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Understanding Tropical-Subtropical Forcing and Predictability of Long-term North American Drought in Coupled Models

U.S. CLIVAR has initiated a Drought in Coupled Models Project (DRICOMP) to encourage diagnostic research into the physical mechanisms of drought and evaluate its simulation in existing coupled models. The common thread among a growing body of literature is that ENSO is a fundamental driver of global drought variability, and La Niña-like conditions play a key role in the circulation anomalies leading to North American drought. An important yet poorly understood process with strong implications for understanding and predicting long term North American drought is how the coupled ocean-atmosphere system maintains persistent cool conditions in the equatorial Pacific Ocean. The questions to be addressed in this proposal are aligned with the objectives of DRICOMP:

(1) how are persistent cool episodes in the equatorial Pacific Ocean represented in today’s state-of-the-art coupled climate models, (2) through what physical mechanisms do such conditions lead to persistent North American drought, (3) how can an understanding of such questions serve to extend the predictive lead time for long-term North American drought, and (4), how do the mechanisms and prospects for predictability depend on the essence of a climate in transition?

The work described in this proposal takes a two-pronged approach. First, a selection of coupled models as determined from the details of their ocean component will be used to characterize and explain the representation of persistent cool equatorial Pacific conditions. Secondly, long-term North American drought variability (in terms of PDSI) and its relationships with the equatorial Pacific, including how that appears to depend on anthropogenic forcing, will be analyzed in the full suite of CMIP3 climate models. The specific contribution of the proposed work to the problem of predictability will be an extended lead time, since we will ascertain (1) how the remote forcing field itself (i.e. low-frequency evolution of equatorial Pacific SST) is modulated, and (2) the coherence between that signal and the predict and (PDSI).