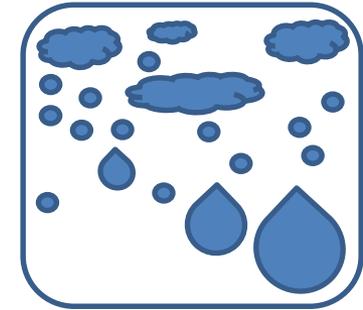


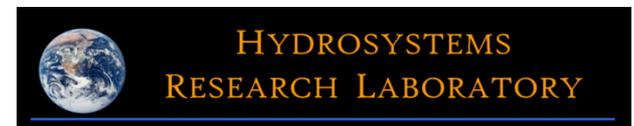
Statistical Downscaling of Precipitation in Florida : Experiments and Observations



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Water . Environment . Climate .

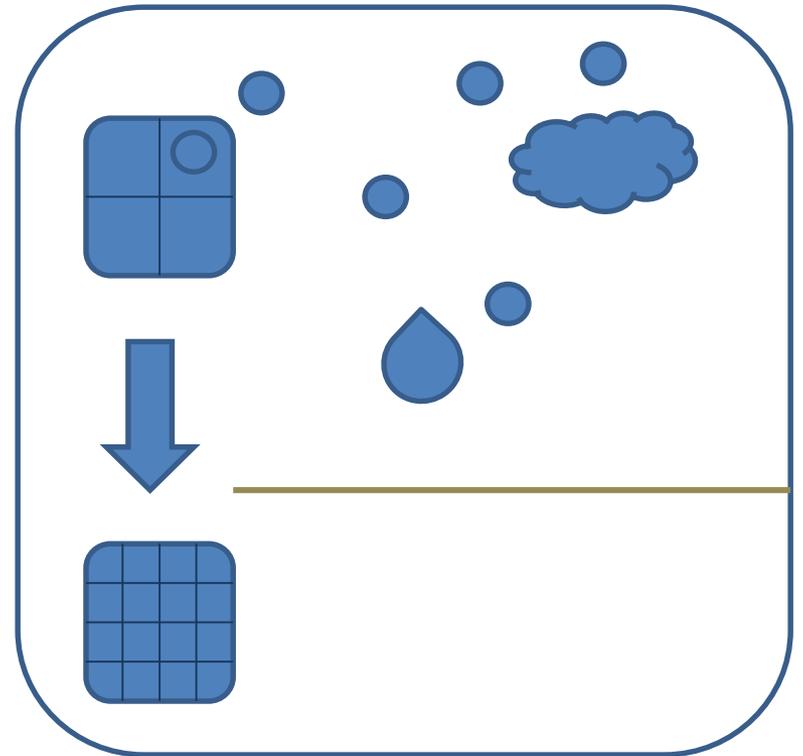
*Committed to Understanding, Modeling
and Managing Terrestrial Hydro-
Environmental Systems*



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Statistical Downscaling

From a drop of water a
logician could predict
an Atlantic or a Niagara
- Sir Arthur C. Doyle.



Precipitation Extremes

- Climate change models suggest an increase in global average annual precipitation during the 21st century, although changes in precipitation may vary from one region to another.
- Natural climate variability and future changes in climate that may alter precipitation intensities or storm durations would have consequences for stormwater infrastructure designed under the stationarity assumption.
- Urban drainage design practices are continuously revisited by:
 - Incorporating climate change factors
 - Analyzing trends in precipitation extremes and their frequencies
 - Evaluating impacts of changing extremes using downscaled precipitation data from GCMs
 - Designing frameworks for risk and uncertainty management

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Floods in a Changing Climate: Extreme Precipitation

Meets, assesses, analyzes, and models of extreme precipitation events linked to global climate in the context of the world's changing climate. This book outlines and documents the impact of climate change and climate variability on extreme precipitation events, providing methods for assessment of the impact of these events and their impacts. It also provides a basis to develop procedures and guidelines for climate-sensitive hydrologic engineering. Topics covered include approaches for assessment of hydro-meteorological floods, recent developments in hydrologic design for flood mitigation, and applications and limitations of improved precipitation forecasts, using information about internal modes of climate teleconnections. State-of-the-art methodologies for precipitation analysis, estimation, and intercomparison are included, and exercises for each chapter, supported by modeling software and computer spreadsheets available online at www.cambridge.org/teegavarapu, enable the reader to apply and engage with the innovative methods of assessment.

This is an important resource for students, researchers in the fields of hydrology, climate change, meteorology, environmental policy, and risk assessment, and will also be available to professionals and policymakers working in hazard mitigation, water resources engineering, and adaptation to weather and climate.

