College of ENGINEERING
UNIVERSITY OF HAWAI'I AT MĀNOA

CEE691 Seminars in Civil and Environmental Engineering

Metrics of El Niño nonlinearity as constraints for tropical Pacific climate change.

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Speaker: Christina got her PhD in Earth & Environmental Engineering from Columbia University in 2012. Prior to that, she got her B.Sc. and M.Sc from the Department of Civil and Environmental Engineering, Aristotle University of Thessaloniki, Greece. She is currently an Assistant Researcher at the Department of Atmospheric Sciences, U. of Hawaii. Her research interests include ENSO dynamics and predictability in current and past climates, the response of mid-latitude atmospheric circulation to climate change, sea level variability and its effect on coastal aquifers and ecosystems, and hydroinformatics and climate model optimization.

Abstract

Tropical Pacific climate varies at interannual, decadal and centennial time scales, and exerts significant influence on global climate, including temperature and precipitation extremes across the globe. Climate model projections of decadal and centennial tropical Pacific climate in response to greenhouse-gas forcing exhibit large spread. This model spread is an important source of uncertainty in estimates of future changes in atmospheric circulation, temperature, precipitation, sea level variability etc., especially at the timescales of regional decision-making (e.g. multidecadal). Here, I will show that part of this spread can be explained by model biases in the simulation of interannual variability, namely the El Niño/Southern Oscillation (ENSO) phenomenon. After a brief explanation of the basic physical processes governing ENSO, I will show that models that exhibit strong ENSO nonlinearities simulate a more accurate balance of ENSO feedbacks. In these models, the response of decadal tropical Pacific variability to external forcing is tied to their ENSO response, and the projected centennial tropical Pacific SST warming pattern is relatively uniform along the equator. On the contrary, climate models with weak ENSO nonlinearities may overestimate the warming of the eastern Pacific, resulting in significantly different projections of temperature and precipitation changes under climate change scenarios. Therefore, ENSO nonlinearities can be used as constraints for model assessments of changes in temperature, circulation, and precipitation patterns, as well as for distributions of their extremes (e.g. sea level, precipitation).