

## ***Interactive comment on “Climate variability of the mid- and high-latitudes of the Southern Hemisphere in ensemble simulations from 1500 to 2000 AD” by S. B. Wilmes et al.***

**Anonymous Referee #2**

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Review comments on "Climate variability of the mid- and high-latitudes of the Southern Hemisphere in ensemble simulations from 1500-2000 AD" by S.B. Wilmes et al.

This paper investigates Southern Hemisphere variability in a multi-centennial context and studies the relation between variability modes among each other and climate variables. The topic is interesting, in particular because a detailed understanding of Southern Hemisphere dynamics and its connection to the mid and low latitudes is still missing. Therefore, the approach of ensemble simulation over a period where both natural and anthropogenic forcing, and internal variability play a role in shaping long-term climate evolution and transition is very adequate.

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However, I find that the paper is not well presented. The manuscript is often not very clear and could be more to the point. There is an imbalance of lacking important information and quite a bit of unnecessary or overly detailed repeating what is found in the literature. Also the number of figures could probably be reduced. I would suggest that the authors revise the manuscript focusing on the topics that are new and important. There are also (as pointed out below) some questions on the methods that should be clarified. After such (major) revisions the manuscript should be appropriate for publication.

Specific points

Abstract

Model and expt. Description, page 3095, line 9ff: I don't think that 50 years are enough for an adjustment from 1990s to 1500 conditions. There is a big change in CO<sub>2</sub> forcing that will influence surface patterns but also ocean heat content etc. Given the length of the run, it would be more appropriate to disregard the first 150 or 170 years.

SAM, page 3096, lines 23ff: does it make any sense to do spectra over multi-decadal times for the 40-year ERA data? I find very little information value in the spectrum figures other than that model and reanalysis data are quite different.

Atmospheric modes, page 3098, lines 15ff: I don't think that fig. 4 can tell us anything useful about the 16th (!) century or so. We can just see by eye that SAM appears to be more susceptible to volcanic forcing and GHG increase (btw: what is the red line underlying the black?). It would be more appropriate to discuss if variations or trends seen in the time series under external forcing conditions are significantly different from the control simulation.

Regional changes, page 3099. It is an interesting finding that the different regions respond differently to the ext. forcing. However, it would be good to learn more why that happens. Unfortunately that point is not taken up again in the discussion of the

C1888

regression analysis in 4.3. Figure 8 is just interpreted in terms of similarity to the modes, but there should be more information how the different regions are influenced.

Page 3100, lines 20ff. Figures should be discussed in order of their appearance. Figure 7, since it just shows a number of straight lines, could probably be taken out. It would be enough to say in the text that there are no changes in the running correlations.

Impact of external forcing: page 3101. This entire paragraph is very hard to understand; I had to read it three times to get it. Also fig 9 does not clearly say what the regression coefficient mean variable per standard deviation or per ext. forcing in  $Wm^{-2}$  or arbitrary aerosol units? Also line 26: should this be per  $1 Wm^{-2}$ ?

Discussion: in general, the discussion of the findings from the literature could be more concise. In 5.2, a very detailed account of the reconstructions is given but the comparison with the models is relatively superficially done (and missing for precip).

Page 3103, line 17: What is the "Fogt" reconstruction?

Page 3111: do you mean CMIP5/AR5?

Fig. 6: temperature <> precipitation.

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