

Interactive comment on “Influence of solar variability, CO₂ and orbital forcing during the last millennium in the IPSLCM4 model” by J. Servonnat et al.

Anonymous Referee #2

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This paper describes a simulation covering the last millennium using the atmosphere-ocean coupled model IPSLCM4. The simulation with changing total solar irradiance (TSI), orbital forcing, and greenhouse gases is accompanied by a control experiment of similar length. The authors provide a statistical decomposition to attribute temperature changes to the individual forcings. The multivariate decomposition of Northern Hemisphere temperature does not provide any surprising results and the comparison with reconstruction data must be said to be not very revealing because one important external forcing, i.e. disturbances by volcanic aerosols, are not included. However, the authors include a spatial decomposition and provide estimates for the signal-to-noise-ratio (SNR) for spatial scales from the sphere to the grid-point area. Since the

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relative role of internal variability and external forcing in judging observed temperature variations is still one of the most important issues in studies of past climate, this refinement is highly welcome and it shows how models can be used to evaluate proxy-based reconstructions and to guide the further development of proxy-networks.

In particular the authors point out that the patterns shown by the variance explained can be very different for different forcing, seasons, and – most importantly – regions. An interesting example is the role of orbital forcing (that is often assumed to be of minor importance for last millennium’s temperature evolution) for the high northern latitude summer temperatures.

Overall, the manuscript is well written and concise. For the abstract, I would recommend to somewhat de-emphasize the nice agreement of the simulations with the range of reconstructions but focus on the really new findings for the local sensitivity and the local SNR estimates. The authors might also consider reformulating the title which could be a bit more catchy if it reflects the new (regional) aspects of this paper.

I therefore recommend publication in *Climate of the Past* after minor revisions.

Specific comments:

P. 424, line 3: To my knowledge, Lamb (1964) did not use the term MCA but “Medieval Warm Epoch” Line 7: maybe include reference Trouet et al. (*Science*, 2009) here.

P. 427, line 10, and p. 429, line 24: if there is a trend of -0.11 deg/yr per 100 yr in the control run over the first century, it is very likely that this is also present in the forced experiment (where radiative forcing is quite weak). So there is not really a point to discuss a 1075 AD trough in temperature here.

P. 430: Rather than showing how excellent the agreement is between the simulation and the reconstructions it would be helpful to discuss why there is agreement in spite of the fact that the volcanic forcing is missing. Amman et al. (2007), Hegerl et al. (2007), and Crowley “Volcanism and the Little Ice Age, *PAGES Newsletter*, 2008) have pointed

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to the important role of cumulative occurrence of volcanic eruptions. Since one of the authors (Swingedouw) is also first author of a paper describing the effect of external forcing in the Toulouse model (similar model set-up, different atmosphere model) where volcanic forcing was applied, the authors should at least discuss this issue a bit more thoroughly.

P. 435, line 9: why use “root mean square” ?

Minor points: Fig. 1 a: Is the radiative forcing (left axis) calculated from the simulation?
Figure caption: TSI is right axis

Fig. 2: The differences in the reconstructions would become visible better when showing all in one figure.

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