

On the Next Generation (NextGen) Seasonal Prediction System for Bangladesh



Nachiketa Acharya¹

and

Simon Mason¹, S. M. Q. Hassan² and Ángel G. Muñoz¹

¹International Research Institute for Climate and Society, Earth Institute at Columbia University, Palisades, NY, USA

²Bangladesh Meteorological Department, Dhaka., Bangladesh

Old +Existing system (subjective consensus)

The screenshot shows the Bangladesh Meteorological Department website with a forecast for Mymensingh. The temperature is 7°C, with a sunrise at 6:26 AM and sunset at 5:48 PM. The forecast for the next 28 hours shows a maximum of 27.5°C and a minimum of 16.8°C. The website includes a navigation menu, a news section about a quake, and a detailed forecast section with a three-month outlook. The forecast is presented as a subjective consensus.

New initiative (more objective)

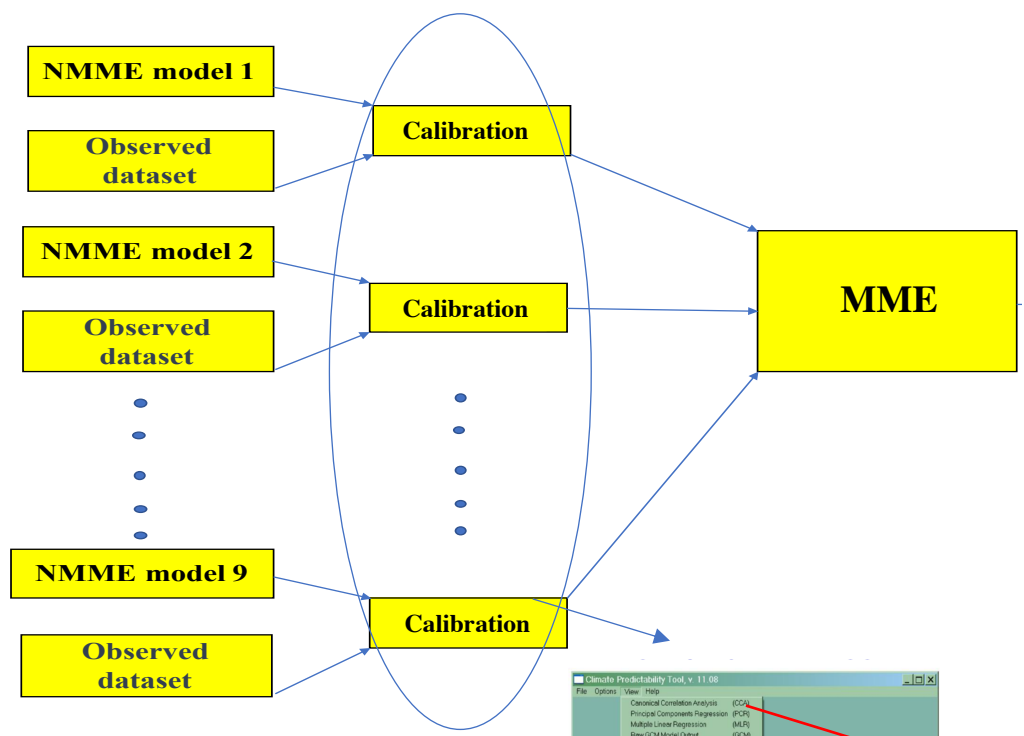
The screenshot shows the Bangladesh Meteorological Department website with a forecast for Chudanga. The lowest minimum temperature of 12.4°C was recorded at Chudanga on 17 February. The forecast for the next 28 hours shows a maximum of 28.1°C and a minimum of 14°C. The website includes a navigation menu, a news section about the lowest minimum temperature, and a detailed forecast section with a three-month forecast. The forecast is presented as a more objective prediction.

Generated by: BMD in collaboration with IRI

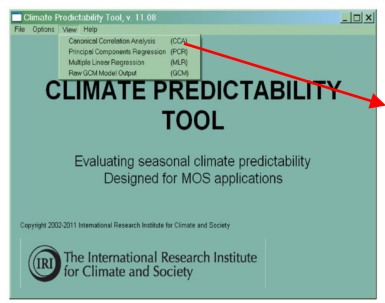
NextGen Forecast System at BMD

In their recent seasonal forecast guidance, the **World Meteorological Organization** recommended the use of an **objective seasonal forecast procedure**, defined as a traceable, reproducible, and well documented set of steps that allows quantification of forecast quality, are preferred.

