

The paper “Multi-millennial-scale SA and its influences on continental tropical climate “by Sanchez-Sesma endeavors to model the solar activity (SA) for the last several thousand years based on the ice core derived ^{10}Be records. Several periodicities or recurrent events of solar oscillation have been identified. Then the influence of solar variation on continental tropical climate has been examined on a temperature reconstruction record. Eventually the author made some predictions on the decreasing trends in solar activity during AD 2050-2250 and AD 3750-4450. Despite the prediction of the diminishing trend in solar activity in a few decades to centuries, which may have important significance in the context of global warming, the work presented by Sanchez-Sesma lacks scientific rigor. The statistical calculations have weak foundation, some logical deductions are inconsistent, and as a result the conclusions drawn are not solidly funded. The problem is aggravated by poor presentation, both due to English problem and technical description of the result. In this context the paper may be considered only if a major revision is done, the inconsistencies are corrected and the concerns are adequately addressed.

General comments:

The author does not produce any new dataset, nor presents any novel method either to interpret or to make future predictions based on proxy ice core data. Several workers used ice core data and discussed the role of solar activity on climate and its possible role on future climate. Sanchez-Sesma uses one of the ice core derived ^{10}Be data as a proxy for solar activity and then makes prediction for the next few centuries. However, the choice of data may be questionable. He has taken data reported in Finkel and Nishiizumi (1997) which produced ^{10}Be data for the past 40,000 year albeit at coarse resolution (20-50 years during the Holocene). Another important drawback of this data set is the lack of data for the recent (last 3000) years. Since the author makes prediction of SA for the next few hundred years, modeling of a dataset having long term variation but poor temporal resolution is not an ideal one. Steinhilber et al. (2009; also cited by the author) presented ^{10}Be data for the last 9300 years with a high resolution of 5 years. This dataset would be a much better choice for the purpose of prediction for the next few hundred years.

The author cites several studies that attempted to determine the effect of planetary motion and in turn torque exerted on the Sun and hence on the solar activity. These studies found a broad range of periodicities, starting from 50 yr to over 4.5 kyr. The effect of this kind of gravitational forcing on SA remains speculative, unless a rigorous analysis is done to identify which periodicities are actually affecting the SA. The conclusion “~9.5 kyr period recurrent pattern suggests that SA is characterized by solar dynamics with long term patterns” seems to be unwarranted. The solar dynamical behavior is expected to be controlled both by external factors, such as gravitational effect of the planets as well as the solar internal dynamics. The internal dynamics has not been discussed in the text. Consequently the statement “are possibly related to the Sun’s rotation rate and impulses of the torque in the Sun’s irregular motion” loses its credibility.

The testing of the forecasting model relied on one of the tropical continental climate records, basically the Congo River Basin Surface Air Temperature (CRB-SAT) record. According to the author this record is isolated from the ocean influences and thus subjected to solar forcing. Despite this assumption the author goes on discussing the influence of the THC (acronym not defined by the author, understandably the thermohaline circulation) on tropical climate. This raises an important question. If the role of ocean on the CRB-SAT is minimal then it means that this temperature record merely represents a local or regional scale climate and not the global/tropical climate, as global climate change is greatly influenced by ocean circulation. If that be the case, then the forecast of 'continental tropical temperature cooling of around 0.5°C for the rest of the 21st century' and similar other prediction on temperature would represent the temperature change on local/regional scale only. On the other hand, if the role of ocean through THC seems to be significant on CRB-SAT then the role of solar effect could be less or relatively insignificant. If that be the case then the purpose of this work itself becomes irrelevant.

In the beginning the statement: 'the main signals of climate long term forcings have not been well described, neither forecasted...' seems to have underestimated the solar insolation variation on Earth which is considered one of the most important long term forcings on Earth's climate, based on which the Milankovitch theory has been developed. The solar insolation variations can precisely be calculated and hence its values can be predicted (i.e <http://bugle.imcce.fr/langues/fr/presentation/equipes/ASD/insola/earth/online/index.php>). According to this calculations the solar insolation will keep increasing, in general in most of the latitudes including the equatorial region of Africa. Increased insolation is expected to rise the global temperature for the next 5-6 thousand years, which does not conform to the author's prediction of cooling in foreseeable future.

On page 1241, Line: 10-15; "finally we discuss....that suggests a possible planetary forcing of SA by an unknown mechanism." The author cites several works whereby gravitational forcing of the planets on solar activity has been discussed. The authors of those papers have proposed several mechanisms, but the actual mechanism may not be identified yet. In that sense the author's claim of 'unknown mechanism' might be true, but the author neither proposes a new mechanism nor establishes the veracity of an existing mechanism.

Other comments:

Page 1240:

Line 5: Replace 'Eemian peiod' by the Eemian, similarly in pg 1244 line 24

Line: 20-21. '...at the center of tropical Africa, generates isolation from the ocean influences '. How does the author arrive at this conclusion; i.e, isolation from the ocean influences?

Line 23: Anthropogenic Global Warming: by coining this term does the author mean that the current warming has a natural component also?

Page 1241

THC – should be explicitly defined.

Line 5: ‘...by considering reconstructed records of related SA...’

