AWCI Training Course: Rainfall bias correction

Provided by the University of Tokyo

March 11 2011

Three steps

1. Evaluation of models -> selecting suitable ones for the region
2. Downloading model precipitation output of selected models and gap-filling
3. Bias correction of historical simulation precipitation output and future projection precipitation output of selected models – using observed precipitation data

Folder organization

- **Training-2011-03-11-Bias**
  - **Bias_correction**
    - Model_output_gapfill.xls
    - Bias_corr_tmp.xls (Bias_corr_tmp_Indonesia-19years.xls, Bias_corr_tmp_Pakistan-10years.xls, Bias_corr_tmp_Thailand-13years.xls)
    - Bias_corr.doc
  - **Data_observation**
    - 06-Japan_Precipitation_Maebashi.xls (and other basins observation data files)
  - **Model_eval**
    - Scoring_CMIP3_Models.xls
  - **Results** (prepared by UT team)
    - Bias_correction (completed bias correction sheets)
    - Model_eval (completed model evaluation sheets -> model selection)

Step 1: Evaluation of Climate Model Output

- Using an internet-based tool developed by UT – IIS
- Evaluating model performance during past simulation (1981 – 2000) against a reference dataset over a region of interest and/or regions closely climatologically/meteorologically related to the region of interest
- Evaluation is based on selected key meteorological elements

Quantitative Evaluation of AOGCM

***** Pre-release Beta Version *****

1. Intercomparison : Re-analysis/Observation Data vs. CMIP3 Model Output
   - 1-D Plot (time-series)
   - 2-D Plot
   - Vector Diagram
   - Cross-sectional View
     - Longitude-time / Latitude-time
     - Longitude-height / Latitude-height

2-D Plot option for evaluation

2. Comparison of Global Warming Projection between:
   - Climate Models
   - Emission Scenarios --- implementation in progress; only monthly data supported
   - Periods of Analysis Time
     - Monthly data
     - Daily data

3. Tools
   - CMIP3 Daily Data Download
   - Interannual Variations at a Glance
     - 2-D Plot
     - Vector Diagram
     - Cross-sectional View
       - Long/Lat-time
       - Long/Lat-height

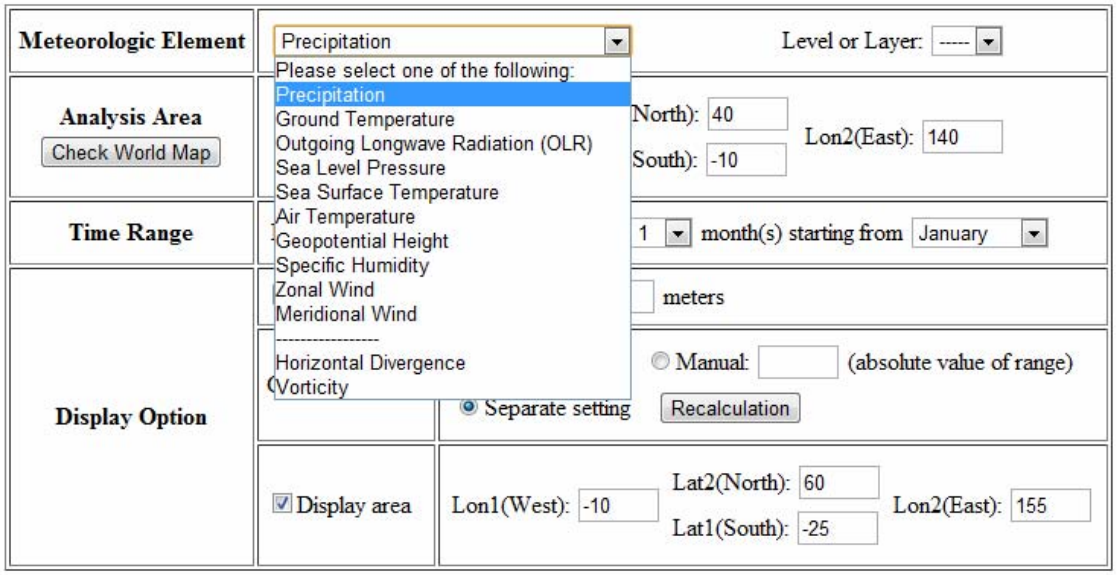
For more details, contact Akio Yamamoto.

Reference Data

Meteorologic Element	Please select one of the following:	Level or Layer: -----
Analysis Area Check World Map	Lon1(West): 40	Lat2(North): 40 Lat1(South): -10 Lon2(East): 140
Time Range	From 1981 To 2000 ; For 1 month(s) starting from January	
Display Option	Maskout the altitude above meters	
	Colorbar for diffs	Max range Manual: (absolute value of range) Separate setting Recalculation
	Display area	Lon1(West): -10 Lat2(North): 60 Lat1(South): -25 Lon2(East): 155

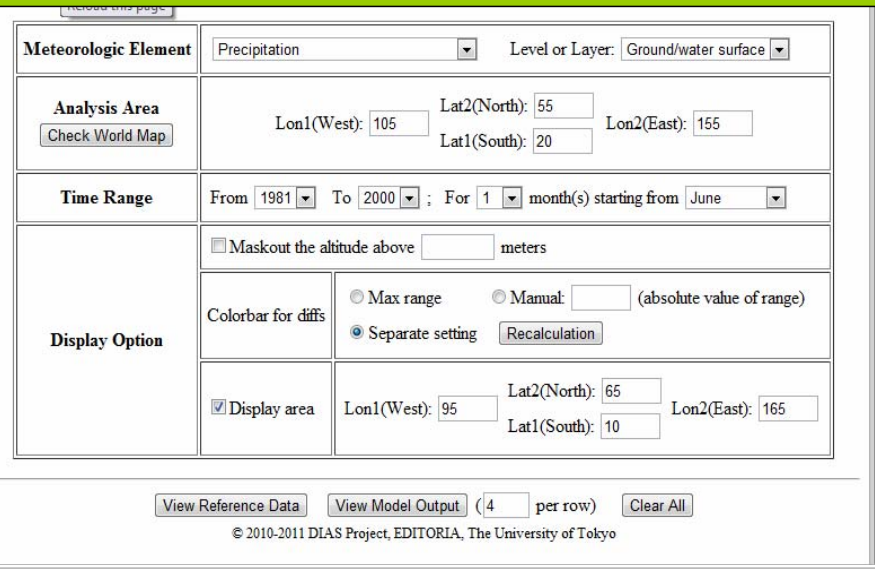
View Reference Data | View Model Output | (3 per row) | Clear All

Model Output: CMIP3



Reference Data

Model Output: CMIP3

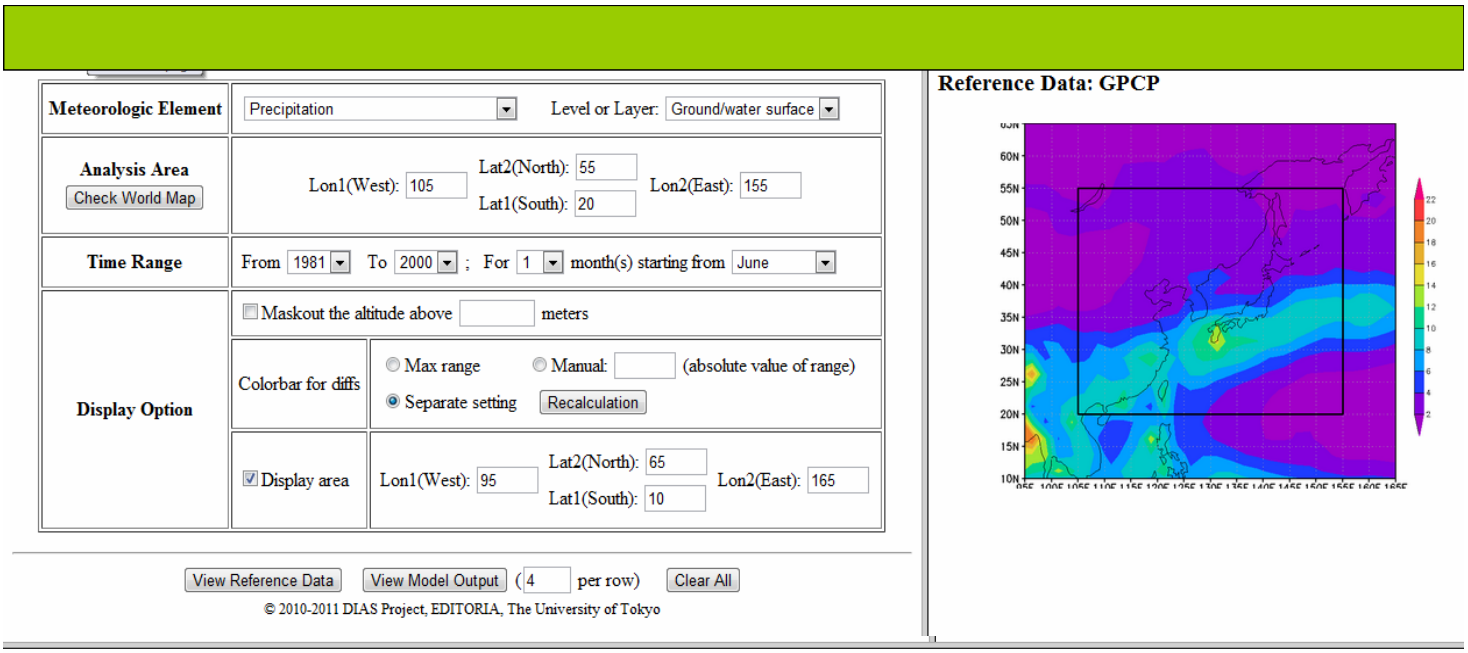


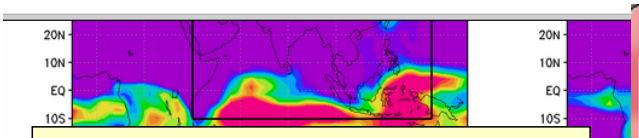
Reference Data: GPCP

Model Output

List of reference datasets for individual meteorological elements

- Precipitation: **GPCP**
- Ground Temperature: **JRA25**
- Outgoing Longwave Radiation: **NOAA**
- Sea Level Pressure: **JRA25**
- Sea Surface Temperature: **HADLEY**
- Air Temperature: **JRA25**
- Geopotential Height: **JRA25**
- Specific Humidity: **JRA25**
- Zonal Wind: **JRA25**
- Meridional wind **JRA25**
- Horizontal divergence: **JRA25**
- Vorticity: **JRA25**





Scroll down the result page to see the summary of analysis results

Summary of Analysis Results Download : CSV file

Model	Scorr	RMSE
bccr_bcm2_0	0.803488	2.55526
cccma_cgcm3_1	0.753476	2.63272
cccma_cgcm3_1_t63	0.707119	2.86139
cnrm_cm3	0.841968	2.69926
csiro_mk3_0	0.815304	2.3014
csiro_mk3_5	0.866608	2.38598
gfdl_cm2_0	0.868471	2.37104
gfdl_cm2_1	0.892548	2.50294
giss_aom	0.731086	3.11295
giss_model_e_h	0.703246	2.72236
giss_model_e_r	0.756397	2.95968
iap_fgoals1_0_g	0.771298	2.48557
ingv_echam4	0.843576	2.09155

Microsoft Excel - pr_Surface_Jan_1981-2000_A(40E-140E,10S-40N)_D(10W-155

File Edit View Insert Format Tools Data Window Help

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	A	B	C	D	E
1	bccr_bcm2_0	0.803488	2.55526		
2	cccma_cgcm3_1	0.753476	2.63272		
3	cccma_cgcm3_1_t63	0.707119	2.86139		
4	cnrm_cm3	0.841968	2.69926		
5	csiro_mk3_0	0.815304	2.3014		
6	csiro_mk3_5	0.866608	2.38598		
7	gfdl_cm2_0	0.868471	2.37104		
8	gfdl_cm2_1	0.892548	2.50294		
9	giss_aom	0.731086	3.11295		
10	giss_model_e_h	0.703246	2.72236		
11	giss_model_e_r	0.756397	2.95968		
12	iap_fgoals1_0_g	0.771298	2.48557		
13	ingv_echam4	0.843576	2.09155		
14	inmcm3_0	0.849952	2.017		
15	ipsl_cm4	0.865569	2.24632		
16	miroc3_2_hires	0.780891	2.82709		
17	miroc3_2_medres	0.825645	2.19177		
18	miub_echo_g	0.888917	1.80879		
19	mpi_echam5	0.854794	2.29265		
20	mri_cgcm2_3_2a	0.82656	1.8486		
21	ncar_ccsm3_0	0.766107	3.03576		
22	ncar_pcm1	0.704558	3.83237		
23	ukmo_hadcm3	0.855597	3.48288		
24	ukmo_hadgem1	0.835898	3.62627		
25					
26					

