

# **Robust Multivariate Bias Correction (RoMBC) Package Help**

## **1. Overview**

The Robust Multivariate Bias Correction (RoMBC) package works around a self-evolving strategy and is designed to deal with the distribution and, auto and cross dependence biases in a multivariate time series at multiple time steps. It starts with a simple single timescale univariate bias correction and depending upon the requirement of the data at hand grows into a comprehensive multivariate multi time scale bias correction. The package avoids the need of asking the users to provide the structure of the bias correction model to be applied by choosing the type of bias correction, number of time nesting and type of cross nesting required. RoMBC is a comprehensive package that offers a wide variety of in-built options by including standard quantile matching and other routinely used bias correction approaches in a time and cross dependence nesting.

Similar to other variants of MBC, in RoMBC, distribution behavior of a time series is represented by its empirical distribution. Auto dependence is represented by LAG1 autocorrelation function while cross-dependence is assumed to be a function of LAG0 and LAG1 correlations. The package uses time nesting at daily, monthly, seasonal and annual time scales.

As a basic minimum requirement, the package applies univariate quantile matching (QM) bias correction at daily time scale and variance correction at multiple time scales. Thereafter, it looks for the need of bias correction in the dependence attributes at daily and dependence and distributional attributes at monthly, seasonal and annual time scales following the requirement of the GCM current and future climate data or calibration and validation data.

## **2. Features**

The RoMBC builds on earlier software packages, for example, Multivariate Recursive Nested Bias Correction (MRNBC) and Multivariate Recursive Quantile-matching Nested Bias Correction (MRQNBC), in the form of an R package.

RoMBC is compiled in R and allows applying the flexible bias correction approach in a fairly

simple manner. The package requires all essential information to be provided in the 'basic.dat' file. In addition, four data files are to be prepared and included before running the package. These include observed and raw data files for calibration as well as verification period. It is not necessary to have equal length of data for raw and observed file either for calibration or verification periods. Also, depending upon the requirement, same file can be used for both calibration and verification periods. As the package considers across the variables dependence, it can also be used to maintain observed spatial dependence across multiple locations in the simulations. User can also specify the bias correction statistics plots to be included. The package also allows flexibility of applying bias correction either to daily or to monthly time series. Users are allowed to define their own seasons. Also, there is an option of averaging or aggregating the data as one move from daily to higher time scales (monthly, seasonal and annual). The option of data aggregation is useful when dealing with variables for example, rainfall. In addition to the name of four data files, the 'basic.dat' file also requires information about the number of years of data, number of variables, width of moving window (for calculating daily statistics), physical lower and upper limits on the variables, whether data consider leap years or not and distribution of calendar months in the seasons specified. All the information is provided in a free format, separated by spaces. At present, the package allows use of a maximum of 150 years of daily data, 25 variables, 6 seasons and 31 days wide moving window.

Upon successful completion of the program, 6 output files are generated, two files containing bias corrected time series for calibration and verification periods and four statistics results files, containing important statistics of 1) Observed and Raw data for calibration; 2) observed and raw data for verification; 3) observed and bias corrected data for calibration; and 4) observed and bias corrected data for verification time periods. Some of the important statistics calculated include means, standard deviations, skewness, LAG1 and LAG2 auto correlations, and distribution plots at daily, monthly, seasonal and annual time scales. In case of multiple variables, auto and LAG1 cross correlations are also computed. The package allows the users to look at a few raw and bias corrected statistics either in the form of a table or as plots at multiple time scales of interest. Package also provides plots of empirical distribution of raw and bias corrected time series. A few extreme and spell statistics are also included.

## **2.1 Presentation of Results**

The applicability of the package is demonstrated on four sample datasets, included with the package. These datasets are expected to cover a variety of options included in the package. The first

dataset considers unequal lengths of time series for calibration and verification periods. It considers synthetically generated daily time series 6 variables look very similar to typical atmospheric variables used in downscaling. The second dataset considers equal lengths of observed and GCM data for calibration (current) and verification time periods. It considers 7 atmospheric variables. The third datasets considers observed and AR1 model simulated monthly rainfall at 15 locations over Sydney region. The forth dataset uses daily rainfall at 18 and daily evaporation at 3 locations over Sydney region. It uses Access GCM data for current and future time periods. This dataset is discussed in detail in the paper.

## **2.2 First dataset**

The first dataset consists of synthetic (mimicking reanalysis (observed) and raw GCM) daily time series of 6 (climate variables) with unequal data lengths. 66 years of daily data (from 1881 to 1946) is used for model calibration whereas another subset of 70 years (from 1947 to 2016) is used for model verification. Likewise, a subset of 63 years of raw GCM data (from 1891 to 1953) is used for model calibration and of 61 years (from 1954 to 2014) is used for model verification. Please note that the specification of start and end years are arbitrary and are specified only to account for leap years in the data. Three seasons in a year are considered. Table 1 presents the details of 'basic.dat' file used for this dataset.

Upon successful completion of the bias correction program, package provides four result files showing the statistics of 1) Observed and Raw data for calibration; 2) Observed and raw data for verification; 3) Observed and bias corrected data for calibration; and 4) observed and bias corrected data for verification. The final bias corrected model picked is presented in Table 2. In the table, correction criteria are shown by zeros and ones. A 'one' with star, '1\*', implies that the statistic is directly applied or is 'built in' as a part of model structure. A zero (0) implies bias correction for that statistic is not needed while one (1) implies correction is needed as per the current climate. Negative one (-1) implies that while the correction is needed, application of bias correction to the future climate time series makes the changes significant and therefore the correction is not applied. As data does not change significantly across two time periods, almost full model is picked.

Statistics for the calibration and verification periods are presented in Tables 3 and 4 and plots of a few statistics are presented in Figure 1. Statistics in the Figure 1 are plotted after scaling them so that they lie on the same plot. The bias correction approach performs well in reproducing the statistics of the reanalysis data in the GCM simulations at all time scales during calibration period

(Table 3). It also reproduces well the time distribution of variable at all selected time scales (results not included here). Some biases in the statistics during verification period are noted. Although, SKEW is not modelled explicitly by the model, the bias correction does improve its representation the corrected time series (Table 4).

### 2.3 Second dataset

The second dataset includes four files of equal lengths with daily records of 7 atmospheric variables averaged over Sydney, Australia, obtained from NCEP-reanalysis and CSIRO data bases. A subset of 30 years of records from 1950 to 1979 is considered for model calibration while remaining 30 years from 1980 to 2009 is used for the model verification. The basic information about the data start and end years, number of years of data, file names, number of variables and type of bias correction model are given in ‘basic.dat’ file in a simple text format. Four seasons in a year are considered. Daily GCM data is considered to have fixed 28 days in each February and thus activating the option of fixed days in a month format for GCM calibration and verification datasets. Observed (reanalysis) data sets for calibration and verification periods still follow standard leap year format. More details on the information included in the ‘basic.dat’ file are provided in the Table 5.

Upon successful completion of the bias correction package, four result files containing a few important statistics of the raw and bias corrected data are created. The structure of final bias correction model selected is presented in Table 6. Tables 7 and 8 provide the snapshots of a part of these files for raw and bias corrected data for mean, standard deviation and auto correlation statistics for calibration and verification periods, respectively. Scaled scatter plots of a few important statistics are presented in Figure 2. Raw data (Tables 7a and 8a, Figure 2) exhibits some biases in these statistics. Bias correction model provides near perfect fit for the calibration period and a reasonably good fit for the verification period. Overall, model does a good job in reproducing these statistics during verification period albeit some biases for some variables (Table 8, Figure 2).

The biases noted during verification period are a function of the differences in the behaviour of the observed and raw time series during calibration and verification time periods. RoMBC like any other bias correction model works on the assumption that the biases are stationary and corrects the verification time series for the biases observed in the calibration time period.



## 2.4 Third dataset

The third dataset consists of observed and model simulated monthly rainfall time series. 70 years of observed rainfall records from 1921 to 1990 at 15 locations around Sydney is used for rainfall generation using AR1 model. As generated rainfall comes from a univariate model with order-one dependence, it is not expected to reproduce the observed spatio-temporal dependence in the simulations. Two sample realisations of monthly rainfall, each 70 years in length, are generated from the rainfall generation model. One realisation is used for the calibration of the bias correction model, whereas the second one is used for model verification. The bias correction model selected is a multivariate recursive nested bias correction (MRNBC) model with the option of bias correction in mean, standard deviation, LAG1 auto and LAG0 cross correlations at monthly, seasonal and annual time scales. Two seasons in a year are considered and being rainfall, the time aggregation option is also activated. The structure of 'basic.dat' file used in this example is presented in Table 9 while the structure of the flexible model selected is provided in Table 10. A few basic statistics of the observed, raw and bias corrected data for the calibration and verification periods are presented in Tables 11 and 12 and in the form of scaled scatter plots in Figure 3. As raw data comes from a model which is calibrated using the observed data, there is a good match between means and standard deviations of observed and simulated raw data for calibration and verification time periods (Tables 11a and 12a). However, as expected, auto and cross dependence attributes are not simulated well by the univariate rainfall generation model. Upon examining the current climate data, the bias correction model recognizes that bias correction in dependence attributes is needed. However, upon examination of future climate bias corrected data, it decides to apply only selected dependence related corrections (Figure 3).

## 2.5 Fourth dataset

The fourth dataset is used in the main paper. It considers the area averaged daily rainfall and evaporation of 18 sub-catchments of the Greater Sydney Region. The observed catchment averaged daily time series is formed using gridded data from the Bureau of Meteorology. 30 years of data from 1976-2005 is considered in the analysis. In addition to observed data, daily time series of GCM rainfall and temperature data for 30 years each for current (1976-2005) and future (2069-2099) climates, for 6 GCMs for RCP8.5 scenario over the study region is obtained and interpolated over the 18 sub-catchments. As evaporation was not directly available from these GCMs, a conditional model was developed using observed evaporation and temperature, and daily time series of GCM evaporation was simulated conditional on the GCM temperature for current and future time

periods. Observed gridded temperature was obtained from Bureau of Meteorology, The Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT) dataset which has been developed to monitor climate variability and change in Australia. The dataset provides a daily record of Australian temperatures since 1910 (Trewin, 2018). In total, six GCMs are used in the in the paper. Data of only one example GCM, Access, is included in the data set. The structure of ‘basic.dat’ file used in this example is presented in Table 13 while the structure of the flexible model selected is provided in Table 14. A few basic statistics of the observed, raw and bias corrected data for the calibration and verification periods are presented in Tables 15 and 16 and in the form of scaled scatter plots in Figure 4. Overall, model predicts negligible changes in rainfall and around 20% increase in the evaporation (Table 16, Figure 4).

## **2.6 Input parameters**

In addition to observed and raw data files, user is required to provide other basic information in the ‘basic.dat’ file in a simple free text format with spaces in between them. Each entry in the file is supported by a heading to provide a short description of that entry.

## **3. Technical specifications**

### **Operating system:**

Windows 7/10

### **Essential applications:**

R 3.0.2 (download from <http://cran.r-project.org/bin/windows/base/>)

### **Running the programme:**

Running the programme is simple. In RGui, open the RGui screen and change the working directory to the folder where all files including the RoMBC.r script, are located. Select ‘RoMBC.r’ file and double click on it in order to run it. Alternatively, open the R-Studio and open the ‘RoMBC.r’ file. Now run the file by selecting it and clicking on the run command.

### **Citation:**

Mehrotra and Sharma (2021), A robust alternative for correcting systematic biases in multi-variable climate model simulations, Environ. Model. Software, 139(2021), 105019, <https://doi.org/10.1016/j.envsoft.2021.105019>

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<https://www.sciencedirect.com/science/article/pii/S1364815221000621?dgcid=author>

**Table 1: Structure of ‘basic.dat’ file for example 1 dataset**

```

Information about observed data for calibration
  No of years of data      Start Year
      66                  1881
Observed data file name along with directory path for calibration(if not in the directory where executable is located)
  i:\FMBC_software\Example1\obsC.dat
Information about observed data for validation
  No of years of data      Start Year
      70                  1947
Observed data file name along with directory path for validation(if not in the directory where executable is located)
  i:\FMBC_software\Example1\obsF.dat
Information about raw data used in calibration
  No of years of data      Start Year
      63                  1891
Data file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example1\rawC.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example1\stat_rawc.dat
Bias corrected data file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example1\bcc.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example1\stat_bcc.dat
Information about data used for bias correction - validation
  No of years of data      Start Year
      61                  1954
Data file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example1\rawF.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example1\stat_rawf.dat
Bias corrected data file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example1\bcf.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example1\stat_bcf.dat
Number of variables
  7
Specify time scale of data used 0-daily; 1-monthly
  0
missing number identifier (any number equal to or slightly higher than the defined value is ok)
  -9000.0
Width of one side of moving window for daily data (in days)
  15
option whether data (gcm_cali gcm_vali obs_cali obs_vali) follows a usual leap year format(0), or a fixed days in a month format (1)
  0 0 0 0
Number of seasons in a year
  3
Number of months in each season
  4 4 4
Month numbering assigned to each season (1-Jan, 2-Feb....., 12-Dec)
  1 2 3 4
  5 6 7 8
  9 10 11 12
Option for creation of plots (0:no plots, 1:plots of statistics, 2: plots of empirical distribution as well)
  1
Specify physical lower and upper limits on the variables/locations and aggration criteria
Variable Lower limit Upper limit time scale aggr 0-av, >0 sum threshold indicator threshold
  1          500      1000      0          0          0
  2          2500     4000      0          0          0
  3          -100      100      0          0          0
  4          -100      100      0          0          0
  5          -100      100      0          0          0
  6          -100      100      0          0          0
  7           0        800      1          1          0.30
Information about no of days in a month for Obs_cali Obs_vali GCM_cali GCM_vali
      31 31 31 31
      28 28 28 28
      31 31 31 31
      30 30 30 30
      31 31 31 31
      30 30 30 30
      31 31 31 31
      31 31 31 31
      30 30 30 30
      31 31 31 31
      30 30 30 30
      31 31 31 31

```

**Table 2: RoMBC model structure adopted for example 1 dataset**

Climate variables	Daily						Monthly						Seasonal						Annual					
	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1 C	L1 F
1	1*	1*	1	1	1	1	1*	0	1	1	1	1	1*	0	1	0	1	-1	1*	0	1	0	1	1
2	1*	1*	1	1	1	1	1*	0	1	1	1	1	1*	0	1	0	1	-1	1*	0	1	0	1	1
3	1*	1*	1	1	1	1	1*	0	1	1	1	1	1*	0	1	1	1	-1	1*	0	1	1	1	1
4	1*	1*	1	1	1	1	1*	0	1	1	1	1	1*	0	1	0	1	-1	1*	0	1	0	1	1
5	1*	1*	1	1	1	1	1*	0	1	1	1	1	1*	0	1	1	1	-1	1*	0	1	0	1	1
6	1*	1*	1	1	1	1	1*	0	1	1	1	1	1*	0	1	1	1	-1	1*	0	1	1	1	1
7	1*	1*	1	-1	1	1	1*	0	1	0	1	1	1*	0	1	0	1	-1	1*	0	1	0	1	1

Note: 1\*: Compulsory correction applied; 0: correction not needed; 1: correction required and applied; -1: correction required but can't be applied

Table 3: A few statistics of raw and bias corrected time series for calibration period: dataset 1  
(a) Raw data

