# A Connection Between Intraseasonal Tropical Variability and Strong Northeast Cyclones

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Strong winter cyclones have tremendous impacts on all aspects of life, regardless of the location they affect. In particular, major winter cyclones that occur in the Northeastern United States have a long track record of disrupting the daily lives of millions of people. The effects of these storms are broad, including lives lost and billions of dollars of damages. Their severe societal impacts have made these cyclones a high priority research topic with an emphasis on increasing the predictability of these storms on synoptic time scales. While most of this past research has focused on the ability of numerical weather prediction to forecast such storms on synoptic time scales, little research has been done to link the frequency of these storms to the intraseasonal variability of the tropical convection

The Madden-Julian Oscillation (MJO) is the leading mode of intraseasonal rainfall variability in the tropics. The MJO also has a strong connection to planetary extratropical flow patterns. This tropical/extratropical connection has been leveraged as a way to increase the predictability of sensible weather events as early as three to four weeks in advance. Such sensible weather events include extreme variations in surface air temperature and tropical cyclone variability. However, it is evident that the frequency of strong (geostrophic relative vorticty ~$10^{-4}$) cyclones is also linked to slowly propagating (0.5 – 4.0 m $s^{-1}$) MJO-like convection. More importantly, there is evidence that the frequency of these strong cyclones is tied to the evolution of this slow convection several weeks before storm onset.

The purpose of this presentation will be to show the results of an analysis of these strong cyclones over the Northeastern United States (NE) and their connection to the slowly propagating tropical convection is presented using the Climate Forecast System Reanalysis (CFSR) version 2 dataset. The MJO is tracked using Wheeler and Hendon's real-time multivariate MJO (RMM) phase space. In the thirty-year climatology of the CFSR (1979-2010) there are roughly 200 winter cyclones that fit the geostrophic relative vorticity criteria over the Northeastern United States. Of these events, RMM phases 3 and 7 emerge as the most populated phases with NE cyclones. However, this distribution is skewed by the onset of major blocking events. Nearly all of the events that occur in phases 3 and 7 occur within 15 days of another event. We present an argument that the slow evolving tropical convection coupled with extratropical dynamical processes can develop a base state favorable for blocking events over eastern North America that in turn adjusts the North American storm track in way that is conducive to the development of cyclones that affect the northeastern United States.