Limited evaluation during the course

- Due to limited time during the training course, evaluation presented here is based on the following items:
  - Only one region that includes the basin of interest
  - Only two meteorological elements, namely precipitation and geopotential height at 500hPa
  - Only three months (20-year monthly mean values) out of the whole year

Please consider more precise evaluation for the real study (more regions, meteorological parameters, and months)

Evaluation of precipitation element – refer to the excel file: Scoring_CMIP3_Models.xls in the folder **Model_eval**

	Meteorological Element: Precipitation						
		June		July		August	
	model	S_corr	RMSE	S_corr	RMSE	S_corr	RMSE
1	bccr_bcm2_0	0.612577	2.9638	0.641915	3.14939	0.654535	3.04457
2	cccma_cgcm3_1	0.67809	2.80344	0.702107	2.9001	0.705981	2.95936
3	cccma_cgcm3_1_t63	0.668077	2.82739	0.699067	2.92443	0.679764	3.07007
4	cnrm_cm3	0.525991	3.40764	0.616057	3.33114	0.658663	3.10189
5	csiro_mk3_0	0.634887	3.01851	0.701048	2.99784	0.804089	2.35907
6	csiro_mk3_5	0.604204	3.39617	0.637255	3.36531	0.765534	2.62358
7	gfdl_cm2_0	0.699975	2.881	0.764176	2.69764	0.722448	2.97213
8	gfdl_cm2_1	0.745677	2.67032	0.77535	2.70179	0.763758	2.77364
9	giss_aom	0.508475	3.4729	0.606315	3.34358	0.68674	2.94604
10	giss_model_e_h	0.522648	4.00037	0.475727	4.49904	0.450178	4.32617
11	giss_model_e_r	0.479788	3.83325	0.595113	3.79972	0.627638	3.51206
12	iap_fgoals1_0_g	0.2221	3.99231	0.45438	3.68498	0.606514	3.1221
13	ingv_echam4	0.712693	2.73918	0.644567	3.17053	0.718778	2.78949
14	inmcm3_0	0.493076	3.41301	0.555526	3.56882	0.655465	3.0002
15	ipsl_cm4	0.468554	3.56933	0.516445	3.75673	0.626658	3.24568
16	miroc3_2_hires	0.759938	2.6016	0.573135	3.74899	0.566137	3.67448
17	miroc3_2_medres	0.778193	2.40629	0.591421	3.54172	0.53499	3.64249
18	miub_echo_g	0.501836	3.57485	0.621491	3.41304	0.7526	2.53125
19	mpi_echam5	0.700632	3.27375	0.667879	3.54028	0.726193	3.01962
20	mri_cgcm2_3_2a	0.624962	3.32155	0.592236	3.59373	0.64089	3.25602
21	ncar_ccsm3_0	0.586914	3.15148	0.607632	3.33779	0.621849	3.3873
22	ncar_pcm1	0.592746	3.73951	0.510997	4.16259	0.593308	3.61601
23	ukmo_hadcm3	0.602475	3.87233	0.656899	3.7304	0.69017	3.61585
24	ukmo_hadgem1	0.63235	3.66643	0.713683	3.61798	0.747354	3.45026

Scorr and RMSE averaging: 1. Analysis period

2. All models

	Meteorological Element: Precipitation						
		June		July		August	
	model	S_corr	RMSE	S_corr	RMSE	S_corr	RMSE
1	bccr_bcm2_0	0.612577	2.9638	0.641915	3.14939	0.654535	3.04457
2	cccma_cgcm3_1	0.67809	2.80344	0.702107	2.9001	0.705981	2.95936
3	cccma_cgcm3_1_t63	0.668077	2.82739	0.699067	2.92443	0.679764	3.07007
4	cnrm_cm3	0.525991	3.40764	0.616057	3.33114	0.658663	3.10189
5	csiro_mk3_0	0.634887	3.01851	0.701048	2.99784	0.804089	2.35907
6	csiro_mk3_5	0.604204	3.39617	0.637255	3.36531	0.765534	2.62358
7	gfdl_cm2_0	0.699975	2.881	0.764176	2.69764	0.722448	2.97213
8	gfdl_cm2_1	0.745677	2.67032	0.77535	2.70179	0.763758	2.77364
9	giss_aom	0.508475	3.4729	0.606315	3.34358	0.68674	2.94604
10	giss_model_e_h	0.522648	4.00037	0.475727	4.49904	0.450178	4.32617
11	giss_model_e_r	0.479788	3.83325	0.595113	3.79972	0.627638	3.51206
12	iap_fgoals1_0_g	0.2221	3.99231	0.45438	3.68498	0.606514	3.1221
13	ingv_echam4	0.712693	2.73918	0.644567	3.17053	0.718778	2.78949
14	inmcm3_0	0.493076	3.41301	0.555526	3.56882	0.655465	3.0002
15	ipsl_cm4	0.468554	3.56933	0.516445	3.75673	0.626658	3.24568
16	miroc3_2_hires	0.759938	2.6016	0.573135	3.74899	0.566137	3.67448
17	miroc3_2_medres	0.778193	2.40629	0.591421	3.54172	0.53499	3.64249
18	miub_echo_g	0.501836	3.57485	0.621491	3.41304	0.7526	2.53125
19	mpi_echam5	0.700632	3.27375	0.667879	3.54028	0.726193	3.01962
20	mri_cgcm2_3_2a	0.624962	3.32155	0.592236	3.59373	0.64089	3.25602
21	ncar_ccsm3_0	0.586914	3.15148	0.607632	3.33779	0.621849	3.3873
22	ncar_pcm1	0.592746	3.73951	0.510997	4.16259	0.593308	3.61601
23	ukmo_hadcm3	0.602475	3.87233	0.656899	3.7304	0.69017	3.61585
24	ukmo_hadgem1	0.63235	3.66643	0.713683	3.61798	0.747354	3.45026

	Analysis Period	
	S_corr	RMSE
	0.63634233	3.0525867
	0.69539267	2.8876333
	0.68230267	2.94063
	0.600237	3.2802233
	0.71334133	2.7918067
	0.66899767	3.1283533
	0.72886633	2.8502567
	0.761595	2.71525
	0.60051	3.2541733
	0.482851	4.2751933
	0.567513	3.71501
	0.42766467	3.5997967
	0.69201267	2.8997333
	0.56802233	3.3273433
	0.537219	3.5239133
	0.63307	3.34169
	0.634868	3.1968333
	0.625309	3.1730467
	0.69823467	3.2778833
	0.61936267	3.3904333
	0.605465	3.29219
	0.56568367	3.83937
	0.649848	3.7395267
	0.69779567	3.5782233
Total Averag	**0.62885435**	**3.2946292**

	Analysis Period	
	S_corr	RMSE
	0.63634233	3.0525867
	0.69539267	2.8876333
	0.68230267	2.94063
	0.600237	3.2802233
	0.71334133	2.7918067
	0.66899767	3.1283533
	0.72886633	2.8502567
	0.761595	2.71525
	0.60051	3.2541733
	0.482851	4.2751933
	0.567513	3.71501
	0.42766467	3.5997967
	0.69201267	2.8997333
	0.56802233	3.3273433
	0.537219	3.5239133
	0.63307	3.34169
	0.634868	3.1968333
	0.625309	3.1730467
	0.69823467	3.2778833
	0.61936267	3.3904333
	0.605465	3.29219
	0.56568367	3.83933
	0.649848	3.7395267
	0.69779567	3.5782233
Total Averag	0.62885435	3.2946292

Scoring

$Scorr_{model} \geq Scorr_{total\ average} \Rightarrow Index_{Scorr} = \mathbf{1}$

$Scorr_{model} < Scorr_{total\ average} \Rightarrow Index_{Scorr} = \mathbf{0}$

$RMSE_{model} \leq RMSE_{total\ average} \Rightarrow Index_{RMSE} = \mathbf{1}$

$RMSE_{model} > RMSE_{total\ average} \Rightarrow Index_{RMSE} = \mathbf{0}$

$Index_{Scorr} = 1$ and $Index_{RMSE} = 1 \Rightarrow Index_{total} = \mathbf{1}$

$Index_{Scorr} = 1$ and $Index_{RMSE} = 0 \Rightarrow Index_{total} = \mathbf{0}$

$Index_{Scorr} = 0$ and $Index_{RMSE} = 1 \Rightarrow Index_{total} = \mathbf{0}$

$Index_{Scorr} = 0$ and $Index_{RMSE} = 0 \Rightarrow Index_{total} = \mathbf{-1}$

	S_corr Index	RMSE Index	Total Index		Gr To
	1	1	1		
	1	1	1		
	1	1	1		
	0	1	0		
	1	1	1		
	1	1	1		
	1	1	1		
	1	1	1		
	0	1	0		
	0	0	-1		
	0	0	-1		
	0	0	-1		
	1	1	1		
	0	0	-1		
	0	0	-1		
	1	0	0		
	1	1	1		
	0	1	0		
	1	1	1		
	0	0	-1		
	0	1	0		
	0	0	-1		
	1	0	0		
	1	0	0		

Scoring

$Scorr_{model} \geq Scorr_{total\ average} \Rightarrow Index_{Scorr} = \mathbf{1}$

$Scorr_{model} < Scorr_{total\ average} \Rightarrow Index_{Scorr} = \mathbf{0}$

$RMSE_{model} \leq RMSE_{total\ average} \Rightarrow Index_{RMSE} = \mathbf{1}$

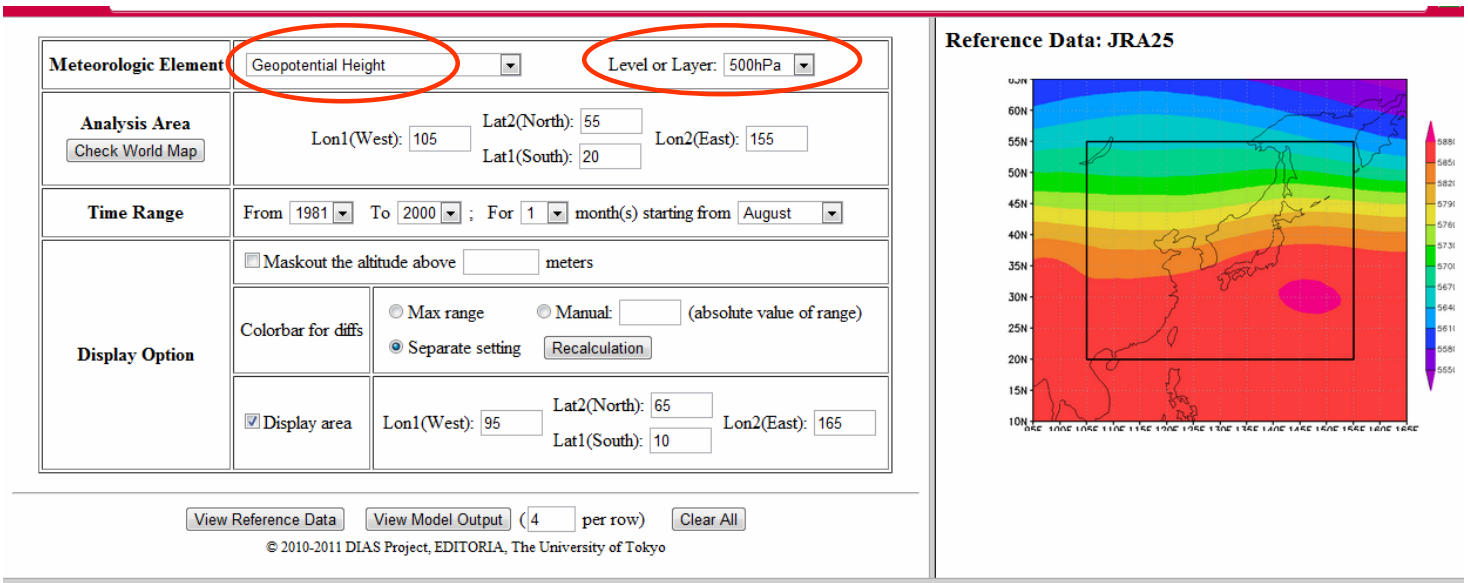
$RMSE_{model} > RMSE_{total\ average} \Rightarrow Index_{RMSE} = \mathbf{0}$

