Review of the manuscript: "On the intrinsic time-scales of temporal variability in measurements of the surface solar radiation "
by M. Bengulescu, P. Blanc and L. Wald, NPGD, doi:10.5194/npg-2016-38

General comment

The paper presents a study of the intrinsic temporal scales of the variability of the surface solar irradiance (SSI) by using a nonlinear and nonstationary method such as the empirical mode decomposition (EMD). The significance of the EMD results is also tested by using a novel and adaptive null-hypothesis test. The main result is the existence of a dominant spectral peak corresponding to the yearly variability cycle, a high-frequency "weather noise" and a low-frequency signature.

The paper is clearly written, logically organized and the results are well-presented. I recommend it for publication in Nonlinear Processes in Geophysics, once some minor comments and general features have been addressed.

Major remarks

1. I suggest to insert some explanations and discussions about the boundary effect problem and on the stopping criteria for the sifting process (pag. 5, Section 3.1.1). I think the adopted ones should be indicated.

2. Some additional descriptions on time variations observed in Figure 5 (bottom panel) could be very useful or, alternatively, a plot of the instantaneous frequency could be added to better show its time variations, also to visually facilitate the reader (pag. 7, line 5).

3. I think that the null-hypothesis test proposed in Section 3.2 is a simple but powerful test to investigate the noise-like existence of IMFs. If I do not misunderstood, this is particularly suitable when the EMD really acts as a dyadic filter. I suggest to remark this also when you describe Figure 7 in which a "dyadic" behavior can be observed for the high-frequency modes.

4. The results discussed in Section 5.4 are really important in the framework of weather and climate systems study. Also a cross-phase analysis could be useful to support these findings (not only related to the AM but also with FM component).

Minor remarks

- Abstract, Line 2: remove "spanning ten years" since it is redundant

- Abstract, Line 4: what does it mean "roughly" here? The EMD effectively sorts the IMFs with their increasing timescales

- Pag. 2, Line 2: "measured in" should be "observed on"

- Pag. 2, line 22: please insert HHT abbreviation

- Pag. 2, line 26-27: some references regarding the application of the EMD to weather and climate systems, together with solar time series, could be useful to support your choice in these frameworks (see references below)

- Pag. 3, line 5: in the framework of denoising signals a method was proposed to discriminate high-frequency flucuations from large-timescale modulation (see Flandrin et al, 2004; Alberti et al, 2016)

- Pag. 5: really good explanation about the EMD sifting process, not the usual one

- Pag. 6, line 1: why did you not include the residue in figure 3?

- Pag. 6, line 3: this is not properly correct. As you explained before, an IMF is a function whose envelopes are symmetric with respect to zero and not of zero mean.

- pag. 7, Equation (7): for completeness, the integral should be a sum, since you have discrete time series

- Pag. 10, line 5: a visual inspection of figure 3 shows that only the first 3 IMFs seem to have a clear annual modulation

- Pag. 10, line 19: I suggest to insert a table with the characteristic periods of each IMF for the 4 data sets with the range of variability (this could be a benefit for the reader)

- Pag. 10, line 31: the transitional mode could be explained in terms of physical processes such as monsoon rainy seasonality?

- Pag. 13, line 6: I suggest to include some references about short-term solar rotiational periodicities and related terrestrial signatures (see Prabhakaran, 2006; Emery et al, 2011, Morner, 2013)

- Pag. 14, line 16: IMFs 6 should be IMF6?

- Pag. 16, line 19: I suggest to insert the background color below each matrix.

Suggested references for the EMD

Alberti, T., Lepreti, F., Vecchio, A., Bevacqua, E., Capparelli, V. and Carbone, V.: Natural periodicities and Northern Hemisphere-Souther Hemisphere connection of fast temperature changes during the last glacial period: EPICA and NGRIP revisited, Clim. Past, 10, 1751-1762, 2014

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Solé, J., Turiel, A. and Llebot, J.E.: Using empirical mode decomposition to correlate paleoclimatic time-series, Nat. Hazards Earth Syst. Sci., 7, 299-307, 2007

Terradas, J., Oliver, R. and Ballester, J.L.: Application of statistical techniques to the analysis of solar coronal oscillations, Astrophys. J., 614, 435-447, 2004

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Wu, Z., Schneider, E.K., Kirtman, B.P., Sarachik, E.S., Huang, N.E. and Tucker, C.J.: The modulated annual cycle: an alternative reference frame for climate anomalies, Clim. Dynam., 31, 823, 2008

Zhen-Shan, L. and Xian, S.: Multi-scale analysis of global temperature changes and trend of a drop in temperature in the next 20 years, Meteorol. Atmos. Phys., 95, 115-121. 2007

Other references

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Emery, B.A., Richardson, I.G., Evans, D.S. et al.: Solar Rotational Periodicities and the Semiannual Variation in the Solar Wind, Radiation Belt, and Aurora, Sol. Phys., 274, 399-425, doi:10.1007/s11207-011-9758-x, 2011

Flandrin, P., Goncalves, P. and Rilling, G.: Detrending and Denoising with empirical mode decomposition, Proceedings of Eusipco, Wien, Austria, 2004

Morner, N.-A., Solar Wind, Earth’s Rotation and Changes in Terrestrial Climate, Physical Review & Research International, 3(2):117-136, 2013

Prabhakaran Nayar, S.R.: Periodicities in solar activity and their signature in the terrestrial environment, ILWS WORKSHOP 2006, GOA, FEBRUARY 19-24, 2006