# Projection of Precipitation and Temperature Extremes over Bangladesh from CMIP6 SSP-RCP Scenarios

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November 23, 2022

**Abstract**

Bangladesh is one of the most vulnerable countries of the world in the event of climate change due to its unique geographical location. This study assessed the impact of climate change on precipitation and temperature extremes over Bangladesh from Coupled Model Intercomparison Project Phase 6 (CMIP6) models under four SSP-RCP (Shared Socioeconomic Pathway-Representative Concentration Pathway) scenarios (SSP126, SSP245, SSP370, and SSP585). At first quantile mapping (QM) method was employed to produce bias-corrected daily data. Then the future changes in climate extremes were assessed using a subset of extreme temperature and precipitation indices devised by the Expert Team on Climate Change Detection and Indices (ETCCDI). For the assessment of precipitation extremes, Consecutive Wet Days (CWD), Number of days with rainfall greater than 10mm (R10mm), Wet Days Precipitation (R95p), total annual rainfall (PRCPTOT), annual maximum 1-day precipitation (Rx1day), and annual maximum 5-day precipitation (Rx5day) have been utilized while for the temperature extremes, frequency of hot days (TX90p) and cool days (TX10p) have been used. The results from the probability density function (PDF) of most of the precipitation indices show rightward shifting in the future indicating a tendency toward wetter conditions. However, the magnitudes of change were different for the selected CMIP6 Global Climate Models (GCMs). The projected increase in CWD is greater over the south-western region of the country while the projected increase in PRCPTOT is greater over the north-eastern region of the country under all scenarios. R10mm shows the highest increase for the SSP585. In response to climate change, the TX90p shows a general increase in this century. However, the frequency of cool days is projected to decrease for most of the SSP scenarios. The results from these analyses present an opportunity to understand the impact of climate change on extreme events in Bangladesh and thus may help the local decision-makers in policy-making, disaster management, and infrastructure planning.

# PROJECTION OF PRECIPITATION AND TEMPERATURE EXTREMES OVER BANGLADESH FROM CMIP6 SSP-RCP SCENARIOS

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AGU FALL MEETING

16 December, 2021

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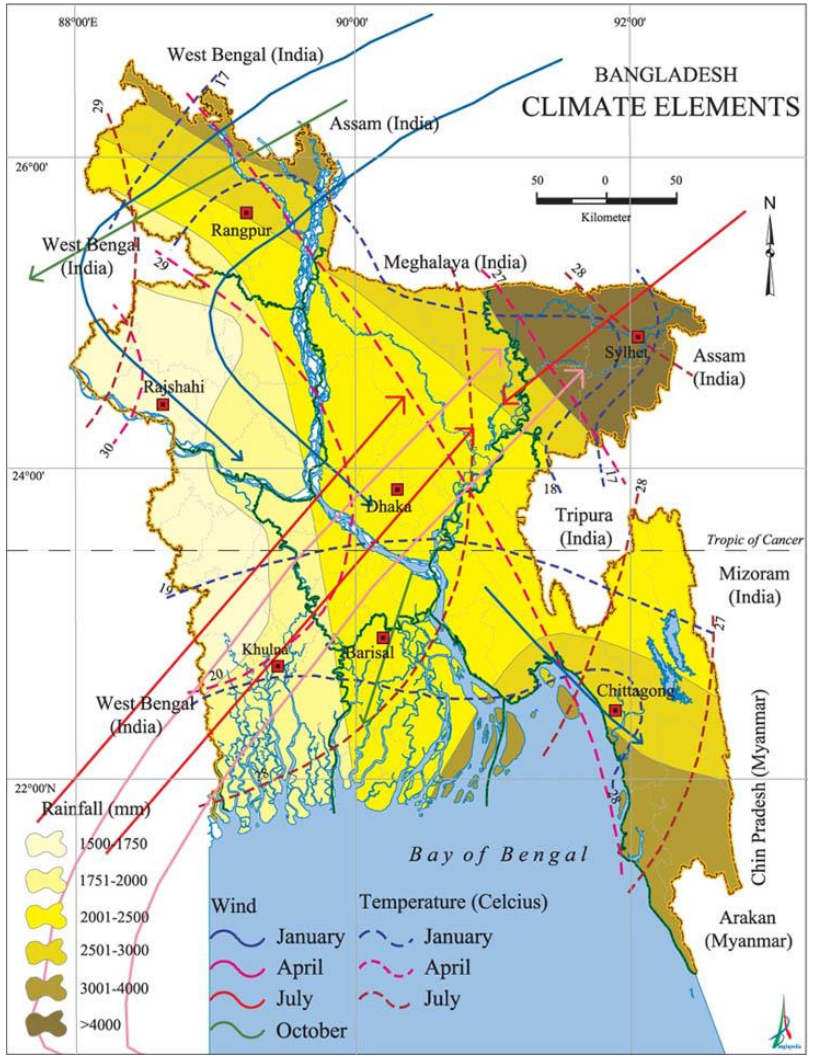


