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The midlatitude response to ENSO - deciphering cause and effect

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It is well established the ENSO affects the midlatitude circulation, temperature and precipitation patterns, most clearly in the Pacific sector, but also in the zonal mean. Seager et al (2003) examined the zonal mean response to ENSO, and argued that while the subtropical jet anomalies arise due to the direct effect of ENSO on the Hadley cell, midlatitude zonal mean anomalies arise due to changes in the propagation of transient midlatitude eddies. In this work, we use a combination of observational analysis, and a heirarchy of models to show that this mechanism of tropical modulation of mid-latitude eddies (TMME), operates in the real atmosphere and is of relevance to ENSO-forced precipitation anomalies.

ENSO-related precipitation anomalies in North America are commonly thought to be related to changes in the paths of storm systems across the Pacific Ocean with, during El Ninos, storms taking a more southern route into Southwestern North America and, during La Nina, storms taking a more northern route into the Pacific Northwest. Analyzing of the paths of coherent phase propagation of transient eddies and of the propagation of wave packets, both in observations and in a set of controlled GCM experiments, we demonstrate that these changes arise from systematic changes in transient eddy propagation. We also analyze the day-by-day evolution of the mean and transient circulation, in a series of idealized short integrations of a GCM, forced by an instantaneous imposition of a tropical Pacific SST anomaly, using a diagnostic linear quasi geostrophic model. This analysis allows us to develop an explicit cause and effect account of the tropical forcing of the mean flow, the impact on eddies, and the subsequent feed back onto the mean flow.