Advanced Statistical-Dynamical Downscaling Methods and Products for California Electricity System Climate Planning

Dan Cayan, David Pierce and Colleagues

Results from Contract EPC-16-063, California Energy Commission

- What models and forecasting tools do regulators and utilities need, but are not available or readily used today?

High spatial (3km) and temporal (hourly) downscaled global weather and climate models covering California are available.

- Their results allow us to investigate wind, humidity and temperature development of recent wildfires and compare with weather and climate during historical fires over the last four decades.
- These same models can be employed to assess weather in climate that may occur in future decades under plausible scenarios of climate change.

These models have strengths and limitations..

A combination of dynamical and statistical models is a good option:

- Dynamical (WRF) downscaling can provide a historical high resolution reanalysis of wind, humidity and other variables for which there are no observed records. But dynamical models are computationally expensive and therefore can't be used to produce "high volume" climate model scenarios.

- LOCA statistical downscaling of vector wind and humidity is computationally efficient and can be used to downscale many global climate model simulations and ensemble members. LOCA requires high resolution observed or model Multi-decade "training" datasets. But LOCA is limited in the number of meteorological variables it can produce and results are constrained to the patterns and fluctuations from the training data.

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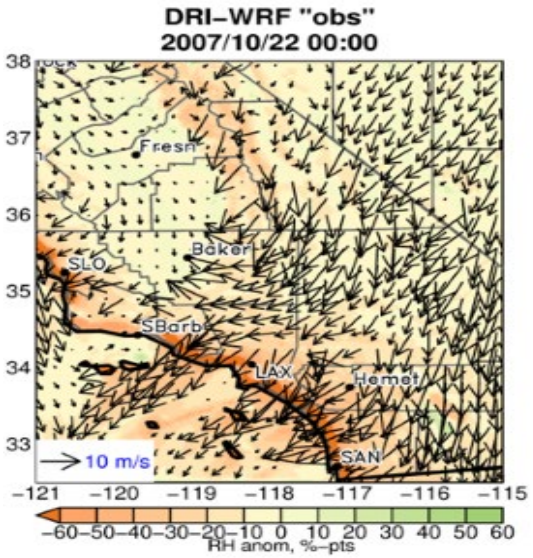

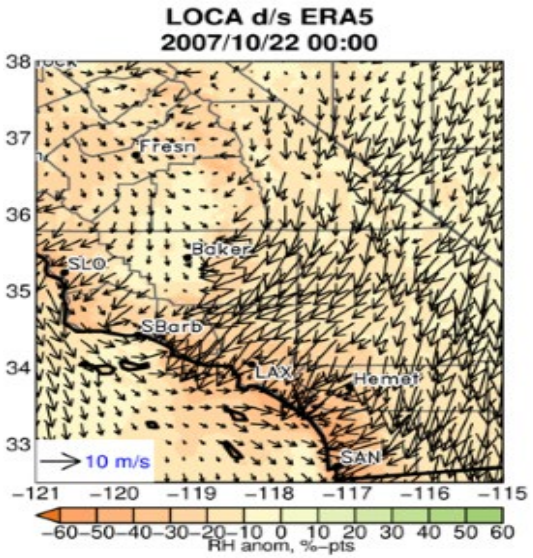

Dynamical modeled (DRI WRF, top) and statistically modeled (LOCA), bottom) hourly wind (vectors) and relative humidity anomaly (shading) of strong Santa Ana event 22 October 2007. Parent global reanalysis from which WRF dynamical model was developed is ERA5 . WRF and LOCA winds and humidity are simulated at 3km spatial resolution, but this plot shows decimated set of wind vectors to avoid clutter.

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- The quality of dynamical and statistical downscaling is dependent upon the availability of global or regional modeling output to provide large scale guidance on projected or historical patterns
- Consideration of multiple variables may be useful in identifying the patterns employed in statistically downscaling individual variables. For example, it was found that the addition of sea level pressure to regional wind patterns added skill when LOCA downscaling wind over the California region.
- Some variables of interest to the wildfire prevention and management community that may be available from regional dynamical models but not from statistical downscaling techniques.
- Regional dynamical model downscaling of high volumes of GCM simulations is not practical because of computational resource limitations.
- Statistical downscaling of a set of variables from CMIP6 simulations is feasible but will require substantial computer resources and data storage.
- Dynamical (WRF) downscaling can provide a historical high resolution reanalysis of wind, humidity and other variables for which there are no observed records.
- LOCA downscaling of vector wind and humidity can be accomplished using these dynamical model results as training datasets.
- Relatively short, limited domain observations (e.g. SDGE winds and humidity) may provide extremely valuable evaluation or calibration of downscaled methods and results.