

Interactive comment on “Recent variability of the solar spectral irradiance and its impact on climate modelling” by I. Ermolli et al.

Anonymous Referee #1

Received and published: 1 November 2012

GENERAL COMMENTS

This paper is primarily intended to be a review of knowledge of solar variability, considering both total irradiance and spectral irradiance, and how uncertainties in that knowledge affect results calculated by atmospheric and climate models. A major review in this area was recently published by Gray et al. (2010), with a more general focus on many different possible forcing mechanisms. This paper emphasizes recent measurements by the SORCE SIM and SOLSTICE instruments, and their impact on terrestrial responses when used in model calculations. In general, it provides a reasonably balanced view of the current situation in this area. However, there are some sections where selected unpublished work is given more emphasis than may be appropriate. These cases are identified below.

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SPECIFIC COMMENTS

1. p. 24559, lines 10-12: While an abstract is intended to be a general summary of the entire paper, it would be helpful to clearly state here that the SORCE measurements during 2004-2009 are the key topic of discussion.
2. p. 24560, lines 4-6: Is the 8% value referring to temperature change? Some other parameter?
3. p. 24560, lines 18-19: Short-term decreases of TSI due to large sunspots can actually be 2-3 times larger than this.
4. p. 24561, lines 4-6: Does this percentage correspond to the 120-350 nm wavelength range given in line 1?
5. p. 24564, lines 18-19: See previous comment #3 regarding the term “conspicuous”.
6. p. 24564, lines 25-26: Although spectrally resolved visible and near-IR solar cycle variations may be of the same “order” as TSI variations, the large amount of solar flux at these wavelengths means that the difference between 0.1% and 0.5% still has important terrestrial consequences. Measurements capable of determining this difference over a solar cycle are not available yet.
7. p. 24565, lines 20-24: Of these instruments, only SIM claims to have a full end-to-end calibration. The ISS SOLSPEC principal investigator reported at the February 2012 workshop (p. 24570, lines 5-9; see “The Earth Observer”, vol. 24, July-August 2012, p. 17-20) that the deuterium lamps intended to monitor long-term instrument calibration are experiencing operational problems, so that determining solar variations for Cycle 24 may be difficult.
8. p. 24566, lines 19-21: Reference solar irradiance measurements can also be used for long-term calibration, as noted on the previous page for SBUV instruments.
9. p. 24567, line 3: The purpose of “recent” should be clarified here. The next section

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(2.2.1) addresses SCIAMACHY measurements that began in 2002, but there is no discussion of UARS SUSIM data that were also in progress at that time and extend through July 2005.

10. p. 24567, lines 18-21: The SCIAMACHY data set is not a true long-term irradiance product, but is essentially a semi-empirical model (like NRLSSI) with a different set of scaling coefficients. Its spectral coverage is valuable for comparisons with SORCE SIM data, but it does not provide any additional validation of the time dependence of those measurements.

11. p. 24569, lines 18-19: The SIM measurements are claimed to have extremely good long-term stability (0.5-1.0% at 200-300 nm, 0.2-0.05% at 310-400 nm), as discussed in Merkel et al. (2011). They do not discuss an increase in uncertainty with time.

12. p. 24569, lines 19-21: It should be pointed out that the SIM UV data (below 308 nm), which represent an important part of this paper, are not part of the SORCE public Level 3 data product.

13. p. 24570, lines 13-27: The work of Woods (2012) is only a conference presentation, not a published (or even submitted) paper. It should not be treated at the same level as other publications. The term "plausible" for this work implies a problem with the current long-term corrections that has not been acknowledged publicly by either the SIM or SOLSTICE teams. This discussion also applies to the overview statement on p. 24564, lines 3-5.

14. p. 24571, lines 1-11: This paragraph seems to be a "looking ahead" statement that adds nothing to the analysis of current SORCE data. It could be combined with similar text on p. 24607 in the Conclusion.

15. p. 24572, lines 8-11: The Thuillier et al. (2012) paper does not show any comparisons of time series with SORCE data. See item #7 for further comments.

16. p. 24572, lines 19-22: DeLand and Cebula (2008) did attempt to address the

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differences in absolute calibration between instruments by normalizing each data set to a single reference spectrum.

17. p. 24573, lines 4-7: The level of consistency between SSI and solar proxies is in fact a key point. If we truly "know" that SSI behavior is completely consistent with proxy behavior, then one could argue that further SSI measurements are not needed.

18. p. 24573, lines 25-28: The agreement in phase between different data sets is forced by the use of the Mg II index as a common reference. However, the derived amplitudes for Cycle 23 shown in this figure differ by a factor of 3. Which result should a user believe?

19. p. 24575, lines 18-29: There was substantial work done to address the differences in TSI measurements prior to 2010, as discussed in the following paragraph and the comment by G. Kopp. I would rephrase this paragraph to say that the PREMOS data "support" the results of the ground-based work, and move it to follow the paragraph on p. 24576, lines 1-20.

20. p. 24577, lines 4-5: As discussed in item #13, this is not a published result, and it should be noted that the SIM team has not publicly acknowledged this statement as a basis for revising their data.

21. p. 24577, lines 12-13: Previous SSI measurements in the UV (e.g. SME, SBUV/2, UARS SUSIM, UARS SOLSTICE) do quote long-term uncertainties for their data, as summarized in Table 1 of DeLand and Cebula (2012) and references therein. The limited lifetime of individual instruments does preclude definite statements about multi-decadal variations at this time.

22. p. 24585, lines 5-10: An examination of the Fontenla et al. (2011) paper found a brief discussion of temperature vs. pressure derivative (their paragraph 60) where the extended wavelength coverage of SORCE SIM is apparently useful. The comment by J. Fontenla contains more discussion of this statement.

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23. p. 24586, lines 17-19: It is not clear from this discussion why the use of UARS SOLSTICE data as described here should lead to lower variability as calculated by NRLSSI. DeLand et al. (2004) discusses comparisons between UARS SUSIM and UARS SOLSTICE at mid-UV wavelengths, but that paper does not address how well the observed rotational modulation values for cycle 22 agree. The UARS SOLSTICE data were forced to have no long-term change at wavelengths longer than 300 nm, but the predominant contribution to the NRLSSI variations at these wavelengths comes from the sunspot darkening term.

24. p. 24588, lines 21-22: Is this statement consistent with the time series shown in Harder et al. (2009) and the conclusions given there?

25. p. 24593, lines 6-7: The Harder et al. (2010) paper only discusses the absolute calibration of SORCE SIM, and does not address its long-term stability. The values quoted in Merkel et al. (2011) (and listed here in item #11) represent uncertainties considerably less than 1%/year if applied over the SIM lifetime. If these values are accepted, then the SIM results do not overlap with the model calculations.

26. p. 24593, lines 16-18: As discussed in item #23, it is not clear why UARS SOLSTICE should be considered to have a “low response” to solar variability for wavelengths longer than 220 nm.

27. p. 24598, lines 18-28: It should be made clear that this discussion is taken from a submitted paper that has not been published.

28. p. 24600, lines 21-24: Because the solar cycle signal used for the HadGEM3 simulations is a factor of 3 larger than the signal from 2004 to 2007 as determined from solar proxies, there is a question as to whether the model responses will in fact scale linearly with this change in forcing.

29. p. 24608, lines 3-5: Please modify this statement in line with previous comments in items #13 and #20.

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TECHNICAL CORRECTIONS

p. 24564, line 20: Should be “challenge”.

p. 24565, line 18: Should be “underflight”.

p. 24594, line 25: Should be “changes”.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 12, 24557, 2012.

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