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# DATA:

Precipitation and temperature data from World Climate Research Programme's (WCRP) Coupled Model Intercomparison Project Phase 6 (CMIP6) was used in this study. Climate indices were calculated and assessed at 0.25 degree spatial resolution all over Bangladesh and compared for 3 different Global Climate Models (GCMs) mentioned below:

- ACCESS-CM2
- CanESM5
- EC-Earth3

# STUDY PERIOD:

- Historical Period: 1951-2014
- Future Shared Socio-Economic Pathways (ssp) : 2015-2100

# SHARED SOCIO-ECONOMIC PATHWAYS (SSP)

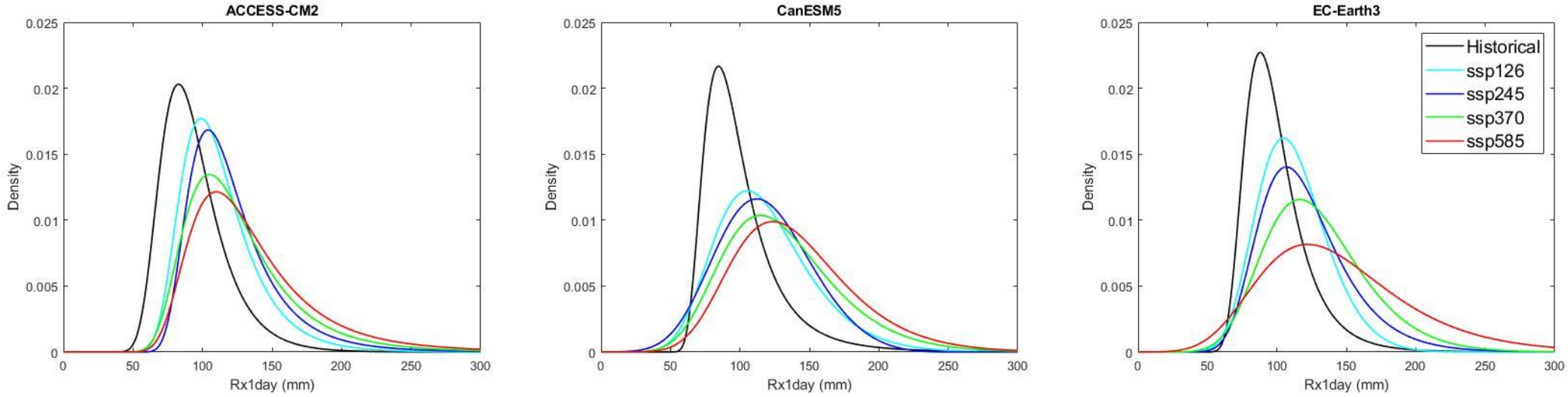
| SSP | Scenario |
|---|---|
| SSP 126 | low GHG emissions: CO2 emissions cut to net zero around 2075 |
| SSP 245 | intermediate GHG emissions (likely): CO2 emissions around current levels until 2050, then falling but not reaching net zero by 2100 |
| SSP 370 | high GHG emissions (unlikely): CO2 emissions double by 2100 |
| SSP 585 | very high GHG emissions (highly unlikely): CO2 emissions triple by 2075 |

# ETCCDI INDICES:

Among the 27 indices defined by Expert Team on Climate Change Detection and Indices (ETCCDI), 7 were used in this study:

- Consecutive Wet Days (CWD)
- Number of Days with Rainfall Greater than 10mm (R10mm)
- Wet Days Precipitation (R95p)
- Annual Maximum 1 day Precipitation (Rx1day)
- Annual Maximum 5 day Precipitation (Rx5day)
- Frequency of Hot Days (Tx90p)
- Frequency of Cool Days (Tx10p)

# ANNUAL MAXIMUM 1 DAY PRECIPITATION (RX1DAY):




Rightward shift and lower peaks of Rx1day indicates the frequency of maximum rainfall in one day to decrease and the intensity to increase.

