Ivanka Charvatova, Jaroslav Strestik 2004 "Periodicities between 6 and 16 years in surface air temperature in possible relation to solar inertial motion" Journal of Atmospheric and Solar-Terrestrial Physics 66 (2004) pp219-227

1. **Jacques Laskar etal** - Laskar, who you met at the Workshop on Celestial Mechanics in Barcelone, is the source of the Milankovic software that I have been using! Note that on my website I have posted his software "ported to the QNial programming language from Queen'sU, and some (92) large tables of total insolation data (45 to 90 degrees latitude North & South, by 1 degree increments, from -6 to +1 MyBP in 1 ky steps). This has been used for a model of glaciation over the last 6MyBP (see the home page of my website), but note that only preliminary, incomplete results are posted and I haven't written the core part about the data, model description, results, and discussion yet! (maybe I'll get back to it Q1 2008). Furthermore, the current models are OK from a global ice volume perspective, but the latitudinal distributions are completely unrealistic (to some extent parameter adjustment would address that):
    http://www.billhowell.ca/Climate and sun/Howell - Glaciation models for the last 6 million years.pdf
    http://www.billhowell.ca/Climate and sun/Glaciation model 005

    Strangely, the whole purpose of the 6 MyBP timescale is to provide the "background" for a 25 ky model of glaciation, which is to be used in the "hobby" paper I am doing with my father on history:
    http://www.billhowell.ca/Civilisations and sun/Howell - Mega-Life, Mega-Death and the Sun II, towards a quasi-predictive model of the rise and fall of civilisations.pdf

    I have only done limited data tables for the Holocene period (lets say the last 15 to 2 ky), but my next step was to apply recurrent NNs to the 6 MyBP timescale as that would be more relevant to neural networks (and time is short!), then go to the Holocene.

    It would be an easy, natural step for Laskar to incorporate the barycentric effects, and I guess that he probably has at some point in time as they are extremely detailed in their models!! But it certainly doesn't show in the Milankovic results from Laskar that I am using. (I should check the papers again, as I might have missed explanations on this).

    Howell - reproduction of total insolation 65N Jun-Jul using Laskar's model

Check on Total Insolation, 65N Jun-Jul
blue - Howell - reproduction of total insolation 65N Jun-Jul using Laskar's model
orange - "Standard graph" from Wikipedia in orange (underneath)
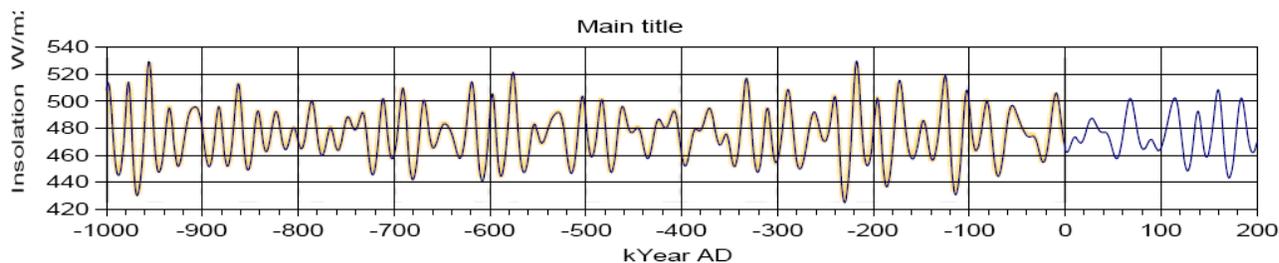
2.   Solar activity and the Barycenter - I am also very excited about finding some software to calculate the movements of the barycenter (perhaps a more complete model of the 4 major panets and Earth would be best to have, and not just the barycenter). Although you are focussed on the "Solar Inertial Motion" (SIM) as being a driver of solar activity (eg sunspots), whether or not that ever works out there are many other exciting possibilities for which the barycenter model would be useful. However, this is a really fun topic!

One caution - it seems from your email that you are looking for high accelerations related to barycentric motions to drive solar activity levels. It seems to me that you do not need this - think of it more as ocean tides driving the Photosphere / Upper convection zone interface instabilities? Interface instabilities are well described according to many theories in Charbonneau's paper (next point). And whether the "connection" is just gravity, or also magnetic field (much less likely due to lower "strength"??), or some specific mechanism isn't too important right now for me - I just want an idea of the "ratio of forces".