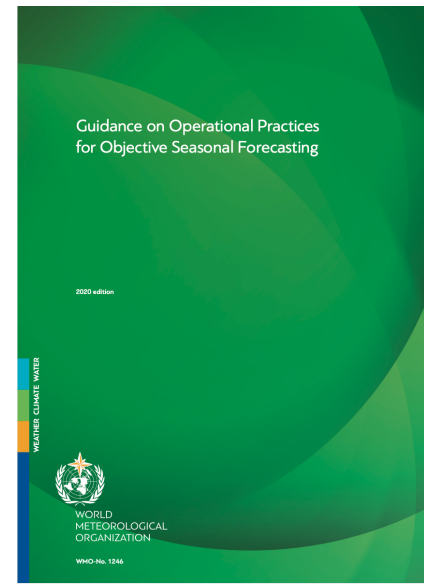
Calibration Procedure



Predictor and Predictand Domain



Canonical Correlation Analysis.

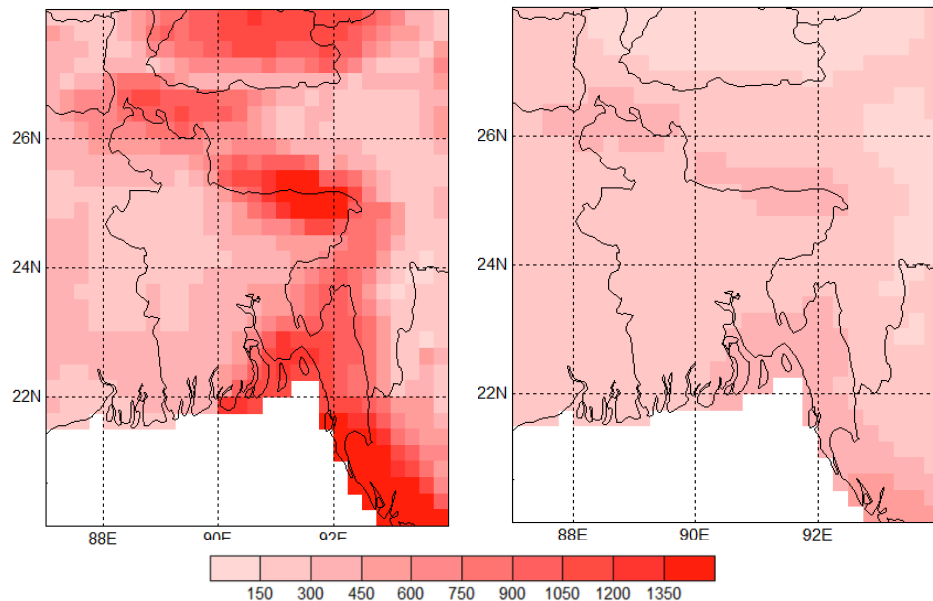
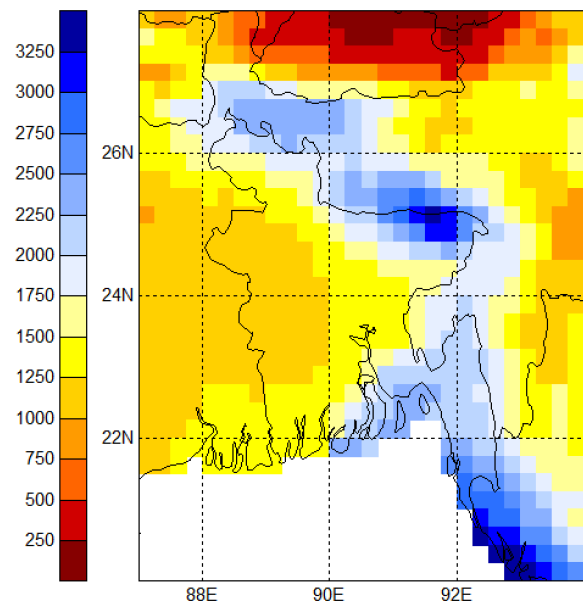


