

Extreme Weather Events Originating from Interactions between Tropopause Polar Vortices and the North Atlantic Jet Stream

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Coherent vortices in the vicinity of the tropopause, referred to as tropopause polar vortices (TPVs), may be extracted from the high latitudes in conjunction with high-latitude upper-level ridge amplification events. Once extracted from the high latitudes, TPVs subsequently may interact with and strengthen midlatitude jet streams as well as act as precursor disturbances for intense midlatitude cyclogenesis events. The purpose of this study is to investigate 1) the mechanisms responsible for the extraction of TPVs from high latitudes and transport of TPVs to middle latitudes, and 2) the strengthening and reconfiguration of the North Atlantic jet stream (NAJ) resulting from TPV–NAJ interactions, and how differences among these interactions impact the development of extreme weather events (EWEs) between North America and Europe. It is hypothesized that 1) the large-scale flow configuration plays an important role in allowing TPVs to be extracted from high latitudes and transported to middle latitudes, and 2) the large-scale flow configuration and disturbances embedded within and/or equatorward of the NAJ play important roles in determining the degree of strengthening and reconfiguration of the NAJ and the potential development of EWEs resulting from TPV–NAJ interactions.

The mechanisms responsible for the extraction of TPVs from high latitudes and transport of TPVs to middle latitudes will be investigated by constructing a TPV climatology from 1979–present utilizing the 0.5° NCEP Climate Forecast System Reanalysis. Multiscale investigations of TPVs from this climatology will be conducted to identify factors and diagnose processes that enable TPV–NAJ interactions to culminate in the development of EWEs between North America and Europe, and representative case studies of such interactions will be presented. The 18–19 November 2013 extreme flooding event in the Mediterranean island of Sardinia, Italy, will be presented as an example case in which a TPV–NAJ interaction contributes to downstream EWE development. The 21–23 December 2013 ice storm over eastern North America will be presented as an example case in which a TPV–NAJ interaction contributes to local EWE development. These and other preliminary case studies illustrate that whether or not TPV–NAJ interactions lead to the development of EWEs may depend upon the large-scale flow configuration and whether and how TPVs interact with disturbances embedded within and/or equatorward of the NAJ. It is thus anticipated that there is a spectrum of possible types of TPV–NAJ interactions, with certain types of interactions expected to be more conducive to the development of EWEs than other types of interactions.