Geophysical Research Abstracts
Vol. 19, EGU2017-3307, 2017
EGU General Assembly 2017

The temperature signature of an IMF-driven change to the global atmospheric electric circuit (GEC) in the Antarctic troposphere

Mervyn Freeman (1), Mai Mai Lam (1,2), and Gareth Chisham (1)
(1) British Antarctic Survey, Cambridge, United Kingdom, (2) University of Reading, Reading, United Kingdom

We use National Centers for Environmental Prediction (NCEP)/National Center for Atmospheric Research (NCAR) reanalysis data to show that Antarctic surface air temperature anomalies result from differences in the daily-mean duskward component,B_y, of the interplanetary magnetic field (IMF). We find the anomalies have strong geographical and seasonal variations. Regional anomalies are evident poleward of 60˚S and are of diminishing representative peak amplitude from autumn (3.2˚C) to winter (2.4˚C) to spring (1.6˚C) to summer (0.9˚C). We demonstrate that anomalies of statistically-significant amplitude are due to geostrophic wind anomalies, resulting from the same B_y changes, moving air across large meridional gradients in zonal mean air temperature between 60 and 80˚S.

Additionally, we find that the mean tropospheric temperature anomaly for geographical latitudes $\leq$ -70° peaks at about 0.7 K and is statistically significant at the 1 - 5% level between air pressures of 1000 and 500 hPa (i.e., ~0.1 to 5.6 km altitude above sea level) and for time lags with respect to the IMF of up to 7 days. The signature propagates vertically between air pressure $p \geq$ 850 hPa ($\leq$ 1.5 km) and p = 500 hPa (~5.6 km). The characteristics of prompt response and vertical propagation within the troposphere have previously been seen in the correlation between the IMF and high-latitude air pressure anomalies, known as the Mansurov effect, at higher statistical significances (1%).

We conclude that we have identified the temperature signature of the Mansurov effect in the Antarctic troposphere. Since these tropospheric anomalies have been associated with B_y-driven anomalies in the electric potential of the ionosphere, we further conclude that they are caused by IMF-induced changes to the global atmospheric electric circuit (GEC). Our results support the view that variations in the ionospheric potential act on the troposphere via the action of resulting variations in the downwards current of the GEC on tropospheric clouds.