Assessing Climate Change Impacts on Streamflow in NC and SC River Basins

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Assessing impacts of climate change on water resources

Top-down climate-analysis based impact assessment

Considerations for using climate projections

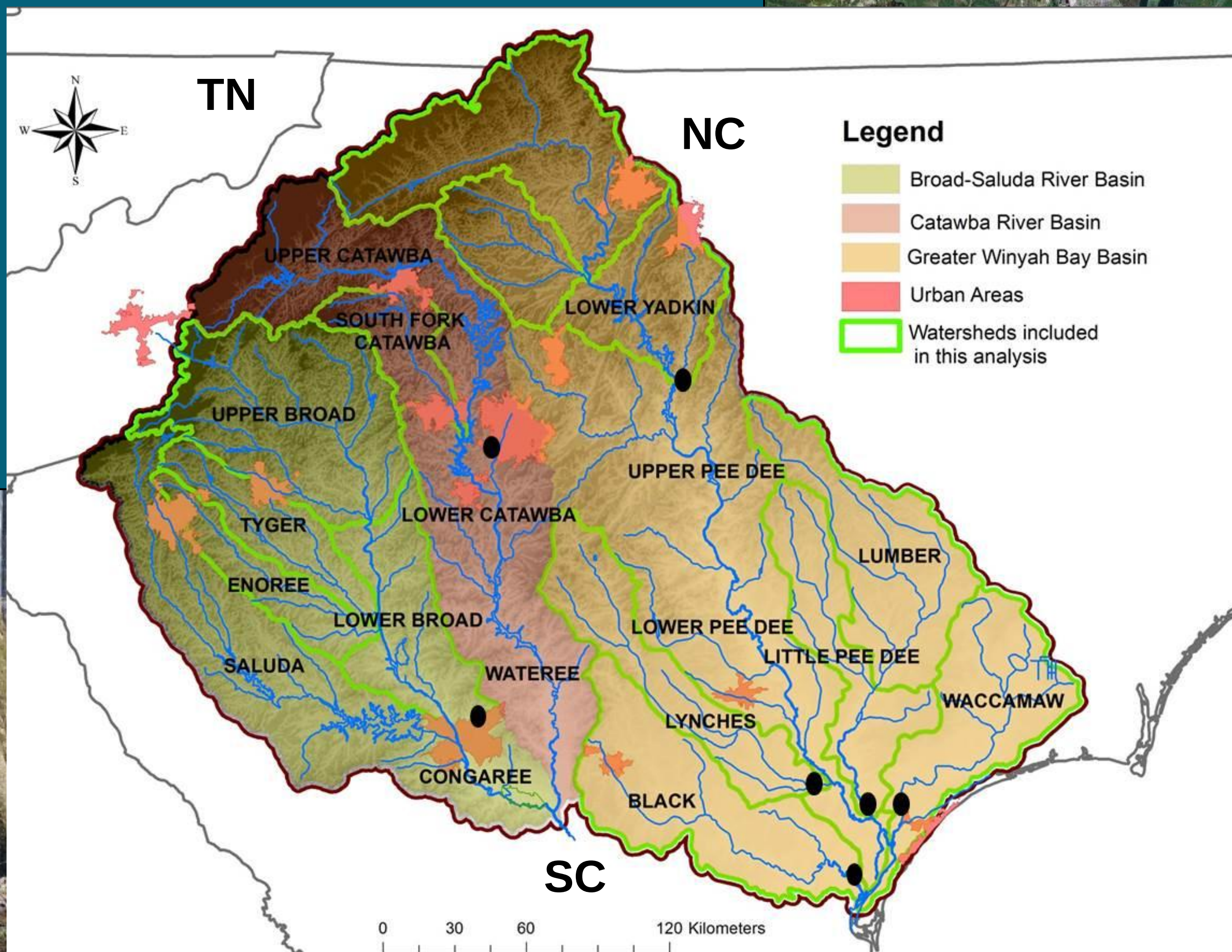
- Choice of GCMs and emission scenarios
- Choice of downscaling methods
- Temporal resolution
- Choice of impact models

} Uncertainty

BUT, it is important to think about climate models and impact assessments as tool for exploration and insight into complex system behavior, rather than just prediction tools for decision-making.

