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Evidence for Solar Signals in the Mesopause Temperature Variability above a Midlatitude Station in Europe

M. Bittner and K. Höppner

German Aerospace Center (DLR-DFD), Germany (michael.bittner@dlr.de)

Nocturnal temperatures are almost continuously derived from OH* (3-1) near infrared emissions in the upper mesosphere (around 87 km) above Wuppertal (51°N, 7°E) from ground based measurements since 1980. The time series analyzed covers the time interval from 1980 until 2004 and consists of 4414 well documented night mean temperature data. OH*-temperature fluctuations on temporal scales of about 3-20 days are derived by removing seasonal and longer term trends from the data record by means of applying various spectral analysis techniques such as the harmonic analysis, maximum entropy method and the wavelet transform, respectively. The residuals are found to well reflect the activity of planetary waves.

Temperature variations show a longer term modulation peaking around 1981 and 1996; minima are encountered around 1986 and 2004. Thus, no conclusive correlation with the solar F10.7cm flux is found. Reasonable agreement of planetary wave activity with the general solar bipolar magnetic field (22-year Hale cycle) is found instead. Further agreement is found with the length of the day (LOD) implying that the internal terrestrial magnetic field is superimposed by the solar magnetic field (Hale cycle) causing modulations of the total magnetic field in the Earth's interior and which leads - in turn - to a modulation of the electromagnetic coupling of angular momentum between the Earth's core and the Earth's mantle. As a result the Earth's rotation period - and thus the activity of planetary waves - should be modulated with the solar magnetic flux, e.g. the quasi 22 year Hale cycle.

Planetary wave activity is further found to be modulated by a quasi two year oscillation. The modulation is strongest around 1994/95 and lowest around 1988 and 2004. It is found that wave activity is enhanced always when the QBO is in its westerly phase.