Climate effects can come from the Earth -Sun distances alone - even if these average out over a year (albedo effects, seasonality, time in each season etc).

Davoid Thomson of Queen's University has seen some sort of correlation between seismic and solar activities. Charvatova's

220   *I. Charvátová, J. Střeštík / Journal of Atmospheric and Solar-Terrestrial Physics 66 (2004) 219–227*
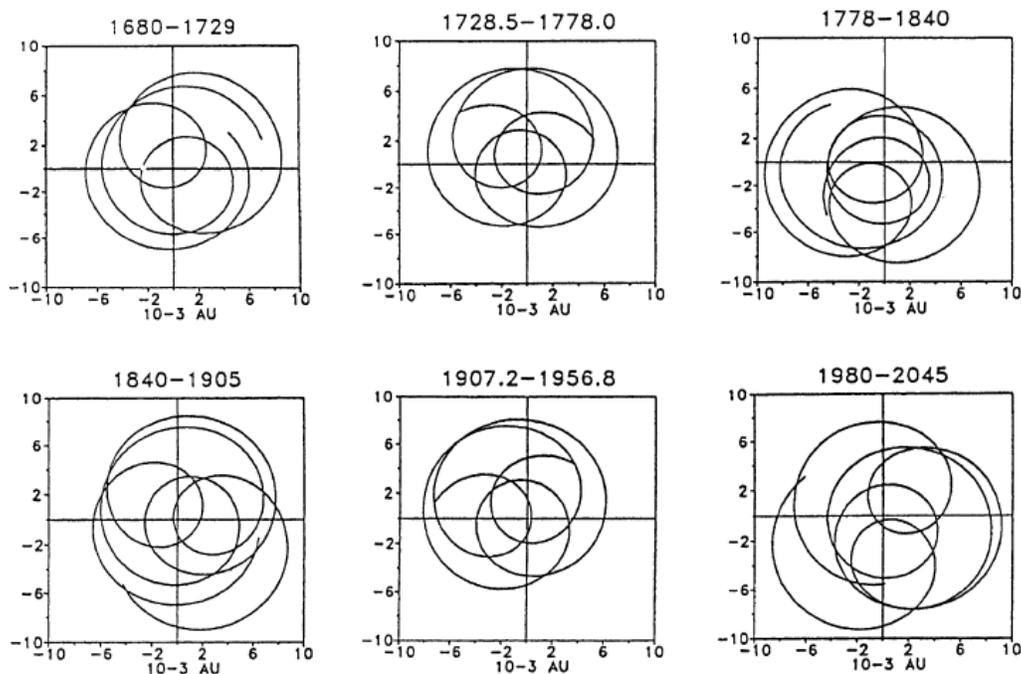

Fig. 1. Solar orbit (in units of 10^{-3} AU, astronomical unit, 150×10^6 km) in 50–65 years segments since 1680. Besides an identity of motion trefoils 1728–1778 and 1907–1957, one can see a similarity (after a rotating) between solar orbit in the years 1840–1905 and 1980–2045.

I am using the following for -3 to +3 kyBP - or is there a better "source of source"?
  Theodor Landscheidt "Solar System Barycenter Ephemeris - Jon Giorgini of JPL calcs"
  http://landscheidt.auditblogs.com/6000-year-ephemeris

A commercial but cheap package is:
  http://www.alcyone-ephemeris.info/ 49$US software

Source code:
  Steve Moshier 2004 "DE118i.ARC - N-body numerical integration of the Sun, Earth, Moon, and
  planets" http://www.moshier.net/ssystem.html

Other references:

Do Planetary Motions Drive Solar Variability?

