AWCI Training Course on Improved Bias Correction and Downscaling Techniques for Climate Change Assessment including Drought Indices

18-20 JUNE 2013, UNIVERSITY OF TOKYO

Estimation of Future Design Rainstorm under the Climate Change Scenario in Peninsular Malaysia

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Objective of Technical Guideline

- To assist engineers, hydrologists and decision makers in designing, planning and developing water-related infrastructure under changing climatic conditions.
- To introduce an approach of quantifying the scale of climatic change to surface water systems.
- The main purpose of this guideline is to derive climate change factor (CCF)
- CCF defined as the ratio of the design rainfall for each of the future periods (time horizons) to the control periods (present rainfall)





Technical Approach











STATISTICAL DOWNSCALING MODEL



DYNAMIC DOWNSCALING MODEL -RegHCM-PM

 2006: A regional hydrologicatmospheric model of Peninsular Malaysia called as 'Regional Hydro-climate Model of Peninsular Malaysia (RegHCM-PM) was developed

 Downscaling global climate change simulation data (Canadian GCM1 current and future climate data) that are at very coarse resolution (~ 410km), to Peninsular Malaysia (West Malaysia) at fine spatial resolution (~9km) – for future period of 2025 to 2050 (2025-2034 & 2041-2050)



Adaptation Tool - **Regional Future Hydroclimate Data Retrieval System** for extreme events (9km x 9km) http://www.futurehydroclimate.nahrim.gov.my