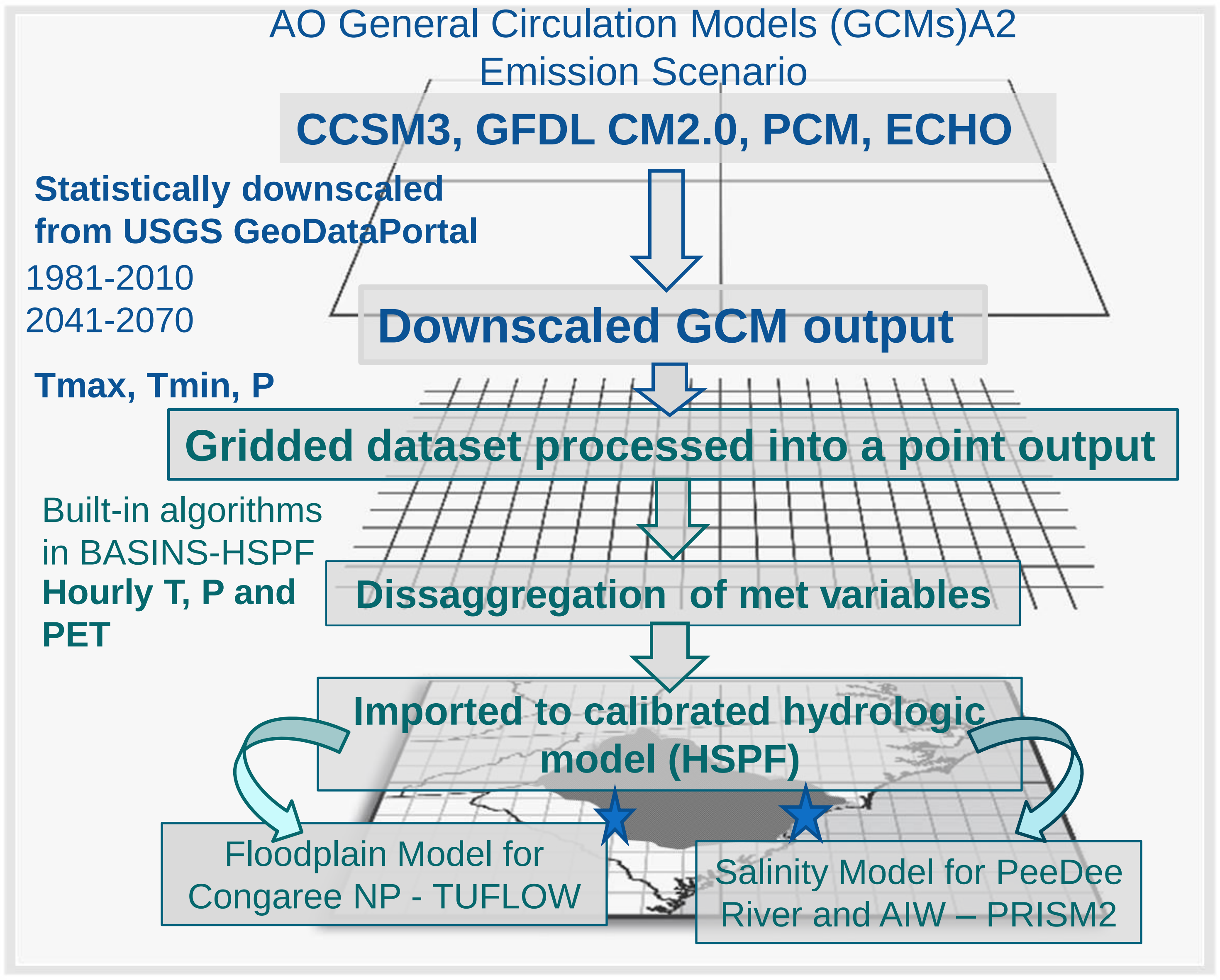
Study Area

Surface water salinity intrusion



Floodplain habitat in Congaree Natl. Park

Modeling secondary impacts of climate change



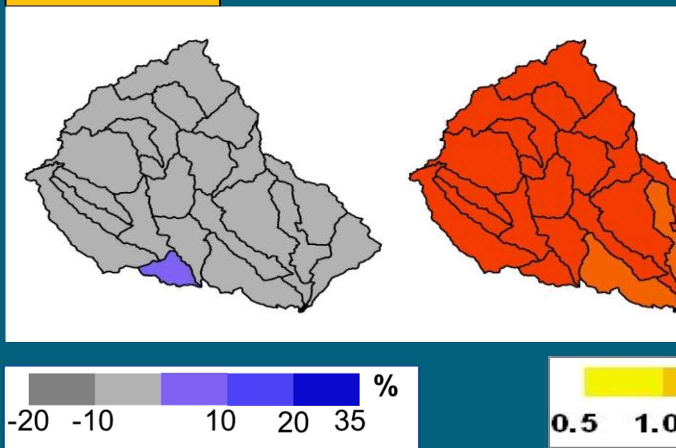
Streamflow variability

- Comparisons using months of January and July
  - Seasonality
  - Variation among GCMs
  - Variation among watersheds

- Intervals: 1981-2010 (control/ historic)
  2041-2070 (future)

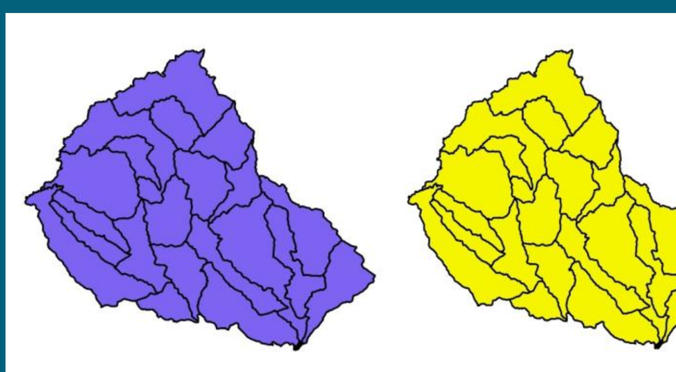
Daily discharge: GFDL General Circ. Model

