Solar activity cycles in global surface temperatures

T. V. Kuznetsova and L. B. Tsirulnik

IZMIRAN, Troitsk, Moscow region, Russia

(tvkuz@izmiran.rssi.ru / Fax: +7 495-3340124)

We study solar activity and surface temperature variations (in the first place at periods of main solar cycles: T∼11 yr, T∼22 yr) to understand a possible influence of solar activity on climate changes in different ranges of periods. The problems are trends, quasi-periodicities and noise in solar and climate processes. We use a method of a non-linear spectral analysis (MGM). MGM is capable of making a self-consistent selection of trends from a data set and singling out harmonics with varying phase and amplitude. We use data: of sunspot numbers W for the period 1700-2003; North and South Hemisphere surface temperatures (NH, SH) and Global Temperature (GT) for 1000-1990. Spectral peaks of our spectra have confidence statistical level higher than 95%. Trends in W and GT show synchronous increasing for 1700-2000. The trends have the highest power in both spectra that point to the main contribution of long-term variations to the changes in the data. Connection of variations of solar activity and terrestrial temperature on different scale has principal different character that points to different physical mechanisms. In particular, time changes of power stationary cycles at periods T=30 yr and T=10 yr in W and GT vary in opposite phase. Analysis shows that even 11-yr solar cycles correspond to cooling of GT, but odd ones to warming. This result about disparity of the 11-yr cycles is not taken usually into account in atmospheric sciences. Non-stationary 22-yr oscillations in both data sets (W and GT) have synchronized time variations including time intervals of regime changes (from amplitude decreasing to increasing). Besides, the cycle at T=22.3 yr. in the NH and SH vary in nearly opposite phase and have different amplitudes. The fact that 22-yr cycle reflects asymmetry of solar activity relative to sign of the solar magnetic field points to a physical mechanism: interaction of solar (IMF) and terrestrial magnetic fields. We elaborated a possible physical mechanism of the 22 yr cycle influence on the GT. However, cycle at T=22 yr. has relative small power in the GT spectrum. Power cycles in the solar and GT spectra (such as at T=300 yr, T=200 yr) can not be explained in terms of this mechanism: an additional mechanism should be elaborated.