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Climate of the Past Discussions

Interactive comment on "Western Europe is warming much faster than expected" *by* G. J. van Oldenborgh et al.

G. J. van Oldenborgh et al.

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We thank the reviewer for the positive comments, which we have addressed as follows.

1. *Data: The analysis has been done on results of an ensemble of climate simulations from different GCMs, which cover a subset of the IPCC CMIP3 models, which have been selected according to a circulation index. It would be very interesting to expand the analyses to all IPCC models, so that well known biases in summer could not influence the results so strongly.*

   We have followed this suggestion and repeated the analysis with the full CMIP3 ensemble (minus the GISS EH model, as the results diverged wildly between the 3 runs of this model). The observed trends are again higher than any member in the full ensemble in large parts of Europe, coinciding pretty well with the regions where the ESSENCE ensemble cannot reproduce the trends. Only the first run of the MIROC medres model gives trends comparable to the observed ones in Europe. (This run shows a strong heating throughout the northern hemisphere, which gives more or less the observed signal in Europe but far too high values over the Pacific area.)

We have added a histogram for the full CMIP3 ensemble in Fig.1c, and added a set of four seasonal maps with the quantile of the observed trend in the PDF defined by the CMIP3 ensemble (weighing all models equally, i.e., downweighing multiple runs). The analysis was repeated for the UK Met Office perturbed physics ensemble that was alluded to in the original text. In this ensemble the obserevd trends are outside the ensemble in similar areas. The climate models are very consistent.

We chose to keep the original subset of CMIP3 models in the paper for KNMI-specific reasons: these are the models that the KNMI'06 scenarios are based on.

2. *Different gridded datasets have been used. Please clarify the abbreviations: only CRUTEM3 and HadSST2 are introduced with references, but you are also referring to HadCRUT3, which needs explanation.*

   This has been clarified further:

   The model results are compared with analysed observations in the CRUTEM3 (Brohan et al., 2006) and HadSST2 (Rayner et al., 2006) datasets. These have been merged with weighing factors proportional to the fraction of land and sea in the grid box. For the global mean temperature the HadCRUT3 dataset has been used, which is a variance-weighed combination of CRUTEM2 and HadSST2. However, this weighing procedure was found to give unrealistic trends in the gridded HadCRUT3 dataset over Europe in summer. The variance of the HadSST2 grid boxes that are mainly land is very small, so these dominate the combined

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Interactive Comment

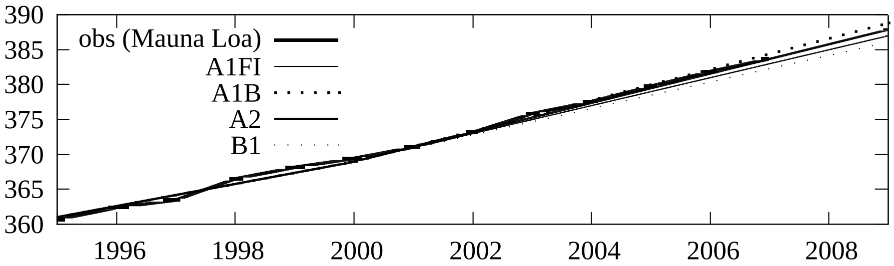

Fig. 1. CO2 concentrations in the Mauna Loa observation (up to 2007) and various SRES scenarios.

value, severely down-weighing the CRUTEM3 land observations. We therefore use the global mean temperature from HadCRUT3, but our own merged dataset for maps of Europe.

3. *Trend definition: The trends are calculated for 1950 to 2007. The GCMs only assume observed GHG/aerosols until 2000. From 2000 onwards the A1B emissions are used. Today we know that the actual emissions are larger than the A1B assumed once, so that the observed trends in the last years cannot be simulated correctly. Please discuss this issue and the influence on your conclusions.*

   In spite of the larger CO2 emissions, the CO2 concentrations observed at Mauna Loa still seem to be lower than assumed in the A1B scenario, see Fig. 1. A sentence to this effect has been added to the text.

   As discussed in the paper, the effects of aerosols do not seem to be modelled very well by the ECHAM5 model. It is not clear to us whether this is due to higher or lower emissions than observed, or the model response.

4. *Observed and modelled trends: In Fig 1a you are using station observations of*

De Bilt, which are representative for a specific surrounding. Please discuss the difficulty in comparing station data to grid box values for GCMs and the influence on your conclusions. A comparison of the De Bilt observations to the ones from the HadSST2/CRUTEM3 dataset for the grid box representing the Netherlands would be helpful. Please include the HadSST2/CRUTEM3 data in figure 1, too.

We have added the interpolated value from the CRUTEM3/HadSST2 dataset to Fig.1c. The whole analysis has been redone with a 'Central Netherlands Temperature', which is the average of 5 homogenised stations representative for a 100km-scale area in the Central Netherlands. This time series also shows a slightly lower trend than the De Bilt series, which had an upward excursion of a few tenths of a degree around the end of the 20th century. Unfortunately this series is not yet documented, making it difficult to use it in this article.

The conclusion that all climate models show a trend lower than the observed one holds regardless of the dataset used. One member of the MIROC medres model has a trend that is almost the same as the one in the CRUTEM3/HadSST2 interpolated time series.

We have added a short discussion of the difficulties in comparing station data to GCM output:

The De Bilt time series has been shown to be reasonably representative for the Netherlands, although there is an (as yet unexplained) warm bias with respect to the mean of other stations around the end of the twentieth century. A preliminary version of the Central Netherlands Temperature (Kattenberg, 2008) gives a slightly lower trend, $A = 2.23 \pm 0.36$. The $5° \times 5°$ CRUTEM3/HadSST2 dataset interpolated to the position of De Bilt is comparable, $A = 2.13 \pm 0.34$.

References

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Interactive comment on Clim. Past Discuss., 4, 897, 2008.