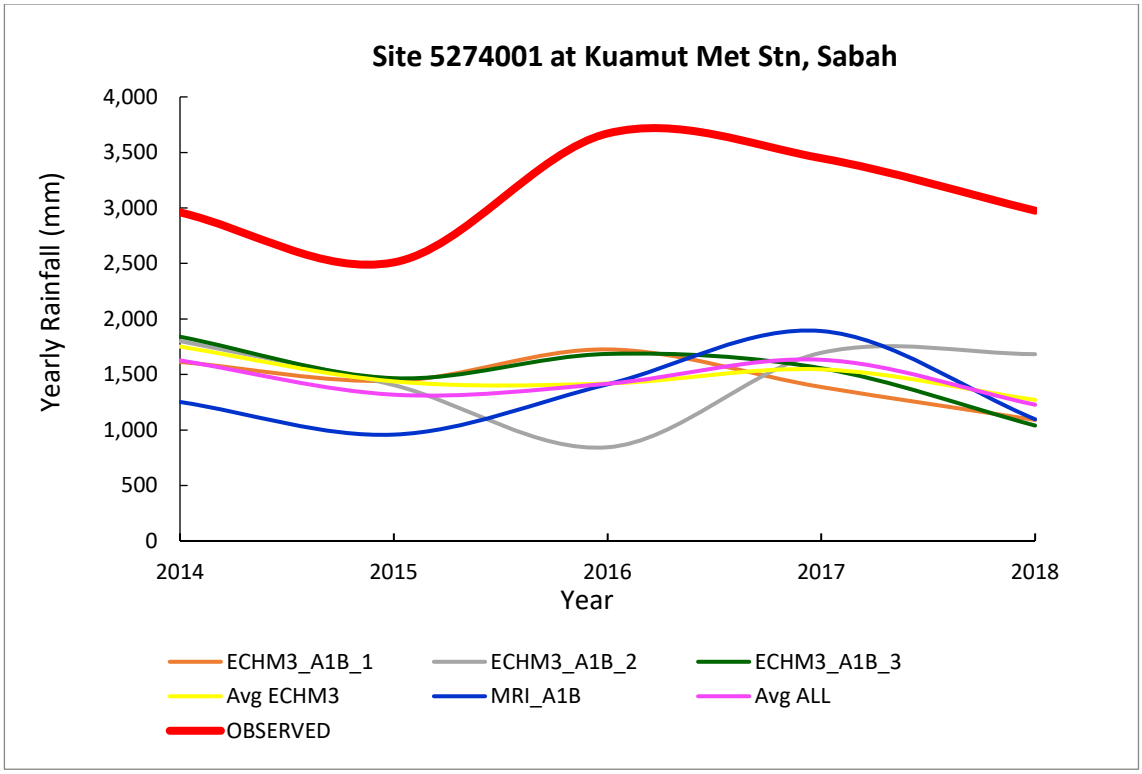


Figure B2-1: Projected and observed 2014-2018 yearly rainfall for Site 5274001 at Kuamut Met Stn, Sabah

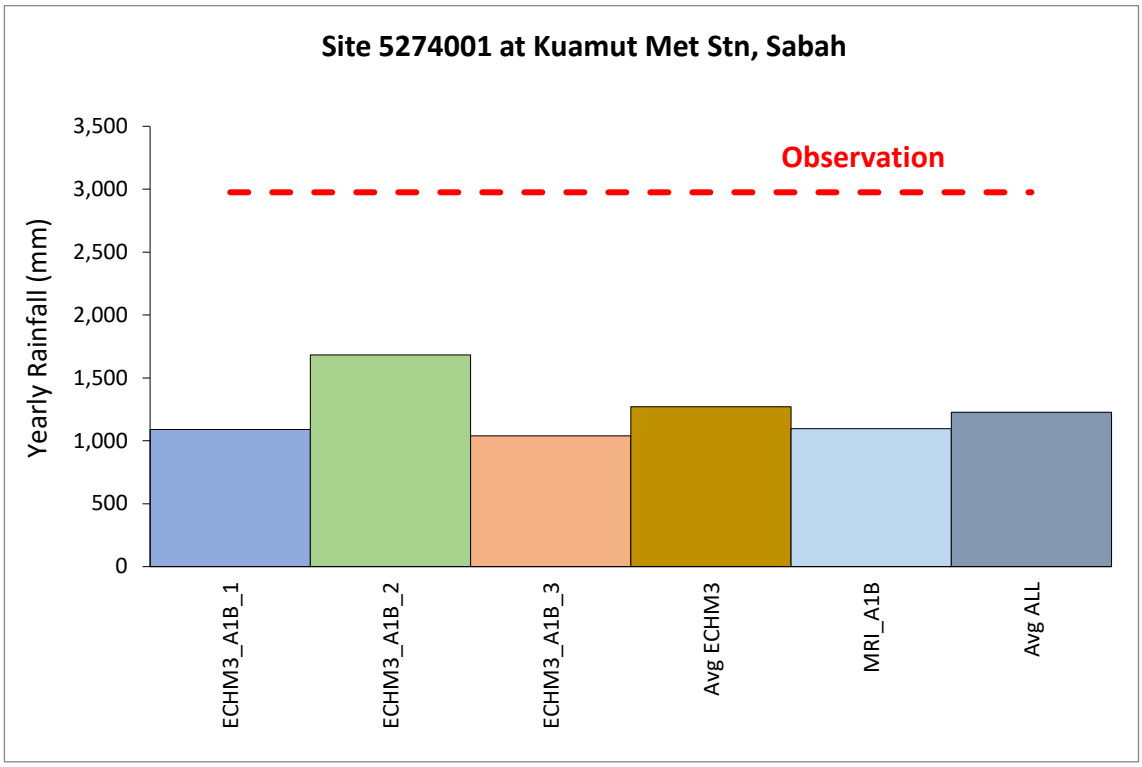


Figure B2-2: Projected and observed 2018 yearly rainfall for Site 5274001 at Kuamut Met Stn, Sabah

Table B2-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5274001 at Kuamut Met Stn, Sabah

Site 5274001 at Kuamut Met Stn, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-46	-43	-53	-60	-63	-53
ECHM3_A1B_2	-39	-44	-77	-51	-43	-51
ECHM3_A1B_3	-38	-42	-54	-55	-65	-51
Average_ECHM3	-41	-43	-61	-55	-57	-51
MRI_A1B	-58	-62	-62	-45	-63	-58
Average_ALL	-45	-47	-61	-53	-59	-53

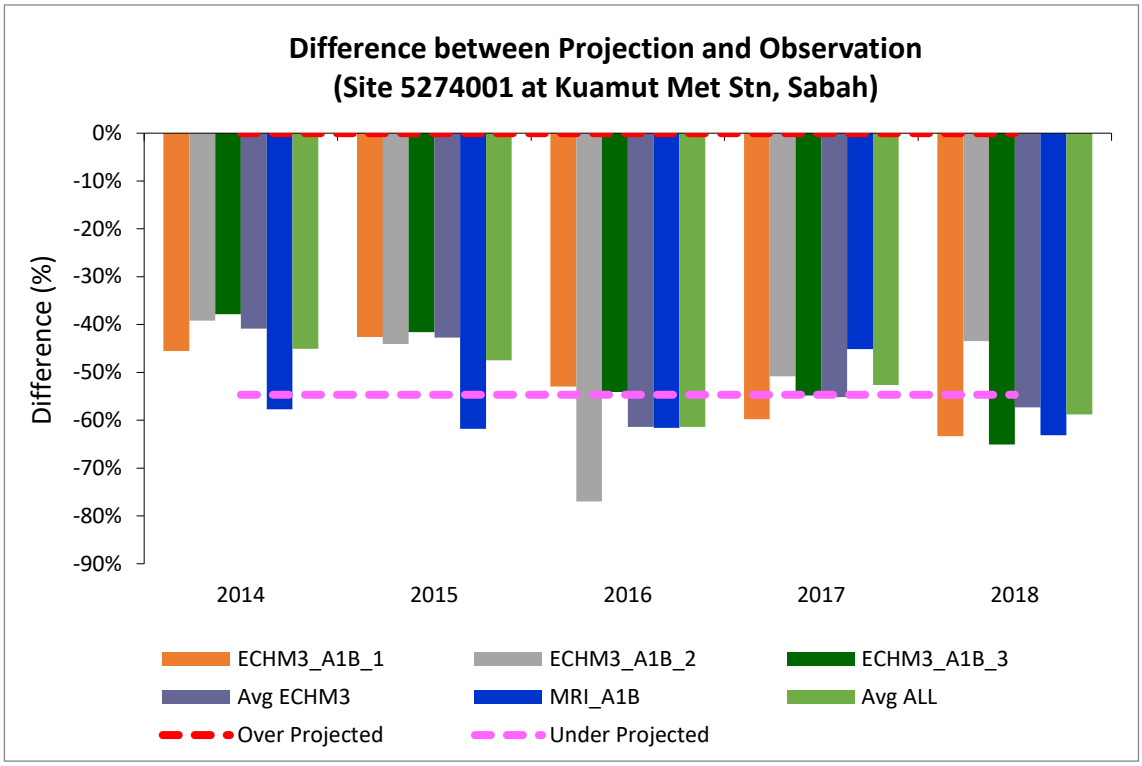


Figure B2-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5274001 at Kuamut Met Stn, Sabah

B3: Site 5357003 at Beaufort JPS, Sabah

Table B3-1: Projected and observed 2014-2018 yearly rainfall for Site 5357003 at Beaufort JPS, Sabah

Site 5357003 at Beaufort JPS, Sabah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	1,928	3,852	3,272	2,583	1,549	2,637
ECHM3_A1B_2	2,998	3,812	2,910	2,995	2,348	3,012
ECHM3_A1B_3	1,781	3,639	3,846	2,609	1,542	2,683
Average_ECHM3	2,236	3,768	3,342	2,729	1,813	2,778
MRI_A1B	2,021	2,186	1,851	2,433	1,819	2,062
Average_ALL	2,182	3,372	2,969	2,655	1,814	2,599
OBSERVED	4,214	3,180	3,002	3,389	3,035	3,364

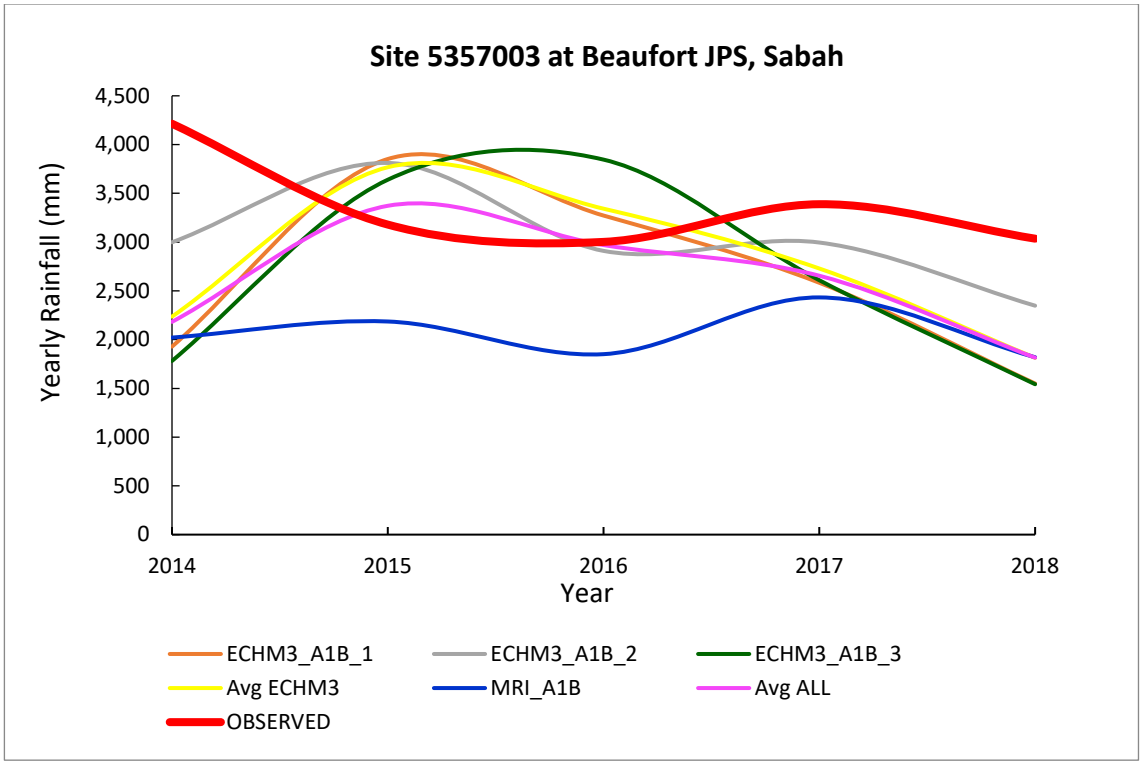


Figure B3-1: Projected and observed 2014-2018 yearly rainfall for Site 5357003 at Beaufort JPS, Sabah

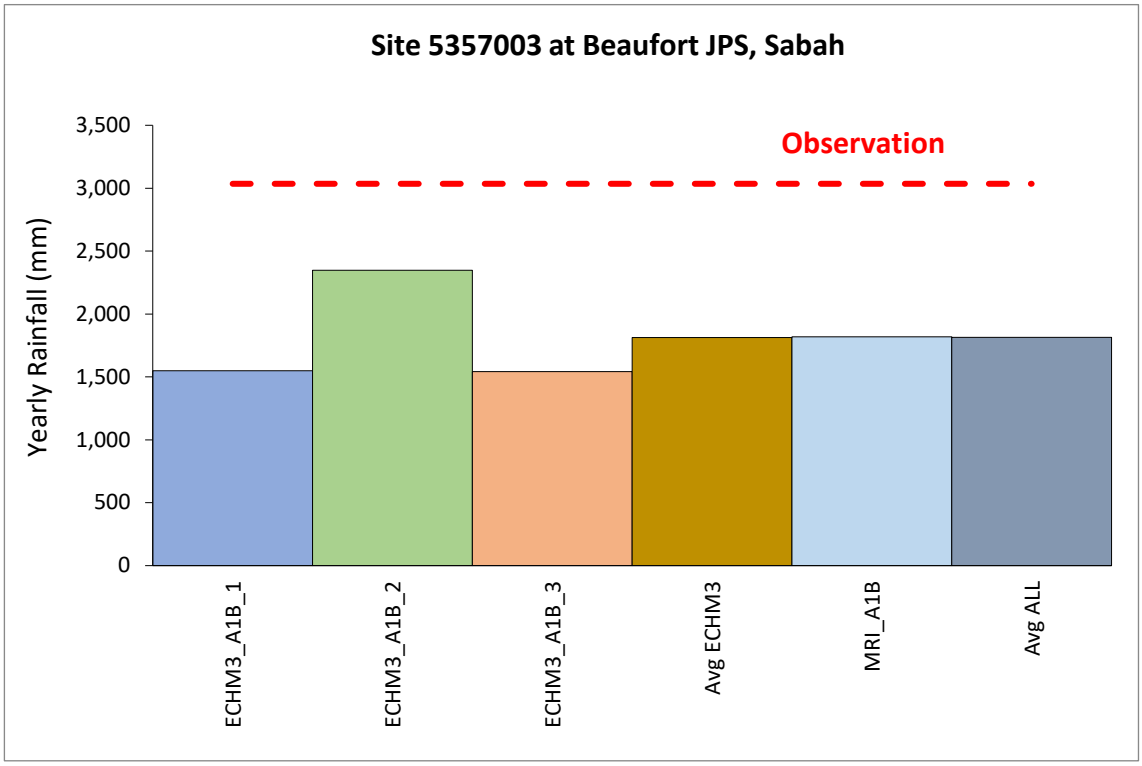


Figure B3-2: Projected and observed 2018 yearly rainfall for Site 5357003 at Beaufort JPS, Sabah

Table B3-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5357003 at Beaufort JPS, Sabah

Site 5357003 at Beaufort JPS, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-54	21	9	-24	-49	-19
ECHM3_A1B_2	-29	20	-3	-12	-23	-9
ECHM3_A1B_3	-58	14	28	-23	-49	-17
Average_ECHM3	-47	18	11	-19	-40	-15
MRI_A1B	-52	-31	-38	-28	-40	-38
Average_ALL	-48	6	-1	-22	-40	-21

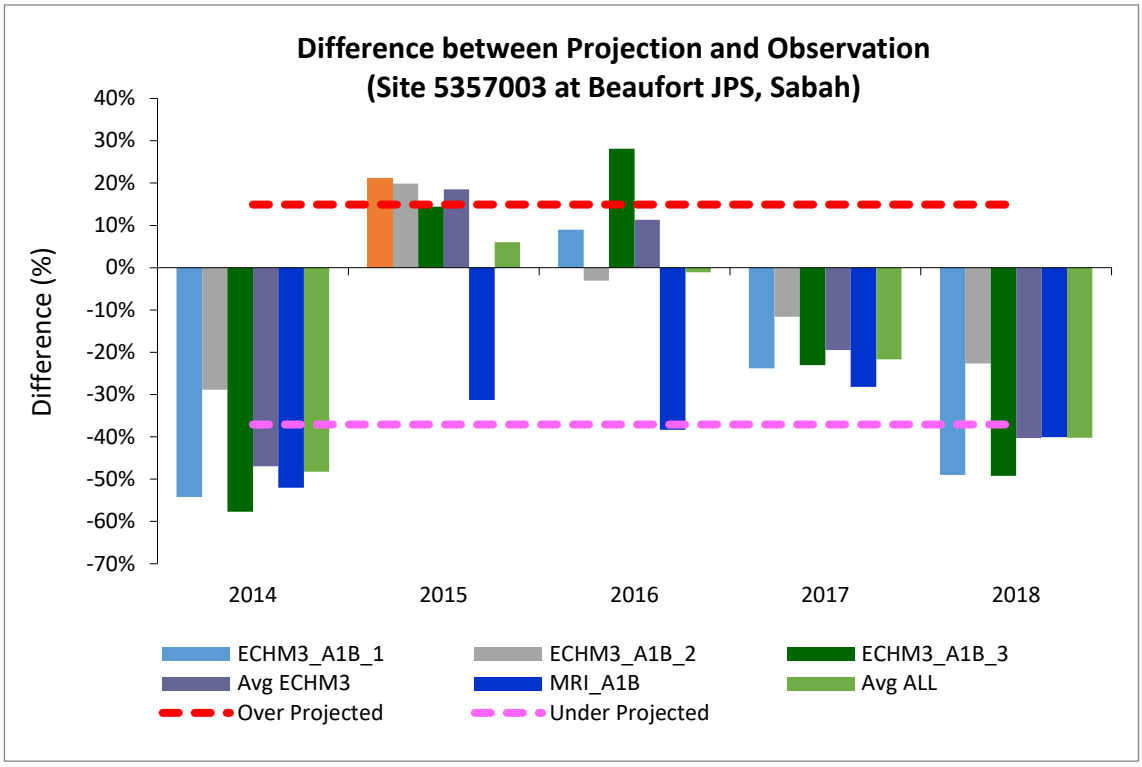


Figure B3-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5357003 at Beaufort JPS, Sabah

B4: Site 5361002 at Keningau Meterologi Stn, Sabah

Table B4-1: Projected and observed 2014-2018 yearly rainfall for Site 5361002 at Keningau Meterologi Stn, Sabah

Site 5361002 at Keningau Meterologi Stn, Sabah						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	519	674	590	867	568	644
ECHM3_A1B_2	802	620	740	696	457	663
ECHM3_A1B_3	535	731	623	650	639	635
Average_ECHM3	618	675	651	738	555	647
MRI_A1B	993	935	881	1,287	911	1,001
Average_ALL	712	740	709	875	644	736
OBSERVED	1,576	1,528	1,300	1,895	1,453	1,550

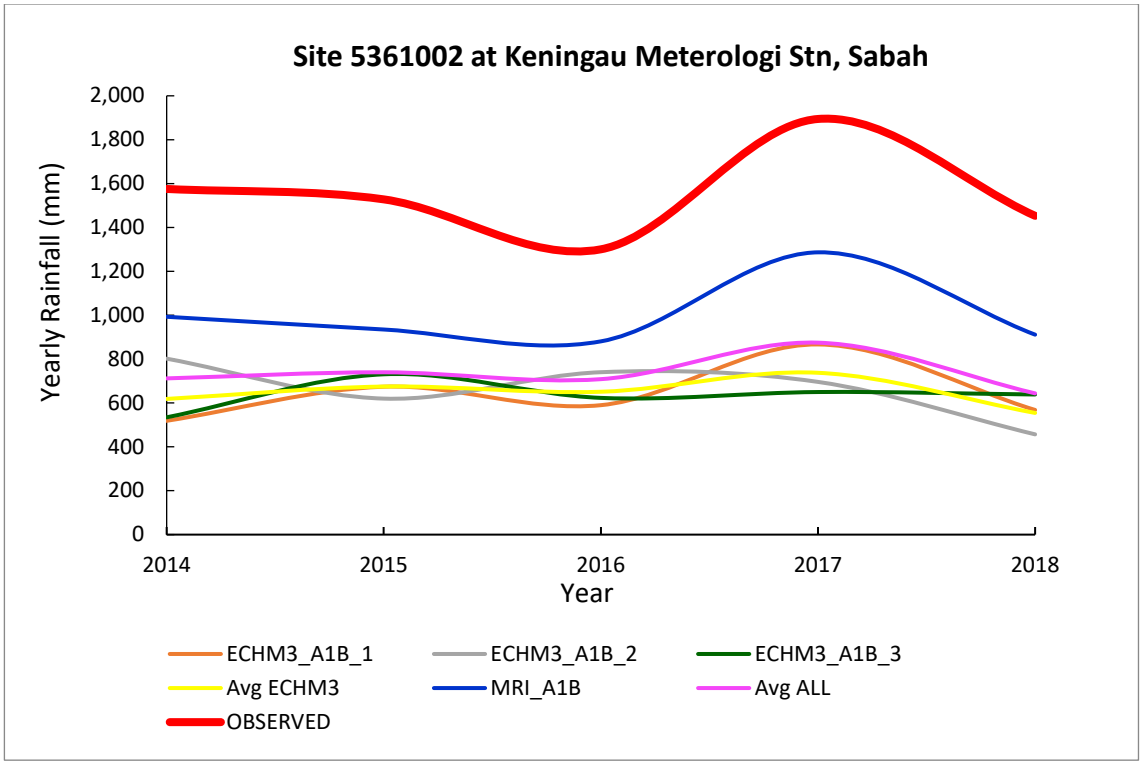


Figure B4-1: Projected and observed 2014-2018 yearly rainfall for Site 5361002 at Keningau Meterologi Stn, Sabah

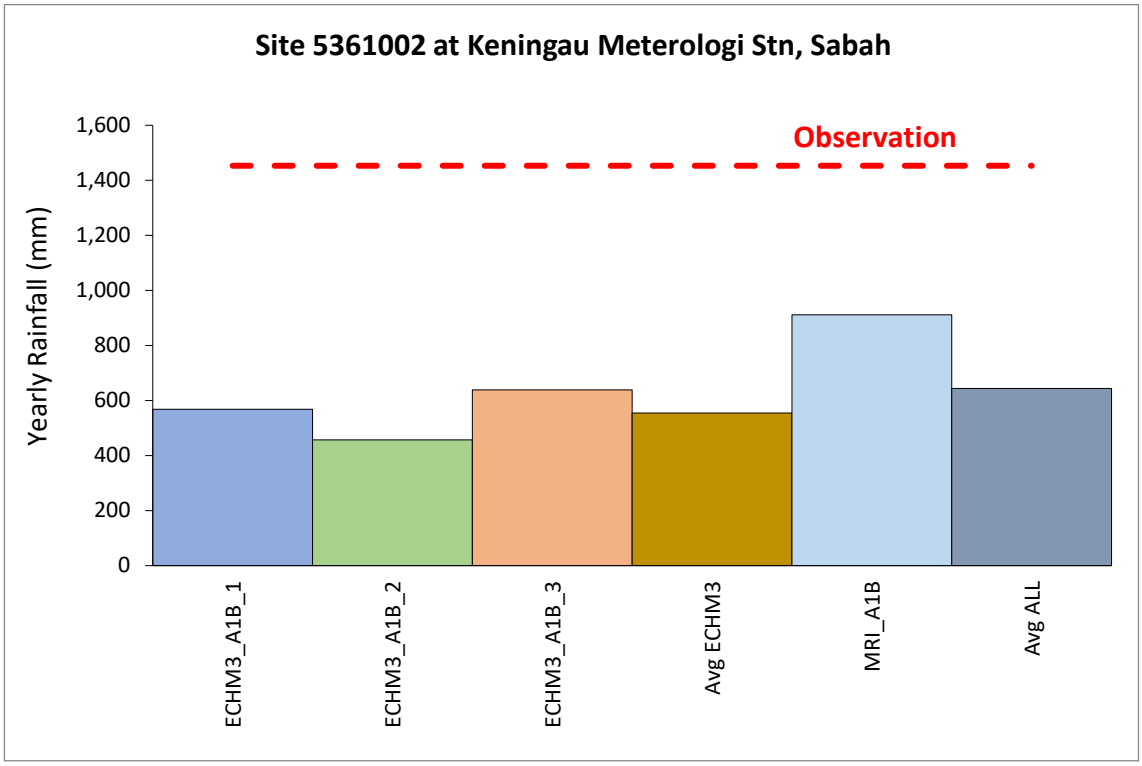


Figure B4-2: Projected and observed 2018 yearly rainfall for Site 5361002 at Keningau Meterologi Stn, Sabah

Table B4-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5361002 at Keningau Meterologi Stn, Sabah

Site 5361002 at Keningau Meterologi Stn, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-67	-56	-55	-54	-61	-59
ECHM3_A1B_2	-49	-59	-43	-63	-69	-57
ECHM3_A1B_3	-66	-52	-52	-66	-56	-58
Average_ECHM3	-61	-56	-50	-61	-62	-58
MRI_A1B	-37	-39	-32	-32	-37	-35
Average_ALL	-55	-52	-46	-54	-56	-52