JULY



Prec

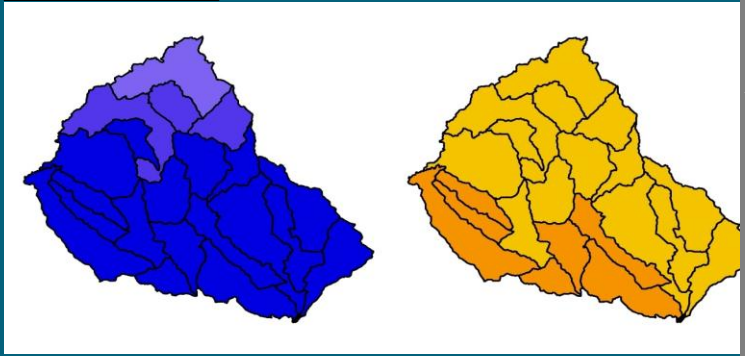
Tmax

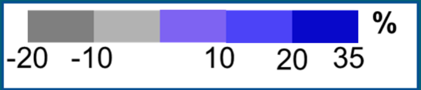


JANUARY

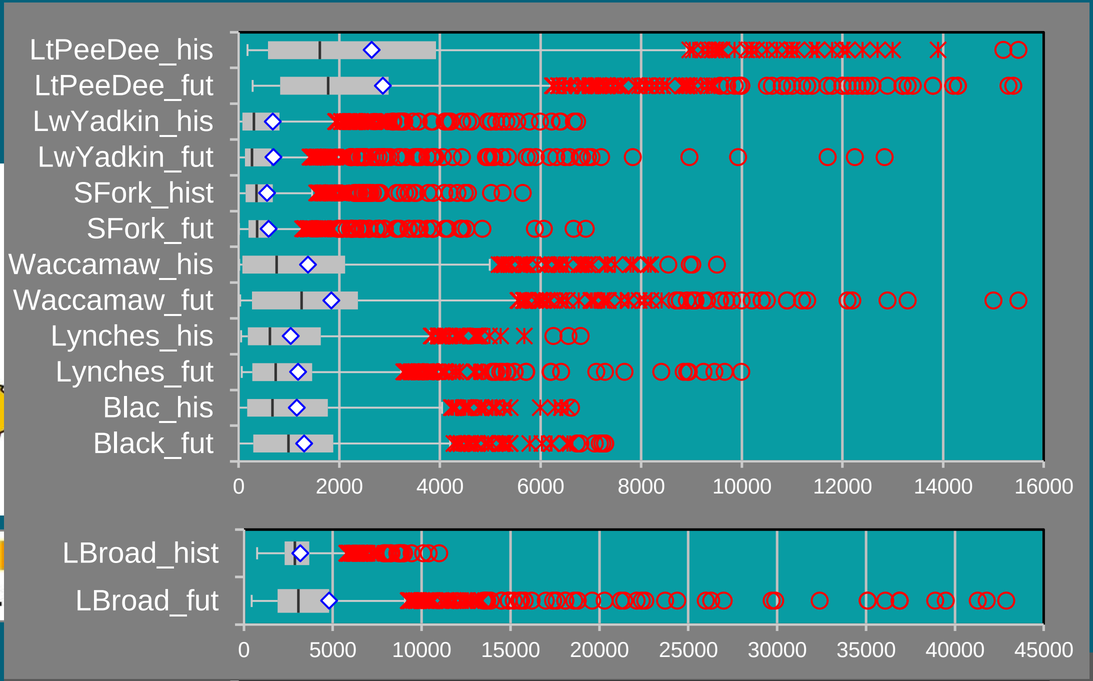
Daily discharge: PCM General Circ. Model