What is meant by ‘related SA’?

Line 18: if the data were taken from the literature then ‘presented’ should be replaced by ‘used’.

Line 25: the calculation of variance between S04 & S09, S04&SO12 etc should be described.

Page 1242:

Line 2 ‘Greenland ice’ should be ‘Greenland ice core’

Line 3 – English problem: ‘located at the Eemian...’ located refers to space. Since Eemian represents a temporal domain ‘located’ is not appropriate here. Better use ‘belonged to the Eemian’.

Line 8: ‘...climate record obtained with a novel and promising molecular technique’ – reader should have some idea about the novel and promising molecular technique that has been used to get the climate record.

Line 9- Improper presentation: ‘...more influenced by the solar than the rest of the world...’ what is the meaning of ‘than the rest of the world’?

Line 11: ‘relatively less influenced by the ocean’ –the author should give evidence in support of this statement.

The following argument viz. ‘...because its signal is coming from the central tropical zone of Africa’ is a weak argument as the atmospheric tele-connections can work remotely.

Line 15 ‘response to SA should be modulated during the interglacial differently due to the increasing intensity of THC...’ contradicts the statement given in line 11.

Page 1243

The author uses three different models to simulate the solar/climate variability. While the first model is a well known Fourier series expansion, the second and third are not. For example, how the equation 2 and 3 have been derived is not clear. If they are taken from the literature then the reference should be given, otherwise the author should show the derivation and their verification. For example, how the values of M in Eqn. 2 have been determined should be explained.

Whether the iterative process (line 18) converges or not should be tested.

How the values of M chosen differently?

Do the all three models yield consistent result?

Page: 1244

Line 4: ^{10}Be – it is a solar proxy variable and available over longer periods than SA records. Give reference.

Inconsistency:

Line 10: FN97 but in line-17 it is written as NF97.

Line 18: What is NF? Is it N_{FS} ?

Calculation of 9390 yr periodicity is not clear. Method of calculation with significance level should be shown.

Line 19: how the number 49.2% is achieved?

Page 1245

Line 8: Normalization process – needs to be defined in the main text. How does it confirm the 9.5 kyr recurrence?

Line 11: ‘verification’ should be preceded by ‘application’, not the other way round.

Line 12: wavelet analysis is problematic. It does not show the ‘cone of influence’ used to examine the edge effect; hence some observed periodicities which fall beyond the cone could become insignificant. A ‘significant’ period (9000 yr) as observed by the author is very likely to fall outside the cone of influence, casting doubt to its ‘significance’.

Line 13: Inconsistency: ‘three main significant periodicities...’, but the very next line gives four periodicities (9000, 5000, 2400, 900 yrs)

Line 17: why a lag of 9500 yr was applied?

Line 24: how 61.4% variance was explained is not clear.

Did all three models Eq. 1, 2, and 3 yield consistent results when applied to a given ^{10}Be record?

Page 1246:

Line1: The Grand Minimum is defined as a deficit of TSI by about 0.5 W/m^2 . This should be compared with that of the Last Glacial Maximum, Little Ice Age etc.

Unusual terminology: THC deglaciation process- better term would be THC induced deglaciation process.

Line 13-14: 'these models of Tcrbexplain for the 20-10 (10-0) kyr BP 30.0, 23.6, and 31.6 (6.5, 10.9 and 8.5) % of the reconstructed Tcrb record.' – Difficult to comprehend.

Line 17; "...when the THC was low and the advected heat from the tropics were also low". No evidence/reference cited in support of this statement.

Page: 1247:

Line 4-5: uncommon language.

Line 5: 'we have found a ~ 9500 yr recurrence of SA...' But in page 1244 line 17 T=9390 yr was shown. If these two figures are considered statistically the same then the author should give the uncertainty levels in periodicity estimation.

English: line 8; 'the following summarizes...' grammatical error.

Line 19: where is the result of FFT?

Line 20-21: difficult to comprehend.

Page 1248

Line 4: 'increasing THC that has been reconstructed...'

Though the intensification of THC from the initiation of last deglaciation is widely known but the reader should get an idea *how much* THC was increased (without digging another citation) that is being used to explain the Tcrb record.

The mechanism given is also not very satisfactory. Unless the time scales of the CTC Tcrb match with that of the THC, the cause effect relationship becomes weak.

Page 1249

Line 5: If the spectral characteristics of the torque exerted by the planets match with those of the proxies of SA, then the particular periodicities should be shown. How the high frequency (i.e. 50 yr) variability affects the SA and in turn the Earth's climate should be discussed.

Line 8: here the author cites other papers in which low frequency variability (~ 4.5 kyr) of planetary influence has been proposed. How it is possible that a wide spectrum of periodicities of planetary influence affect the SA and in turn the Earth's climate?

The last paragraph in Discussion is irrelevant and should be removed.

Conclusion:

SA oscillations at 84, 178 and 2400 yr are possibly related to the Sun's rotation rate – remains a speculation.

Page 1251: there are several projections of cooling and warming ranging from 0.3 to 0.65°C for the next couple of hundred years without any error estimation. If the errors in periodicity estimations are quantified (which have not been done) then these temperature change estimates may not remain significant.