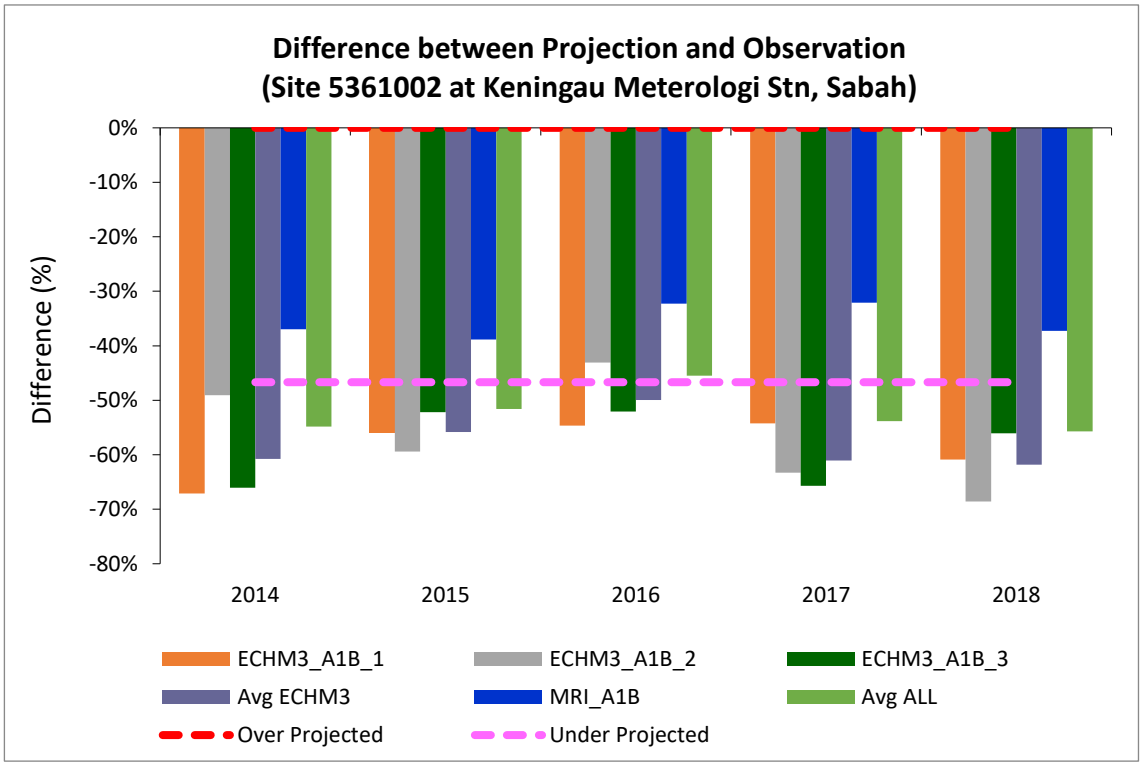


Figure B4-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5361002 at Keningau Meterologi Stn, Sabah

B5: Site 5862002 at Ulu Moyog, Sabah

Table B5-1: Projected and observed 2014-2018 yearly rainfall for Site 5862002 at Ulu Moyog, Sabah

Site 5862002 at Ulu Moyog, Sabah						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	2,840	4,051	2,529	4,074	2,648	3,229
ECHM3_A1B_2	3,196	3,335	3,227	2,102	2,579	2,888
ECHM3_A1B_3	2,898	4,370	2,452	4,247	2,813	3,356
Average_ECHM3	2,978	3,919	2,736	3,474	2,680	3,157
MRI_A1B	2,388	2,556	3,505	3,718	2,797	2,993
Average_ALL	2,831	3,578	2,928	3,535	2,709	3,116
OBSERVED	5,222	4,614	4,282	5,611	4,105	4,766

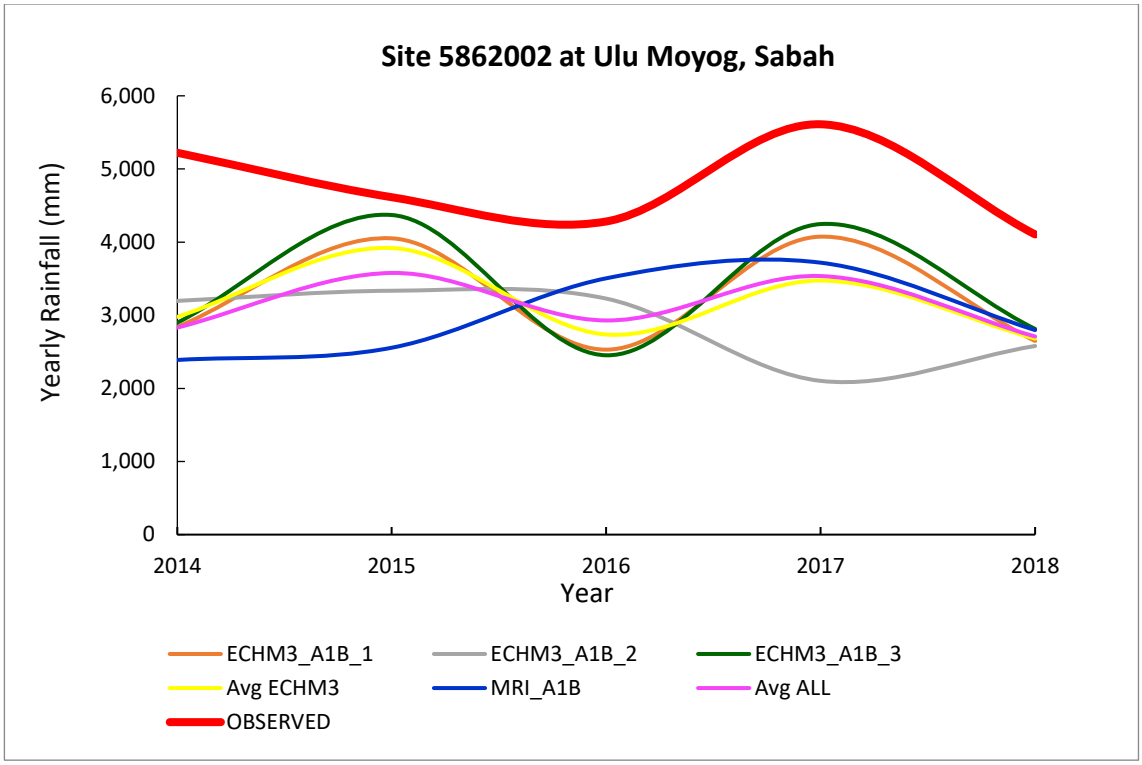


Figure B5-1: Projected and observed 2014-2018 yearly rainfall for Site 5862002 at Ulu Moyog, Sabah

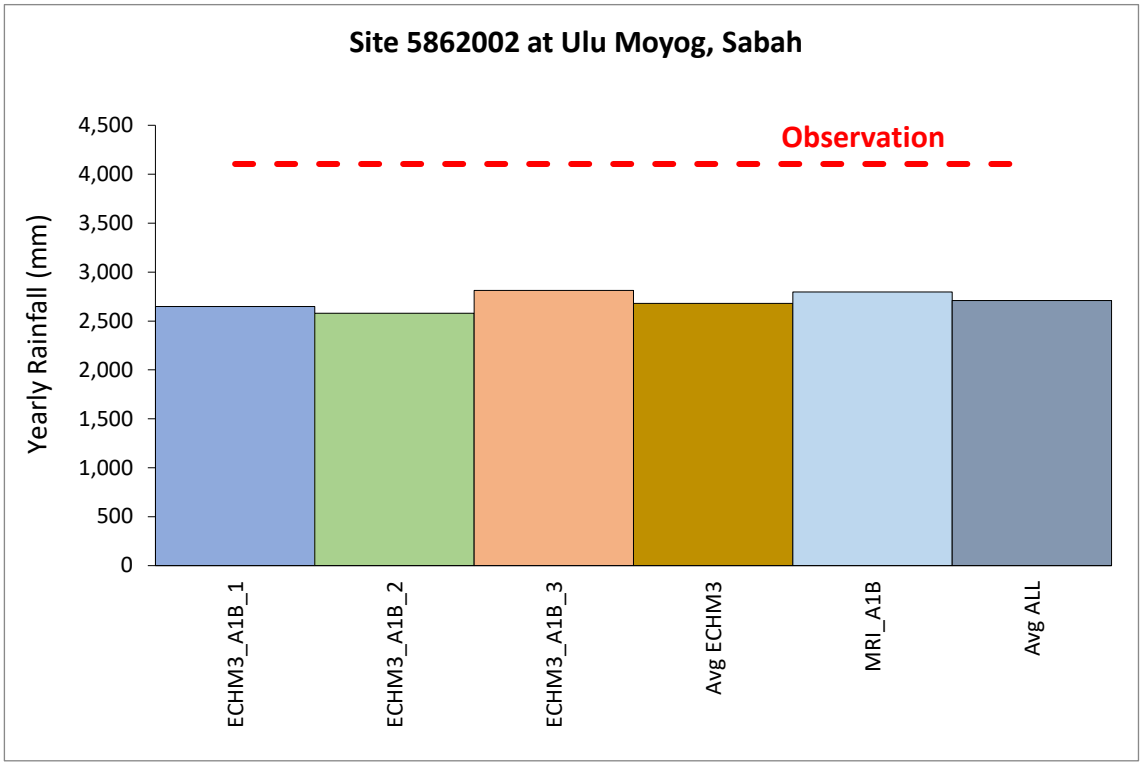


Figure B5-2: Projected and observed 2018 yearly rainfall for Site 5862002 at Ulu Moyog, Sabah

Table B5-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5862002 at Ulu Moyog, Sabah

Site 5862002 at Ulu Moyog, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-46	-12	-41	-27	-35	-32
ECHM3_A1B_2	-39	-28	-25	-63	-37	-38
ECHM3_A1B_3	-44	-5	-43	-24	-31	-30
Average_ECHM3	-43	-15	-36	-38	-35	-33
MRI_A1B	-54	-45	-18	-34	-32	-37
Average_ALL	-46	-22	-32	-37	-34	-34

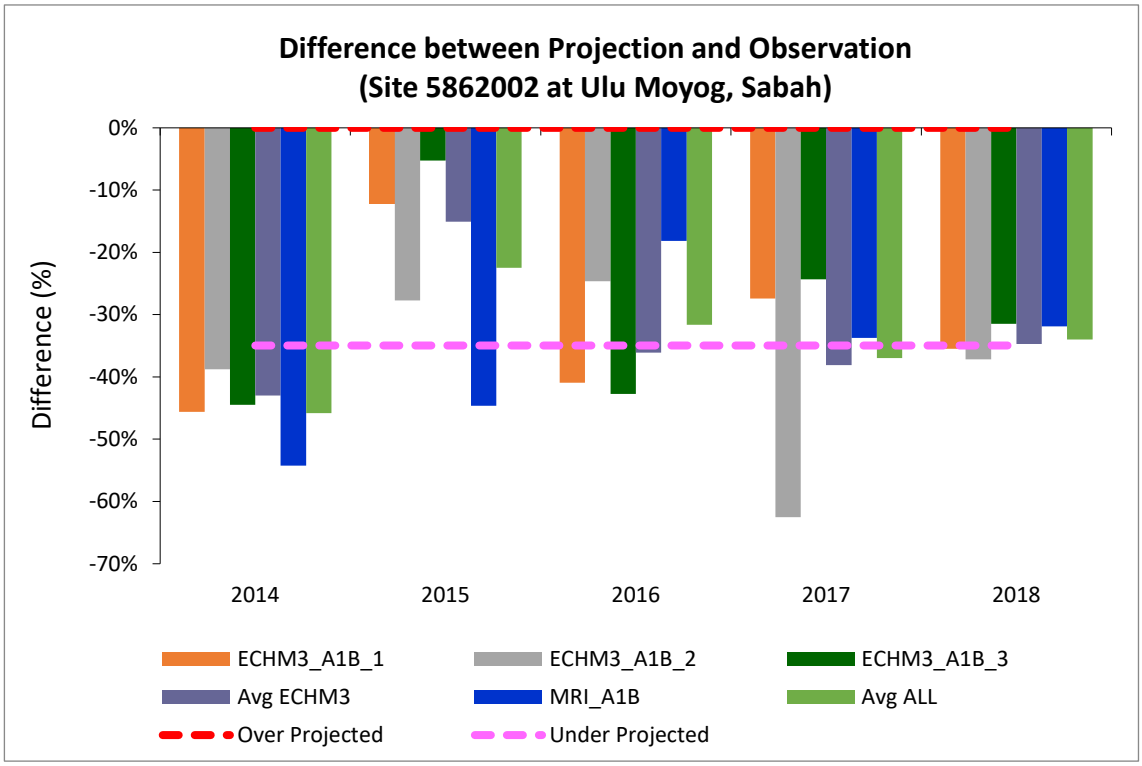


Figure B5-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5862002 at Ulu Moyog, Sabah

B6: Site 5961002 at Inanam Meteorological Stn, Sabah

Table B6-1: Projected and observed 2014-2018 yearly rainfall for Site 5961002 at Inanam Meteorological Stn, Sabah

Site 5961002 at Inanam Meteorological Stn, Sabah						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	1,762	3,253	2,837	1,771	1,153	2,155
ECHM3_A1B_2	2,828	2,075	2,215	2,334	2,067	2,304
ECHM3_A1B_3	1,798	3,368	2,835	1,829	988	2,164
Average_ECHM3	2,129	2,899	2,629	1,978	1,403	2,208
MRI_A1B	3,833	4,430	5,077	5,181	4,420	4,588
Average_ALL	2,555	3,281	3,241	2,779	2,157	2,803
OBSERVED	2,745	2,018	1,333	3,309	2,327	2,346

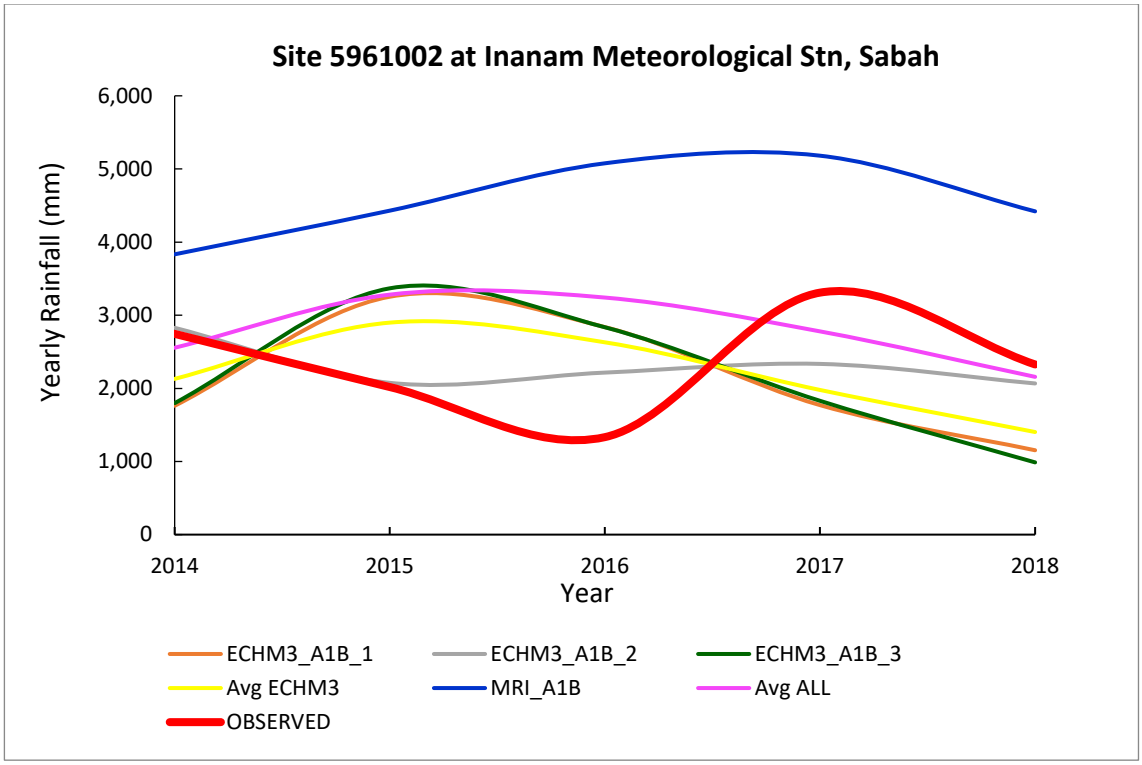


Figure B6-1: Projected and observed 2014-2018 yearly rainfall for Site 5961002 at Inanam Meteorological Stn, Sabah

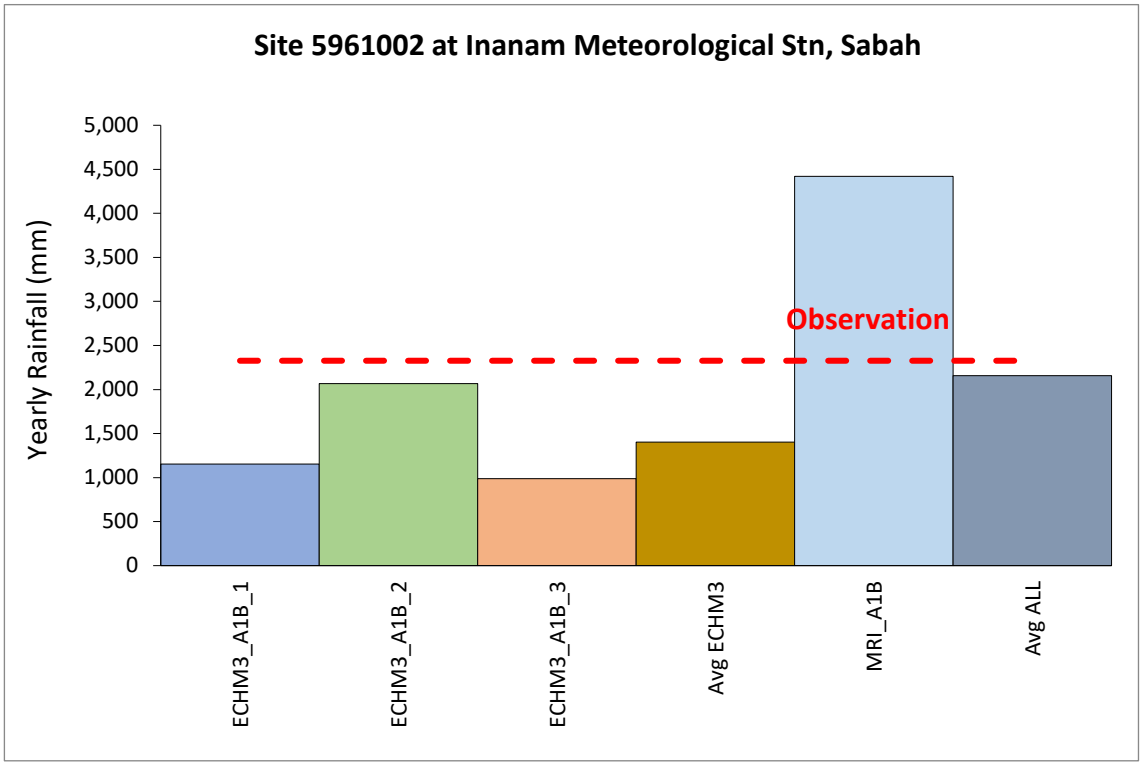


Figure B6-2: Projected and observed 2018 yearly rainfall for Site 5961002 at Inanam Meteorological Stn, Sabah

Table B6-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5961002 at Inanam Meteorological Stn, Sabah

Site 5961002 at Inanam Meteorological Stn, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-36	61	113	-46	-50	8
ECHM3_A1B_2	3	3	66	-29	-11	6
ECHM3_A1B_3	-35	67	113	-45	-58	9
Average_ECHM3	-22	44	97	-40	-40	8
MRI_A1B	40	120	281	57	90	117
Average_ALL	-7	63	143	-16	-7	35

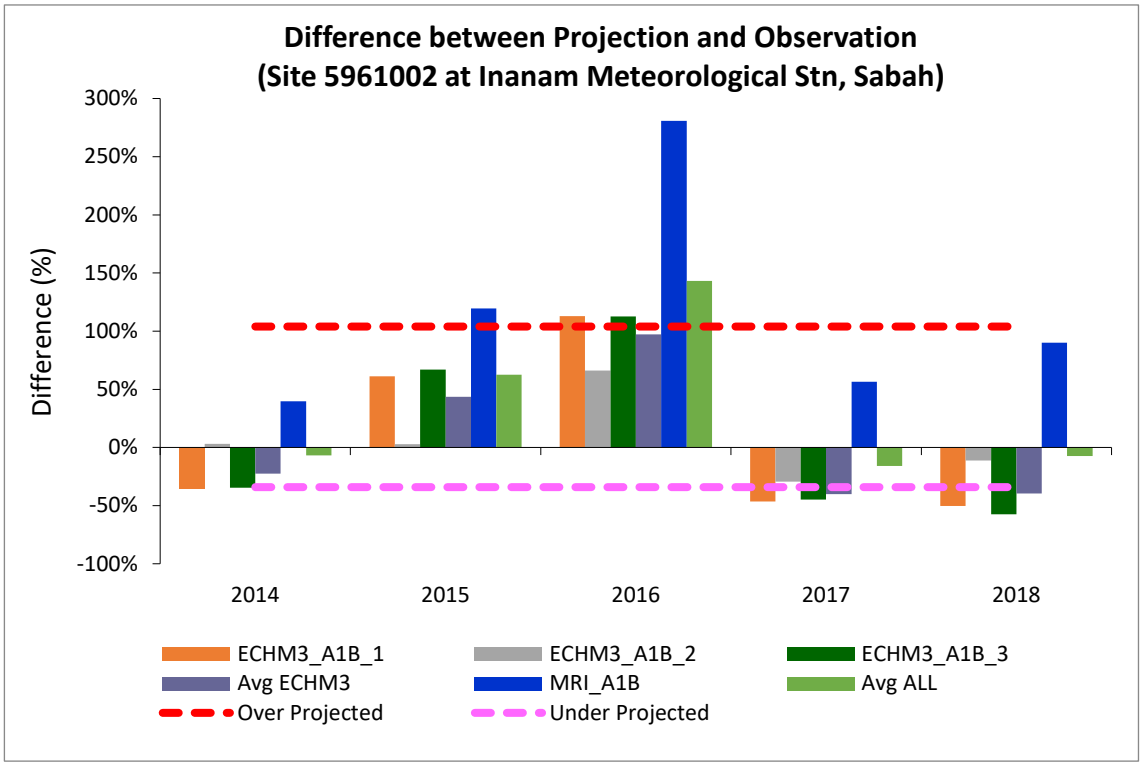


Figure B6-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5961002 at Inanam Meteorological Stn, Sabah

B7: Site 5973001 at Trusan Sapi Met Stn, Sabah

Table B7-1: Projected and observed 2014-2018 yearly rainfall for Site 5973001 at Trusan Sapi Met Stn, Sabah

Site 5973001 at Trusan Sapi Met Stn, Sabah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	3,197	2,784	3,890	3,315	1,822	3,002
ECHM3_A1B_2	2,527	2,314	1,709	2,454	3,384	2,478
ECHM3_A1B_3	3,751	3,171	3,871	3,380	1,872	3,209
Average_ECHM3	3,158	2,756	3,157	3,050	2,360	2,896
MRI_A1B	1,630	1,531	1,401	2,188	1,178	1,586
Average_ALL	2,776	2,450	2,718	2,834	2,064	2,568
OBSERVED	2,479	3,856	4,467	4,012	3,190	3,601

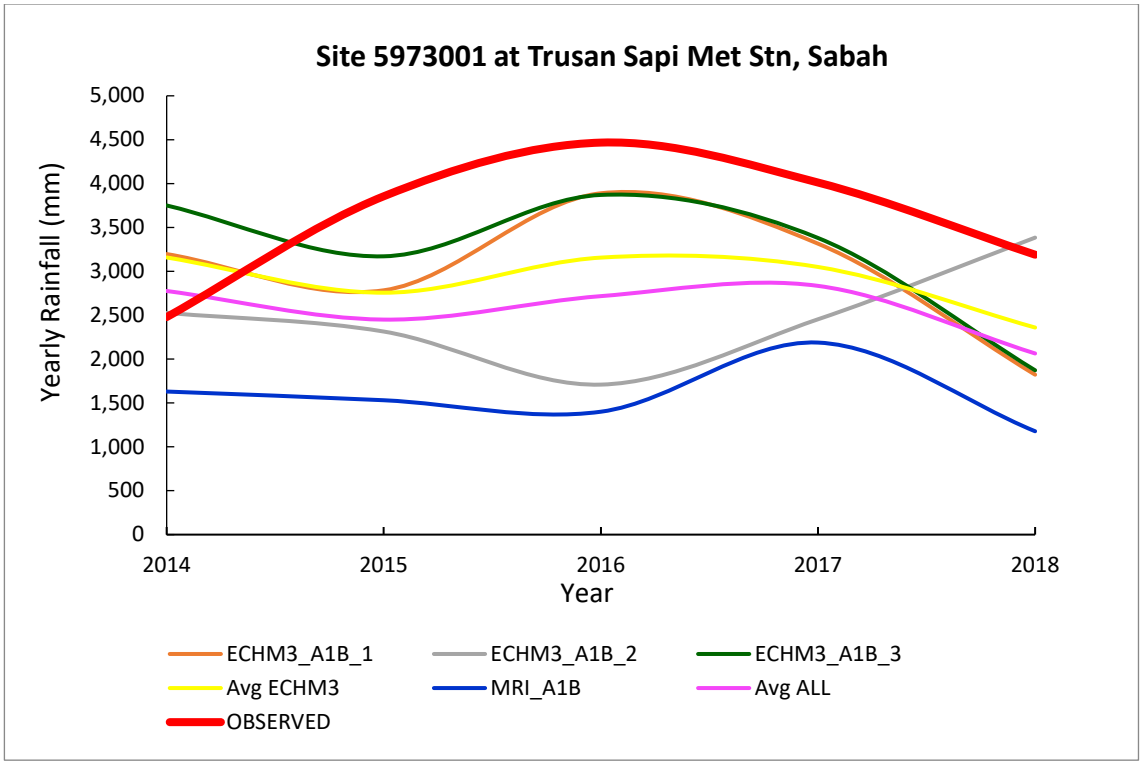


Figure B7-1: Projected and observed 2014-2018 yearly rainfall for Site 5973001 at Trusan Sapi Met Stn, Sabah

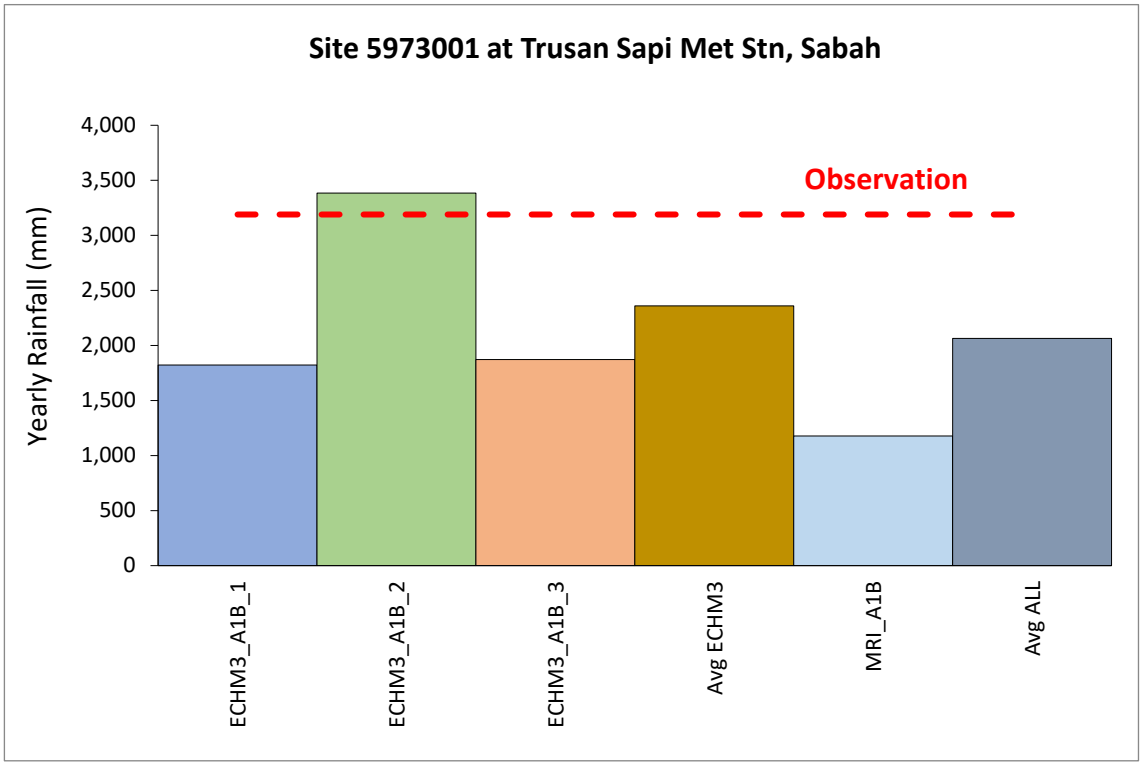


Figure B7-2: Projected and observed 2018 yearly rainfall for Site 5973001 at Trusan Sapi Met Stn, Sabah