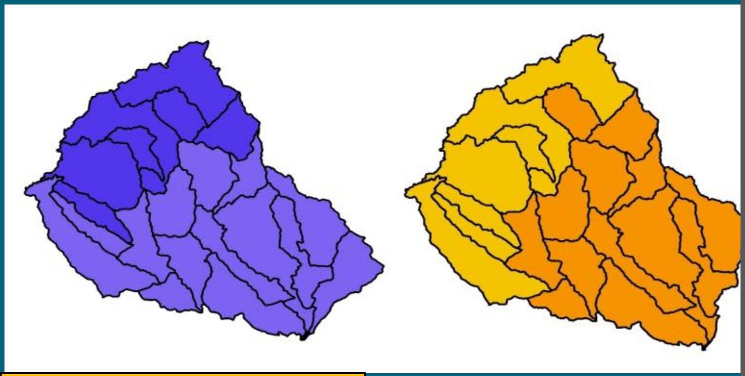
JULY

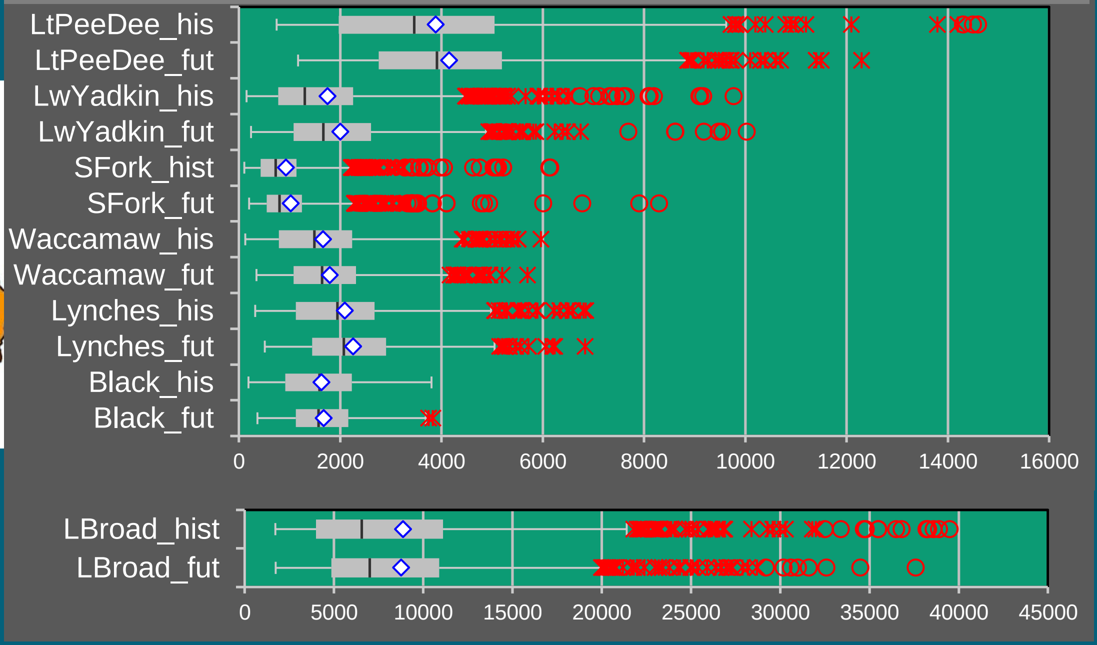