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	799.40	805.69	10.542	7.4299	.62870E-01	-.12854	-.11779E-01	-.22238E-01	-.67708	-.54362
2	3084.6	3073.6	13.193	8.4765	.11059	.50794E-01	.39346E-01	-.14441	-.85165	-.24490
3	14.795	16.188	1.7220	.48145	.76639	.82490E-01	.61275	-.47547E-01	-.13596	.12685
4	3.7248	13.765	.88165	1.1297	-.48964E-01	-.23689	.63557E-01	.40442E-01	-.41173	.17587
5	-.98509E-01	1.7502	.67302E-01	.32193	-.13883	-.12418	.23475	-.17527	.44326	.11812
6	-6.7990	-9.1578	.48908	.40696	.42394	.47465E-01	.30411	-.41958	-.15263	-.71371
7	887.47	985.01	201.02	83.676	.21672	.34838	.80311E-01	-.16441E-02	.66522	.21706
Statistics at Seasonal Level										
1	799.38	805.70	17.397	12.741	.99954	.99976	-.12478	-.65324E-01	-.25392E-01	-.15630
2	3084.8	3073.9	30.456	36.732	.99989	.99980	-.30331	-.42270	-.10025	-.19424
3	14.804	16.192	2.1092	.85664	.98923	.99710	.45663	.99414E-02	.16403	.32335
4	3.7131	13.741	1.8144	3.3508	.77211	.92402	-.23691	-.34361	-.40158	-.31950E-01
5	-.96981E-01	1.7321	.18993	2.0910	-.64208E-01	.12503	-.36097	-.44311	-.20454	.29945
6	-6.7846	-9.1417	1.7929	2.2961	.90707	.91262	-.38030	-.44559	-.20932	-.53133
7	295.82	328.34	140.79	56.526	.78577	.96836	-.60404E-01	-.17793	.96754	.28439
Statistics at Monthly Level										
1	799.43	805.70	26.792	24.580	.42446	.39699	.23920	.72657E-01	-.27991E-01	-.16701
2	3084.8	3073.8	39.296	45.252	.55487	.71762	.32193	.37708	-.36819	-.59164
3	14.799	16.193	2.6909	1.6979	.48684	.12926E-01	.33767	.41860E-01	.28140	.71638E-01
4	3.7081	13.740	2.6834	4.5095	.40959	.51490	.21202	.23404	.14113	.27600
5	-.97095E-01	1.7364	.26000	2.6064	.55019	.71750	.30841	.37587	-.45568	.34304
6	-6.7856	-9.1526	2.4328	3.1765	.62998	.68015	.34905	.36055	.44128	.28678
7	73.860	82.061	65.708	24.005	.97445E-01	.21818	-.15371E-02	.72933E-01	2.0688	.54541
Statistics at Daily Level										
1	799.40	805.69	53.653	50.347	.80070	.72517	.51085	.37853	-.26637	-.32212
2	3084.6	3073.6	65.999	64.529	.84539	.83993	.61417	.62909	-.57220	-.67300
3	14.796	16.188	7.8458	7.1405	.36528	.31682	.12927	.36456E-01	.64827	.23459
4	3.7249	13.766	5.9554	8.7603	.66245	.69140	.37797	.39626	.19452	.41635
5	-.98530E-01	1.7505	.54695	4.1441	.65920	.67425	.36271	.46986	-.41660	.26120
6	-6.7990	-9.1581	4.8965	5.7430	.62386	.64095	.34524	.36708	.14528	.20862
7	2.4300	2.6970	6.9734	2.7321	.43824	.32296	.16406	.11628	6.6146	2.2250

(b) Bias corrected

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	799.40	799.47	10.542	10.921	.62870E-01	.94025E-01	-.11779E-01	.12730	-.67708	-.13186
2	3084.6	3084.7	13.193	13.999	.11059	.10670	.39346E-01	.68580E-01	-.85165	.14052
3	14.795	14.807	1.7220	1.8423	.76639	.69179	.61275	.46890	-.13596	.21764
4	3.7248	3.7337	.88165	.72924	-.48964E-01	-.26734	.63557E-01	.79405E-01	-.41173	-.25631
5	-.98509E-01	-.97579E-01	.67302E-01	.42164E-01	-.13883	-.56019E-02	.23475	-.22096E-01	.44326	-.40563
6	-6.7990	-6.7926	.48908	.45128	.42394	.31172	.30411	.73994E-01	-.15263	-.17513
7	887.47	895.89	201.02	192.74	.21672	.12704	.80311E-01	.70572E-01	.66522	.18868
Statistics at Seasonal Level										
1	799.38	799.45	17.397	18.043	.99954	.99950	-.12478	-.53760E-01	-.25392E-01	-.11588
2	3084.8	3084.9	30.456	30.872	.99989	.99989	-.30331	-.27840	-.10025	-.10475
3	14.804	14.815	2.1092	2.4023	.98923	.98513	.45663	.39250	.16403	.55310
4	3.7131	3.7222	1.8144	1.7106	.77211	.77951	-.23691	-.36858	-.40158	-.27911
5	-.96981E-01	-.96050E-01	.18993	.18504	-.64208E-01	-.12865	-.36097	-.38060	-.20454	-.34562
6	-6.7846	-6.7780	1.7929	1.8232	.90707	.90336	-.38030	-.39037	-.20932	-.48721
7	295.82	298.63	140.79	133.29	.78577	.80986	-.60404E-01	-.10900	.96754	.76390
Statistics at Monthly Level										
1	799.43	799.49	26.792	26.890	.42446	.43067	.23920	.24542	-.27991E-01	.11720
2	3084.8	3084.9	39.296	39.093	.55487	.57814	.32193	.33875	-.36819	-.37185
3	14.799	14.811	2.6909	3.1265	.48684	.52987	.33767	.32527	.28140	.38893
4	3.7081	3.7156	2.6834	2.3948	.40959	.47244	.21202	.23919	.14113	.86905E-01
5	-.97095E-01	-.96270E-01	.26000	.24704	.55019	.58339	.30841	.31481	-.45568	-.39871
6	-6.7856	-6.7811	2.4328	2.4396	.62998	.65596	.34905	.33665	.44128	.22299
7	73.860	74.637	65.708	64.043	.97445E-01	.63531E-01	-.15371E-02	-.25524E-01	2.0688	1.4488
Statistics at Daily Level										
1	799.40	799.47	53.653	53.639	.80070	.74783	.51085	.45324	-.26637	-.26086
2	3084.6	3084.7	65.999	65.973	.84539	.80748	.61417	.55720	-.57220	-.56874
3	14.796	14.806	7.8458	7.8578	.36528	.35952	.12927	.14774	.64827	.25708
4	3.7249	3.7337	5.9554	5.9586	.66245	.55712	.37797	.25610	.19452	.60485
5	-.98530E-01	-.97543E-01	.54695	.54718	.65920	.58930	.36271	.35344	-.41660	-.39985
6	-6.7990	-6.7928	4.8965	4.8977	.62386	.61448	.34524	.33244	.14528	.15083
7	2.4300	2.4530	6.9734	7.1307	.43824	.38426	.16406	.16525	6.6146	6.8261

Table 4: A few statistics of raw and bias corrected time series for verification period: dataset 1

## (a) Raw data

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	801.50	805.92	10.283	6.9144	.11100	-.13996	-.65297E-02	-.64731E-01	-.69523	-.65363
2	3086.4	3073.9	13.095	7.8885	.17648	.58347E-02	.64109E-01	-.18070	-.86594	-.29494
3	17.175	16.193	1.8802	.45871	.78198	.84011E-01	.59589	-.47478E-01	-.97254E-01	.15780
4	5.5408	13.826	.08068	1.0746	-.89283E-01	-.24324	-.32667E-01	-.92760E-02	-.48679	.11915
5	.67280E-02	1.7746	.66921E-01	.31893	-.15098	-.13928	.13901	-.21219	.61315	-.31644E-01
6	-6.5318	-9.1293	.48091	.40072	.46181	-.12857E-01	.30362	-.35265	-.15479	-.71785
7	1034.3	965.64	282.16	77.046	.15706	.32043	.54365E-01	.90377E-01	.41021	-.46695E-01
Statistics at Seasonal Level										
1	801.48	805.93	16.908	12.384	.99958	.99977	-.11422	-.72344E-01	-.21166E-01	-.14879
2	3086.6	3074.2	30.728	36.510	.99989	.99980	-.30497	-.43185	-.72179E-01	-.18651
3	17.183	16.197	2.2564	.84371	.99168	.99703	.50499	-.39717E-01	.29060	.29663
4	5.5293	13.801	1.8234	3.3770	.08629	.92333	-.23685	-.33838	-.41845	-.12336E-01
5	.82582E-02	1.7566	.19212	2.0910	-.33127	.13613	-.36604	-.44240	-.18635	.29925
6	-6.5168	-9.1130	1.8441	2.3064	.89452	.91152	-.38329	-.44316	-.16383	-.52089
7	344.77	321.88	155.89	62.215	.83799	.95617	-.70795E-01	-.22035	.89083	.34466
Statistics at Monthly Level										
1	801.49	805.96	26.498	24.293	.41758	.38807	.22793	.63796E-01	-.24743E-01	-.85187E-01
2	3086.5	3074.1	39.336	44.838	.56323	.71479	.31907	.37629	-.31270	-.58565
3	17.178	16.194	2.7977	1.6762	.52306	-.23667E-02	.38124	.60236E-01	.39952	.49144E-01
4	5.5274	13.799	2.6862	4.5468	.41864	.51733	.22373	.23026	.20236	.26496
5	.78922E-02	1.7612	.26453	2.6074	.54484	.71584	.30430	.37498	-.50771	.33287
6	-6.5194	-9.1250	2.4788	3.1708	.64101	.68655	.35254	.36308	.42072	.28071
7	86.263	80.457	72.284	24.579	.82450E-01	.25562	.86015E-01	.11867	1.7117	.62554
Statistics at Daily Level										
1	801.50	805.93	53.419	50.289	.80208	.72397	.51172	.37665	-.26487	-.32320
2	3086.4	3073.9	65.847	64.415	.84730	.83823	.61718	.62506	-.56516	-.68177
3	17.174	16.193	7.6448	7.1429	.38719	.31695	.14718	.33566E-01	.70504	.22336
4	5.5411	13.826	5.8318	8.7867	.69734	.69418	.39976	.40022	.19833	.42556
5	.67028E-02	1.7747	.54598	4.1434	.67625	.67707	.37617	.47406	-.41558	.26704
6	-6.5322	-9.1297	4.9168	5.7239	.62698	.64249	.35067	.36815	.16968	.21137
7	2.8318	2.6438	8.2521	2.6772	.43572	.31402	.14636	.11768	6.6261	2.0999

## (b) Bias corrected

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	799.40	799.47	10.542	10.921	.62870E-01	.94025E-01	-.11779E-01	.12730	-.67708	-.13186
2	3084.6	3084.7	13.193	13.999	.11059	.10670	.39346E-01	.68580E-01	-.85165	.14052
3	14.795	14.807	1.7220	1.8423	.76639	.69179	.61275	.46890	-.13596	.21764
4	3.7248	3.7337	.88165	.72924	-.48964E-01	-.26734	.63557E-01	.79405E-01	-.41173	-.25631
5	-.98509E-01	-.97579E-01	.67302E-01	.42164E-01	-.13883	-.56019E-02	.23475	-.22096E-01	.44326	-.48563
6	-6.7990	-6.7926	.48908	.45128	.42394	.31172	.30411	.73994E-01	-.15263	-.17513
7	887.47	895.89	201.02	192.74	.21672	.12704	.80311E-01	.70572E-01	.66522	.18868
Statistics at Seasonal Level										
1	799.38	799.45	17.397	18.043	.99954	.99950	-.12478	-.53760E-01	-.25392E-01	-.11588
2	3084.8	3084.9	30.456	30.872	.99989	.99989	-.30331	-.27840	-.10025	-.10475
3	14.804	14.815	2.1092	2.4023	.98923	.98513	.45663	.39250	.16403	.55310
4	3.7131	3.7222	1.8144	1.7106	.77211	.77951	-.23691	-.36858	-.40158	-.27911
5	-.96981E-01	-.96050E-01	.18993	.18504	-.64208E-01	-.12865	-.36097	-.38060	-.20454	-.34562
6	-6.7846	-6.7780	1.7929	1.8232	.90707	.90336	-.38030	-.39037	-.20932	-.48721
7	295.82	298.63	140.79	133.29	.78577	.80986	-.60404E-01	-.10900	.96754	.76390
Statistics at Monthly Level										
1	799.43	799.49	26.792	26.890	.42446	.43067	.23920	.24542	-.27991E-01	.11720
2	3084.8	3084.9	39.296	39.093	.55487	.57814	.32193	.33875	-.36819	-.37185
3	14.799	14.811	2.6909	3.1265	.48684	.52987	.33767	.32527	.28140	.38893
4	3.7081	3.7156	2.6834	2.3948	.40959	.47244	.21202	.23919	.14113	.06905E-01
5	-.97095E-01	-.96270E-01	.26000	.24704	.55019	.58339	.30841	.31481	-.45568	-.39871
6	-6.7856	-6.7811	2.4328	2.4396	.62998	.65596	.34905	.33665	.44128	.22299
7	73.860	74.637	65.708	64.043	.97445E-01	.63531E-01	-.15371E-02	-.25524E-01	2.0688	1.4488
Statistics at Daily Level										
1	799.40	799.47	53.653	53.639	.80070	.74783	.51085	.45324	-.26637	-.26086
2	3084.6	3084.7	65.999	65.973	.84539	.80748	.61417	.55720	-.57220	-.56874
3	14.796	14.806	7.8458	7.8578	.36528	.35952	.12927	.14774	.64827	.65785
4	3.7249	3.7337	5.9554	5.9586	.66245	.55712	.37797	.25610	.19452	.20408
5	-.98530E-01	-.97543E-01	.54695	.54718	.65920	.58930	.36271	.35344	-.41660	-.39985
6	-6.7990	-6.7928	4.8965	4.8977	.62386	.61448	.34524	.33244	.14528	.15083
7	2.4300	2.4530	6.9734	7.1307	.43824	.38426	.16406	.16525	6.6146	6.8261

Table 5: Structure of ‘Basic.dat’ file for dataset 2

```

Information about observed data for calibration
  No of years of data      Start Year
      30                  1950
Observed data file name along with directory path for calibration(if not in the directory where executable is located)
  i:\FMBC_software\Example2\obs_cali.dat
Information about observed data for validation
  No of years of data      Start Year
      30                  1980
Observed data file name along with directory path for validation(if not in the directory where executable is located)
  i:\FMBC_software\Example2\obs_vali.dat
Information about raw data used in calibration
  No of years of data      Start Year
      30                  1950
Data file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example2\gcm_raw_cali.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example2\stat_raw_cali.dat
Bias corrected data file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example2\gcm_bc_cali.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example2\stat_bc_cali.dat
Information about data used for bias correction - validation
  No of years of data      Start Year
      30                  1980
Data file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example2\gcm_raw_vali.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example2\stat_raw_vali.dat
Bias corrected data file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example2\gcm_bc_vali.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  i:\FMBC_software\Example2\stat_bc_vali.dat
Number of variables
  7
Specify time scale of data used 0-daily; 1-monthly
  0
missing number identifier (any number equal to or slightly higher than the defined value is ok)
  -9000.0
Width of one side of moving window for daily data (in days)
  15
option whether data (gcm_cali gcm_vali obs_cali obs_vali) follows a usual leap year format(0), or a fixed days in a month format (1)
  1 1 0 0
Number of seasons in a year
  4
Number of months in each season
  3 3 3 3
Month numbering assigned to each season (1-Jan, 2-Feb....., 12-Dec)
  1 2 3
  4 5 6
  7 8 9
  10 11 12
Option for creation of plots (0:no plots, 1:plots of statistics, 2: plots of empirical distribution as well)
  1
Specify physical lower and upper limits on the variables/locations and aggration criteria
variable Lower limit Upper limit higher time scale aggr 0-av, >0 sum threshold indicator threshold
  1 500 1000 0 0 0 0
  2 -100 100 0 0 0 0
  3 -100 100 0 0 0 0
  4 200 500 0 0 0 0
  5 -100 100 0 0 0 0
  6 -100 100 0 0 0 0
  7 -100 100 0 0 0 0
Information about no of days in a month for Obs_cali Obs_vali GCM_cali GCM_vali
      31 31 31 31
      28 28 28 28
      31 31 31 31
      30 30 30 30
      31 31 31 31
      30 30 30 30
      31 31 31 31
      31 31 31 31
      30 30 30 30
      31 31 31 31
      30 30 30 30
      31 31 31 31

```



Table 6: RoMBC model structure adopted for example 2 dataset

Climate variables	Daily						Monthly						Seasonal						Annual					
	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	Q M	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1 C	L1 F
1	1*	1*	1	1	1	1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
2	1*	1*	1	1	1	1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
3	1*	1*	1	1	1	1	1*	0	1	1	1	-1	1*	0	0	0	0	0	1*	0	0	1	0	0
4	1*	1*	1	1	1	1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
5	1*	1*	1	1	1	1	1*	0	1	1	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
6	1*	1*	1	1	1	1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
7	1*	1*	1	-1	1	1	1*	0	1	1	1	-1	1*	0	0	1	0	0	1*	0	0	0	0	0

Note: 1\*: Compulsory correction applied; 0: correction not needed; 1: correction required and applied; -1: correction required but can't be applied

Table 7: A few statistics of raw and bias corrected time series for calibration period: dataset 2

