

1. Objective

All solar spectral irradiance (SSI) observations must be corrected for instrumental effects (i.e. sensor degradation) that may otherwise cause spurious trends.

Our challenge: detect undocumented trends in solar spectral irradiance (SSI) records with as few assumptions as possible.

This problem arises with other datasets: ozone concentration, ground temperature, etc. How to detect such trends when there is no absolute reference ?



- 1.Compare observations with an absolute reference ► Ideal ! But if indeed possible, then skip this poster...
- 2.Compare observations with an SSI model Dangerous because of the risk of inbreeding
- 3.Compare observations with a multi-solar proxy model Dangerous because of collinearity (numerical problems)
- 4.Compare observations with a combination of several solar proxies **r** Risky because of poor traceability (each proxy describes a different aspect)
- 5.Compare observations with several solar proxies, taken individually Probably the least objectionable solution...

3. What are your assumptions ?

We want a method that is:

- Transparent and fully traceable: all assumptions must be explicited !
- Provides realistic confidence intervals

Assumptions

- The SSI varies in phase with the proxy (on time scales >> lifetime of active regions)
- The long-term stability of the proxy must be at least as good as that of the SSI
- Need to observe at least 1/2 solar cycle

No assumption on the functional relationship between proxy and SSI, which may be nonlinear.

No proxy model fit to the SSI.

Identifying and extracting trends from irradiance records

Compare the SSI at two dates for which the proxy shows the same value.

 $\Delta SSI \neq 0 \Leftrightarrow$ indication of a trend

This approach has been exploited before by Woods [2011], Morrill [2014].

$$f(t_0) = 1 \qquad at \ launch$$

$$f(t) = 1 + a_0(t - t_0) + \sum_{k=1}^{N} a_k \sin \left(\frac{1}{2} + \frac{1}{2}$$

Main advantages

scattered light problem after ~2008.





We observe significant trends in SORCE/SOLSTICE and SORCE/SIM observations from 2003-2015



A new transparent and traceable method for detecting undocumented trends. You know exactly what your assumptions are (open science approach !)

Using this approach with SORCE/SIM and SORCE/SOLSTICE data, we find strong evidence for trends that are comparable to the solar cycle amplitude.

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7. Trends in SORCE observations ?

8. Conclusions