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CLIMATIC TRENDS AND CYCLES ON THE FINNISH PINE TIMBERLINE

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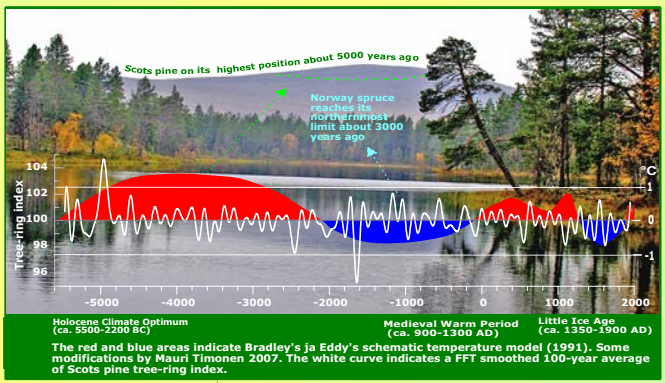
Spectrum analysis was applied to a 7638 years long tree-ring chronology of Scots pine (Pinus sylvestris L.) for Finnish Lapland. The Mean chronology was built of 1485 detrended (negative exponential curve or linear regression) ring-width series. The most significant cycles found in the chronology were 30-32, 37, 47-49, 81-85 and 95 years. A low pass Gaussian filter of 81 years was used to smooth the periodic oscillations in the chronology. Jiang's scanning t-test was applied to a low pass series of the chronology, resulting in 20 change points detected. At last the whole 7638-year series was portioned into 21 comparatively high / low index episodes with an average duration of 366 years. A decreasing trend was found during a period from 5000BC to 2700BC, an increasing trend from 2700BC to 400BC, followed by a roughly normal stage between 425BC and 1148AD. The last 850 years contains 3 episodes: the highest index episode from 1149AD to 1447AD, the lowest index episode from 1448AD to 1735AD, and a secondary higher index for the last episode from 1736AD to 2004AD. Meanwhile, the influences of the Santorini volcano eruption between 1650BC and 1620BC, and of the Krakatau volcano eruption in 540AD on the tree-ring index are shown in the low pass curve as very low indices, and are also detected as extreme events at 95% confidence level, but other extreme events in the tree-ring chronology need more detailed analysis. In addition, all the 21 episodes were compared to results published in some previous studies on the glaciers in the Alps and on the ice-cores in Greenland.



The red and blue areas indicate Bradley's ja Eddy's schematic temperature model (1991). Some modifications by Mauri Timonen 2007. The white curve indicates a FFT smoothed 100-year average of Scots pine tree-ring index.

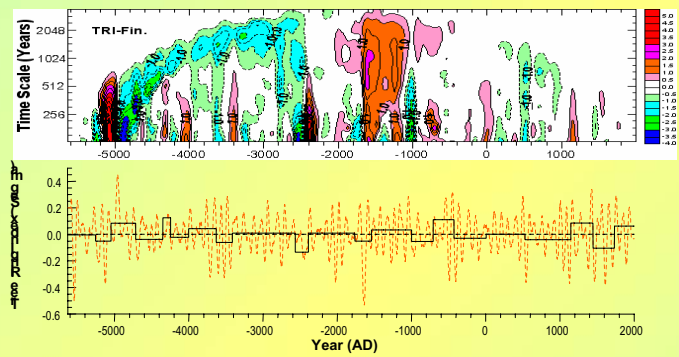


Fig.1a. The contours of Jiang's scanning t-test for the Finnish 7638-yr pine tree-ring chronology. 1b. The change points and the episode averages (thick solid line), and a low-pass curve with a Gaussian filter on the scale of 81 years.

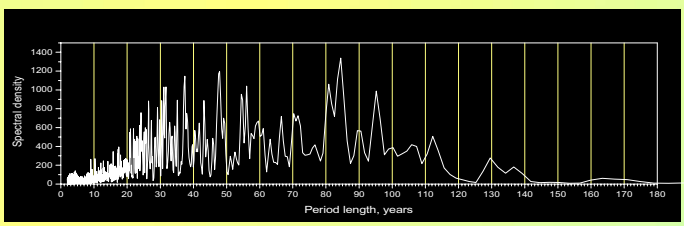


Fig 2. Spectral density graph analysed by SAS JMP software. The result coincides well with Jiang's analysis.