This volume is the first in a collection of four books, within the International Hydrology Centre on flood disaster management theory and practice within the context of anthropogenic climate change. The other books are:

1. Floods in a Changing Climate: Hydrologic Modeling, by R. P. Mays and D. Vagesh Kumar
2. Floods in a Changing Climate: Hydrologic Modeling, by R. P. Mays and D. Vagesh Kumar
3. Floods in a Changing Climate: Flood Risk Management, by Giacomo Di Baldovino
4. Floods in a Changing Climate: Risk Management, by Christian Ferro-Ve

International Hydrology Series

The International Hydrology Series is a collaborative publishing program between the International Hydrological Program (IHP), UNESCO and Cambridge University Press. The IHP addresses theoretical issues in the conduct of hydrological research, as well as practical, applied and water management issues raised by hydrological projects. Authors from international scope, the series comprises a major collection of research monographs, synthesis volumes and graduate texts.

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Teegavarapu

Floods in a Changing Climate: Extreme Precipitation

CAMBRIDGE



International Hydrology Series

Floods in a Changing Climate Extreme Precipitation

Ramesh S. V. Teegavarapu

CAMBRIDGE

Downscaling methods

- Main Focus
 - Statistical downscaling of Precipitation
 - Florida and South Florida.
- Spatial Resolution
 - Point and Different Grid Scales
- Temporal Resolution
 - Monthly and Daily (work in progress)
- Analyses
 - Evaluation of different Methodologies
 - Comparative evaluation of other methodologies (e.g., BCSD-based data)
 - Optimal Predictor sets
 - Use of available traditional and machine learning techniques to develop transfer functions
 - Downscaling skill – use of performance measures
 - Extreme Events
 - Methodologies to handle stationarity issues

Main Issues

- Spatial scale (resolution) of downscaling
- Temporal scale (month, day or sub-daily) of downscaling
- Function Approximation techniques for developing predictor-predictand relationships
- Stationarity of relationships
- Optimal selection of predictor variables – variations in region- and site-specific selections
- Skill of the models
 - Replication of historical behavior
 - Characterizing extremes and other region specific anomalies
- Assessment Metrics (Performance measures, error measures and others)
- Model Selection
- Bias corrections – Multi-objective Framework
- Evaluation and handling of GCM-based multiple scenario and multi model uncertainties
- Propagation of uncertainties in hydrologic simulation and determination of climate change-sensitive hydrological design.

- The inabilities of climate change models in reproducing precipitation extremes accurately and limitations of downscaling models in replicating the spatial and temporal variability of the same are discussed in different studies
- Temperature can be downscaled with more skill than precipitation.
- Emission scenarios and limited skills of multi-model GCM-based projections of future are considered to be the first and second sources of uncertainty respectively.

Sustainable Hydrologic Design

- An adaptive approach for stormwater management is to upgrade existing infrastructure with changing IDF relationships over time and evolving temporal precipitation distributions.
- Sustainable hydrologic design that identifies a compromise between current and future climate-based conditions can be devised.
- Preferences of hydrologists, water managers or design personnel towards future climate change can be included in such a design process.
- Studies have explored different hypotheses about how different characterizations of climate change uncertainty may affect water managers' beliefs, opinions, choices and actions.

Potential Solutions

- Acknowledging the limitations of the climate change models hydrologists may develop perceptions towards the accuracy of results from these models.
- Perceptions can be translated to preferences towards predicted future changes in the main hydrological inputs*
- Methodologies already exist to develop IDF curves based on downscaled GCM simulations and also upper and lower limits of precipitation extremes considering multi-model scenario uncertainties.
- Bounds on the precipitation intensities are used and a mathematical programming formulation with an objective of modeling preferences of decision makers towards future precipitation intensities is solved.

Conclusions

- Different methods are experimented for downscaling precipitation data in Florida.
- NCEP-GCM and GCM-based downscaling methods are evaluated at point and different grid scale resolutions.
- The grid-scale resolutions include : 1/8, 1/2 and 1 Degree resolutions.
- Transfer functions linking GCM scale and grid-scale predictors in NCEP-GCM approach is critical in obtaining improved downscaling values at different resolutions.
- The downscaling models provided improved precipitation estimates (based on Canadian Centre for Climate Modeling and Analysis model – CGCM-CGCM3.1/T63 Model) compared to BCSD values at different stations in Florida. It is important to note that no bias corrections have been applied to the outputs of downscaling methods.
- A search for optimal selection of variables (as predictors) is on and methodologies are planned for selection of optimal number and type.

Thank you