Table B7-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 5961002 at Trusan Sapi Met Stn, Sabah

Site 5973001 at Trusan Sapi Met Stn, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	29	-28	-13	-17	-43	-14
ECHM3_A1B_2	2	-40	-62	-39	6	-27
ECHM3_A1B_3	51	-18	-13	-16	-41	-7
Average_ECHM3	27	-29	-29	-24	-26	-16
MRI_A1B	-34	-60	-69	-45	-63	-54
Average_ALL	12	-36	-39	-29	-35	-26

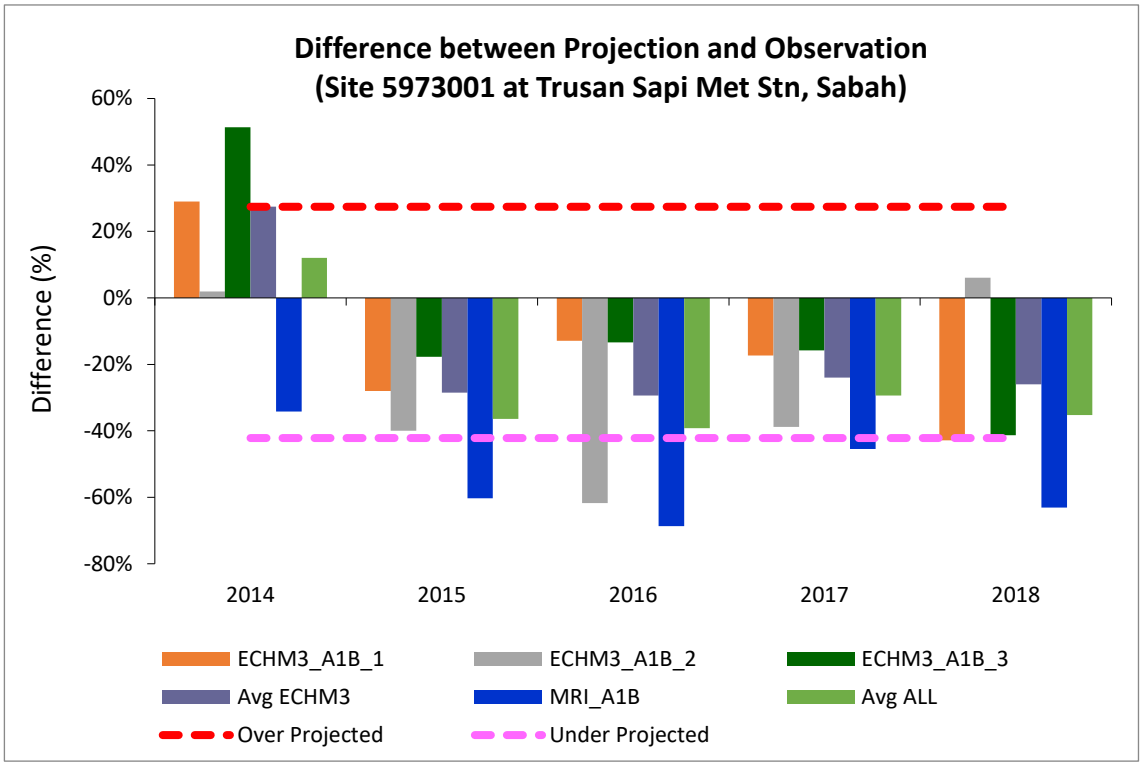


Figure B7-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 5973001 at Trusan Sapi Met Stn, Sabah

B8: Site 6264001 at Tamu Darat Agr. Stn, Sabah

Table B8-1: Projected and observed 2014-2018 yearly rainfall for Site 6264001 at Tamu Darat Agr. Stn, Sabah

Site 6264001 at Tamu Darat Agr. Stn, Sabah						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	1,288	2,157	1,536	1,542	1,510	1,607
ECHM3_A1B_2	1,320	975	1,471	1,518	1,216	1,300
ECHM3_A1B_3	1,346	2,650	1,761	1,754	1,495	1,801
Average_ECHM3	1,318	1,927	1,589	1,605	1,407	1,569
MRI_A1B	1,471	1,572	1,557	1,925	1,352	1,575
Average_ALL	1,356	1,838	1,581	1,685	1,393	1,571
OBSERVED	3,386	2,859	2,234	4,117	2,535	3,026

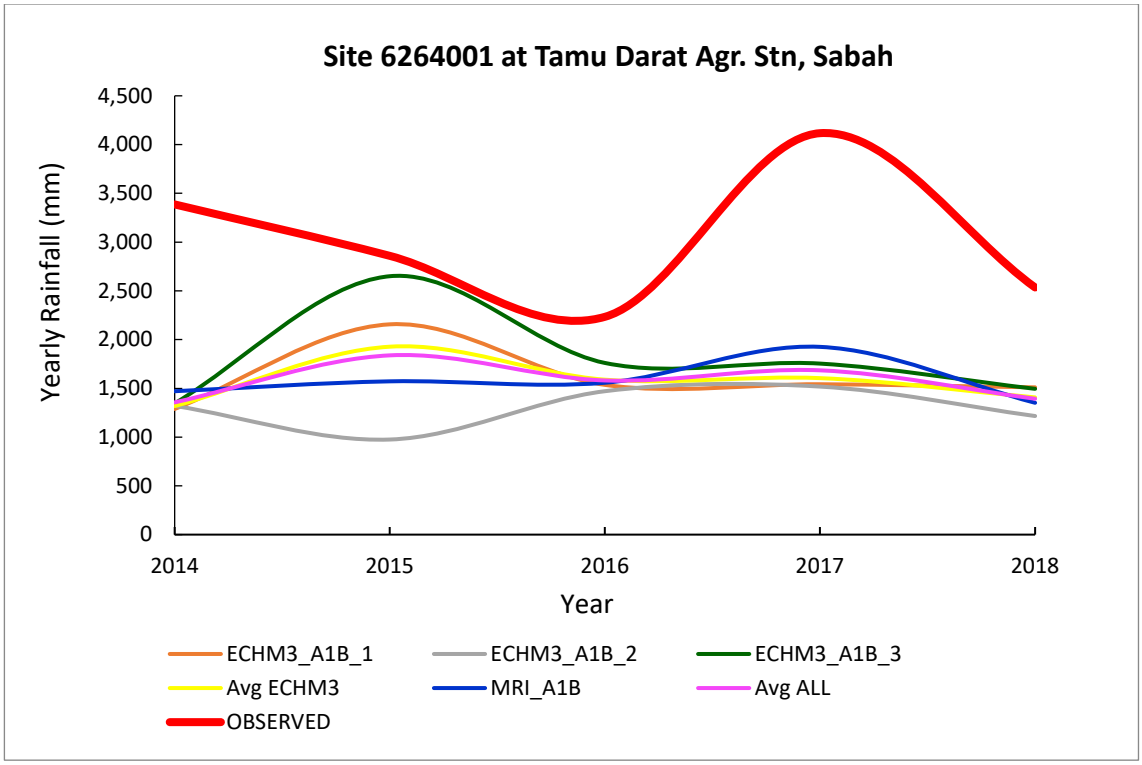


Figure B8-1: Projected and observed 2014-2018 yearly rainfall for Site 6264001 at Tamu Darat Agr. Stn, Sabah

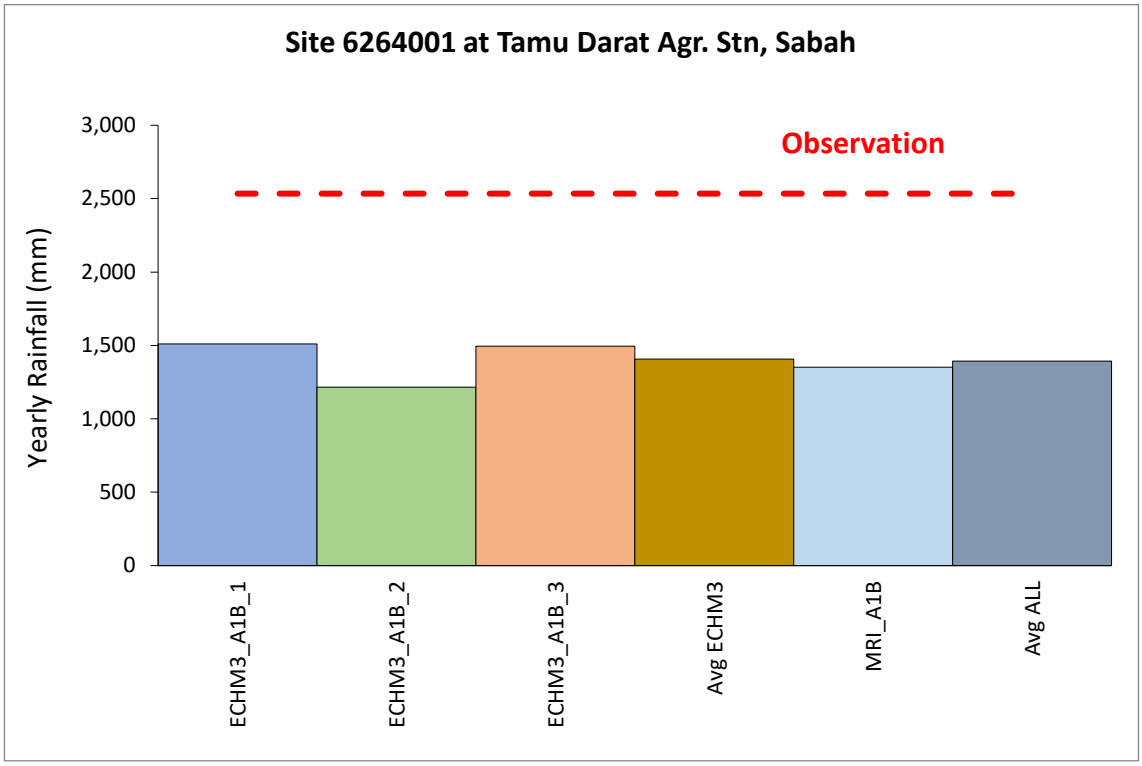


Figure B8-2: Projected and observed 2018 yearly rainfall for Site 6264001 at Tamu Darat Agr. Stn, Sabah

Table B8-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 6264001 at Tamu Darat Agr. Stn, Sabah

Site 6264001 at Tamu Darat Agr. Stn, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-62	-25	-31	-63	-40	-44
ECHM3_A1B_2	-61	-66	-34	-63	-52	-55
ECHM3_A1B_3	-60	-7	-21	-57	-41	-37
Average_ECHM3	-61	-33	-29	-61	-44	-46
MRI_A1B	-57	-45	-30	-53	-47	-46
Average_ALL	-60	-36	-29	-59	-45	-46

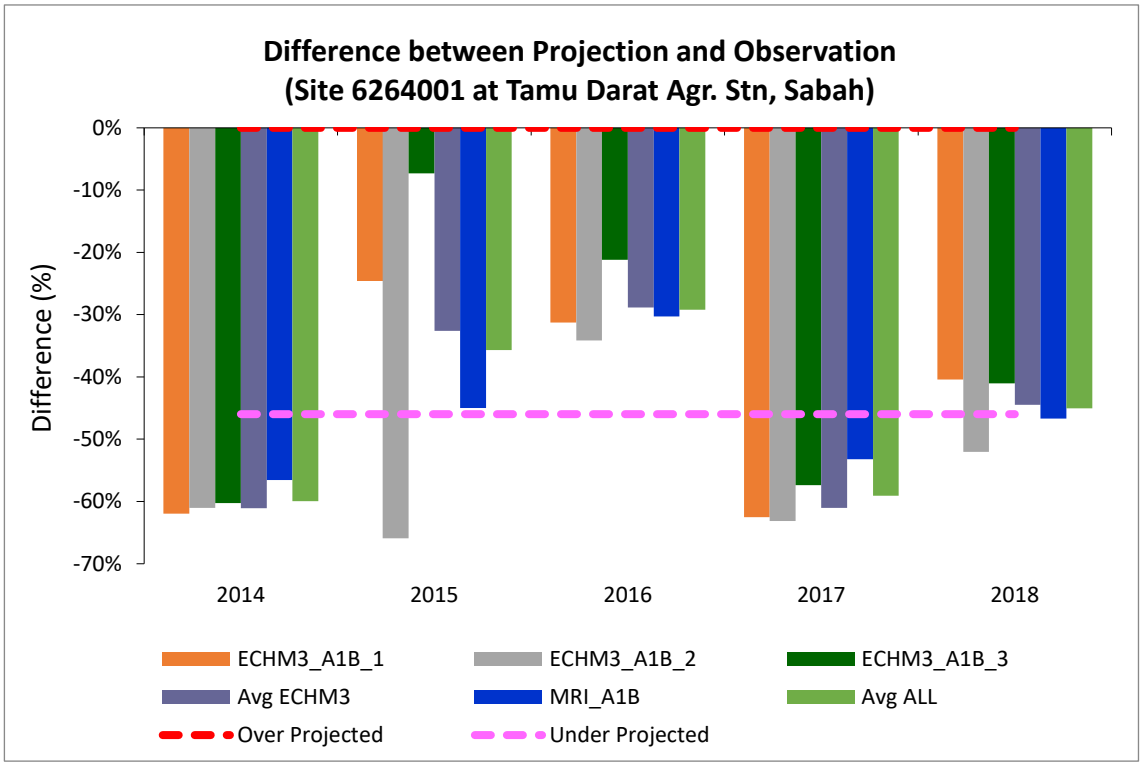


Figure B8-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 6264001 at Tamu Darat Agr. Stn, Sabah

B9: Site 6868001 at Kudat JPS, Sabah

Table B9-1: Projected and observed 2014-2018 yearly rainfall for Site 6868001 at Kudat JPS, Sabah

Site 6868001 at Kudat JPS, Sabah						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	2,332	5,097	3,217	2,821	1,497	2,993
ECHM3_A1B_2	2,476	1,217	832	2,693	1,914	1,826
ECHM3_A1B_3	1,943	4,307	3,163	3,154	1,783	2,870
Average_ECHM3	2,250	3,540	2,404	2,889	1,731	2,563
MRI_A1B	1,908	2,557	1,695	2,290	2,092	2,109
Average_ALL	2,165	3,294	2,227	2,739	1,821	2,449
OBSERVED	2,197	1,847	1,689	3,066	2,253	2,210

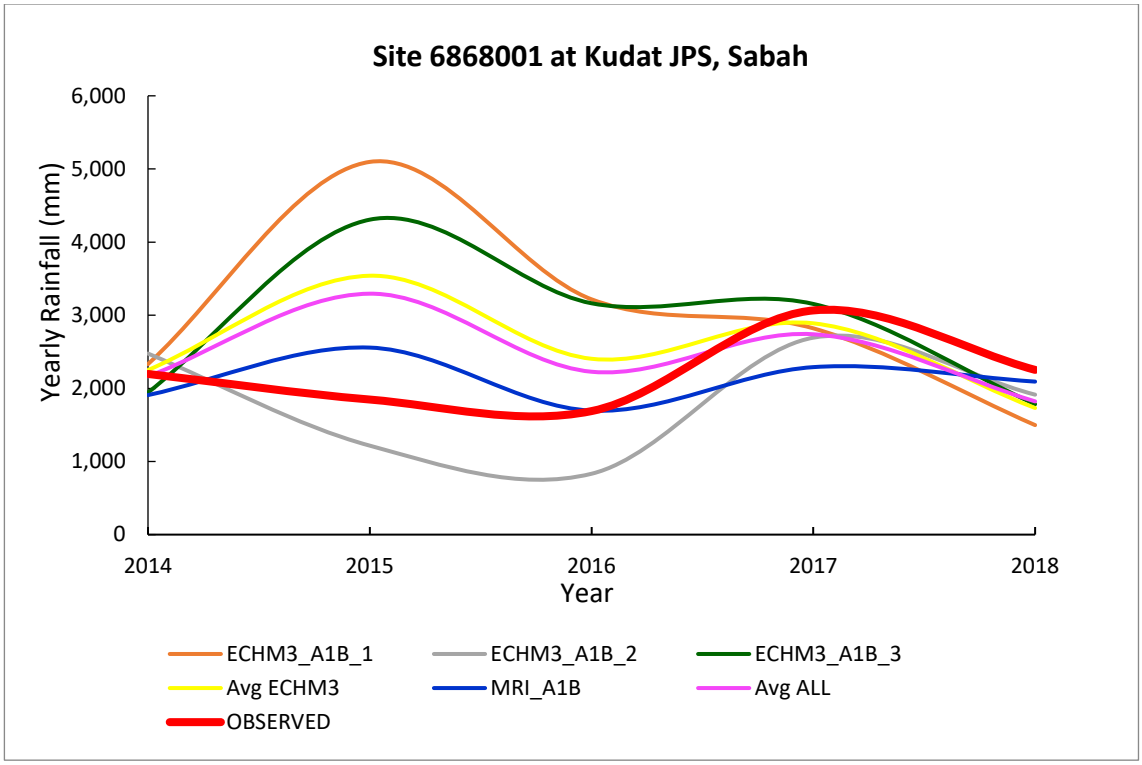


Figure B9-1: Projected and observed 2014-2018 yearly rainfall for Site 6868001 at Kudat JPS, Sabah

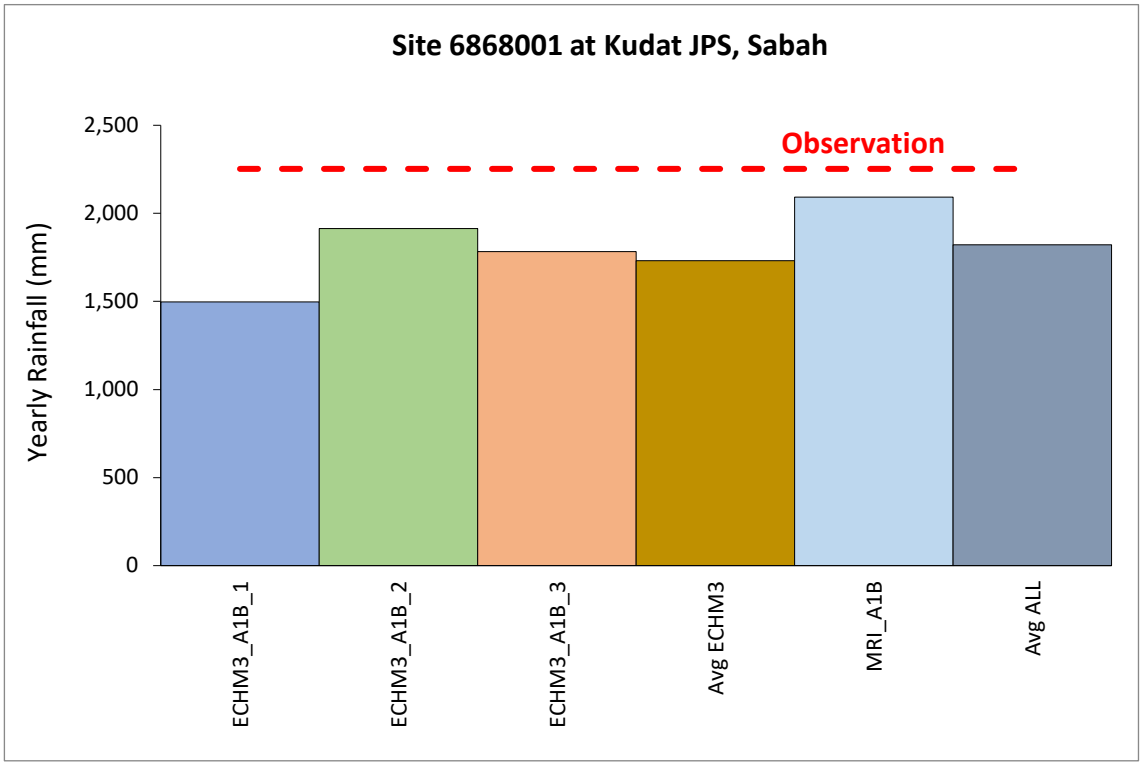


Figure B9-2: Projected and observed 2018 yearly rainfall for Site 6868001 at Kudat JPS, Sabah

Table B9-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 6868001 at Kudat JPS, Sabah

Site 6868001 at Kudat JPS, Sabah						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	6	176	90	-8	-34	46
ECHM3_A1B_2	13	-34	-51	-12	-15	-20
ECHM3_A1B_3	-12	133	87	3	-21	38
Average_ECHM3	2	92	42	-6	-23	22
MRI_A1B	-13	38	0	-25	-7	-1
Average_ALL	-1	78	32	-11	-19	16

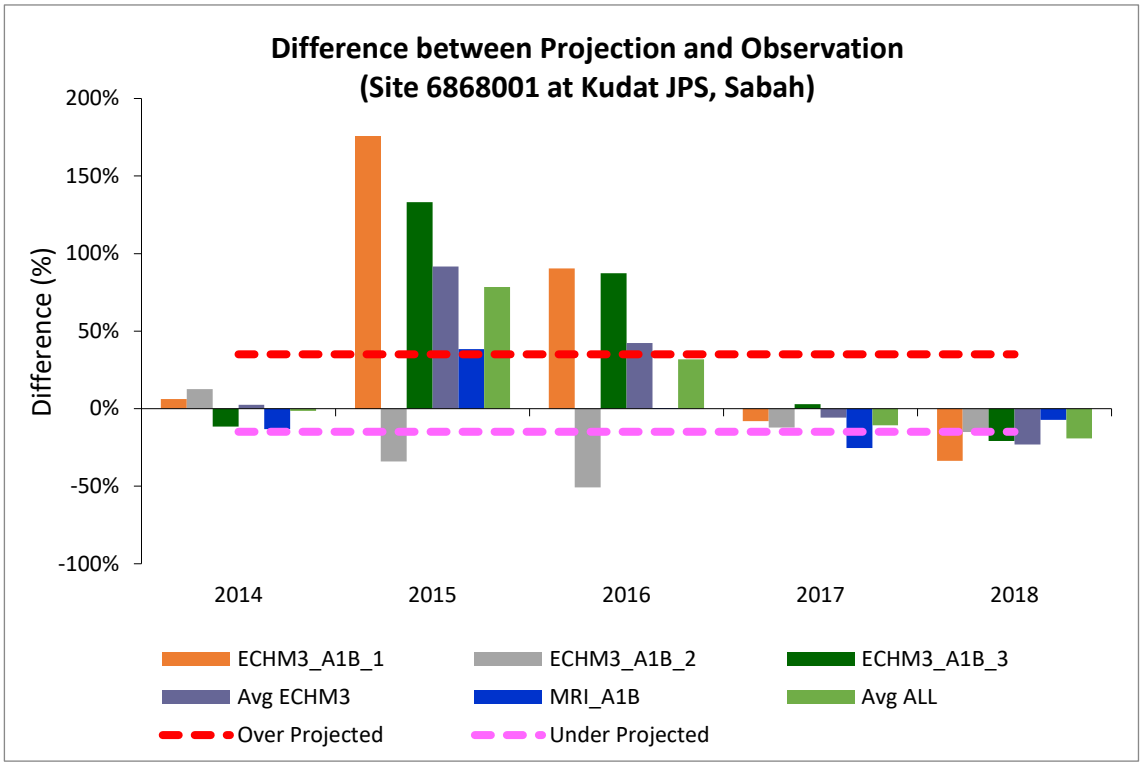


Figure B9-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 6868001 at Kudat JPS, Sabah

B10: Site 1105027 at Serian, Sarawak

Table B10-1: Projected and observed 2014-2018 yearly rainfall for Site 1105027 at Serian, Sarawak

Site 1105027 at Serian, Sarawak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	3,916	5,588	6,418	5,637	6,566	5,625
ECHM3_A1B_2	5,037	6,162	6,217	4,294	4,374	5,217
ECHM3_A1B_3	3,977	5,405	6,922	5,222	6,707	5,647
Average_ECHM3	4,310	5,718	6,519	5,051	5,882	5,496
MRI_A1B	4,971	4,203	4,614	3,664	3,777	4,246
Average_ALL	4,475	5,339	6,043	4,704	5,356	5,183
OBSERVED	2,835	3,743	4,401	4,399	4,246	3,925

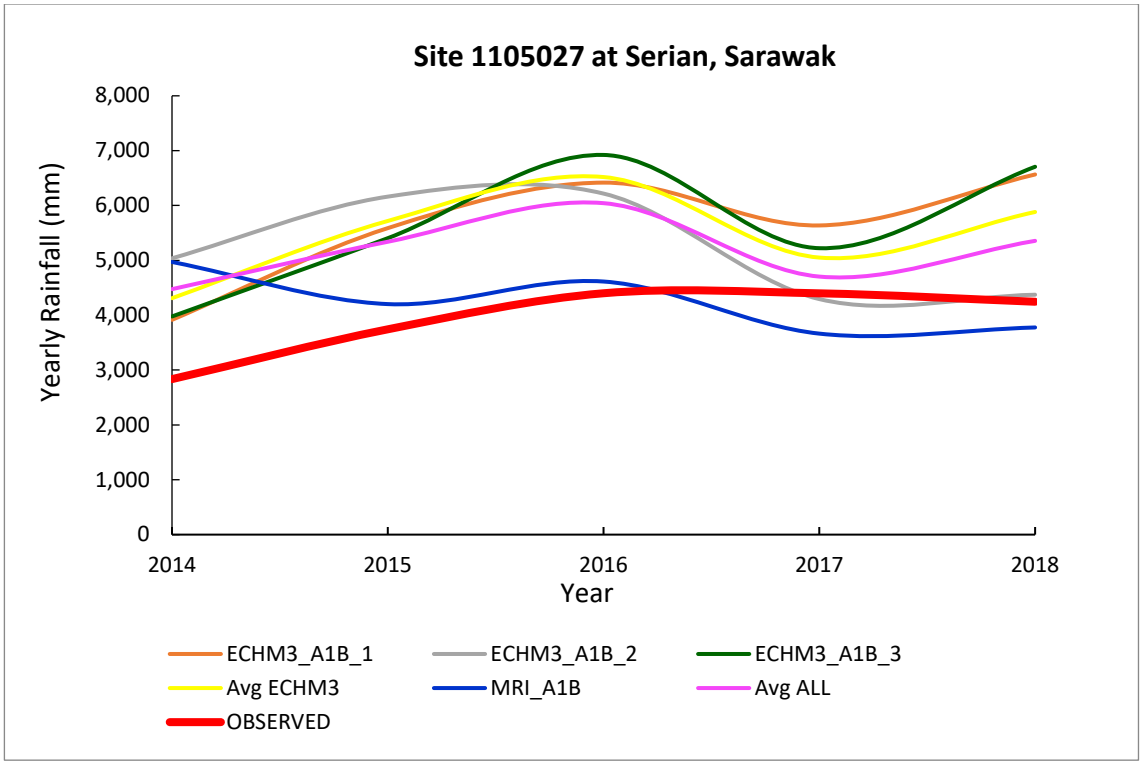


Figure B10-1: Projected and observed 2014-2018 yearly rainfall for Site 1105027 at Serian, Sarawak

