

## ***Interactive comment on “Climate and carbon-cycle variability over the last millennium” by J. H. Jungclaus et al.***

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This manuscript describes experiments with a coupled atmosphere-ocean general circulation model that included an interactive carbon cycle, aimed at understanding changes in surface temperature and CO<sub>2</sub> concentration over the last millennium. The modeled temperature fluctuations are found to be qualitatively consistent with available records, while the modeled preindustrial CO<sub>2</sub> fluctuations and industrial CO<sub>2</sub> surge are too small.

The manuscript is generally clear and well-presented, although the description of the modeling details is rather abbreviated. The work reported is of interest to climate scientists, and I recommend publication. Some suggestions are:

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1. Information on the fossil fuel emissions assumed as forcing should be provided.
2. It would be useful to describe the model representation of sea and land snow and ice, and how important albedo changes are for the temperature response.
3. The discussion could be extended slightly to consider *why* the modeled preindustrial CO<sub>2</sub> fluctuations might be too small (e.g., not enough soil carbon in long-lived pools?).
4. Another good diagnostic for whether the modeled sensitivity to solar variability is reasonable would be to compare the modeled amplitude of the temperature response to the 11-year solar cycle with that derived from observations (cf. Tung et al., Constraining model transient climate response using independent observations of solar-cycle forcing and response, GRL, 2008).

Typographic comments:

1. p. 1027:18-19 “Regression slopes varied by  $\pm 0.07$  for the control and 0.06 ppm for the forced simulations.” – should the units be ppm/K?
2. p. 1043, figure caption: “the strongly forced and controlled experiments” – should be something like “the strong-solar-variability and the control experiment”.

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