Joint CDWR-NOAA Project to Improve Sub-seasonal Precipitation Forecasts for California

Background

- NOAA (especially DGD) is deeply indebted to CDWR for your patience and working with us in setting up a state funded project to improve a federal capability that then benefits the sponsoring state (and others).
- We are really enthusiastic to be working with CDWR on this project!
- We have an excellent team from ESRL PSD who will work on this project.

Leaders of the Project with California DWR

Michael Scheuerer
Statistical postprocessing of sub-seasonal precipitation forecasts

Lisa Bengtsson
Improving the modeling of thunderstorms and their variability in ensemble prediction systems.

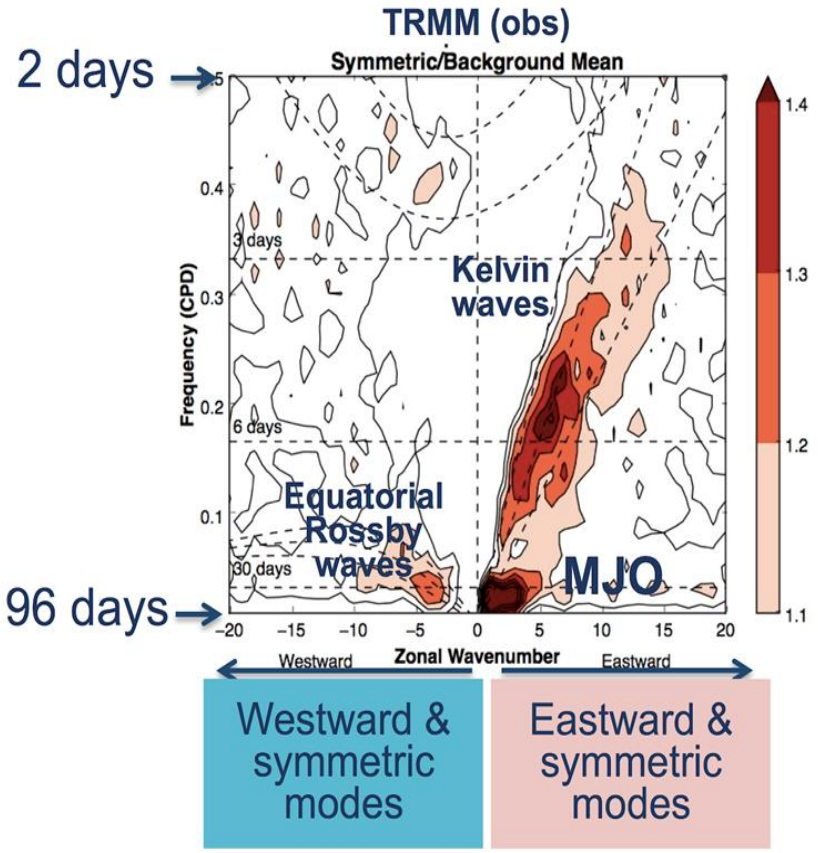
Juliana Dias
Diagnosing problems with thunderstorms in numerical weather and climate prediction systems.