Forecast Skill for JJAS

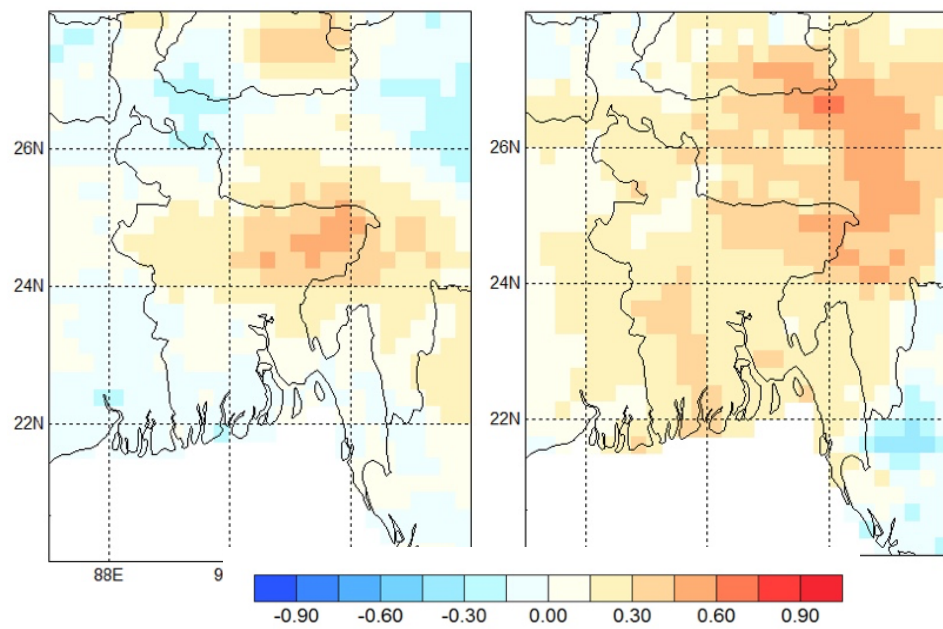
Individual GCM

Non-calibrated RMSE (mm) **Calibrated (CCA)**

JJAS Climatology (mm)

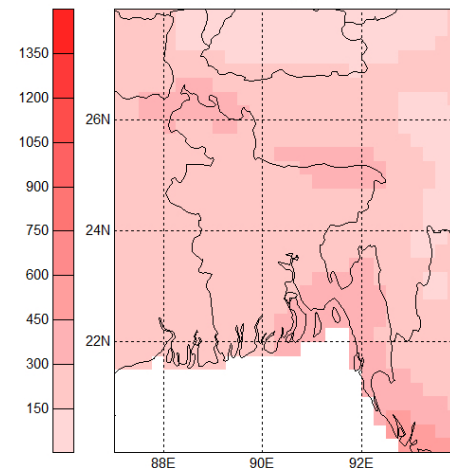


Spearman's CC

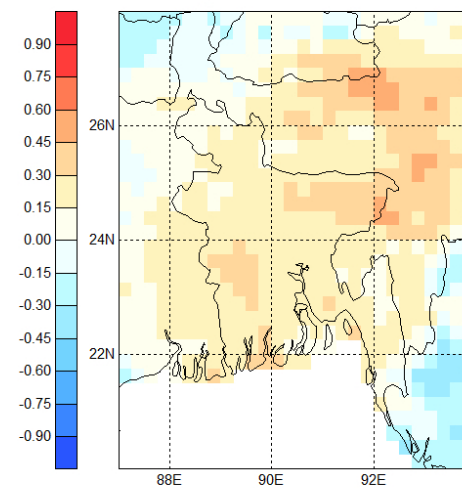


Skill of Calibrated MME (CMME)

