Clim. Past Discuss., 8, C393–C398, 2012
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Climate of the Past Discussions

Interactive comment on "Constraining the temperature history of the past millennium using early instrumental observations" *by* P. Brohan et al.

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Received and published: 15 May 2012

While we are very interested in the application of the new data set, there are a number of issues with respect to the comparisons to the CMIP5 models and the conclusions drawn that require more attention.

1) Climate model drift: Coupled ocean-atmosphere models require many centuries to millennia of spin up before reaching a quasi-equilibrium, but because of the computational cost, model experiments are often performed after only perhaps 500 years of spin up. This can lead to drifts in transient experiments that are not related to the changing boundary conditions being imposed. Thus users of the data have to be care-

ful to exclude drifts from their diagnostics before drawing conclusions. In the case of at least one of the GISS-E2-R models shown in Fig. 1, this drift has not been excluded. This impacts the long-term trend in first few centuries of the hemispheric mean temperatures. We note as an aside that only one GISS-E2-R model is actually included in the figure, despite the legend, and that we think that it is mislabeled in any case. We include both model timeseries in the attached figures - both uncorrected, and corrected for the control run drift. Similar issues are almost certainly also evident with MIROC-ESM.

2) The CMIP5 experimental design for the Last Millennium. This was specifically set up so that model groups could sample from multiple estimates of the key forcings (including solar, volcanic, and land use) (Schmidt et al, 2011; 2012). In particular, two estimates of the volcanic forcing were suggested: Gao et al (2008) (GRA) and Crowley et al (2008) (CEA), which differ in the raw data that was processed, the procedure for estimating stratospheric sulphate injection, and the assumptions relating aerosol amounts to aerosol optical depths (and hence radiative forcing). The two time series differ both in magnitude and timing of eruptions (though timings around 1810-1820 are not very different). In the models shown in Fig 9a, the authors include simulations that use different forcings. Indeed, the difference between GISS-E2-R p124 and p125 is predominantly the different volcanic forcings (CEA and GRA respectively) (this is explained in the online Metafor documentation for these runs).

Any climate model response to a volcanic eruption can be expressed as a combination of the intrinsic response to a unit forcing, modulated by the magnitude of the forcing. Thus a conclusion such as is quoted here that 'models overestimate volcanic responses' is not justified on the basis of the comparisons shown. Indeed, the model responses to the much better observed Pinatubo eruption shows that models do a reasonable job at matching the observations (Hansen et al, 2007). Rather, the difference between p124 and p125 GISS-E2-R demonstrates that the different forcing histories have a material impact on the size of the response, and that it appears that

the model using the GRA reconstruction greatly over-estimates the response. The model using the CEA reconstruction is closer in magnitude to the observations. For reference, the forcings used in bcc-csm1-1 and ccsm4 are reportedly both from GRA (though the response in bcc-csm1-1 is surprisingly muted), while it is not obvious from the documentation what was used for mpi-esm-p and miroc-esm. It is even possible that fgoals-g1 does not have any volcanic forcing at all - this should be investigated before any conclusions can be drawn related to the skill, or lack thereof, of the models.

3) While CMIP5 is an open resource, the use of specific simulations and the conclusions that can be drawn are enhanced if specific citations are given to the specific experiments and simulations. This should be possible via a unique DOI for each simulation - see PCMDI website for updates on this status of these links.

Note: Allegra LeGrande and Rick Healy contributed to this comment.

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Interactive comment on Clim. Past Discuss., 8, 1653, 2012.

