IPRC Seminar

Matthew England

Climate Change Research Center,
University of New South Wales, Australia

"Role of trade wind variations in Pacific and global decadal climate variability"

The role of observed trade wind variations associated with the Interdecadal Pacific Oscillation (IPO) in driving global climate is investigated using a high-resolution ocean model forced by observed wind and surface flux trends over the Pacific. In the main perturbation experiment the surface momentum, heat and freshwater flux trends as observed in the Pacific region (1992-2011) are applied regionally, while the rest of the globe is forced by CORE normal year surface fluxes. This period is characterized by a marked Walker circulation and trade acceleration, and a trend toward a strongly negative phase of the IPO with significant east Pacific cooling. This experiment is compared to a control CORE normal year experiment. An idealized "future" trend experiment is also investigated wherein the applied atmospheric trends during 1992-2011 are reversed back to normal-year conditions over the period 2012-2031.

We find a strengthening of the Equatorial Undercurrent (EUC) in response to strengthened winds, which brings cool water to the surface of the eastern Pacific, and an increase in the Pacific shallow overturning cells, which in turn drives additional heat into the subsurface western Pacific. The wind acceleration also results in an increase in the strength and subsequent heat transport of the Indonesian throughflow, which transports some of the additional heat from the western Pacific into the Indian Ocean. This results in a warm subsurface western Pacific, a cool upper eastern Pacific and a warm subsurface Indian Ocean, with an overall increase in Indo-Pacific heat content.

Experiments applying a symmetric reversal of the atmospheric fields mimic a return to the positive phase of the IPO, characterized by weaker Pacific trade winds. In response we find a slowdown of the (EUC) and Pacific shallow overturning cells, and a resulting return to climatological SST conditions in the western and eastern Pacific. The ITF also slows back down to its original values. However, the temperature, heat content and ITF responses are not quite symmetric due to an overall increase in the surface heat flux into the ocean associated with the cooler surface of the Pacific, and also due to irreversible heat transfer from the Pacific into the Indian Ocean via the ITF. There is also irreversible heat transport across the thermocline via diapycnal mixing, further contributing to this asymmetry. Here we find an Indo-Pacific subsurface ocean that remains warmer than it was in its initial state. This could have implications for long-term heat content changes in the ocean interior.

Friday, December 8, 2017 11:00 am - 12:00 pm, POST 414