

Comments on New Danish Solar Study

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Is it possible to guess what the Sun will do in 2011 or 2022 and conclude that it has no role for climate change today? You be the judge!

New sensational results (April 2000)

At the European Geophysical Society meeting in April two scientists, Peter Thejil and Knud Lassen, present sensational new results on solar activity and climate. Read their report that discloses the fingerprint of the anthropogenic greenhouse effect.

Above is a direct quote from the Danish Meteorological Institute's (DMI) Research and Development web cover-page section. Such popular titles are catchy but they should certainly not to be taken to suggest that the DMI analysis has proved the signature of human-impact in global temperature record. We highly recommend a quick and independent read of the DMI report #99-9. But since your time is likely to be short today, let us give you a summary and analysis.

The "news" revealed here is that the previous high-correlation shown for the sunspot cycle length and terrestrial (globally-averaged or just northern-hemispheric mean) temperature by Eigil Friis-Christensen and Knud Lassen (1991; FCL91) is no longer valid.

According to the DMI claim, by adding new temperature data and "expected values of the next sunspot extrema [i.e., timings for the coming sunspot number minima and maxima for one or two more cycle ahead of now—say up to A.D. 2011 or 2022]" it has now shown that the "solar model fails to fit the temperature data convincingly through the 1990's."

The "sensational" results naturally generate new (almost identically worded!) items like:

"Don't blame the Sun" in the New Scientist and

"Sun 'minor player' in climate change" from BBC News.

Does this really mean that we can now rule out the role of the Sun for climate change?

The answer is no. The reason may be found in the questionable analysis of the claim itself. Let's start with Thejil and Lassen's summary admission: "This conclusion is based on assumptions about as-yet unobserved solar cycles ..." And contrast this with their claim: "It seems possible that the upturn [of the surface temperature since 1970's] is a result of human activity, but we cannot on the basis of the existing data say that we have proven the emergence of the effects of [anthropogenic] greenhouse gases..."

Statistically, Thejil and Lassen statements may sound reasonable but methodologically there are obvious problems. The problem arises both in terms of solar physics and climate.

The most important thing to note is that this analysis is purely a statistical exercise and it is based only on a SINGLE measure of solar activity (the sunspot cycle length). Next it should be remembered that the kind of correlation shown by FCL91 manifests on long time scales, at least from one decade to another, or longer. Therefore, what is involved in the analysis would require a 5-point or 3-point smoothing filters; to do the analysis properly one needs solar activity data at least one or two solar cycles into the future!

As can be logically guessed, but as yet not sufficiently appreciated, prediction of future behavior of the Sun is notoriously difficult. Just take a look at the highly-active and sunspot-filled month of April compared to the featureless surface of the Sun in May (http://science.nasa.gov/headlines/y2000/ast09may_1m.htm). Therefore the most puzzling and confusing aspect of this report is simply this: How is it possible to know the sunspot cycle length one or two sunspot cycles in the future?

Also mentioned in the DMI report is the slim possibility that if the current sunspot cycle has the shortest possible duration of 9.4 years together with a very short cycle length of 8 years for the next sunspot cycle, then the previous FCL91 can fit the available temperature data extending through the whole 1990's.

Should we believe in this statistical display of the future?

More important is what is missing from the discussion – the question of the actual changes in terms of the Sun's radiative and charged-particle emission. It is not the changes in the solar cycle length that will effect the Earth's globally-averaged temperature; it is the changes in the Sun's visible light, or Sun's ultraviolet light, or its charged-particle winds, or even the incoming, but sun-modulated, cosmic rays that will make a difference in the Earth's temperature.

None of these critical questions are posed in the report.

But there are even greater problems having to do with how we record long-term climatic changes. Before we can attribute the causes of climate change we need to ask if we have sufficiently reliable records of temperature changes on timescales of decades to centuries. The question focused in the DMI report appears to be whether the temperature changes over the last 20 years is unusual.

We may be excused for repeating this question if one just considers how unevenly the surface was sampled in deriving those temperature records (to confirm this fact, please go to <http://www.cru.uea.ac.uk/ftpdata/tavegl.dat>; For the DMI-report, the Northern Hemisphere Land air temperature was used, through an update from P. D. Jones, University of East Anglia, UK). There were only surface coverage of 10-40% for data between 1850s-1900s while coverage for 1970's-1990's was claimed to be over 80%.

However, other independent examinations of the surface thermometer records from 1897-1996 suggest that only 18.4% of the earth is covered by the so-called "global" temperature records if one were to impose the minimal data requirement that no more than 10 years of missing data is allowed within any of the 5 degrees X 5 degrees spatial grid cells used in the reconstruction.

This matter of having an accurate global temperature records is important enough that it has been examined in the January 2000 National Academy of Science report. The bottom line is that the apparently accelerated warming of 0.3-0.4°C in the world-wide surface temperature records over the last twenty years is not supported by either the balloon or the satellite measurements of the global air temperature over the lower troposphere. In the lower troposphere, the global trend in air temperature change measured by the Microwave Sounding Units onboard NOAA/NASA satellites has only been barely above zero. Therefore, the apparent surface temperature trend over the last twenty years is not a proof of any human-induced changes. This is mainly because the expected anthropogenic greenhouse gases-caused temperature trend in the troposphere should be even larger than the surface trend and no accelerated warming trend in the troposphere has thus far been observed.

Summary:

The key question in Sun-climate research today is not about statistical prowess. Absence of statistical correlations certainly do not mean there is no physical connection between the Sun and climate. The analysis in DMI report 99-9 is premature. Its simplistic results are based solely on statistical arguments with no

obvious relevance to present reality.

The DMI report's introduction only briefly mentions one plausible physical interpretation of the variation in sunspot cycle length as changes in the total energy output of Sun. There are several more plausible routes for the Sun to influence the climatic system. This aspect of the Sun-climate research has been amply summarized, for example, on the GCMi website.

Web pages and References:

[The Danish Meteorological Institute](#)

The actual report DMI-report #99-9 "Solar forcing of the Northern hemisphere land air temperature: New data" by P. Thejil and K. Lassen (see also [press release issued by DMI](#)).

Alex Kirby, "[Sun 'minor player' in climate change](#)," *BBC News*, May 3, 2000.

E. Friis-Christensen & K. Lassen (1991). "Length of the solar cycle: An indicator of solar activity closely associated with climate," *Science* 254, 698-700.

"Reconciling Observations of Global Temperature Change" (2000) National Academy Press.