Forecasting Pan-Tropical Ecological Impacts of the 2015 El Niño Southern Oscillation (ENSO)

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February 26, 2016

The El Niño Southern Oscillation (ENSO) is an irregular periodic climate fluctuation, occurring every eight to 12 years, that is driven by variations in sea surface temperatures (SSTs) over the tropical eastern Pacific Ocean and extending westward across the equatorial Pacific. The warming phase is called El Niño and the cooling phase is called La Niña. This dominant ocean cycle, linked with the Walker Circulation, affects ocean turnover and nutrient availability, as well as temperatures and precipitation globally. El Niño also has strong effects on the global carbon cycle seasonally because, although weakened ocean circulation reduces marine carbon outflow, terrestrial emissions more than compensate for this reduction. Strong drying conditions in the Asia-Pacific region and western South America during El Niño lead to reduced ecosystem productivity and increased mortality and fire risk, which are responsible for the increased source of carbon to the atmosphere.

A record-setting El Niño appears to be setting up for a late fall or early winter peak, providing relief from the California drought but portending hot and dry conditions for the island nations of the western Pacific. To study the responses and feedbacks of drought effects induced by ENSO events, we have conducted a series of global Earth system model simulations using the Accelerated Climate Model for Energy (ACME) v0.3 model. These simulations will draw upon the ensemble of NOAA ENSO forecast sea surface temperature (SST) predictions that extend 9 months into the future. The experimental design consists of a carbon cycle spin up simulation using repeated 1982–2006 SST forcing from reanalysis, 5-y ENSO simulations for the 1997 (1996–2000) and the 2015 (2014–2018) events, and one or more non-ENSO control simulations. A combined set of historical and NOAA forecast SSTs are being used for the 2015 ENSO simulations. Analysis of ecosystem impacts, investigating anomalies in soil moisture, GPP, and stomatal conductance, will be performed across both events. ACME coupler output from the atmosphere will be saved at 3- or 6-h frequency for use as offline forcing for new model parameterization development and testing within the NGEE Tropics project.

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