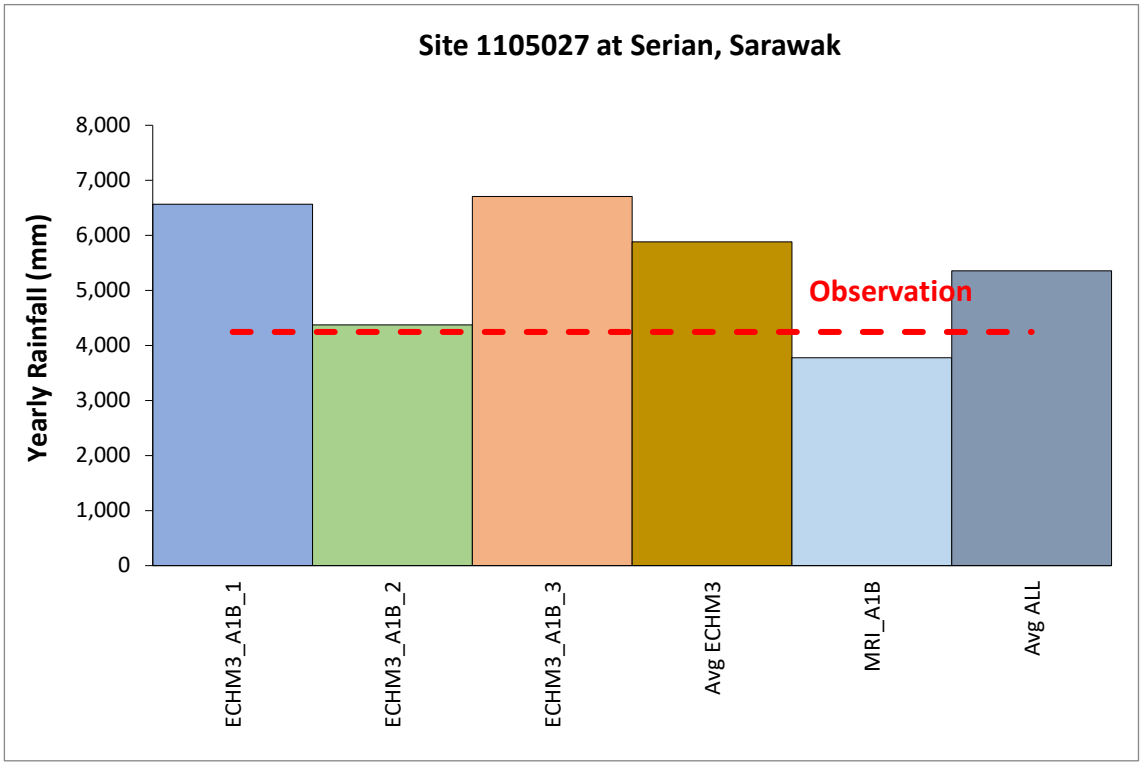


Figure B10-2: Projected and observed 2018 yearly rainfall for Site 1105027 at Serian, Sarawak

Table B10-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 1105027 at Serian, Sarawak

Site 1105027 at Serian, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	38	49	46	28	55	43
ECHM3_A1B_2	78	65	41	-2	3	37
ECHM3_A1B_3	40	44	57	19	58	44
Average_ECHM3	52	53	48	15	39	41
MRI_A1B	75	12	5	-17	-11	13
Average_ALL	58	43	37	7	26	34

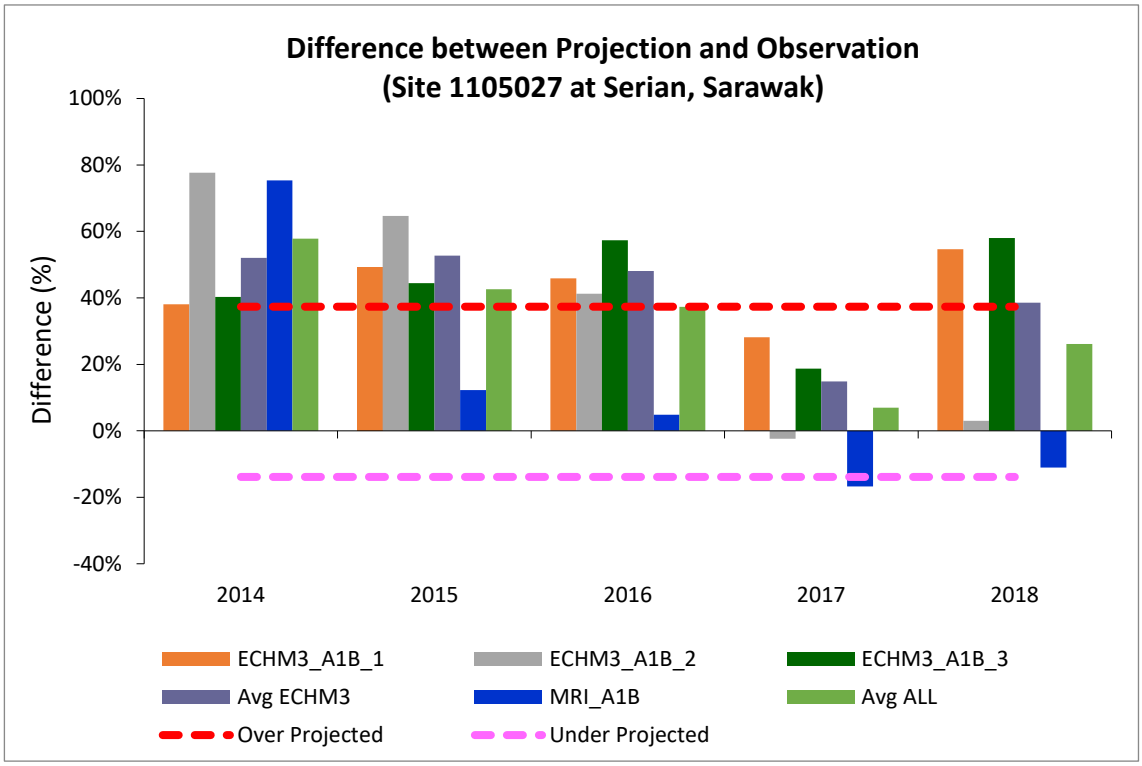


Figure B10-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 1105027 at Serian, Sarawak

B11: Site 1302078 at Kampung Git, Sarawak

Table B11-1: Projected and observed 2014-2018 yearly rainfall for Site 1302078 at Kampung Git, Sarawak

Site 1302078 at Kampung Git, Sarawak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	2,823	5,045	5,572	4,370	4,792	4,521
ECHM3_A1B_2	3,693	4,310	4,181	3,310	3,206	3,740
ECHM3_A1B_3	3,021	4,731	6,610	4,024	5,012	4,679
Average_ECHM3	3,179	4,695	5,454	3,901	4,337	4,313
MRI_A1B	4,099	3,996	4,310	4,127	3,611	4,029
Average_ALL	3,409	4,520	5,168	3,958	4,155	4,242
OBSERVED	2,950	4,171	5,067	4,081	4,006	4,055

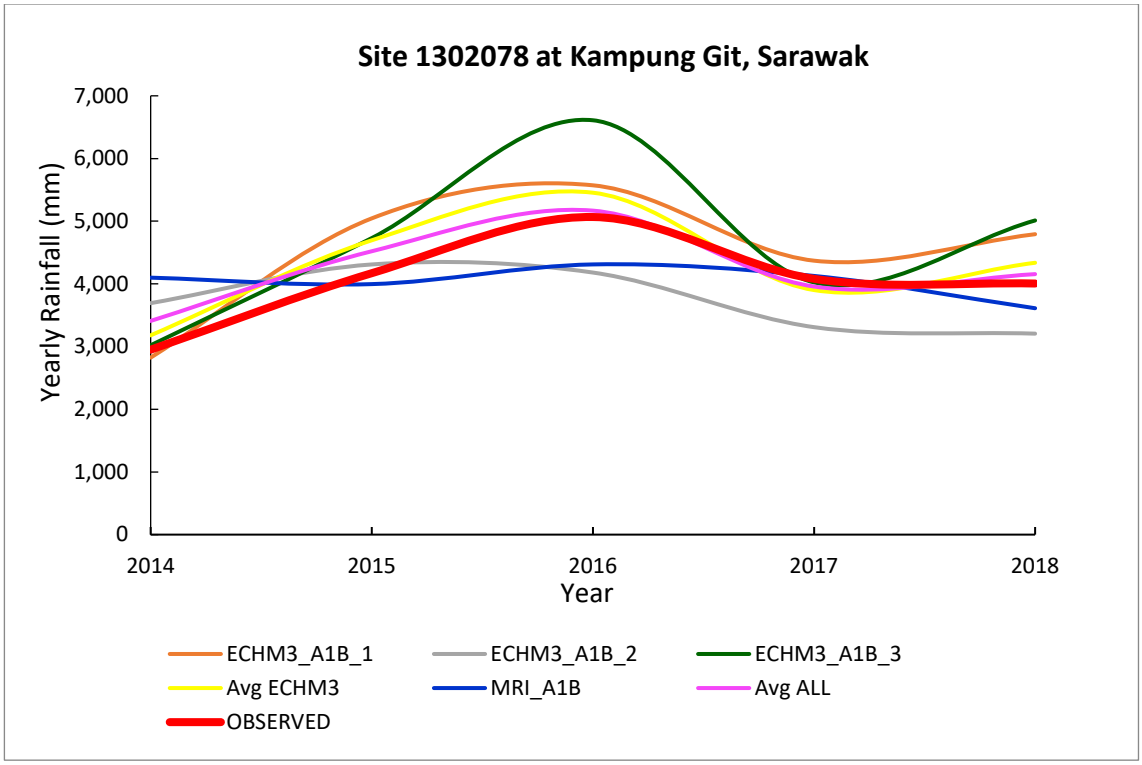


Figure B11-1: Projected and observed 2014-2018 yearly rainfall for Site 1302078 at Kampung Git, Sarawak

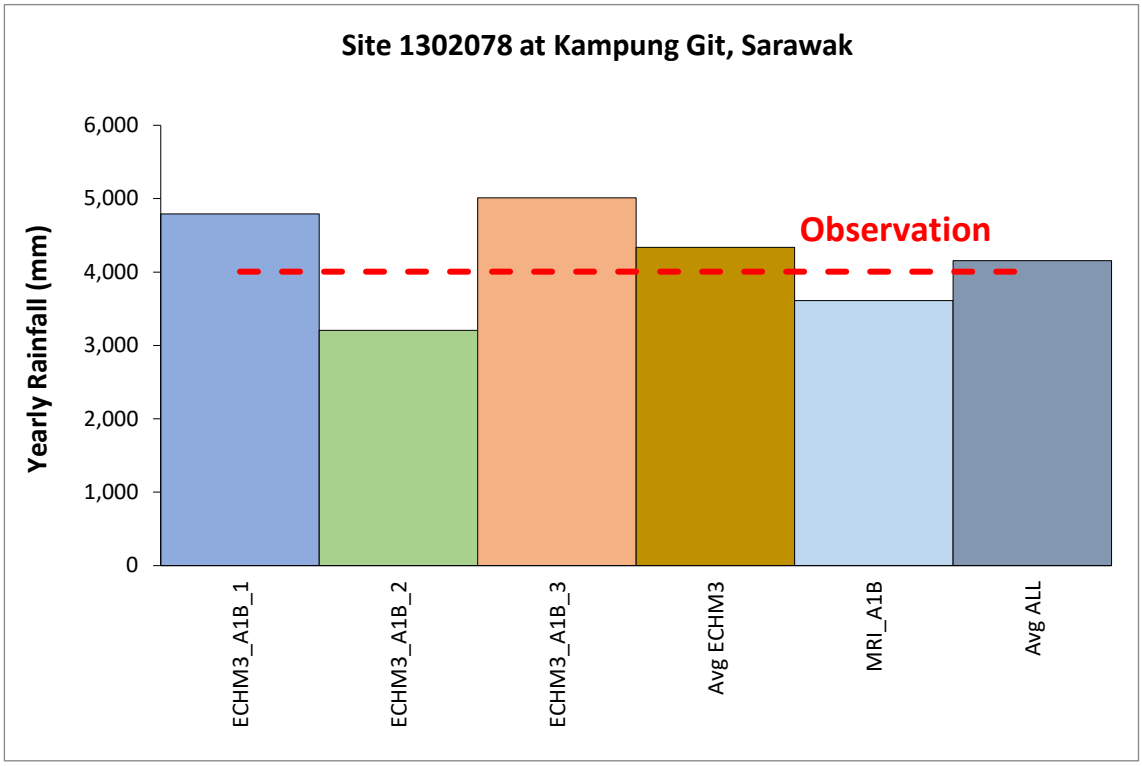


Figure B11-2: Projected and observed 2018 yearly rainfall for Site 1302078 at Kampung Git, Sarawak

Table B11-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 1302078 at Kampung Git, Sarawak

Site 1302078 at Kampung Git, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-4	21	10	7	20	11
ECHM3_A1B_2	25	3	-17	-19	-20	-6
ECHM3_A1B_3	2	13	30	-1	25	14
Average_ECHM3	8	13	8	-4	8	6
MRI_A1B	39	-4	-15	1	-10	2
Average_ALL	16	8	2	-3	4	5

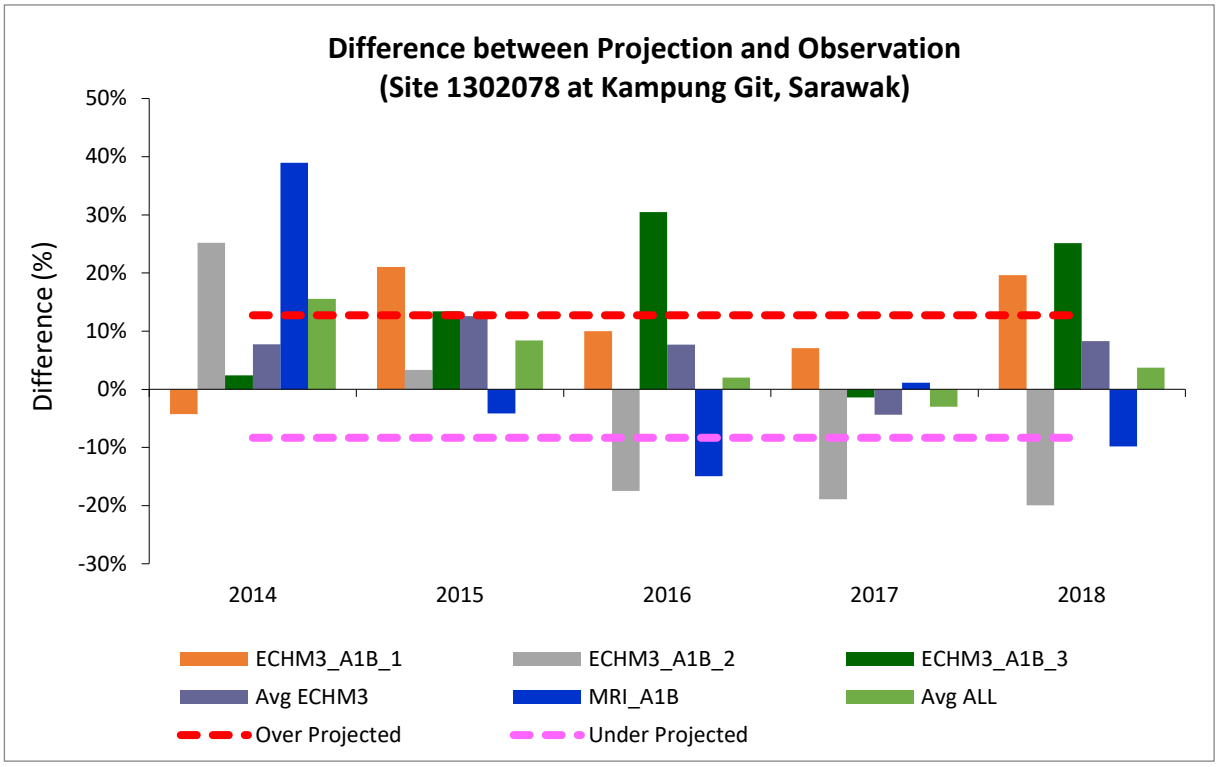


Figure B11-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 1302078 at Kampung Git, Sarawak

B12: Site 1321001 at Nanga Mujan, Sarawak

Table B12-1: Projected and observed 2014-2018 yearly rainfall for Site 1321001 at Nanga Mujan, Sarawak

Site 1321001 at Nanga Mujan, Sarawak						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	1,512	1,863	1,765	2,029	2,528	1,939
ECHM3_A1B_2	2,163	2,344	1,391	1,518	1,321	1,747
ECHM3_A1B_3	1,424	1,970	1,879	1,736	2,254	1,853
Average_ECHM3	1,700	2,059	1,678	1,761	2,035	1,846
MRI_A1B	1,479	1,327	1,750	1,414	1,496	1,493
Average_ALL	1,645	1,876	1,696	1,674	1,900	1,758
OBSERVED	2,983	3,161	3,693	4,084	4,153	3,615

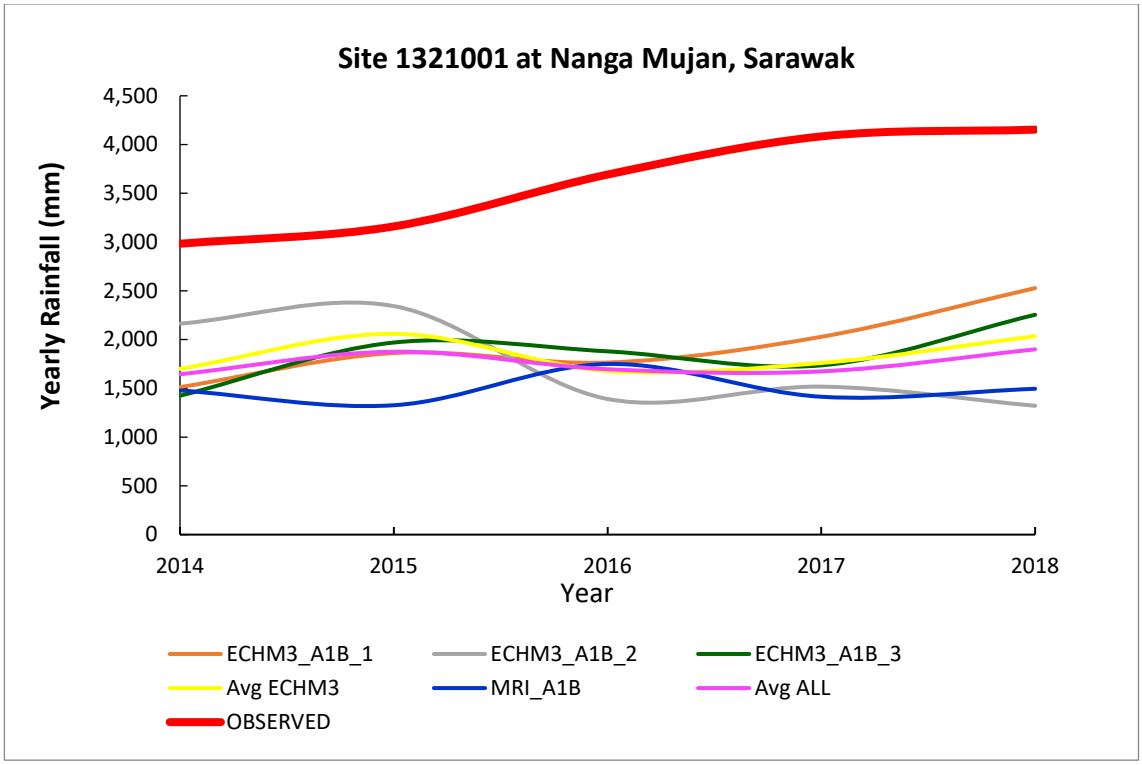


Figure B12-1: Projected and observed 2014-2018 yearly rainfall for Site 1321001 at Nanga Mujan, Sarawak

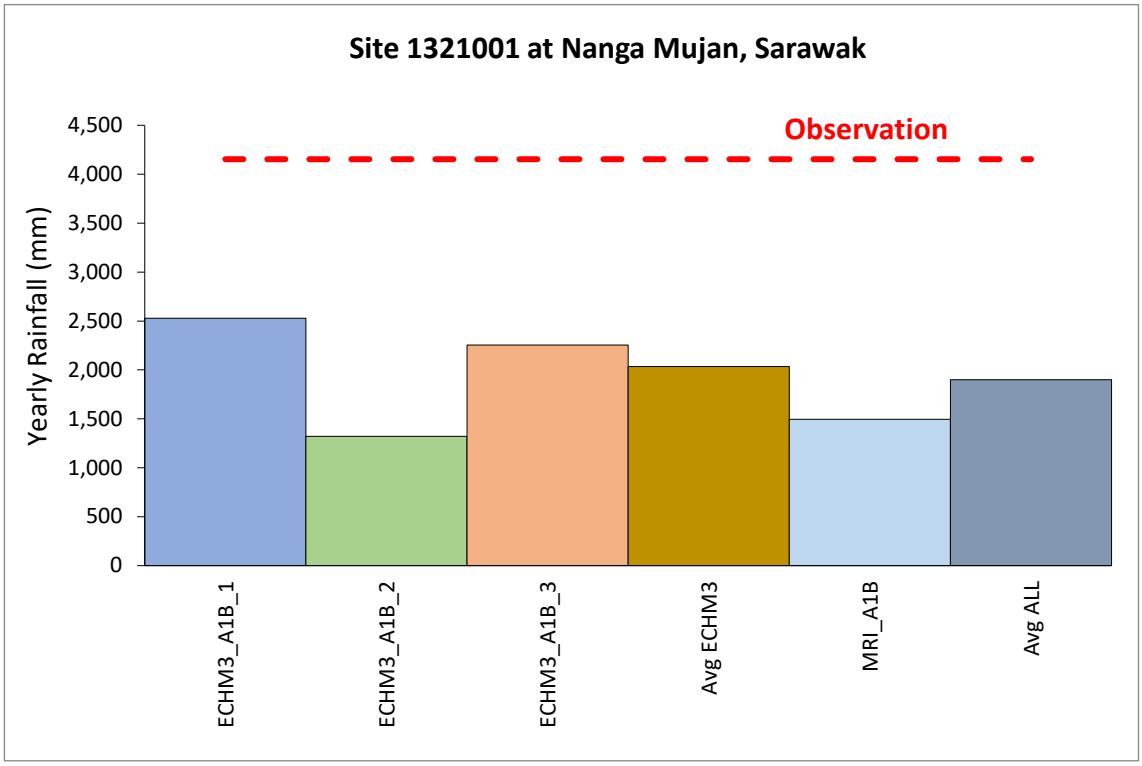


Figure B12-2: Projected and observed 2018 yearly rainfall for Site 1321001 at Nanga Mujan, Sarawak

Table B12-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 1321001 at Nanga Mujan, Sarawak

Site 1321001 at Nanga Mujan, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-49	-41	-52	-50	-39	-46
ECHM3_A1B_2	-27	-26	-62	-63	-68	-49
ECHM3_A1B_3	-52	-38	-49	-57	-46	-48
Average_ECHM3	-43	-35	-55	-57	-51	-48
MRI_A1B	-50	-58	-53	-65	-64	-58
Average_ALL	-45	-41	-54	-59	-54	-51

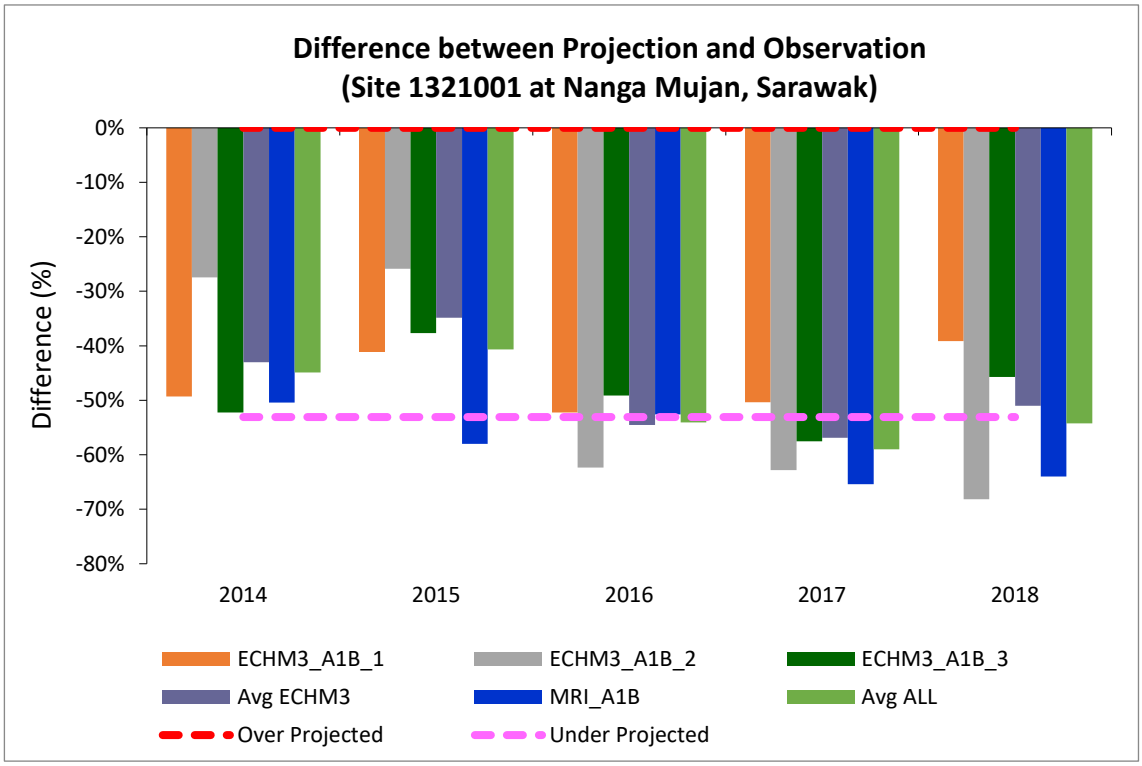


Figure B12-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 1321001 at Nanga Mujan, Sarawak

B13: Site 1403001 at Kuching Airport, Sarawak

Table B13-1: Projected and observed 2014-2018 yearly rainfall for Site 1403001 at Kuching Airport, Sarawak

