The role of sub-seasonal tropical convective variability for the midlatitude response to ENSO

Erik Swenson†; David Straus
† George Mason University, USA
Leading author: swenson@cola.iges.org

The boreal wintertime Northern Hemisphere (NH) midlatitude response to a significant El-Niño Southern Oscillation (ENSO) warm event has been studied extensively for over 30 years. As well as the forcing itself, the response is primarily understood in terms of an average across the season. However, its development and variability at sub-seasonal time scales is much less clear. Also, its predictability is severely limited by the internal nature of the atmosphere, especially at midlatitudes. Depending on its definition, sub-seasonal and internal variability of the forcing itself also compounds the problem. For the typical coupled or AMIP-type experiments, the issues at hand are very difficult to address cleanly. Although, by narrowing the problem and redefining the external forcing as the diabatic heating rate (Q) from tropical convection, more progress can be made. Multiple sets of 50-member ensemble integrations are performed with the Community Atmospheric Model v4.0 (CAM4.0) with sea surface temperature (SST) prescribed from two warm events (DJFM 1982/83 and 1991/92). Q is computed from a control set and decomposed in terms of the climatological plus slowly evolving SST signal (Q0), the seasonal mean ensemble deviation (Q1), the 30-120 day low frequency variability (Qlow), and the 2-30 day high frequency variability (Qhigh). A series of experimental integrations are performed by prescribing Q across the tropical Indo-Pacific, and varying Q in terms of its components. The impact of Q variability on the midlatitude circulation is assessed by contrast. Keeping in mind the neglect of extratropical-tropical coupling and model dependence for Q, the effect of Q variability for the midlatitude response to ENSO is quantified, and examined in terms of its sub-seasonal evolution, particularly regarding its relationship with the Pacific jet/storm track. The possibility of nonlinearity bridging the traditionally separated sub-seasonal and seasonal time scales is considered. At sub-seasonal time scales, a significant part of the variability in midlatitudes is related, if not directly forced, by Q variability in the tropics, thus having potential implications for the response. Interestingly, internally generated seasonal mean variability of Q (in relation to SST) has a significant impact on the response as well. In addition to theoretical insight, the demonstrated sensitivity to Q further suggests the importance of model convective parameterization for ENSO-based prediction/predictability.