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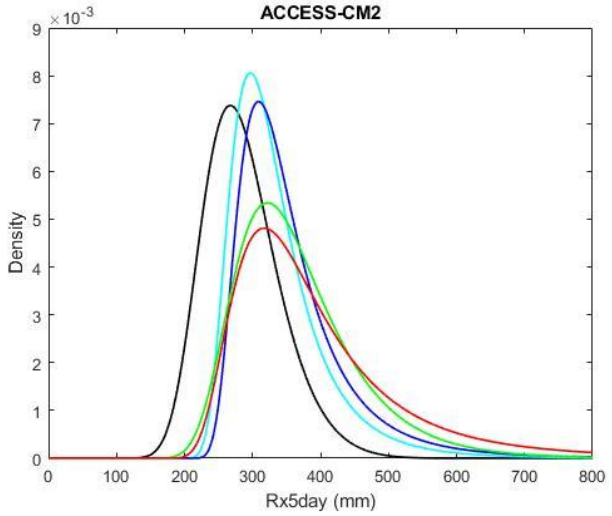
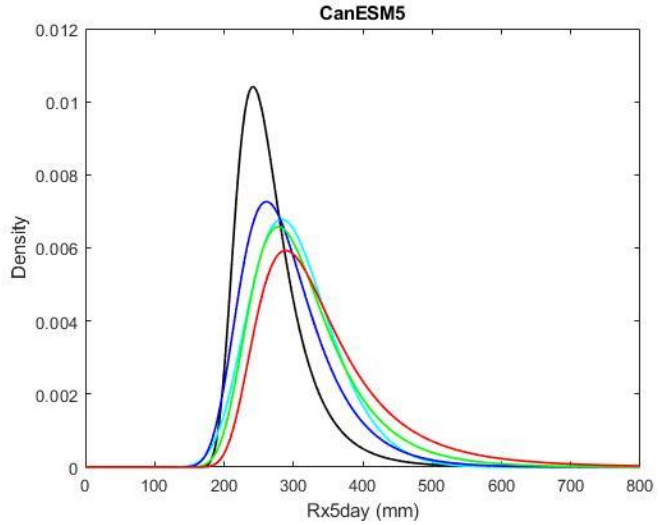
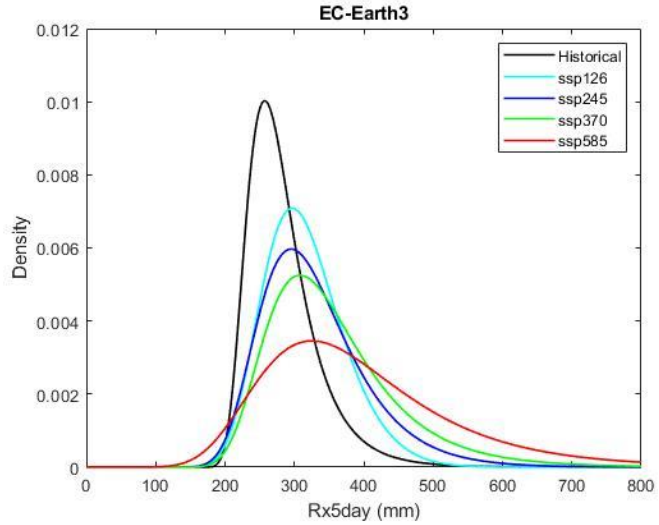
# ANNUAL MAXIMUM 5 DAY PRECIPITATION (RX5DAY):




From CanESM5 and EC-Earth3, lowering of peak and rightward shift for future scenarios are observed. This indicates the frequency of maximum rainfall in one day to decrease and the intensity to increase.