Solar Physics Volume 229, Number 1 / June, 2005
Cornelis De Jager1 Contact Information and Gerard J. M. Versteegh2 Contact Information
(1)   Royal Netherlands Institute for Sea Research, P.O. Box 59, NL 1790 AB Den Burg, The
       Netherlands
(2)   Hanse Wissenschaftskolleg, Lehmkuhlenbusch 4, D 27753 Delmenhorst, Germany

Accepted: 14 March 2005

Abstract We examine the occasionally forwarded hypothesis that solar activity originates by planetary
  Newtonian attraction on the Sun. We do this by comparing three accelerations working on solar
  matter at the tachocline level: Those due to planetary tidal forces, to the motion of the Sun around
  the planetary system's centre of gravity, and the observed accelerations at that level. We find that
  the latter are by a factor of about 1000 larger than the former two and therefore cannot be caused
  by planetary attractions. We conclude that the cause of the dynamo is purely solar.
So often I have seen calculations of small effects leading to the erroneous dismissal of a process. I
won't have confidence in this paper either util I have a chance to look at the details.

http://www.springerlink.com/content/px231t26j2h68646/
Peter Kammeyer[1]

(1) United States Naval Observatory, Washington, D.C., United States of
     America

Abstract A package of FORTRAN software has been developed which provides planetary and lunar
positions, with respect to the solar system barycenter, for all times in the interval 1801–2049; positions
agree to 1 milliarcsecond with those generated by Jet Propulsion Laboratory Development Ephemeris
200 (DE200). The system consists of approximately 800 kilobytes of ephemeris files and 40 kilobytes
of programs, totalling 5% of the storage required by DE200. After removal of reference orbits,
segments of DE200 positions were fitted by finite Chebyshev series of degree 40. The Chebyshev
coefficients were rounded to integer multiples of a suitable unit and packed to form the ephemeris files.

3.   **Dynamo models of the solar cycle**, Paul Charbonneau 2005
http://solarphysics.livingreviews.org/Articles/lrsp-2005-2/
This is an awesome description (of course - Charbonneau's work is usually fun and deep) of solar dynamo models, and Paul is careful to keep options open (I like to call it Multiple conflicting hypothesis - the only way to go. A bit like ensemble learning in NNs).   He even starts with the question "What is a model?" - just as Graham Bonham-Carter (Canada's geological survey, now retired) and Vladimir Cherkassky at IJCNN often ask the same question.

There are a collection of animations if you download the "lrsp-2005-2Resources.tar.gz" file. These help a lot with visualization of how the models work.

I think Charbonneau prefers the "Babcock-Leighton" model where the photosphere circulates towards the poles at the surface, descends and circulates to the equator at the interface between the photopshere and convective zone. Instabilities at the interface give rise to sunspot (magnetic fibrils) activity, and solar flares etc. (I probably have this wrong). If I remember correctly Charbonneau had a lot to do with the continued progress of the Babcock-Leighton concept, but I don't think he is married to it, and he keeps his mind open. If you haven't looked at this yet, do so before the Canadian solar physics workshop!

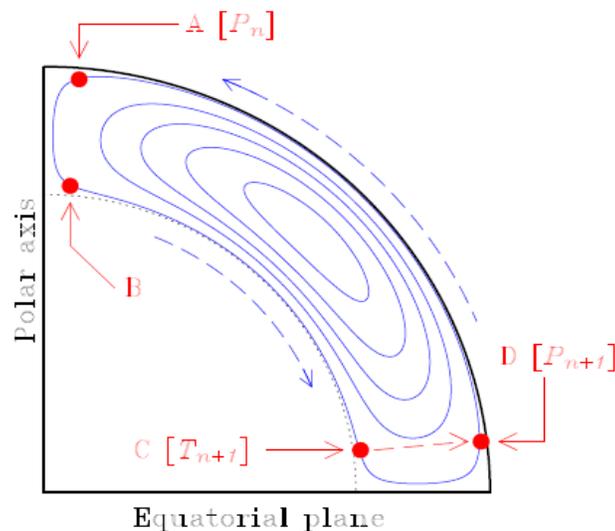http://solarphysics.livingreviews.org/Articles/lrsp-2005-2/

Figure 17: Operation of a solar cycle model based on the Babcock–Leighton mechanism. The diagram is drawn in a meridional quadrant of the Sun, with streamlines of meridional circulation plotted in blue. Poloidal field having accumulated in the surface polar regions ("A") at cycle n must first be advected down to the core-envelope interface (dotted line) before production of the toroidal field for cycle $n+1$ can take place (B→C). Buoyant rise of flux rope to the surface (C→D) is a process taking place on a much shorter timescale.