## (a) Raw data

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	794.81260	801.81570	11.07615	6.48417	-.00992	.00670	-.11382	-.11062	-.96318	-.15844
2	11.85767	19.59069	.92815	1.57433	.33265	-.08557	.19667	-.07736	-.00982	.31654
3	13.17055	28.01361	.87910	1.99338	.54293	.11176	.29168	-.29251	-.66259	-.23973
4	314.49210	318.78520	.59719	.55259	-.03634	-.15974	-.10205	.08584	.62379	.15254
5	10.83555	12.29951	1.47997	1.71984	-.27599	-.20689	.11715	.18380	.10133	.24343
6	1.36723	2.71904	.84796	.68802	.00964	-.12859	.29021	.33753	-.09025	-.42543
7	-.07574	.44324	.07759	.04170	-.32606	.03260	.20014	-.15016	.06629	-.05898
Statistics at Seasonal Level										
1	795.31300	802.34440	20.39622	26.76151	.16184	.02511	-.20461	-.84657	-.09733	-.13673
2	11.94472	19.60793	1.44061	3.05961	.26435	.14247	.08148	-.23969	.06576	.52357
3	13.19893	28.02888	1.44355	4.66459	.15866	.04267	.17951	-.38841	.11390	.45719
4	314.46650	318.79400	5.41005	3.12094	.00131	-.01643	-.95212	-.84869	.15663	.49516
5	10.86561	12.30282	3.30714	6.27838	.04932	.03517	-.25427	-.80170	.04717	.07051
6	1.38987	2.72258	1.33818	1.28204	.22178	.17406	.02164	-.19118	.20634	-.05164
7	-.07832	.44153	.22043	.10947	.04917	.10276	-.66237	-.56617	-.10211	-.17734
Statistics at Monthly Level										
1	795.29950	802.07310	25.93666	30.31085	.39917	.75037	.25618	.42919	.00706	-.26131
2	11.92105	19.56870	2.40452	5.10792	.27180	.13886	.15533	.00673	.25562	.38378
3	13.20546	27.98813	2.01489	6.58438	.33338	.34646	.11978	.10906	.31916	.27268
4	314.52950	318.82780	5.95683	3.52441	.81329	.75298	.46613	.39676	.07677	.34216
5	10.84255	12.26371	4.30935	7.30355	.35642	.66190	.17210	.38298	.18946	.20722
6	1.37122	2.70800	2.11019	2.08538	.13949	.18166	.12983	-.01590	-.10573	.21800
7	-.07569	.44227	.26207	.14550	.54396	.35136	.31928	.18341	-.36481	-.23738
Statistics at Daily Level										
1	795.17030	802.06520	52.98769	39.46332	.80411	.90695	.51485	.76023	-.20804	-.36580
2	11.91415	19.56943	6.59131	15.23799	.45394	.59810	.15635	.23381	.91426	.92997
3	13.18867	27.99234	6.77156	15.49419	.37049	.60772	.10879	.31517	.78014	-.12194
4	314.50670	318.81500	7.09389	4.56450	.88540	.85917	.78182	.71003	.03398	-.01541
5	10.87214	12.29071	9.04825	10.58193	.74194	.83024	.46237	.65239	.20257	.24931
6	1.37059	2.71886	7.45185	6.31226	.49701	.54580	.11775	.20096	-.05463	-.03304
7	-.07706	.44197	.53425	.42655	.68808	.60496	.39610	.28090	-.37952	-.12088

## (b) Bias corrected

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	795.17	795.17	11.061	9.3768	-.99058E-02	-.65261E-02	-.11381	-.11886	-.96319	-.82884E-01
2	11.914	11.914	.96167	.93513	.33266	.30320	.19668	-.42741E-01	-.98151E-02	-.34967E-01
3	13.188	13.187	.86952	.86267	.54294	.44914	.29169	-.36922E-01	-.66259	.12934
4	314.51	314.50	.59281	.65205	-.36328E-01	-.11373	-.10198	-.19618	.62391	.14540
5	10.872	10.875	1.4679	1.4781	-.27598	-.14182	.11716	.14802	.10133	-.44369
6	1.3701	1.3704	.83385	.70614	.96541E-02	-.88579E-01	.29022	.27854	-.90254E-01	-.76497E-01
7	-.77000E-01	-.77222E-01	.76586E-01	.60326E-01	-.32605	-.11392	.20015	-.10392	.66290E-01	-.22787
Statistics at Seasonal Level										
1	795.21	795.21	20.345	19.410	.99944	.99948	-.20460	-.39926	-.97332E-01	.67663E-01
2	11.917	11.917	1.4670	1.5169	.98887	.98789	.81491E-01	-.32150E-04	.65764E-01	.43372
3	13.194	13.193	1.4387	1.5314	.98972	.98701	.17952	.14005	.11390	.24870
4	314.54	314.54	5.4436	5.4465	.99970	.99970	-.95211	-.95327	.15662	.16778
5	10.854	10.854	3.2959	3.2674	.91697	.91541	-.25426	-.34684	.47173E-01	.45452E-01
6	1.3684	1.3682	1.3531	1.2406	.61263	.63025	.21647E-01	-.13724	.20634	-.13828
7	-.76030E-01	-.76051E-01	.22092	.21296	.14970	.15378	-.66236	-.78777	-.10211	-.13366
Statistics at Monthly Level										
1	795.30	795.28	25.937	25.791	.39918	.37159	.25619	.22128	.70548E-02	.15374
2	11.921	11.915	2.0405	2.2792	.27181	.17731	.15534	.47322E-01	.25562	.19925
3	13.205	13.199	2.0149	2.2045	.33339	.23384	.11979	.96658E-01	.31916	.29282
4	314.53	314.53	5.9568	5.9713	.81330	.80955	.46614	.45457	.76766E-01	.98493E-01
5	10.843	10.845	4.3094	4.1944	.35643	.35884	.17211	.15665	.18946	.20096
6	1.3712	1.3652	2.1102	2.0543	.13950	.15862	.12984	-.17129E-01	-.10573	.45449E-01
7	-.75689E-01	-.75885E-01	.26207	.25754	.54397	.51366	.31929	.28116	-.36481	-.44319
Statistics at Daily Level										
1	795.17	795.17	52.988	52.996	.80412	.80153	.51486	.50555	-.20804	-.20807
2	11.914	11.914	6.5913	6.5912	.45395	.60600	.15636	.24741	.91426	.91415
3	13.189	13.187	6.7716	6.7718	.37050	.56270	.10880	.26259	.78014	.78034
4	314.51	314.50	7.0939	7.0922	.88541	.89739	.78183	.79501	.33976E-01	.34472E-01
5	10.872	10.876	9.0483	9.0473	.74195	.73927	.46238	.48673	.20257	.20241
6	1.3706	1.3700	7.4519	7.4527	.49702	.51200	.11776	.16602	-.54628E-01	-.54558E-01
7	-.77060E-01	-.77243E-01	.53425	.53428	.68809	.69303	.39611	.41547	-.37952	-.37934

Table 8: A few statistics of raw and bias corrected time series for verification period: dataset 2

## (a) Raw data

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	802.54400	804.88480	8.24078	5.55648	.00062	.05787	-.31081	-.38833	.45871	.50423
2	14.55578	19.81402	.83537	1.37419	.41963	.06397	.34520	.00765	-.02783	-.14958
3	16.16421	27.97035	.97117	1.93598	.56657	.32962	.16865	.30374	-.20598	-.24923
4	315.15110	319.94120	.72180	.53326	.35424	.43394	.29407	.38857	-.17430	-.77996
5	10.96024	12.42488	1.21249	1.08545	.11899	-.16061	-.00739	.03346	-.18692	-.59432
6	1.52278	2.55975	.52059	.66482	.06427	-.21438	.11530	-.05695	-.23976	.10915
7	-.11541	.41118	.04796	.03516	.02007	.14855	.11886	.13805	.54829	.34961
Statistics at Seasonal Level										
1	802.59940	804.85860	20.05032	27.33052	.07819	.03557	-.46944	-.83651	.15219	-.07411
2	14.53467	19.78944	1.44952	3.19703	.10807	-.08414	.13201	-.23378	-.21674	.29251
3	16.16446	27.97396	1.69983	5.33887	.04073	-.00407	.15855	-.47863	.20454	-.02461
4	315.13170	319.93530	5.10300	3.09277	.00206	-.03517	-.93845	-.76784	.14859	.57867
5	10.93281	12.47173	2.99045	5.81299	.04733	-.00282	-.48093	-.85598	.28448	.09663
6	1.49193	2.51583	1.08435	1.32642	-.00811	.16169	-.01940	.12712	-.35661	-.08748
7	-.11580	.40908	.21283	.11503	-.02865	-.07848	-.79011	-.46049	-.52749	-.37545
Statistics at Monthly Level										
1	802.49550	804.61990	26.73181	31.76105	.41975	.70961	.19440	.39799	-.09576	-.34779
2	14.53987	19.78832	2.37383	5.20840	.10715	.19273	.04492	-.01734	.08453	.25392
3	16.16158	27.95698	2.40473	6.99345	.24609	.41466	.05646	.21161	.20854	.03739
4	315.18540	319.96960	5.71912	3.58860	.78996	.72501	.44904	.37146	.08743	.50494
5	10.94025	12.40907	4.05373	7.05531	.36997	.61111	.17676	.31739	.43950	.22839
6	1.50217	2.52657	1.98726	2.11904	-.02357	.09428	.02616	.13217	-.06715	-.06799
7	-.11443	.40979	.25800	.16639	.56403	.25743	.30329	.15947	-.56034	-.26756
Statistics at Daily Level										
1	802.37460	804.72200	53.75423	40.20984	.79841	.91255	.50453	.77637	-.30850	-.36210
2	14.53335	19.80636	8.48021	15.72155	.42558	.61204	.10318	.25116	.77109	.91383
3	16.14070	27.99209	8.03056	15.69899	.35078	.61569	.10014	.32783	.55773	-.09223
4	315.16410	319.95370	6.96778	4.71903	.86444	.86262	.75042	.71139	.07565	-.04180
5	10.97513	12.43323	9.12886	10.61447	.70597	.82706	.39794	.63863	.25012	.25439
6	1.50283	2.52533	7.76968	6.55768	.44950	.56036	.07829	.19700	-.11677	.02167
7	-.11551	.40945	.54737	.44334	.65908	.62168	.34904	.29279	-.46302	-.09431

## (b) Bias corrected

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	802.38	798.29	8.1524	10.442	.62854E-03	-.20888	-.31079	-.31919	.45871	.65822
2	14.532	12.232	.83091	1.0087	.41964	.22164	.34521	.14718	-.27828E-01	-.38547
3	16.140	13.405	.96395	1.1420	.56658	.64695	.16866	.58326	-.20598	-.36221
4	315.17	315.58	.71427	.77538	.35425	.43188	.29410	.31073	-.17428	-.27818
5	10.974	11.054	1.1945	1.1351	.11900	.15700E-01	-.73840E-02	.38029E-01	-.18692	-.30301
6	1.5022	1.3134	.52365	.95727	.64283E-01	-.41380E-01	.11531	.84904E-01	-.23976	-.57961
7	-.11554	-.12275	.47158E-01	.76138E-01	.20084E-01	-.22278	.11887	-.10849	.54829	-.12262
Statistics at Seasonal Level										
1	802.41	798.33	20.073	21.684	.99941	.99933	-.46943	-.28695	.15219	.20523E-01
2	14.532	12.239	1.4437	1.9745	.99101	.97495	.13202	-.20196	-.21674	-.30405E-01
3	16.146	13.407	1.7043	1.9316	.98924	.97933	.15856	.40815	.20454	-.94221E-01
4	315.19	315.61	5.1257	5.3453	.99974	.99971	-.93844	-.92052	.14859	.23147
5	10.958	11.035	2.9907	3.2113	.93149	.92367	-.48092	-.44282	.28448	.57210
6	1.5018	1.3119	1.0851	1.7587	.64567	.46618	-.19393E-01	.11767	-.35661	-.27986
7	-.11455	-.12124	.21238	.27800	.20150	.14097	-.79010	-.65740	-.52749	.46592
Statistics at Monthly Level										
1	802.50	798.34	26.732	29.754	.41976	.31099	.19441	.21723	-.95755E-01	.10510
2	14.540	12.219	2.3738	2.7854	.10716	.25093	.44929E-01	.10076	.84526E-01	.20218
3	16.162	13.395	2.4047	2.5560	.24610	.23753	.56470E-01	.13993	.20854	-.70421E-01
4	315.19	315.61	5.7191	5.9957	.78997	.78764	.44905	.45759	.87425E-01	.23027
5	10.940	11.028	4.0537	4.6316	.36998	.24124	.17677	.61529E-01	.43950	.26086
6	1.5022	1.3250	1.9873	3.0033	-.23559E-01	-.19199E-01	.26170E-01	.11570	-.67153E-01	-.36573
7	-.11443	-.12034	.25800	.41902	.56404	.16325	.30330	.43084E-01	-.56034	.20052
Statistics at Daily Level										
1	802.37	798.29	53.754	55.095	.79842	.81559	.50454	.54621	-.30850	-.21617
2	14.533	12.232	8.4802	7.0773	.42559	.63884	.10319	.30283	.77109	.94197
3	16.141	13.406	8.0306	7.0362	.35079	.60159	.10015	.30869	.55773	.84904
4	315.16	315.58	6.9678	7.2209	.86445	.89783	.75043	.79054	.75651E-01	.50667E-01
5	10.975	11.055	9.1289	9.6751	.70598	.74647	.39795	.48932	.25012	.20396
6	1.5028	1.3148	7.7697	11.581	.44951	.51671	.78298E-01	.16277	-.11677	.42313E-01
7	-.11551	-.12274	.54737	1.2672	.65909	.59393	.34905	.27287	-.46302	-.39469

Table 9: Structure of Basic.dat file used for dataset 3

```

Information about observed data for calibration
  No of years of data      Start Year
      70                  1921
Observed data file name along with directory path for calibration(if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\data_obsc.dat
Information about observed data for validation
  No of years of data      Start Year
      70                  1921
Observed data file name along with directory path for validation(if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\data_obsc.dat
Information about raw data used in calibration
  No of years of data      Start Year
      70                  1921
Data file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\data_rawc.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\stat_rawc.dat
Bias corrected data file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\data_bcc.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\stat_bcc.dat
Information about data used for bias correction - validation
  No of years of data      Start Year
      70                  1921
Data file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\data_rawf.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\stat_rawf.dat
Bias corrected data file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\data_bcf.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example3\stat_bcf.dat
Number of variables
  15
Specify time scale of data used 0-daily; 1-monthly
  1
missing number identifier (any number equal to or slightly higher than the defined value is ok)
  -9000.0
Number of seasons in a year
  2
Number of months in each season
  6
Month numbering assigned to each season (1-Jan, 2-Feb....., 12-dec)
  1  2  3  4  5  6
  7  8  9 10 11 12
Option for creation of plots (0:no plots, 1:plots of statistics, 2: plots of empirical distribution as well)
  0
Specify physical lower and upper limits on the variables/locations and aggregation criteria
variable Lower limit Upper limit higher time scale aggr 0-av, >0 sum threshold indicator threshold
  1         0         1500         1         1         1         0.3
  2         0         1500         1         1         1         0.3
  3         0         1500         1         1         1         0.3
  4         0         1500         1         1         1         0.3
  5         0         1500         1         1         1         0.3
  6         0         1500         1         1         1         0.3
  7         0         1500         1         1         1         0.3
  8         0         1500         1         1         1         0.3
  9         0         1500         1         1         1         0.3
 10         0         1500         1         1         1         0.3
 11         0         1500         1         1         1         0.3
 12         0         1500         1         1         1         0.3
 13         0         1500         1         1         1         0.3
 14         0         1500         1         1         1         0.3
 15         0         1500         1         1         1         0.3

```

Table 10: RoMBC model structure adopted for example 3 dataset

Climate variables	Daily						Monthly						Seasonal						Annual					
	SD	QM	LA G0	LA G1	L1C	L1F	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1C	L1F	SD	QM	LA G0	LA G1	L1 C	L1 F
1	-9	-9	-9	-9	-9	-9	1*	1*	1	1	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
2	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
3	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
4	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
5	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
6	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
7	-9	-9	-9	-9	-9	-9	1*	1*	1	1	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
8	-9	-9	-9	-9	-9	-9	1*	1*	1	1	1	-1	1*	0	-1	1	-1	0	1*	0	-1	0	-1	-1
9	-9	-9	-9	-9	-9	-9	1*	1*	1	1	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
10	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
11	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
12	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	1	-1	0	1*	0	-1	0	-1	-1
13	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
14	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	0	-1	0	1*	0	-1	0	-1	-1
15	-9	-9	-9	-9	-9	-9	1*	1*	1	0	1	-1	1*	0	-1	1	-1	0	1*	0	-1	0	-1	-1

Note: -9: Correction not considered; 1\*: Compulsory correction applied; 0: correction not needed; 1: correction required and applied; -1: correction required but can't be applied