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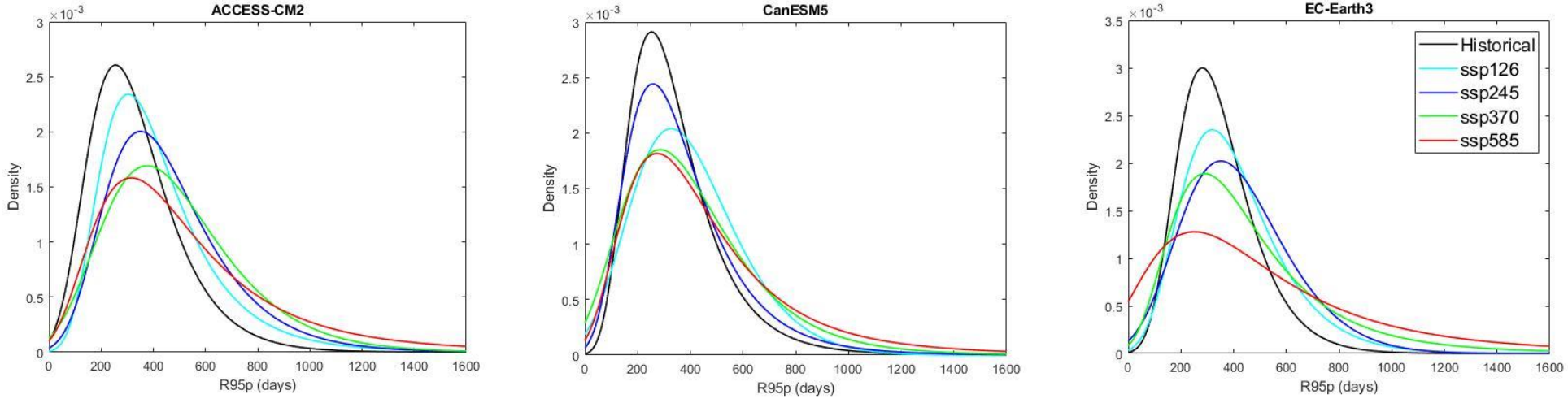
# WET DAYS PRECIPITATION (R95P):




R95p plots show lowering of peaks and rightward shift in most future scenarios. This indicates that the frequency of wet days are projected to decrease in the future but the intensity is projected to increase.

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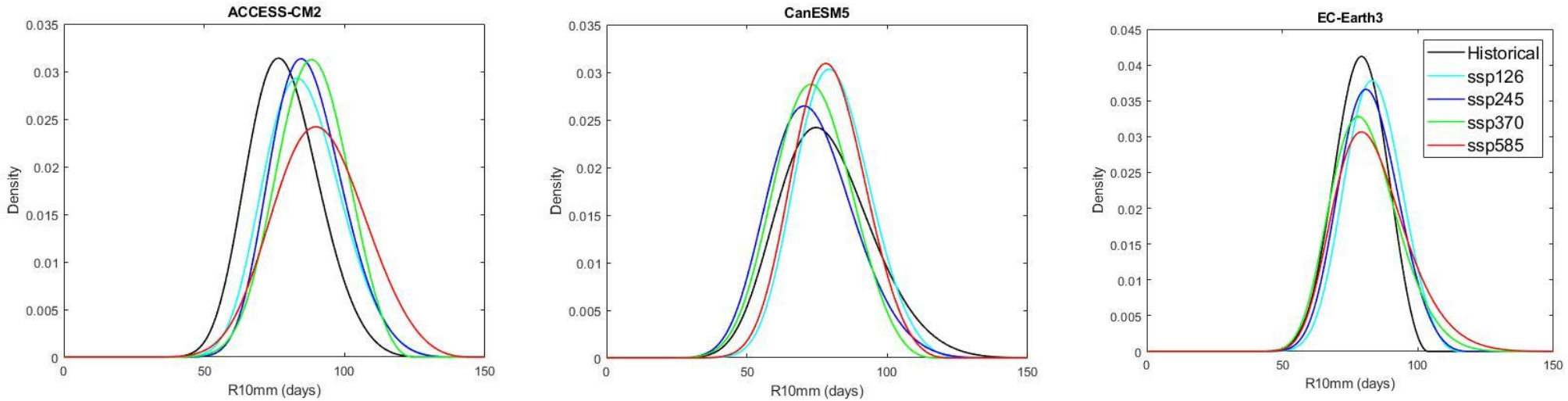
# NUMBER OF DAYS WITH RAINFALL GREATER THAN 10MM (R10MM):




R10mm plots show lowering of peak for most ssp scenarios which indicates the frequency of number of days with rainfall greater than 10mm is predicted to decrease.

