Autumnal season extratropical transition events and their impact on the early wintertime stratospheric circulation

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Abstract

It has become increasingly accepted that recurving tropical cyclones (TCs) can have substantial impacts on the hemispheric general circulation as well as downstream forecast uncertainty. A recurving TC that transitions into an extratropical cyclone can excite a Rossby wave train and/or a blocking ridge that is associated with meridional fluxes of heat and momentum. In some cases, meridional fluxes of heat and momentum extend well into the stratosphere, where such fluxes are associated with an upward EP flux from the troposphere into the stratosphere. An environment characterized by EP flux convergence experiences an increase in wave activity and consequently a decrease in the westerly momentum of mean zonal wind. When an extratropical transitioning TC occurs during the spin-up of the northern hemisphere wintertime circulation, the impact of the EP flux convergence in the stratosphere can be to slow the establishment of the wintertime stratospheric polar vortex and the associated stratospheric polar night jet. (Typical recovery times in the stratosphere are on radiative timescales of 30-60 days.)

From a case study perspective, this talk will explore the hypothesis that the processes associated with the extratropical transition of TC Dale (1996) were responsible for a warming of the Arctic polar cap and an observed weakening of the stratospheric polar vortex. After TC Dale recurved and became extratropical, there was a surge in EP flux from the troposphere to the stratosphere. The EP flux convergence (associated with a decrease in westerly momentum) was located along the flank of the stratospheric polar vortex and was associated with stratospheric ridge amplification over Alaska. The ridge amplification occurred at a point in the season when the stratospheric polar night jet was climatologically spinning up for the winter; however, the flux of wave activity from the troposphere to the stratosphere associated with recurving TC Dale resulted in a weakened stratospheric polar vortex and a substantial departure from climatology. The potential implications of events similar to Dale on the Arctic Oscillation (AO) as well as subseasonal forecasting will be highlighted.