Table 11: A few statistics of raw and bias corrected time series for calibration period: dataset 3

(a) Raw data

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	1020.0	1020.6	278.25	289.33	.20079	-.72673E-02	.11883	-.14027	.41272	.68209
2	1233.0	1204.0	346.21	364.06	.12895	-.68615E-01	.97378E-01	-.20474	.58218	.26037
3	777.67	825.74	265.26	244.20	.16416	.38877E-01	.15105	-.10876	.79906	.52426
4	1492.1	1537.3	493.86	373.58	.20773	.22108	.16393	.29685	.68392	.70558
5	1003.2	1015.5	282.43	352.36	.61195E-01	-.33299E-01	.10917	.94902E-01	.46197	1.2800
6	847.90	803.31	279.82	240.24	.11364	-.96642E-01	.17030	-.87959E-01	.59495	.33969
7	1717.9	1721.0	571.43	639.71	.92883E-01	.43665E-01	.77821E-01	.95544E-01	.75477	.69640
8	1296.1	1177.8	423.34	425.02	.23547	.23314	.26224	.12171	.69044	1.0031
9	761.59	740.30	247.70	234.21	.10014	.21106	-.69488E-02	.87074E-01	.64455	.58042
10	850.96	865.76	233.67	220.70	.10368	.14456	.83202E-01	.10029	.75813	.29947
11	662.06	685.95	184.97	225.98	.13379	.37699	.10125	.29107	.39915	.40045
12	1026.8	993.90	326.46	295.54	.12130	.14272	-.19787E-01	.16269	.55826	.39022
13	726.83	758.70	230.78	198.09	.20124	.11792E-01	.99244E-01	-.15048	.65003	.47358
14	852.32	834.07	230.71	221.46	-.92547E-02	.10774	.62117E-01	-.71522E-01	.37807	.13083
15	1178.5	1244.3	323.55	398.63	.95619E-01	.14261	.11505	.73766E-02	.54859	.21068
Statistics at Seasonal Level										
1	510.01	510.28	184.79	183.08	.88980	.89992	.24327	-.43453E-01	.94651	.66807
2	616.52	602.02	277.10	252.76	.78483	.84189	.37354	.96751E-01	.82174	.64315
3	388.84	412.87	194.47	176.74	.77678	.81743	.31415	.17734	1.4665	1.1023
4	746.07	768.67	387.61	302.91	.73578	.84213	.41301	.30583	1.1228	.79173
5	501.60	507.75	211.08	252.82	.81549	.79036	.28590	.47410E-01	1.0218	2.4356
6	423.95	401.66	206.96	174.01	.78151	.82332	.26797	.14361	1.2901	1.0200
7	858.94	860.51	432.50	442.69	.75135	.79624	.34261	.12113	1.1469	1.2948
8	648.05	588.90	325.81	300.15	.75319	.80386	.40734	.30503	.97957	1.2712
9	380.79	370.15	168.92	156.40	.83176	.87389	.18111	.12516	1.0965	.85006
10	425.48	432.88	154.15	151.96	.88997	.90434	.13812	-.27255E-01	1.0456	.84170
11	331.03	342.98	120.25	137.70	.89401	.90231	.94476E-01	.25289	.51620	.66487
12	513.42	496.95	237.23	195.16	.79570	.88506	.29013	.46929E-01	1.0540	.66134
13	363.42	379.35	158.44	135.03	.83702	.89156	.24027	-.57373E-01	1.2587	.70550
14	426.16	417.04	150.98	136.73	.88857	.92321	.59577E-01	.69771E-01	.85885	.58081
15	589.26	622.16	262.19	273.50	.78738	.83952	.35375	.18355	.84178	.80628
Statistics at Monthly Level										
1	84.953	85.039	64.026	61.133	.11609	.13844	.92577E-01	.11447	1.8015	1.7707
2	102.78	100.39	93.969	82.978	.68774E-01	.68348E-01	.40018E-01	.10209	1.9586	1.6782
3	64.796	68.841	64.962	66.560	.11086	.50607E-01	.10408	.29124E-01	1.9747	2.4499
4	124.30	128.05	128.47	115.55	.85886E-01	.16265E-01	.43502E-01	-.28635E-02	2.2036	2.1561
5	83.521	84.540	74.296	90.832	.59836E-01	.83842E-01	-.75039E-02	.70953E-01	2.1116	6.5284
6	70.644	66.891	70.277	62.562	.11806	.11474	.82839E-01	.50984E-01	1.9376	2.2506
7	143.12	143.33	144.16	152.45	.68143E-01	.12672	.41341E-01	.73413E-01	2.1536	3.2247
8	107.99	98.142	107.56	97.383	.12875	.13539	.67141E-01	.13662	2.0011	2.2046
9	63.483	61.657	59.300	54.795	.10463	.53862E-01	.25125E-01	.17590E-01	2.9013	2.2552
10	70.844	72.105	54.536	53.369	.13536	.67363E-01	.28747E-01	.74372E-01	1.7081	1.7009
11	55.147	57.037	42.124	44.476	.12366	.88843E-01	.41270E-01	.10799	1.4474	1.4725
12	85.595	82.743	82.921	74.375	.73014E-01	.74615E-01	.23481E-01	.54057E-01	2.6154	2.2324
13	60.562	63.210	53.284	50.063	.10552	.16057	.52604E-01	.25349E-01	1.9695	1.5994
14	71.035	69.526	52.602	48.425	.11734	.42633E-01	.68051E-01	.13804E-01	1.7060	1.5669
15	98.232	103.71	89.485	87.351	.60905E-01	.12033	.40208E-01	.63530E-01	1.9854	1.8573

(b) Bias corrected

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	1020.0	1020.0	278.25	290.94	.20079	.15230	.11883	-.12002	.41272	.76780
2	1233.0	1233.0	346.21	350.70	.12895	.10113	.97378E-01	-.26552	.58218	.19233
3	777.67	777.67	265.26	264.87	.16416	.89743E-01	.15105	-.32934E-01	.79906	.52409
4	1492.1	1492.1	493.86	489.44	.20773	.18655	.16393	.29149	.68392	.70788
5	1003.2	1003.2	282.43	287.85	.61195E-01	.76691E-01	.10917	.81700E-01	.46197	.50639
6	847.90	847.90	279.82	294.09	.11364	.11116	.17030	-.11278	.59495	.33813
7	1717.9	1717.9	571.43	530.75	.92883E-01	.37152E-01	.77821E-01	-.35814E-02	.75477	.15802
8	1296.1	1296.1	423.34	424.05	.23547	.23290	.26224	.12825	.69044	.90265
9	761.59	761.59	247.70	229.74	.10014	.46560E-01	-.69488E-02	.93858E-01	.64455	.45718
10	850.96	850.96	233.67	223.31	.10368	.17178	.83202E-01	.79402E-01	.75813	.11018
11	662.06	662.06	184.97	190.27	.13379	.10398	.10125	.18706	.39915	.25608
12	1026.8	1026.8	326.46	303.86	.12130	.99363E-01	-.19787E-01	.53278E-01	.55826	.53691
13	726.83	726.83	230.78	201.45	.20124	.13992	.99244E-01	-.13190	.65003	-.32902E-01
14	852.32	852.32	230.71	241.74	-.92547E-02	.10762	.62117E-01	-.29864E-01	.37807	.25825
15	1178.5	1178.5	323.55	345.33	.95619E-01	.97147E-01	.11505	.21505E-01	.54859	.41065
Statistics at Seasonal Level										
1	510.01	510.01	184.79	185.54	.88980	.90353	.24327	.38063E-01	.94651	1.1110
2	616.52	616.52	277.10	267.15	.78483	.81869	.37354	.23494	.82174	.72992
3	388.84	388.84	194.47	194.15	.77678	.76705	.31415	.21593	1.4665	1.1930
4	746.07	746.07	387.61	387.65	.73578	.75121	.41301	.25911	1.1228	1.0107
5	501.60	501.60	211.08	204.81	.81549	.85428	.28590	.13683	1.0218	.76271
6	423.95	423.95	206.96	206.00	.78151	.80316	.26797	.19960	1.2901	.82071
7	858.94	858.94	432.50	405.82	.75135	.79215	.34261	.24386	1.1469	.73458
8	648.05	648.05	325.81	331.34	.75319	.75066	.40734	.42832	.97957	1.2175
9	380.79	380.79	168.92	168.11	.83176	.82211	.18111	.63514E-01	1.0965	.79702
10	425.48	425.48	154.15	151.73	.88997	.90023	.13812	.51778E-01	1.0456	.68469
11	331.03	331.03	120.25	119.67	.89401	.90450	.94476E-01	.53420E-01	.51620	.58215
12	513.42	513.42	237.23	222.91	.79570	.82201	.29013	.12093	1.0540	.71620
13	363.42	363.42	158.44	146.35	.83702	.85471	.24027	.53380E-01	1.2587	.49300
14	426.16	426.16	150.98	149.30	.88857	.91403	.59577E-01	.47890E-01	.85885	.70652
15	589.26	589.26	262.19	256.13	.78738	.81707	.35375	.26959	.84178	.79925
Statistics at Monthly Level										
1	84.953	84.990	64.026	64.040	.11609	.12806	.92577E-01	.81132E-01	1.8015	1.8015
2	102.78	102.80	93.969	93.962	.68774E-01	.19778E-01	.40018E-01	.57621E-01	1.9586	1.9586
3	64.796	64.833	64.962	64.958	.11086	.11655	.10408	.64139E-01	1.9747	1.9747
4	124.30	124.27	128.47	128.46	.85886E-01	.78668E-01	.43502E-01	.32345E-01	2.2036	2.2036
5	83.521	83.486	74.296	74.258	.59836E-01	.29228E-01	-.75039E-02	.89073E-01	2.1116	2.1116
6	70.644	70.589	70.277	70.249	.11806	.97861E-01	.82839E-01	.76905E-01	1.9376	1.9376
7	143.12	143.09	144.16	144.16	.68143E-01	.92277E-01	.41341E-01	.45244E-01	2.1536	2.1536
8	107.99	108.00	107.56	107.56	.12875	.13559	.67141E-01	.11584	2.0011	2.0011
9	63.483	63.455	59.300	59.301	.10463	.86223E-01	.25125E-01	-.34854E-02	2.9013	2.9013
10	70.844	70.869	54.536	54.558	.13536	.46505E-01	.28747E-01	.67995E-01	1.7081	1.7081
11	55.147	55.091	42.124	42.065	.12366	.54710E-01	.41270E-01	.46473E-01	1.4474	1.4474
12	85.595	85.504	82.921	82.901	.73014E-01	.81613E-01	.23481E-01	.35019E-01	2.6154	2.6154
13	60.562	60.566	53.284	53.285	.10552	.91387E-01	.52604E-01	.43167E-01	1.9695	1.9695
14	71.035	71.046	52.602	52.599	.11734	.39495E-01	.68051E-01	.16439E-01	1.7060	1.7060
15	98.232	98.200	89.485	89.487	.60905E-01	.46138E-01	.40208E-01	.20829E-01	1.9854	1.9854



Table 12: A few statistics of raw and bias corrected time series for verification period: dataset 3

## (a) Raw data

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	1020.0	1005.6	278.25	219.56	.20079	-.66530E-01	.11883	-.11345	.41272	.43369
2	1233.0	1266.3	346.21	358.46	.12895	.16292	.97378E-01	.14805	.58218	.74283
3	777.67	781.17	265.26	284.39	.16416	.16555E-02	.15105	.16046	.79906	1.3386
4	1492.1	1447.9	493.86	465.16	.20773	-.35173E-01	.16393	.58039E-01	.68392	.57882
5	1003.2	1016.2	282.43	258.97	.61195E-01	.19399	.10917	.15210	.46197	.66826
6	847.90	822.18	279.82	240.73	.11364	.15809	.17030	.61933E-01	.59495	.48861
7	1717.9	1770.2	571.43	631.18	.92883E-01	.27920	.77821E-01	-.23134E-01	.75477	.75706
8	1296.1	1245.6	423.34	333.99	.23547	.14296	.26224	-.96190E-01	.69044	.78949
9	761.59	739.85	247.70	212.39	.10014	.18020	-.69489E-02	-.18178	.64455	.59869
10	850.96	864.11	233.67	201.45	.10368	.27374	.83202E-01	.93836E-01	.75813	.18647
11	662.06	644.82	184.97	189.63	.13379	.70329E-01	.10125	-.15089	.39915	.80709
12	1026.8	915.99	326.46	228.79	.12130	.20076E-01	-.19787E-01	-.18457	.55826	.64622
13	726.83	788.23	230.78	238.53	.20124	.32660	.99244E-01	-.24068E-01	.65003	.31927
14	852.32	850.50	230.71	228.45	-.92545E-02	.17853	.62117E-01	-.20640E-01	.37807	.23765
15	1178.5	1206.6	323.55	457.03	.95619E-01	.32722	.11505	.15554	.54859	.41340
Statistics at Seasonal Level										
1	510.01	502.78	184.79	149.72	.88980	.92948	.24327	-.56629E-01	.94651	.59455
2	616.52	633.15	277.10	242.19	.78483	.87865	.37354	.20528	.82174	.68641
3	388.84	390.59	194.47	188.03	.77678	.83177	.31415	.94482E-01	1.4666	1.0285
4	746.07	723.97	387.61	347.98	.73578	.78072	.41301	.26357	1.1228	1.0142
5	501.60	508.11	211.08	187.40	.81549	.87786	.28590	.16020	1.0218	.92644
6	423.95	411.09	206.96	161.79	.78151	.87420	.26797	.14417	1.2901	.44551
7	858.94	885.09	432.50	424.85	.75135	.82202	.34261	.21113	1.1469	1.0265
8	648.05	622.79	325.81	258.21	.75319	.83689	.40734	.21671	.97957	.77818
9	380.79	369.92	168.92	141.00	.83176	.88632	.18111	.11363	1.0965	.91293
10	425.48	432.05	154.15	140.14	.88997	.90831	.13812	.21541	1.0456	.52666
11	331.03	322.41	120.25	129.42	.89401	.86520	.94476E-01	-.34750E-01	.51620	.80956
12	513.42	457.99	237.23	170.25	.79570	.88006	.29013	-.77520E-01	1.0540	.56220
13	363.42	394.12	158.44	151.74	.83702	.89748	.24027	.20730	1.2587	.58326
14	426.16	425.25	150.98	149.22	.88857	.90717	.59577E-01	.12177	.85885	.42771
15	589.26	603.30	262.19	306.43	.78738	.79589	.35375	.47107	.84178	.91288
Statistics at Monthly Level										
1	84.953	83.824	64.026	59.709	.11609	.51171E-01	.92578E-01	.74508E-01	1.8015	1.5093
2	102.78	105.59	93.969	84.562	.68774E-01	.12825	.40018E-01	.78775E-03	1.9586	1.5339
3	64.796	65.078	64.962	67.491	.11086	.10256	.10408	.84095E-01	1.9747	2.4281
4	124.30	120.74	128.47	110.07	.85886E-01	.111320	.43502E-01	.39972E-01	2.2036	2.0895
5	83.521	84.662	74.296	67.369	.59836E-01	.46659E-01	.75039E-02	.57500E-02	2.1116	1.9700
6	70.644	68.419	70.277	63.892	.11806	.40197E-01	.82839E-01	.52722E-01	1.9376	1.8965
7	143.12	147.63	144.17	146.36	.68143E-01	.76841E-01	.41341E-01	.49845E-01	2.1536	2.4304
8	107.99	103.84	107.56	91.603	.12875	.96683E-01	.67141E-01	.60823E-01	2.0011	1.7166
9	63.483	61.597	59.300	51.454	.10463	.41886E-01	.25125E-01	.50083E-01	2.9013	1.6140
10	70.844	72.002	54.536	50.499	.13536	.35480E-01	.28747E-01	.38413E-01	1.7081	1.3845
11	55.147	53.760	42.124	42.737	.12366	.12831	.41270E-01	.10349	1.4474	1.6967
12	85.595	76.347	82.921	65.982	.73014E-01	.27357E-01	.23481E-01	.21936E-01	2.6154	1.8343
13	60.562	65.690	53.284	56.167	.10552	.62678E-01	.52604E-01	.83027E-01	1.9695	1.9355
14	71.035	70.901	52.602	50.079	.11734	.14220	.68051E-01	.25952E-01	1.7060	1.2594
15	98.232	100.43	89.485	91.614	.60905E-01	.21206	.40208E-01	.11657	1.9854	2.3029