Site 1403001 at Kuching Airport, Sarawak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	2,782	5,484	5,329	4,591	5,069	4,651
ECHM3_A1B_2	3,797	4,409	3,833	3,594	3,436	3,814
ECHM3_A1B_3	3,010	5,128	6,398	4,035	4,832	4,681
Average_ECHM3	3,196	5,007	5,187	4,074	4,445	4,382
MRI_A1B	4,332	4,076	4,284	3,908	3,646	4,049
Average_ALL	3,480	4,774	4,961	4,032	4,246	4,299
OBSERVED	3,519	4,412	4,977	3,792	3,872	4,114

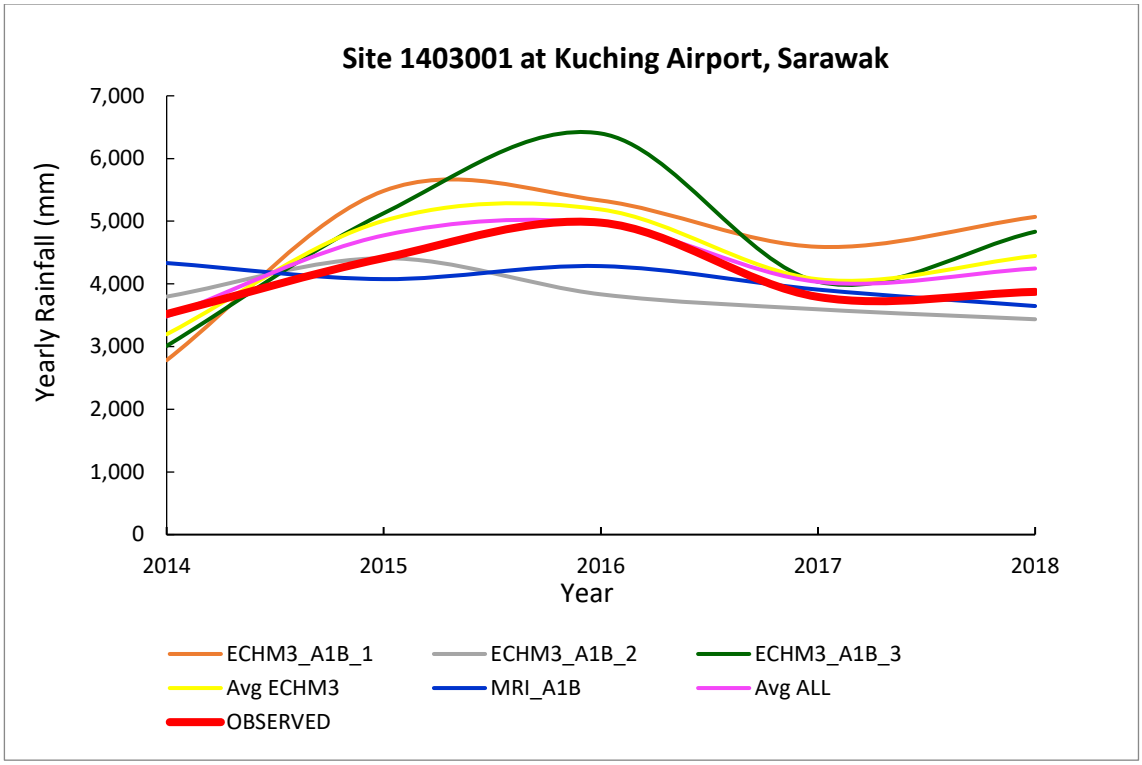


Figure B13-1: Projected and observed 2014-2018 yearly rainfall for Site 1403001 at Kuching Airport, Sarawak

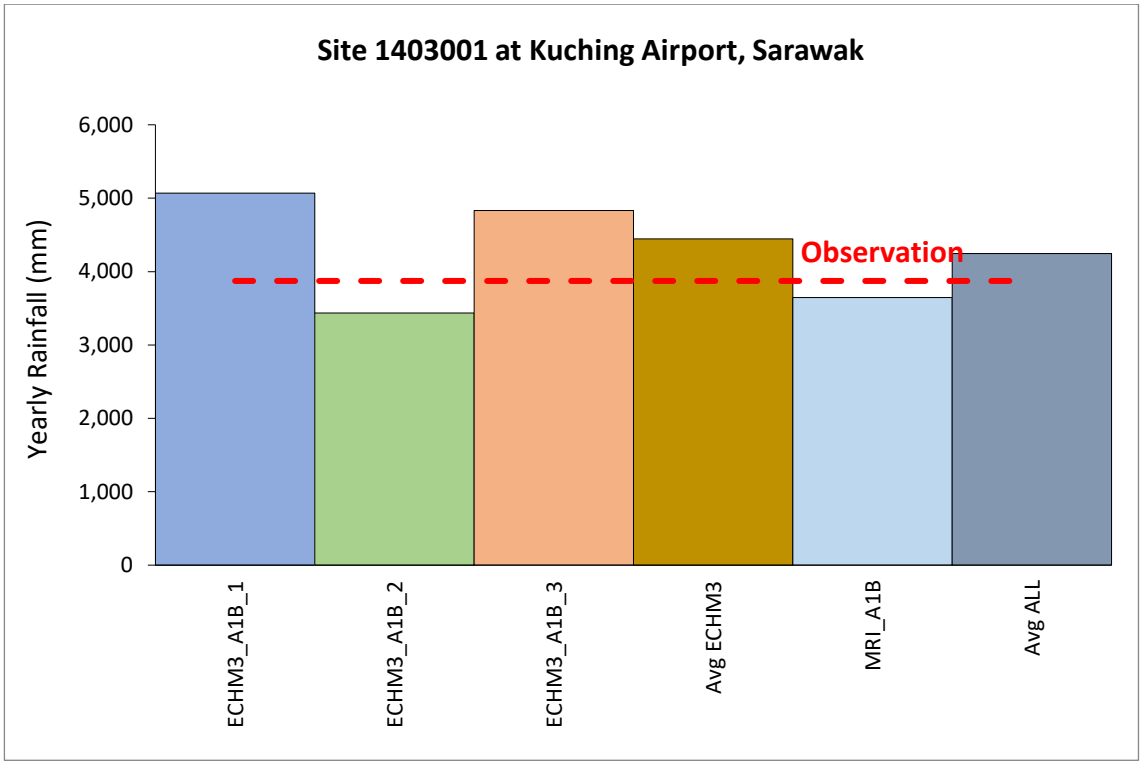


Figure B13-2: Projected and observed 2018 yearly rainfall for Site 1403001 at Kuching Airport, Sarawak

Table B13-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 1403001 at Kuching Airport, Sarawak

Site 1403001 at Kuching Airport, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-21	24	7	21	31	12
ECHM3_A1B_2	8	0	-23	-5	-11	-6
ECHM3_A1B_3	-14	16	29	6	25	12
Average_ECHM3	-9	13	4	7	15	6
MRI_A1B	23	-8	-14	3	-6	0
Average_ALL	-1	8	0	6	10	5

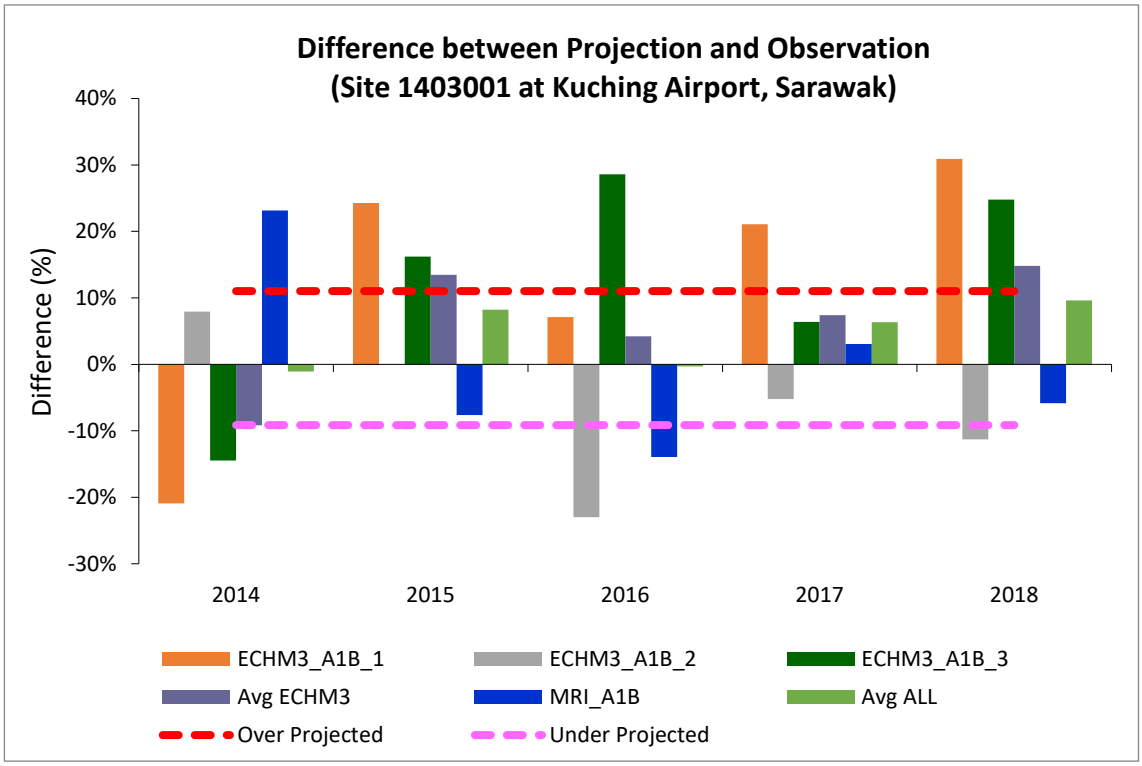


Figure B13-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 1403001 at Kuching Airport, Sarawak

B14: Site 1506034 at Asa Jaya, Sarawak

Table B14-1: Projected and observed 2014-2018 yearly rainfall for Site 1506034 at Asa Jaya, Sarawak

Site 1506034 at Asa Jaya, Sarawak						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	1,776	4,112	3,394	3,479	3,838	3,320
ECHM3_A1B_2	2,931	3,464	2,261	2,777	1,982	2,683
ECHM3_A1B_3	1,899	3,958	4,156	2,840	3,502	3,271
Average_ECHM3	2,202	3,845	3,270	3,032	3,107	3,091
MRI_A1B	4,184	3,772	3,352	3,579	3,068	3,591
Average_ALL	2,698	3,827	3,291	3,169	3,098	3,216
OBSERVED	3,308	4,663	4,758	3,479	3,919	4,025

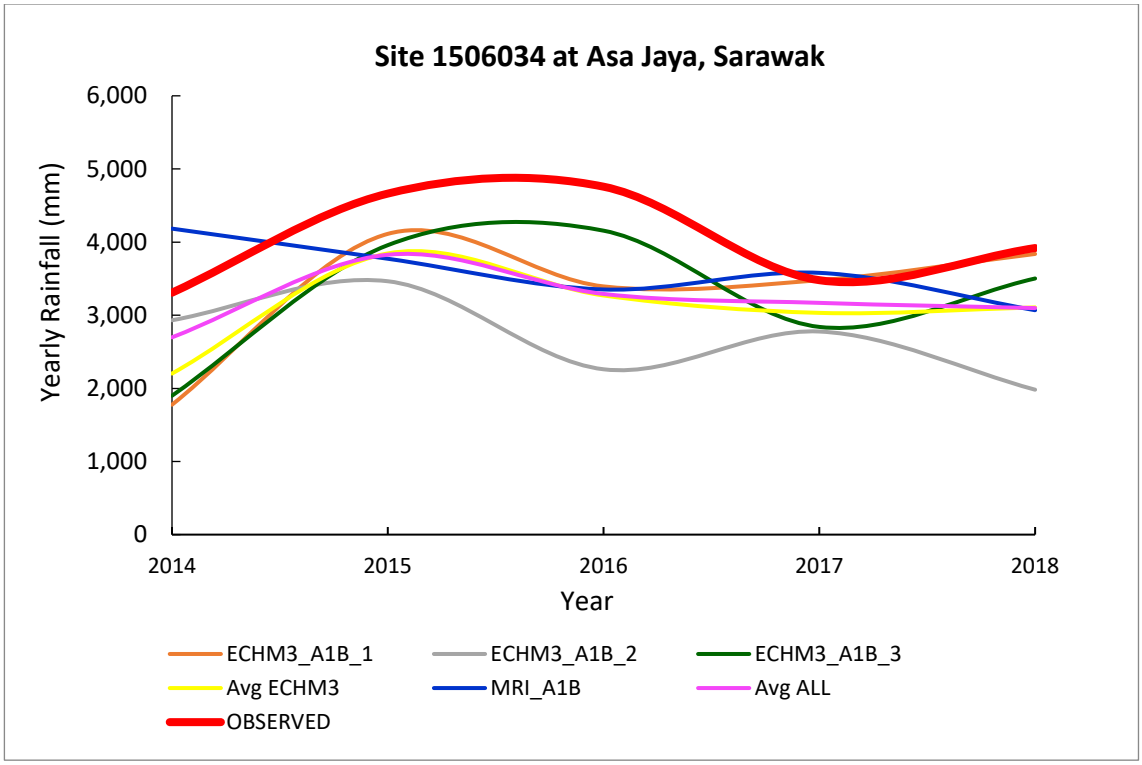


Figure B14-1: Projected and observed 2014-2018 yearly rainfall for Site 1506034 at Asa Jaya, Sarawak

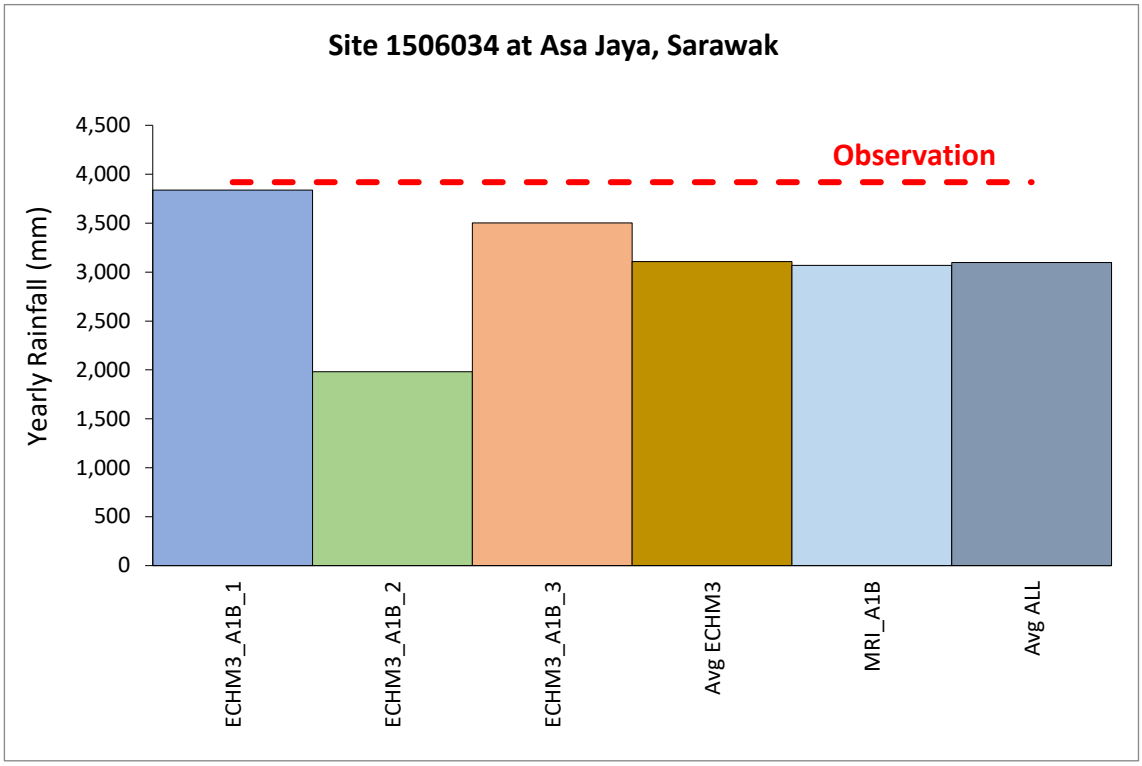


Figure B14-2: Projected and observed 2018 yearly rainfall for Site 1506034 at Asa Jaya, Sarawak

Table B14-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 1506034 at Asa Jaya, Sarawak

Site 1506034 at Asa Jaya, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-46	-12	-29	0	-2	-18
ECHM3_A1B_2	-11	-26	-52	-20	-49	-32
ECHM3_A1B_3	-43	-15	-13	-18	-11	-20
Average_ECHM3	-33	-18	-31	-13	-21	-23
MRI_A1B	26	-19	-30	3	-22	-8
Average_ALL	-18	-18	-31	-9	-21	-19

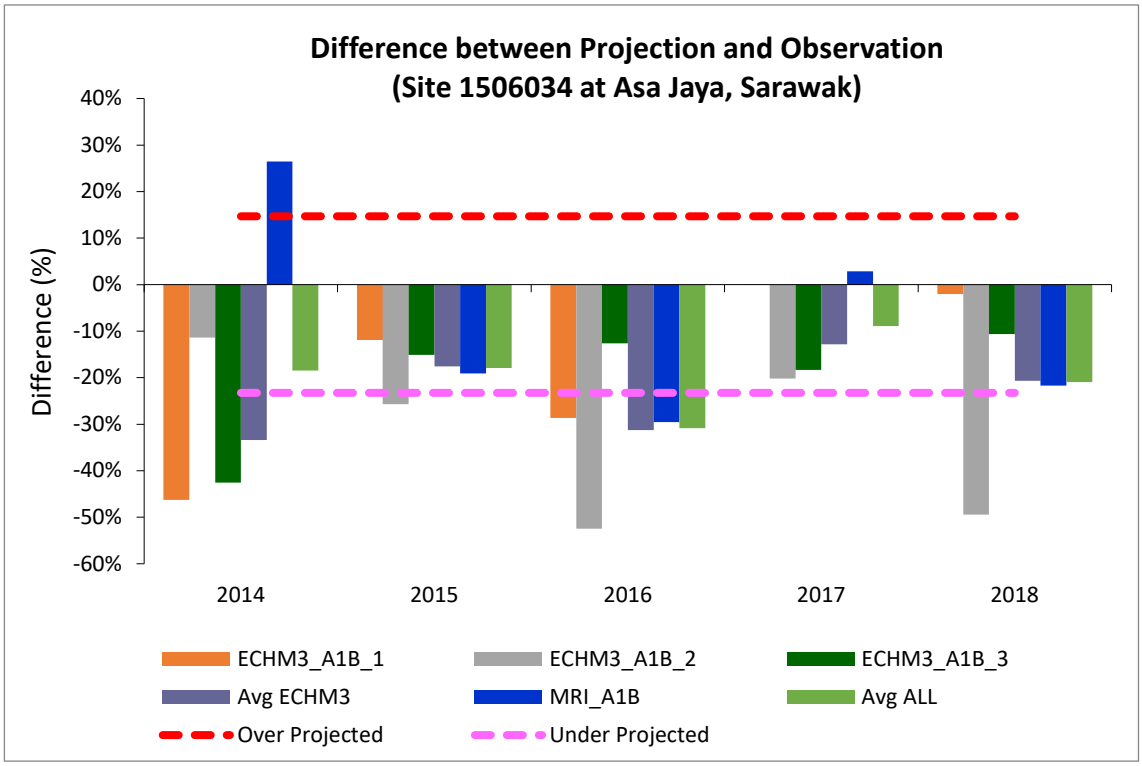


Figure B14-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 1506034 at Asa Jaya, Sarawak

B15: Site 2021036 at Kanowit Water Works, Sarawak

Table B15-1: Projected and observed 2014-2018 yearly rainfall for Site 2021036 at Kanowit Water Works, Sarawak

Site 2021036 at Kanowit Water Works, Sarawak						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	2,405	2,895	2,462	2,419	3,365	2,709
ECHM3_A1B_2	3,337	2,825	2,294	2,369	2,716	2,708
ECHM3_A1B_3	2,640	2,763	2,539	2,622	3,353	2,783
Average_ECHM3	2,794	2,827	2,432	2,470	3,145	2,734
MRI_A1B	2,649	2,789	2,396	2,553	2,406	2,558
Average_ALL	2,758	2,818	2,423	2,491	2,960	2,690
OBSERVED	2,760	3,169	2,507	3,103	3,295	2,966

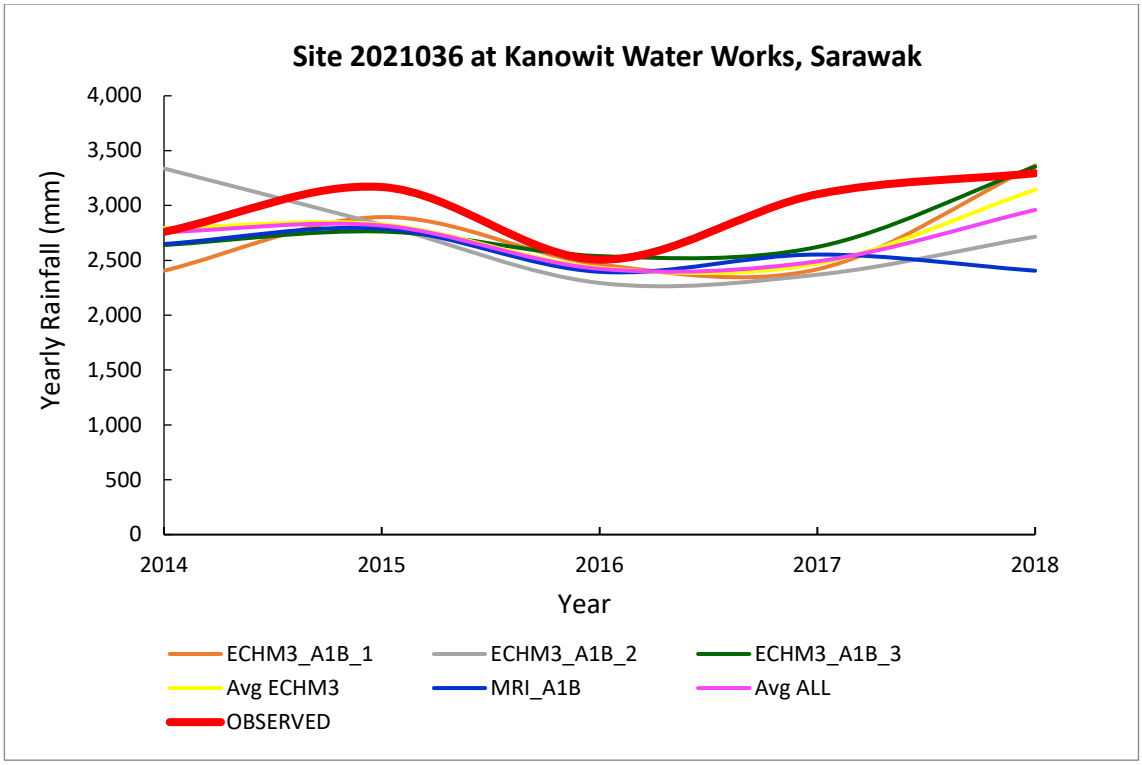


Figure B15-1: Projected and observed 2014-2018 yearly rainfall for Site 2021036 at Kanowit Water Works, Sarawak

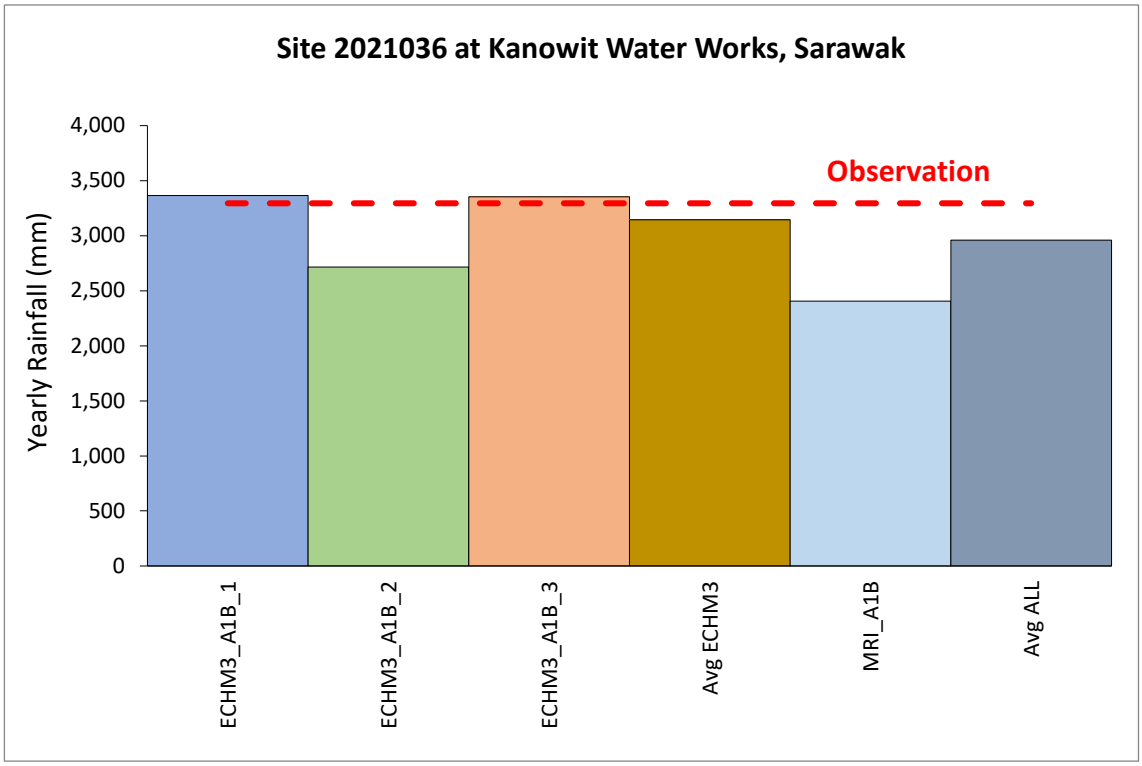


Figure B15-2: Projected and observed 2018 yearly rainfall for Site 2021036 at Kanowit Water Works, Sarawak

Table B15-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2021036 at Kanowit Water Works, Sarawak

Site 2021036 at Kanowit Water Works, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-13	-9	-2	-22	2	-9
ECHM3_A1B_2	21	-11	-8	-24	-18	-8
ECHM3_A1B_3	-4	-13	1	-16	2	-6
Average_ECHM3	1	-11	-3	-20	-5	-7
MRI_A1B	-4	-12	-4	-18	-27	-13
Average_ALL	0	-11	-3	-20	-10	-9

