ATS/CIRA Colloquium

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Linking Arctic to lower latitude processes through resilient tropopause-based vortices

Hosted by Russ Schumacher

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ATS room 101; Discussion will begin at 11:15am
Refreshments will be served at 10:45am in the weather lab

Born in polar regions, a tropopause polar vortex (TPV) is an often sub-synoptic cyclone embedded within the larger-scale tropospheric polar vortex. TPVs can be long-lived phenomena with monthly time scales, and have complex interactions with features such as sea ice, moisture, and surface cyclones. Unfortunately little is known regarding how polar processes interact with lower latitude weather and climate. This talk will examine the hypothesis that TPVs are one such feature that links the polar region to lower latitude processes, where diabatic heating from infrared radiation, coupled with weak deformation, is required to maintain the structure in order to have a significant impact at lower latitudes.

In order to improve numerical weather and climate prediction, knowledge gained through detailed analysis of TPV processes, and their interactions with jet streams, are essential. This talk will present a synthesis of the dynamics of TPVs and known implications. While it is well-established that TPVs are an important precursor to the formation of surface cyclones, the processes culminating in the uncertainties of cyclogenesis are not. The hypothesis is explored using the threefold tropopause framework in consideration with Rossby wave growth along the midlatitude waveguide. In this framework, there are three bands of concentrated upper-level Ertel potential vorticity (EPV) gradients in subtropical, polar, and Arctic regions. TPVs are most closely associated with the Arctic EPV band, and from this perspective, are a coherent vortex embedded within the larger-scale tropospheric polar vortex. Variations in the strength of midlatitude waveguide influence the isolation of TPVs, thereby leading to a seasonal dependence on lower latitude impacts. When influenced by the midlatitude waveguide, TPVs have the potential to merge with the polar jet stream, and in rare cases, both the polar and subtropical jet streams to result in an exceptionally strong jet streak. Jet streaks provide favorable dynamics for large-scale ascent, which can result in winter storms or severe weather outbreaks as far south as the United States Gulf Coast. The strength of jet streaks therefore also depends on the strength of TPVs. It is proposed that downstream forecast error can derive from upstream sensitivities in TPVs long before the formation of a jet streak and ensuing weather event.

Link to colloquium videos and announcement page: http://www.atmos.colostate.edu/dept/colloquia.php