Geophysical Research Abstracts
Vol. 14, EGU2012-3781, 2012
EGU General Assembly 2012

Solar activity – climate relations: A critical review.

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The presentation of solar activity-climate relations is extended with the most recent sunspot and global temperature data series. The extension of data series shows clearly that the changes in terrestrial temperatures are related to sources different from solar activity after ∼1985. Based on analyses of data series for the years 1850-1985 it is demonstrated that, apart from an interval of positive deviation followed by a similar negative excursion in Earth's temperatures between ∼1923 and 1965, there is a strong correlation between solar activity and terrestrial temperatures delayed by 3 years, which complies with basic causality principles. A regression analysis between solar activity represented by the cycle-average sunspot number, SSNA, and global temperature anomalies, ΔTA , averaged over the same interval lengths, but delayed by 3 years, provides the relation $\Delta TA \sim 0.009\ (\pm.002) \bullet SSNA$. Since the largest ever observed SSNA is ∼90 (in 1954-1965), and the smallest possible is ∼ 0, the total solar activity-related changes in global temperatures could amounts to no more than $\pm 0.4^{\circ}$C over the past ∼400 years where sunspots have been recorded. The shortcomings of the solar-cycle length model and of the cosmic radiation-cloud model are discussed. It is suggested that the in-cycle variations and also the longer term variations in global temperatures over the examined 135 years are mainly caused by corresponding changes in the total solar irradiance level representing the energy output from the core, but further modulated by varying energy transmission properties in the active outer regions of the Sun.