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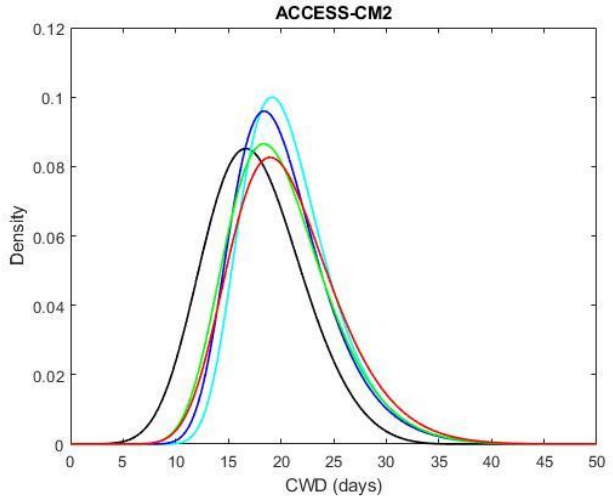
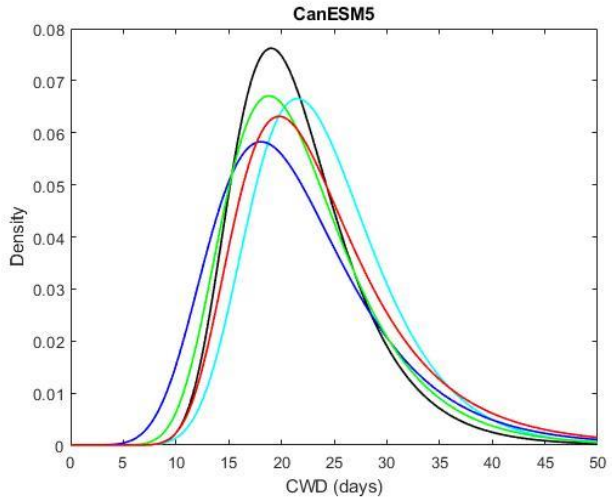
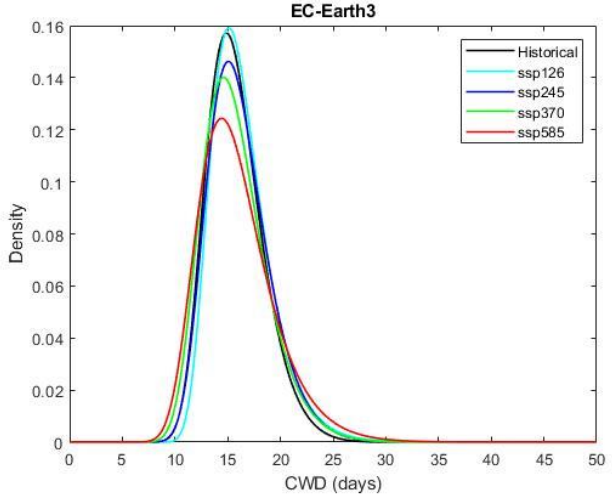
# CONSECUTIVE WET DAYS (CWD):




CWD plots for most ssp shows leftward shift which indicates a possible decrease in consecutive wet days.

