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Correlation between surface temperature variations and energetic electron precipitation in northern hemisphere winter during the last three solar cycles

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Several studies suggest that energetic particle precipitation into the upper atmosphere can cause notable changes in ion and neutral chemistry in the upper and middle atmosphere. During polar winter these changes can last long enough to descend down to the stratospheric levels. Some recent studies also suggest a link between global geomagnetic activity and changes in stratospheric and tropospheric temperatures. Geomagnetic activity was used in these studies as a proxy of energetic particle precipitation in lack of a homogeneous long term energetic particle dataset.

We have recently recalibrated the NOAA/POES energetic particle fluxes, which now form a homogeneous series over the last 30 years. Using this data set, we have studied the statistical relationship between the northern hemisphere winter surface air temperatures and energetic electron precipitation in 1980-2010. We study the effects of local energetic electron precipitation in addition to precipitation averaged globally over the whole polar region. Using monthly surface air temperature maps we find strong positive (negative) correlation between the surface temperatures and precipitation in northern Eurasia (north-western Atlantic). The range of temperature variations attributable to variations in electron precipitation can be nearly 10 K. We also discuss possible mechanisms behind the observed surface temperature variations caused by electron precipitation.