Modulation of Wintertime MJO Teleconnections by the Northern Hemisphere Stratospheric Polar Vortex

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Skillful subseasonal weather predictions for the Northern Hemisphere (NH) extratropics remain a major challenge for the forecast community and strongly depend on knowledge of the position and strength of the polar jet stream. Two intraseasonal modes of variability that modulate the strength and position of the polar jet stream are: (1) the Madden-Julian Oscillation (MJO) and (2) NH polar vortex variability. Indeed, the polar vortex exerts a downward influence that can alter weather patterns and the tropospheric waveguide, thus potentially also influencing the MJO-associated Rossby wavetrains.

This talk investigates the hypothesized modulating effect of the MJO teleconnections by the state of the stratospheric polar vortex. A series of composites from reanalysis are generated: (1) MJO-only cases (neutral vortex), (2) strong/weak vortex-only composites (weak MJO), and (3) MJO + polar vortex composites (both strong and weak vortex events). We show that in the MJO + polar vortex composites, the MJO-induced wavetrains are considerably altered across the NH compared to the two single-index composite cases. The largest difference is seen over the Atlantic and Europe, where the longwave pattern in the MJO + polar vortex composites are quite different to the MJO-only composites. Thus, subseasonal forecasts made using only the MJO would result in large errors from the Eastern Seaboard of the US into Europe. MJO + polar vortex composite results over much of North America and especially the United States are more variable and depend on particular wave propagation characteristics. We also show that the magnitude and phase of the near-surface Arctic Oscillation / North Atlantic Oscillation (i.e., two popular indices for temperature and extreme weather forecasts across North American and Europe) are also substantially altered when considering MJO-only, vortex-only, and the MJO + polar vortex conditions. Relations of these composites to extreme weather frequency via blocking episodes and their utility for subseasonal forecasting are also discussed.