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Climate of the Past Discussions

Interactive comment on "Climatic changes between 20th century and pre-industrial times over South America in regional model simulations" *by* S. Wagner et al.

Anonymous Referee #1

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Review of: Climatic changes between 20th century and pre-industrial times over South America in regional model simulations.

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In this paper, the authors describe results from present day (PD; i.e. Late 20th century) and pre-industrial (PI; mid-1700s) time slice simulations with the CCLM regional model configured over southern South America (∼15-65S) using a spatial resolution of ∼50 km. Three CCLM simulations are described:

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1) A 5-year simulation (1993-97) driven with ERA-40 results. These results are used to provide a “modern climate / correct forcing” comparisons.

2) A 35-year 20th century simulation driven with ECHO-G results. It is not clear whether the ECHO-G results are from a transient GHG or fixed GHG simulation, but the CCLM CO2 concentrations are set to 330 ppm for this simulation. The analysis is conducted on the final 30 years of the run.

3) Like 2), but using a CO2 concentrations appropriate the mid-1700s AD - 280 ppm in the regional model. The forcing is from ECHO-G, but again specifics of the ECHO-G simulation are not clear,but presumably the run used GHG concentrations appropriate for $\sim$1750. Whether there were changes in the ECHO-G simulation to volcanic, solar or orbital forcing is not stated in the paper. It is assumed here that this simulation used no external forcing other than GHG concentrations matching the 280 ppm used in CCLM.

The main findings are:

1) The regional model simulates the mean and annual cycle of temperature and precipitation fairly well, including improvements (in comparison to coarse grid GCMs) with features associated with the Andes. Such improvement in resolution of terrain-related features in regional model output is an expected result.

2) The CO2 changes result in increased temperature (PI to PD) of 1-2C with the largest changes in the Andes. The CO2 changes also result in a poleward shift of the circulation pattern resulting in increased precipitation in the southern Andes and decreases farther north.

The basic idea behind this work is a good one - to get an idea of PI-to-PD climate changes in southern South America using a regional model forced with appropriate boundary conditions. the results are fairly clear (as summarized above). However, The presentation has some major shortcomings including:

1) Comparisons with existing related experiments and observations are lacking. There

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is considerable literature dealing with observed and/or simulated 20th and 21st century trends in Southern Hemisphere and South American climate and circulation and their possible relation to changes in GHG (including ozone) – e.g. Marshall, 2003; Cai and Cowan, J. Clim. 2007 and references therein; IPCC AR4 report (Chap. 11.6.3) among many others. What is important here is that the large-scale circulation changes in the S. Hemisphere relating to altered GHG concentrations have been explored in by others and are qualitatively consistent with those found in the CCLM results. The results in the present paper would be considerably strengthened if cast in the context of these other results.

2) Comparisons with proxy-derived inferences concerning LIA-to-modern climate changes in South America are confined to two short paragraphs (with three citations). Given the similarity of the CCLM results with other findings (previous paragraph), the paper would benefit from a more thorough discussion of the model results as they relate to proxy-derived inferences for LIA-modern precipitation and temperature changes in southern South America (for example, van Guten et al. Holocene 2009, among others).

3) I found the results section overly descriptive with insufficient attention to physical processes. Attention to this point would result in more concise and informative text.

4) Important technical points regarding the analysis and experimental set-up are not stated. For one example, the paper does not describe the ECHO-G simulations or the forcings used for these; are these from time slice simulations with only CO2 changes or transient simulations including irradiance changes as well? Or perhaps the CO2 changes were only made in CCLM (this seems unlikely). A table describing the experiments and forcing data sets would be useful and would make the text more concise.

In short, this paper presents some useful results but requires major revision before it is suitable for publication in Climate of the Past.

Other points:

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** The text on figures labeling contour levels, colors, latitude and longitude is generally too small to read, even when the web version is magnified. Inability to read the values portrayed in figures is a hindrance for reviewers.

* Fig. 2b upper left, comparing simulated and observed precipitation in Antofagasta (observed annual average of a few mm), has some problem.

* The introduction needs to be tightened up, points are raised that are not followed up on later in the paper and some of the text does not seem relevant (e.g. relating to the mid-Holocene). Finding from other altered GHG simulations could be briefly introduced here (what sort of changes do we expect?). A more concise summary of the general idea of LIA-modern climate change would be useful, and would set the stage for later discussion relating the model results and proxy-based inferences.

* The shortness of the 5-year ERA-40 driven simulation should be pointed out – how representative are annual cycles drawn from a sample of five?

* One might point out how large (or small) the 280-330 ppm changes in CO2 are in comparison to 20th century changes.

* The spatial resolution of the CRU, GPCC and NCEP-reanalysis data used for comparisons should be noted and related to the results.

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