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HYDROLOGIC IMPLICATIONS OF ERRORS IN DYNAMICALLY-DOWNSCALED AND BIAS-CORRECTED CLIMATE MODEL ESTIMATES FOR WEST-CENTRAL FLORIDA

Jeffrey Geurink*, Syewoon Hwang, Wendy D. Graham, Alison Adams

ABSTRACT: Simulated hydrologic responses for streamflow, groundwater levels, and spring discharge were examined and compared for four climate input scenarios. These climate scenarios include observed data at model basins, observed data that was spatially averaged over the model domain, and two forms of dynamically-downscaled and bias-corrected NCEP/NCAR reanalysis data using the fifth-generation Mesoscale Model (MM5). The observed spatially-averaged scenario was used to evaluate the importance of accurately representing spatial variability of climate inputs. A calibrated and verified application of the integrated HSPF-MODFLOW model code called the Integrated Hydrologic Model (IHM) was used as the hydrologic simulator to deterministically estimate hydrologic responses for each climate input scenario from 1989 to 2005 over west-central Florida (WCF). For specific conditions, this study identifies hydrologic implications of errors in dynamically-downscaled and bias-corrected MM5 climate estimates. Compared to observed data, raw MM5 results significantly overestimate precipitation (particularly for the dry season), underestimate daily maximum temperature, and accurately estimate daily minimum temperature. Monthly ensembles of daily observations from 1989 to 2005 were used to form observed monthly cumulative distribution functions (CDF) for daily precipitation and temperature. Using the monthly CDFs, raw MM5 precipitation and temperature outputs were bias-corrected with two sets of observations: model sub-basin data used previously for calibration and verification of an IHM model application in WCF and 12x12 km gridded data from a national source. Biases in the precipitation and temperature estimates were effectively removed by both bias-correction processes. Observed monthly CDFs for daily precipitation and temperature, mean monthly precipitation and temperature, and the spatial pattern of mean seasonal precipitation were well reproduced by bias-corrected estimates. However, observed magnitude and timing of precipitation for specific annual, seasonal, monthly, or daily periods was not well reproduced by the bias-corrected MM5 precipitation. Results of this study indicate dynamically-downscaled and bias-corrected MM5 climate data provide sufficient efficacy to describe multi-year mean annual streamflow, springflow, and groundwater levels for retrospective conditions in WCF. However, errors in bias-corrected MM5 climate estimates can produce inaccurate daily, monthly, seasonal, and annual responses for streamflow, springflow, and groundwater levels that may preclude their use for operational and long-term planning purposes.

* Water Resources Engineer, Tampa Bay Water, 2575 Enterprise Road, Clearwater, FL 33763 USA, Phone: 727-791-2312, Fax: 727-725-7067, Email: jgeurink@tampabaywater.org