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Solar Wind, Earth's Rotation and Changes in Terrestrial Climate

Dear Editor,

OVERALL MARKS of this manuscript: Major Revision: (>7-8)

I believe that this paper is interesting. It summarizes a theory that the variation in solar wind are a major driver of climate change. The paper is qualitative in its claim, the authors argues using empirical evidences of mutual correlation among a set of geophysical records.

However, I believe that the author needs to revise the paper as indicated below to clarify possible misunderstanding.

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General comments:

A major point of possible confusion that needs clarification:

The author argues (e.g. Fig 7 and other points in the paper) that solar maximum brings an Earth Deceleration, while a solar minimum brings an Earth Acceleration. This is a quite ambiguous statement because acceleration or deceleration are "variation in the speed". The things appear more complex.

If we look at the figure in Le Mouël et al. (2010) we find the following:



which plots in blue the amplitude of the semi-annual variation of LOD and in red the sunspot number.

The author should note that the "amplitude of the semi-annual oscillation" is not as the same of the LOD index. Essentially, the above figure is based on the following argument.

LOD record presents an annual (12 month) and a semi-annual (6-month) oscillation. The amplitude of the semi-annual oscillation is low during solar maxima and is high during solar minima. This means that during solar maxima LOD varies less on a 6-month time scale, while during solar minima it varies more on 6-month intervals.

The author needs to be more explicit of how he thinks that this dynamics of the semiannual oscillation of LOD, which appears to be directly linked to the 11-year solar cycle, influences the climate.

On the contrary, if we look at the evolution of LOD on the multidecadal scale it is possible to notice we notice that LOD is negatively correlated to the 60-year temperature oscillation as the figure below shows:



which means that the Earth spins slower during the 60-year temperature minima (solar minima ~1970) and spins faster during the 60-year temperature maxima (solar maxima assuming that it was ~2000-2004). See also Mazzarella and Scafetta. But his is true on a 60-year time scale and above. This issue too needs to be clarified in the paper.

Finally, the LOD oscillations are very small. In the paper the author appears to prefer a mechanism in which solar wind first changes LOD (it is not clear how) and later LOD changes the ocean oscillation and the climate. However, the mechanism may be inverted. Solar variation changes the climate oscillation (e.g. by means of cloud/albedo changes) that changes the wind/ocean oscillations which then alter the LOD. Is it possible to discriminate between the two cases?

Detailed comments:

Line 44: "...~750 km s-1 (fast solar wind)." Provide a citation

Line 76: "Friis-Christensen and Lassen (1991)..." this paper has been criticized about the last data point that they plotted which was not actual data. Consider to add this reference which corrects the error:

Thejll, P., and Lassen, K., 2000. Solar forcing of the northern hemisphere land air temperature: new data. J. Atmos. Solar-Terrest Phys. 62, 1207-1213.

Line 93-99. Consider adding also:

Scafetta N., 2012. Multi-scale harmonic model for solar and climate cyclical variation throughout the Holocene based on Jupiter-Saturn tidal frequencies plus the 11-year solar dynamo cycle. Journal of Atmospheric and Solar-Terrestrial Physics 80, 296-311.

where a harmonic model for solar variation is developed and hind-cast all previous solar minima/maxima for millennia and forecasts a new minimum in 2030-2040.

Line 98: "the future minimum at ~2040 will also generate Little Ice Age climatic conditions." This would be correct if anthropogenic GHG warming does not exist. But it exists, so the projected cooling may be partially compensated: see Scafetta (2012a).

Line 151: "Sancetta"?

Line 158-162: the Gleissberg cycle is about 80-90 year, de Vries cycle is about 200-240 yr

Line 214: "he record" -> "he records"

Line 221: "...cycle affect only the atmospheric circulation...."

## However,

Scafetta N., 2012. A shared frequency set between the historical mid-latitude aurora records and the global surface temperature. Journal of Atmospheric and Solar-Terrestrial Physics 74, 145-163.

Mazzarella A. and N. Scafetta, 2012. Evidences for a quasi 60-year North Atlantic Oscillation since 1700 and its meaning for global climate change. Theoretical Applied Climatology 107, 599-609.

Also talk about a direct influence on ocean circulations.

245: "lagging-behind the general rotation of the solid Earth." Provide a reference.

Figure 5 and its comments: consider adding a comment to Mazzarella A., A. Giuliacci and N. Scafetta, 2012. Quantifying the Multivariate ENSO Index (MEI) coupling to CO2 concentration and to the length of day variations. Theoretical Applied Climatology DOI: <u>10.1007/s00704-012-0696-9</u>.

Figure 8: "Medidional" ?

Note: Anonymous Reviewer