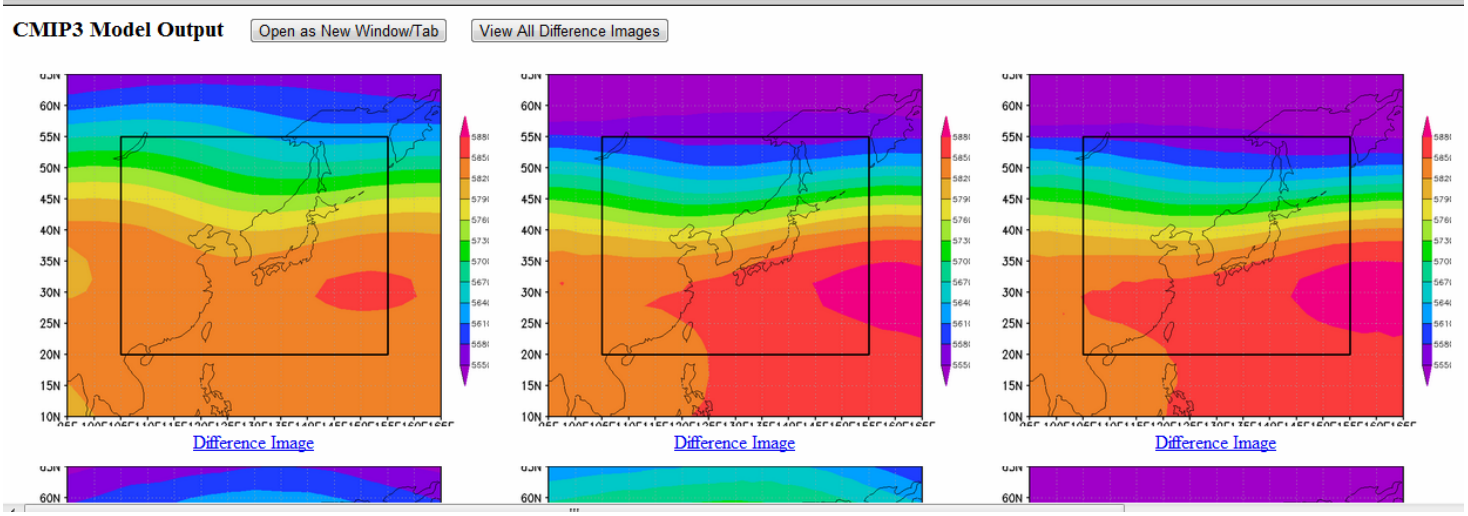
$Index_{Scorr} = 1$ and $Index_{RMSE} = 1 \Rightarrow Index_{total} = \mathbf{1}$

$Index_{Scorr} = 1$ and $Index_{RMSE} = 0 \Rightarrow Index_{total} = \mathbf{0}$

$Index_{Scorr} = 0$ and $Index_{RMSE} = 1 \Rightarrow Index_{total} = \mathbf{0}$

$Index_{Scorr} = 0$ and $Index_{RMSE} = 0 \Rightarrow Index_{total} = \mathbf{-1}$





Meteorological Element: Precipitation

	model	June S_corr	June RMSE	July S_corr	July RMSE	August S_corr	August RMSE	Analysis Period S_corr	Analysis Period RMSE	S_corr Index	RMSE Index	Total Index	Grand Total
1	bccr_bcm2_0	0.61258	2.9638	0.64192	3.14939	0.65454	3.04457	0.636342	3.052587	1	1	1	1
2	cccma_cgcm3_1	0.67809	2.80344	0.70211	2.9001	0.70598	2.95936	0.695393	2.887633	1	1	1	2
3	cccma_cgcm3_1_t63	0.66808	2.82739	0.69307	2.92443	0.67976	3.07007	0.682303	2.94063	1	1	1	2
4	cnrm_cm3	0.52599	3.40764	0.61606	3.33114	0.65866	3.10189	0.600237	3.280223	0	1	0	1
5	csiro_mk3_0	0.63489	3.01851	0.70105	2.99784	0.80409	2.35907	0.713341	2.791807	1	1	1	1
6	csiro_mk3_5	0.6042	3.39617	0.63726	3.36531	0.76553	2.62358	0.668998	3.128353	1	1	1	0
7	gfdl_cm2_0	0.69998	2.881	0.76418	2.69764	0.72245	2.97213	0.728866	2.850257	1	1	1	2
8	gfdl_cm2_1	0.74568	2.67032	0.77535	2.70179	0.76376	2.77364	0.761595	2.71525	1	1	1	2
9	giss_aom	0.50848	3.4729	0.60632	3.34358	0.68674	2.94604	0.60051	3.254173	0	1	0	1
10	giss_model_e_h	0.52265	4.00037	0.47573	4.49304	0.45018	4.32617	0.482851	4.275193	0	0	-1	-2
11	giss_model_e_r	0.47979	3.83325	0.59511	3.79972	0.62764	3.51206	0.567513	3.71501	0	0	-1	-2
12	iap_fgoals1_0_g	0.2221	3.99231	0.45438	3.68498	0.60651	3.1221	0.427665	3.599797	0	0	-1	0
13	ingv_echam4	0.71269	2.73918	0.64457	3.17053	0.71878	2.78949	0.692013	2.899733	1	1	1	1
14	inmcm3_0	0.49308	3.41301	0.55553	3.56882	0.65547	3.0002	0.568022	3.327343	0	0	-1	-2
15	ipsl_cm4	0.46855	3.56933	0.51645	3.75673	0.62666	3.24568	0.537219	3.523913	0	0	-1	-1
16	miroc3_2_hires	0.75994	2.6016	0.57314	3.74899	0.56614	3.67448	0.63307	3.34169	1	0	0	1
17	miroc3_2_medres	0.77819	2.40629	0.59142	3.54172	0.53499	3.64249	0.634868	3.196833	1	1	1	2
18	miub_echo_g	0.50184	3.57485	0.62149	3.41304	0.7526	2.53125	0.625309	3.173047	0	1	0	0
19	mpi_echam5	0.70063	3.27375	0.66788	3.54028	0.72619	3.01962	0.698235	3.277883	1	1	1	2
20	mri_cgcm2_3_2a	0.62496	3.32155	0.59224	3.59373	0.64089	3.25602	0.619363	3.390433	0	0	-1	-1
21	ncar_ccsm3_0	0.58691	3.15148	0.60763	3.33779	0.62185	3.3873	0.605465	3.29219	0	1	0	0
22	ncar_pcm1	0.59275	3.73951	0.511	4.16259	0.59331	3.61601	0.565684	3.83937	0	0	-1	-1
23	ukmo_hadcm3	0.60248	3.87233	0.6569	3.7304	0.69017	3.61585	0.649848	3.739527	1	0	0	1
24	ukmo_hadgem1	0.63235	3.66643	0.71368	3.61798	0.74735	3.45026	0.697796	3.578223	1	0	0	1
							Total Aver	0.62885	3.2946				

Ranking: Model name	Grand Total Index
bccr_bcm2_0	1
cccma_cgcm3_1	2
cccma_cgcm3_1_t63	2
cnrm_cm3	1
csiro_mk3_0	1
csiro_mk3_5	0
gfdl_cm2_0	2
gfdl_cm2_1	2
giss_aom	1
giss_model_e_h	-2
giss_model_e_r	-2
iap_fgoals1_0_g	0
ingv_echam4	1
inmcm3_0	-2
ipsl_cm4	-1
miroc3_2_hires	1
miroc3_2_medres	2
miub_echo_g	0
mpi_echam5	2
mri_cgcm2_3_2a	-1
ncar_ccsm3_0	0
ncar_pcm1	-1
ukmo_hadcm3	1
ukmo_hadgem1	1

Meteorological Element: Geopot. Height (500hPa)

	model	June S_corr	June RMSE	July S_corr	July RMSE	August S_corr	August RMSE	Analysis Period S_corr	Analysis Period RMSE	S_corr Index	RMSE Index	Total Index
1	bccr_bcm2_0	0.92835	42.137	0.68805	38.7503	0.69066	31.2514	0.769018	37.37957	1	0	0
2	cccma_cgcm3_1	0.96034	12.1987	0.82921	14.5219	0.80023	18.0919	0.863257	14.9375	1	1	1
3	cccma_cgcm3_1_t63	0.95057	14.3994	0.83283	15.8524	0.78427	19.6293	0.855891	16.62703	1	1	1
4	cnrm_cm3	0.90104	17.0395	0.67893	18.977	0.66063	18.0058	0.746865	18.00743	1	1	1
5	csiro_mk3_0	0.80627	23.1564	0.6043	23.1591	0.70118	27.1938	0.703915	24.5031	0	1	0
6	csiro_mk3_5	0.88601	63.9483	0.55536	59.6278	0.68586	54.8755	0.709078	59.48387	0	0	-1
7	gfdl_cm2_0	0.94046	31.4908	0.83179	27.3932	0.87713	29.223	0.883127	29.369	1	1	1
8	gfdl_cm2_1	0.92567	24.4431	0.79289	17.2348	0.83797	18.0807	0.852177	19.91953	1	1	1
9	giss_aom	0.93177	13.1936	0.76769	16.0444	0.80164	13.4748	0.833701	14.2376	1	1	1
10	giss_model_e_h	-0.0596	58.0014	-0.089	54.7427	0.02033	52.6278	-0.04274	55.12397	0	0	-1
11	giss_model_e_r	0.02228	62.4547	-0.0987	61.4984	0.05355	57.5357	-0.00763	60.49627	0	0	-1
12	iap_fgoals1_0_g	0.94534	25.5939	0.83552	32.7476	0.70043	29.6172	0.827099	29.31957	1	1	1
13	ingv_echam4	0.89798	44.285	0.79143	46.5454	0.66853	44.3619	0.785983	45.0641	1	0	0
14	inmcm3_0	0.91836	41.0846	0.54528	41.1217	0.4309	39.6705	0.631515	40.6256	0	0	-1
15	ipsl_cm4	0.93275	38.4356	0.62588	39.9597	0.62993	40.5019	0.729519	39.6324	1	0	0
16	miroc3_2_hires	0.94224	9.39756	0.77507	12.7123	0.83326	10.3543	0.850188	10.82139	1	1	1
17	miroc3_2_medres	0.91122	21.0351	0.71776	19.0286	0.77466	22.107	0.801216	20.72357	1	1	1
19	mpi_echam5	0.89361	17.0725	0.7286	16.2374	0.80024	13.6242	0.807485	15.6447	1	1	1
20	mri_cgcm2_3_2a	0.94695	46.519	0.73166	51.0715	0.72191	52.6381	0.800174	50.0762	1	0	0
21	ncar_ccsm3_0	0.95232	43.5029	0.92088	45.0631	0.77055	43.9763	0.88125	44.18077	1	0	0
22	ncar_pcm1	0.82989	22.5139	0.38696	18.9013	0.54189	12.9726	0.586249	18.12927	0	1	0
23	ukmo_hadcm3	0.9263	11.2868	0.79111	12.4782	0.81675	10.68	0.844717	11.48167	1	1	1
24	ukmo_hadgem1	0.94347	19.894	0.84893	21.0376	0.71469	23.4727	0.835696	21.4681	1	1	1
							Total Aver	0.71947	30.315			
18	miub_echo_g	NO	NO	NO	NO	NO	NO					

Sorted: Model name	Grand Total Index
cccma_cgcm3_1	2
cccma_cgcm3_1_t63	2
gfdl_cm2_0	2
gfdl_cm2_1	2
miroc3_2_medres	2
mpi_echam5	2
bccr_bcm2_0	1
cnrm_cm3	1
csiro_mk3_0	1
giss_aom	1
ingv_echam4	1
miroc3_2_hires	1
ukmo_hadcm3	1
ukmo_hadgem1	1
csiro_mk3_5	0
iap_fgoals1_0_g	0
miub_echo_g	0
ncar_ccsm3_0	0
ipsl_cm4	-1
mri_cgcm2_3_2a	-1
ncar_pcm1	-1
giss_model_e_h	-2
giss_model_e_r	-2
inmcm3_0	-2