Prec **Tmax**







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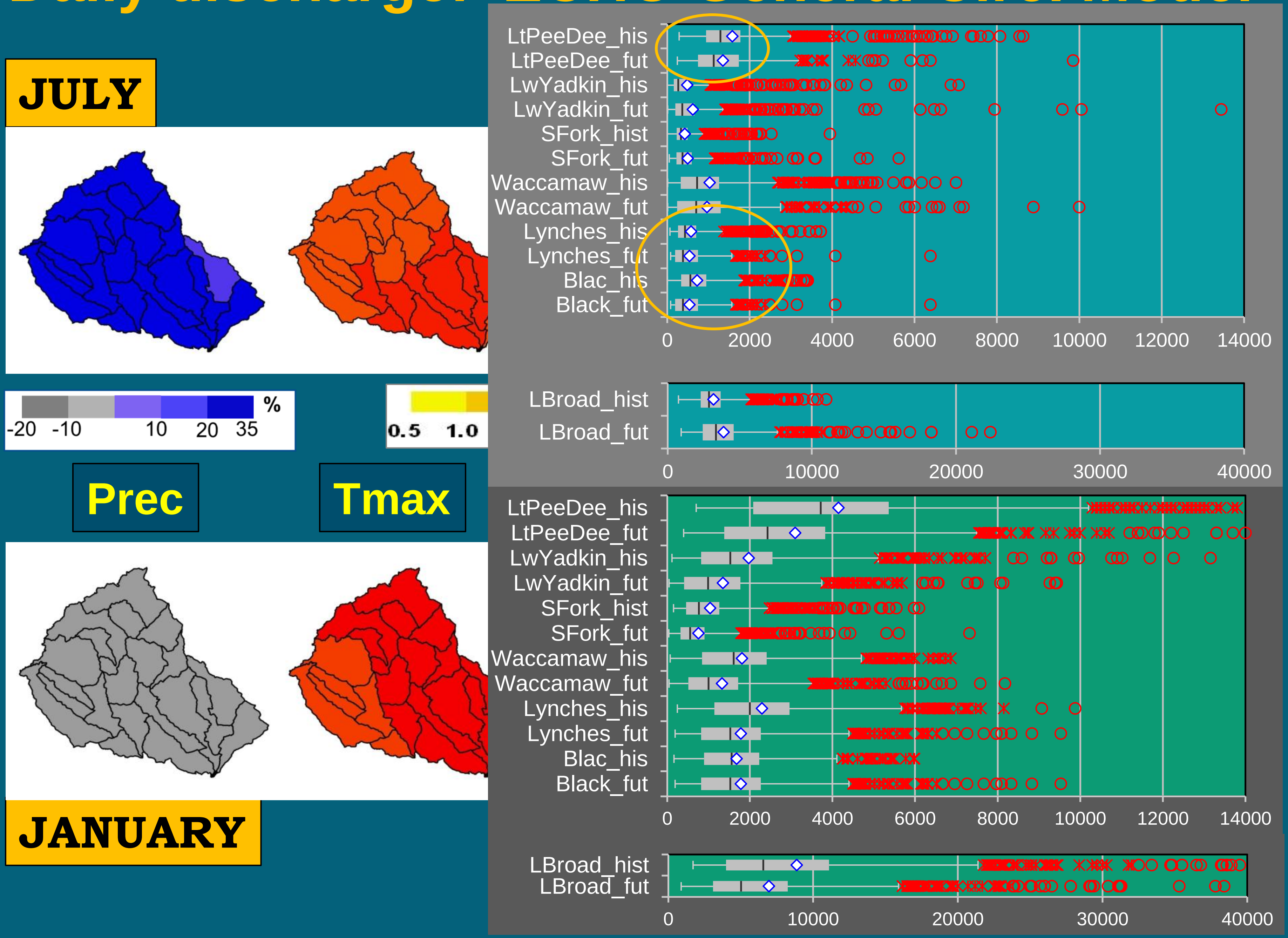