**4.   Solar insolation -Milankovic cycles, galactic rays, and the barycenter** - Here is
where it should be easy to produce interesting initial results! For example, Charvatova suggests
that the Earth-Sun distance is affected almost as much by the barycenter displacement as by Earth
orbit eccentricity (part of the Milankovic cycle).

*www.billhowell.ca/Climate and sun/Howell - Glaciation models for the last 6 million years.pdf*
Here are several glaciation models for the last million years. Paillard's model of glaciation is an
evolution beyond Milankovic models. In my "hobby paper" I show two sets of results for much
longer periods of time.

## Figure ?? - Graphs of recent glaciation models over the last 1 MyBP

a) Milankovic insolation cycles and 1 My of glaciations (global insolation values), Reference: Laskar etal, Wikipedia
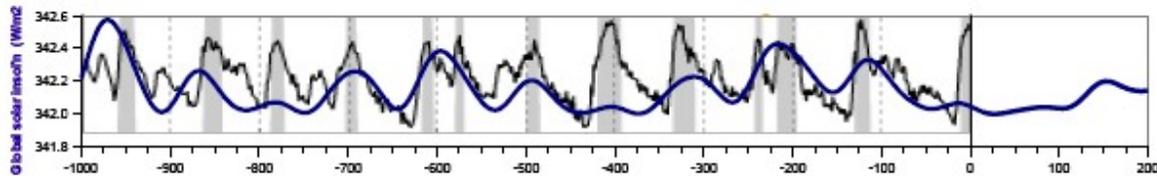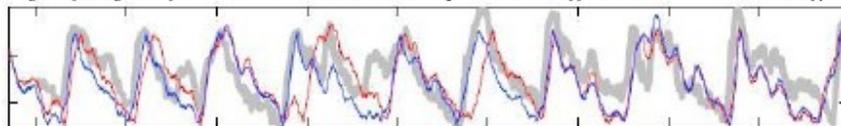
b) Paillard's Milankovic threshold model for 1 My of glaciations, Reference: Frédéric Parrenin, Didier Paillard 2003
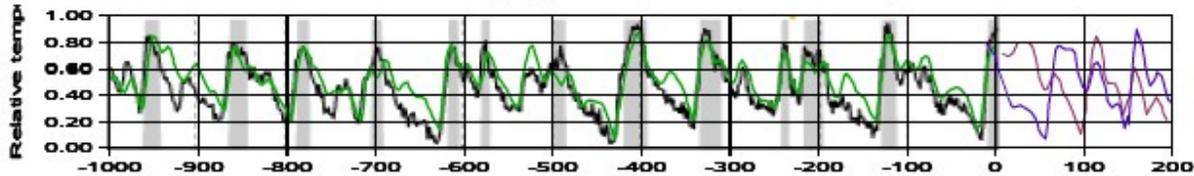
c) Howell's variant of Paillard's model for 1 My of glaciation (this paper - non-optimized results from first generation modelling)
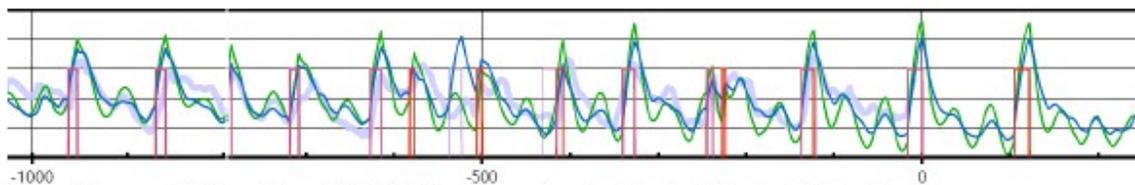
d) Tziperman, Raymo, Huybers, Wunsch 2006 - Nonlinear phase locking to Milankovitch forcing

