Session: B8 Oral presentation

The impact of increasing greenhouse gases on El Niño/Southern Oscillation (ENSO)

David Battisti[†]; Daniel Vimont; Julie Leloup; William Roberts
[†] University of Washington, USA
Leading author: david@atmos.washington.edu

El Niño/Southern Oscillation (ENSO) is the dominant pattern of natural interannual climate variability, affecting the livelihoods of more than a half billion people. Unfortunately, nearly all the high-end global climate models feature distorted ENSO cycles - or no ENSO at all - mainly due to gross biases in their climatological mean states of the atmosphere and ocean in the tropical Pacific. As such, output from these models cannot be used directly to address the important issue of how ENSO (and its teleconnected climate anomalies) will be affected by increasing greenhouse gases. This talk will discuss a way forward. We first review an offline linearized coupled model of the tropical atmosphere-ocean system, LOAM. We then demonstrate how LOAM can be used to unambiguously determine how and why ENSO changes in the full-physics climate models when the mean state changes due to external forcing, such as Milankovitch or anthropogenic climate change. Applying the tool to the output of the NCAR CCSM, for example, shows that ENSO variance is reduced in the mid-Holocene in this model because the tropical Pacific SST is reduced, weakening the Bjerknes Feedback (ocean mean state changes destabilize ENSO, but not enough to compensate for the stabilization due to reduced SST). In contrast, applying the tool to the identical experiments using the HADCM3 shows that ENSO is reduce in that model because of a weaker thermocline that stabilizes the ENSO mode. Finally, we introduce a method for side-stepping the mean state biases in the CMIP3 models to obtain better projections of how anthropogenic climate change will impact the spatio-temporal structure of ENSO and its teleconnections. Results are presented for the mid-21st Century.