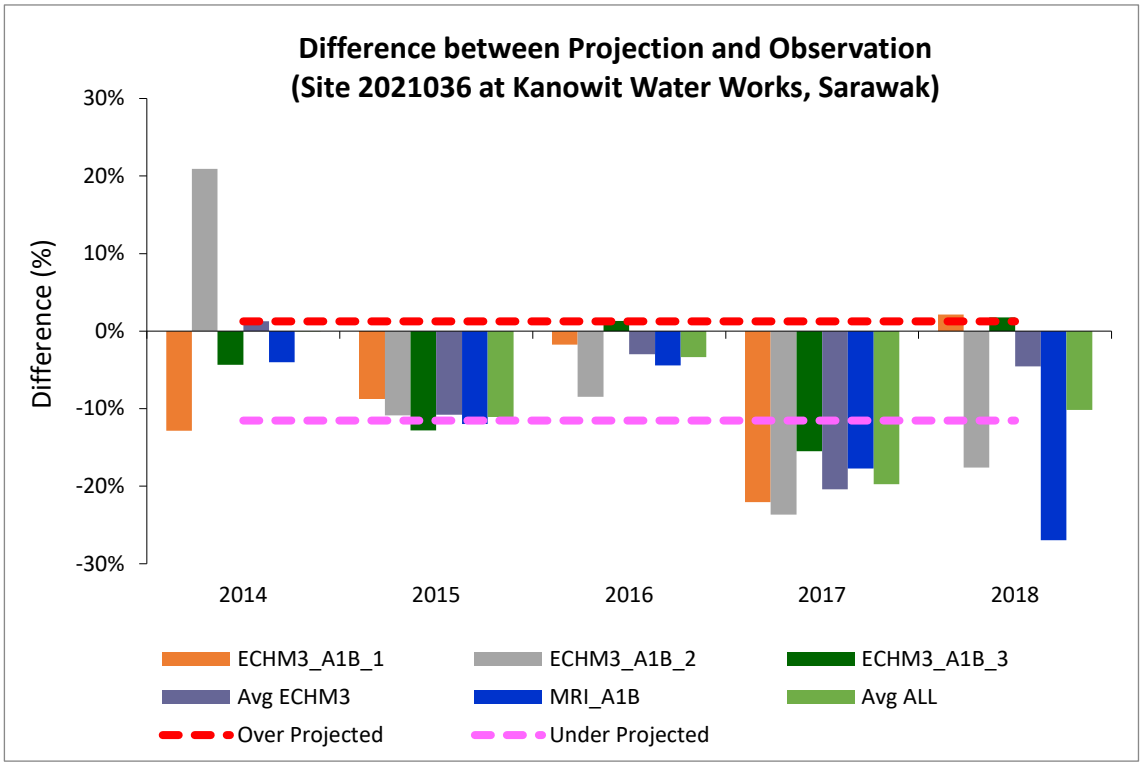


Figure B15-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2021036 at Kanowit Water Works, Sarawak

B16: Site 2115008 at Sarikei DID, Sarawak

Table B16-1: Projected and observed 2014-2018 yearly rainfall for Site 2115008 at Sarikei DID, Sarawak

Site 2115008 at Sarikei DID, Sarawak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	2,703	3,254	2,359	2,741	2,878	2,787
ECHM3_A1B_2	2,609	2,417	2,211	2,074	2,576	2,377
ECHM3_A1B_3	2,956	3,179	2,472	2,631	2,764	2,800
Average_ECHM3	2,756	2,950	2,347	2,482	2,739	2,655
MRI_A1B	2,751	2,525	2,516	2,946	2,441	2,636
Average_ALL	2,755	2,844	2,389	2,598	2,665	2,650
OBSERVED	2,713	3,270	2,896	3,034	3,033	2,989

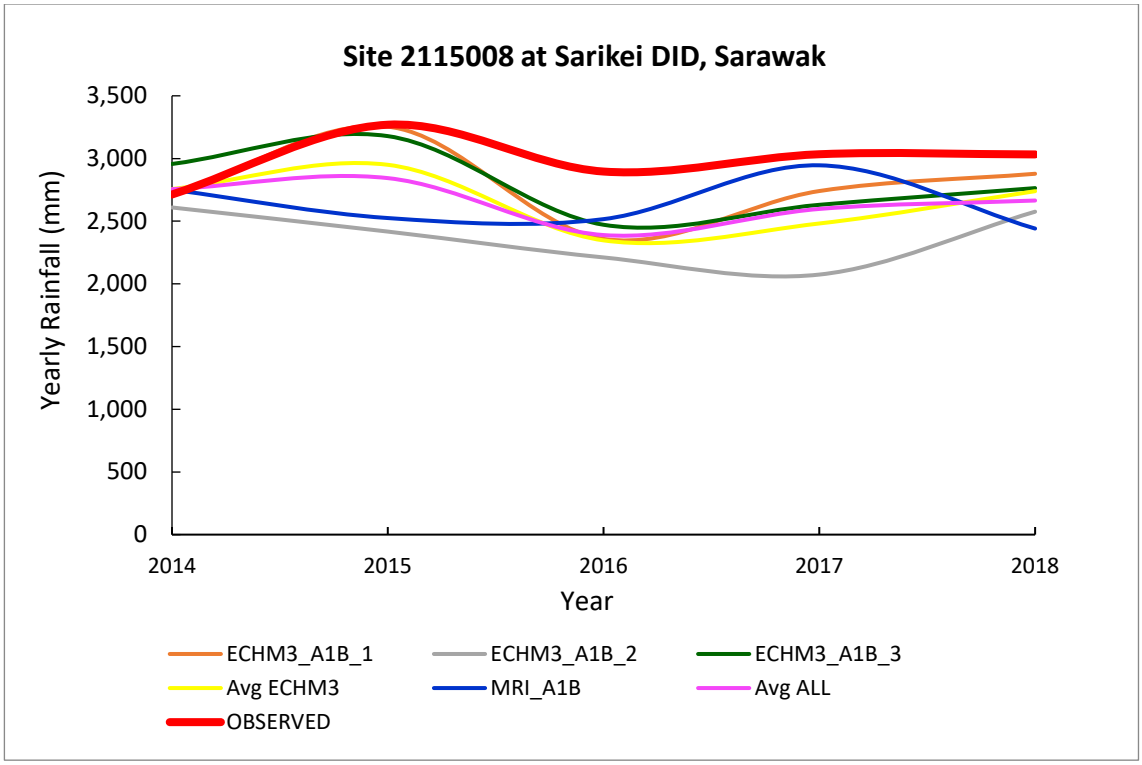


Figure B16-1: Projected and observed 2014-2018 yearly rainfall for Site 2115008 at Sarikei DID, Sarawak

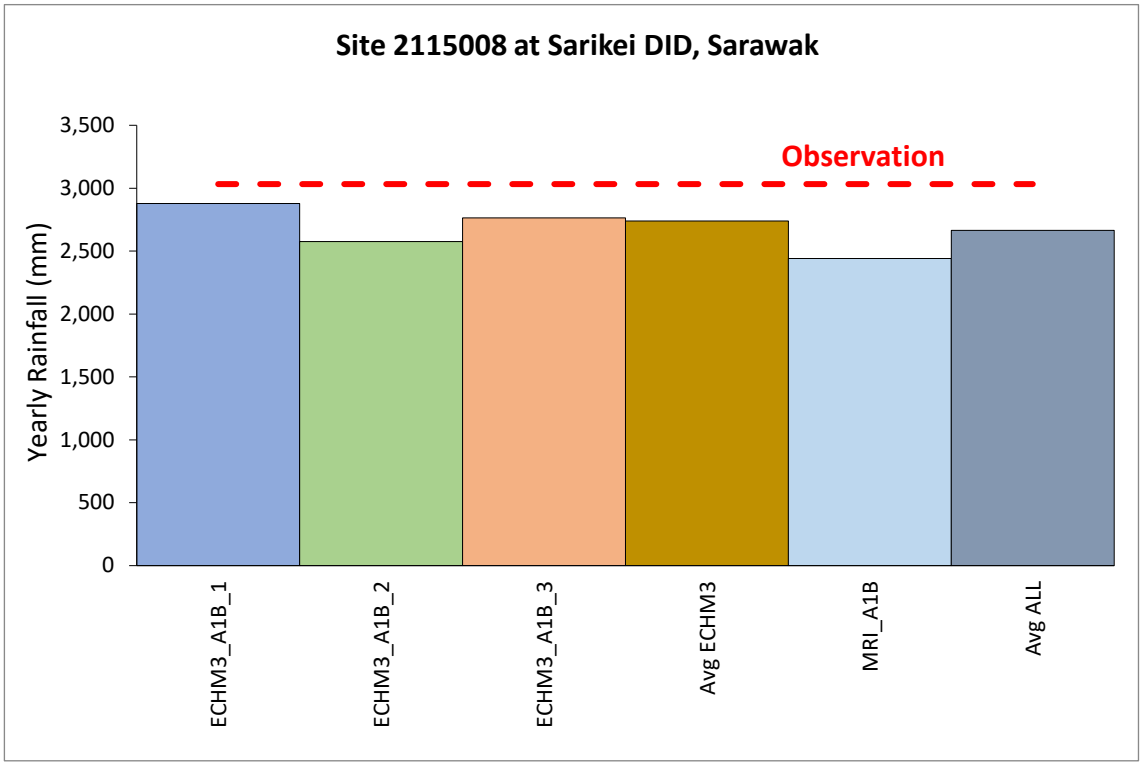


Figure B16-2: Projected and observed 2018 yearly rainfall for Site 2115008 at Sarikei DID, Sarawak

Table B16-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2115008 at Sarikei DID, Sarawak

Site 2115008 at Sarikei DID, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	0	0	-19	-10	-5	-7
ECHM3_A1B_2	-4	-26	-24	-32	-15	-20
ECHM3_A1B_3	9	-3	-15	-13	-9	-6
Average_ECHM3	2	-10	-19	-18	-10	-11
MRI_A1B	1	-23	-13	-3	-19	-11
Average_ALL	2	-13	-17	-14	-12	-11

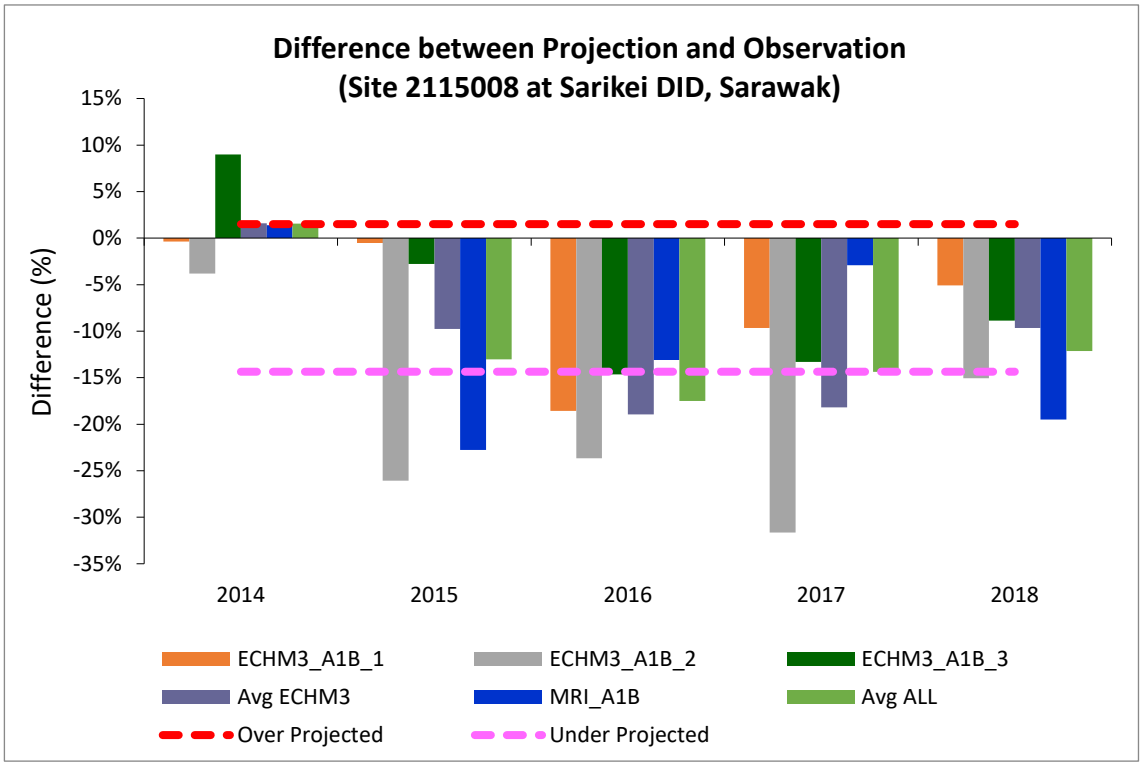


Figure B16-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2115008 at Sarikei DID, Sarawak

B17: Site 2219001 at Sibu New Airport, Sarawak

Table B17-1: Projected and observed 2014-2018 yearly rainfall for Site 2219001 at Sibu New Airport, Sarawak

Site 2219001 at Sibu New Airport, Sarawak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	3,583	4,252	3,467	3,777	4,332	3,882
ECHM3_A1B_2	4,457	3,573	3,424	3,155	3,786	3,679
ECHM3_A1B_3	3,557	4,192	3,402	3,628	4,238	3,803
Average_ECHM3	3,866	4,006	3,431	3,520	4,119	3,788
MRI_A1B	3,573	4,109	3,507	3,702	3,439	3,666
Average_ALL	3,793	4,032	3,450	3,565	3,949	3,758
OBSERVED	3,508	3,420	5,268	4,854	3,458	4,101

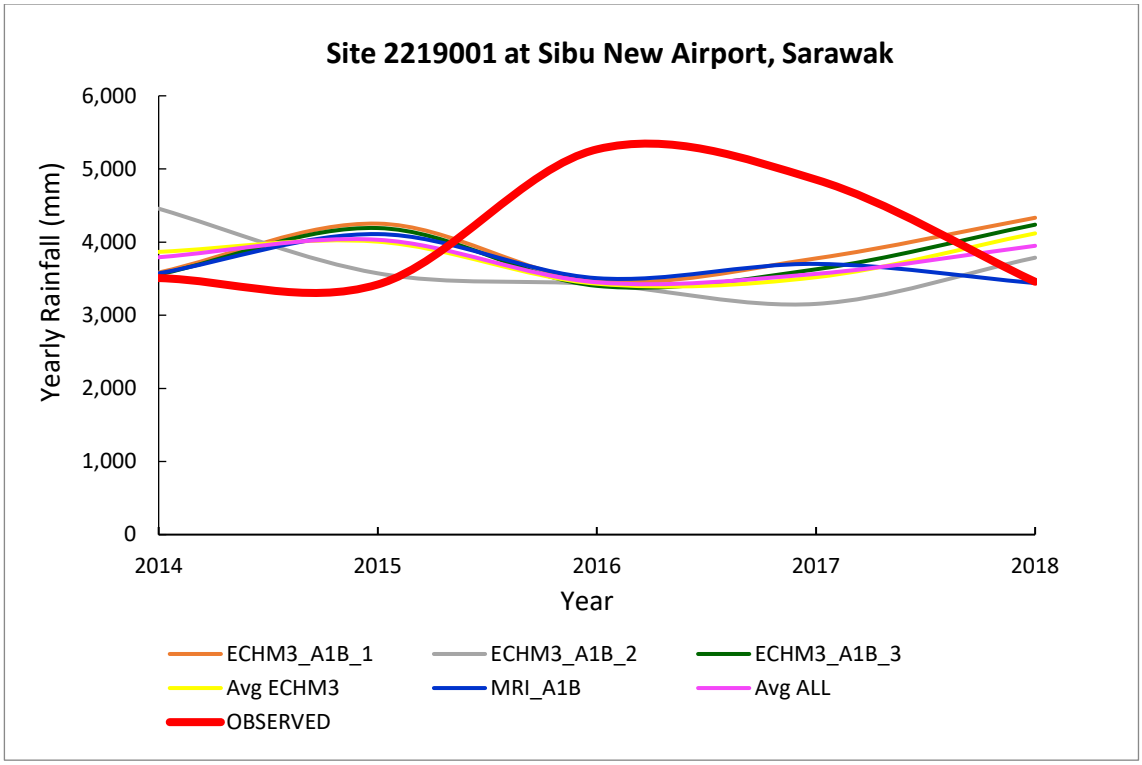


Figure B17-1: Projected and observed 2014-2018 yearly rainfall for Site 2219001 at Sibu New Airport, Sarawak

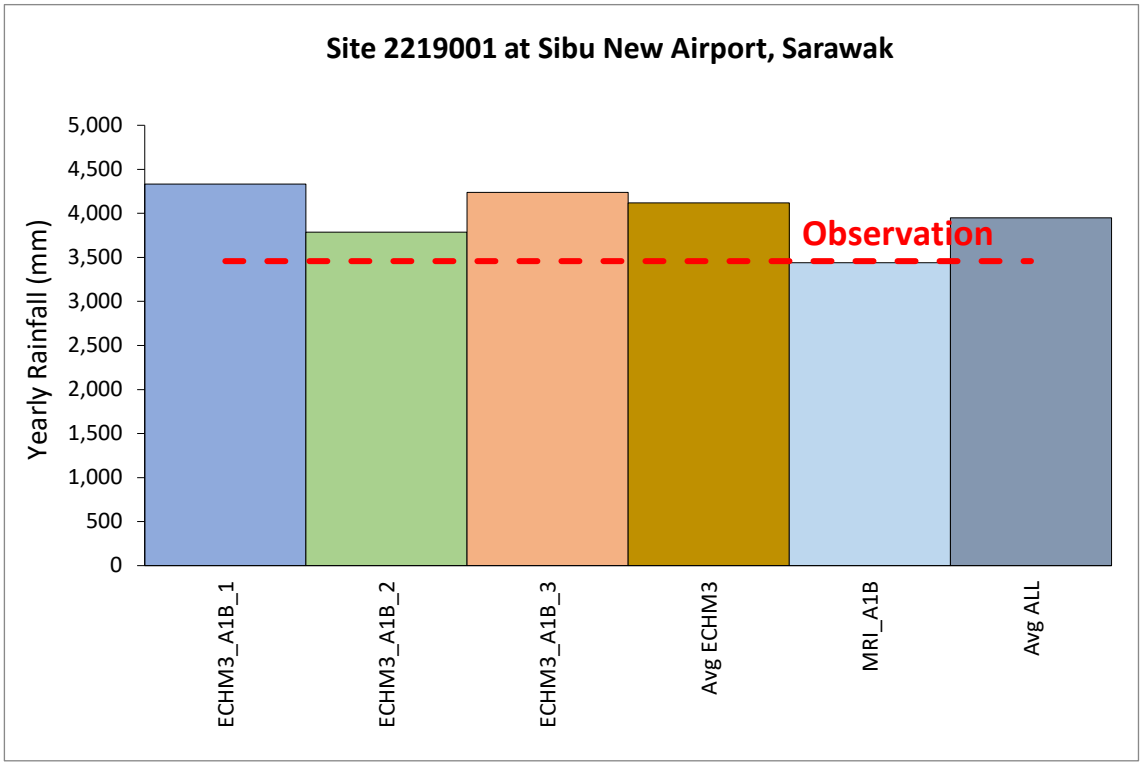


Figure B17-2: Projected and observed 2018 yearly rainfall for Site 2219001 at Sibu New Airport, Sarawak

Table B17-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2219001 at Sibu New Airport, Sarawak

Site 2219001 at Sibu New Airport, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	2	24	-34	-22	25	-1
ECHM3_A1B_2	27	4	-35	-35	10	-6
ECHM3_A1B_3	1	23	-35	-25	23	-3
Average_ECHM3	10	17	-35	-27	19	-3
MRI_A1B	2	20	-33	-24	-1	-7
Average_ALL	8	18	-35	-27	14	-4

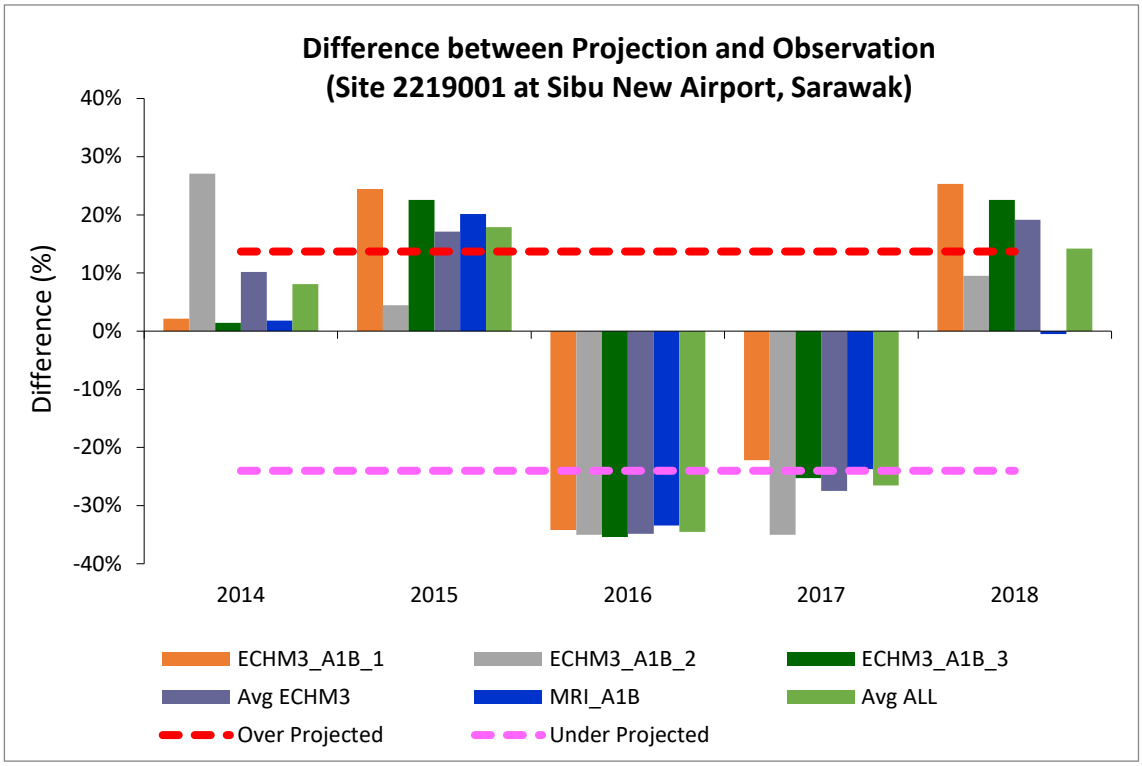


Figure B17-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2219001 at Sibu New Airport, Sarawak

B18: Site 2737103 at Belaga, Sarawak

Table B18-1: Projected and observed 2014-2018 yearly rainfall for Site 2737103 at Belaga, Sarawak

Site 2737103 at Belaga, Sarawak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	3,649	3,870	4,110	3,572	4,264	3,893
ECHM3_A1B_2	3,461	3,831	2,774	3,005	2,957	3,206
ECHM3_A1B_3	3,333	3,884	3,838	3,603	4,670	3,866
Average_ECHM3	3,481	3,861	3,574	3,394	3,964	3,655
MRI_A1B	2,376	3,578	3,306	3,037	2,812	3,022
Average_ALL	3,205	3,790	3,507	3,305	3,676	3,497
OBSERVED	2,889	3,723	3,640	4,199	3,284	3,547

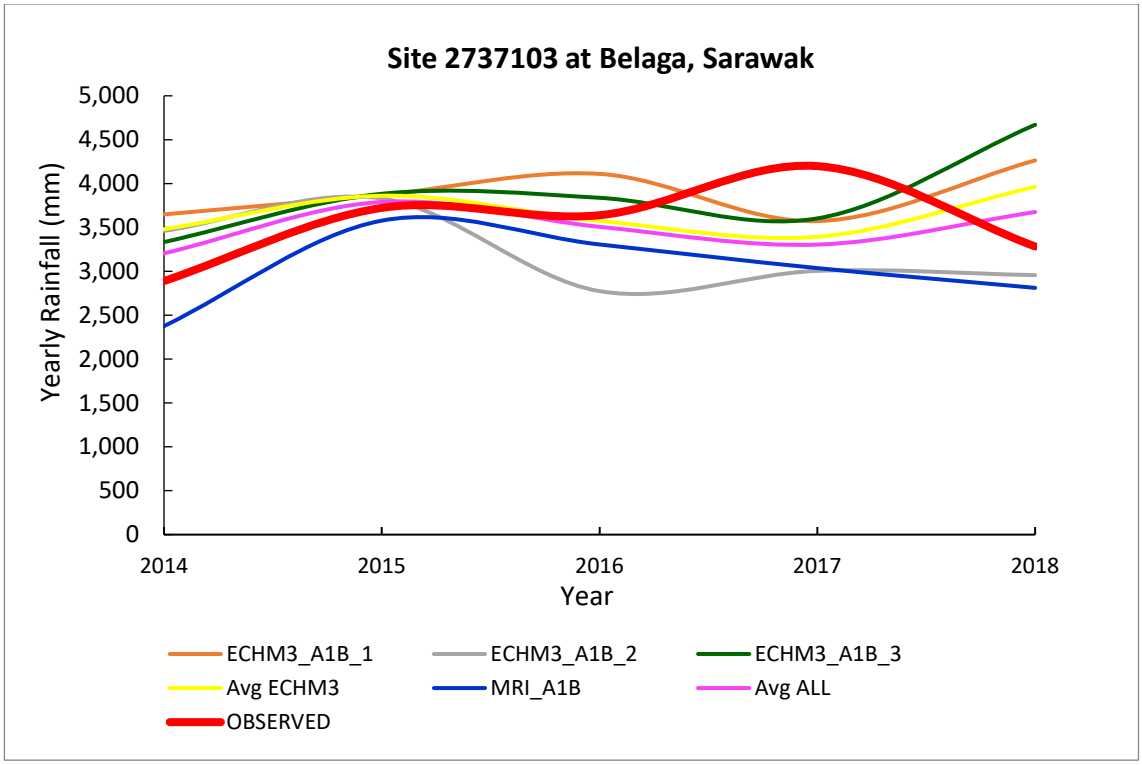


Figure B18-1: Projected and observed 2014-2018 yearly rainfall for Site 2737103 at Belaga, Sarawak

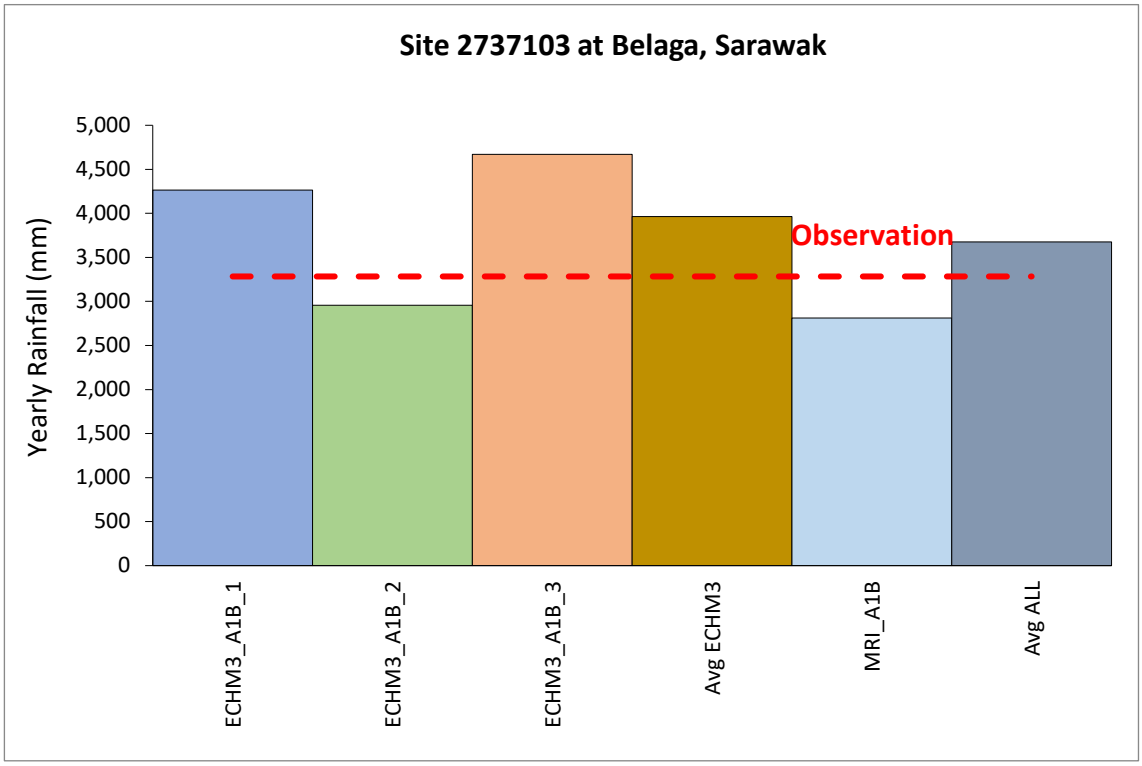


Figure B18-2: Projected and observed 2018 yearly rainfall for Site 2737103 at Belaga, Sarawak