## (b) Bias corrected

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	1020.0	1022.3	278.25	235.83	.20079	.68778E-01	.11883	-.63212E-01	.41272	.45804
2	1233.0	1321.7	346.21	398.89	.12895	.48596	.97378E-01	.26509	.58218	.57537
3	777.67	754.51	265.26	252.02	.16416	.23133	.15105	.59006E-01	.79906	.44423
4	1492.1	1426.2	493.86	567.31	.20773	.30192	.16393	.40055E-01	.68392	.11147
5	1003.2	1012.1	282.43	247.07	.61195E-01	.96771E-01	.10917	.13732	.46197	.41278
6	847.90	881.66	279.82	292.54	.11364	.34896	.17030	.24469	.59495	.68049E-01
7	1717.9	1806.5	571.43	530.33	.92883E-01	.21968	.77821E-01	.19204	.75477	.47236
8	1296.1	1393.7	423.34	388.46	.23547	.18918	.26224	-.16298E-01	.69044	.78729
9	761.59	772.77	247.70	230.05	.10014	.32772	-.69489E-02	.40317E-01	.64455	.15785
10	850.96	861.17	233.67	203.82	.10368	-.17895E-01	.83202E-01	.24181E-01	.75813	-.69561E-01
11	662.06	630.91	184.97	177.22	.13379	-.18132	.10125	-.26121E-01	.39915	.51427
12	1026.8	961.37	326.46	255.48	.12130	.35644	-.19787E-01	.75071E-01	.55826	-.10340
13	726.83	772.54	230.78	249.44	.20124	.22753	.99244E-01	.67505E-01	.65003	.67365
14	852.32	893.80	230.71	236.91	-.92545E-02	-.45885E-01	.62117E-01	-.11523	.37807	.85103E-01
15	1178.5	1160.7	323.55	358.56	.95619E-01	.29920	.11505	.11815	.54859	.51653
Statistics at Seasonal Level										
1	510.01	511.17	184.79	163.79	.88980	.91697	.24327	.31254E-01	.94651	.63264
2	616.52	660.84	277.10	284.71	.78483	.84363	.37354	.44720	.82174	.98478
3	388.84	377.25	194.47	194.62	.77678	.76979	.31415	.20996	1.4666	.81137
4	746.07	713.10	387.61	427.77	.73578	.69569	.41301	.37310	1.1228	.83620
5	501.60	506.05	211.08	181.63	.81549	.87962	.28590	.15436	1.0218	.38381
6	423.95	440.83	206.96	189.28	.78151	.86968	.26797	.23720	1.2901	.37596
7	858.94	903.27	432.50	423.24	.75135	.78533	.34261	.23341	1.1469	.52937
8	648.05	696.84	325.81	304.89	.75319	.80237	.40734	.39674	.97957	1.0273
9	380.79	386.38	168.92	163.56	.83176	.84666	.18111	.24070	1.0965	.55521
10	425.48	430.59	154.15	146.54	.88997	.88642	.13812	.12548	1.0456	.22910
11	331.03	315.45	120.25	117.72	.89401	.87487	.94476E-01	-.74604E-01	.51620	.38157
12	513.42	480.69	237.23	195.89	.79570	.84239	.29013	.28298	1.0540	.54418
13	363.42	386.27	158.44	178.06	.83702	.81257	.24027	.27169	1.2587	.97175
14	426.16	441.90	150.98	157.67	.88857	.89335	.59577E-01	-.29016E-01	.85885	.27336
15	589.26	580.37	262.19	288.01	.78738	.74803	.35375	.53065	.84178	.73633
Statistics at Monthly Level										
1	84.953	85.221	64.026	68.649	.11609	.20325E-01	.92578E-01	.56353E-01	1.8015	1.9664
2	102.78	110.21	93.969	103.98	.68774E-01	.78919E-01	.40018E-01	-.23470E-01	1.9586	2.2194
3	64.796	62.873	64.962	69.127	.11086	.10396	.10408	.77111E-01	1.9747	2.4277
4	124.30	118.93	128.47	128.51	.85886E-01	.12107	.43502E-01	.68263E-01	2.2036	2.4444
5	83.521	84.335	74.296	69.038	.59836E-01	.59852E-01	.75039E-02	.14401E-01	2.1116	1.7103
6	70.644	74.436	70.277	74.636	.11806	.46799E-01	.82839E-01	.80952E-01	1.9376	1.9293
7	143.12	150.64	144.17	155.02	.68143E-01	-.53880E-02	.41341E-01	.58765E-01	2.1536	2.0263
8	107.99	116.19	107.56	112.93	.12875	-.10117	.67141E-01	-.14226E-01	2.0011	2.1172
9	63.483	64.402	59.300	62.793	.10463	.70474E-01	.25125E-01	.14458E-01	2.9013	3.5220
10	70.844	71.725	54.536	54.073	.13536	.21338E-01	.28747E-01	.43116E-01	1.7081	1.5503
11	55.147	52.588	42.124	42.558	.12366	.60664E-01	.41270E-01	.67925E-01	1.4474	1.6929
12	85.595	80.166	82.921	77.024	.73014E-01	-.84923E-02	.23481E-01	.84945E-02	2.6154	2.3353
13	60.562	64.426	53.284	61.057	.10552	.71842E-01	.52604E-01	.97140E-01	1.9695	2.1645
14	71.035	73.676	52.602	55.595	.11734	.76736E-01	.68051E-01	.50961E-02	1.7060	1.5045
15	98.232	96.629	89.485	96.843	.60905E-01	.10845	.40208E-01	.58472E-01	1.9854	2.1

Table 13: Structure of Basic.dat file used for dataset 4

```

Information about observed data used in calibration
  No of years of data   Start Year
      30             1976             108             1901
Observed data file name along with directory path for calibration(if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\rain_evp_obs.dat
Information about observed data used in validation
  No of years of data   Start Year
      30             1976             108             1901
Observed data file name along with directory path for validation(if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\rain_evp_obs.dat
Information about raw data used in calibration
  No of years of data   Start Year
      30             1976
Data file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\rainEvp_access_hist.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\stat_access_raw_1976_05.dat
Bias corrected data file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\rainEvp_access_BC_1976_05.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\stat_access_bc_1976_05.dat
Information about data used for bias correction - validation
  No of years of data   Start Year
      30             2010
Data file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\rainEvp_access_rcp85.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\stat_access_r_2010_39.dat
Bias corrected data file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\rainEvp_access_bc_2010_39.dat
Statistics (to be computed and stored) file name with directory path (if not in the directory where executable is located)
  E:\Raj\FMBC_software\Example4\stat_access_bc_2010_39.dat
Number of variables
  21
Specify time scale of data used 0-daily; 1-monthly
  0
missing number identifier (any number equal to or slightly higher than the defined value is ok)
  -9000.0
Width of one side of moving window for daily data (in days)
  11
Option whether data follows a usual leap year format(0), or a fixed days in a month format (1)
  0 0 0 0
Number of seasons in a year
  4
Number of months in each season
  3 3 3 3
Month numbering assigned to each season (1-Jan, 2-Feb....., 12-Dec)
  1 2 3
  4 5 6
  7 8 9
  10 11 12
Option for creation of plots (0:no plots, 1:plots of statistics, 2: plots of empirical distribution as well)
  2
Specify physical lower and upper limits on the variables/locations and aggregation criteria
  variable   Lower limit   Upper limit   higher time scale aggr 0-av, >0 sum   Threshold indicator   Threshold
  1           0           800           1           1           1.0
  2           0           800           1           1           1.0
  3           0           800           1           1           1.0
  4           0           800           1           1           1.0
  5           0           800           1           1           1.0
  6           0           800           1           1           1.0
  7           0           800           1           1           1.0
  8           0           800           1           1           1.0
  9           0           800           1           1           1.0
  10          0           800           1           1           1.0
  11          0           800           1           1           1.0
  12          0           800           1           1           1.0
  13          0           800           1           1           1.0
  14          0           800           1           1           1.0
  15          0           800           1           1           1.0
  16          0           800           1           1           1.0
  17          0           800           1           1           1.0
  18          0           800           1           1           1.0
  19          0           50           1           0           5.0
  20          0           50           1           0           5.0
  21          0           50           1           0           5.0

Information about no of days in a month for Obs_cali Obs_vali GCM_cali GCM_vali
      31 31 31 31
      29 29 29 29
      31 31 31 31
      30 30 30 30
      31 31 31 31
      30 30 30 30
      31 31 31 31
      31 31 31 31
      30 30 30 30
      31 31 31 31
      30 30 30 30
      31 31 31 31

```



Table 14: RoMBC model structure adopted for example dataset 4

Climate variable s	Daily						Monthly						Seasonal						Annual					
	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1 C	L1 F	SD	QM	LA G0	LA G1	L1C	L1F
1	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
2	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
3	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
4	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
5	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
6	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
7	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
8	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
9	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
10	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
11	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
12	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
13	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
14	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
15	1*	1*	-1	-1	-1	-1	1*	1	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
16	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
17	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
18	1*	1*	-1	-1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
19	1*	1*	-1	1	-1	-1	1*	1	1	1	1	-1	1*	0	0	1	0	0	1*	0	0	1	0	0
20	1*	1*	-1	1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0
21	1*	1*	-1	1	-1	-1	1*	0	1	0	1	-1	1*	0	0	0	0	0	1*	0	0	0	0	0

Note: 1\*: Compulsory correction applied; 0: correction not needed; 1: correction required and applied; -1: correction required but can't be applied

Table 15: A few statistics of raw and bias corrected time series for calibration period: dataset 4

## (a) Raw data

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	858.71	714.57	219.02	165.00	-.13398	-.10721	.12022	-.11268	.17356	.34882E-01
2	860.84	714.89	224.25	165.03	-.14926	-.10772	.14284	-.11279	.22185	.35161E-01
3	1371.1	708.54	365.75	166.69	.93771E-01	-.74243E-01	.73320E-01	-.14863	-.93760E-01	.92200E-01
4	1047.9	708.42	266.85	166.52	.28823E-01	-.74909E-01	.44938E-01	-.14682	.48283E-01	.90590E-01
5	914.67	726.40	242.38	164.10	-.17943E-01	-.25717E-01	.11188	-.17331	.33874	.71770E-01
6	874.74	704.36	221.04	168.09	-.13435	-.58190E-01	.15999E-01	-.16572	.38485	.10749
7	750.38	772.27	224.44	160.69	.11129	.60964E-01	.26678	-.19204	.63034	.12244
8	772.55	698.03	205.13	166.05	-.26869	-.54672E-01	.18539	-.15275	.55293	.10573
9	744.92	758.86	236.85	160.60	.18577	.40420E-01	.33339	-.18756	.51354	.89527E-01
10	771.53	685.87	187.34	161.42	-.17191	-.50538E-01	.19630	-.16001	.25175	.11491
11	865.14	667.68	256.07	153.26	-.19625E-01	-.52408E-01	.28091	-.19286	.89628	.12327
12	884.07	669.75	248.17	154.17	-.57029E-01	-.52302E-01	.25608	-.18850	.91652	.12288
13	882.72	662.50	268.96	151.31	.13383E-01	-.51659E-01	.28317	-.20044	.91766	.12401
14	928.07	670.08	280.13	150.77	.22308E-01	-.41665E-01	.26706	-.20027	.94539	.11777
15	784.17	642.57	207.64	145.11	.14663E-01	-.44730E-01	.19770	-.22649	.72453	.12052
16	694.56	644.47	154.50	145.89	-.19561	-.42423E-01	.85740E-01	-.18695	.12330	.15899
17	663.93	634.85	141.60	142.56	-.19305	-.43513E-01	.70633E-01	-.19209	.21575E-01	.17860
18	1515.3	768.22	486.37	152.05	.10381	.63910E-01	.16374	-.18683	.92436	.22870
19	1292.0	1454.0	271.96	71.772	.79867	-.12507	.63581	.12188E-01	1.2261	.26615
20	1176.0	1151.6	83.697	30.180	.26795E-01	-.22840	.32412E-01	.21872	.70558	.80220
21	1357.5	1563.5	102.84	68.285	-.14463	-.32935E-01	-.11601	.20617E-02	.24647E-01	.28657
Statistics at Seasonal Level										
1	214.68	178.64	100.40	91.120	.82953	.78240	-.17719	-.27694	.93414	.75499
2	215.21	178.72	107.43	91.180	.80604	.78233	-.21369	-.27742	1.0187	.75515
3	342.77	177.14	208.53	90.749	.73209	.78749	-.32263	-.28742	.90565	.70321
4	261.98	177.11	132.66	90.674	.80660	.78749	-.21551	-.28696	1.1978	.70441
5	228.67	181.60	135.17	85.848	.73614	.81620	-.32881	-.22081	.91703	.67403
6	218.69	176.09	101.44	91.039	.83621	.78647	-.17637	-.28372	1.0078	.68612
7	187.60	193.07	120.47	77.773	.70280	.86151	-.21361	-.43711E-01	1.2455	.55500
8	193.14	174.51	105.53	88.851	.76870	.79028	-.31875	-.26790	.95606	.69410
9	186.23	189.71	119.39	78.927	.71055	.85323	-.14103	-.87498E-01	1.1361	.59170
10	192.88	171.47	89.928	85.796	.83413	.79646	-.22538	-.25461	.78612	.70325
11	216.28	166.92	123.16	82.414	.76602	.80227	-.20856	-.24136	1.4650	.74205
12	221.02	167.44	119.97	82.742	.78424	.80187	-.23895	-.24361	1.3291	.73503
13	220.68	165.63	128.32	81.626	.76078	.80299	-.19579	-.23450	1.5358	.75725
14	232.02	167.52	134.99	80.507	.75842	.81136	-.20644	-.21692	1.5588	.74343
15	196.04	160.64	99.364	79.557	.81567	.80091	-.22887	-.19975	1.0341	.83087
16	173.64	161.12	72.657	76.506	.85639	.81328	-.90176E-01	-.19453	.46557	.77620
17	165.98	158.71	69.915	74.605	.85295	.81619	-.11746	-.17737	.76387	.61189
18	378.83	192.06	242.64	72.750	.70685	.87703	-.19884	.13887E-02	1.6560	.50931
19	323.01	363.50	169.87	168.20	.81112	.81269	-.64339	-.93446	.58602	.53900E-01
20	293.99	287.90	108.86	109.48	.87865	.86738	-.90663	-.97322	.14849	-.12864E-01
21	339.38	390.88	120.21	149.76	.88745	.86602	-.86760	-.94637	.22482	-.10289E-01
Statistics at Monthly Level										
1	71.124	59.487	52.169	44.671	.52907E-01	.22420	.72362E-01	.52986E-01	1.6136	1.4862
2	71.298	59.513	55.494	44.698	.49197E-01	.22432	.59703E-01	.53013E-01	1.7316	1.4858
3	113.55	59.057	104.74	45.479	.87109E-01	.22014	.82111E-01	.62084E-01	1.7721	1.5464
4	86.758	59.045	68.742	45.414	.46642E-01	.22029	.98049E-01	.61856E-01	1.9248	1.5447
5	75.828	60.570	69.283	44.383	.73016E-01	.18625	.96586E-01	.25447E-01	1.7519	1.5275
6	72.610	58.734	54.104	46.088	.30976E-01	.21328	.10914	.63595E-01	1.7781	1.5722
7	62.071	64.413	62.104	42.921	.51233E-01	.11110	.97071E-01	-.59293E-01	2.1146	1.4236
8	63.969	58.202	57.187	44.896	.37510E-01	.21073	.35851E-01	.60779E-01	1.8292	1.5782
9	61.571	63.290	62.007	42.820	.48415E-01	.12962	.73498E-01	-.39259E-01	2.0600	1.4471
10	63.861	57.195	47.588	43.350	.25421E-01	.21169	.70178E-01	.56205E-01	1.4029	1.5559
11	71.752	55.688	67.841	41.678	.62440E-02	.21626	.22037E-02	.46914E-01	2.7066	1.4829
12	73.288	55.860	65.423	41.836	.58463E-02	.21606	.18666E-01	.48132E-01	2.2997	1.4908
13	73.236	55.259	70.897	41.317	.67984E-02	.21538	-.13397E-02	.44051E-01	2.8618	1.4693
14	76.989	55.893	74.564	41.070	.49557E-02	.20596	-.60412E-03	.34258E-01	2.8796	1.4567
15	64.962	53.608	51.673	40.517	.20141E-01	.20545	.75190E-01	.32737E-01	1.6296	1.4472
16	57.527	53.770	37.960	38.840	.60605E-01	.19817	.48529E-01	.44113E-01	1.0691	1.4778
17	55.056	52.976	37.250	37.975	.75036E-01	.18870	.10892E-01	.45392E-01	1.0778	1.4761
18	125.60	64.095	131.95	41.314	.12439E-01	.90936E-01	.83344E-02	-.74752E-01	2.9578	1.3310
19	107.45	120.82	63.515	63.419	.81449	.78553	.51178	.43319	.82307	.30532
20	97.963	95.756	41.775	41.004	.76376	.82032	.44025	.46122	.35096	.67711E-01
21	113.05	130.03	46.908	56.806	.70425	.80653	.40736	.45350	.41551	.73983E-01
Statistics at Daily Level										
1	2.3511	1.9564	6.6164	4.6782	.31451	.36936	.97437E-01	.11815	6.2529	4.2812
2	2.3569	1.9572	7.0437	4.6817	.31494	.36921	.10178	.11812	6.7042	4.2827
3	3.7539	1.9399	11.852	4.7896	.44101	.35675	.16563	.11066	8.0444	4.5766
4	2.8692	1.9396	8.0757	4.7778	.38736	.35779	.13466	.11126	8.1726	4.5600
5	2.5043	1.9888	7.1751	4.7996	.53558	.35988	.21009	.10739	7.1230	4.6103
6	2.3950	1.9285	6.0886	4.9395	.44686	.34047	.16256	.10125	7.3249	4.8136
7	2.0545	2.1144	7.3944	4.8060	.36109	.38963	.11205	.11596	8.0879	4.4229
8	2.1152	1.9111	6.6954	4.7678	.38363	.35050	.13359	.10527	7.0384	4.6850
9	2.0396	2.0777	7.3871	4.7503	.34781	.38360	.11388	.11379	8.1180	4.4332
10	2.1124	1.8778	5.8352	4.5983	.37938	.36227	.11668	.10789	6.3444	4.6004
11	2.3687	1.8280	9.3122	4.4997	.25401	.36848	.51785E-01	.10877	14.585	4.6792
12	2.4205	1.8337	8.2550	4.5021	.34112	.36883	.98220E-01	.10894	11.737	4.6513
13	2.4169	1.8139	10.174	4.4959	.21752	.36653	.30633E-01	.10801	15.629	4.7523
14	2.5410	1.8346	10.252	4.4867	.25465	.37010	.47821E-01	.10884	15.104	4.7319
15	2.1471	1.7593	6.5906	4.5903	.34489	.34590	.10020	.10143	7.3732	5.2318
16	1.9017	1.7645	5.3790	4.2555	.27320	.37004	.49972E-01	.10731	6.0660	4.6838
17	1.8178	1.7381	5.2701	4.2405	.28060	.36055	.47208E-01	.10333	6.0495	4.8637
18	4.1489	2.1034	15.580	4.6909	.39417	.40757	.13329	.12252	10.182	4.5507
19	3.5368	3.9806	2.6602	2.5480	.70773	.85831	.64585	.77404	1.2794	1.1291
20	3.2191	3.1526	2.0662	1.6227	.52075	.82708	.46717	.76219	.80177	.59371
21	3.7159	4.2805	2.4671	2.2803	.53369	.84440	.41907	.76276	1.0620	.69116