Precipitation

	model	July S_corr	July RMSE	August S_corr	August RMSE	Analysis Period S_corr	Analysis Period RMSE	S_corr Index	RMSE Index	Total Index	Grand Total
1	bccr_bcm2_0	0.61258	2.9638	0.64192	3.14939	0.65454	3.04457	0.636342	3.052587	1	1	1	1
2	cccma_cgcm3_1	0.67809	2.80344	0.70211	2.9001	0.70598	2.95936	0.695393	2.887633	1	1	1	2
3	cccma_cgcm3_1_t63	0.66808	2.82739	0.69907	2.92443	0.67976	3.07007	0.682303	2.94063	1	1	1	2
4	cnrm_cm3	0.52599	3.40764	0.61606	3.33114	0.65866	3.10189	0.600237	3.280223	0	1	0	1
5	csiro_mk3_0	0.63489	3.01851	0.70105	2.99784	0.80409	2.35907	0.713341	2.791807	1	1	1	1
6	csiro_mk3_5	0.6042	3.39617	0.63726	3.36531	0.76553	2.62358	0.668998	3.128353	1	1	1	0
7	gfdl_cm2_0	0.69998	2.881	0.76418	2.69764	0.72245	2.97213	0.728866	2.850257	1	1	1	2
8	gfdl_cm2_1	0.74568	2.67032	0.77535	2.70179	0.76376	2.77364	0.761595	2.71525	1	1	1	2
9	giss_aom	0.50848	3.4729	0.60632	3.34358	0.68674	2.94604	0.60051	3.254173	0	1	0	1
10	giss_model_e_h	0.52265	4.00037	0.47573	4.49304	0.45018	4.32617	0.482851	4.275193	0	0	-1	-2
11	giss_model_e_r	0.47979	3.83325	0.59511	3.79972	0.62764	3.51206	0.567513	3.71501	0	0	-1	-2
12	iap_fgoals1_0_g	0.2221	3.99231	0.45438	3.68498	0.60651	3.1221	0.427665	3.599797	0	0	-1	0
13	ingv_echam4	0.71269	2.73918	0.64457	3.17053	0.71878	2.78949	0.692013	2.899733	1	1	1	1
14	inmcm3_0	0.49308	3.41301	0.55553	3.56882	0.65547	3.0002	0.568022	3.327343	0	0	-1	-2
15	ipsl_cm4	0.46855	3.56933	0.51645	3.75673	0.62666	3.24568	0.537219	3.523913	0	0	-1	-1
16	miroc3_2_hires	0.75994	2.6016	0.57314	3.74899	0.56614	3.67448	0.63307	3.34169	1	0	0	1
17	miroc3_2_medres	0.77819	2.40629	0.59142	3.54172	0.53499	3.64249	0.634868	3.196833	1	1	1	2
18	miub_echo_g	0.50184	3.57485	0.62149	3.41304	0.7526	2.53125	0.625309	3.173047	0	1	0	0
19	mpi_echam5	0.70063	3.27375	0.66788	3.54028	0.72619	3.01962	0.698235	3.277883	1	1	1	2
20	mri_cgcm2_3_2a	0.62496	3.32155	0.59224	3.59373	0.64089	3.25602	0.619363	3.390433	0	0	-1	-1
21	ncar_ccsm3_0	0.58691	3.15148	0.60763	3.33779	0.62185	3.3873	0.605465	3.29219	0	1	0	0
22	ncar_pcm1	0.59275	3.73951	0.511	4.16259	0.59331	3.61601	0.565684	3.83937	0	0	-1	-1
23	ukmo_hadcm3	0.60248	3.87233	0.6569	3.7304	0.69017	3.61585	0.649848	3.739527	1	0	0	1
24	ukmo_hadgem1	0.63235	3.66643	0.71368	3.61798	0.74735	3.45026	0.697796	3.578223	1	0	0	1
						Total Aver	0.62885	3.2946					

Ranking	
Model name	Grand Total Index
bccr_bcm2_0	1
cccma_cgcm3_1	2
cccma_cgcm3_1_t63	2
cnrm_cm3	1
csiro_mk3_0	1
csiro_mk3_5	0
gfdl_cm2_0	2
gfdl_cm2_1	2
giss_aom	1
giss_model_e_h	-2
giss_model_e_r	-2
iap_fgoals1_0_g	0
ingv_echam4	1
inmcm3_0	-2
ipsl_cm4	-1
miroc3_2_hires	1
miroc3_2_medres	2
miub_echo_g	0
mpi_echam5	2
mri_cgcm2_3_2a	-1
ncar_ccsm3_0	0
ncar_pcm1	-1
ukmo_hadcm3	1
ukmo_hadgem1	1

Geopot. height

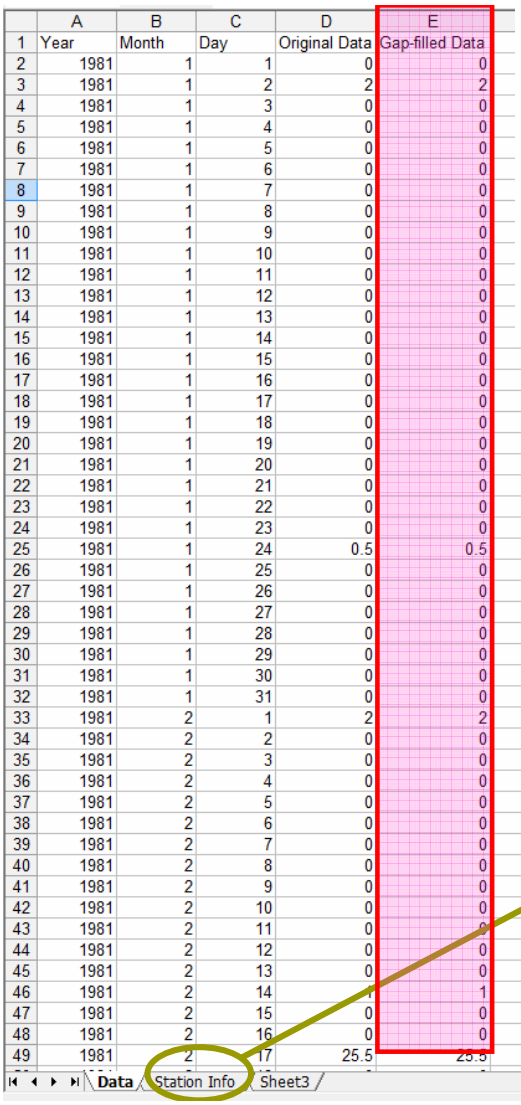
	model	July S_corr	July RMSE	August S_corr	August RMSE	Analysis Period S_corr	Analysis Period RMSE	S_corr Index	RMSE Index	Total Index
1	bccr_bcm2_0	0.92835	42.137	0.68805	38.7503	0.69066	31.2514	0.769018	37.37957	1	0	0
2	cccma_cgcm3_1	0.96034	12.1987	0.82921	14.5219	0.80023	18.0919	0.863257	14.9375	1	1	1
3	cccma_cgcm3_1_t63	0.95057	14.3994	0.83283	15.8524	0.78427	19.6233	0.855831	16.62703	1	1	1
4	cnrm_cm3	0.90104	17.0395	0.67893	18.977	0.66063	18.0058	0.746865	18.00743	1	1	1
5	csiro_mk3_0	0.80627	23.1564	0.6043	23.1591	0.70118	27.1938	0.703915	24.5031	0	1	0
6	csiro_mk3_5	0.88601	63.9483	0.55536	59.6278	0.68586	54.8755	0.709078	59.48387	0	0	-1
7	gfdl_cm2_0	0.94046	31.4908	0.83179	27.3932	0.87713	29.223	0.883127	29.369	1	1	1
8	gfdl_cm2_1	0.92567	24.4431	0.79289	17.2348	0.83797	18.0807	0.852177	19.91953	1	1	1
9	giss_aom	0.93177	13.1936	0.76769	16.0444	0.80164	13.4748	0.833701	14.2376	1	1	1
10	giss_model_e_h	-0.0596	58.0014	-0.089	54.7427	0.02033	52.6278	-0.04274	55.12397	0	0	-1
11	giss_model_e_r	0.02228	62.4547	-0.0987	61.4984	0.05355	57.5357	-0.00763	60.49627	0	0	-1
12	iap_fgoals1_0_g	0.94534	25.5939	0.83552	32.7476	0.70043	29.6172	0.827099	29.31957	1	1	1
13	ingv_echam4	0.89798	44.285	0.79143	46.5454	0.66853	44.3619	0.785983	45.0641	1	0	0
14	inmcm3_0	0.91836	41.0846	0.54528	41.1217	0.4309	39.6705	0.631515	40.6256	0	0	-1
				[illegible]688	39.9597	0.62993	40.5019	0.729519	39.6324	1	0	0
				[illegible]607	12.7123	0.83326	10.3543	0.850188	10.82139	1	1	1
				[illegible]776	19.0286	0.77466	22.107	0.801216	20.72357	1	1	1
19	mpi_echam5	0.89361	17.0725	0.7286	16.2374	0.80024	13.6242	0.807485	15.6447	1	1	1
20	mri_cgcm2_3_2a	0.94695	46.519	0.73166	51.0715	0.72191	52.6381	0.800174	50.0762	1	0	0
21	ncar_ccsm3_0	0.95232	43.5029	0.92088	45.0631	0.77055	43.9763	0.88125	44.18077	1	0	0
22	ncar_pcm1	0.82989	22.5139	0.38696	18.9013	0.54189	12.9726	0.586249	18.12927	0	1	0
23	ukmo_hadcm3	0.9263	11.2868	0.79111	12.4782	0.81675	10.68	0.844717	11.48167	1	1	1
24	ukmo_hadgem1	0.94347	19.894	0.84893	21.0376	0.71469	23.4727	0.835696	21.4681	1	1	1
						Total Aver	0.71947	30.315				
18	miub_echo_g	NO	NO	NO	NO	NO	NO					

Missing model output!

Sorted	
Model name	Grand Total Index
cccma_cgcm3_1	2
cccma_cgcm3_1_t63	2
gfdl_cm2_0	2
gfdl_cm2_1	2
miroc3_2_medres	2
mpi_echam5	2
bccr_bcm2_0	1
cnrm_cm3	1
csiro_mk3_0	1
giss_aom	1
ingv_echam4	1
miroc3_2_hires	1
ukmo_hadcm3	1
ukmo_hadgem1	1
csiro_mk3_5	0
iap_fgoals1_0_g	0
miub_echo_g	0
ncar_ccsm3_0	0
ipsl_cm4	-1
mri_cgcm2_3_2a	-1
ncar_pcm1	-1
giss_model_e_h	-2
giss_model_e_r	-2
inmcm3_0	-2

Step 2: Downloading and correcting the model output

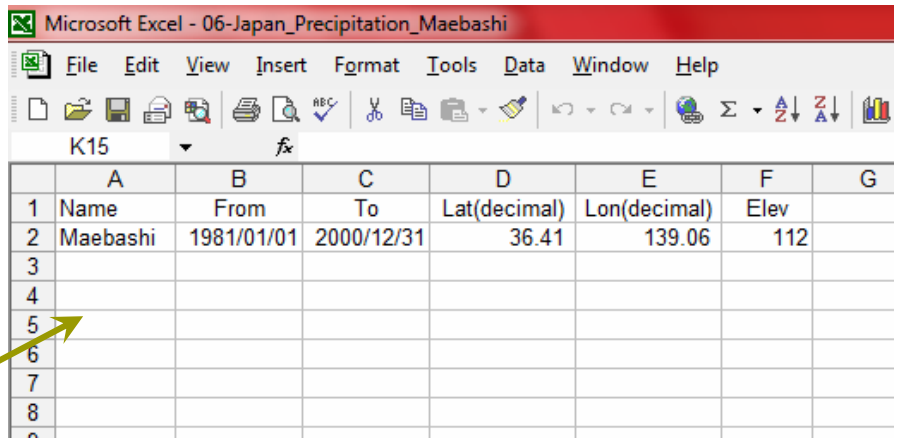
- Using an internet-based tool developed by UT – IIS
- Check the observation data file – coordinates of the selected raingauge *(raingauge selected and data prepared by the UT team in advance; gap filling applied:* ***no data -> 0****)*
- Downloading precipitation data of the selected models and of the grid cell corresponding to the selected raingauge. Both datasets: 20 century experiment and future scenario.
- Gap-filling of the model output data (correcting model calendar).



