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Interactive comment on "Solar Forcing for CMIP6 (v3.1)" *by* Katja Matthes et al.

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During the last few months we realized that we did a mistake in constructing the variable preindustrial control forcing dataset. Therefore we would like to revise it and will change the text in the paper as indicated below. Instead of scaling solar cycle amplitudes to the rather small amplitudes of the preindustrial period around 1850, we will scale the solar cycle amplitude to be representative of the last grand solar maximum. We will however make sure that the mean of this constructed solar cycle is in agreement with the pi control solar forcing value. By prescribing a rather strong solar cycle amplitude, we expect to learn how the solar cycle contributes to natural climate variability and whether the synchronization between the NAO and the solar cycle (Thiéblemont et al., 2015) is a robust feature.

The new text reads as follows:

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For those groups that are interested, we also provide a 1000-year solar forcing time series with 11-year solar cycle variability included but without long-term trend (Fig. 25). This time series still has slightly different solar cycle amplitudes and also preserves the variable phase of the solar cycle, however, the solar cycle mean activity level is held constant as compared to the reference scenario in Fig. 23. By running a second PI control experiment with solar cycle variability, this provides one additional periodic forcing on top of the seasonal cycle. Since the PI control is also used to determine model variability at decadal timescales, including a solar cycle would certainly change the mean climate and the variance of the control experiment as compared to the “standard” control experiment with constant 1850 solar forcing. However, not including the solar cycle variability may underestimate the variance of the climate system and may lead to climate system biases. Ideally the groups would do two PI control experiments: one with and one without solar cycle variability.

The variable PI control forcing has been generated by scaling the annual and sub-annual components of the REF forcing dataset to a constant solar cycle mean activity level representative for the time period last grand solar maximum.. The scaling procedure for SSI and F10.7 is described in Appendix G. Constant background components have been added. These have been adjusted such that the mean values of the resulting SSI and F10.7 time series are consistent with the constant PI control forcing. The scaling of geomagentic Ap and Kp indices is described in Appendix H. MEE-induced ion-pair production rates for the variable PI control forcing have then been calculated from the scaled Ap data. GCR-induced ion-pair production rates have been calculated using a constant value representative for the 1850–1873 period. The variable PI control proton forcing is identical to the REF forcing since it does not include any long-term trend. Note that the temporal averages of SSI, TSI, F10.7, Ap, Kp, as well as GCR-induced ion-pair production rates are fully consistent wit the values provided in the constant PI control forcing dataset. This, however, is not the case for the proton and MEE forcings, which, in the latter case, do not account for large, sporadic events. The variable PI control dataset (see Fig. 25) covers the time period from 1.1.1850 until

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9.9.2053 (end of solar cycle 27). The dataset can be extended to cover 1000 years by multiple repetition of the solar cycle sequence 12–27. The first 450 years of the resulting forcing time series are consistent in solar cycle phase and short-term fluctuations with the REF and EXT datasets. Solar forcing only experiments based on variable PI control, REF, and EXT forcing data would therefore be ideally suited to address the impact of long-term solar activity variations on the climate system.

Appendix G, last paragraph: For the construction of the variable PI control forcing, anual and sub-annual SSI components are scaled individually to grand solar maximum average conditions at each wavelength bin. The scaling has been performed for the D+ and D$-$ components based on SD(D+) and MAD(D$-$), respectively, as in the the future scenario construction. For A+ and A$-$, we use the corresponding solar cycle averages to construct time-resolved scaling functions. The background contributions SSIbg were set to constant values. These have been adjusted such that the mean values of the resulting SSI and F10.7 time series are consistent with the constant PI control forcing. The same procedure was also applied to the F10.7 radio flux.

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