## (b) Bias corrected

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	858.71	858.70	219.02	200.26	-.13398	-.12029	.12022	.59949E-01	.17356	.48730
2	860.84	860.84	224.25	201.23	-.14926	-.10078	.14284	.99003E-01	.22185	.50008
3	1371.1	1371.1	365.75	333.52	.93771E-01	-.65338E-01	.73320E-01	-.20555E-01	-.93760E-01	.51614
4	1047.9	1046.5	266.85	264.75	.28823E-01	.60730E-02	.44938E-01	-.51211E-01	.48283E-01	.45148
5	914.67	913.00	242.38	220.22	-.17943E-01	-.18740E-02	.11188	-.28412E-01	.33874	.48508
6	874.74	873.96	221.04	212.46	-.13435	-.84509E-02	.15999E-01	-.10617E-01	.38485	.51123
7	750.38	750.19	224.44	198.34	.11129	.47988E-01	.26678	-.16368	.63034	.28136
8	772.55	771.81	205.13	190.00	-.26869	.11425E-01	.18539	-.60336E-01	.55293	.24442
9	744.92	743.44	236.85	214.01	.18577	.63371E-01	.33339	-.65250E-01	.51354	-.57459E-01
10	771.53	769.64	187.34	182.66	-.17191	-.67954E-01	.19630	-.92220E-01	.25175	.35768
11	865.14	863.95	256.07	253.93	-.19625E-01	-.83967E-01	.28091	-.12041	.89628	.63255
12	884.07	882.68	248.17	240.43	-.57029E-01	-.67015E-01	.25608	-.12801	.91652	.56920
13	882.72	882.72	268.96	269.85	.13383E-01	-.76887E-01	.28317	-.13627	.91766	.72184
14	928.07	926.97	280.13	278.16	.22308E-01	-.63665E-01	.26706	-.11485	.94539	.70617
15	784.17	783.34	207.64	199.80	.14663E-01	-.80223E-01	.19770	-.12655	.72453	.42192
16	694.56	693.84	154.50	159.12	-.19561	-.19987E-01	.85740E-01	-.22920E-01	.12330	.23657
17	663.93	663.60	141.60	151.89	-.19305	-.85422E-02	.70633E-01	-.47507E-01	.21575E-01	.77053
18	1515.3	1515.3	486.37	431.93	.10381	-.22688E-01	.16374	-.87350E-01	.92436	.24504
19	1292.0	1292.2	271.96	172.48	.79867	.70471	.63581	.27293	1.2261	1.2534
20	1176.0	1176.0	83.697	68.300	.26795E-01	-.12081	.32412E-01	-.11988	.70558	.15139
21	1357.5	1357.5	102.84	89.567	-.14463	.66162E-01	-.11601	-.92127E-01	.24647E-01	.33456
Statistics at Seasonal Level										
1	214.68	214.68	100.40	92.936	.82953	.84616	-.17719	.26370E-01	.93414	.42488
2	215.21	215.21	107.43	99.796	.80604	.82456	-.21369	-.40508E-01	1.0187	.58115
3	342.77	342.77	208.53	188.65	.73209	.75604	-.32263	-.24248	.98565	.80990
4	261.98	261.61	132.66	125.49	.80660	.81271	-.21551	-.69759E-02	1.1978	.89110
5	228.67	228.25	135.17	121.68	.73614	.77948	-.32881	-.25048	.91703	.68135
6	218.69	218.49	101.44	95.223	.83621	.85133	-.17637	-.29426E-01	1.0078	.66858
7	187.60	187.55	120.47	105.17	.70280	.75868	-.21361	-.18770	1.2455	.55305
8	193.14	192.95	105.53	92.866	.76870	.82006	-.31875	-.17060	.95606	.59300
9	186.23	185.86	119.39	105.71	.71055	.74101	-.14103	-.11743	1.1361	.39518
10	192.88	192.41	89.928	83.989	.83413	.84344	-.22538	-.37461E-01	.78612	.45510
11	216.28	215.99	123.16	112.49	.76602	.79380	-.20856	.11468E-01	1.4650	.87872
12	221.02	220.67	119.97	108.31	.81252	.82522	-.23895	.40379E-02	1.3291	.75642
13	220.68	220.68	128.32	120.20	.76078	.77446	-.19579	.43606E-01	1.5358	.99748
14	232.02	231.74	134.99	124.24	.75842	.78028	-.20644	.31510E-01	1.5588	.98962
15	196.04	195.83	99.364	94.110	.81567	.81464	-.22887	-.30161E-01	1.0341	.55065
16	173.64	173.46	72.657	72.067	.85639	.85012	-.98176E-01	.52543E-01	.46557	.41321
17	165.98	165.90	69.915	68.337	.85295	.85764	-.11746	.51769E-01	.36387	.59160
18	378.83	378.83	242.64	213.94	.70685	.75043	-.19894	-.32321E-01	1.6560	1.1256
19	323.01	323.05	169.87	160.98	.81112	.80979	-.64339	-.80865	.58602	.38122
20	293.99	293.99	108.86	108.23	.87865	.87564	-.90663	-.92293	.14849	.16772
21	339.38	339.37	120.21	118.46	.88745	.88859	-.86760	-.89212	.22482	.19890
Statistics at Monthly Level										
1	71.124	71.413	52.169	49.777	.52907E-01	.96812E-01	.72362E-01	-.19793E-01	1.6136	1.4000
2	71.298	71.538	55.494	53.095	.49197E-01	.86458E-01	.59703E-01	-.33427E-02	1.7316	1.5849
3	113.55	114.10	104.74	97.093	.87109E-01	.12095	.82111E-01	-.13074E-03	1.7721	2.0391
4	86.758	87.156	68.742	67.023	.46642E-01	.99685E-01	.98049E-01	-.21830E-01	1.9248	2.3636
5	75.828	76.078	69.283	62.896	.73016E-01	.15618	.96586E-01	-.22628E-01	1.7519	1.6971
6	72.610	72.858	54.104	51.830	.30976E-01	.88672E-01	.10914	-.11339E-01	1.7781	1.7361
7	62.071	62.524	58.155	51.233E-01	.10214	.97071E-01	-.71608E-01	2.1146	1.6635	
8	63.969	64.313	57.187	53.440	.37510E-01	.72232E-01	.35851E-01	-.32540E-01	1.8292	1.7077
9	61.571	61.996	62.007	59.131	.48415E-01	.76375E-01	.73498E-01	-.96957E-01	2.0600	1.5648
10	63.861	64.165	47.588	46.454	.25421E-01	.99304E-01	.70178E-01	-.57817E-01	1.4029	1.3387
11	71.752	72.069	67.841	64.589	.62440E-02	.66595E-01	.22037E-02	-.56632E-01	2.7066	2.5249
12	73.288	73.604	65.423	61.181	.58463E-02	.74840E-01	.18666E-01	-.51501E-01	2.2997	2.2082
13	73.236	73.658	70.897	69.000	.67984E-02	.60794E-01	-.13397E-02	-.65482E-01	2.8618	2.7016
14	76.989	77.350	74.564	71.276	.49557E-02	.72486E-01	-.60412E-03	-.72133E-01	2.8796	2.7758
15	64.962	65.368	51.673	50.631	.20141E-01	.11651	.75190E-01	-.17729E-01	1.6296	1.6452
16	57.527	57.937	37.960	38.498	.60605E-01	.97823E-01	.48529E-01	-.28075E-01	1.0691	1.1176
17	55.056	55.392	37.250	36.262	.75036E-01	.10755	.10892E-01	.89397E-02	1.0778	1.0425
18	125.60	126.43	131.95	122.83	.12439E-01	.61997E-01	.83344E-02	-.11336	2.9578	2.5454
19	107.45	107.25	63.515	61.433	.81449	.77882	.51178	.45181	.82307	.72560
20	97.963	97.725	41.775	41.050	.76376	.76902	.44025	.42833	.35096	.34737
21	113.05	112.90	46.908	45.373	.70425	.74390	.40736	.43121	.41551	.32927
Statistics at Daily Level										
1	2.3511	2.3511	6.6164	6.6164	.31451	.30113	.97437E-01	.67177E-01	6.2529	6.2528
2	2.3569	2.3569	7.0437	7.0437	.31494	.29611	.10178	.65428E-01	6.7042	6.7042
3	3.7539	3.7538	11.852	11.851	.44101	.30282	.16563	.87847E-01	8.0444	8.0444
4	2.8692	2.8652	8.0757	8.0770	.38736	.32952	.13486	.91307E-01	8.1726	8.1696
5	2.5043	2.4997	7.1751	7.1767	.53558	.33809	.21009	.10180	7.1230	7.1200
6	2.3950	2.3929	6.0886	6.0891	.44686	.32967	.16256	.82165E-01	7.3249	7.3228
7	2.0545	2.0540	7.3944	7.3944	.36109	.29361	.11205	.72226E-01	8.0879	8.0877
8	2.1152	2.1131	6.6954	6.6963	.38363	.30362	.13359	.83061E-01	7.0384	7.0372
9	2.0396	2.0355	7.3871	7.3882	.34781	.28992	.11388	.73571E-01	8.1180	8.1159
10	2.1124	2.1072	5.8352	5.8369	.37938	.32351	.11668	.80784E-01	6.3444	6.3407
11	2.3687	2.3654	9.3122	9.3130	.25401	.24641	.51785E-01	.44348E-01	14.585	14.582
12	2.4205	2.4167	8.2550	8.2559	.34112	.28161	.98220E-01	.58949E-01	11.737	11.734
13	2.4169	2.4169	10.174	10.174	.21752	.23411	.30633E-01	.40077E-01	15.629	15.629
14	2.5410	2.5380	10.252	10.253	.25465	.25094	.47821E-01	.47933E-01	15.104	15.102
15	2.1471	2.1448	6.5906	6.5909	.34489	.30897	.10020	.73684E-01	7.3732	7.3716
16	1.9017	1.8997	5.3790	5.3797	.27320	.29087	.49972E-01	.60429E-01	6.0660	6.0646
17	1.8178	1.8169	5.2701	5.2705	.28060	.27566	.47208E-01	.51115E-01	6.0495	6.0489
18	4.1489	4.1489	15.580	15.580	.39417	.33711	.13329	.87348E-01	10.182	10.182
19	3.5368	3.5378	2.6620	2.6620	.70773	.71700	.64585	.61143	1.2794	1.2802
20	3.2191	3.2192	2.0662	2.0668	.52075	.53134	.46717	.45559	.80177	.80155
21	3.7159	3.7167	2.4671	2.4678	.53369	.54896	.41907	.40979	1.0620	1.0618



Table 16: A few statistics of raw and bias corrected time series for validation period: dataset 4

