PROJECTED TRENDS IN CLIMATE EXTREMES IN THE PASSAIC RIVER BASIN BASED ON GLOBAL CLIMATE MODEL SIMULATIONS

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Introduction

- By downscaling and bias-correcting Global Climate Model (GCM) outputs, more accurate predictions concerning specified regions can be made.
- Multivariate Adaptive Constructed Analog (MACA) models provide daily precipitation and temperature information for point localities by modifying coarse resolution data from GCMs to a higher spatial resolution.
- In this study, trends in climate extremes over the Passaic River Basin (PRB) between 2051-2075 are estimated based on three MACA models (bcc-csm1-1m, CCSM4, and MRI-CGCM3) to determine potential impacts of climate change in emissions scenarios RCP 4.5 (medium emissions) and 8.5 (extreme emissions).

Fig. 1 – Study Site: Passaic River Basin

Methods

- Historical minimum and maximum temperature and precipitation raw data were downloaded from the MACA model. Observation data obtained from PRISM.
- MACA precipitation data correction methods include quantile mapping (Equation 1) and a linear correction factor method (Equations 2 and 3).

\[ q_{\text{corr}}(x) = \frac{q_{\text{obs}}(x)}{q_{\text{mod}}(x)} \]  
\[ q_{\text{corr}}(x) = q_{\text{mod}}(x) + \left( q_{\text{obs}}(x) - q_{\text{mod}}(x) \right) \]  
\[ q_{\text{corr}}(x) = \frac{q_{\text{obs}}(x)}{q_{\text{mod}}(x)} \]

- Correction methods tested for reliability using a Cumulative Distribution Function (Figure 2).

Fig. 2 – CDF comparison of bias correction methods used to determine most reliable dataset for climate analysis

- Bias correction applied to 2051-2075 precipitation projections.

References


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Discussion and Future Work

- The linear method of correction is more accurate than quantile mapping for this dataset.
- MACA is more accurate at the seasonal level than the daily.
- We hypothesize that the impacts on temperature are due to increased precipitation and associated cloudiness given that there is an overall increase in wet days, extreme precipitation, and consecutive precipitation.
- The increase in rainfall is most likely due to decreased longwave cooling at nights—therefore, there would be a reduced amount of very cool nights and an increase in warm nights.
- For TN10p, the models agree that there will less extremely cold days, but RCP 8.5 for bcc-csm1-1m and MRI-CGCM3 shows less of a decrease than RCP 4.5. The models generally also see an increase in the days per year that will experience warmer nights, except in the case of CCSM4 RCP 8.5, which sees a decrease in the 90th percentile of warm nights.
- Given the continuous deforestation and urbanization of the PRB and the “heat island effect,” temperatures may increase further.
- Future work can involve incorporating more MACA models for a fuller analysis.