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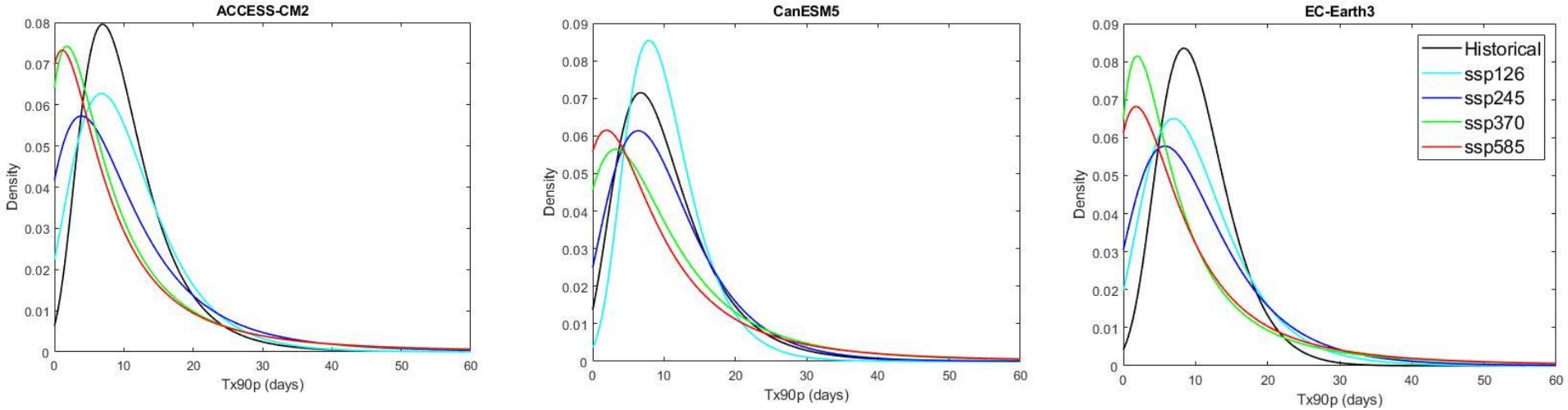
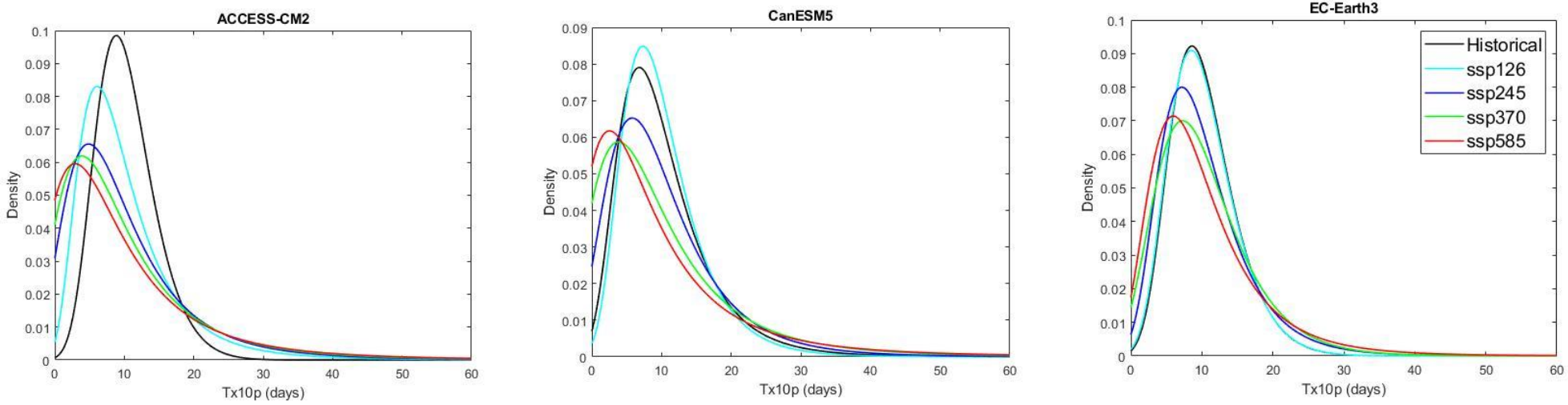
# FREQUENCY OF HOT DAYS (TX90P):




Tx90p plots from all the GCMs show the overall temperature of hot days to increase in future.

# FREQUENCY OF COOL DAYS (TX10P):




Tx10p lower peaks for all ssp except for ssp126 and leftward shift for all the scenarios. This indicates the cold days are predicted to get even colder in future.

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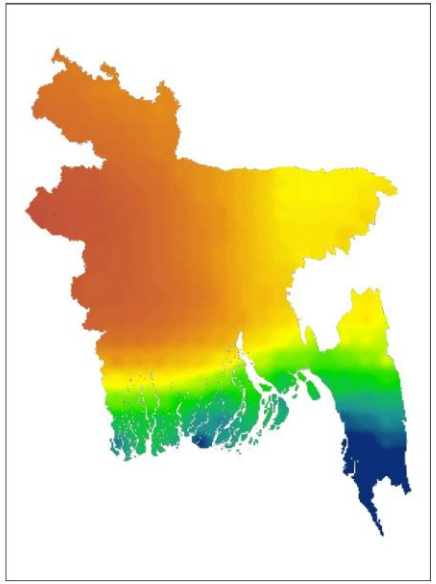
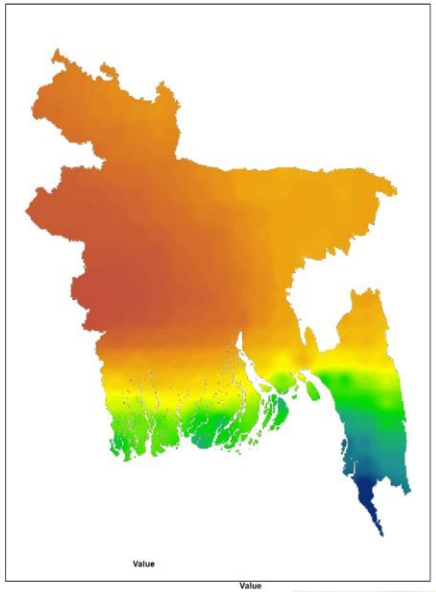
# SPATIAL PLOT OF CWD (HISTORICAL AND SSP585)