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	GEV-Max (L-Moments) Model cccma_cgcm3_1 cccma_cgcm3_1_tG3 cnrm_cm3 csiro_mk3_0	2 95.74 89.06 97.58 97.58	5 114.54 131.96 113.27 113.27	- 10 121.95 162.37 124.71 124.71	2046-20 20 126.73 193.13 136.53 136.53	055 25 127.89 203.23 140.47 140.47	50 130.70 235.42 153.20 153.20	100 132.61 269.03 166.77 166.77	1000 135.57 393.04 219.17 219.17	
	GEV-Max (L-Moments) Model cccma_cgcm3_1 cccma_cgcm3_1_t63 cnrm_cm3 csiro_mk3_0 csiro_mk3_5	2 95.74 89.06 97.58 97.58 112.92	5 114.54 131.96 113.27 113.27 123.34	10 121.95 162.37 124.71 124.71 130.26	2046-20 20 126.73 193.13 136.53 136.53 136.93	055 25 127.89 203.23 140.47 140.47 139.05	50 130.70 235.42 153.20 153.20 145.60	100 132.61 269.03 166.77 166.77 152.11	1000 135.57 393.04 219.17 219.17 173.79	
CC FACTOR	GEV-Max (L-Moments) Model cccma_cgcm3_1 cccma_cgcm3_1_t63 cnrm_cm3 csiro_mk3_0 csiro_mk3_5 gfdl_cm2_0	2 95.74 89.06 97.58 97.58 112.92 86.05	5 114.54 131.96 113.27 113.27 123.34 103.21	10 121.95 162.37 124.71 124.71 130.26 116.67	2046-20 126.73 193.13 136.53 136.53 136.93 131.41	25 127.89 203.23 140.47 140.47 139.05 136.50	50 130.70 235.42 153.20 153.20 145.60 153.57	100 132.61 269.03 166.77 166.77 152.11 172.80	1000 135.57 393.04 219.17 219.17 173.79 256.67	
CC FACTOR	GEV-Max (L-Moments) Model cccma_cgcm3_1 cccma_cgcm3_1_t63 cnrm_cm3 csiro_mk3_0 csiro_mk3_5 gfdl_cm2_0 gfdl_cm2_1	2 95.74 89.06 97.58 97.58 97.58 112.92 86.05 108.71	5 114.54 131.96 113.27 113.27 123.34 103.21 132.36	10 121.95 162.37 124.71 124.71 130.26 116.67 140.20	2046-20 126.73 193.13 136.53 136.93 131.41 144.63	25 127.89 203.23 140.47 140.47 139.05 136.50 145.62	50 130.70 235.42 153.20 153.20 145.60 153.57 147.82	100 132.61 269.03 166.77 152.11 172.80 149.15	1000 135.57 393.04 219.17 219.17 173.79 256.67 150.79	
CC FACTOR	GEV-Max (L-Moments) Model cccma_cgcm3_1 cccma_cgcm3_1_tG3 cmm_cm3 csiro_mk3_0 csiro_mk3_0 csiro_mk3_5 gfdl_cm2_0 gfdl_cm2_1 giss_aom	2 95.74 89.06 97.58 97.58 97.58 112.92 86.05 108.71 112.92	5 114.54 131.96 113.27 113.27 123.34 103.21 132.36 123.34	10 121.95 162.37 124.71 124.71 130.26 116.67 140.20 130.26	2046-24 20 126.73 136.53 136.53 136.93 131.41 144.63 136.93	25 25 203.23 140.47 140.47 140.47 139.05 136.50 145.62 139.05	50 130.70 235.42 153.20 153.20 153.57 145.60 153.57 147.82 145.60	100 132.61 269.03 166.77 152.11 172.80 149.15 152.11	1000 135.57 393.04 219.17 219.17 173.79 256.67 150.79 173.79	
CC FACTOR	GEV-Max (L-Moments) Model cccma_cgcm3_1 cccma_cgcm3_1_t63 cnrm_cm3 csiro_mk3_0 csiro_mk3_0 gfdl_cm2_0 gfdl_cm2_1 giss_aom iap_fgoals1_0_g	2 95.74 89.06 97.58 97.58 112.92 86.05 108.71 112.92 111.81	5 114.54 131.96 113.27 113.27 123.34 103.21 132.36 123.34 136.65	10 121.95 162.37 124.71 124.71 130.26 116.67 140.20 130.26 150.64	2046-20 126.73 193.13 136.53 136.53 136.93 131.41 144.63 136.93 162.47	25 25 127.89 203.23 140.47 140.47 139.05 136.50 145.62 139.05 165.92	50 130.70 235.42 153.20 153.20 145.60 153.57 147.82 145.60 175.76	100 132.61 269.03 166.77 166.77 152.11 172.80 149.15 152.11 184.42	1000 135.57 393.04 219.17 219.17 173.79 256.67 150.79 173.79 206.68	
CC FACTOR	GEV-Max (L-Moments) Model cccma_cgcm3_1 ccrma_cgcm3_1_t63 cnrm_cm3 csiro_mk3_0 csiro_mk3_5 gfdl_cm2_0 gfdl_cm2_1 giss_aom iap_fgoals1_0_g ingv_echam4	2 95.74 89.06 97.58 97.58 112.92 86.05 108.71 112.92 111.81 113.08	5 114.54 131.96 113.27 113.27 123.34 103.21 132.36 123.34 136.65 166.52	10 121.95 162.37 124.71 130.26 116.67 140.20 130.26 150.64 205.39	2046-20 126.73 193.13 136.53 136.53 136.93 131.41 144.63 136.93 162.47 245.53	255 25 127.89 203.23 140.47 140.47 139.05 136.50 145.62 139.05 165.92 258.87	50 130.70 235.42 153.20 145.60 153.57 147.82 145.60 175.76 301.96	100 132.61 269.03 166.77 152.11 172.80 149.15 152.11 184.42 347.84	1000 135.57 393.04 219.17 173.79 256.67 150.79 173.79 206.68 206.68	

16 ipsl_cm4

17 miroc3 2 hires K-1

18 miroc3_2_hires

20 miub_echo_g

22 mri_cgcm2_3_2a

21 mpi echam5

19 miroc3_2_medres

117.63

135.06

135.07

108.74

121.13

108.11

114.33

138.42 157.03

241.30

241.30

182.75

193.18

138.20

152.85

194.19

194.20

148.23

161.95

127.00

139.84

179.68

293.54

293.55

223.95

226.75

148.06

163.04

188.04

311.73

311.73

238.98

238.20

151.01

165.88

218.04

373.20

373.20

292.25

276.13

159.65

173.56



255.40

443.28

443.28

357.40

318.08

167.54

179.86

460.50

757.38

757.35

700.20

493.78

189.50

193.82







(with climate change scenario)

1-day Future IDF Parameter (λ_{BH}) corresponding to Return Period in Kedah state

