Theme 3: Modeling the Physical System

Improving Model Processes - Overview

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Improving Model Processes

- Environmental prediction is key element of NOAA's mission of **Science, Service, and Stewardship**
- To improve *prediction*, need to *understand* model treatment of physical processes over range of time-space scales
- From this understanding, can assess model skill – develop process better representations
  - Better predictions lead to more reliable actionable intelligence for decision makers
- PSD research spans the weather-climate continuum to understand and *improve model processes*
  - minutes to multiple decades; local to global

Research to inform actions ranging from issuing weather/flood warnings to future climate projections
Example of Improving Model Processes to Support Stakeholder Needs: Streamflow Forecasting

- Russian River has some of the most severe flood damage in California
- Small tributaries especially flood-prone
  - Flows are not forecast by NWS
- PSD prototyping distributed hydrologic models to provide streamflow estimates everywhere in the basin
  - Assess sensitivity to precipitation forcing
- Part of a national effort by NWS
  - Determine how distributed modeling can be used to support flash flood services
Example of Improving Model Processes to Support Stakeholder Needs: Streamflow Forecasting

- PSD modeling research to inform flood risk management for extreme events
  - WRF-Hydro modeling framework
  - Impact of soil moisture and QPE on initial conditions (see poster by R. Zamora)
  - Propagation of forecast uncertainty from precipitation to streamflow (see poster by M. Scheurer)

Max model QPF’s (blue ellipse) generally displaced from max QPE \( \rightarrow \) timing, intensity errors in streamflow (but still useful situational awareness for forecasters)
Strategic Context

- **NOAA Strategic Goal(s) Addressed:**
  - Weather Ready Nation
  - Climate Adaptation and Mitigation

- **NOAA Strategic Objective(s) Addressed:**
  - Improved scientific understanding of the changing climate system and its impacts
  - Reduced loss of life, property, and disruption from high impact events

- **NOAA 5-Year Plan Objective(s) Addressed:**
  - Improved predictive guidance

- **OAR Science Question(s) Addressed:**
  - How can we improve forecasts, warnings, and decision support for high-impact weather events?
  - What causes climate variability and change on global to regional scales?

- **PSD Strategic Goal Addressed:**
  - Understand, attribute, and predict extremes in a variable and changing climate

*Improving model processes strongly supports goals and objectives at all NOAA levels*
What You Will Hear: Use-Inspired Research to Improve Model Processes Across the Weather-Climate Continuum

- Robert Pincus: *Radiative Forcing in CMIP6*
  - **Future climate projections:** In providing reliable projections of future climate, including extreme events, do we understand model error characteristics?

- Jian-Wen Bao: *Evaluation of Microphysics Schemes for Numerical Weather Prediction*
  - **Precipitation forecasts:** How much complexity is required to accurately represent microphysical processes in weather forecast models?
What You Will Hear: Use-Inspired Research to Improve Model Processes Across the Weather-Climate Continuum

- **Stefan Tulich:** *Improving Weather and Climate Prediction Models Through the Super-Parameterization Approach*
  - **Innovation:** What key processes must be represented to capture extreme events?
- **Kelly Mahoney:** *High Resolution Modeling to Understand Flood Risk and Hail Impacts in Future Climates*
  - **Inform decision-makers:** How can high-resolution modeling better inform future flood risk management applications?