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Solar and geomagnetic precursors of the climate change

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Observed climate change and warming are temporary and spatially non-uniform over the globe whereas the global models tend to predict the gradual increase of temperature due to the antropogenic impact. In particular, rapid climate changes in the Arctic in 1990-2000s can not be accounted solely for the anthropogenic effect since the actually observed changes exceed the predictions of the global climate models. Such discrepancy is usually attributed to the intrinsic variability of the climate system. However, the Sun influences the Earth climate through mechanisms that are not fully understood but which can be linked to solar variations of luminosity, magnetic field, UV radiation, solar flares and modulation of the cosmic ray intensity. In this contribution we (re)examined the long-term behavior of some solar proxies and surface air and see temperatures (SAT and SST). The satellite composite of total solar irradiance (TSI) covered approximately three last solar cycles has been used for determination of the inter-annual solar variability. In the spectrum of anomalies relative to 11-yr cycle a strong 12-month harmonic is clearly seen along with some lower (3-4 yr) periodicities.
Examination of the long-term behavior of the solar proxy in the individual months of the year reveals the persisted increase of solar irradiance anomalies in December-February. Although the TSI time series has no overall trend, in Nov-Feb the 0.32 W/m2 upward trend is detected. The largest differential anomaly (between 1983 and 2002) is 1.21 W/m2. The natural seasonal weather cycle may play a role of amplifier of solar annual signal.
In order to check further the external (solar) forcing-climate hypothesis, comparisons between the geomagnetic aa index and the update SAT and SST have been made over the time interval of 1868-2009. The long-term variability of the 11-yr running average aa index shows the overall upward trend that rises from 1900 to 1950s, decreases until 1960s, rises again to 1990s and has been decreasing since then, more rapidly after 2003. On a decadal scale the geomagnetic trend correlates well with the evolution of SAT globally averaged over hemispheres and over the particular surface areas. Changes in global temperature are seemed to follow changes in aa with time delay of 6-10 years. If the recent years are included, the correlation between decadal temperature and aa does not obviously fail after 1990s, when solar irradiance and magnetic activity drop, whereas temperature continues an accelerated rise. Thus correlations between solar/magnetic variations and climate may be more significant than previously realized. After the warmest period of 2005-2007 the temperature tends to become cooler and the next years will show whether this trend is stable.