

Identifying and Extracting Undocumented Trends from Solar Irradiance Records

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The unusually large solar cycle variations reported by the SORCE/SIM and SORCE/SOLSTICE instruments challenge our ability to identify and correct undocumented trends in solar irradiance records. This problem of detecting undocumented trends frequently arises as well in the homogenization of climate data, e.g. ozone records.

In the absence of an external reference, most trend detection schemes proceed by comparing the observations with some reconstruction that is based on proxy data. This approach has two problems: different assumptions on the reconstruction may lead to substantially different answers, and the errors associated with the proxy reconstruction may be hard to distinguish from the true trend. This situation calls for a strategy that is traceable and fully transparent, allowing the user to know exactly how significant the trend is for a given proxy.

Here we present a new scheme that fulfills these two conditions. The method proceeds by comparing the spectral irradiance at two dates when the solar proxy reaches the same level. This idea of comparing two observations of the spectral irradiance has been applied before. We considerably improve it by providing a method that 1) allows us to extract the trend at any time without the need to explicitly build a model that relates the irradiance to the proxy, 2) provides realistic confidence intervals, allowing us to test how significant the trend actually is, and 3) whose transparency avoids the risk of confusion between the trend and a proxy model error.

We illustrate this new method with two examples: a comparison of different reconstructions of the MgII index for solar UV irradiance, and an assessment of the trends extracted from SORCE/SIM and SORCE/SOLSTICE observations since 2003 by considering different solar proxies. The Matlab code is available upon request.