Rossby Wave Packet Climatology and the Impact of Hemispheric Flow Patterns and ENSO

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It is known that Rossby wave packets (RWPs) are directly linked to amplification of the mid-latitude storm tracks, high impact weather events, increases in numerical weather prediction uncertainty, and the sensitivity of ensembles to the initial conditions. This research produces an objective, track-based climatology of wave packets, tests the sensitivity of the results to changes in the methods used in filtering the raw data and in tracking, and explores the relationship between RWPs and the large-scale flow patterns.

Reanalysis wind and geopotential height data at 300 hPa every 6 hours were spectrally filtered using a Hilbert transform technique under the assumption that wave packets propagate along a waveguide defined by the 14-day running average of the 300 hPa wind. After some spatial smoothing, the local maxima in wave packet envelope amplitude (WPA) were tracked using two objective techniques: a point-based cost optimization routine and a hybrid of point-identification and object-based tracking following rules similar to those used in the tracking of tropical convective clusters. The first term of the eddy energetics equation was used as a cross-check for the purpose of hand-verifying wave packet tracks in order to compare the performance of each tracking method.

This talk will review the spatial and temporal distribution of RWPs across the Northern Hemisphere, and how these distributions change for relatively weak versus strong RWPs. The interaction of RWPs and various teleconnections are explored. El Nino and warm PDO conditions favor higher probabilities of significant RWPs in the subtropical North Pacific, while La Nina and cold PDO conditions favor more frequent RWPs south of Tibet, over North America, and the eastern North Pacific. Negative AO conditions favor less wave packet activity in the North Pacific storm track and increased high latitude wave packet activity in Alaska, Greenland, and Siberia. The PNA in both strongly negative and strongly positive phases is directly linked with increased RWP activity in the North Pacific and over North America, but no correlation between RWP activity and the index is found. Finally, it is found through composite analysis and lagged one point correlations that RWP activity increases in the North Pacific storm track just prior to and during a significant drop (> 3 standard deviations) in the daily AO Index, and that this activity can be seen to propagate like a RWP across North America and into the Atlantic. Each AO drop event is then examined and a description of the likely sources of the drop is provided, demonstrating that the dominant reason for a change in AO phase is wave packet activity.