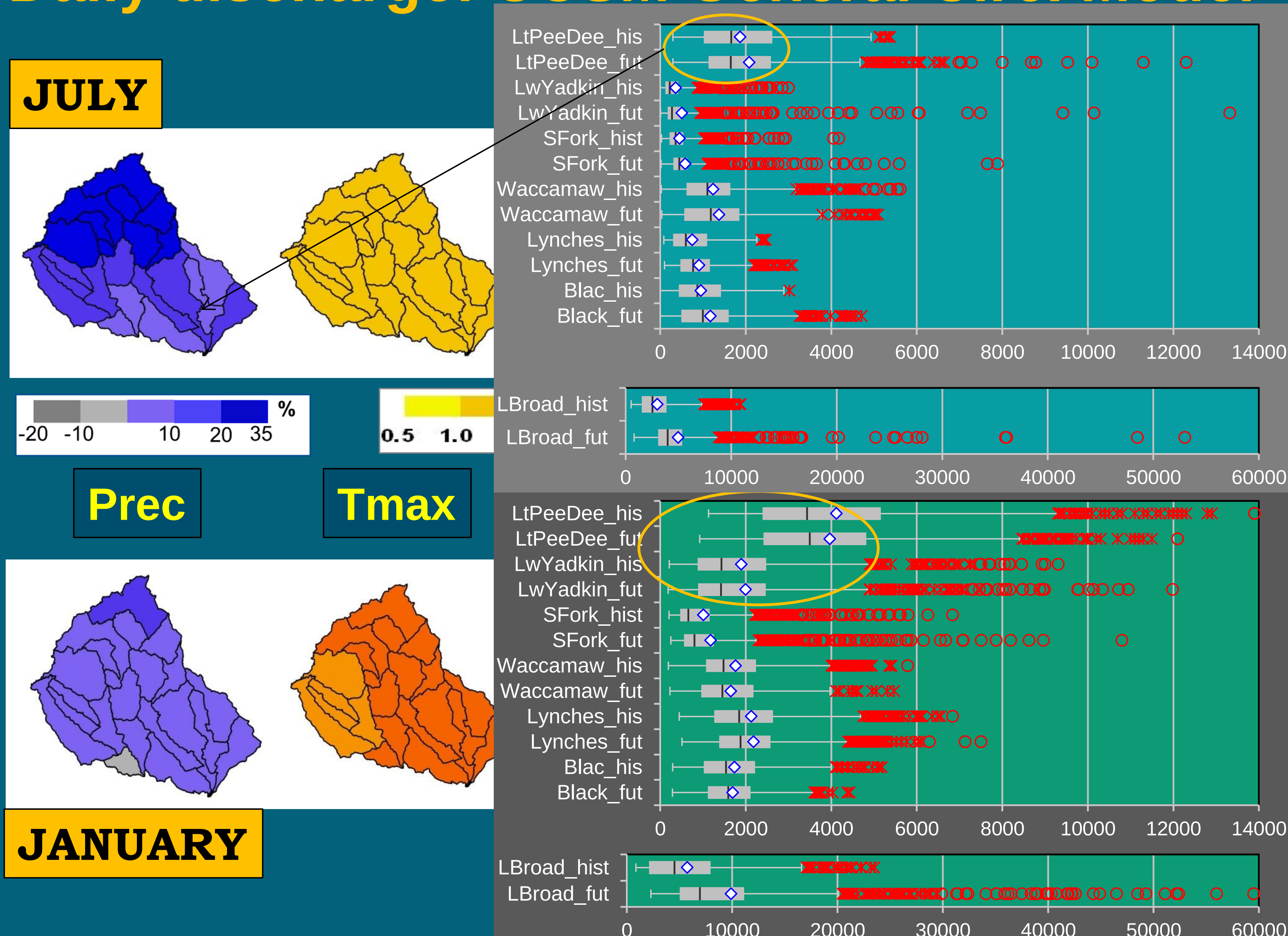
Daily discharge: ECHO General Circ. Model