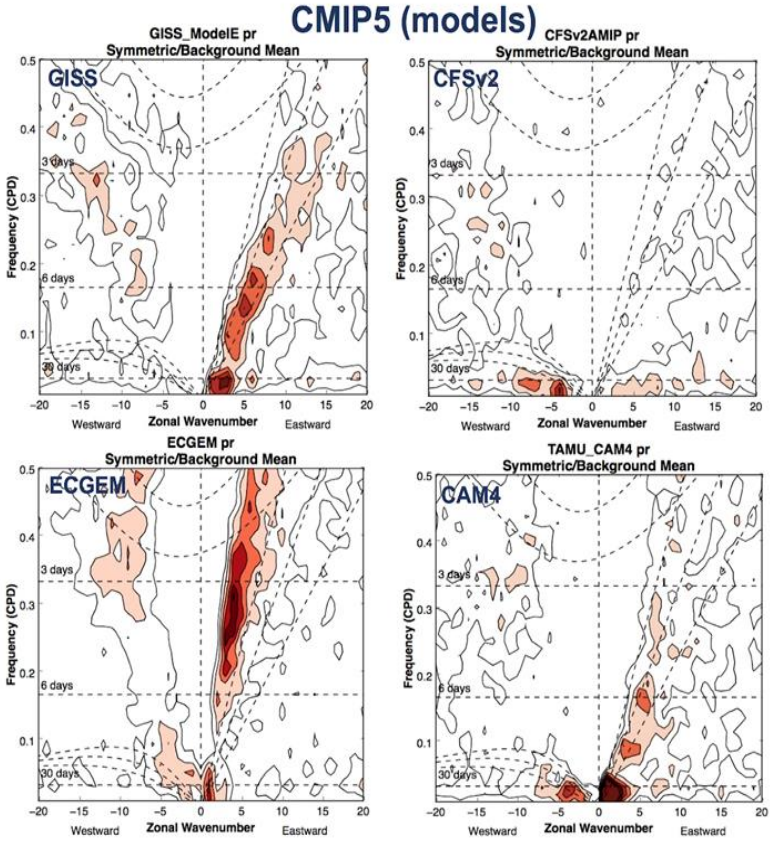
Each of these scientists are 5-10 years past the Ph.D. and emerging leaders in their disciplines. Expect to see them in future visits.

Three Foci for Improvement of S2S Western US Precipitation

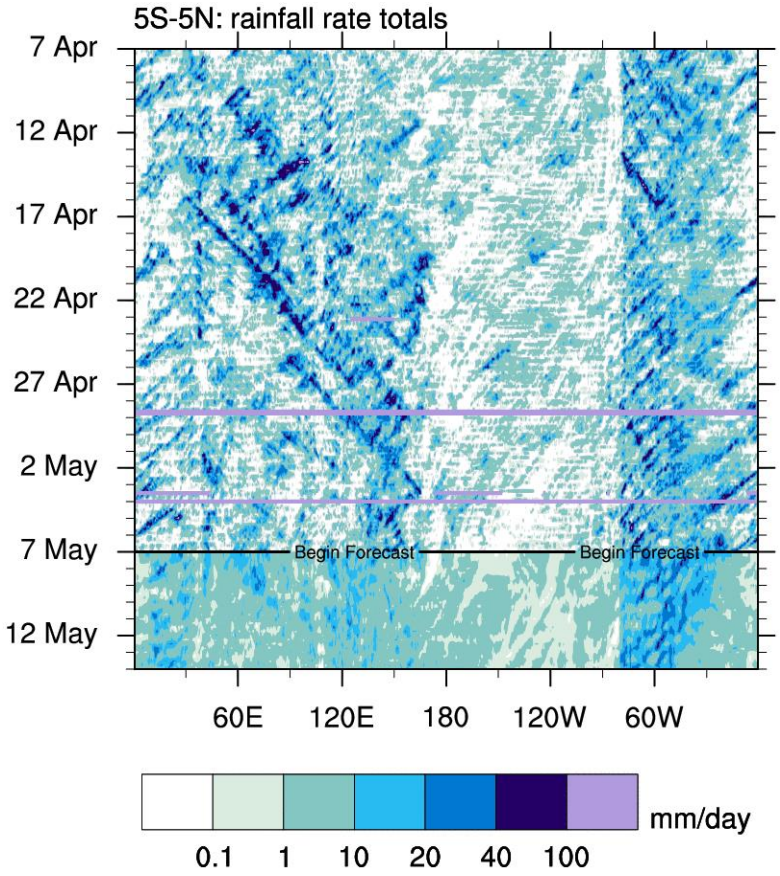
- **Statistical postprocessing**: While a dramatically improved S2S prediction system is being developed, statistically adjust the real-time forecast guidance to correct for systematic errors, statistically downscale, filter out the noise and thereby improve skill.
- **Novel and Comprehensive Diagnostics of Tropical Convection:** What's wrong with the simulation of tropical thunderstorms and the Madden-Julian Oscillation that modulate land-falling storms on the US West Coast.
  - Must understand what needs fixing before targeting model improvements.
- **Improve the representation of those tropical thunderstorms**.