Earth-Sun distances change almost as much with the barycenter as with Earth orbit eccentricity - but not for long, though! So on a timescale such as the Holocene- barycentric movement could be a big factor, but much less for full glacial periods (100 ky).
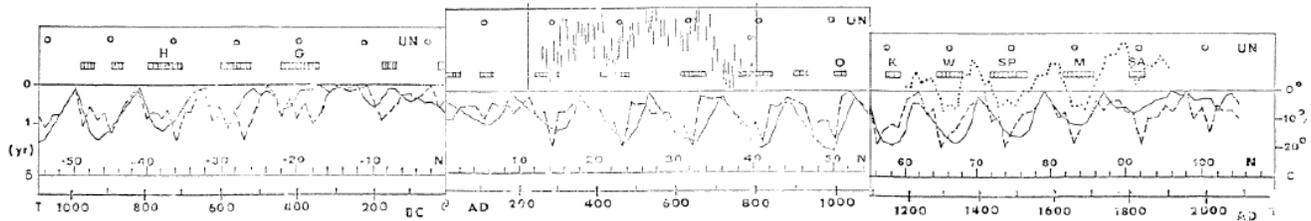
I. Charvatova 1988 "The relations between solar motion and solar variability" Bulletin Astonomical Institure of Cechoslovakia v41 (1990) pp56-59

My plot of a 1 datapoint in 73 of:
> Theodor Landscheidt "Solar System Barycenter Ephemeris - Jon Giorgini of JPL calcs"
> http://landscheidt.auditblogs.com/6000-year-ephemeris

is given in the second file attached to this email "*Landscheidt - trim ephemeris data -3 to 3 kyBP.pdf*". It does NOT resemble Charvatova's above!! But a simple integration may do the trick. Note that the DURATION of events seems to be emphasized more by Charvatova than the amplitude? (This is like the temperature - sunspot relation?).

The barycenter concept might help me with the glaciation models:
- **-6 MyBP** - There are three obvious shortcomings with my -6 MyBP glaciation model which is a varant of Paillard's model:
  ○ the "finite impulses" that initiate deglaciation in the Paillard models beg a physical explanation, of which there are a large number of candidates. However, the barycenter idea might be yet another possible explanation - if "extreme peak" effects occur every 100 ky or so due to Milankovic-barycenter combined effects or some other external combination. The barycenter process might also explain many high frequency "squiggles" in the data, but much of the short-term effect would likely be averaged out over glaciation times (100 ky).
  ○ "glaciation" behaviour in the earliest period isn't well described, and the effect if precession doesn't show up very well.
  ○ Regional distributions of ice volume are unrealistic.

    I don't immediately see how the barycenter process will help the last two points

- **Glaciation since -25 kyBP Holocene period** -   As the barycenter displacements rival the Earth orbit eccentricity, this should provide a rich and very interesting set of results - very much what I'm looking for with our study of history!!! Furthermore, I expect to see small but significant effects on cosmic/galactic rays, which are turning out to be very important for climate.
- **Extrapolation of Tapping's sunspot-irradiance relations, Usoskin radioisotopic data last 11 ky,** - In my paper on history, I've used isotope data & Tappings irradiance relations to roughly build solar activity over the period of civilisation.   I suspect that the barycenter information will make a nice explanation to help explain history.

    http://www.billhowell.ca/Civilisations and sun/Howell - Mega-Life, Mega-Death and the Sun II, towards a quasi-predictive model of the rise and fall of civilisations.pdf

5.   WCCI08 Hong Kong Competition - I was supposed to be helping put together a competition for WCCI08 on Climate, but I haven't worked on it and the deadline is tomorrow!!
- Quasi-Biannual Oscillation, El Nino and other wind-ocean oscillations -
- Glaciations -
- Origins of Life - OK, this one is off topic, but Stuart Kauffman of the Sante Fe Institute ("At the edge of Chaos" fame) is now at the university of Calgary, and there are big challenges with the molecules of life.

6.   Geology meets Astronomy: Varves - Deposits of "mud" keep coming up (just like flood records), and if I ever get the time I'd like to look at this, and I wonder if the Charvatova paper would help here. Recent references to varves:

- Tim Patterson, geologist at Carelton University in Ottawa - his work in BC has shown awesome correlations between varve data, climate reversals, and fish stocks over almost 3,000 years. What a story! I don't think that Valdes ever got a chance to meet Patterson even though he has tried. Pity - he should try again with you! Patterson sees the Gleissberg (75-90 year), Suess (200-500), and Bond (1100-1500) cycles in his data (as many climate studies do?)..

- Ken Tapping has looked at this in the past, and still has an interest. One topic is data from the past, and given his and Paul Charbonneau's frequent comments on the lack of data related to how we enter into major solar minima like the Maunder minima, this might be useful for solar science as well, especially theories (which the solar physicists don't like) such as the planetary driver of sunspot activity (the recurring failure of which Charbonneau's paper documents).