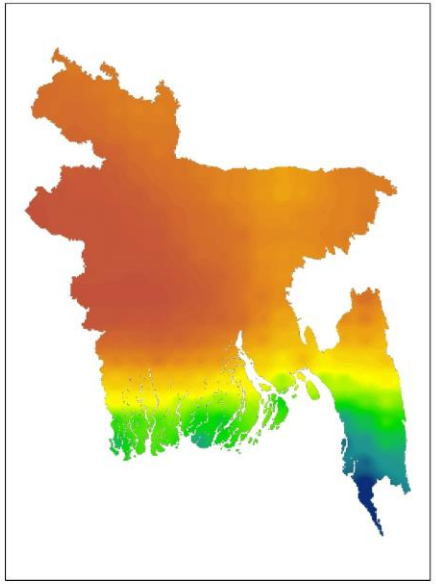
Historical (1951-2014)



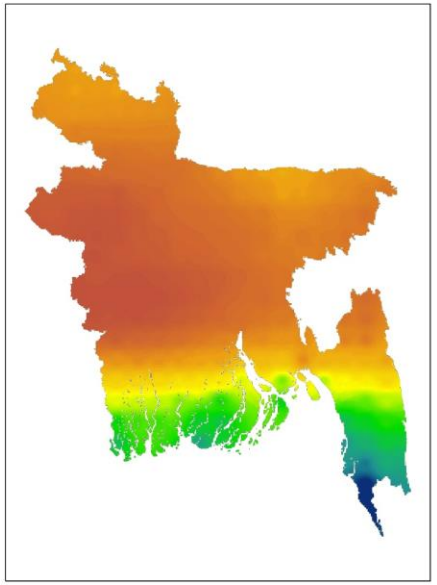
(2015-2040)

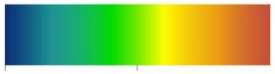



(2041-2070)



(2071-2100)





High : 70.6 Low : 12.21875

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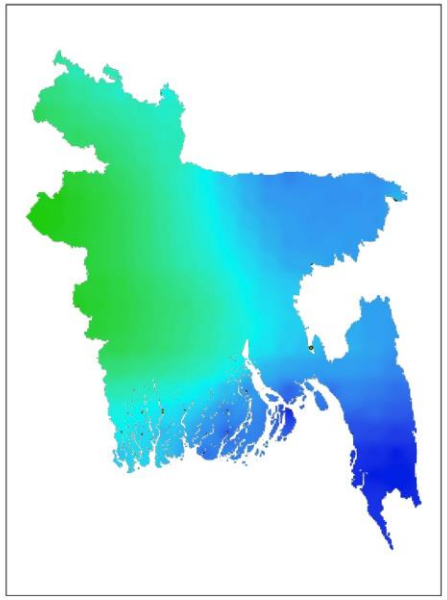
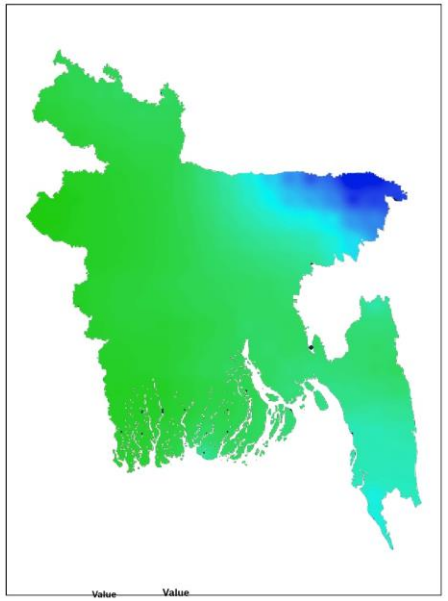
# SPATIAL PLOT OF RX1DAY (HISTORICAL AND SSP585)

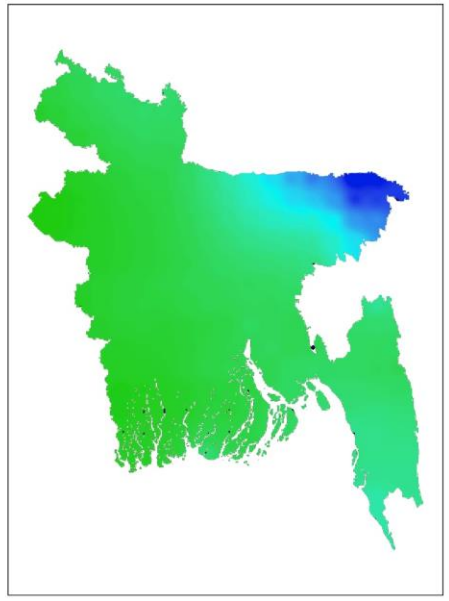
Historical (1951-2014)