(a) Raw data

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	858.71	681.88	219.02	148.01	-.13398	-.22289	.12022	-.10826	.17356	.19252
2	860.84	682.26	224.25	148.11	-.14926	-.22274	.14284	-.10820	.22185	.19128
3	1371.1	692.87	365.75	145.61	.93771E-01	-.22886	.73320E-01	-.88603E-01	-.93760E-01	.22413
4	1047.9	692.24	266.85	145.52	.28824E-01	-.22900	.44938E-01	-.89015E-01	.48283E-01	.22516
5	914.67	718.48	242.38	142.16	-.17943E-01	-.22311	.11188	-.94421E-01	.33874	.16201
6	874.74	693.59	221.04	145.51	-.13435	-.23025	.15999E-01	-.79294E-01	.38485	.22892
7	750.38	773.14	224.44	139.21	.11129	-.21488	.26678	-.92783E-01	.63034	.10094E-01
8	772.55	682.01	205.13	142.77	-.26869	-.23189	.18539	-.83728E-01	.55293	.23216
9	744.92	756.81	236.85	138.82	.18577	-.21677	.33339	-.97386E-01	.51354	.47450E-01
10	771.53	667.71	187.34	136.90	-.17191	-.22931	.19630	-.77183E-01	.25175	.19281
11	865.14	650.72	256.07	128.17	-.19625E-01	-.22088	.28091	-.53785E-01	.89628	.63671E-01
12	884.07	652.61	248.17	129.07	-.57029E-01	-.22173	.25608	-.56734E-01	.91652	.82165E-01
13	882.72	645.50	268.96	126.21	.13383E-01	-.21989	.28317	-.46149E-01	.91766	.28928E-01
14	928.07	654.66	280.13	126.59	.22308E-01	-.22348	.26706	-.48923E-01	.94539	.25219E-01
15	784.17	625.17	207.64	120.66	.14663E-01	-.22092	.19770	-.12051E-01	.72453	-.78461E-01
16	694.56	617.02	154.50	119.45	-.19561	-.24370	.85739E-01	-.35675E-01	.12330	.23182E-01
17	663.93	603.91	141.60	115.94	-.19305	-.25849	.70632E-01	-.20096E-01	.21575E-01	-.56063E-02
18	1515.3	773.44	486.37	141.21	.10381	-.24361	.16374	-.27314E-01	.92436	.19576
19	1292.0	1895.5	271.96	79.945	.79867	.23573	.63581	.15676	1.2261	.30492
20	1176.0	1330.7	83.697	43.926	.26795E-01	.26114	.32412E-01	-.17406E-01	.70558	.11383
21	1357.5	1934.9	102.84	71.716	-.14463	.25970	-.11601	.32006E-02	.24648E-01	.99481E-01
Statistics at Seasonal Level										
1	214.68	170.47	100.40	98.830	.82953	.73903	-.17719	-.46301	.93414	.76142
2	215.21	170.57	107.43	98.924	.80604	.73891	-.21369	-.46338	1.0187	.76129
3	342.77	173.22	208.53	103.73	.73209	.72104	-.32263	-.50039	.98565	.87660
4	261.98	173.06	132.66	103.50	.80660	.72167	-.21551	-.49958	1.1978	.87289
5	228.67	179.62	135.17	96.627	.73614	.76257	-.32881	-.45716	.91703	.93232
6	218.69	173.40	101.44	105.32	.83621	.71358	-.17637	-.50467	1.0078	.92512
7	187.60	193.28	120.47	80.881	.70280	.84393	-.21361	-.28774	1.2455	.78274
8	193.14	170.50	105.53	101.38	.76870	.72214	-.31875	-.48949	.95606	.90680
9	186.23	189.20	119.39	83.832	.71055	.82760	-.14103	-.33641	1.1361	.85396
10	192.88	166.93	89.928	96.466	.83413	.73415	-.22538	-.48299	.78612	.80891
11	216.28	162.68	123.16	90.530	.76602	.75102	-.20856	-.48627	1.4650	.86142
12	221.02	163.15	119.97	91.188	.78424	.74909	-.23895	-.48649	1.3291	.86434
13	220.68	161.38	128.32	88.934	.76078	.75521	-.19579	-.48357	1.5358	.85625
14	232.02	163.66	134.99	87.172	.75842	.76768	-.20644	-.46486	1.5588	.86291
15	196.04	156.29	99.364	83.658	.81567	.76764	-.22887	-.46391	1.0341	.85251
16	173.64	154.26	72.657	80.918	.85639	.77183	-.98176E-01	-.42941	.46557	.85362
17	165.98	150.98	69.915	77.749	.85295	.77790	-.11746	-.40373	.36387	.86262
18	378.83	193.36	242.64	72.777	.70685	.87031	-.19884	-.14541	1.6560	.65684
19	323.01	473.86	169.87	231.97	.81112	.79685	-.64339	-.95638	.58602	.25678E-01
20	293.99	332.67	108.86	129.28	.87865	.86251	-.90663	-.96199	.14849	-.34051E-01
21	339.38	483.73	120.21	176.63	.88745	.87705	-.86760	-.95407	.22482	-.46066E-01
Statistics at Monthly Level										
1	71.124	56.813	52.169	48.039	.52907E-01	.30855	.72362E-01	.11562	1.6136	1.7428
2	71.298	56.846	55.494	48.080	.49197E-01	.30854	.59703E-01	.11600	1.7316	1.7425
3	113.55	57.728	104.74	49.325	.87109E-01	.32443	.82111E-01	.13633	1.7721	1.7299
4	86.758	57.675	68.742	49.234	.46642E-01	.32443	.98049E-01	.13572	1.9248	1.7297
5	75.828	59.872	69.283	47.487	.73016E-01	.26836	.96586E-01	.11896	1.7519	1.6647
6	72.610	57.787	54.104	49.961	.30976E-01	.32208	.10914	.13904	1.7781	1.7362
7	62.071	64.448	62.104	44.568	.51233E-01	.10823	.97071E-01	.57806E-01	2.1146	1.3449
8	63.969	56.820	57.187	48.362	.37510E-01	.31971	.35851E-01	.12594	1.8292	1.7362
9	61.571	63.081	62.007	44.733	.48415E-01	.15143	.73498E-01	.72553E-01	2.0600	1.4344
10	63.861	55.627	47.588	46.426	.25421E-01	.31343	.70178E-01	.11904	1.4029	1.7352
11	71.752	54.212	67.841	44.357	.62440E-02	.29773	.22036E-02	.12051	2.7066	1.7507
12	73.288	54.369	65.423	44.560	.58463E-02	.30025	.18666E-01	.12057	2.2997	1.7466
13	73.236	53.777	70.897	43.854	.67984E-02	.29170	-.13397E-02	.11874	2.8618	1.7621
14	76.989	54.542	74.564	43.427	.49557E-02	.27511	-.60410E-03	.11225	2.8796	1.7380
15	64.962	52.083	51.673	42.427	.20141E-01	.26406	.75189E-01	.10775	1.6296	1.8347
16	57.527	51.396	37.960	40.924	.60605E-01	.27402	.48529E-01	.77175E-01	1.0691	1.8298
17	55.056	50.300	37.250	39.969	.75036E-01	.26093	.10892E-01	.58885E-01	1.0778	1.8974
18	125.60	64.460	131.95	42.404	.12439E-01	.44373E-01	.83343E-02	.31872E-01	2.9578	1.3386
19	107.45	157.56	63.515	86.023	.81449	.79425	.51178	.45005	.82307	.20283
20	97.963	110.65	41.775	50.006	.76376	.81109	.44025	.45319	.35096	.46057E-01
21	113.05	160.94	46.908	66.955	.70425	.80047	.40736	.45160	.41551	-.31775E-01
Statistics at Daily Level										
1	2.3511	1.8669	6.6164	4.8889	.31451	.36555	.97437E-01	.89971E-01	6.2529	5.4123
2	2.3569	1.8680	7.0437	4.8938	.31494	.36532	.10178	.89880E-01	6.7042	5.4169
3	3.7539	1.8970	11.852	5.0907	.44101	.34633	.16563	.81077E-01	8.0444	5.5847
4	2.8692	1.8953	8.0757	5.0741	.38736	.34771	.13486	.81533E-01	8.1726	5.5660
5	2.5043	1.9671	7.1751	5.0890	.53558	.34335	.21009	.73105E-01	7.1230	5.5545
6	2.3950	1.8990	6.0886	5.2812	.44686	.32468	.16256	.73708E-01	7.3249	5.8287
7	2.0545	2.1168	7.3944	5.0216	.36109	.36983	.11205	.71878E-01	8.0879	5.0874
8	2.1152	1.8673	6.6954	5.0619	.38363	.33730	.13359	.79426E-01	7.0384	5.6666
9	2.0396	2.0721	7.3871	4.9770	.34781	.36452	.11388	.71989E-01	8.1180	5.1717
10	2.1124	1.8281	5.8352	4.8322	.37938	.35099	.11668	.83437E-01	6.3444	5.4732
11	2.3687	1.7816	9.3122	4.6472	.25401	.36024	.51785E-01	.82931E-01	14.585	5.2549
12	2.4205	1.7868	8.2550	4.6590	.34112	.36019	.98220E-01	.83239E-01	11.737	5.2686
13	2.4169	1.7673	10.174	4.6229	.21752	.35896	.30633E-01	.82033E-01	15.629	5.2410
14	2.5410	1.7924	10.252	4.6052	.25465	.36059	.47822E-01	.81178E-01	15.104	5.1995
15	2.1471	1.7116	6.5906	4.6554	.34489	.33837	.10020	.74260E-01	7.3732	5.4006
16	1.9017	1.6894	5.3790	4.3405	.27320	.36749	.49972E-01	.89283E-01	6.0660	5.1890
17	1.8178	1.6535	5.2701	4.3094	.28060	.36048	.47208E-01	.87295E-01	6.0495	5.3051
18	4.1489	2.1175	15.580	4.7561	.39417	.37935	.13329	.77111E-01	10.182	4.6198
19	3.5368	5.1090	2.6602	3.3762	.70773	.87962	.64585	.80174	1.2794	.87574
20	3.2191	3.6429	2.0662	1.9410	.52075	.85595	.46717	.79119	.80177	.47653
21	3.7159	5.2972	2.4671	2.6879	.53369	.83878	.41907	.76454	1.0620	.46101

## (b) Bias corrected

Variable	Mean		SD		LAG1 Correl		LAG2 Correl		Skewness	
	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled	Observed	Modelled
Statistics at Annual Level										
1	858.71	811.60	219.02	197.03	-.13398	-.17449	.12022	-.32617	.17356	.76025
2	860.84	811.41	224.25	206.35	-.14926	-.18114	.14284	-.31820	.22185	.75793
3	1371.1	1298.4	365.75	296.86	.93771E-01	-.16858	.73320E-01	-.25694	-.93760E-01	.68065
4	1047.9	1007.1	266.85	223.05	.28824E-01	-.14804	.44938E-01	-.28850	.48283E-01	.69657
5	914.67	982.66	242.38	188.22	-.17943E-01	-.15279	.11188	-.25613	.38874	.20271
6	874.74	858.79	221.04	174.52	-.13435	-.14771	.15999E-01	-.22374	.38485	.33957
7	750.38	738.84	224.44	176.51	.11129	-.22973	.26678	-.17379	.63034	.17529
8	772.55	731.37	205.13	168.56	-.26869	-.24812	.18539	-.20571	.55293	.39711
9	744.92	726.50	236.85	178.18	.18577	-.23939	.33339	-.27062	.51354	-.88089E-03
10	771.53	737.22	187.34	148.93	-.17191	-.22538	.19630	-.10953	.25175	.18169
11	865.14	791.10	256.07	219.46	-.19625E-01	-.14808	.28091	-.63544E-01	.89628	1.1573
12	884.07	822.87	248.17	206.60	-.57029E-01	-.14874	.25608	-.13309	.91652	.94913
13	882.72	803.23	268.96	241.20	.13383E-01	-.15837	.28317	-.31025E-01	.91766	1.1154
14	928.07	847.47	280.13	240.81	.22308E-01	-.14075	.26706	-.74251E-01	.94539	1.1341
15	784.17	739.12	207.64	149.35	.14663E-01	-.21391	.19770	-.21937E-01	.72453	.13625
16	694.56	660.13	154.50	119.93	-.19561	-.22389	.85739E-01	-.84068E-01	.12330	-.58375E-01
17	663.93	620.26	141.60	102.06	-.19305	-.26471	.70632E-01	-.50965E-01	.21575E-01	-.54426E-01
18	1515.3	1442.9	486.37	358.87	.10381	-.22452	.16374	-.98286E-01	.92436	.53299
19	1292.0	1589.6	271.96	283.47	.79867	.91154	.63581	.81477	1.2261	.23580
20	1176.0	1360.9	83.697	93.408	.26795E-01	.14196	.32412E-01	-.23233	.70558	-.28273
21	1357.5	1734.2	102.84	82.119	-.14463	.20191	-.11601	.39738E-01	.24648E-01	.36032
Statistics at Seasonal Level										
1	214.68	202.90	100.40	115.86	.82953	.71823	-.17719	-.96013E-01	.93414	1.4331
2	215.21	202.85	107.43	123.99	.80604	.69141	-.21369	-.14611	1.0187	1.3843
3	342.77	324.61	208.53	223.35	.73209	.64065	-.32263	-.33625	.98565	1.3082
4	261.98	251.76	132.66	147.88	.80660	.71192	-.21551	-.21760	1.1978	1.4904
5	228.67	220.66	135.17	144.21	.73614	.67549	-.32881	-.41515	.91703	1.2242
6	218.69	214.70	101.44	112.87	.83621	.75779	-.17637	-.19721	1.0078	1.3089
7	187.60	184.71	120.47	124.26	.70280	.66992	-.21361	-.34896	1.2455	1.4990
8	193.14	182.84	105.53	116.52	.76870	.68741	-.31875	-.34247	.95606	1.2413
9	186.23	181.62	119.39	120.95	.71055	.67328	-.14103	-.33286	1.1361	1.4969
10	192.88	184.31	89.928	99.918	.83413	.74669	-.22538	-.25072	.78612	1.2515
11	216.28	197.77	123.16	119.71	.76602	.72566	-.20856	-.13698	1.4650	1.2283
12	221.02	205.72	119.97	118.38	.78424	.73788	-.23895	-.18531	1.3291	1.2073
13	220.68	200.81	128.32	126.28	.76078	.71352	-.19579	-.10308	1.5358	1.3868
14	232.02	211.87	134.99	126.74	.75842	.73224	-.20644	-.89179E-01	1.5588	1.3213
15	196.04	184.78	99.364	96.065	.81567	.76688	-.22887	-.20378	1.0341	1.0490
16	173.64	165.03	72.657	74.183	.85639	.80681	-.98176E-01	-.69463E-01	.46557	.96166
17	165.98	155.06	69.915	70.463	.85295	.80322	-.11746	-.10781	.36387	.87501
18	378.83	360.72	242.64	202.39	.70685	.75392	-.19884	-.20068	1.6560	1.3456
19	323.01	397.40	169.87	214.59	.81112	.79033	-.64339	-.75329	.58602	.45606
20	293.99	340.21	108.86	130.38	.87865	.86826	-.90663	-.90813	.14849	.18230
21	339.38	433.55	120.21	143.83	.88745	.89771	-.86760	-.92694	.22482	.71867E-01
Statistics at Monthly Level										
1	71.124	67.713	52.169	60.598	.52907E-01	.10741	.72362E-01	.17582E-01	1.6136	2.5611
2	71.298	67.697	55.494	63.573	.49197E-01	.12833	.59703E-01	.32426E-01	1.7316	2.5086
3	113.55	108.36	104.74	108.48	.87109E-01	.12056	.82111E-01	.87459E-01	1.7721	2.4614
4	86.758	84.120	68.742	75.504	.46642E-01	.76628E-01	.98049E-01	.62946E-01	1.9248	2.6514
5	75.828	73.701	69.283	71.340	.73016E-01	.13966	.96586E-01	.11107	1.7519	2.2124
6	72.610	71.707	54.104	58.939	.30976E-01	.95960E-01	.10914	.43823E-01	1.7781	2.3666
7	62.071	61.644	62.104	66.507	.51233E-01	.54268E-01	.97071E-01	.88253E-01	2.1146	2.5286
8	63.969	60.853	57.187	58.498	.37510E-01	.16359	.35851E-01	.87055E-01	1.8292	2.2375
9	61.571	60.516	62.007	63.834	.48415E-01	.75054E-01	.73498E-01	.92006E-01	2.0600	2.4073
10	63.861	61.440	47.588	52.243	.25421E-01	.10039	.70178E-01	.44018E-01	1.4029	2.1856
11	71.752	65.885	67.841	64.206	.62440E-02	.51199E-01	.22036E-02	.11812	2.7066	2.4352
12	73.288	68.567	65.423	62.379	.58463E-02	.72225E-01	.18666E-02	.80003E-01	2.2997	2.2521
13	73.236	66.918	70.897	68.145	.67984E-02	.46132E-01	-.13397E-02	.11817	2.8618	2.7506
14	76.989	70.607	74.564	68.616	.49557E-02	.38396E-01	-.60410E-03	.10989	2.8796	2.5449
15	64.962	61.684	51.673	51.103	.20141E-01	.61186E-01	.75189E-01	.69072E-01	1.6296	1.9136
16	57.527	55.018	37.960	42.153	.60605E-01	.33085E-01	.48529E-01	-.10119E-01	1.0691	2.1232
17	55.056	51.731	37.250	40.401	.75036E-01	.34189E-01	.10892E-01	-.77492E-02	1.0778	1.9371
18	125.60	120.34	131.95	116.72	.12439E-01	-.64717E-01	.83343E-02	.63842E-01	2.9578	2.4973
19	107.45	132.08	63.515	80.360	.81449	.77561	.51178	.46585	.82307	.69356
20	97.963	113.07	41.775	51.313	.76376	.75004	.44025	.41913	.35096	.34693
21	113.05	144.21	46.908	55.453	.70425	.74708	.40736	.41496	.41551	.14481
Statistics at Daily Level										
1	2.3511	2.2224	6.6164	7.1859	.31451	.29497	.97437E-01	.61832E-01	6.2529	8.1344
2	2.3569	2.2218	7.0437	7.6630	.31494	.28284	.10178	.60174E-01	6.7042	8.6431
3	3.7539	3.5552	11.852	12.420	.44101	.32032	.16563	.83492E-01	8.0444	9.2134
4	2.8692	2.7572	8.0757	8.6375	.38736	.32102	.13486	.84213E-01	8.1726	9.6060
5	2.5043	2.4167	7.1751	7.6860	.53558	.34826	.21009	.72710E-01	7.1230	8.8449
6	2.3950	2.3513	6.0886	6.5518	.44686	.32859	.16256	.73489E-01	7.3249	8.7916
7	2.0545	2.0231	7.3944	7.9511	.36109	.31805	.11205	.53571E-01	8.0879	9.9154
8	2.1152	2.0026	6.6954	6.8890	.38363	.31748	.13359	.69274E-01	7.0384	8.1695
9	2.0396	1.9893	7.3871	7.6656	.34781	.30630	.11388	.47568E-01	8.1180	9.0750
10	2.1124	2.0185	5.8352	6.1117	.37938	.31911	.11668	.62964E-01	6.3444	7.4712
11	2.3687	2.1662	9.3122	9.0674	.25401	.23606	.51785E-01	.29166E-01	14.585	15.783
12	2.4205	2.2530	8.2550	8.0612	.34112	.28819	.98220E-01	.42936E-01	11.737	12.226
13	2.4169	2.1994	10.174	9.9070	.21752	.21306	.30633E-01	.23999E-01	15.629	17.520
14	2.5410	2.3205	10.252	9.9272	.25465	.22193	.47822E-01	.26633E-01	15.104	16.867
15	2.1471	2.0237	6.5906	6.4910	.34489	.28648	.10020	.53451E-01	7.3732	8.0844
16	1.9017	1.8076	5.3790	5.5370	.27320	.29815	.49972E-01	.53653E-01	6.0660	6.9005
17	1.8178	1.6984	5.2701	5.4114	.28060	.28739	.47208E-01	.54570E-01	6.0495	7.1431
18	4.1489	3.9507	15.580	14.862	.39417	.31137	.13329	.51824E-01	10.182	10.589
19	3.5368	4.3513	2.6602	3.3729	.70773	.76289	.64585	.65146	1.2794	1.2299
20	3.2191	3.7253	2.0662	2.4468	.52075	.60248	.46717	.51297	.80177	.75695
21	3.7159	4.7475	2.4671	2.9476	.53369	.55265	.41907	.42689	1.0620	.67746