Daily discharge: CCSM General Circ. Model



In Summary..

- Variation between watersheds but no distinct pattern by ecoregions
- Changes in precipitation more uncertain at a regional scale
- Temperature alone can influence the hydrologic budget i.e., higher precipitation may be more than compensated by very high temperatures

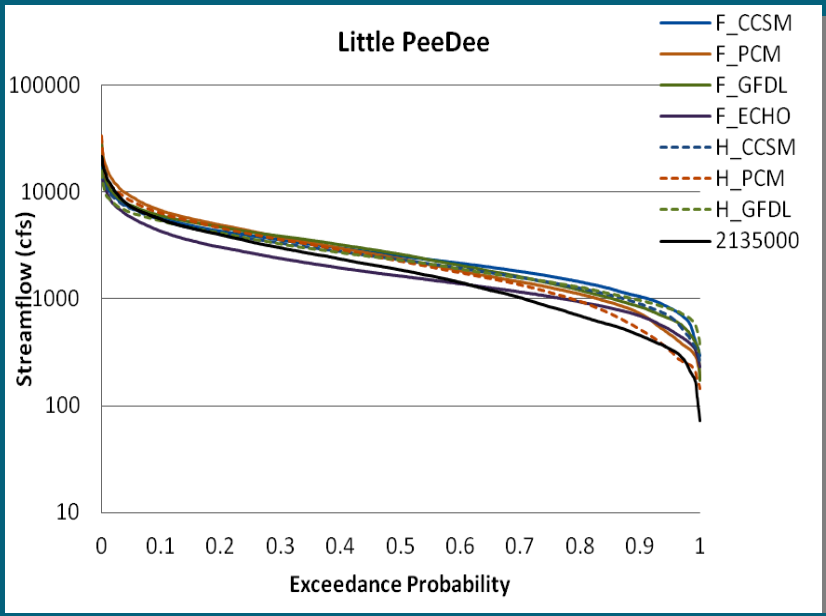
Further Analysis..

