# Hydrometeorological Forcings

Christa Peters-Lidard
Allen White
David Novak (Rapporteur)

# Primary Technical Topic

- What are the "forcings" needed for NOAA hydrologic prediction services of the future and for external partners?
  - Current NOAA water cycle prediction services:
    - Streamflow (RFCs): lumped, conceptual (SAC/Snow-17) with prescribed PET and T-based snowmelt
    - Tides/Salinity/Currents/Temperatures (OFS): ROMS
    - Drought (CPC): leaky bucket model -> Palmer DSI
    - Regional NWP (NCEP/EMC): NAM
    - Global NWP/Seasonal (NCEP/EMC): GFS/CFS
    - Long-term Climate (GFDL): AM3
  - Future NOAA water cycle prediction services:
    - Streamflow (RFCs??): distributed, physically-based water and energy balance + ecology + groundwater + water quality with data assimilation
    - Tides/Salinity/Currents/Temperatures (OFS): NEMS+ROMS???
    - Drought (CPC??): distributed, physically-based water and energy balance + ecology + groundwater + water quality with data assimilation
    - Regional NWP (NCEP/EMC): NEMS
    - Global NWP/Seasonal (NCEP/EMC): NEMS
    - Long-term Climate (GFDL): ESM

# Definition: Hydromet Forcings

- Definition of "forcing" depends on the problem, application, time-scale, and the model

- We separate three important inputs:
  1. Forcing (outside of model and imposed on simulation)
  2. State Variables (initialized, assimilated)
  3. Model static fields (topography/bathymetry, soils, geology)

- <u>Current Forcings:</u>

  Precipitation (QPE/QPF), Air Temperature, Freezing Level

  with prescribed land cover/vegetation, PET

# Definition: Hydromet Forcings

- Future Forcings (Uncoupled):

  Upper BC: Precipitation (QPE/QPF). Air Temperature, Freezing Level, Wind, Humidity, Radiation, Pressure

  Internal: Ecological and human influences included (irrigation, land cover change, reservoirs/withdrawls)

  Lower BC or prognostic: Ground water table, Permafrost Active Layer

  Lateral BC: tides

- Future Forcings (Coupled—NEMS, ESM):