- Eric Wan, Oregon health & Sciences University - Wan did a paper on using varve data from ~300 MyBP to model modern sunspot cycles! Wan is extremely well known for advanced signal processing, and if I'm not mistaken he first implemented Unscented Kalman Filters (UKF) for recurrent neural networks (Lee Feldkamp, Danil Prokhorov, and Ken Marko had extensively applied Extended Kalman Filters (EKF) at Ford.) . Almost two years ago I purchased source code for Wan's "Rebel" software, and I still haven't done anything (it's supposed to be one of the key elements of a paper that I should have finished by now, and I haven't started!).

From: *Eric Wan "Combining sunspot and fossil data: Committee predictions" ?Publication? ?date?*
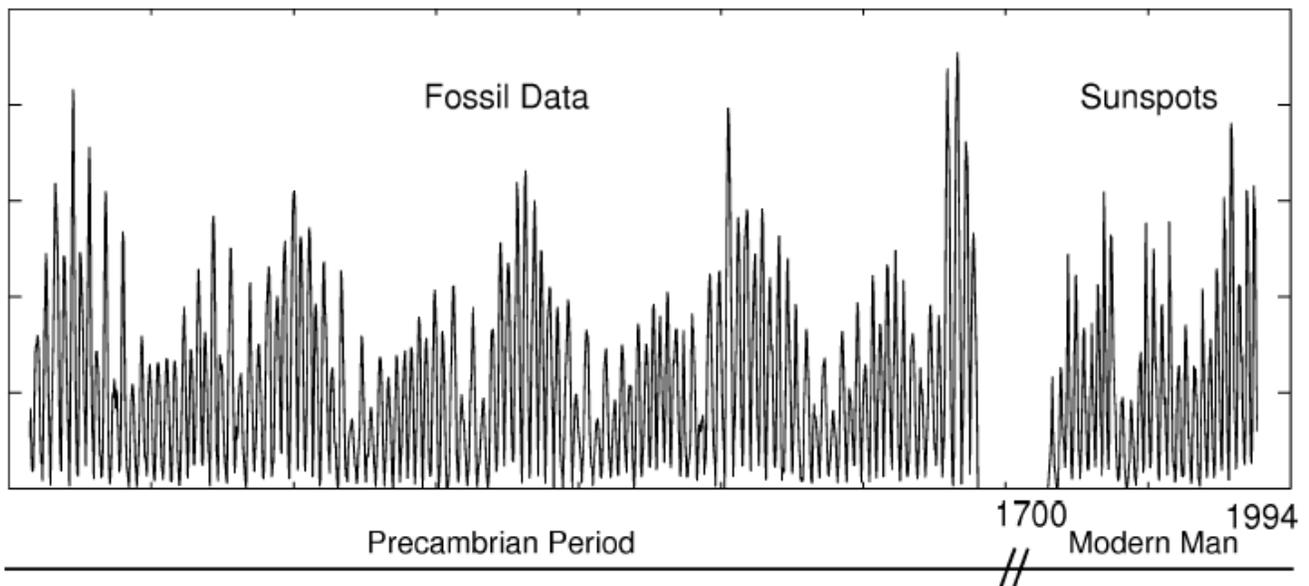

Figure 1. Fossil data and sunspot numbers.

7.   **Julio Valdes, Graham Bonham-Carter** *"Time dependent neural network models for detecting changes of state in Earth and planetary processes" Proceedings of IJCNN 2005, International Joint Conference on Neural Networks. Montreal, paper #1439, pp????-????, 31 July – 4 August 2005.*