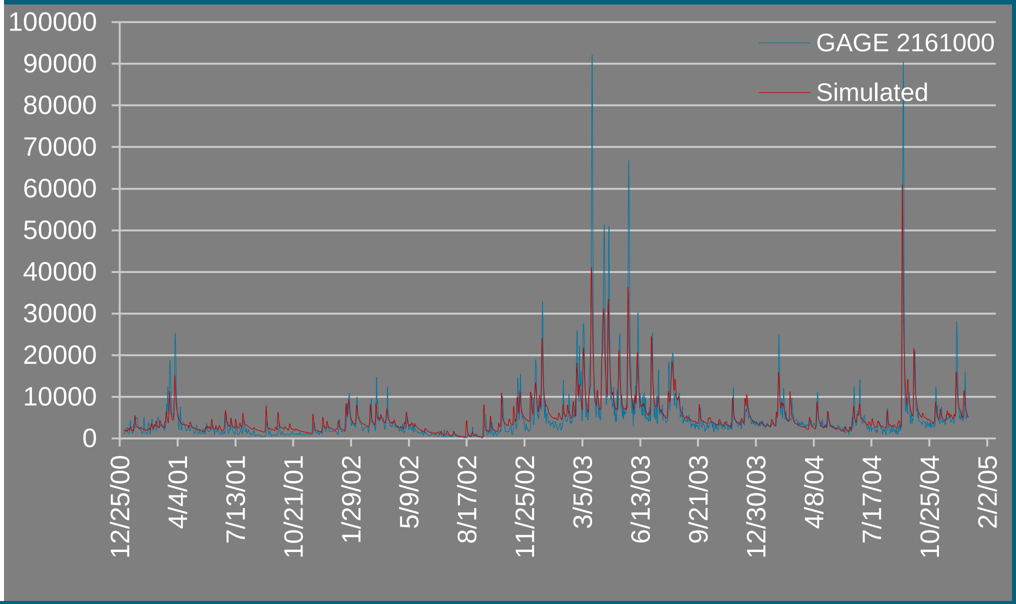
- Future vs. control climate comparisons for potential bias adjustments
- Causes of variability in response between watersheds for similar change in climate
- Very high-flow outliers in only some watersheds – Is it from differential prec intensity/storm activity (likely not), physical characteristics of the watershed (maybe, but ecoregions not a good indicator) just an artifact of calibration?
- Statistical vs. dynamical downscaling (NARCCAP data)

Challenges

Hard to look at change in extreme flow statistics that are meaningful for regulation (like min and max 7Q10) and management, while accounting for various types of biases -

- Statistical downscaling bias
- Statistical downscaling uncertainty
- Hydrological calibration and parametric uncertainty





Acknowledgments

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Questions??

The A2 storyline assumes greater emphasis on national identities. Population growth slows but does not come to a peak by the close of the century. Technological growth is slower, and economic growth per capita is less than in A1. The B1 and B2 scenarios place greater emphasis on sustainability and environmental protection. B1 is characterized by a world economy that emphasizes reduced material demand and clean and efficient technologies. Global population peaks mid century. B2 is characterized by greater regionalization. Technological development is slower than in B1, and global population rises throughout the 21st century, though at a slower rate than in A2

Min 7Q10: The lowest streamflow that occurs over 7 consecutive days and has a 10-year recurrence interval period, or a 1 in 10 chance of occurring in any one year. Daily streamflows in the 7Q10 range are general indicators of prevalent drought conditions which normally cover large areas. 7Q10 values are also used by the State for regulating water withdrawals and discharges into streams.

Hamon (1963) Method (PET = 0 when T < 0)

PET = 0.1651 x Ld x RHOSAT x KPEC

where PET is the daily PET (mm); Ld

is the daytime length, which is time from sunrise to sunset in multiples of 12 hours; RHOSAT is the saturated vapor density (g/m3) at the daily mean air temperature (T); and

Where,

RHOSAT = 216.7 x ESAT / (T + 273.3)

ESAT = 6.108 x EXP (17.26939 x T / (T + 237.3))

T is the daily mean air temperature (°C); ESAT is the saturated vapor pressure (mb) at the given T; and

KPEC is the calibration coefficient, which is set to 1.2 in this study.