  Sun

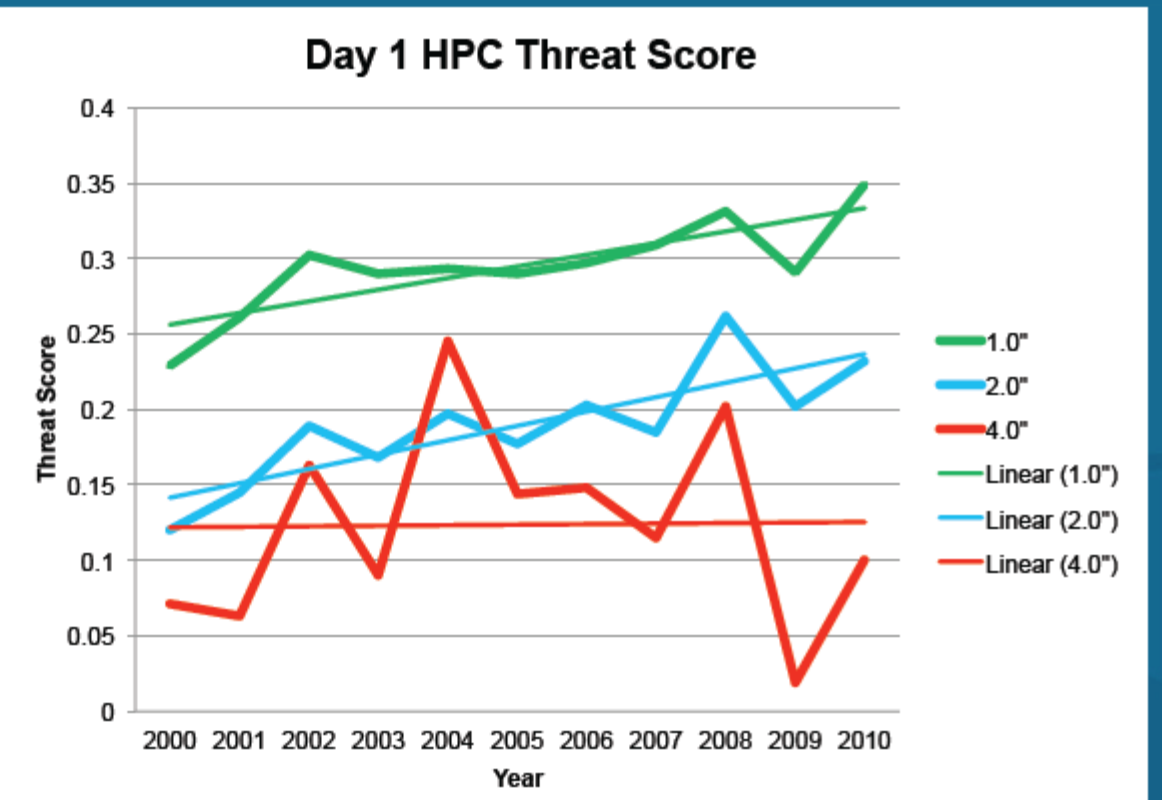
  CO2, Aerosols

  SST

  Human/Social

# Key Recommendation 1: Measure QPE/QPF skill with respect to streamflow/hydromet forecast skill

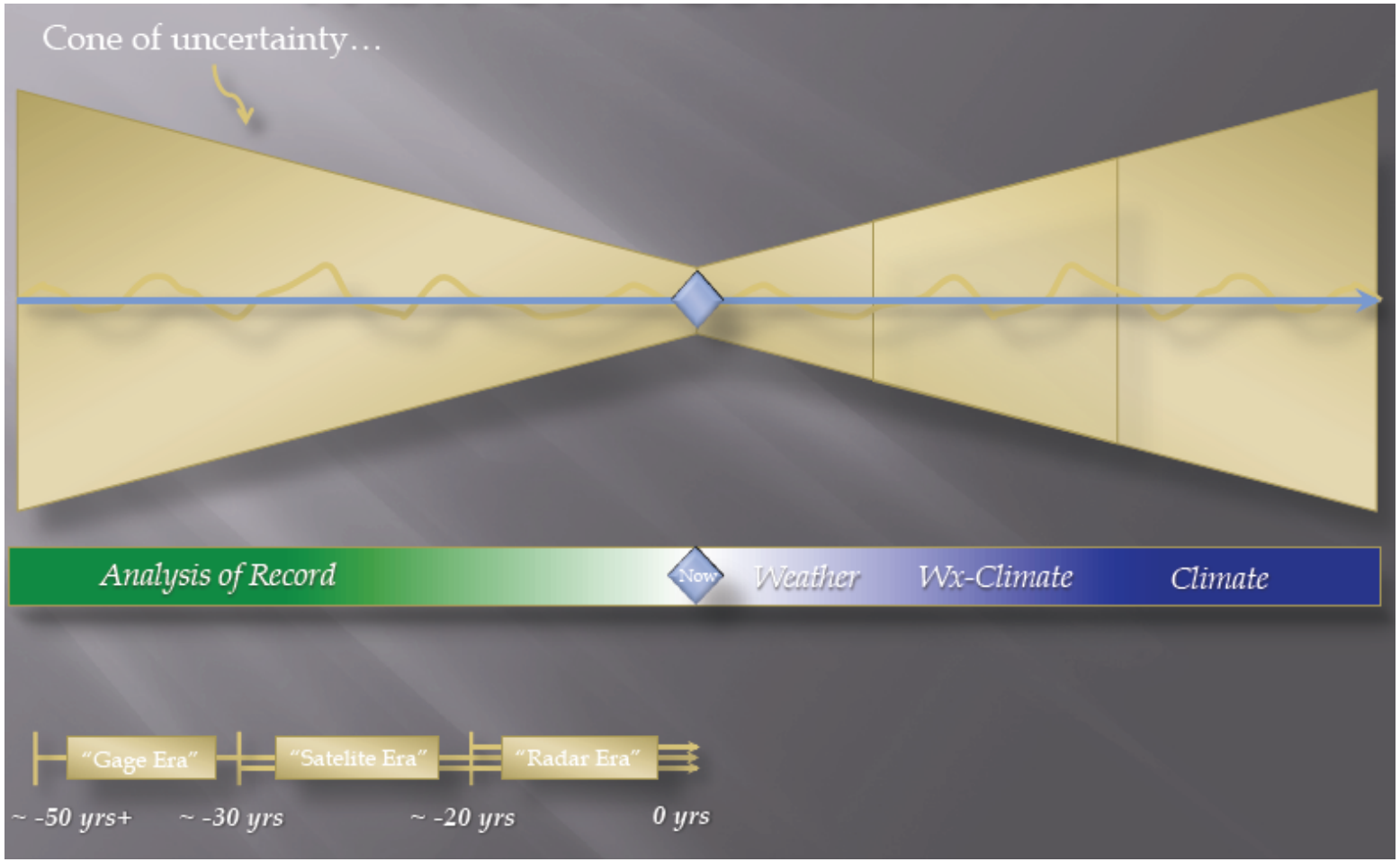
Forecast improvement of extreme events (4”) lags improvement of more common events (1”)



