GEOMAGNETIC ACTIVITY AND POLAR SURFACE AIR TEMPERATURE VARIABILITY

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In this paper we use the ERA-40 and ECMWF operational surface level air temperature data sets from 1957 to 2006 to examine polar temperature variations during years with different levels of geomagnetic activity, as defined by the A_p index. Previous modelling work has suggested that NO_x produced at high latitudes by energetic particle precipitation can eventually lead to detectable changes in surface air temperatures (SATs). We find that during winter months, polar SATs in years with high A_p index are different than in years with low A_p index; the differences are statistically significant at the 2-sigma level and range up to about ±4.5 K depending on location. The temperature differences are larger when years with wintertime Sudden Stratospheric Warmings are excluded. We take into account solar irradiance variations, unlike previous analyses of geomagnetic effects in ERA-40 and operational data. Although we can not conclusively show that the polar SAT patterns are physically linked by geomagnetic activity, we conclude that geomagnetic activity likely plays a role in modulating wintertime surface air temperatures. We tested our SAT results against variation in the Quasi Biennial Oscillation, the El Niño Southern Oscillation and the Southern Annular Mode. The results suggested that these were not driving the observed polar SAT variability. However, significant uncertainty is introduced by the Northern Annular Mode and we cannot robustly exclude a chance linkage between sea surface temperature variability and geomagnetic activity.

Geomagnetic activity, stratosphere-troposphere coupling, temperature

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