STOCHASTIC DOWNSCALING OF HOURLY PRECIPITATION SERIES FROM CLIMATE CHANGE PROJECTIONS

Ziwen Yu[1], *Franco Montalto[2], Stefan Jacobson [3], Upmanu Lall[4], Daniel Bader[4], Radley Horton[4]*

[1]University of Florida, Gainesville, FL, USA
[2]Drexel University, Philadelphia, PA USA
[3]Philadelphia Water Department, Philadelphia, PA USA
[4]Columbia University, New York City, NY USA

Stochastic precipitation generators (SPGs) are often used to produce synthetic precipitation series for water resource management. Typically, a SPG assumes a stationary climate. We present an hourly precipitation generation algorithm for non-stationary conditions that is informed by average monthly temperature (AMT) projected by Global Climate Models (GCMs) that have higher-confidence than precipitation in these models. The physical basis for precipitation formation is considered explicitly in the design of the algorithm using hourly Pressure Change Events (PCE) to define the relationship between hourly precipitation and AMT. The algorithm consists of a multi-variable Markov Chain and a moving window driven by time, temperature, and pressure change. We demonstrate the methodology by generating a 100-year, continuous, synthetic hourly precipitation series using GCM AMT projections for the Northeast US. The synthetic results, when compared with historical observations, suggest that future precipitation in this region will be more variable with more frequent mild events and fewer but intensified extremes especially in warm seasons. Summers are predicted to have less precipitation while winters will be wetter, generally agreeing with current research on climate change projections in the northeast US. The Clausius–Clapeyron (CC) relationship is represented in the results, but more so for high intensity PCE. The amplification of extreme precipitation events varies for a given temperature depending on the PCE type. For decreasing PCE, extreme precipitation intensification starts at AMT of 22°C and at 12°C for increasing PCE. Our approach may provide more physically plausible weather ensembles for numerous applications involving climate change.

PRESENTER BIO: Dr. Yu is an Assistant Professor in Big Data Analytics in ABE department at UF. He has more than 10 years of experience solving urban hydrology problems by applying data science methods and developing modelling tools. Dr. Yu has worked in the development of multiple smart water resource management systems that integrate hydrological modeling, historical climate data, weather forecasts, and public engagement, to support the management of future cities and other settlements. He believes that the accurate representation of physical relationships found in any system of interest is more important than the specification of a given method.