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Climate of the Past Discussions

Interactive comment on "A reconstruction of radiocarbon production and total solar irradiance from the Holocene ^{14}C and CO_2 records: implications of data and model uncertainties" *by* R. Roth and F. Joos

Anonymous Referee #1

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Review of "A reconstruction of radiocarbon production total solar irradiance from the Holocene 14C and CO2 records: implications of data and model uncertainties" by Raphael Roth and Fortunat Joos.

In their paper, Roth and Joos investigate the radiocarbon production during the Holocene using an Earth System Model of intermediate complexity, as well as records of CO2 and 14C. They present reconstructions of the 14C production rate, solar modulation potential and total solar irradiance.

The paper is well-written, of general interest and presents a clear innovation over previous work. I therefore recommend publication after minor revisions.

Previous studies had used much less sophisticated models of the carbon cycle to reconstruct the 14C production rate and TSI, and reading the paper I was very surprised that nobody had thought of using a model of intermediate complexity before, since it strongly improves the representation of the carbon cycle.

What I especially liked about the paper is the rather comprehensive treatment of uncertainties that the authors attempted using Monte-Carlo methods. I see this as a strong point very strong point of the paper.

There is just one major issue that I see with the paper: The model description is incomplete. The handling of 14C in the LPX model is not documented since the Scholze et al. publication that the authors cite only deals with 13C.

I have seen the original implementation of carbon isotopes in LPJ, and here 14C is dealt with in a very similar way to 13C, with two exceptions: Obviously, radioactive decay of 14C is implemented, but for photosynthesis the model does not discriminate against 14C, instead setting the Δ14C of assimilated carbon (GPP) to the Δ14C of atmospheric CO2. Since discrimination against 14C should be double the discrimination against 13C, this would obviously introduce a small bias in the atmospheric Δ14C. Not having seen the LPX code, I do not know whether the implementation in LPX is identical to the original implementation of C isotopes in LPJ, or whether this was corrected. Either way, it needs to be documented in the paper.

I assume the bias in atmospheric Δ14C introduced by the non-discrimination against 14C during photosynthesis (if this actually is the case in LPX) would be so small that it is already covered by the uncertainty range the authors specify for the land C pools.

Another issue arises from Fig. A3. Here it appears as if the total error is larger than the ΔTSI signal for some of the time. This begs the question whether the ΔTSI recon-

struction is meaningful at all. This would need to be discussed in the text.

Of course there are a number of minor details as well:

- Fig. 3f: “windtress” is missing an s and should be “windstress”.

- Fig. 12 caption, last sentence: Sentence either has a “for” too many or is missing something.

- Page 1167, lines 16-20: This is the most important sentence in the introduction since it shows what is new in your study. One needs to read it a number of times in order to understand it – I’d suggest adding a “However” at the beginning and then to split up the sentence into at least two.

- Page 1168, line 24: Most readers will be familiar with the half-life of radioactive isotopes, but the average life time is not so well known – a sentence explaining how the two relate to each other would be a help to the uninitiated reader.

- Page 1171, line 8: The motivation for applying sinusoidal perturbations only becomes clear in section 3. A sentence here would make things easier for the reader.

- Page 1171, line 22: missing “model” after “sediment”.

- Page 1177, line 18: “close” should be “closely”.

- Page 1183, line 21: “reservoir” should be plural “reservoirs”

- page 1189, line 6: “method” should be plural “methods”

- page 1189, line 9: Missing “the” before “present solar minimum”

Interactive comment on Clim. Past Discuss., 9, 1165, 2013.