

Preconditioning of Arctic Stratospheric Polar Vortex Shift Events

Jinlong HUANG¹, Wenshou TIAN¹, Lesley J. GRAY², Jiankai ZHANG¹, Yan LI¹, Jiali LUO¹, and Hongying TIAN¹

¹ *Key Laboratory for Semi-Arid Climate Change of the Ministry of Education, College of Atmospheric Sciences, Lanzhou University, Lanzhou, China*

² *National Centre for Atmospheric Science (NCAS), Physics Department, Oxford University, Oxford, United Kingdom*

This study examines the preconditioning of events in which the Arctic stratospheric polar vortex shifts towards Eurasia (EUR events), North America (NA events) and the Atlantic (ATL events) using composite analysis. An increase in blocking days over northern Europe and a decrease in blocking days over the Bering Strait favor the movement of the vortex towards Eurasia, while the opposite changes in blocking days over those regions favor the movement of the vortex towards North America. An increase in blocking days over the eastern North Atlantic and a decrease in blocking days over the Bering Strait are conducive to movement of the stratospheric polar vortex towards the Atlantic. These anomalous precursor blocking patterns are interpreted in terms of the anomalous zonal wave-1 or wave-2 planetary wave fluxes into the stratosphere that are known to influence the vortex position and strength. In addition, the polar vortex shift events are further classified into events with small and large polar vortex deformation, since the two types of events are likely to have a different impact at the surface. A significant difference in the zonal wave-2 heat flux into the lower stratosphere exists prior to the two types of events and this is linked to anomalous blocking patterns. This study further defines three types of tropospheric blocking events in which the spatial patterns of blocking frequency anomalies are similar to the patterns prior to EUR, NA and ATL events, respectively. Following these three types of blocking events, movements of the polar vortex towards Eurasia, North America and the Atlantic are observed. These shifts of the polar vortex towards Eurasia, North America and the Atlantic lead to statistically significant negative height anomalies near the tropopause and corresponding surface cooling anomalies over these three regions.

Key words: the stratospheric polar vortex, tropospheric blocking, planetary scale wave