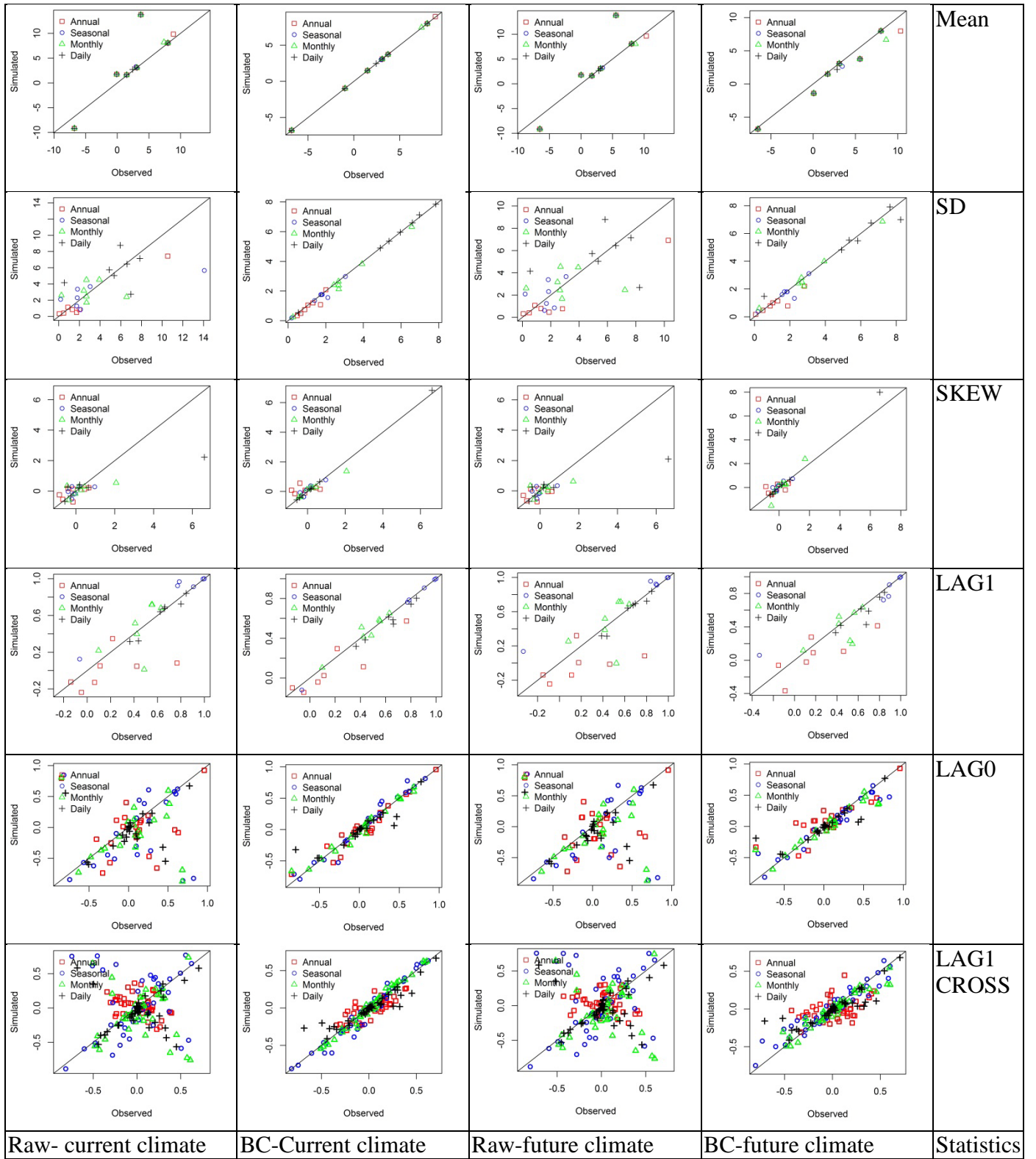


Figure 1: Scatter plots of raw vs observed and bias corrected vs observed statistics for calibration/current climate and validation/future climate time periods – dataset 1.



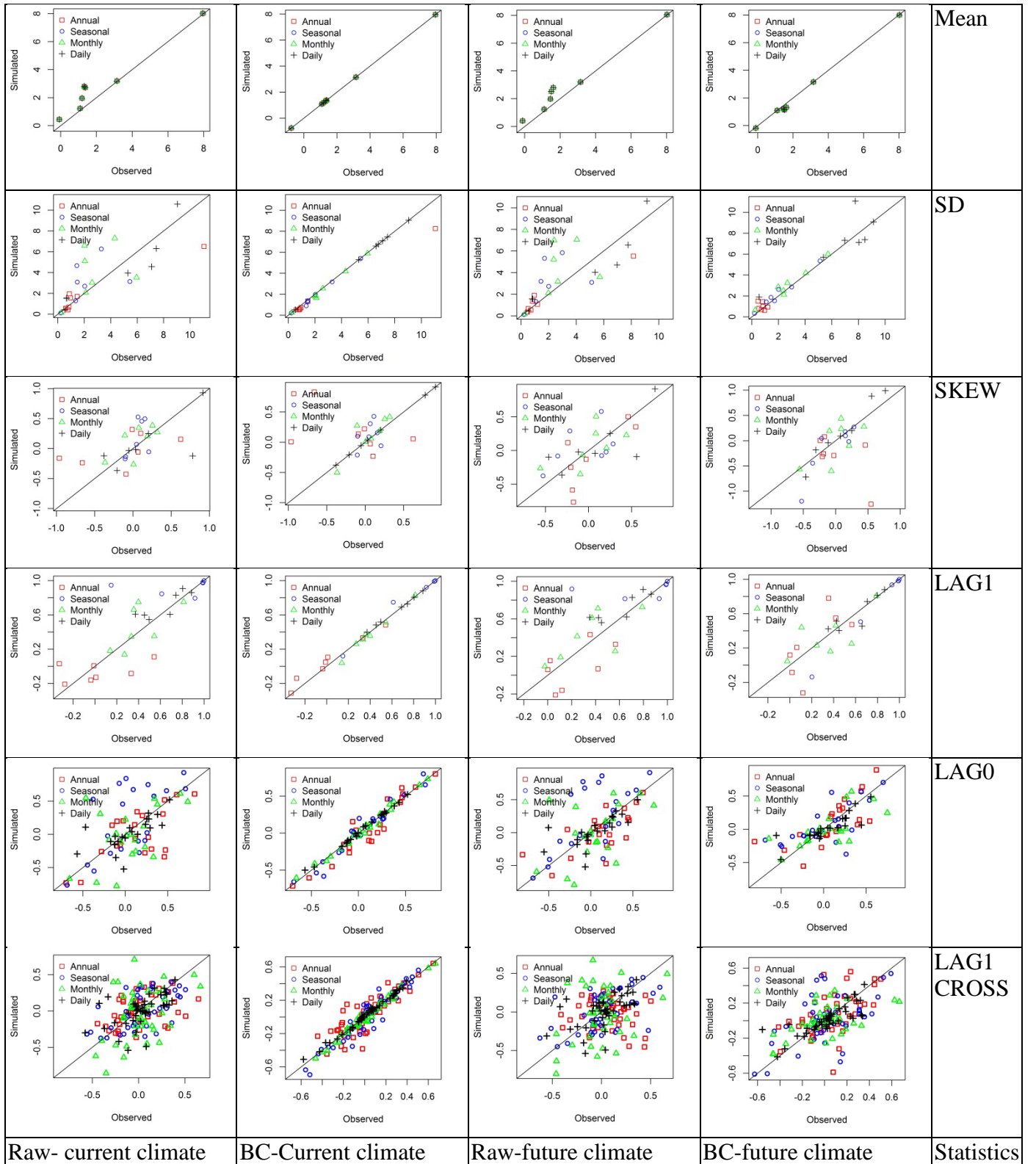


Figure 2: Scatter plots of raw vs observed and bias corrected vs observed statistics for calibration/current climate and validation/future climate time periods – dataset 2.

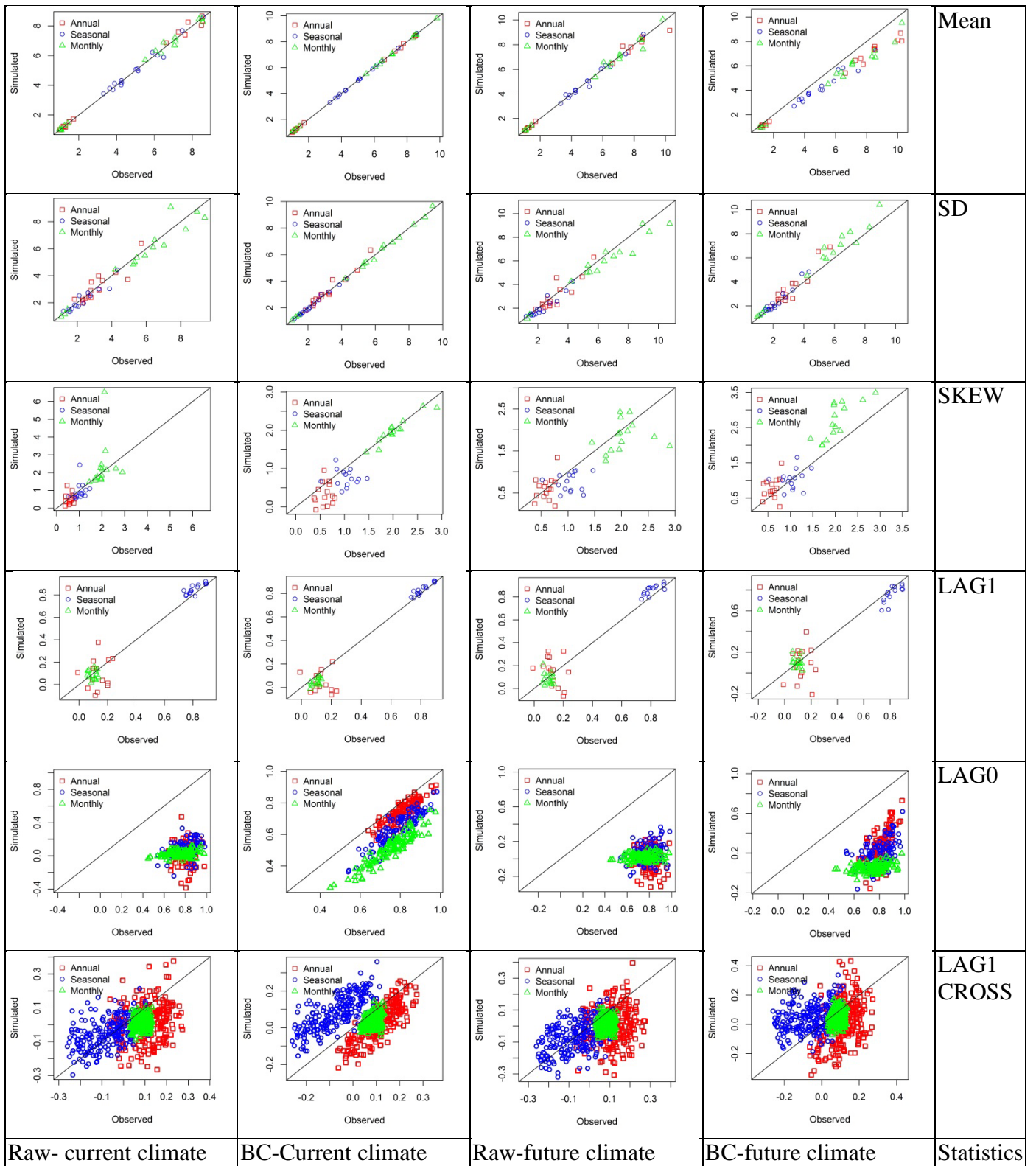


Figure 3: Scatter plots of raw vs observed and bias corrected vs observed statistics for calibration/current climate and validation/future climate time periods – dataset 3.



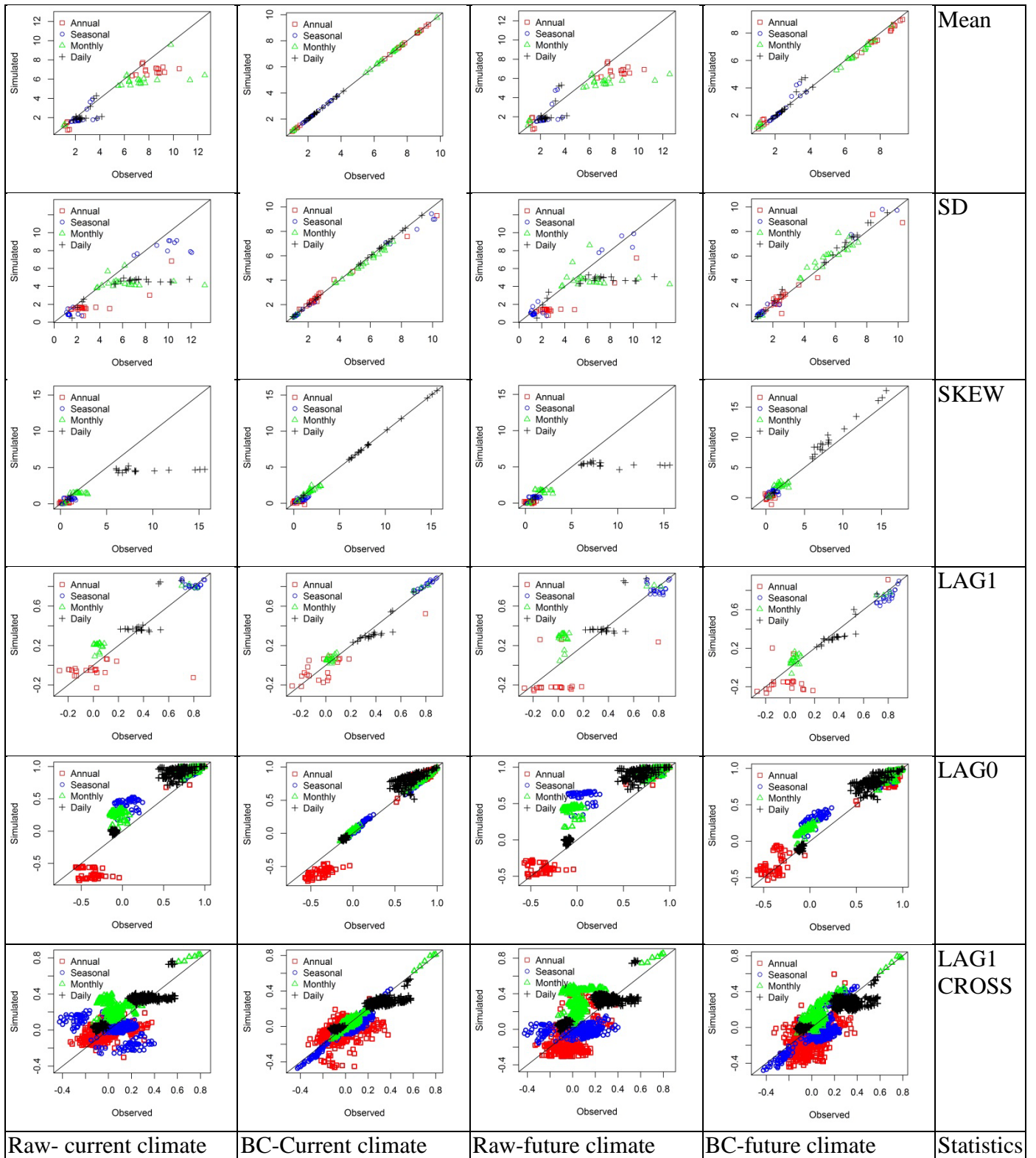


Figure 4: Scatter plots of raw vs observed and bias corrected vs observed statistics for calibration/current climate and validation/future climate time periods – dataset 4.