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On the signature of the downward propagation of stratospheric extremes events to the troposphere

Prof. Martin Dameris[1], Theresa Runde[1], Dr. Hella Garny[1], Doug Kinnison[2]

[1] DLR (German Aerospace Center)

[2] UCAR

Martin.Dameris@dlr.de

An advanced analysis is presented detecting the response of the troposphere to outstanding stratospheric circulation patterns during northern winter. Two clusters of stratospheric winter situations are formed, i.e. specially strong and weak stratospheric polar vortex events. In addition, each cluster is divided regarding the strength of the tropospheric response following such stratospheric situations. This results in four groups of events: Strong and weak polar vortices with significant or non-significant tropospheric response each. For the determination of the stratospheric and tropospheric dynamical state the daily timeseries of the polar cap averaged geopotential height anomaly (deviation from the climatological mean) is used. It is shown that this timeseries is almost equivalent to the timeseries derived from empirical orthogonal functions of geopotential height, as used in previous studies. The method is applied to data derived from two chemistry-climate models, E39CA and WACCM3.5. In addition ERA40 reanalyses data are investigated in the same way. The analyses indicate that situations with a weak tropospheric response occur more frequent (in about 80% of all cases) than those with a strong tropospheric response. A key result of the study is that the strength of the tropospheric response after a stratospheric extreme event is independent of the strength of the stratospheric perturbation itself in all three datasets.