Table B18-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 2737103 at Belaga, Sarawak

Site 2737103 at Belaga, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	26	4	13	-15	30	12
ECHM3_A1B_2	20	3	-24	-28	-10	-8
ECHM3_A1B_3	15	4	5	-14	42	11
Average_ECHM3	20	4	-2	-19	21	5
MRI_A1B	-18	-4	-9	-28	-14	-15
Average_ALL	11	2	-4	-21	12	0

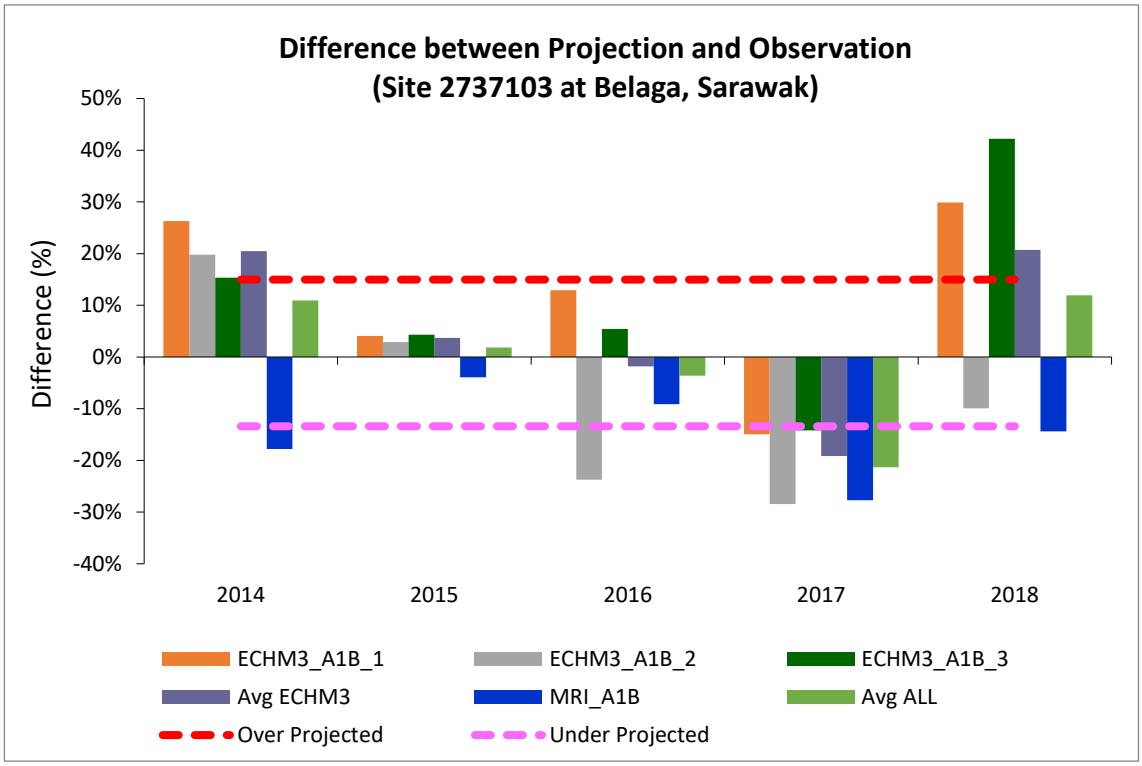


Figure B18-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 2737103 at Belaga, Sarawak

B19: Site 3541033 at Long Jegan, Sarawak

Table B19-1: Projected and observed 2014-2018 yearly rainfall for Site 3541033 at Long Jegan, Sarawak

Site 3541033 at Long Jegan, Sarawak						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	2,102	2,600	2,402	1,733	1,947	2,157
ECHM3_A1B_2	2,278	1,830	1,527	1,326	2,163	1,825
ECHM3_A1B_3	2,013	2,481	2,146	2,207	2,118	2,193
Average_ECHM3	2,131	2,304	2,025	1,755	2,076	2,058
MRI_A1B	2,455	2,694	2,353	2,503	2,576	2,516
Average_ALL	2,212	2,401	2,107	1,942	2,201	2,173
OBSERVED	3,175	3,056	2,728	4,183	3,970	3,422

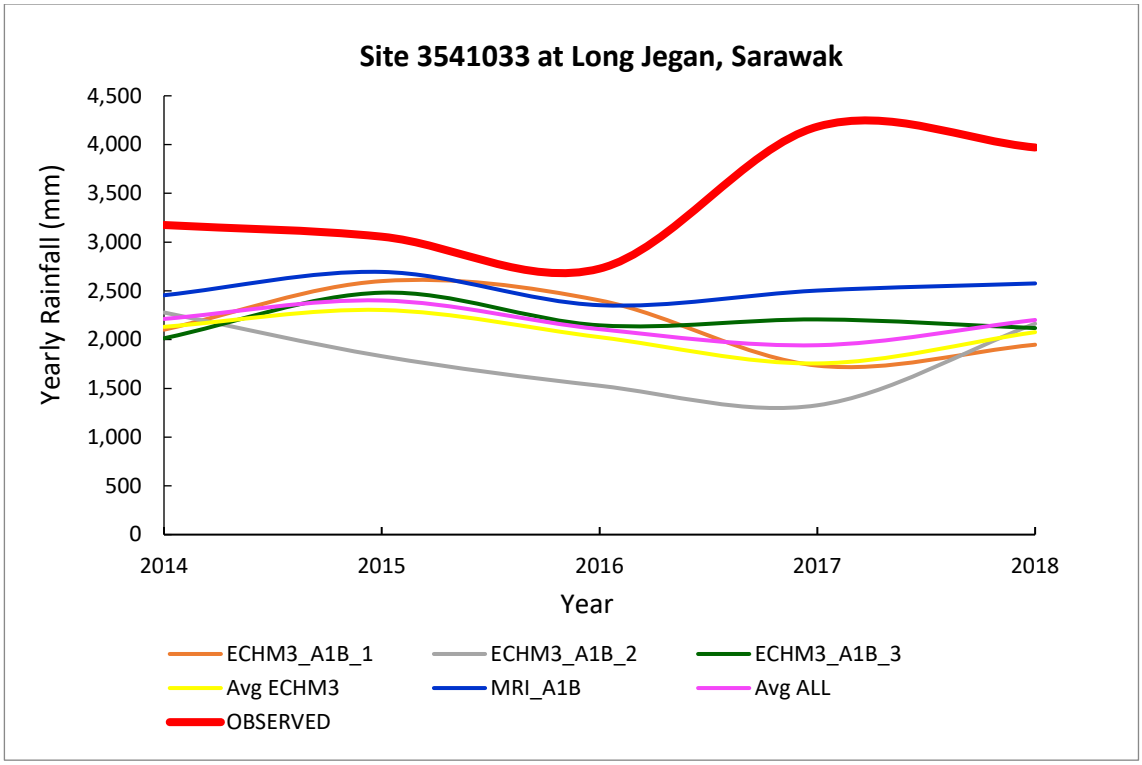


Figure B19-1: Projected and observed 2014-2018 yearly rainfall for Site 3541033 at Long Jegan, Sarawak

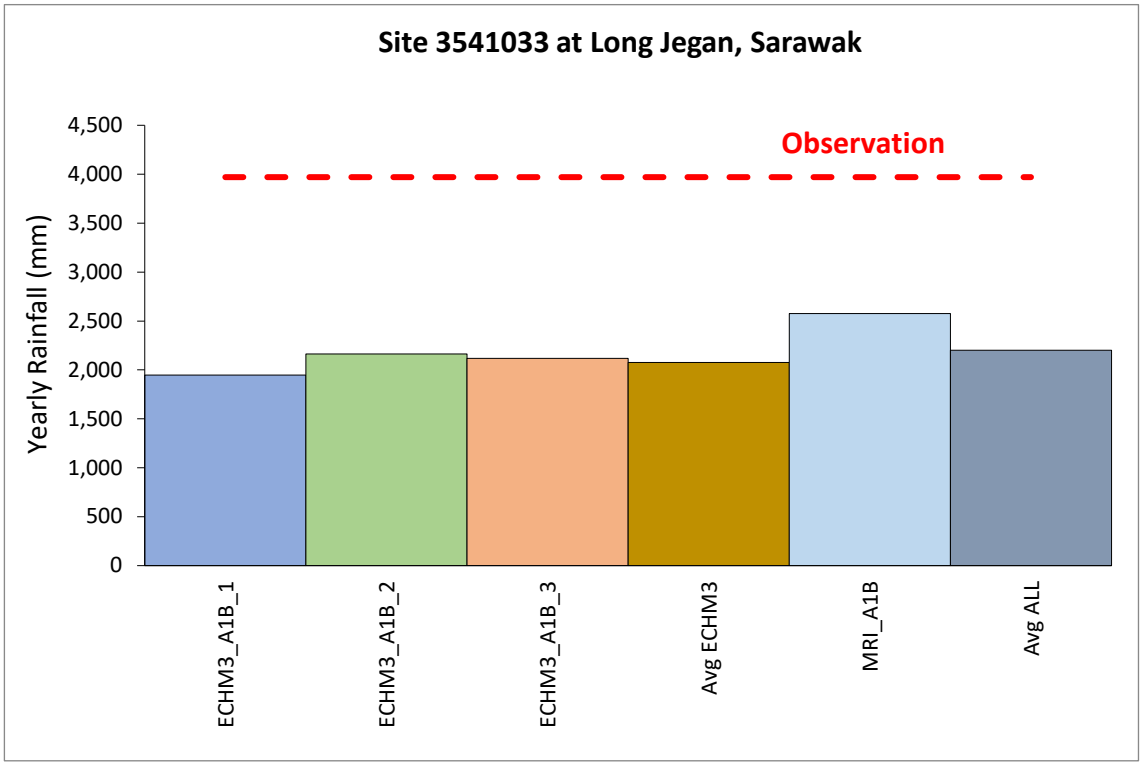


Figure B19-2: Projected and observed 2018 yearly rainfall for Site 3541033 at Long Jegan, Sarawak

Table B19-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3541033 at Long Jegan, Sarawak

Site 3541033 at Long Jegan, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-34	-15	-12	-59	-51	-34
ECHM3_A1B_2	-28	-40	-44	-68	-46	-45
ECHM3_A1B_3	-37	-19	-21	-47	-47	-34
Average_ECHM3	-33	-25	-26	-58	-48	-38
MRI_A1B	-23	-12	-14	-40	-35	-25
Average_ALL	-30	-21	-23	-54	-45	-35

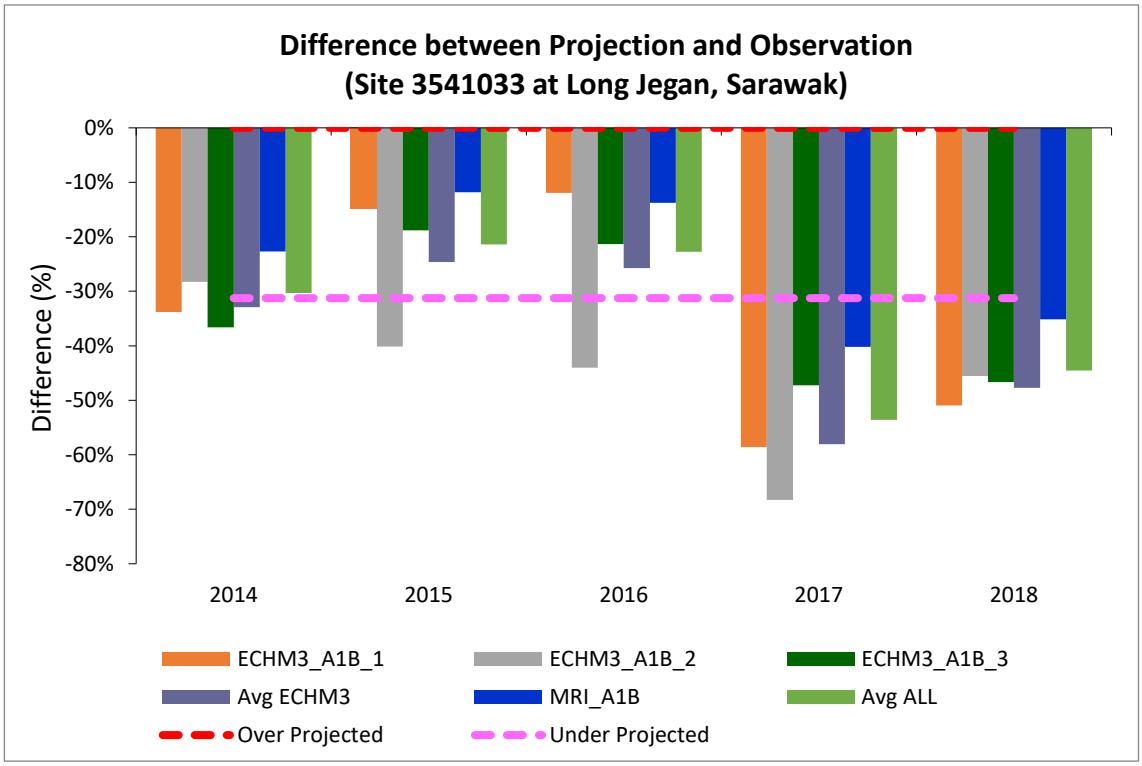


Figure B19-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3541033 at Long Jegan, Sarawak

B20: Site 3956001 at Ba Kelalan, Sarawak

Table B20-1: Projected and observed 2014-2018 yearly rainfall for Site 3956001 at Ba Kelalan, Sarawak

Site 3956001 at Ba Kelalan, Sarawak						
Model	Yearly Rainfall (mm)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	4,289	3,490	3,676	5,185	4,940	4,316
ECHM3_A1B_2	4,563	5,619	3,602	3,478	3,616	4,176
ECHM3_A1B_3	4,211	3,315	3,759	4,835	4,357	4,096
Average_ECHM3	4,354	4,142	3,679	4,499	4,304	4,196
MRI_A1B	2,065	3,090	3,208	3,455	2,371	2,838
Average_ALL	3,782	3,879	3,561	4,238	3,821	3,856
OBSERVED	2,223	2,270	2,005	2,502	2,489	2,297

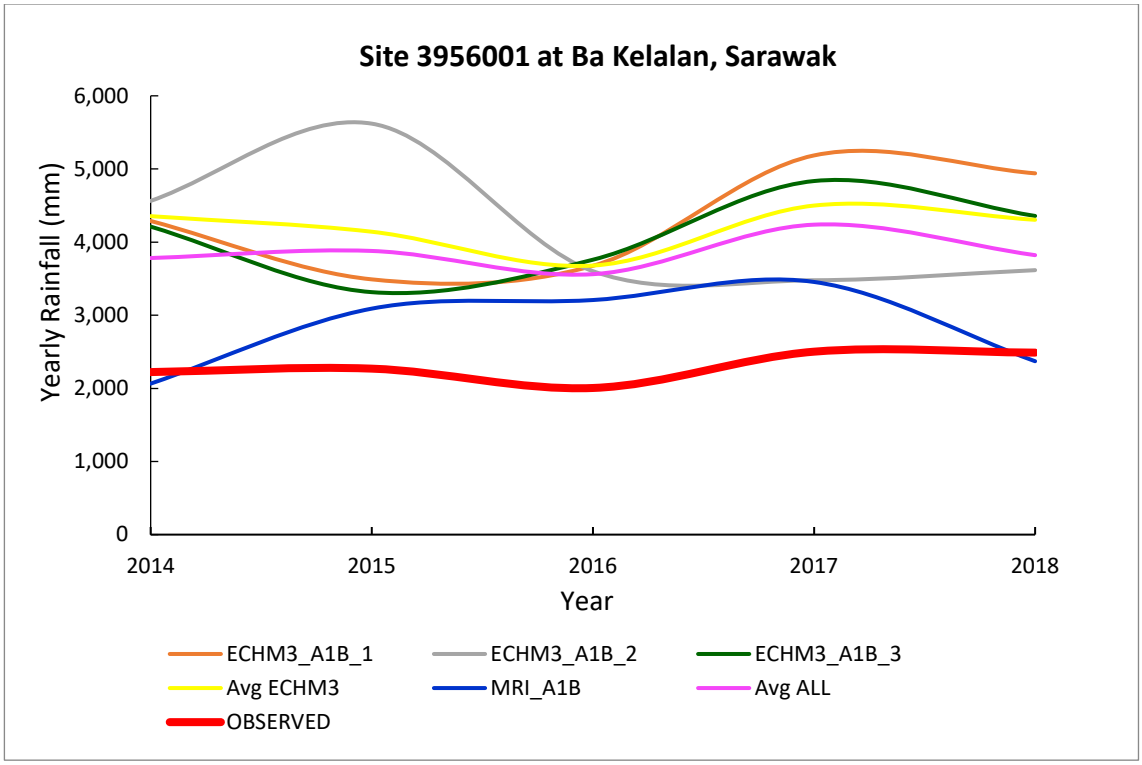


Figure B20-1: Projected and observed 2014-2018 yearly rainfall for Site 3956001 at Ba Kelalan, Sarawak

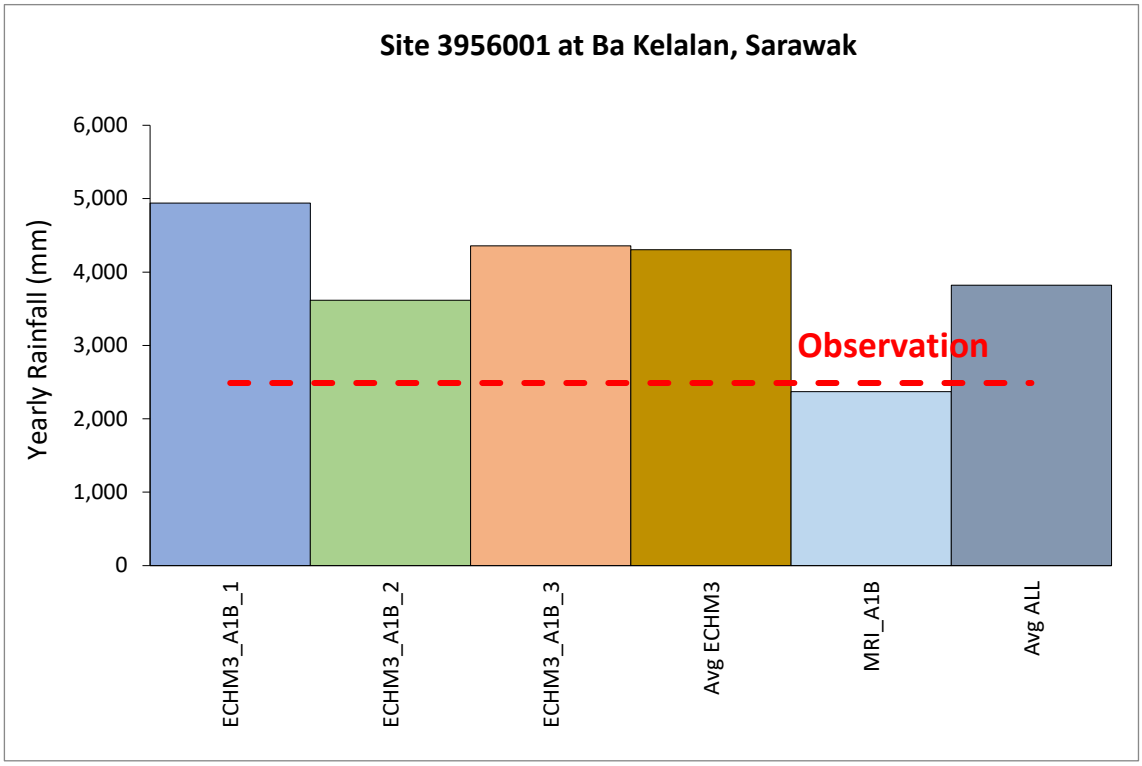


Figure B20-2: Projected and observed 2018 yearly rainfall for Site 3956001 at Ba Kelalan, Sarawak

Table B20-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 3956001 at Ba Kelalan, Sarawak

Site 3956001 at Ba Kelalan, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	93	54	83	107	99	87
ECHM3_A1B_2	105	148	80	39	45	83
ECHM3_A1B_3	89	46	87	93	75	78
Average_ECHM3	96	82	83	80	73	83
MRI_A1B	-7	36	60	38	-5	24
Average_ALL	70	71	78	69	54	68

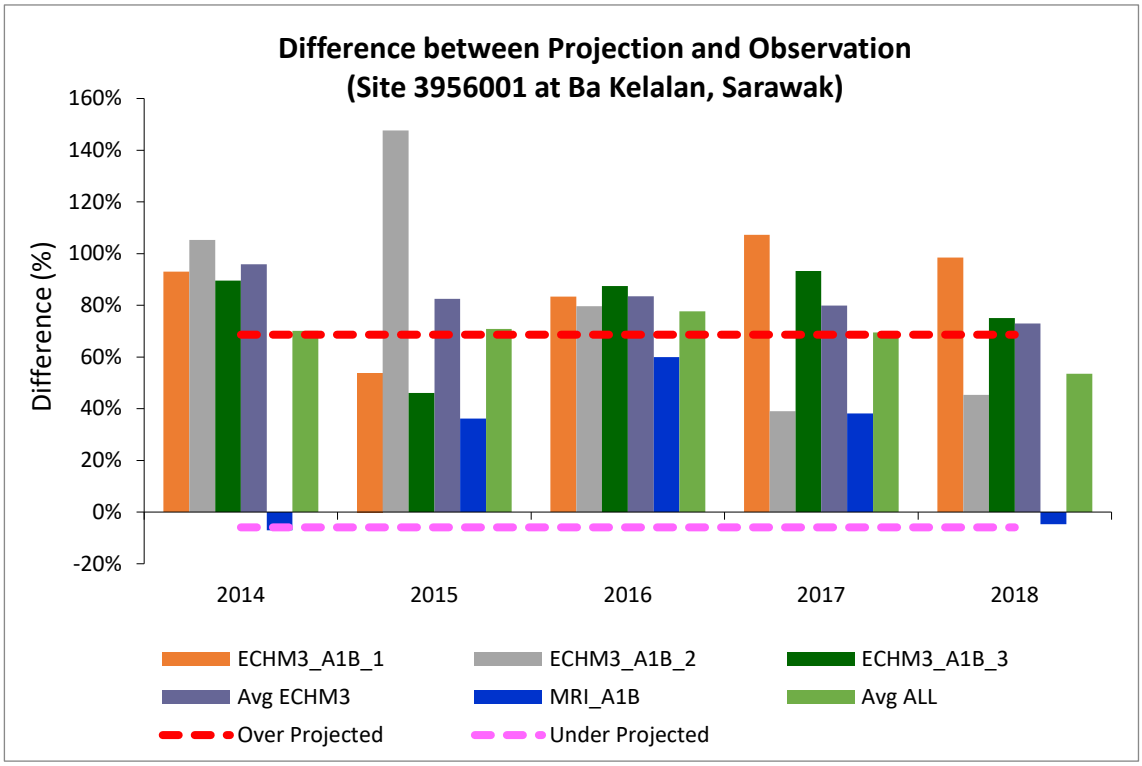


Figure B20-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 3956001 at Ba Kelalan, Sarawak

B21: Site 4339005 at Miri Airport, Sarawak

Table B21-1: Projected and observed 2014-2018 yearly rainfall for Site 4339005 at Miri Airport, Sarawak

Site 4339005 at Miri Airport, Sarawak						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	641	815	1,113	1,179	888	927
ECHM3_A1B_2	1,370	1,088	676	1,246	588	994
ECHM3_A1B_3	626	1,017	824	1,035	1,149	930
Average_ECHM3	879	974	871	1,153	875	950
MRI_A1B	1,618	2,379	1,830	1,991	1,805	1,924
Average_ALL	1,064	1,325	1,111	1,363	1,107	1,194
OBSERVED	2,357	2,492	1,860	3,044	3,173	2,585

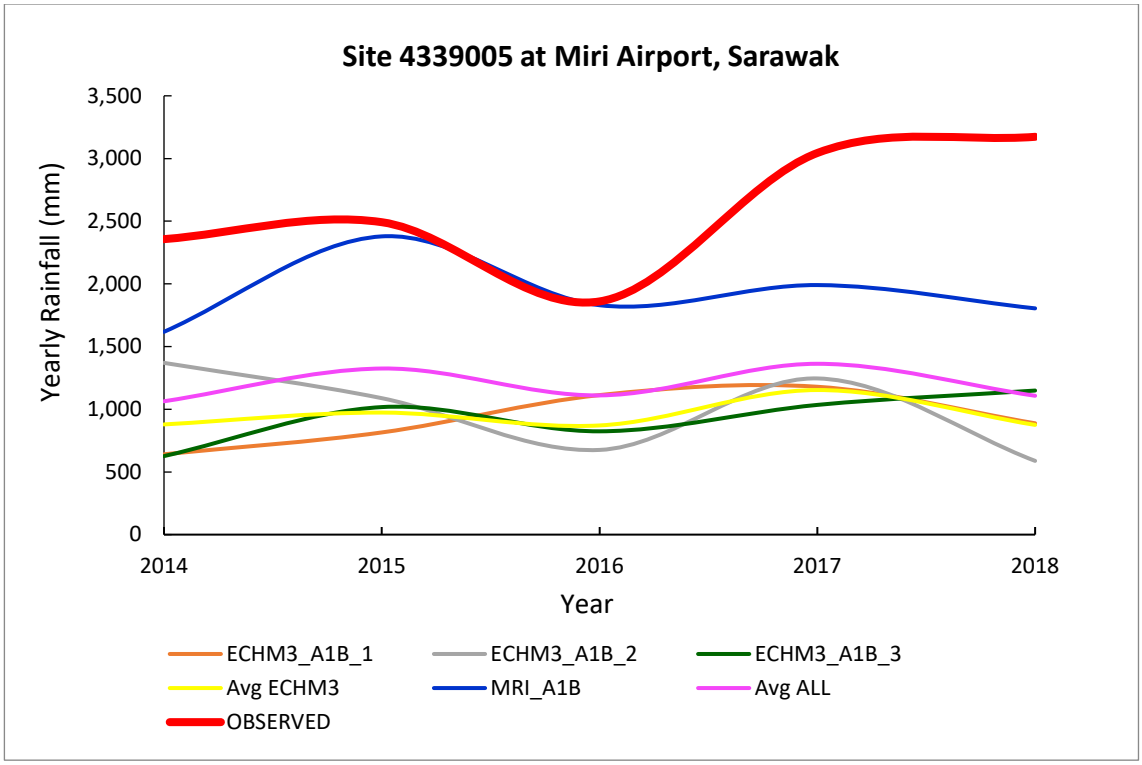


Figure B21-1: Projected and observed 2014-2018 yearly rainfall for Site 4339005 at Miri Airport, Sarawak

