Geophysical Research Abstracts
Vol. 18, EGU2016-5401, 2016
EGU General Assembly 2016

The importance of ENSO Nonlinearities in Tropical Pacific Response to External Forcing.

Christina Karamperidou and Fei-Fei Jin
Department of Atmospheric Sciences, University of Hawaii, Honolulu, United States (ckaramp@hawaii.edu)

Tropical Pacific climate variability operates at multiple timescales: from seasonal to interannual to decadal and centennial; climate model simulations are inconclusive as to the direction and magnitude of changes at these distinct timescales in response to external forcing, and their potential interactions. While the impact that centennial-scale changes in tropical Pacific climate might have on decadal variability and ENSO activity has been extensively investigated, the reverse question –how ENSO activity affects decadal and centennial Pacific climate variability- has received limited attention. It has been shown that large ENSO events may warm the cold tongue at decadal and centennial scales via residual nonlinear dynamical heating, and they may influence the sensitivity of the tropical Pacific zonal SST gradient to external forcing (ENSO rectification hypothesis). Then the question becomes: do models exaggerate or mute forced tropical Pacific warming based on what kind of ENSO they simulate? What is the dominant balance of feedbacks that creates ENSO nonlinearities, and does it affect model projections of decadal tropical Pacific climate variability? Here, we use instrumental and paleoclimate data, as well as climate model simulations to investigate whether ENSO nonlinearities and rectification play a role in creating the inter-model spread of decadal & centennial tropical Pacific climate projections. We show that models that exhibit strong ENSO nonlinearities simulate a more accurate balance of ENSO feedbacks, which includes ENSO rectification processes. In these models, the response of decadal tropical Pacific variability to external forcing is tied to their ENSO response, and the projected tropical Pacific SST warming pattern is more uniform along the equator. On the contrary, climate models with weak ENSO nonlinearities may overestimate the warming of the cold tongue, in the absence of strong thermodynamic damping and ENSO rectification processes that would balance the effects of radiative forcing. Hence, we highlight that simulating the "right" ENSO for wrong reasons may lead to potentially biased projections of warming patterns and decadal variability changes in the tropical Pacific.