

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 #1

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General comments

I have reviewed the manuscript “Climate variability of the mid- and high-latitudes of the Southern Hemisphere in ensemble simulations from 1500 to 2000 AD” by S. Wilmes, C. Raible, and T. Stocker. In my opinion, this paper shows interesting results about the climatic variability of the Southern Hemisphere during the past 500 yr. Using a climate model, authors describe characteristics of three atmospheric indexes, the temperature and precipitation of four specific areas of South America and links between these variables. The influence of solar, greenhouse gas and volcanic forcing is also analyzed.

I recommend the paper as appropriate for publication but after some important revisions. I have written my comments below and the authors should consider it in their revision.

Specific comments

I am not an expert on numerical simulations and therefore I have not commented it. My comments are focused in the results.

1) In Figs. 2a-d should be given more detail (colors or contours) because it is not easy to distinguish the characteristics that the authors mention in lines 18-19 of page 3096.

2) In my opinion, the definition of SPD mode is unclear. I recommend see Fig. 1 in Mo (2000). The SPD of the model (Fig. 2c) resembles the EOF3 showed by Mo while the SPD of ERA40 (Fig. 2d) resembles the EOF2 of Mo. The authors should confirm that they are comparing the modeled SPD with the SPD of the ERA40. They may be comparing different modes of circulation. Please, also see the ENSO mode and the South Pacific wave train described by Kidson (1999).

3) In the definition of index ZW3 the authors compare the first EOF of the model and ERA40 finding a shift of 30° among them. It is important to know how are the other EOFs since, as it was previously mentioned, the authors may be comparing different structures and this is the reason for the shift. In other words, is the EOF1 of the model different from, for example, the EOF2 of ERA40? In my opinion, it is not clear why the authors consider both SAM and ZW3 because part of the SAM structure is a wave 3 in subpolar latitudes (see Fig. 7 in Kidson 1999 or Fig. 1d in Mo 2000). Therefore, it is not clear that the ZW3 is a circulation mode independent of the SAM. Authors should analyze this point. See the similarity of the circulation field associated to the temperature in the region SA1 (Fig. 8) and the structure of the SAM in Fig. 1d of Mo (2000). See also the influence of the SAM on the temperature of southern South America in Fig. 10 of Garreaud et al. (2009).

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In Fig. 8 it is important that the authors describe the mechanisms establishing the links between the circulation fields and the South American temperature (and precipitation) since otherwise it is just a statistical exercise. More details (colours or contours) should be added in this figure to better distinguish the anomalies of circulation.

4) I think that it is not clear the methodology used to select the regions of temperature and precipitation SA1 to SA4. In particular, the region SA1 contains the area of Patagonia on both sides of the Andes Cordillera. Therefore, this region includes the very wet area of Chile and the arid region of Argentina. This makes unclear the analysis presented in Fig. 8 because the forcing of precipitation is different on both sides of the Cordillera. The links with the precipitation over other areas of South America (Fig. 6) can also be different.

Please, correct the caption of Fig. 6 (temperature or precipitation?)

5) The Fig. 7 should be after Fig. 8 following the order in the text.

6) A comparison between model results and reconstructions of temperature is made in Section 5.2 but I do not find comments regarding the comparison between model results and reconstructed precipitation.

7) In lines 26-27 of page 3110: I do not agree because the influence of each mode of atmospheric circulation could be found analyzing the relationship between the time series of the mode and the temperature (and precipitation) in South America. There is abundant bibliography describing the influence of the SAM and ENSO in the region (see references in Garreaud et al. 2009).

References: Garreaud, R., M. Vuille, R. Compagnucci, J. Marengo, 2009: Present-day South American climate. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 281: 180-195. Kidson, J., 1999: Principal Modes of Southern Hemisphere Low-Frequency Variability Obtained from NCEP–NCAR Reanalyses. *Journal of Climate*. Mo, K., 2000: Relationships between Low-Frequency Variability in the Southern Hemisphere and Sea

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Surface Temperature Anomalies. Journal of Climate.

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