Comment on “Testing Hypotheses about Sun-Climate Complexity Linking”

Rypdal and Rypdal (RR) [1] assert that the hypothesized linking between the Sun and climate complexity, first suggested by Scafetta and West (SW) [2] and developed in subsequent publications [3–6], is not supported by data. However, RR employed Lévy Flight noise in their analysis instead of the Lévy Walk (LW) signal used by SW. In fact, RR focused on the statistics of increments while SW focused on the statistics of the time intervals. RR stress the rapid fluctuations within a record, while SW stress the slow trending patterns. In their Fig. 1, RR found that the increments of the residual temperature record have Gaussian statistics while the increments of the residual of the solar flare index (SFI) do not and concluded that SW are in error. However, the SFI index measures a daily average of the intensity of the daily solar flare energy output. SW explicitly considered SFI irrelevant for climate change (see Sec. 4B in [3]). SW research focuses [2] on a very different observable: the waiting-time intervals between hard-x-ray flares which are Lévy distributed [7]. The latter record is interpreted as an indicator of the stochastic properties of the solar trending dynamics. So, Gaussian distributed temperature increments create no problem. Because LWs are characterized by the temporal properties of events (not related to their intensity), detrending a LW sequence of its low frequency component destroys its long-trending inferences. Also subsequent research [4–6] further stresses that the link SW found between solar dynamics and climate records must be searched for in the temporal trending (i.e., the smooth) of the signals. Moreover, the temperature trending that RR removes with a fourth-order polynomial fit corresponds to the Gleissberg (50–90 years), Suess (160–260 years), and millenarian solar variability and removing it severely alters the solar signature on the temperature [5]. Figure 1 clarifies the above comments. Panel (a) shows that both long and short solar records share the same scaling exponent of the temperature. Panels (b)–(f) analyze with RR’s smoothing methodology synthetic LW signals mixed with noise, and results equivalent to Fig. 2 in [1] emerge . If the synthetic LW record is detrended of its smooth, the LW memory is suppressed and random noise scaling ($\delta = H = 0.5$) is found, which proves that RR’s results are an artifact of their detrending methodology. In conclusion, both RR’s data and methodology are inappropriate for studying a LW signal and testing a solar-climate link as SW did in their work. In any case, a recent publication has shown the existence of a spectral coherence between climate records and astronomical oscillations at multiple time scales that clearly supports a significant solar-climate coupling [6].

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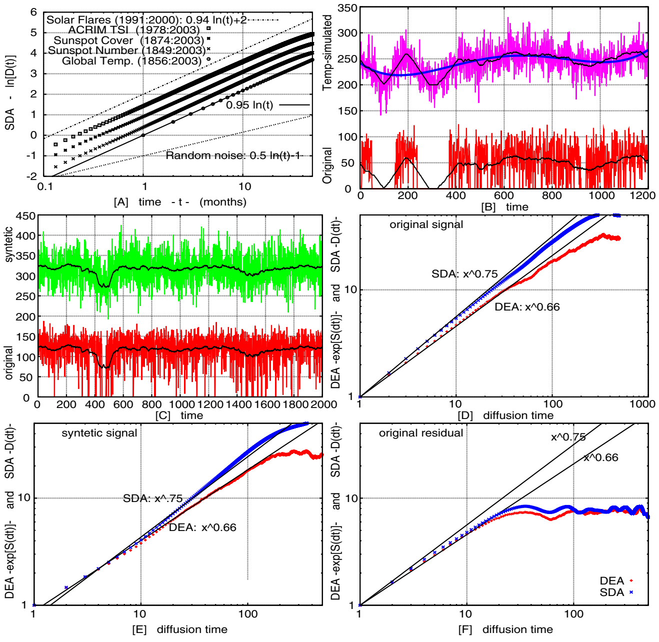

FIG. 1 (color online). (a) The scaling exponents of solar flare waiting time intervals, long solar records, and temperature are the same. Thus, the same dynamics that generates the LW solar flare statistics at least up to four months [2,7] drives the solar activity also at longer scales that drives climate [4]. (b) A LW noise (bottom) [2,7] with waiting time exponent $\mu = 2.1$ that symbolizes the solar flare data. (Top) A Gaussian random noise modulated with the LW smooth black curve; it symbolizes a long scale solar record or the temperature record (note that its increments are Gaussian distributed). The upper smooth curve is a fourth-order polynomial fit revealing that LW signals can present large trends generated by their LW memory, which would be lost through detrending. The synthetic sequence simulates the fact that solar activity was lower 100 year ago [5], which likely implies that large flares were rarer. (c) The same model as in [2] with $\mu = 2.5$ that yields $\delta = 0.66$ and $H = 0.75$. Panels (d) and (e) analyze the signals in (c) and show that both the original and synthetic records present LW scaling within the scale interval 0–100 time units. Panel (f) shows that if the LW noise is detrended of its smooth component, its intrinsic LW scaling properties disappear also within the scale interval 0–100 despite the fact that the detrending has smoothed the scale >100, which is what is observed in Figs. 2b and 2d in [1].

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[1] M. Rypdal and K. Rypdal, Phys. Rev. Lett. **104**, 128501 (2010).
[2] N. Scafetta and B. J. West, Phys. Rev. Lett. **90**, 248701 (2003).
[3] N. Scafetta *et al.*, Phys. Rev. E **69**, 026303 (2004).
[4] N. Scafetta and B. J. West, Complexity **10**, 51 (2005).
[5] N. Scafetta, J. Atmos. Terr. Phys. **71**, 1916 (2009).
[6] N. Scafetta, J. Atmos. Terr. Phys. **72**, 951 (2010).
[7] P. Grigolini, D. Leddon, and N. Scafetta, Phys. Rev. E **65**, 046203 (2002).