



The modulation of solar activity on the Earth's temperature on millennial time scales

Xinhua Zhao and Xueshang Feng

National Space Science Center, Chinese Academy of Sciences, Beijing, China (xzhao@spaceweather.ac.cn)

The solar impact on the Earth's climate change is an ancient topic with intense controversy. In this study, we use the newly reconstructed data to investigate the periodicities of solar activity (sunspot number) and the changing of the Earth's surface temperature (summer temperature of the Lake Qinghai and the local temperature of Antarctica) as well as the correlations between them on the millennial time scales. We find that the millennial cycle is the only common periodicity between these variables, and the variations of the Earth's temperature have the Eddy-cycle component that is discovered in solar activity. Further wavelet analysis demonstrates that the correlations between the millennium-cycle component of solar activity and that of the Earth temperature keep both strong and stable during the past 8000 years. The correlation between solar activity and the Lake Qinghai temperature is positive, while the correlation between solar activity and the Antarctica temperature is negative. This is consistent with the so-called "bipolar seesaw" phenomena discovered in the climatology. Particularly, the variation of solar activity leads that of the Qinghai temperature about 20-50 years, and leads that of the Antarctica temperature about 30-80 years. These results support that solar activity might have great modulations on the long-term change of the Earth's surface temperature before modern industry.