

Abstract

The term Super El Niños refers to the strongest and most powerful of El Niños, such as those that developed during 1972, 1982, and 1997. These powerful El Niños have impacted economies, societies, and ecosystems disproportionately compared to their milder cousins.

In this talk, we show that Super El Niños distinguish themselves from the normal El Niños not only in their impacts, but also in their characteristic SST signature. In particular, we focus attention to their SST anomaly pattern that is intensified in the eastern Pacific Ocean.

We weave together observational analyses with simple numerical simulations to clearly demonstrate that eastern Pacific intensified super El Niños result from the interaction of an El Niño and a positive Indian Ocean Dipole.

Further, we identify a self-limiting behavior inherent to El Niño Southern Oscillation (ENSO) dynamics. This behavior—a consequence of the atmospheric Kelvin wave response that develops to the east of ENSO's convective anomalies—dampens sea surface temperature (SST) variations in the eastern Pacific, thereby preventing super El Niños from developing through tropical Pacific dynamics alone.

Our model explains the features of the large 1972, 1982, and 1997 El Niños; the large SST anomalies during the 2015 El Niño, however, were likely enhanced by strong decadal variability.