Root mean squared error

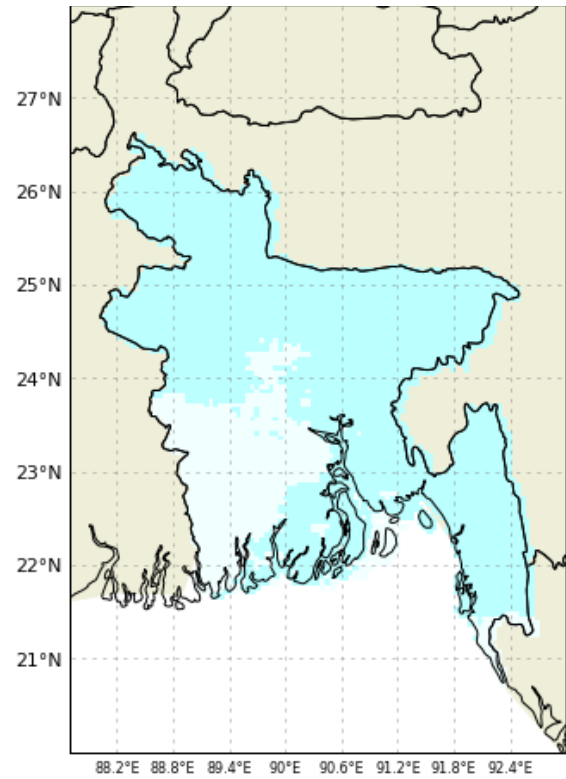


Spearman's correlation

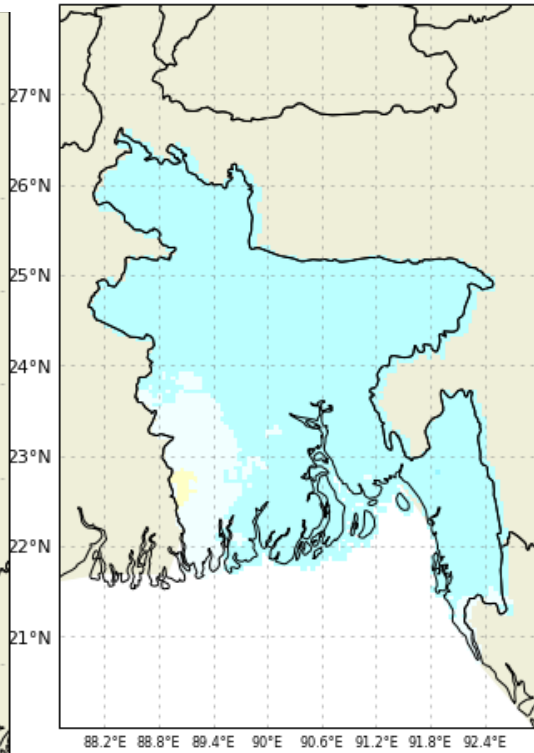


How good is the NextGen for monsoon 2020?

