

Interactive comment on “Differences between the QBO in the first and in the second half of the ERA-40 reanalysis” by H. J. Punge and M. A. Giorgetta

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The authors thank referee #1 for his inspiring comments. Regarding the second paragraph of his comment, we agree that a more detailed documentation and explanation of the differences occurring during ERA-40 are desirable. We will therefore extend the article by an additional section for the final version to be submitted to ACP.

These further investigations are focussed on the timing of potential changes as asked for in paragraph #4 of the review. We computed running 7-year averages of both annual mean and QBO amplitude of the zonal wind. This way, the QBO is largely averaged over, but variations on the scale of a couple of years, or a possible shift, would still be detectable. The same analysis was performed for temperature, and 7-year based

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annual cycle amplitudes were computed. We can show that much of the difference found in the composites is due to more westerly winds above 10 hPa during the second half of the 1980s and much of the 1990s. In the zonal wind QBO amplitude, the most prominent feature is a secondary maximum arising at 3 hPa in 1985 descending and merging into the principal maximum until 1994. It is however difficult to relate these findings to concrete changes to the assimilation system, mostly because of the 7-year averaging.

One could argue that the change in 1985 (build from the period September 1981 - August 1988) relates to the switches among streams occurring in 1985 and 1986, which the reviewer proposed as potential sources of differences.

Generally, variability and trends are small at 10 hPa and below, so comparison to Naujokat rawinsondes as proposed by the reviewer in paragraph #3 does not help too much. There are however two more easterly phases in 1965 and 1988 that can also be found in Baldwin and Grays Figure 1 in both Naujokat and ERA-40 winds, which hints towards natural variability being the cause of the differences observed. As the reviewer already pointed out, rocketsonde data sets end in the early 1980s, and that is before the major changes described above happened. There are also gaps in the records that inhibit the use of the same methods used in ERA-40 for the observations.

Minor comments #1 and #2 will be corrected in the final version. Regarding Minor comment #3, we did find a decrease in the annual cycle amplitude from the first to the second half of ERA-40. This can be traced to intraseasonal changes. Most prominently, in the solsticial seasonal (7-year running) mean zonal winds between between 10 and 2 hPa switched from easterly (6 to 12 m/s) to westerly (similar amplitudes) around 1985 (boreal summer) and 1980 (boreal winter). These changes account for much of the changes observed in the annual mean.

A more detailed discussion of the new findings will be included in the final version of the article.

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