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Possible Effect of Solar Wind on Rossby Wave Propagation and Breaking

H. Lu (1), C. Franzke (1), M. Jarvis (1), and O. Martius (2)

(1) British Antarctic Survey, High Cross, Madingley Road, Cambridge, UK, (2) Institute for Atmospheric and Climate Science, ETH, Zurich

Variability in the solar wind may influence the energy balance in the thermosphere through mass density alteration and/or the deposition of energetic particles into the Earth's thermosphere, which in turn alter the thermal structure and chemical composition of the upper atmosphere. Observational studies have also suggested a solar wind-climate connection; the anomalous circulation pattern linked to the solar wind resembles a positive Northern Atlantic Oscillation (NAO) in the Europe and Atlantic region which in turn may affect the relative location of the storm track, blocking and the strength of the polar jet streams. However, the processes involved remain unknown.
Statistical inference from reanalysis data sets has shown that solar wind dynamic pressure (SWDP) may influence stratospheric and tropospheric winter circulation dynamically through an enhanced positive Northern Annular Mode (NAM) and a stronger stratospheric polar vortex during Northern Hemispheric (NH) winter. Especially when solar activity is high, the NAM anomalies may propagate downward to cause a significant perturbation near the surface. In this talk, a space-time spectral analysis is applied to geopotential height data from the ERA-40 and ERA-Interim reanalyses for the period of 1958-2009 in order to provide some new insights on possible SWDP modulation of the mean state and planetary waves during NH winter. We shall address how planetary wave and mean flow interaction may play a role in the downward transfer of SWDP signals from the stratosphere to the troposphere. In addition, we show how the signals vary longitudinally in terms of anomalous changes of geo-potential height and cyclonic/anti-cyclonic activity at mid- to high latitudes. Provided that the signals can be supported by plausible mechanisms, SWDP can play a significant role in nudging regional weather patterns to remain in a particular phase over an extended period and therefore improve our ability to predict their seasonal variability.