Weather and Climate Research to Improve Flood Preparedness and Resilience

John W. Nielsen-Gammon

Texas A&M University

Texas State Climatologist

Director, Texas Center for Climate Studies

Extreme Precipitation Events and Statistics

- Robust operational statistical techniques exist for:
  - Shorter return periods (<100 yr)
  - (assuming a stationary climate)
- Gaps and Issues:
  - Frequency analysis of extremely rare events and Probable Maximum Precipitation analysis are incompatible
  - Local influences on extreme events
  - Storm space-time structure affects watershed response
  - Climate is not stationary

RFA vs. PMP, Local Influences

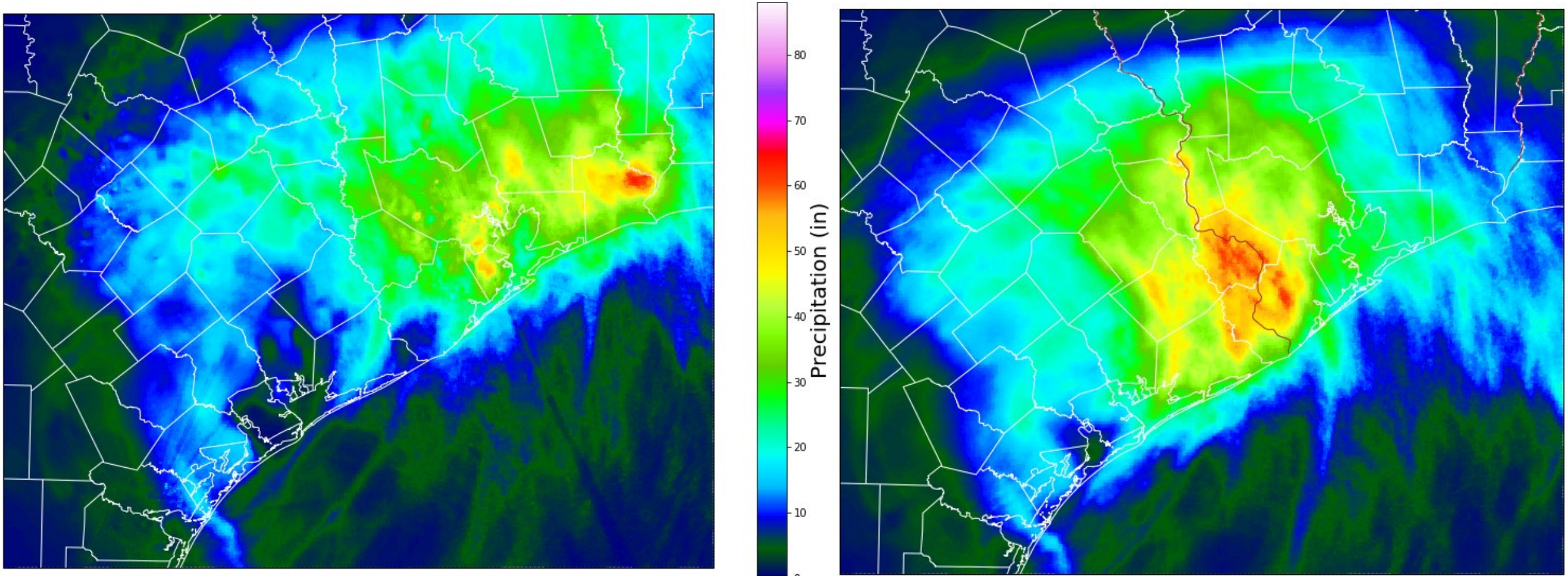
- Expanding the sample size spatially
  - RFA: Fixed neighborhood size for all frequencies
  - PMP: Unique neighborhood for each individual storm
- Treatment of rare events
  - RFA: Statistical (with large uncertainties)
  - PMP: Deterministic (physically unjustified, uncertainties ignored)
- Research need: Combine methods
  - Transpose storms within RFA
  - Frequencies by storm type
- Research need: Are storms influenced by location?
  - Urbanization | Coastline | Local and regional topography | Land surface

Each Storm Is a Random Event

- Conventional analyses (~location)
- PMP (~location, ~moisture)
- InFRM Watershed Hydrology Assessments (~location, ~orientation, ~motion)
- Research need: Storm database
  - Events
  - Physically reasonable PDF of location, orientation, and motion
  - Derived quantities: DAD, etc.
- Research need: Specifying the possible (dynamical models, machine learning)

Harvey

Harvey Moving Slowly



Climate Is Not Stationary

- Research need: Effect on traditional analyses
- Research need: Robust way of quantifying nonstationarity
  - Lots of observations, models, etc.
  - Seasonality, storm type, etc.
- Research need: Robust way of applying nonstationary frequency estimates
  - Design lifetime
  - Combining different types of uncertainty