Poster #1-45

Tropical Ecological Forecasting for ENSO Using a Global Modeling Framework

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Strong drying conditions in the Asia-Pacific region and tropical South America during El Niño–Southern Oscillation (ENSO) lead to reduced ecosystem productivity and increased mortality and fire risk. Sea surface temperature (SST) anomalies in the equatorial Pacific drive teleconnections with temperature through changes in atmospheric circulation that also impact precipitation and soil moisture, producing indirect effects on temperature through land–atmosphere coupling. We performed a set of simulations using the U.S. Department of Energy's Energy Exascale Earth System Model (E3SM), forced with prescribed sea surface temperatures, to study the responses and feedbacks of drought effects on terrestrial ecosystems induced by both of these events and to understand the effects of SST anomalies on temperature through changes in soil moisture. The E3SM model was configured to run with active atmosphere and land models alongside the "data" ocean and thermodynamic sea ice models. The Community Atmosphere Model used the Spectral Element dynamical core (CAM-SE) operating on the ne30 (~1°) grid, and the E3SM Land Model (ELM) was equivalent to the Community Land Model with prognostic biogeochemistry (CLM4.5-BGC). We used Optimal Interpolation SSTs (OISSTv2) and predicted SST anomalies from NCEP's Climate Forecast System (CFSv2) as forcing. We conducted transient simulations from 1982 to present, following a spin up simulation, and analyzed the ENSO impacts on tropical terrestrial ecosystems for the 5-year periods centered on two strong ENSO events. In addition, we applied a mechanism-denial experiment to decouple the variability of soil moisture from that of SST anomalies. Soil moisture variability was found to amplify and extend the effects of SST forcing on eastern Amazon temperature and carbon fluxes in E3SM. In particular, during the dry season, after ENSO SST anomalies had dissipated, soil moisture variability became the dominant driver in the eastern Amazon, explaining 67%–82% of the temperature difference between El Niño and La Niña years, and 85%–91% of the difference in carbon fluxes. We will present simulation results and discuss the importance of capturing land-atmosphere interactions through model coupling. In addition, we will discuss the potential utility of this modeling framework for ecological forecasting on seasonal to decadal scales.