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Links between boreal polar-night jet oscillations and geophysical fields

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The middle atmosphere in winter shows a high variability in polar latitudes, which are primarily caused by radiative cooling and by internal dynamic processes. The aim of this study is to examine the variation of polar cap temperature profiles of the middle atmosphere in winter, based on daily reanalysis data from NASA (MERRA, 1979 to 2014) by an Empirical Orthogonal Function analysis (EOF). Therefore the dominant time periods of Polar-night Jet Oscillations (PJO) have been identified by the first two EOF modes. The correlation to major sudden stratospheric warmings (MSSWs) is based on the representation of the two leading EOF time series in phase space. The robustness of the criterion for determining PJO events is verified. The numbers of strong MSSW with PJO and without PJO are equally distributed by applying the 3σ-criterion.

The relationship of the polar cap temperature anomalies to geophysical fields of the mid-latitudes is investigated by a linear regression with different lags. The characteristic poleward and downward propagation of the zonal-mean zonal wind anomalies with a typical period of 60 days is confirmed even using daily data. The resulting hemispheric temperature distribution of a warm upper stratospheric anomaly and a half as strong cold one in the mesosphere agrees with the expected pattern given by EOF analysis. Also the analysis of further meteorological parameters reveals the poleward movement of a ridge above the Pacific Ocean, which replaces the polar low. Thereby, according to the geostrophic relationship results are shown for the zonal-mean zonal and the meridional wind, which describe the anticyclonic rotation around a high pressure area.