Check out the timing of the barycentric "periods" from Charvatova & Strestik as compared to the Valdes/Bonham-Carter results (figure below - green arrows for Charvatova & Strestik). There isn't a stand-out correspondence between them, but perhaps "phases" such as circulating in the outer perimeter, versus being in a treffoil, might do something. Keep in mind that Valdes/Bonham-Carter didn't do a correlation - they did entirely separate analysis of the phase changes in ice-core temperatures and in the sunspot cycle, and there is reasonably good correspondence in the changes of phase/state for both series, from ~1800 to 1930 (the "ends" of the time series are chopped off as they are needed for the Computational Intelligence techniques Julio employed.) Hopefully Valdes will do something here.
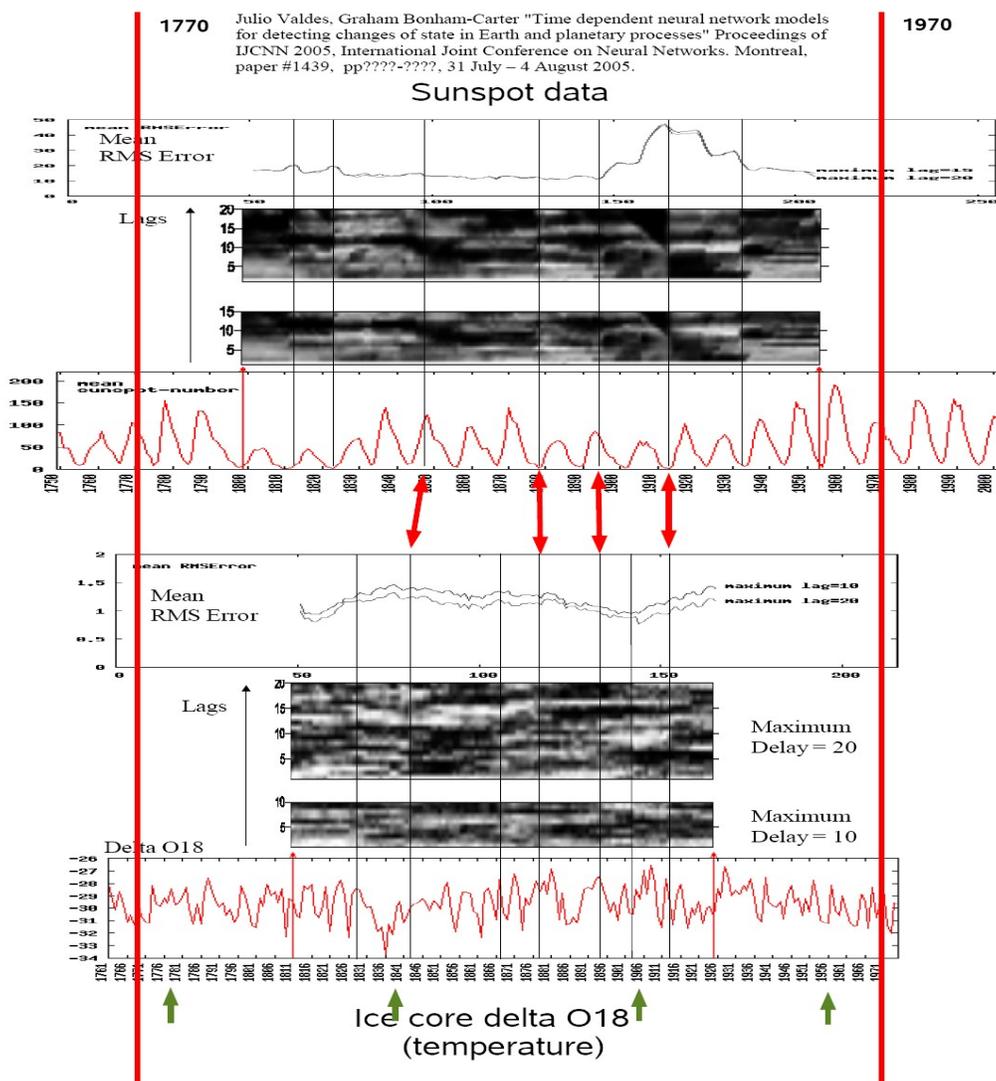
8. **Mayan calendar** - This is a crazy subject of no relevance to the rest of the email, but I met someone who is deep into the Mayan calendar (also spirituality, which I'm not - but I'm in no position to understand/ criticize others who are interested in this), and will present next Thursday. I am always baffled by the Mayan calendar. Maybe the Chartova paper is a starting point for yet another of millions of attempts to explain the calendar...

Note that the Mayan calendar definitely fits in with my "hobby paper" on civilizations. Also note the inner and outer calendars - kind of like the barycenter versus Milankovic (not really)...

http://mayaportal.lucita.net/

enddoc