				1-day λ _{BH}										
State	No.	Station ID	Station Name	Return Period, T										
				2	5	10	20	25	50	100	200			
	1	6207032	Ampang Pedu	69.47	71.27	72.22	73.00	73.22	73.86	74.41	74.90			
	2	5507076	Bt.27, Jln Baling	58.55	60.64	61.84	62.86	63.16	64.04	64.84	65.56			
	3	5808001	Bt.61, Jln Baling	51.41	53.74	55.00	56.06	56.37	57.24	58.02	58.71			
	4	5704055	Kedah Peak	92.90	98.19	100.91	103.08	103.70	105.44	106.93	108.24			
Kedah	5	5806066	Klinik Jeniang	68.59	69.98	70.71	71.30	71.47	71.95	72.37	72.73			
	6	6108001	Komp Rmh Muda	60.25	64.83	67.41	69.61	70.27	72.14	73.83	75.37			
	7	6206035	Kuala Nerang	53.34	58.78	61.68	64.07	64.76	66.71	68.42	69.94			
	8	6306031	Padang Sanai	65.37	65.71	66.84	68.48	69.10	71.32	73.94	76.97			
	9	6103047	JPS Alor Setar	69.44	75.61	79.04	81.94	82.79	85.23	87.41	89.38			

IDF Parameters

State	Station ID	Station None	Derived Parameters								
State	Station ID	Station Name	λ	λвн	к	θ	η				
	5507076	Bt. 27, Jalan Baling	52.40	64.84	0.172	0.104	0.788				
	5704055	Kedah Peak	81.58	106.93	0.200	0.437	0.719				
	5806066	Klinik Jeniang	59.79	72.37	0.165	0.203	0.791				
	5808001	Bt. 61, Jalan Baling	47.50	58.02	0.183	0.079	0.752				
Kedah	6103047	Setor JPS Alor Setar	64.83	87.41	0.168	0.346	0.800				
	6108001	Kompleks Rumah Muda	52.34	73.83	0.173	0.120	0.792				
	6206035	Kuala Nerang	54.85	68.42	0.174	0.250	0.810				
	6207032	Ampang Padu	66.10	74.41	0.177	0.284	0.842				
	6306031	Padang Sanai	60.33	73.94	0.193	0.249	0.829				



Application: Kedah River Basin



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ANALYSIS OUTCOME DESIGNED FLOOD PEAKS – KEDAH RIVER BASIN

				Peak Disch 100-yea	arges (Q _p) ars ARI		
ltem	Time Horizon	Climate Change Factor (CCF)	1-Day Design Rainfall (mm)	Climate Change Scenario Flood Magnitude, Q _p (m ³ /s)	Climate Change Scenario Flood Magnitude Increment (m ³ /s)	Percentage Increase of Flood Magnitude (%)	
Baseline	-	-	241	2048	-	-	
1	2020	1.05	245	2111	63	3.1	
2	2030	1.09	257	2268	220	10.7	
3	2040	1.14	268	2430	382	18.7	
4	2050	1.19	280	2602	554	27.1	
5	2060	1.25	293	2785	737	36.0	





Generated Flood Extent Map Location: Sg Kedah Landuse: Future Rainfall: 2060, 100y ARI

Area for flood depth (km ²)									
0.01 -	0.5 -	\1.2 m	Sum						
0.5 m	1.2 m	>1.2 III	Juin						
50.50	41.55	35.57	127.62						
	Ar 0.01 - 0.5 m 50.50	Area for floor 0.01 - 0.5 - 0.5 m 1.2 m 50.50 41.55	Area for flood depth (km 0.01 - 0.5 - 0.5 m 1.2 m 50.50 41.55						

Legend River Projected Flood Depth (m) 0.0 - 0.5 0.5 - 1.2 >1.2

CONCLUSION

- Current practice of strengthening and empowering the water related sectors through integration and sustainability approach strategies and policies are required to be improved.
- Water system designs, operations and managements to be reviewed and re-established – incorporate CCF in strategic planning and development.
- Impacts of climate change on the country's water related hazards – projected and quantified through CCF.
- CCF determine appropriate adaptation options, measures, and actions.

AHRIN