



Reflective stratospheric polar vortex pattern linked to North American cold-extremes

Marlene Kretschmer (1), Judah Cohen (2), Jakob Runge (3), and Dim Coumou (4)

(1) Potsdam, Germany (kretschmer@pik-potsdam.de), (2) Atmospheric and Environmental Research, Lexington, MA, USA, (3) DLR Institute of Data Science, Jena, Germany, (4) VU University Amsterdam, Department of Water and Climate Risk, Institute for Environmental Studies (IVM), Netherlands

The stratospheric polar vortex can influence the tropospheric circulation and thereby winter weather in the mid-latitudes. Weak zonal-mean vortex states, e.g. associated with Sudden Stratospheric Warmings, often precede a negative phase of the North Atlantic Oscillation, increasing the risk of cold-spells especially over Eurasia. Using cluster analysis, we show that in addition to this zonally symmetric disturbed vortex, there exists an asymmetric pattern linked to a negative phase of the Western Pacific Oscillation (WPO) and cold-spells in the northeastern United States (US). Compared to the well-documented symmetric pattern, the asymmetric pattern has a shorter lifetime but occurs more frequently and is more relevant for US cold-spells. Applying causal effect networks, we test the causal atmospheric pathways associated with this asymmetric pattern. We show that high-pressure around Greenland causes upward wave-activity over eastern Siberia leading to reflected downward propagating waves over Alaska and a negative WPO. This reflective mechanism is thus sensitive to the exact region of upward wave-activity and also state-dependent on the strength of the vortex.