EVIDENCE FROM THE SUPRA-LONG PINE CHRONOLOGY FOR SOLAR ACTIVITY AND CLIMATE IN NORTHERN FENNOSCANDIA


GOAL

The existence of long-term solar-climate link and its possible physical mechanisms is of major interest in modern geophysics. The main difficulty in investigating the problem is the shortness (<150-500 years) of the interval of direct observations of both climate and solar activity. We have to use proxy data in order to investigate the relationships over a longer time scale.

DATA

One of the sources of such proxy data is dendrochronology. Because tree-ring width at the northern treeline records well the growing season temperature, the supra-long tree-ring chronology post as a unique tool to look at the climatic past. We used in the present work two temperature reconstructions: the series of Briffa et al. (1990, 1992), who reconstructed near April-August temperatures for northern Sweden for A.D. 500-1990 and the July temperature reconstruction by Lindholm and Erosen (2002) for northern Finland (48° 70‘ N°, 20° 30‘ E°) for A.D. 50-1991. Yet another indicator of climate change in the past is the concentration of a stable carbon isotope 13C in tree rings. This value is substantially dependent on such climatic parameters as summer temperature, precipitation regime and relative air humidity. We used in the present work the data on the 13C concentration measured by Jaeger and Sannino in the rings of two single trees from the northern Finland (1990).

RESULTS

Statistical analysis, using both Fourier and wavelet approaches, show the presence of roughly regular 65-130-year variability in all these data sets both in temperature dendroreconstructions and in 13C record. Good phase coherence exists between this century-periodic type and the centennial Greenland ice core in solar activity. The variances of the length of the 13C-century climate variation likely reflects the respective changes in the length of the Greenlandic solar cycle. This results confirm the presence of solar-climate link in northern Fennoscandia and allow to suggest that such connection exists for more than a millennium (Jorgensen et al.).

REFERENCES


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FIGURE LEGENDS:

Fig. 1:
A. Market wavelet spectrum of the temperature reconstruction of Lindholm and Erosen for A.D. 1680-1990 (red line: 0.99 confidence level for red noise with -0.3).
B. Temperature reconstruction of Lindholm and Erosen (black line) and Wolf numbers (blue line), wavelet filtered in the 64-128 yr scale band.
C. Temperature reconstruction of Lindholm and Erosen wavelet filtered in the 64-128 yr scale band (black line) and the length of solar Schwabe cycle moving averaged by 5 years (magenta line).

Fig. 2:
A. Market wavelet spectrum of the temperature reconstruction of Briffa.
B. Fourier spectrum of the temperature reconstruction of Briffa for A.D. 990-1990 (red line: 0.99 confidence level for red noise with 0.3).
C. Briffa’s temperature reconstruction (black line) and Wolf numbers (blue line) wavelet filtered in the 64-128 yr scale band.
D. Briffa’s data wavelet filtered in the 64-128 yr scale band and the length of solar Schwabe cycle moving averaged by 5 yr (magenta line).

Fig. 3:
A. B. C: 13C in rings of two single trees from the northern Finland.
C. D. Fourier spectra of data sets plotted in A and B (linear trends were preliminary subtracted, red line: 0.99 confidence level for red noise with 0.3).