Scientists find errors in hypothesis linking solar flares to global temperature

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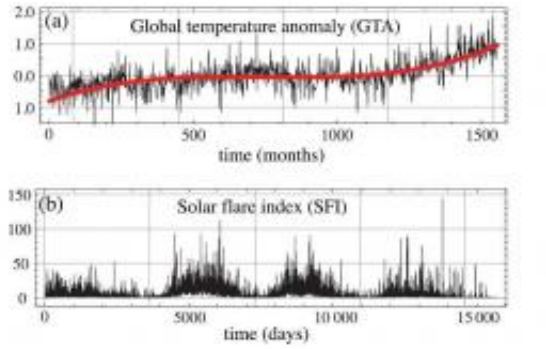

In contrast to a previous analysis, a new study has shown that the distributions of (a) the global temperature anomaly by month since 1880 and (b) the solar flare index by day over a few solar cycles are fundamentally different. One feature the detrended data do have in common is self-similarity: the probability density functions are the same on different time scales, which means that neither can be described as Lévy walks. Image credit: Rypdal and Rypdal.

(PhysOrg.com) -- The field of climate science is nothing if not complex, where a host of variables interact with each other in intricate ways to produce various changes. Just like any other area of science, climate science is far from being fully understood. As an example, a new study has discredited a previous hypothesis suggesting the existence of a link between solar flares and changes in the earth's global temperature. The new study points out a few errors in the previous analysis, and concludes that the solar and climate records have very different properties that do

not support the hypothesis of a sun-climate complexity linking.

In a handful of studies published in *Physical Review Letters* between 2003 and 2008, a team from Duke University and the Army Research Office including Nicola Scafetta and Bruce West analyzed data that appeared to show that solar flares have a significant influence on global temperature. Solar flares, which are large explosions in the sun's atmosphere that are powered by magnetic energy, vary in time from a few per month to several per day. Although solar flares occur near sunspots, their frequency variation occurs on a much shorter time scale than the 11-year sunspot cycle. In their studies, the researchers' results seemed to show that data from solar flare activity correlates with changes in the global temperature on a short time scale. Specifically, their analysis showed that the two time records can both be characterized by the same Lévy walk process.

However, in the new study, which is also published in Physical Review Letters, Martin Rypdal and Kristoffer Rypdal of the University of Tromso in Norway have reexamined the data and the previous analysis and noticed some shortcomings. One of the biggest causes of concern is that the previous analysis did not account for larger trends in factors that affect solar flares and global temperature. For instance, the solar cycle has its 11-year periodic trend, where periods of lots of sunspots cause larger numbers of solar flares. Likewise, the global temperature anomaly has numerous other factors (a "multi-decadal, polynomial trend") that impacts global temperature fluctuations. By not detrending this data, the analysis resulted in abnormally high values of certain variables that pointed to Lévy walk processes. By estimating the untrended data, Rypdal and Rypdal hypothesized that the solar flare records might be described by a Lévy flight, while the global temperature anomaly might obey a distribution called persistent fractional Brownian motion.

"The first thing we do when we approach a time series with a strong

random component is to perform standard statistical analyses like plotting of probability density distributions on different time scales," Martin Rypdal told *PhysOrg.com*. "We look at the shape of these rescaled distributions. If the signal is statistically self-similar, it looks almost the same on all time scales. [Here, we've shown] that the solar flare signal and the global temperature signal are both self-similar, but their distributions are very different, and so are the exponents used for rescaling. We were very surprised that Scafetta and West never show such results in their papers. It seems that they have designed all their tests with the purpose of proving a wanted result, and deliberately avoided analysis that points in other directions."

As the researchers explain in their paper, the finding that the scaling behavior of both the solar flare activity and the global temperature remain self-similar for large changes in scale provides evidence that the data sets cannot be described as Lévy walks.

The Norwegian researchers also noted that the previous analysis had errors beyond the lack of detrending. Most significantly, they found that the analysis could not distinguish between Lévy walks, Lévy flights and Gaussian processes such as fractional Brownian motion. For this reason, the analysis would have concluded that some other data sets were described by Lévy walks when they were not. To demonstrate, the Norwegian researchers created a fake data set from a fractional Brownian motion model with a trend. When they applied the previous analysis to this data, the analysis described the data as a Lévy walk.

Last, the Norwegian researchers formulated a new analysis which could distinguish between these three different processes, and applied the analysis to the detrended solar flare data sets. The results revealed that the solar flare records actually follow a Lévy flight, as they had hypothesized. Also, by applying the analysis to detrended global temperature anomalies, the researchers found that the data is well

described as persistent fractional Brownian motion, as they also hypothesized. As the researchers explain, the results provide more evidence to support the supposedly controversial theory of human-induced global warming.

"The theory of anthropogenic global warming consists of a set of logically interconnected and consistent hypotheses," Martin Rypdal said. "This means that if a cornerstone hypothesis is proven to be false, the entire theory fails. A corresponding theory of global warming of solar origin does not exist. What does exist is a set of disconnected, mutually inconsistent, ad hoc hypotheses. If one of these is proven to be false, the typical proponent of solar warming will pull another ad hoc hypothesis out of the hat. This has been the strategy of Scafetta and West over the years, and we have no illusion that our paper will put them to silence. However, the only scientifically valid strategy to confront these new hypotheses is to shoot down every new missile as they come in, using the most advanced weapons at hand. We believe that this operation was successfully accomplished with respect to the complexity linking hypothesis, but there will be many more battles to be fought until the issue of the contribution of solar variability to recent global warming is settled."

More information: M. Rypdal and K. Rypdal. "Testing Hypotheses about Sun-Climate Complexity Linking." Physical Review Letters 104, 128501 (2010). DOI:10.1103/PhysRevLett.104.128501

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