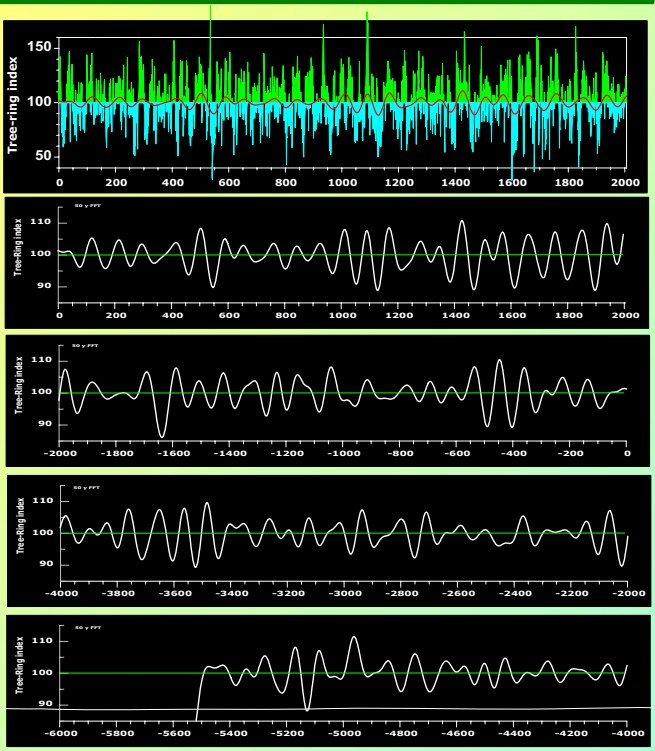


Fig.3. 50-yr FFT smoothing on the Finnish 7638-yr pine chronology brings the strong 84-yr cycle clearly visible.

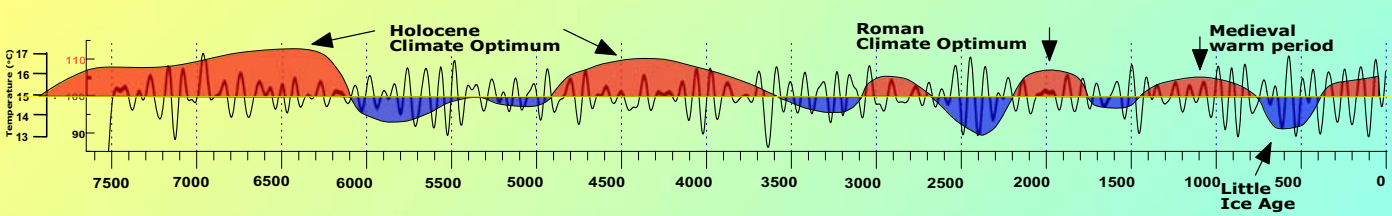


Fig. 4. The red-blue curve: average near-surface temperatures of the norhern hemisphere during the past 11 000 years (red-blue modified from Dansgaard et al., 1969, and Schönwiese, 1995). The black curve: 50-yr FFT smoothing on the tree-ring index of the Finnish 7638-yr supralong pine chronology.

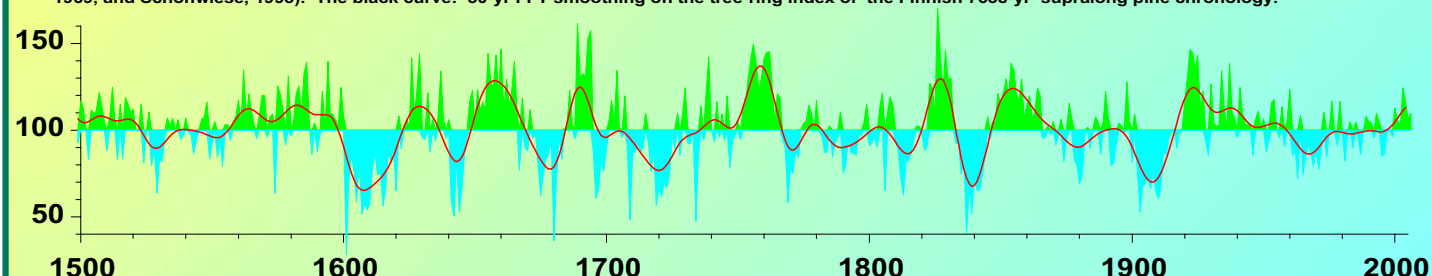


Fig. 5. The green-blue curve colours indicate the annual variation of Finnish timberline pine. The red curve shows an 11-yr FFT smoothing of tree-ring indices based on a tree-ring data set of 16 plots/360 cores, collected around the pine timberline area.