Non-linear controls on the persistence of La Niña events in CCSM4

A explanation for why La Niña events persist for more than one year in CCSM4’s preindustrial climate simulation will be presented. CCSM4 simulates a realistic ENSO cycle with asymmetries between the warm and cold phases of ENSO. The most striking asymmetry is the extended duration of some La Niña events for up to two years, even three years. CCSM4 simulates three nonlinearities capable of generating this asymmetry: 1) stronger atmospheric damping of large warm events, 2) stronger wind response for large warm events, and 3) stronger thermocline response for large cold events. A heat budget analysis of composite La Niña events suggest that an asymmetry in the delayed thermocline feedback plays a role controlling the duration of La Niña events. La Niña events i) initiate from a state with a very shallow thermocline (driven by the strong response to the preceding El Niño) and ii) drive a weaker recharge response. Both processes prevent the equatorial Pacific from returning to neutral or warm conditions and cold conditions persist for a second year. In order to isolate the effect of this nonlinear ocean response from the other two atmosphere nonlinearities we fit CCSM4’s heat budget into a nonlinear delayed-oscillator equation. Sensitivity experiments with this nonlinear delayed-oscillator confirms that the thermocline nonlinearity (3) causes the asymmetry in the recharge/discharge process that causes La Niña events persist for more than one year. Implications for observed La Niña events and their predictability will be discussed.

Seminars are live webcast: http://www.fin.ucar.edu/it/mms/ml-live.htm
* Refreshments are served before seminar. *

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