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Climate of the Past Discussions

Interactive comment on "Discrepancies of surface temperature trends in the CMIP5 simulations and observations on the global and regional scales" *by* L. Zhao et al.

Anonymous Referee #2

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The paper attempts to compare observed trends with modelled ones in the recent CMIP5 coordinated ensemble of climate simulations. Unfortunately it uses a methodology that is totally unsuited to answer the question, does not even implement this methodology consistently and systematically fails to address the causes of variability of the trend. I recommend that this paper is rejected.

The main tool employed to estimate the trend is a 10-year running regression. This gives a smoothed approximation of the non-linear trend over the last 115-155 years. The comparison with observations is based on two metrics: whether the observed trend is within he envelop of the 16 selected CMIP5 models, and a correlation between observed and modelled trends. Neither of these makes physical sense: the envelop

depends crucially on the number of models and the number of ensemble members, but this dependence is never discussed, nor is the expected number of times that the observations would be outside of it by pure chance. Similarly, the correlation also depends on these numbers, and is insensitive to an overall scaling factor, which is not discussed either.

The methodology is not executed consistently. By averaging the ensemble members of models with multiple realisations the natural variability is suppressed relative to the models with only a single run. This gives an inconsistent ensemble, with differing variability among the ensemble members, making a comparison whether the discrepancies with the observations are more or less than expected impossible. Secondly, the limitations of the observational datasets are never considered. As an example, the southern hemisphere has less than 50% coverage in HadCRUT4 before 1948, making both the uninterpolated HadCRUT4 and interpolated GISTEMP estimates not very accurate. This can easily be seen from the difference between the curves. Without masking the models to the grid points with observations a comparison is meaningless. The same holds even stronger for Antarctica.

Finally, the fluctuations in the global mean temperature have clear and well-known interpretations. Some are externally forced, such as the responses to volcanic eruptions, which are here noted as curious discrepancies. It is well-known that either the observations strongly underestimate the global mean temperature response to the Krakatau (1883) and Santa Maria (1905) eruptions, or the models overestimate these, explaining the discrepancies noted in the text. Other deviations are due to internal natural variability. One cannot expect a freely running coupled climate model to reproduce these fluctuations, mainly due to ENSO and winter temperatures in Asia and North America, except in a general statistical sense. No attempt is made to make this distinction or quantify the differences between the observational; and modelled responses to external forcing (including the trends due to greenhouse gases) and the amplitude of the internal variability.

In contrast, the state of the art in the literature (which is not cited) employs well-defined metrics of the discrepancy and attempts to account for both model and observational errors, taking natural variability into account in a rigorous way. This has already been done for the CMIP3 ensemble. For discussions of the global mean temperature record in the CMIP5 ensemble see eg

Jones, Stott & Christidis, "Attribution of observed historical near surface temperature variations to anthropogenic and natural causes using CMIP5 simulations", JGR A, 2013

and for local temperature trends

Bhend & Whetton, "Consistency of simulated and observed regional changes in temperature, sea level pressure and precipitation", Climatic Change, 2013

Knutson, Zeng & Wittenberg, "Multi-Model Assessment of Regional Surface Temperature Trends: CMIP3 and CMIP5 Twentieth-century simulations", J. Climate, 2013

van Oldenborgh, Doblas-Reyes, Drijfhout & Hawkins, "Reliability of regional climate model trends", ERL, 2013.

These papers include citations of the relevant literature for CMIP3. Alternatively, just read the relevant chapter in the recently released IPCC 5th assessment report (chapter 9) and the citations in it.

Interactive comment on Clim. Past Discuss., 9, 6161, 2013.