	A	B	C	D	E
1	Year	Month	Day	Original Data	Gap-filled Data
2	1981	1	1	0	0
3	1981	1	2	2	2
4	1981	1	3	0	0
5	1981	1	4	0	0
6	1981	1	5	0	0
7	1981	1	6	0	0
8	1981	1	7	0	0
9	1981	1	8	0	0
10	1981	1	9	0	0
11	1981	1	10	0	0
12	1981	1	11	0	0
13	1981	1	12	0	0
14	1981	1	13	0	0
15	1981	1	14	0	0
16	1981	1	15	0	0
17	1981	1	16	0	0
18	1981	1	17	0	0
19	1981	1	18	0	0
20	1981	1	19	0	0
21	1981	1	20	0	0
22	1981	1	21	0	0
23	1981	1	22	0	0
24	1981	1	23	0	0
25	1981	1	24	0.5	0.5
26	1981	1	25	0	0
27	1981	1	26	0	0
28	1981	1	27	0	0
29	1981	1	28	0	0
30	1981	1	29	0	0
31	1981	1	30	0	0
32	1981	1	31	0	0
33	1981	2	1	2	2
34	1981	2	2	0	0
35	1981	2	3	0	0
36	1981	2	4	0	0
37	1981	2	5	0	0
38	1981	2	6	0	0
39	1981	2	7	0	0
40	1981	2	8	0	0
41	1981	2	9	0	0
42	1981	2	10	0	0
43	1981	2	11	0	0
44	1981	2	12	0	0
45	1981	2	13	0	0
46	1981	2	14	1	1
47	1981	2	15	0	0
48	1981	2	16	0	0
49	1981	2	17	25.5	25.5

Data | Station Info | Sheet3

- Open the Excel file with the observed precipitation data for the selected station: e.g. **06-Japan_Precipitation_Maebashi.xls**
- Check the "**Station Info**" sheet for the station coordinates and data period



Microsoft Excel - 06-Japan_Precipitation_Maebashi

File Edit View Insert Format Tools Data Window Help

K15

	A	B	C	D	E	F	G
1	Name	From	To	Lat(decimal)	Lon(decimal)	Elev	
2	Maebashi	1981/01/01	2000/12/31	36.41	139.06	112	
3							
4							
5							
6							
7							
8							

Quantitative Evaluation of AOGCM

*** Pre-release Beta Version ***

1. Intercomparison : Re-analysis/Observation Data vs. CMIP3 Model Output
   - 1-D Plot (time-series)
   - 2-D Plot
   - Vector Diagram
   - Cross-sectional View
     - Longitude-time / Latitude-time
     - Longitude-height / Latitude-height

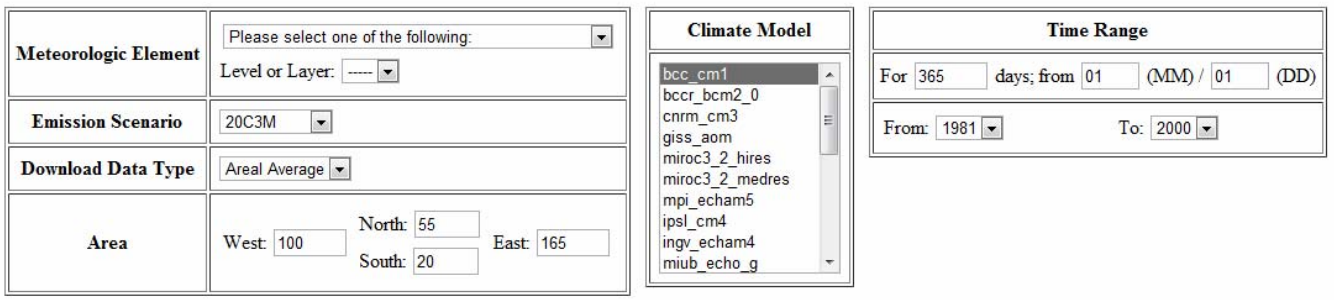
2. Comparison of Global Warming Projection between:
   - Climate Models
   - Emission Scenarios --- implementation in progress; only monthly data supported

   - Periods of Analysis Time
     - Monthly data
     - Daily data

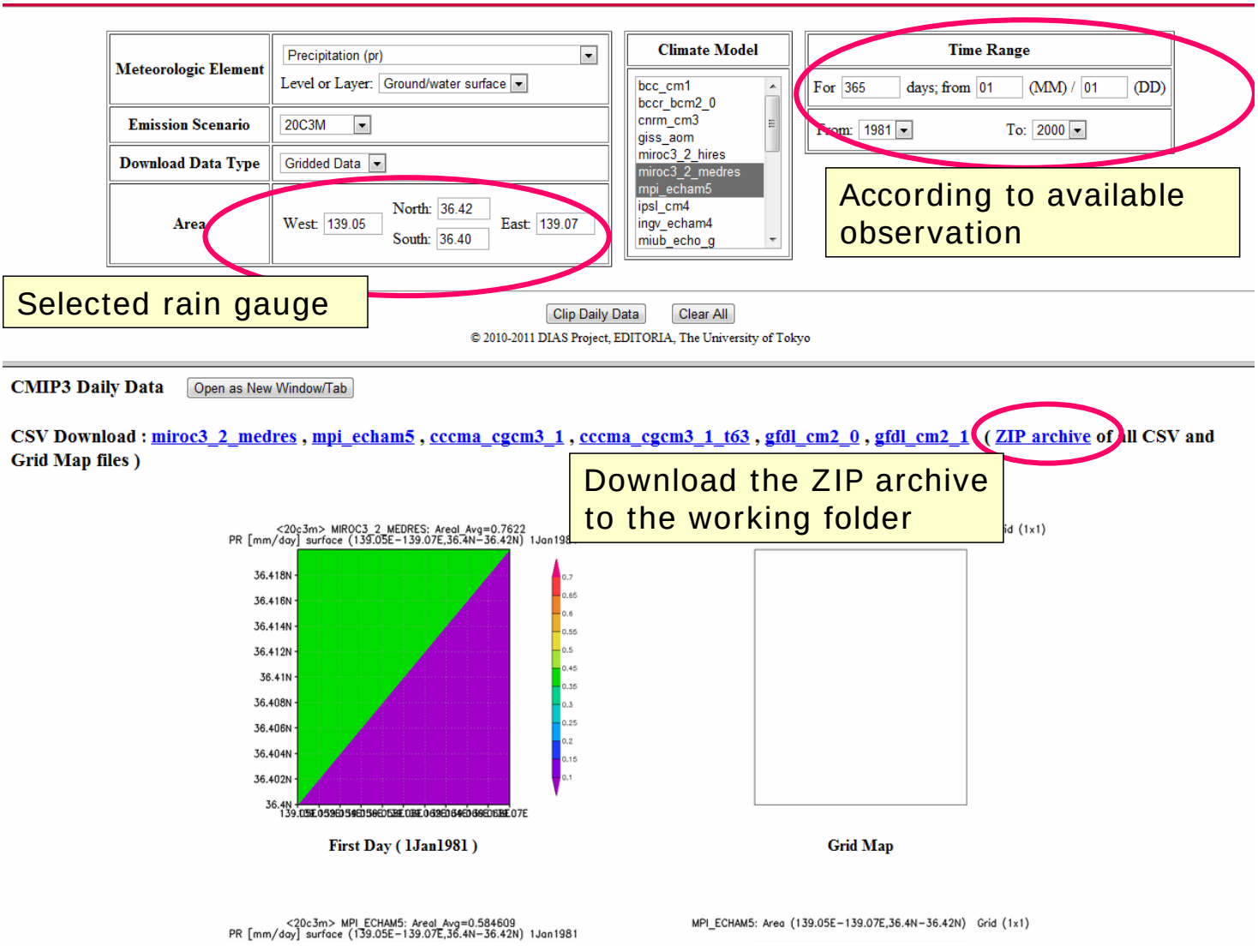
3. Tools
   - CMIP3 Daily Data Download
   - Interannual Variations at a Glance
     - 2-D Plot
     - Vector Diagram
     - Cross-sectional View
       - Long/Lat-time
       - Long/Lat-height

CMIP3 daily data download

For more details, contact Akio Yamamoto.



CMIP3 Daily Data



	A	B	C	D	E
1	time in nc	correct tim	model nam	1 (38 34)	
2	########	1/1/1981	cccma_cg	0.001156	
3	########	2/1/1981	cccma_cg	1.22819	
4	########	3/1/1981	cccma_cg	1.9044	
5	########	4/1/1981	cccma_cg	0.195379	
6	########	5/1/1981	cccma_cg	0.002187	
7	########	6/1/1981	cccma_cg	0.127914	
8	########	7/1/1981	cccma_cg	0.748566	
9	########	8/1/1981	cccma_cg	0.366801	
10	########	9/1/1981	cccma_cg	10.9606	
11	########	10/1/1981	cccma_cg	2.25395	
12	########	11/1/1981	cccma_cg	27.0339	
13	########	12/1/1981	cccma_cg	0.367401	
14	########	13/1/1981	cccma_cg	1.34455	
15	1/12/1980	14/1/1981	cccma_cg	0.366162	
16	2/12/1980	15/1/1981	cccma_cg	0.050405	
17	3/12/1980	16/1/1981	cccma_cg	0.842435	
18	4/12/1980	17/1/1981	cccma_cg	2.26E-05	
19	5/12/1980	18/1/1981	cccma_cg	3.90862	
20	6/12/1980	19/1/1981	cccma_cg	0.507117	
21	7/12/1980	20/1/1981	cccma_cg	0.742456	
22	8/12/1980	21/1/1981	cccma_cg	0.02088	
23	9/12/1980	22/1/1981	cccma_cg	0.493923	
24	########	23/1/1981	cccma_cg	0.873639	
25	########	24/1/1981	cccma_cg	1.4759	
26	########	25/1/1981	cccma_cg	0.489548	
27	########	26/1/1981	cccma_cg	0.887414	
28	########	27/1/1981	cccma_cg	0.049876	
29	########	28/1/1981	cccma_cg	20.0824	
30	########	29/1/1981	cccma_cg	0.584784	
31	########	30/1/1981	cccma_cg	0.403377	
32	########	31/1/1981	cccma_cg	1.10557	
33	########	1/2/1981	cccma_cg	0.314795	
34	########	2/2/1981	cccma_cg	0.419418	
35	########	3/2/1981	cccma_cg	0.368945	
36	########	4/2/1981	cccma_cg	3.77445	
37	########	5/2/1981	cccma_cg	0.449212	
38	########	6/2/1981	cccma_cg	0.61717	
39	########	7/2/1981	cccma_cg	15.3979	
40	########	8/2/1981	cccma_cg	0.138247	
41	########	9/2/1981	cccma_cg	30.5729	
42	########	10/2/1981	cccma_cg	2.43288	
43	########	11/2/1981	cccma_cg	0.048676	
44	########	12/2/1981	cccma_cg	0.803033	
45	########	13/2/1981	cccma_cg	40.1363	
46	1/1/1981	14/2/1981	cccma_cg	0.448283	
47	2/1/1981	15/2/1981	cccma_cg	0.852612	
48	3/1/1981	16/2/1981	cccma_cg	0.746594	
49	4/1/1981	17/2/1981	cccma_cg	1.67163	

cccma_cgcm3_1_pr-grid_surface_A

Correcting the model output for missing values

- Three different “calendars” used by CMIP3 models:
  - “Correct” calendar (365 days, leap years considered)
  - No leap years considered (29 February missing)
  - 360-day year calendar (29 February, 31 May, 31 July, 31 August, 31 October, and 31 December are all missing)
- Observation in the “correct” calendar – we need to adjust those model outputs using different calendars to the “correct” one.

Downloaded file of the ingv_echam4 model

Previous day value replaces the “missing” one

2.14241

Corrected file of the ingv_echam4 model

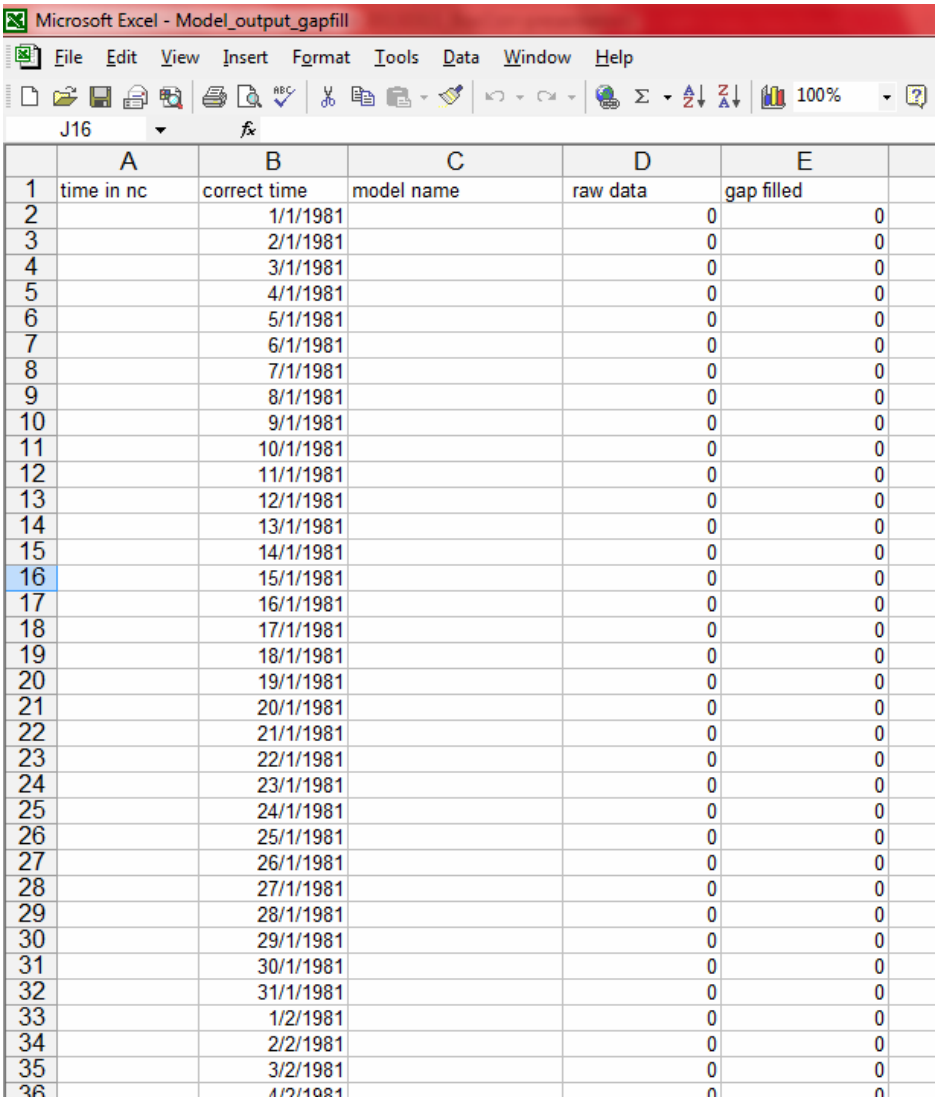
MS Excel formula:

