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Persistent temperature disturbances and solar forcing

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In a recent series of papers (refs), we have analyzed daily land-based temperature series (maximum, minimum, mean, differences between maximum and minimum) from tens of meteorological stations in several regions (Europe, USA, Australia). We select stations with long (100 to 300 years), homogeneous series with almost no gap. The long-term (decadal to centennial) evolution of temperature disturbances (which display characteristic times from several days to 1-2 weeks) reveals a clear solar signature. The secular trend of disturbances rises from 1900 to 1950, decreases from 1950 to 1975 and then increases again, decreasing in the most recent decade. This trend is the same as that found for a number of solar indices. Our investigations reveal high spatial heterogeneity and seasonality of the climate system and underlines regional and seasonal variations in the observed solar signature. We compare short-term autocorrelation properties of temperature disturbances for different seasons at decadal timescales. The solar signature appears to be significantly stronger in Winter and in the late Fall seasons. Intensities of disturbances may vary by a factor in excess of 2. We have performed a special analysis of tens of station data from two 2.5°x2.5° areas of the US North Pacific: again we find that the long term evolution of temperature disturbances from 1945 to 2008 closely follows that of solar activity, with a large (30%) modulation compared to corresponding changes in solar irradiance. In another study, we have analyzed the longest (up to 300 years) series from 3 European stations. We have partitioned daily temperatures and their differences in two subsets as a function of high vs low solar activity. We follow a pattern recognition approach and demonstrate, using the two-sample Kolmogorov-Smirnov statistics, that the separation is statistically significant and robust. Differences between the annual changes for the two classes are large (1°C). We have finally investigated a truly global parameter, the amplitude of the seasonal semi-annual variation of the length of day, and found a strong modulation of this amplitude by the Schwabe solar cycle. In all of these studies, significant solar forcing is present and may be a rather general feature. We speculate over possible mechanisms: these likely involve cloudiness modulated by cosmic rays, solar activity, the EUV part of the solar flux, the downward ionosphere-earth current density...

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