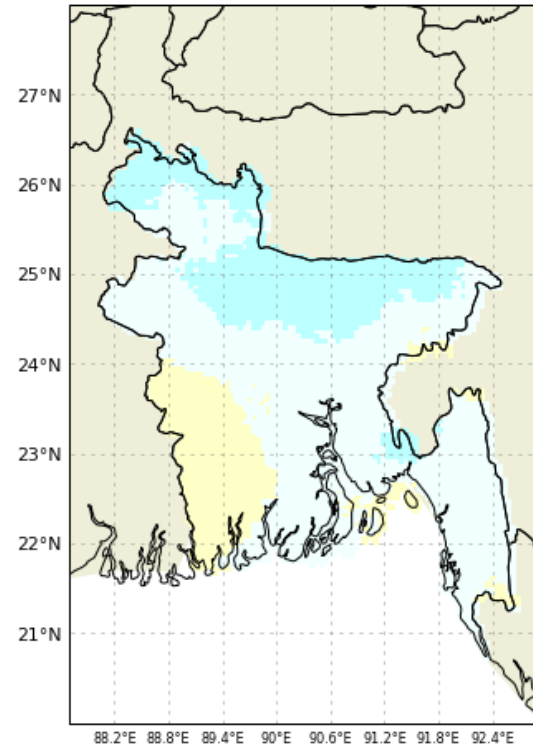
JJAS forecast issued on May 2020



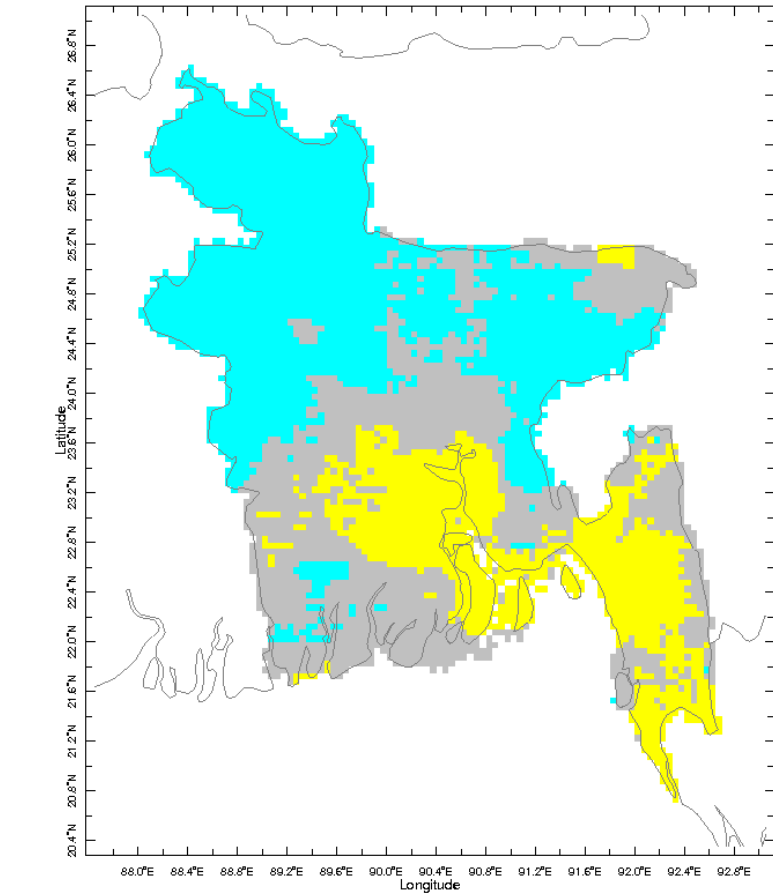
JJA forecast issued on May 2020



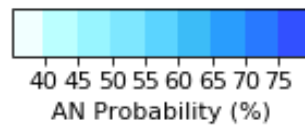
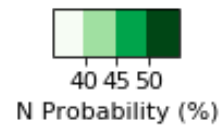
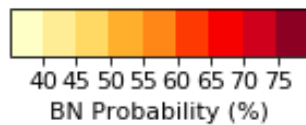
JAS forecast issued on Jun 2020



Observed category during Jun-July, 2020



Jun-Jul 2020



Forecast Maproom at BMD

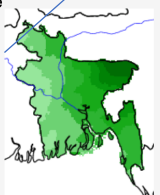


BMD Map Room

The climate and society maproom is a collection of maps and other figures that monitor climate and societal conditions at present and in the recent past. The maps and figures can be manipulated and are linked to the original data. Even if you are primarily interested in data rather than figures, this is a good place to see which datasets are particularly useful for monitoring current conditions.

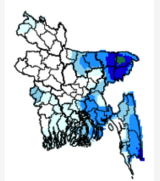
Climate

Historical, current and forecast climate conditions around the country.



Agriculture and Climate

The variability of seasonal precipitation, and the sub-seasonal statistics of these, play a key role in the quality and quantity of agricultural output.



BMD Maproom Climate

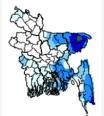
Climate

Historical, current and forecast climate conditions around the country.

Climate Analysis Climate Monitoring Climate Forecast

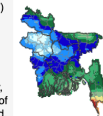
Daily Climate Analysis

The Maproom explores historical daily precipitation by calculating simple seasonal statistics.



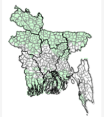
Seasonal Trend Analysis

Rainfall time series (1981-2017) and temperature time series (1981-2017) reconstructed from station observations, remote sensing and other proxies. This interface allows users to view rainfall, maximum, minimum and mean temperature seasonal trends expressed per year, over the selected period or percent of the average over the selected period.




Dekad Climate Analysis

Rainfall and temperature time series reconstructed from station observations and remote sensing proxies. This interface allows users to view rainfall, maximum, minimum and mean temperature dekadal climatologies and anomalies.




Extreme Rainfall Analysis

The Maproom facilitates the exploration of the history of extreme monthly and seasonal rainfall characteristics.