# Key Recommendation 1: Measure QPE/QPF skill with respect to streamflow/hydromet forecast skill

- Accurate QPE and QPF is necessary but not sufficient for hydromet forecast skill
- QPE improvement strategies:
  - Dual-pol and gap-filling radars
  - Incorporate regional networks, satellites esp. in terrain
- QPF improvement strategies:
  - Higher spatial resolution
  - Microphysics schemes
  - Aerosols (direct/indirect effects)
  - Water vapor transport (atm rivers/jets)

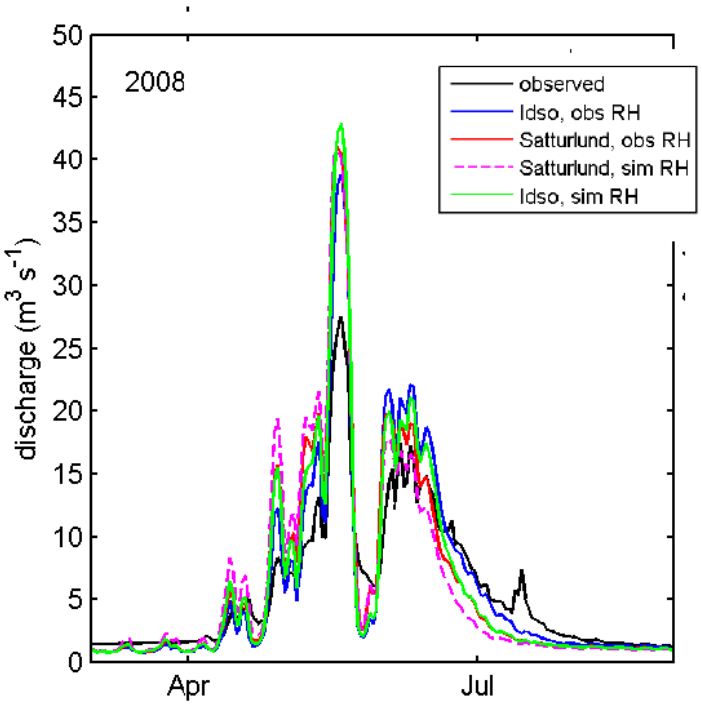
# Key Recommendation 2:
# Provide continuous, seamless retrospective and forecast multi-sensor forcing analysis including uncertainties



# Key Recommendation 2: Provide continuous, seamless retrospective and forecast multi-sensor forcing analysis including uncertainties

- Probabalistic forcing analysis including analysis of record and ensemble forecasts needed for:
  - Uncertainty analysis and error propagation studies
  - Data assimilation (EnKF)
- Co-variation among forcing fields (e.g., radiation/ precipitation or rainfall/pressure) must be preserved in forcing analysis
- Need access to raw data and methods used in AOR to support reproduction of different/finer spatial/ temporal resolution products
  - Hyper-resolution nested model-based forcing analysis for urban/orographic

# Key Recommendation 3:
# Quality control, stewardship, and access to multi-agency, state, local, private, international forcing datasets


Streamflow is sensitive to the LW algorithm chosen and to whether relative humidity is estimated or measured

Temp Precip Relative Humidity Wind NetRad SWin LWin

Common ⟵ ⟶ Rare

# Key Recommendation 3: Quality control, stewardship, and access to multi-agency, state, local, private, international forcing datasets

- Uncertainty of individual inputs (station, radar, satellite, model)
- Strategic network design and gap-filling (e.g., CASA)
- Interagency and international partnering for access to satellite data (esp. geostationary VIS/IR and microwave polar orbiters)
- OCONUS forcing should be similar latency and quality to CONUS forcing