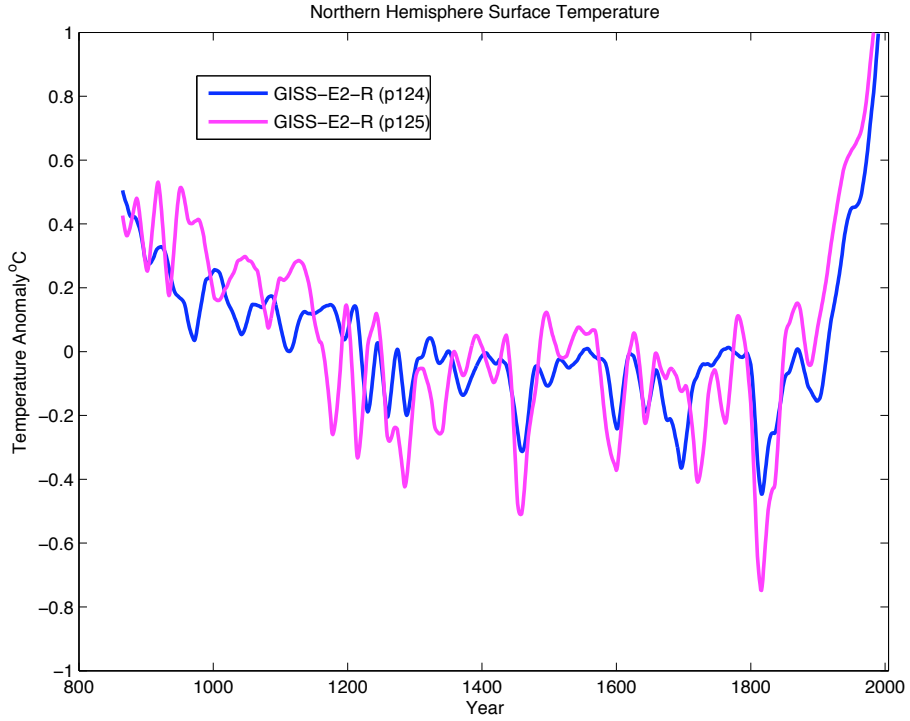

Fig. 1. NH surface air temperatures from GISS-E2-R (p124 and p125) (30yr smooth). Time-series uncorrected for control run drift. Note that the colours correspond to the correct labeling in Fig 9.

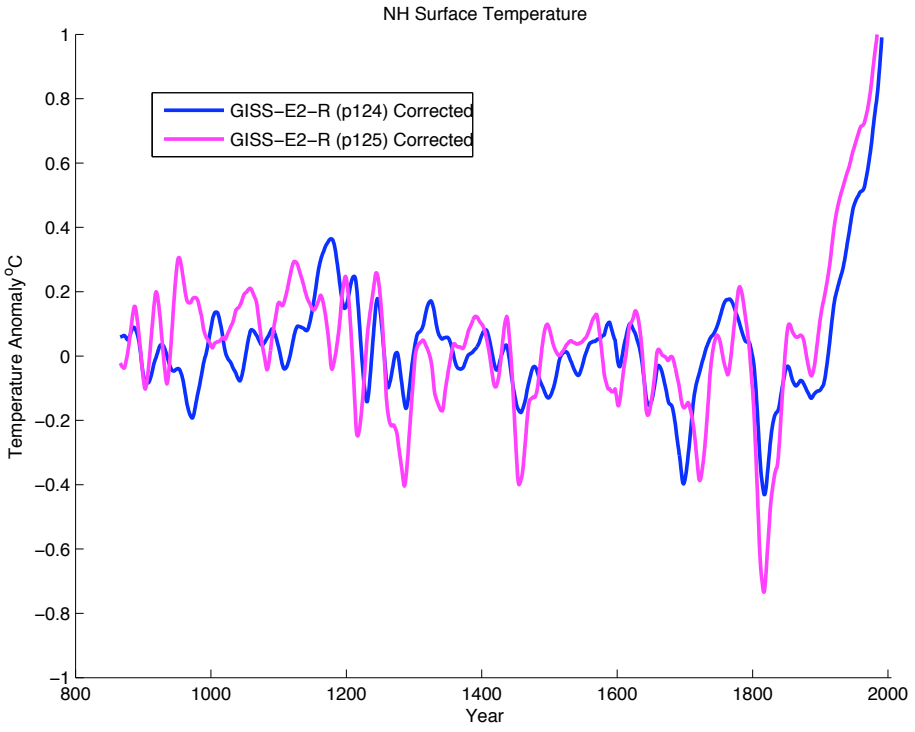

Fig. 2. NH surface air temperatures from GISS-E2-R (p124 and p125) (30yr smooth). Time-series corrected for drift (by removing running 30 year means of the relevant control simulation).