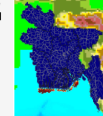
Monthly Climate Analysis

Rainfall time series (1981-2017) and temperature time series (1981-2017) reconstructed from station observations, remote sensing and other proxies. This interface allows users to view rainfall, maximum, minimum and mean temperature monthly climatologies and anomalies.



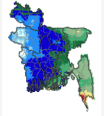
Extreme Temperature Analysis

The Maproom facilitates the exploration of the history of extreme monthly and seasonal minimum and maximum temperatures.



Seasonal Climate Analysis

Rainfall time series (1981-2017) and temperature time series (1981-2018) reconstructed from station observations, remote sensing and other proxies. This interface allows users to view rainfall, maximum, minimum and mean temperature seasonal climatologies, anomalies and probability of exceedance.

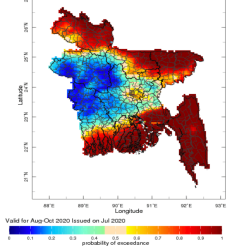


Maproom Bangladesh Forecasts

Precipitation Flexible Seasonal NextGen Forecast

Field: Probability of exceeding Rainfall: 1000 mm

Precipitable Seasonal Gen Forecast



This Maproom shows full distribution rainfall forecast using a NextGen multi-model approach.

NextGen is a systematic general approach for designing, implementing, producing and verifying objective climate forecasts. It involves the identification of decision-relevant variables by the stakeholders; the analysis of the physical mechanisms, sources of predictability and suitable candidate predictors (in models and observations) for these key relevant variables. In those cases when prediction skill is high enough, NextGen helps select the best dynamical models for the region of interest through a process-based evaluation, and automatizes the generation and verification of tailored multi-model, statistically calibrated predictions at seasonal and sub-seasonal timescales.

The system takes advantage of the expertise of forecasters and local scientists at the country's climate monitoring and forecasting centers to provide a robust and reliable forecast. NextGen also provides probabilities of exceeding (or not) particular thresholds of interest in the decision-making process, thus enabling users to forecast with the same system both mean and extreme values.

The models employed in this forecast are CanSIPSv2, COLA-RSMAS-CCSM4, GFDL-CM2p5-FIOR-A06, GFDL-CM2p5-FIOR-B01, NASA-GEOS5S, NCEP-CFSv2, and the predictand is rainfall from BMD ERA5. The default map shows, for the latest forecast made, the median value of the seasonal rainfall total forecast in the season. Users can use the Field menu to express the forecast in different ways, as follows:

- Rainfall:** most likely seasonal total rainfall
- Anomaly:** deviation in mm of the most likely seasonal total rainfall from yearly average of the most likely seasonal total rainfall predicted by the hindcast (1982-2010)
- Percent of Median:** deviation in percentages of the most likely seasonal total rainfall from yearly median of the most likely seasonal total rainfall predicted by the hindcast (1982-2010)
- Probability of non-exceeding a Percentile:** forecast probability of seasonal total rainfall to be below/above the historically observed (1982-2010) chosen percentile
- Probability of non-exceeding a Precipitation amount:** forecast probability of seasonal total rainfall to be below/above the chosen rainfall amount

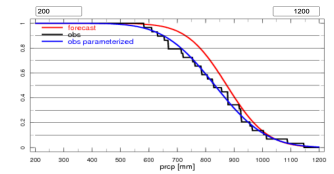
The Layers button, showing when mousing over the map, will reveal inactive layers on the map.

Clicking on the map will reveal information about the location clicked, as well as the full forecast distribution at that given location, compared with the historical distribution. Cumulative full distribution of the forecast (red) together with the climatological distribution (blue and black) for the forecast in view on the map shows under **Probability of Exceedance**, as well as the full

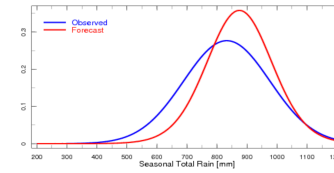
Valid for: Issued on: Lead Time: Aug-Oct 2020 0000 1 Jul 2020 2.5

Forecast made for: [91.675E-91.725E, 24.425N-24.475N] located in or near Moulvibazar Sadar, Moulvibazar, Sylhet

Probability of Exceedance



Probability Distribution



Aug-Oct 2020 Forecast Issued July 2020 at [91.675E-91.725E, 24.425N-24.475N]