Model Performance Deficiencies Extend Beyond the MJO to Higher Frequency Tropical Waves





Systematic Model Errors in GFS Convection



Comparing rainfall observations to GFS forecasts, it is clear that the GFS produces excessive light rain rates, weak diurnal cycle, and has trouble propagating disturbances (not only the MJO, but also smaller scale waves)

Figure: Time–longitude plots of rainfall rates (3 hourly, 0.5°x 0.5°) averaged over 5°S-5°N. Observations from TMPA/TRMM 3B42RT for the last 30 days and GFS forecast for the next 7 days. From Michael Ventrice's Hovmollers Page.

Improvement of the Deep Convective Parameterization

Tasks include:

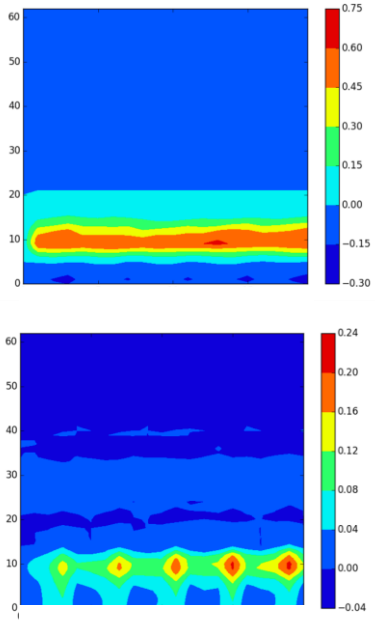
- Understand features of other successful (convective) parameterizations to improve FV3GFS schemes.
- Introduce convective organization, stochasticity and memory important for interaction with tropical wave dynamics through:
  - Lateral communication by cellular automata
  - Prognostic cloud life-cycle (memory from previous time-step, and ability to represent several stages of the convection)
  - Representation of sub-grid scale variability of cloud number modeled by stochastic processes.
- Improve variability of precipitation by including process-level physically based stochastic perturbations.
- Super-parameterization to inform sub-grid variability

More Examples of the Errors in the GFS Deep Convective Parameterization

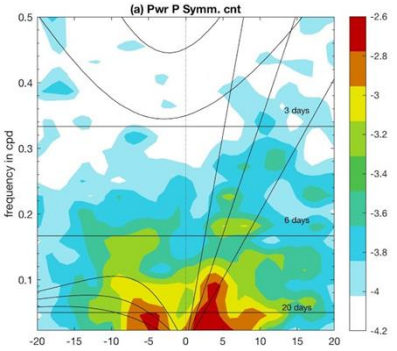
What can we learn from other state-of-the-art convection parameterizations?

GFS

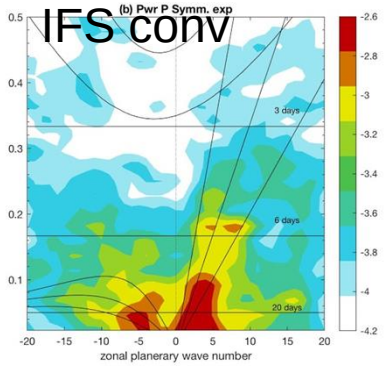
IFS



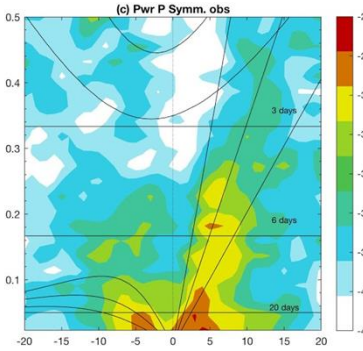
FV3 GFS v0



FV3 GFS w IFS conv



Observed



Example with the ECMWF's IFS convection scheme in FV3GFS. More power in the Kelvin mode (too much in low frequencies).

Better realism in diurnal cycle of shallow convection.