=IF(D670="missing",D669,D670)

1. Please open the file ***Model_output_gapfill.xls***

in the folder ***Bias_correction***

2. Copy and paste the data from the downloaded model output files – expand the sheet for more model outputs



Microsoft Excel - Model_output_gapfill

File Edit View Insert Format Tools Data Window Help

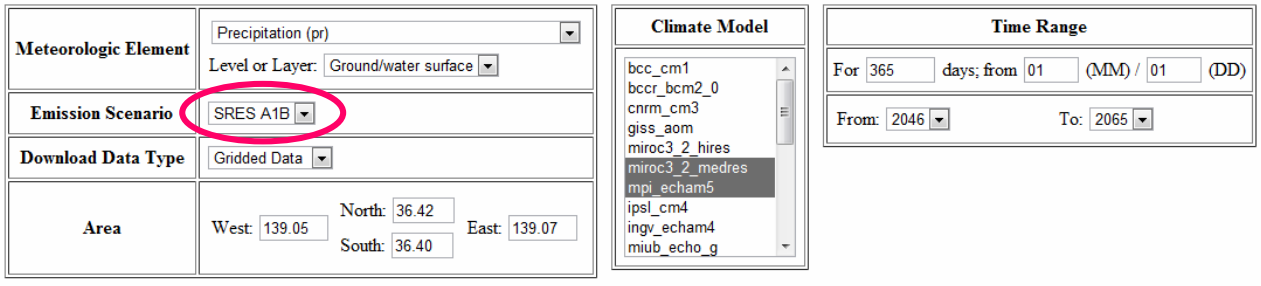
J16

	A	B	C	D	E
1	time in nc	correct time	model name	raw data	gap filled
2		1/1/1981		0	0
3		2/1/1981		0	0
4		3/1/1981		0	0
5		4/1/1981		0	0
6		5/1/1981		0	0
7		6/1/1981		0	0
8		7/1/1981		0	0
9		8/1/1981		0	0
10		9/1/1981		0	0
11		10/1/1981		0	0
12		11/1/1981		0	0
13		12/1/1981		0	0
14		13/1/1981		0	0
15		14/1/1981		0	0
16		15/1/1981		0	0
17		16/1/1981		0	0
18		17/1/1981		0	0
19		18/1/1981		0	0
20		19/1/1981		0	0
21		20/1/1981		0	0
22		21/1/1981		0	0
23		22/1/1981		0	0
24		23/1/1981		0	0
25		24/1/1981		0	0
26		25/1/1981		0	0
27		26/1/1981		0	0
28		27/1/1981		0	0
29		28/1/1981		0	0
30		29/1/1981		0	0
31		30/1/1981		0	0
32		31/1/1981		0	0
33		1/2/1981		0	0
34		2/2/1981		0	0
35		3/2/1981		0	0

Model_output_gapfill.xls

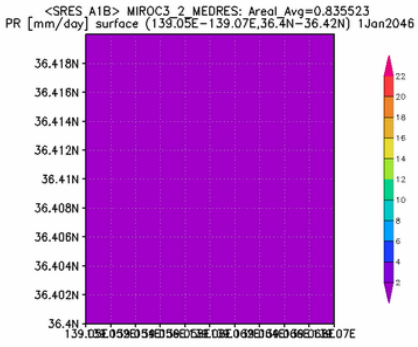
	A	B	C	D	E	F	G	H	I	J	K
	time in nc	correct time	model name	1 (50 34)	gap filled	time in nc	correct time	model name	1 (50 46)	gap filled	time in nc
2	18/11/1980	1/1/1981	cccma_cgcm3_1	0.00115643	**0.00115643**	18/11/1980	1/1/1981	cccma_cgcm3_1_t63	1.9688	**1.9688**	3/12/1980
3	19/11/1980	2/1/1981	cccma_cgcm3_1	1.22819	**1.22819**	19/11/1980	2/1/1981	cccma_cgcm3_1_t63	10.144	**10.144**	4/12/1980
4	20/11/1980	3/1/1981	cccma_cgcm3_1	1.9044	**1.9044**	20/11/1980	3/1/1981	cccma_cgcm3_1_t63	1.43902	**1.43902**	5/12/1980
5	21/11/1980	4/1/1981	cccma_cgcm3_1	0.195379	**0.195379**	21/11/1980	4/1/1981	cccma_cgcm3_1_t63	2.01472	**2.01472**	6/12/1980
6	22/11/1980	5/1/1981	cccma_cgcm3_1	0.0021866	**0.0021866**	22/11/1980	5/1/1981	cccma_cgcm3_1_t63	8.64222	**8.64222**	7/12/1980
7	23/11/1980	6/1/1981	cccma_cgcm3_1	0.127914	**0.127914**	23/11/1980	6/1/1981	cccma_cgcm3_1_t63	6.83988	**6.83988**	8/12/1980
8	24/11/1980	7/1/1981	cccma_cgcm3_1	0.748566	**0.748566**	24/11/1980	7/1/1981	cccma_cgcm3_1_t63	2.49323	**2.49323**	9/12/1980
9	25/11/1980	8/1/1981	cccma_cgcm3_1	0.366801	**0.366801**	25/11/1980	8/1/1981	cccma_cgcm3_1_t63	1.79789	**1.79789**	10/12/1980
10	26/11/1980	9/1/1981	cccma_cgcm3_1	10.9606	**10.9606**	26/11/1980	9/1/1981	cccma_cgcm3_1_t63	17.8008	**17.8008**	11/12/1980
11	27/11/1980	10/1/1981	cccma_cgcm3_1	2.25395	**2.25395**	27/11/1980	10/1/1981	cccma_cgcm3_1_t63	0.664143	**0.664143**	12/12/1980
12	28/11/1980	11/1/1981	cccma_cgcm3_1	27.0339	**27.0339**	28/11/1980	11/1/1981	cccma_cgcm3_1_t63	1.05521	**1.05521**	13/12/1980
13	29/11/1980	12/1/1981	cccma_cgcm3_1	0.367401	**0.367401**	29/11/1980	12/1/1981	cccma_cgcm3_1_t63	1.08372	**1.08372**	14/12/1980
14	30/11/1980	13/1/1981	cccma_cgcm3_1	1.34455	**1.34455**	30/11/1980	13/1/1981	cccma_cgcm3_1_t63	6.23615	**6.23615**	15/12/1980
15	1/12/1980	14/1/1981	cccma_cgcm3_1	0.366162	**0.366162**	1/12/1980	14/1/1981	cccma_cgcm3_1_t63	2.51249	**2.51249**	16/12/1980
16	2/12/1980	15/1/1981	cccma_cgcm3_1	0.0504053	**0.0504053**	2/12/1980	15/1/1981	cccma_cgcm3_1_t63	2.79714	**2.79714**	17/12/1980
17	3/12/1980	16/1/1981	cccma_cgcm3_1	0.842435	**0.842435**	3/12/1980	16/1/1981	cccma_cgcm3_1_t63	1.59868	**1.59868**	18/12/1980
18	4/12/1980	17/1/1981	cccma_cgcm3_1	2.26E-05	**2.2631E-05**	4/12/1980	17/1/1981	cccma_cgcm3_1_t63	2.47582	**2.47582**	19/12/1980
19	5/12/1980	18/1/1981	cccma_cgcm3_1	3.90862	**3.90862**	5/12/1980	18/1/1981	cccma_cgcm3_1_t63	3.44869	**3.44869**	20/12/1980
20	6/12/1980	19/1/1981	cccma_cgcm3_1	0.507117	**0.507117**	6/12/1980	19/1/1981	cccma_cgcm3_1_t63	8.1956	**8.1956**	21/12/1980
21	7/12/1980	20/1/1981	cccma_cgcm3_1	0.742456	**0.742456**	7/12/1980	20/1/1981	cccma_cgcm3_1_t63	2.18615	**2.18615**	22/12/1980
22	8/12/1980	21/1/1981	cccma_cgcm3_1	0.0208802	**0.0208802**	8/12/1980	21/1/1981	cccma_cgcm3_1_t63	7.26239	**7.26239**	23/12/1980
23	9/12/1980	22/1/1981	cccma_cgcm3_1	0.493923	**0.493923**	9/12/1980	22/1/1981	cccma_cgcm3_1_t63	5.21056	**5.21056**	24/12/1980
24	10/12/1980	23/1/1981	cccma_cgcm3_1	0.873639	**0.873639**	10/12/1980	23/1/1981	cccma_cgcm3_1_t63	4.50911	**4.50911**	25/12/1980
25	11/12/1980	24/1/1981	cccma_cgcm3_1	1.4759	**1.4759**	11/12/1980	24/1/1981	cccma_cgcm3_1_t63	5.25168	**5.25168**	26/12/1980
26	12/12/1980	25/1/1981	cccma_cgcm3_1	0.489548	**0.489548**	12/12/1980	25/1/1981	cccma_cgcm3_1_t63	1.4015	**1.4015**	27/12/1980
27	13/12/1980	26/1/1981	cccma_cgcm3_1	0.887414	**0.887414**	13/12/1980	26/1/1981	cccma_cgcm3_1_t63	2.00832	**2.00832**	28/12/1980
28	14/12/1980	27/1/1981	cccma_cgcm3_1	0.0498759	**0.0498759**	14/12/1980	27/1/1981	cccma_cgcm3_1_t63	1.4143	**1.4143**	29/12/1980
29	15/12/1980	28/1/1981	cccma_cgcm3_1	20.0824	**20.0824**	15/12/1980	28/1/1981	cccma_cgcm3_1_t63	1.96477	**1.96477**	30/12/1980
30	16/12/1980	29/1/1981	cccma_cgcm3_1	0.584784	**0.584784**	16/12/1980	29/1/1981	cccma_cgcm3_1_t63	2.33262	**2.33262**	31/12/1980
31	17/12/1980	30/1/1981	cccma_cgcm3_1	0.403377	**0.403377**	17/12/1980	30/1/1981	cccma_cgcm3_1_t63	2.05113	**2.05113**	1/1/1981
32	18/12/1980	31/1/1981	cccma_cgcm3_1	1.10557	**1.10557**	18/12/1980	31/1/1981	cccma_cgcm3_1_t63	4.91068	**4.91068**	2/1/1981
33	19/12/1980	1/2/1981	cccma_cgcm3_1	0.314795	**0.314795**	19/12/1980	1/2/1981	cccma_cgcm3_1_t63	8.57478	**8.57478**	3/1/1981
34	20/12/1980	2/2/1981	cccma_cgcm3_1	0.419418	**0.419418**	20/12/1980	2/2/1981	cccma_cgcm3_1_t63	3.86201	**3.86201**	4/1/1981
35	21/12/1980	3/2/1981	cccma_cgcm3_1	0.368945	**0.368945**	21/12/1980	3/2/1981	cccma_cgcm3_1_t63	0.459304	**0.459304**	5/1/1981
36	22/12/1980	4/2/1981	cccma_cgcm3_1	3.77445	**3.77445**	22/12/1980	4/2/1981	cccma_cgcm3_1_t63	10.0864	**10.0864**	6/1/1981
37	23/12/1980	5/2/1981	cccma_cgcm3_1	0.449212	**0.449212**	23/12/1980	5/2/1981	cccma_cgcm3_1_t63	4.86497	**4.86497**	7/1/1981
38	24/12/1980	6/2/1981	cccma_cgcm3_1	0.61717	**0.61717**	24/12/1980	6/2/1981	cccma_cgcm3_1_t63	3.8959	**3.8959**	8/1/1981
39	25/12/1980	7/2/1981	cccma_cgcm3_1	15.3979	**15.3979**	25/12/1980	7/2/1981	cccma_cgcm3_1_t63	11.0662	**11.0662**	9/1/1981
40	26/12/1980	8/2/1981	cccma_cgcm3_1	0.138247	**0.138247**	26/12/1980	8/2/1981	cccma_cgcm3_1_t63	5.3073	**5.3073**	10/1/1981
41	27/12/1980	9/2/1981	cccma_cgcm3_1	30.5729	**30.5729**	27/12/1980	9/2/1981	cccma_cgcm3_1_t63	3.57788	**3.57788**	11/1/1981

