

- WRF-Hydro Model Evaluation against Observed Discharge over USGS Sites USGS 02135000, SC near-surface variables such as air temperature and relative humidity. All these variables 300 gec 250 200 are important to hydrological modeling. 150 ິ ເຊັ້າ 200 150 The intensity and frequency of flood and drought have been increased and the trend is 100 expected to continue. This study conducted WRF-Hydro offline simulations driven by en 100 WRF-downscaled climate variables to understand the climate change impact on 50 hydrological extremes and to provide information to climate resilience and risk Jan Feb Mar Apr Jul Jul Sep Oct Nov Dec assessment. ■CCSM ■Had-GEM ■GFDL —obs USGS 03431500, TN spatially distributed soil-related parameters. () 1800 8 1500 1200 • The LSM is at a grid spacing of 4 km; hydrological routing is at a spatial resolution of 200 1000 m. Time step is 10 seconds. m 1200 800 600 baseflow ("pass-through") are active in this study. 600 400 200 Feb Mar Apr Jun Jul Jul Sep Sep Oct Dec • WRF driven by GFDL-ESM2G, 1995-2004, 2045-2054, RCP8.5 **CCSM** Had-GEM GFDL —obs • WRF driven by HadGEM-ES, 1995-2004, 2045-2054, RCP8.5 Figure 2. Comparison in 10yr monthly mean discharge between USGS observation and WRF-hydro simulations. The WF-hydro input is provided by WRF CCSM, WRF HadGEM and WRF GFDL, respectively. **Model Calibration for Hurricane Charley in August 2004:** WRF Model Projected Changes in Decadal Maximum Precipitation USGS 2295420 USGS 2295420 16:47 EDT 08/13/04 20:47 UTC 08/13/04 1000 5 dBZ LIGHT 10 15 20 25 ODERATE 30 35 40 40 45 HEAVY 50 55 60 65 EXTREME 70 75 800 1 3 5 7 9 11 13 15 17 19 21 23 1 3 5 7 9 11 13 15 17 19 21 23 ----- Measured ------ default ------ Mod1 Measured default Mod1 Mod3 -----Mod3 WRF-CCSM4 WRF-HadGEM USGS 2359000 USGS 2359000 86°W 1400 1400 1200 -100 -80 -60 -40 -20 0 20 40 60 80 100 1000 WRF-Hydro Model Projected Changes in Discharge 1000 800 600 CCSM max-avg compared over future Had-GEM max avg compared over future 3 5 7 9 11 13 15 17 19 21 23 1 3 5 7 9 11 13 15 17 19 21 23 default -----Mod1 ----- Measured ------ Mod1 ------ Mod2 Figure 1. Left: two sites are calibrated together without zoning; Right: two sites are calibrated separately. Key findings for calibration: CCSM 16points max-avg 🌿 Had-GEM 16points max-avg 🔍
- **Motivation:** Climate variability and climate change have significant impacts on precipitation as well as **Model Description:** • WRF-Hydro (offline):WRF-Hydro version 5 with a basic configuration. No nudging, no • Surface flow, saturated subsurface flow, gridded channel routing, and a conceptual **Meteorological Input for WRF-Hydro:** • WRF driven by CCSM4, 1995-2004, 2045-2054, RCP8.5









Because there is only one parameter for the entire domain that represents one key feature, it is difficult to adjust that only parameter to improve model performance over the entire domain. We found that, compared to calibrating the only parameter over entire domain of interest, using spatial zoning approach can significantly improve the model performance, because the bias over the three groups are different, and the calibration need to work on the parameters for these groups towards different directions.

Understanding the Impacts of Climate Variability/Change on Hydrological Extremes

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Figure 3. Dots: projected changes (%) in 10yr averaged annual maximum discharge from historical to midcentury under RCP8.5 scenario. Background map: future 10yr mean annual maximum discharge projected by WRF-Hydro driven by three different WRF simulations.

diff in %

-26.000784 - -19.125913

-19.125912 - -10.006208

-10.006207 - 0.000000

0.000001 - 43.469715

43.469716 - 72.895896

diff in %

-20.587335 - 0.000000

46.466652 - 82.188400

82.188401 - 125.531547

125.531548 - 162.113742

0.000001 - 46.466651



0.000001 - 30.844037

30.844038 - 56.801933

WRF-Hydro Model Projected Changes in Surface Water Depth





Figure 4. WRF-Hydro driven by WRF_CCSM4 projected changes (%) in 10yr seasonal average surface-water-depth. The numbers are normalized by historical 10yr annual average.





Figure 5. WRF-Hydro driven by WRF_HadGEM projected changes (%) in 10yr seasonal average surface-water-depth. The numbers are normalized by historical 10yr annual average.



Figure 6 WRF-Hydro driven by WRF_GFDL projected changes (%) in 10yr seasonal average surface-water-depth. The numbers are normalized by historical 10yr annual average.

WRF-Hydro Model Projected Extremes of Surface Water Depth



Figure 7. Non-stationary GEV estimated 50-yr return level of surface water depth (unit: ft). The GEV use 20yr data from historical and future periods.

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