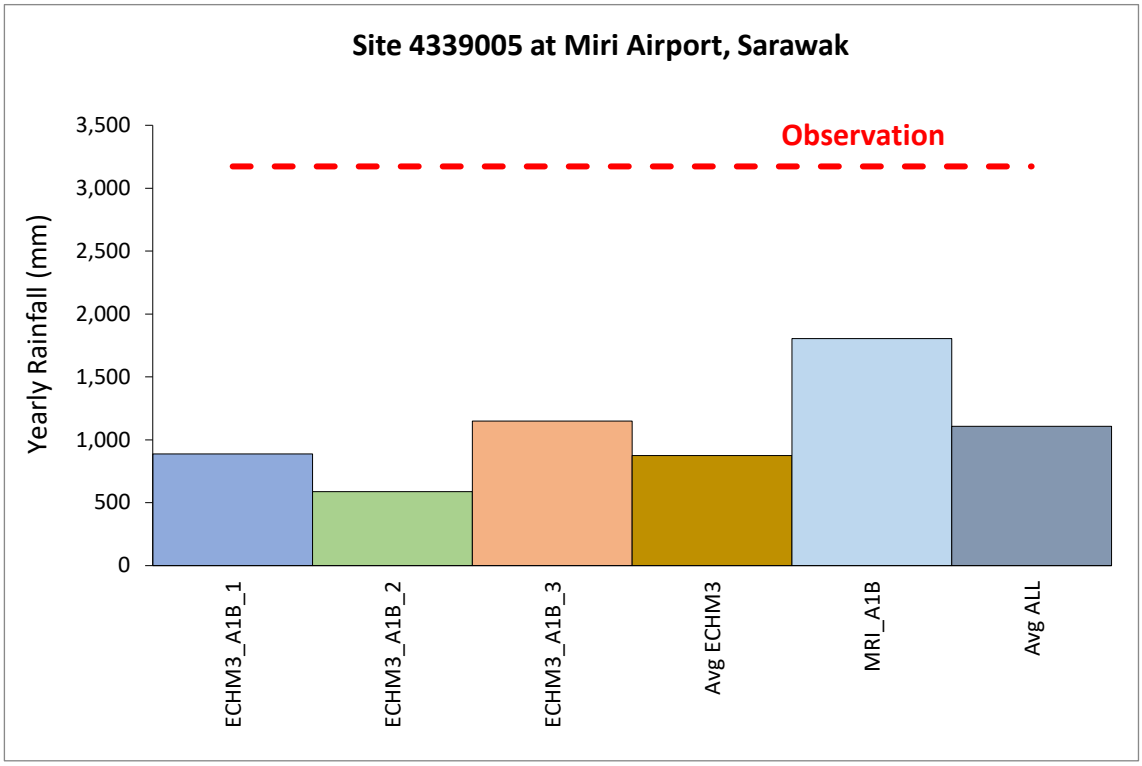


Figure B21-2: Projected and observed 2018 yearly rainfall for Site 4339005 at Miri Airport, Sarawak

Table B21-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4339005 at Miri Airport, Sarawak

Site 4339005 at Miri Airport, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-73	-67	-40	-61	-72	-63
ECHM3_A1B_2	-42	-56	-64	-59	-81	-60
ECHM3_A1B_3	-73	-59	-56	-66	-64	-64
Average_ECHM3	-63	-61	-53	-62	-72	-62
MRI_A1B	-31	-5	-2	-35	-43	-23
Average_ALL	-55	-47	-40	-55	-65	-52

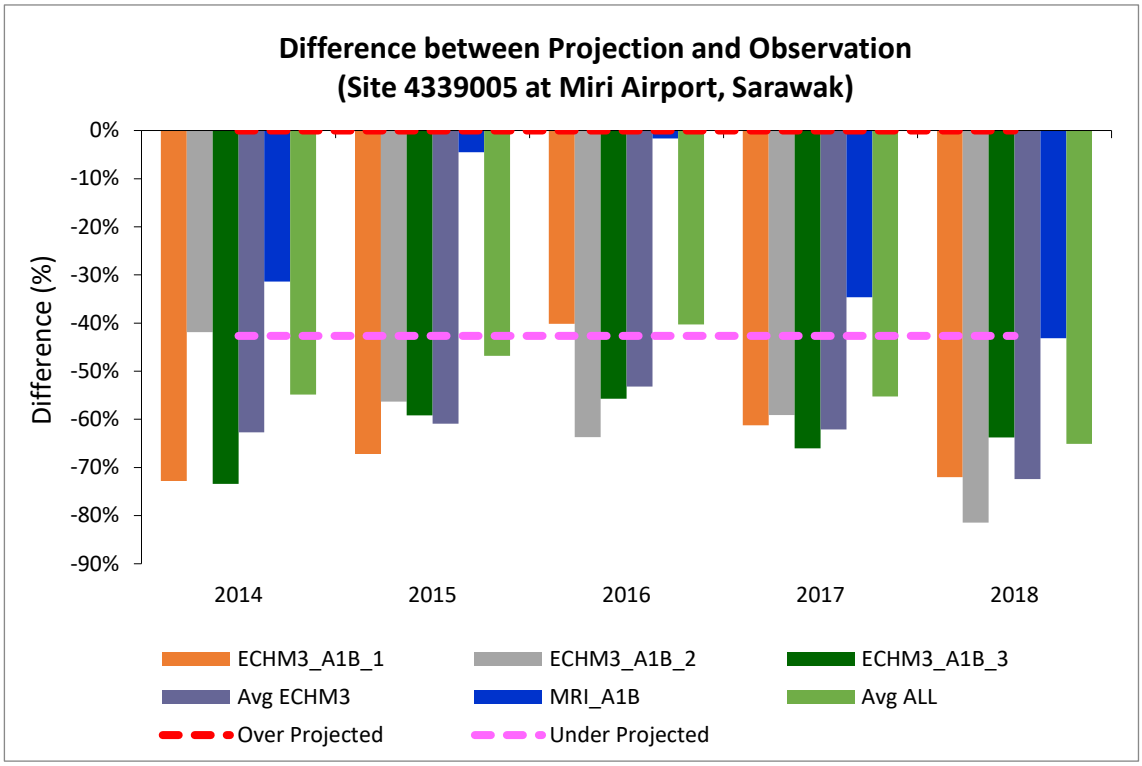


Figure B21-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4339005 at Miri Airport, Sarawak

B22: Site 4749001 at Limbang DID, Sarawak

Table B22-1: Projected and observed 2014-2018 yearly rainfall for Site 4749001 at Limbang DID, Sarawak

Site 4749001 at Limbang DID, Sarawak						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	1,829	2,198	2,681	2,083	1,616	2,081
ECHM3_A1B_2	2,530	2,123	1,437	2,887	2,227	2,241
ECHM3_A1B_3	2,124	2,139	2,616	1,607	1,566	2,010
Average_ECHM3	2,161	2,153	2,245	2,192	1,803	2,111
MRI_A1B	2,025	2,303	2,590	2,431	1,959	2,262
Average_ALL	2,127	2,191	2,331	2,252	1,842	2,149
OBSERVED	3,907	3,347	2,678	4,194	4,046	3,634

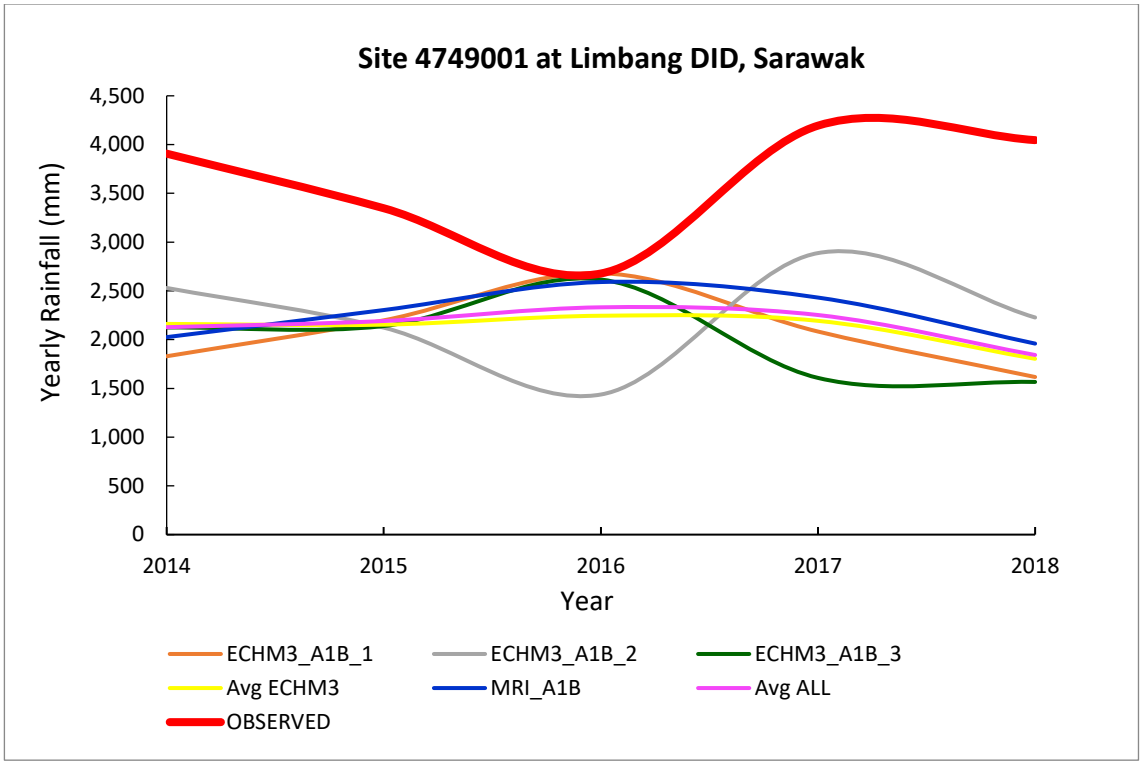


Figure B22-1: Projected and observed 2014-2018 yearly rainfall for Site 4749001 at Limbang DID, Sarawak

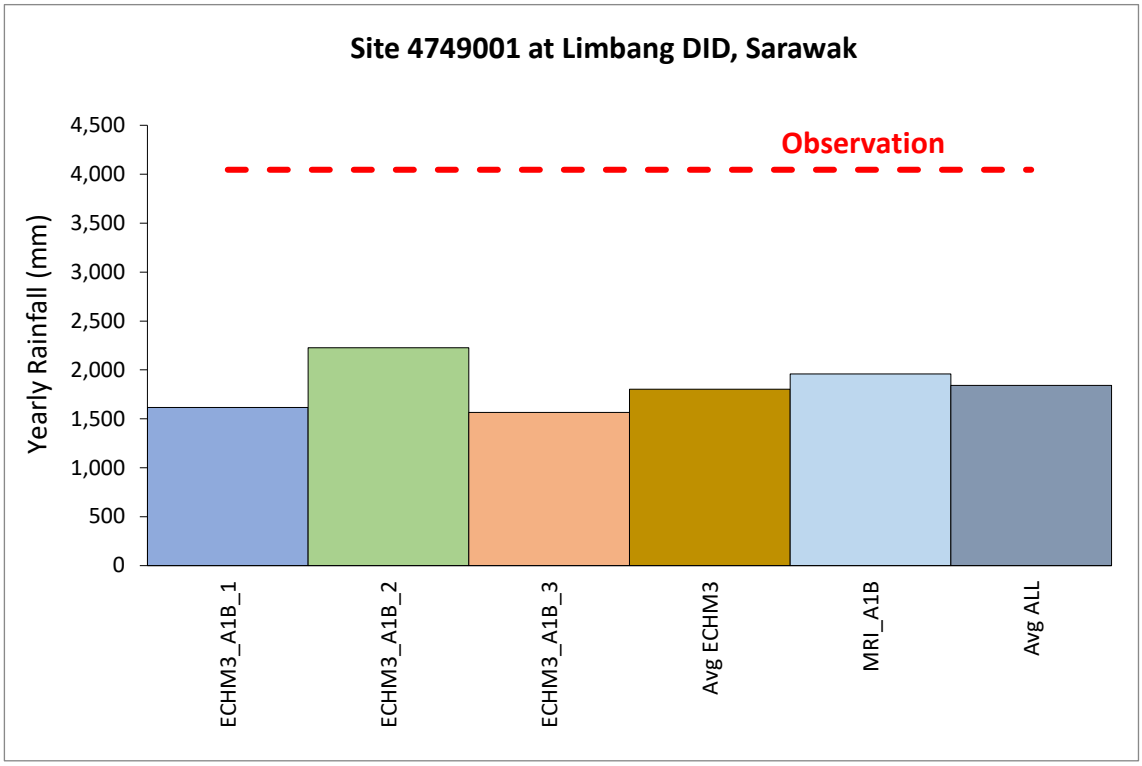


Figure B22-2: Projected and observed 2018 yearly rainfall for Site 4749001 at Limbang DID, Sarawak

Table B22-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4749001 at Limbang DID, Sarawak

Site 4749001 at Limbang DID, Sarawak						
Model	Difference (%)					
	2014	2015	2016	2017	2018	Average
ECHM3_A1B_1	-53	-34	0	-50	-60	-40
ECHM3_A1B_2	-35	-37	-46	-31	-45	-39
ECHM3_A1B_3	-46	-36	-2	-62	-61	-41
Average_ECHM3	-45	-36	-16	-48	-55	-40
MRI_A1B	-48	-31	-3	-42	-52	-35
Average_ALL	-46	-35	-13	-46	-54	-39

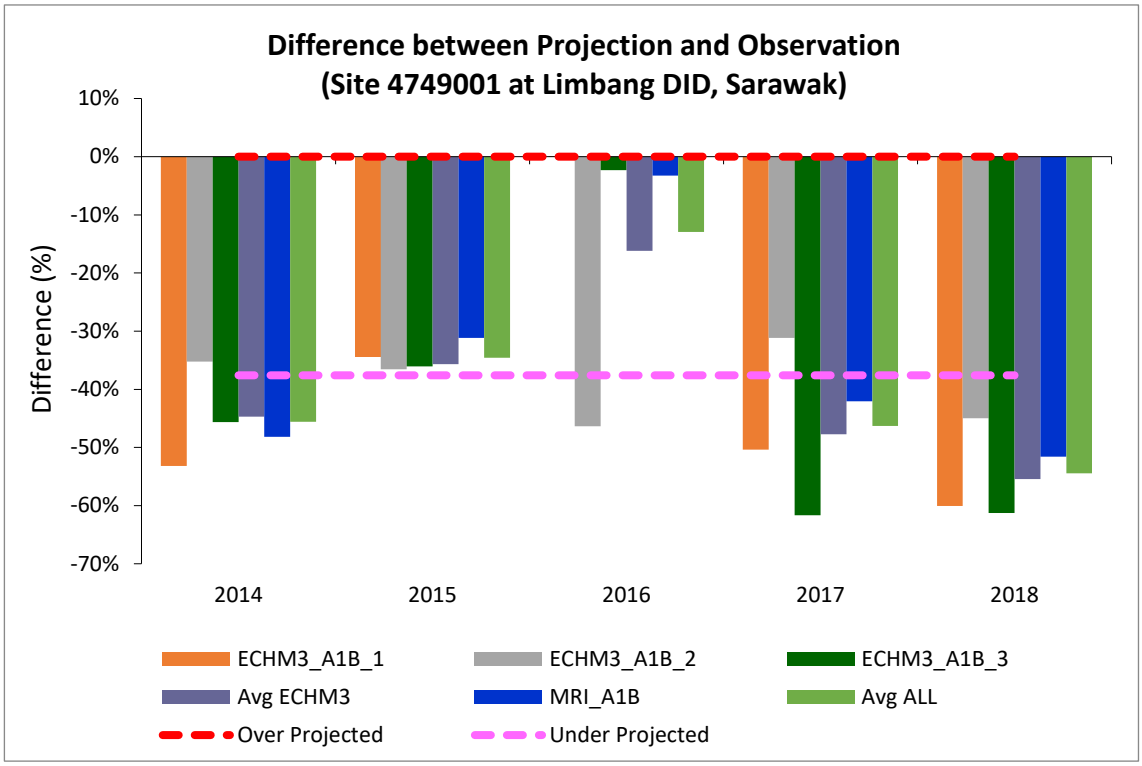


Figure B22-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4749001 at Limbang DID, Sarawak

B23: Site 4854009 at Lawas Airfield, Sarawak

Table B23-1: Projected and observed 2014-2018 yearly rainfall for Site 4854009 at Lawas Airfield, Sarawak

Site 4854009 at Lawas Airfield, Sarawak						
Model	**Yearly Rainfall (mm)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	2,135	4,877	5,328	3,359	2,076	3,555
ECHM3_A1B_2	3,561	4,336	3,698	4,324	2,694	3,723
ECHM3_A1B_3	2,374	4,960	4,737	2,638	2,088	3,359
Average_ECHM3	2,690	4,724	4,588	3,440	2,286	3,546
MRI_A1B	2,858	2,004	2,539	3,022	1,610	2,407
Average_ALL	2,732	4,044	4,075	3,336	2,117	3,261
OBSERVED	4,323	4,029	3,243	4,106	3,591	3,858

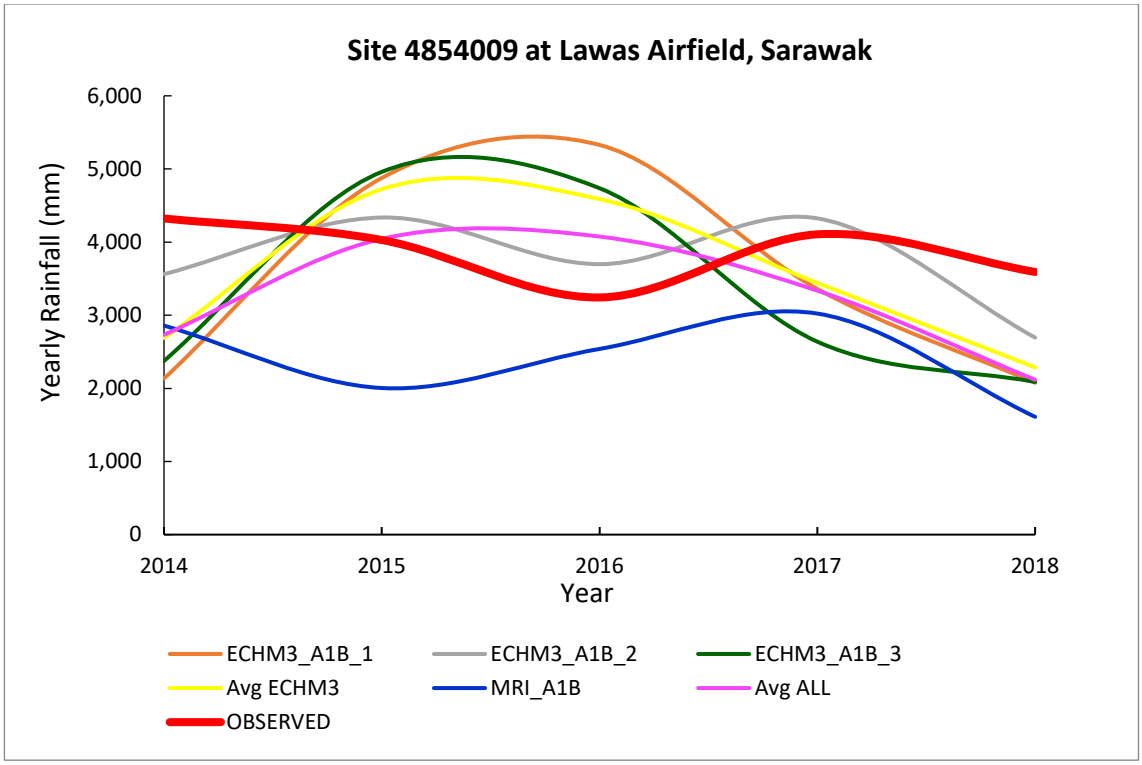


Figure B23-1: Projected and observed 2014-2018 yearly rainfall for Site 4854009 at Lawas Airfield, Sarawak

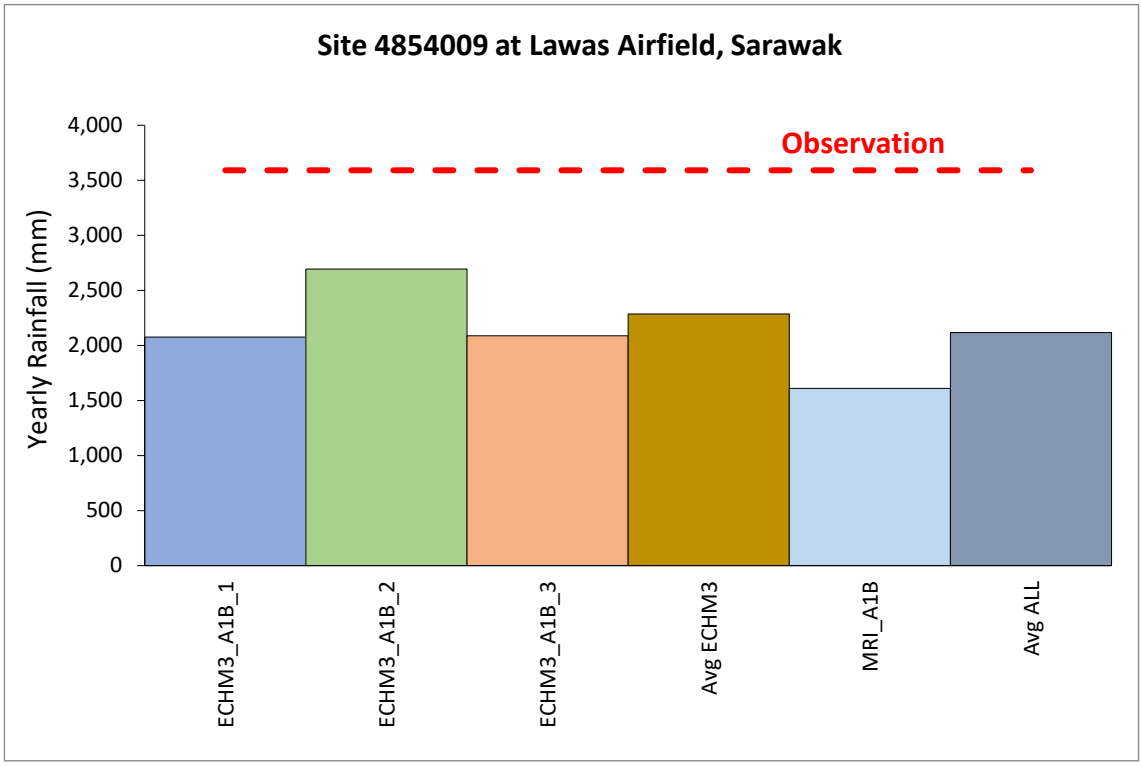


Figure B23-2: Projected and observed 2018 yearly rainfall for Site 4854009 at Lawas Airfield, Sarawak

Table B23-2: Difference between projected and observed 2014-2018 yearly rainfall for Site 4854009 at Lawas Airfield, Sarawak

Site 4854009 at Lawas Airfield, Sarawak						
Model	**Difference (%)**					
	2014	**2015**	**2016**	**2017**	**2018**	**Average**
ECHM3_A1B_1	-51	21	64	-18	-42	-5
ECHM3_A1B_2	-18	8	14	5	-25	-3
ECHM3_A1B_3	-45	23	46	-36	-42	-11
Average_ECHM3	-38	17	41	-16	-36	-6
MRI_A1B	-34	-50	-22	-26	-55	-37
Average_ALL	-37	0	26	-19	-41	-14

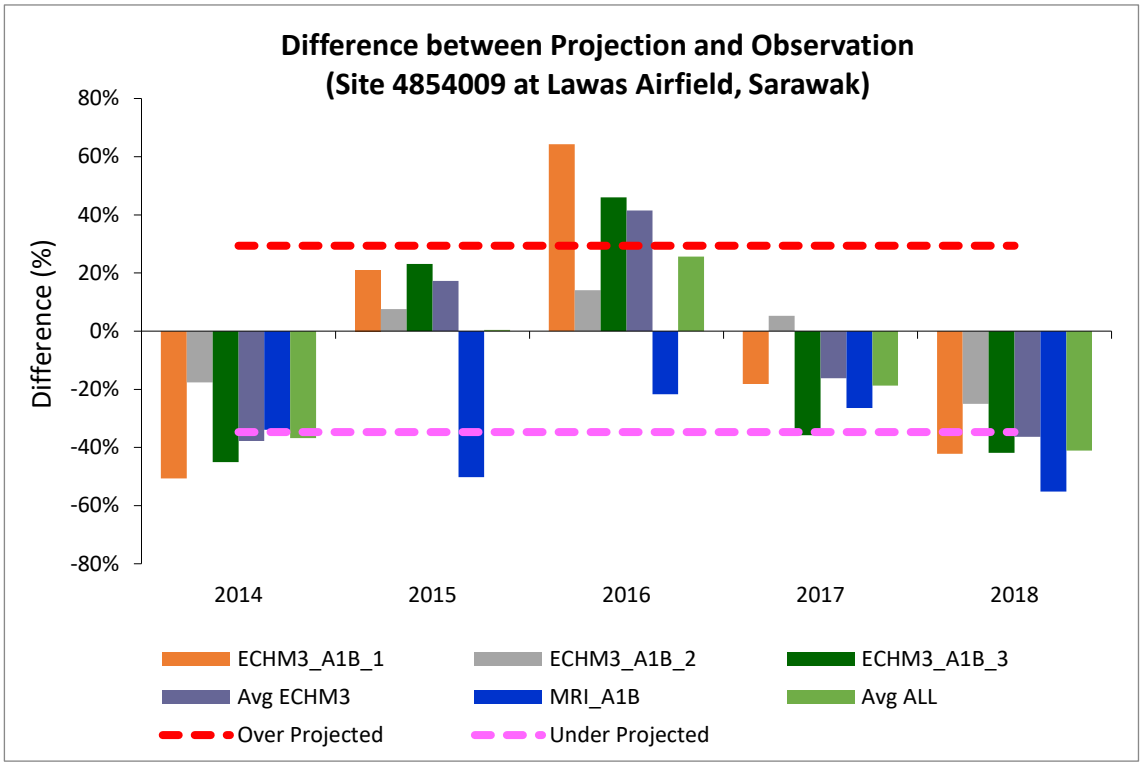


Figure B23-3: Difference between projected and observed 2014-2018 yearly rainfall for Site 4854009 at Lawas Airfield, Sarawak