Repeat the same data download procedure for the future scenario

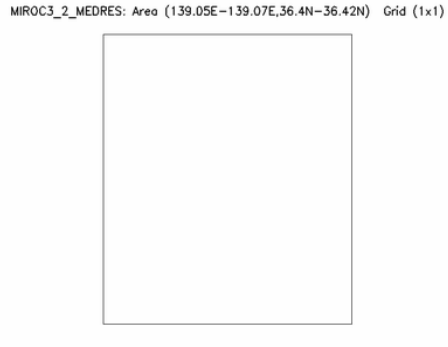


CMIP3 Daily Data Open as New Window/Tab

CSV Download : miroc3_2_medres , mpi_echam5 , cccma_cgcm3_1 , cccma_cgcm3_1_t63 , gfdl_cm2_0 , gfdl_cm2_1 (ZIP archive of all CSV and Grid Map files)



First Day (1Jan2046)

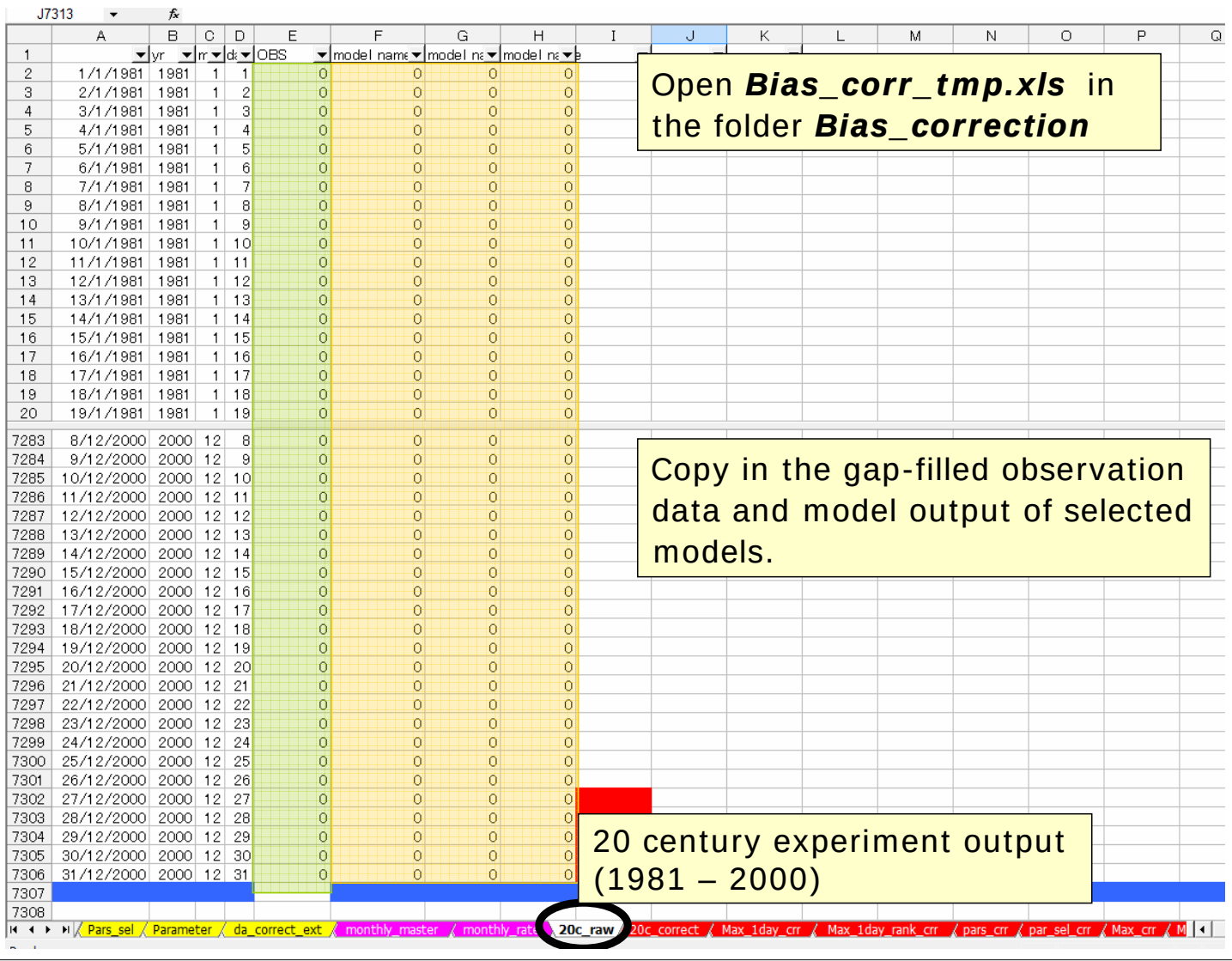


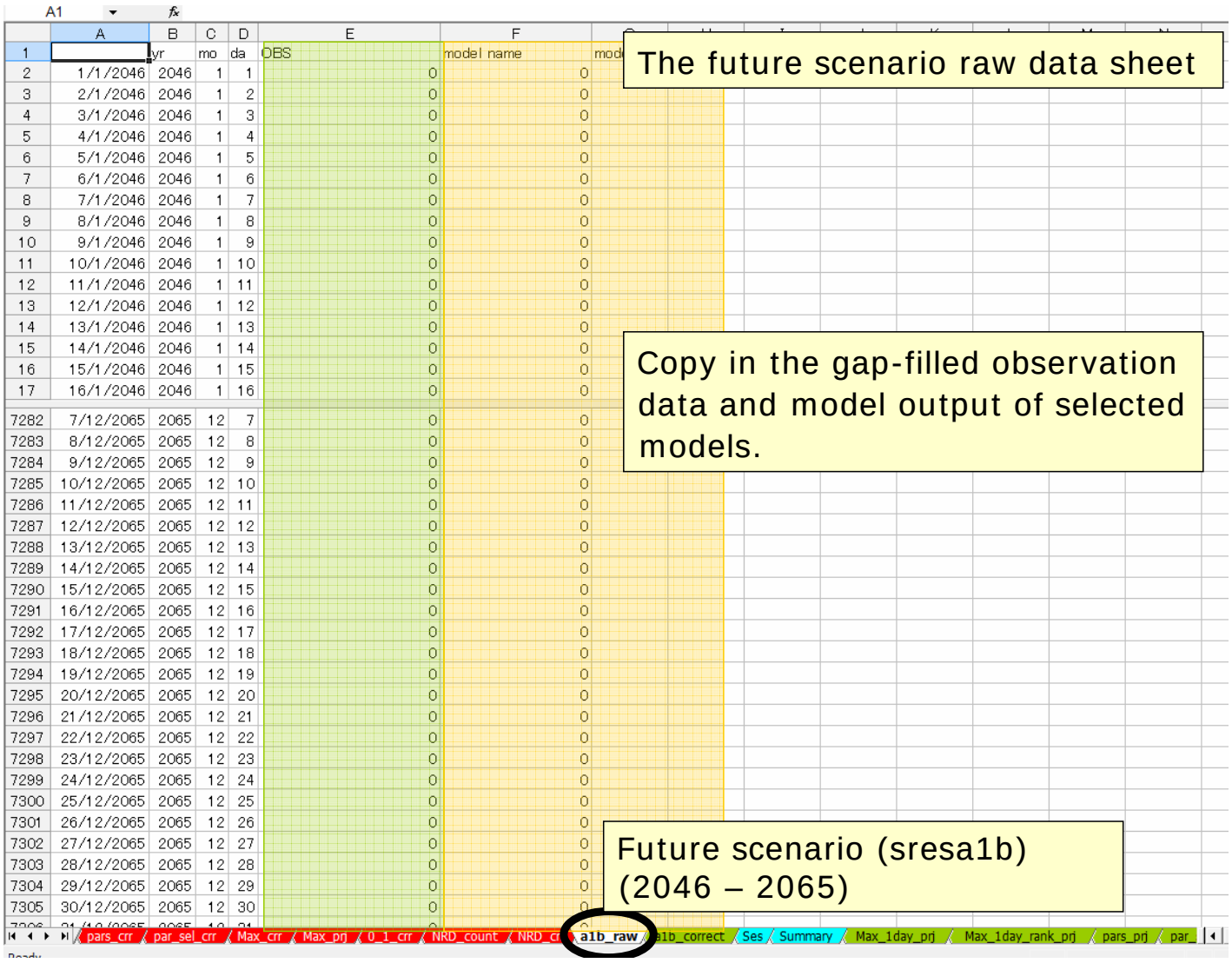
Grid Map

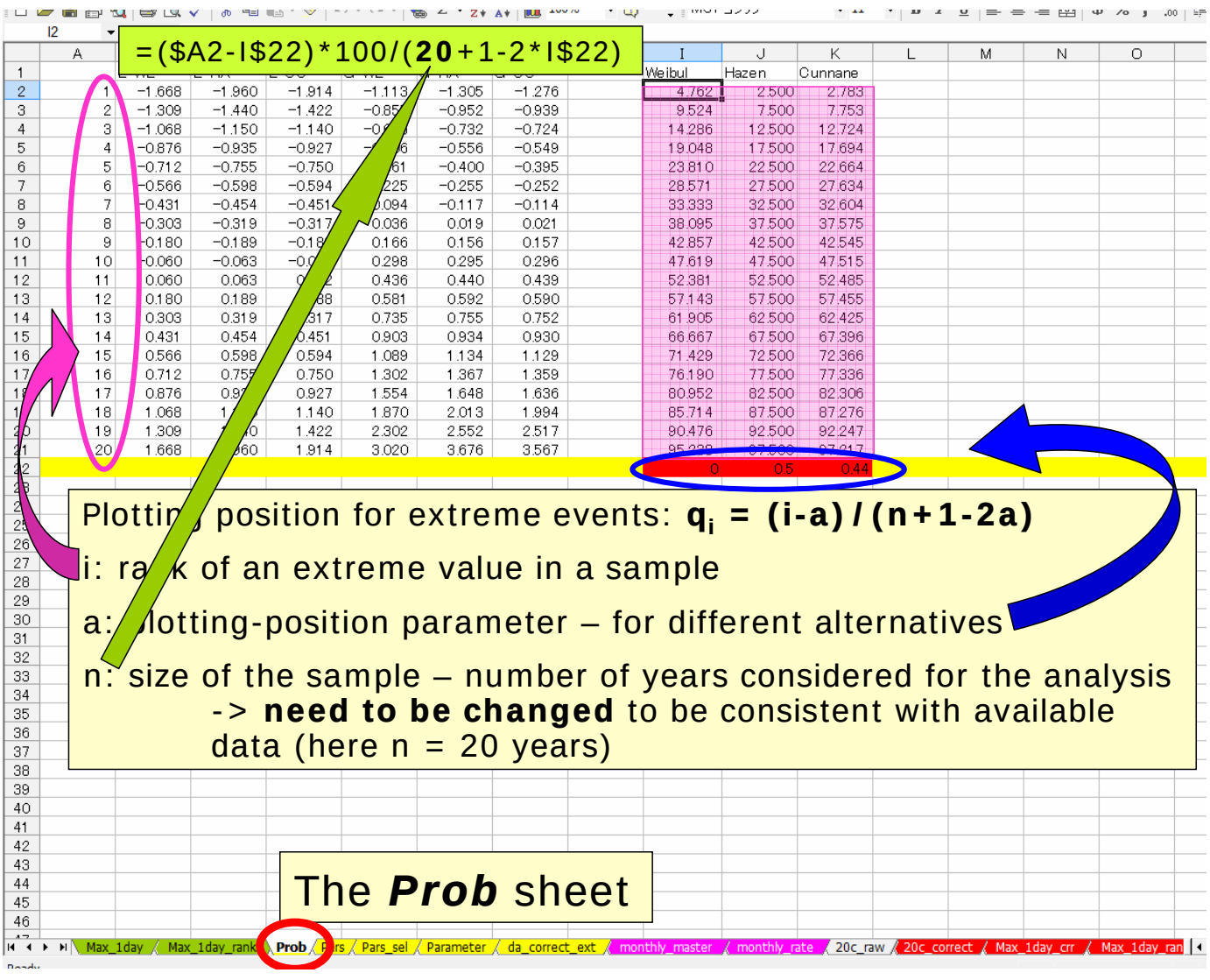
Step 3: Rainfall bias correction

- Using a method developed at UT – available through the prepared MS Excel sheet
- Inputting gap filled observation and model output data into the template sheet
- Reading the corrected model rainfall data output.

