Title: ENSO transition, duration and amplitude asymmetries: Role of the nonlinear wind stress coupling in a conceptual model

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Key findings:

- This paper has summarized the ENSO transition, duration and amplitude asymmetries in observations and two of the GFDL climate models: CM2.1 and CM2.5
- By including a parameterization for the nonlinear wind stress response that the central equatorial Pacific wind stress anomalies respond more strongly to El Nino sea surface temperatures, the well-known delayed-oscillator ENSO conceptual model can simulate the ENSO asymmetries in a consistent manner.
- The conceptual model suggests that the nonlinear wind stress response in CM2.1 and the negative feedback for ENSO in CM2.5 may have been too strong compared to the observations.
- The results agree with Dommenget et al (2013) that El Ninos are mostly triggered by stochastic wind, less predictable, while La Ninas are more predictable.

Overview of the research:

The El Nino/Southern Oscillation (ENSO) exhibits well-known asymmetries: (1) warm events are stronger than cold events; (2) strong warm events are more likely to be followed by cold events than vice versa; and (3) cold events are persistent than warm events. Control experiments from the two GFDL climate models, CM2.1 and CM2.5, have estimated the ENSO asymmetries with differing amplitudes. The ENSO asymmetries in CM2.1 tend to be strong while those in the CM2.5 tend to be weaker than the observed.

To shed light on the understanding of the ENSO asymmetries, we begin with a widely-used delayed-oscillator conceptual model for ENSO and modify it so that the wind stress anomalies depend more strongly on the sea surface temperature during warm conditions, as is observed and is apparently manifested in the climate models, especially the CM2.1.

Relevance to NOAA Science:

The current study has examined the skills of two of the GFDL climate models in reproducing the ENSO asymmetries. The findings contribute to the understanding of the ENSO asymmetries, and provide guides for improving the climate models.

Relevance to the society:

The current study has implications to the predictability of ENSO. In particular, it supports the notion that El Ninos are mostly triggered by stochastic wind while La Ninas are more readily to follow El Ninos, and are more predictable. Understanding the cause to the ENSO asymmetry will be crucial to better predicting how the statistics of ENSO may evolve in a changing climate.