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The response of the tropical Pacific and ENSO to Global Warming

Hosted by Eric Maloney

Thursday, February 16, 2012

**ATS room 101; Discussion will begin at 3:30pm
Refreshments will be served at 3:00pm in the coffee lounge**

I will present new ideas explaining two central questions about the response of the tropical Pacific climate to increasing greenhouse gases:

1. Is the equatorial Pacific going to become El Niño- or La Niña-like?
2. Is ENSO going to strengthen or weaken?

Theory and models anticipate that, because humidity increases faster than precipitation as the tropics warm, the Walker circulation will slow-down in order to maintain a balanced flow of water vapor into areas of convection. Unlike during ENSO events, the ocean does not amplify the atmospheric response via the Bjerknes feedback. This occurs because the thermocline adjustment to changes in the trade winds is fundamentally different on climate change timescales. Moreover, the thermal stratification of the upper ocean increases in response to global warming, effectively enhancing the cooling effect of equatorial upwelling. These two processes 'put a brake' on the weakening of the Walker circulation. This results in a subtle pattern of enhanced equatorial warming, that is neither El Niño- or La Niña-like.

The robust ocean changes in response to global warming, however do lead to robust changes in ENSO. Climate models do not agree on whether ENSO will strengthen or weaken as greenhouse gases increase. This lack of agreement has been widely reported in the literature, but a cogent explanation remains elusive. Myriad ocean or atmospheric processes that affect ENSO can all be altered as the Earth warms leading to diverging responses in the models. I will show that the weaker Walker circulation leads to weaker climatological upwelling resulting in weaker ENSO, but the increased ocean thermal stratification leads to stronger ENSO. Each model exhibits a different balance between these mechanisms explaining whether ENSO strengthens, remains unchanged, or weakens. The upshot is that the same opposing mechanisms that stabilize the response of the mean climate; could also lessen the sensitivity of ENSO to increasing greenhouse gases.

Link to colloquium videos and announcement page: <http://www.atmos.colostate.edu/dept/colloquia.php>