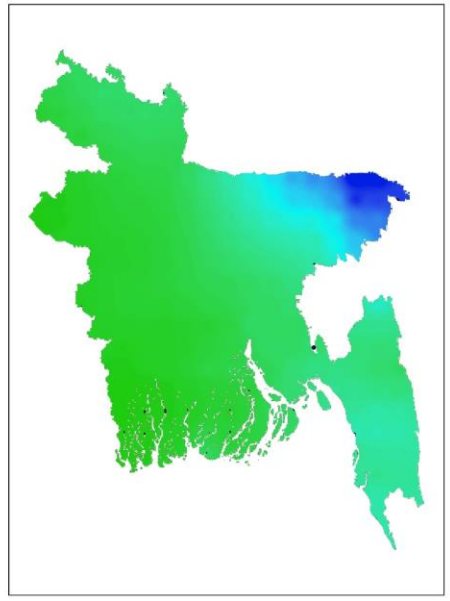
(2015-2040)



(2041-2070)



(2071-2100)



High : 590.8493333

Low : 57.197

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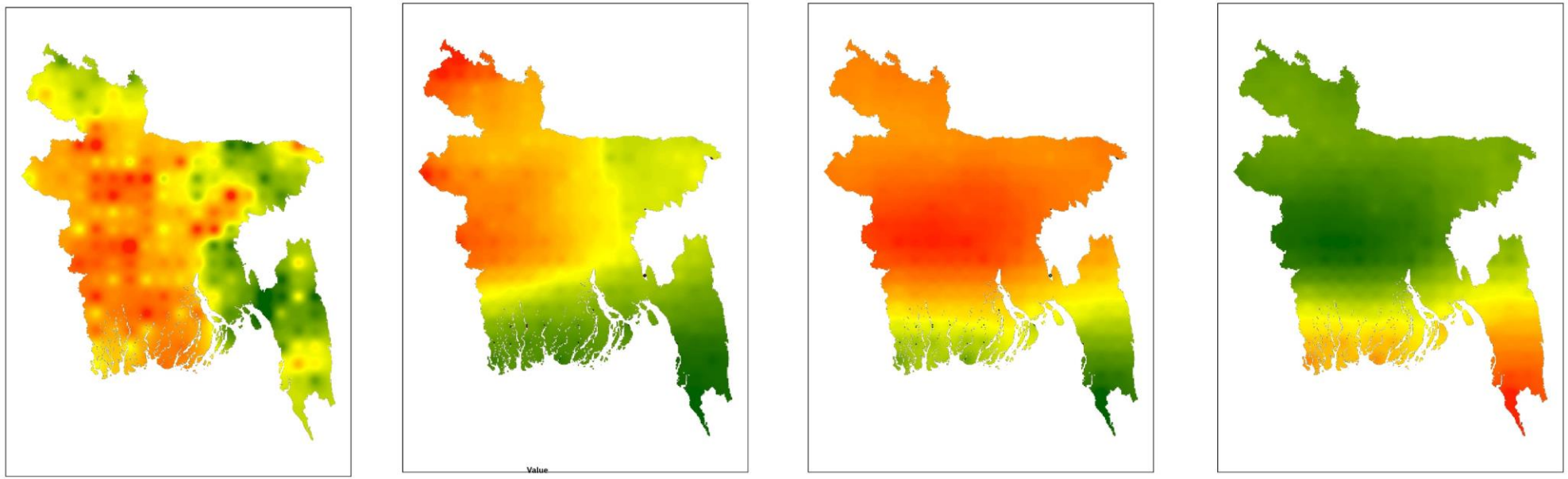
# SPATIAL PLOT OF TX90P (HISTORICAL AND SSP585)

Historical (1951-2014) (2015-2040) (2041-2070) (2071-2100)

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# CONCLUSION:

- The intensity of Rx1day, Rx5day, R10mm and R95p are predicted to increase under all future scenarios.
- CWD shows possible decrease in the future.
- Tx90p shows increase in temperature throughout the century.
- Tx10p indicated the cool days to get even cooler in the future.
- When the future time period was divided into 3 parts, the change in precipitation and temperature throughout the century seemed almost uniform.

The results form this analyses present an opportunity to understand the impact of climate change on extreme events in Bangladesh thus may help the local decision-makers in policy-making, disaster management and infrastructure planning.

# THANK YOU

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