- Excel sheet explanation.




The future scenario raw data sheet
Copy in the gap-filled observation data and model output of selected models.
Future scenario (sresa1b) (2046 – 2065)
a1b_raw


=($A2-I$22)*100/(20+1-2*I$22)
Plotting position for extreme events: $q_i = (i-a)/(n+1-2a)$
i: rank of an extreme value in a sample
a: plotting-position parameter – for different alternatives
n: size of the sample – number of years considered for the analysis
-> need to be changed to be consistent with available data (here n = 20 years)
The Prob sheet

E9 =7305-COUNTIF('20c_raw'!E2:E7306,0)+1

	OBS	miroc3_2_h	0	0
a 1	0.03	0.09	#DIV/0!	#DIV/0!
a 2	0.03	0.03	0.03	0.03
b 1	−2.64	−5.22	#DIV/0!	#DIV/0!
b 2	−2.64	−2.64	−2.64	−2.64
bottom	56.50	43.86	0.00	0.00
Rank	55	69	1	1
Norain rank	2306			0

In observed 20yr data, start from 2782th rank is no_rain_day(rainfall = 0)

=7305-COUNTIF('20c_raw'!E2:E7306,0)+1

Need to change total number of days in the analyzed period according to the available data – for finding a rank of no-rain day in observed data and thus determining the no-rain amount in the model output. Here 20 years means 7305 days.

The ***Parameter*** sheet

Max_1day / Max_1day_rank / Prob / Pars / Pars_sel / **Parameter** / da_correct_ext / monthly_master / monthly_rate / 20c_raw / 20c_correct / Max_1day_crr / Max_1day_ran

	A	B	C	D	E	F	G	H	I
1		yr	mo	da	OBS(Maebashi)	miroc3_2_hires	miroc3_2_hires	0	0
2	1/1/1981	1981	1	1	0.00	0.000000	0	0	0
3	2/1/1981	1981	1	2	2.00	0.000000	0	0	
4	3/1/1981	1981	1	3	0.00	0.000000	0	0	
5	4/1/1981	1981	1	4	0.00	5.701959	5.701958749	0	
6	5/1/1981	1981	1	5	0.00	0.000000	0	0	
7	6/1/1981	1981	1	6	0.00	0.000000	0	0	
8	7/1/1981	1981	1	7	0.00	0.000000	0	0	
9	8/1/1981	1981	1	8	0.00	0.000000	0	0	
10	9/1/1981	1981	1	9	0.00	0.000000	0	0	
11	10/1/1981	1981	1	10	0.00	0.000000	0	0	
12	11/1/1981	1981	1	11	0.00	0.000000	0	0	
13	12/1/1981	1981	1	12	0.00	0.000000	0	0	
14	13/1/1981	1981	1	13	0.00	0.000000	0	0	
15	14/1/1981	1981	1	14	0.00	0.000000	0	0	
16	15/1/1981	1981	1	15	0.00	0.000000	0	0	
17	16/1/1981	1981	1	16	0.00	0.000000	0	0	
18	17/1/1981	1981	1	17	0.00	0.000000	0	0	
19	18/1/1981	1981	1	18	0.00	0.000000	0	0	
7281	6/12/2000	2000	12	6	0.00	0.000000	0	0	
7282	7/12/2000	2000	12	7	0.00	0.000000	0	0	
7283	8/12/2000	2000	12	8	0.00	0.000000	0	0	
7284	9/12/2000	2000	12	9	0.00	0.000000	0	0	
7285	10/12/2000	2000	12	10	0.00	0.000000	0	0	
7286	11/12/2000	2000	12	11	0.00	0.000000	0	0	
7287	12/12/2000	2000	12	12	0.00	0.000000	0	0	
7288	13/12/2000	2000	12	13	0.00	0.000000	0	0	
7289	14/12/2000	2000	12	14	0.00	0.202889	0.20288893	0	
7290	15/12/2000	2000	12	15	0.00	0.000000	0	0	
7291	16/12/2000	2000	12	16	0.00	0.000000	0	0	
7292	17/12/2000	2000	12	17	0.00	0.000000	0	0	
7293	18/12/2000	2000	12	18	0.00	0.000000	0	0	
7294	19/12/2000	2000	12	19	0.00	0.000000	0	0	
7295	20/12/2000	2000	12	20	0.00	0.000000	0	0	
7296	21/12/2000	2000	12	21	0.00	0.000000	0	0	
7297	22/12/2000	2000	12	22	0.00	0.000000	0	0	
7298	23/12/2000	2000	12	23	0.00	0.094156	0.094156158	0	
7299	24/12/2000	2000	12	24	0.00	0.000000	0	0	
7300	25/12/2000	2000	12	25	0.50	0.000000	0	0	
7301	26/12/2000	2000	12	26	0.00	0.000000	0	0	
7302	27/12/2000	2000	12	27	0.00	0.000000	0	0	
7303	28/12/2000	2000	12	28	0.00	0.000000	0	0	
7304	29/12/2000	2000	12	29			0	0	
7305	30/12/2000	2000	12	30			0	0	
7306	31/12/2000	2000	12	31			0	0	
7307									

The 20-th century experiment corrected model output

20c_correct sheet

monthly_rate / 20c_raw / **20c_correct** / Max_1day_crr / Max_1day_rank_crr / pars_crr / par_sel_crr / Max_crr / Max_prj / 0_1_crr / NRD_count / NRD_crr / a1b_raw / a1b_c

The future scenario (sres a1b) corrected model output

	A	B	C	D	E	F	G	H	I
1		yr	mo	da	miroc3_2_hires	OBS(Maebashi)	miroc3_2_hires	0.00	0.00
2	1/1/2046	2046	1	1	0.000000	0	0	0	0
3	2/1/2046	2046	1	2	1.762939	2	1.762938562	0	0
4	3/1/2046	2046	1	3	8.037374	0	8.037374053	0	0
5	4/1/2046	2046	1	4	0.000000	0	0	0	0
6	5/1/2046	2046	1	5	1.610385	0	1.610384594	0	0
7	6/1/2046	2046	1	6	10.98917	0	10.98891704	0	0
8	7/1/2046	2046	1	7	0.000000	0	0	0	0
9	8/1/2046	2046	1	8	0.000000	0	0	0	0
10	9/1/2046	2046	1	9	0.000000	0	0	0	0
11	10/1/2046	2046	1	10	0.000000	0	0	0	0
12	11/1/2046	2046	1	11	0.000000	0	0	0	0
13	12/1/2046	2046	1	12	3.166402	0	3.166401527	0	0
14	13/1/2046	2046	1	13	5.602045	0	5.602045019	0	0
15	14/1/2046	2046	1	14	0.000000	0	0	0	0
16	15/1/2046	2046	1	15	0.000000	0	0	0	0
17	16/1/2046	2046	1	16	0.000000	0	0	0	0
18	17/1/2046	2046	1	17	0.000000	0	0	0	0
19	18/1/2046	2046	1	18	0.000000	0	0	0	0
20	19/1/2046	2046	1	19	17.537229	0	17.53722851	0	0
21	20/1/2046	2046	1	20	0.000000	0	0	0	0
7285	10/12/2065	2065	12	10	0.000000	0	0	0	0
7286	11/12/2065	2065	12	11	0.000000	0	0	0	0
7287	12/12/2065	2065	12	12	0.000000	0	0	0	0
7288	13/12/2065	2065	12	13	0.000000	0	0	0	0
7289	14/12/2065	2065	12	14	0.000000	0	0	0	0
7290	15/12/2065	2065	12	15	0.000000	0	0	0	0
7291	16/12/2065	2065	12	16	0.000000	0	0	0	0
7292	17/12/2065	2065	12	17	0.000000	0	0	0	0
7293	18/12/2065	2065	12	18	0.217953	0	0.217953056	0	0
7294	19/12/2065	2065	12	19	0.234716	0	0.2347161	0	0
7295	20/12/2065	2065	12	20	0.000000	0	0	0	0
7296	21/12/2065	2065	12	21	0.000000	0	0	0	0
7297	22/12/2065	2065	12	22	0.000000	0	0	0	0
7298	23/12/2065	2065	12	23	0.000000	0	0	0	0
7299	24/12/2065	2065	12	24	0.000000	0	0	0	0
7300	25/12/2065	2065	12	25	0.000000	0.5	0	0	0
7301	26/12/2065	2065	12	26	0.000000	0	0	0	0
7302	27/12/2065	2065	12	27	0.000000	0	0	0	0
7303	28/12/2065	2065	12	28	0.000000	0	0	0	0
7304	29/12/2065	2065	12	29	0.000000	0	0	0	0
7305	30/12/2065	2065	12	30	0.000000	0	0	0	0
7306	31/12/2065	2065	12	31				0	0
7307									
7308						3.358179329	4.273584843	0	0
7309									

a1b_correct sheet

NRD_count / NRD_crr / a1b_raw / a1b_correct / Ses / Summary / Max_1day_prj / Max_1day_rank_prj / pars_prj / par_sel_prj / 0_1_prj / NRD_count_prj / NRD_crr_prj

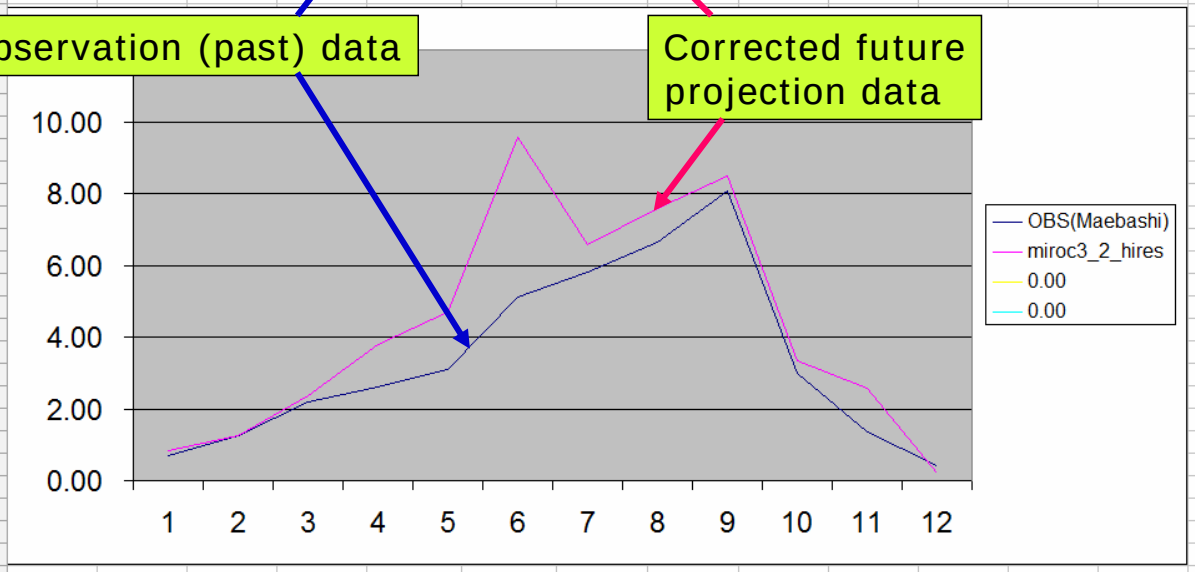
20-year average monthly rainfall comparison: past and future

F2 =SUMPRODUCT((a1b_correct!$C$2:$C$7306=$C2)*a1b_correct!G$2:G$7306)/$B2

	A	B	C	D	E	F	G	
1		days	month		OBS(Maeba	miroc3_2_hi	0.00	
2		620	1		0.70	0.82	0.00	
3		565	2		1.25	1.26	0.00	
4		620	3		2.18	2.35	0.00	
5		600	4		2.61	3.79	0.00	0.00
6		620	5		3.09	4.69	0.00	0.00
7		600	6		5.12	9.57	0.00	0.00
8		620	7		5.82	6.58	0.00	0.00
9		620	8		6.65	7.57	0.00	0.00
10		600	9		8.08	8.50	0.00	0.00
11		620	10		2.98	3.34	0.00	0.00
12		600	11		1.37	2.58	0.00	0.00
13		620	12		0.41	0.20	0.00	0.00

Observation (past) data

Corrected future projection data



Ses sheet

Max_crr / Max_prj / 0_1_crr / NRD_count / NRD_crr / a1b_raw / a1b_correct / Ses / Summary / Max_1day_prj / Max_1day_rank_prj / pars_prj / par_sel_prj / 0_1_prj / NRD

Thank you for your attention

Enjoy your further, self-practice