Reply to "Comments on 'Global Regional Comparison of Daily 2-m and 1000-hPa Maximum and Minimum Temperatures in Three Global Reanalyses'"

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Pitman and Perkins (2009, hereafter PP09) compared three global reanalyses, focusing on their daily simulation of maximum and minimum temperature. We argued that the differences in 2-m maximum and minimum air temperature between the three reanalyses were large in terms of the 2-m air temperature, but substantially smaller in the 1000-hPa air temperature. We concluded that "the probability distribution functions of the 2-m air temperatures from the three reanalyzes are sufficiently different that either the 2-m air temperatures should not be used or all three products should be used independently in any application and the differences highlighted."

Brands et al. (2012) undertook a repeat of our analyses, focusing on the comparison of two reanalyses: 40-yr European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis (ERA-40) and the Japanese 25-yr Reanalysis Project (JRA-25). They suggest the following:

(a) PP09 erred in mixing up the ERA-40 data, in effect using the 1000-hPa data instead of the 2-m air temperature data;
(b) differences in the simulated 2-m air temperatures between ERA-40 and JRA-25 are, in fact, similar or smaller than the simulated 1000-hPa temperature; and
(c) PP09's conclusion that the 1000-hPa products should be preferentially used is flawed and should be withdrawn.

We agree with Brands et al. (2012) that we erred in using the 1000-hPa data instead of the 2-m air temperature data. We apologize for this error, which appears to have been caused at the time of downloading the data. Thus, the careful checking of scripts, analyses, etc., did not identify the error because it was contained in how we located the primary data within a directory structure.

We have repeated our analysis, with newly obtained data, to explore whether we agree with Brands et al.'s conclusions as to the implication of our error.

In PP09, the difference between ERA-40 and JRA-25 was regionally in excess of 10°C and commonly in excess of 5°C. This should be corrected to regionally in excess of 4°C and commonly in excess of 2°C. The 1000-hPa temperatures are, as noted by Brands et al. (2012), similar or locally larger. In contrast, in the 99.7th percentile of maximum temperature, the differences between ERA-40 and JRA-25 are as large or larger in the 2-m temperatures than in the 1000-hPa temperatures. These can exceed 6°–8°C over continental surfaces in South America, Africa, and southern Eurasia. In the case of minimum temperature, the 2-m difference in the mean between ERA-40 and JRA-25 is typically 3°C, except over Antarctica where JRA-25 is in excess of 5°C warmer; and the 1000-hPa difference is generally within 2°C. Across all three reanalyses, differences in the minimum temperature 0.3rd percentile are much greater at 2 m than at 1000 hPa; differences over land at 2 m are generally at least 5°C with some regions in excess of 10°C (over the mid and high latitudes of the Northern Hemisphere and over Antarctica) whereas differences at 1000 hPa are mostly no more than 4°C.

We conclude therefore as follows:

Brands et al. (2012) provide a very welcome and important correction to PP09 and they are correct in identifying a noteworthy error in part of our analysis. They are correct in their conclusion that that the differences in the simulated mean maximum and mean minimum 2-m air temperatures between ERA-40 and JRA-25 are more similar than we showed and are commonly smaller than

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the simulated 1000-hPa temperature. However, we note here that this correction is only true of the mean maximum and mean minimum temperatures. For extremes (the 99.7th and 0.3rd percentiles), the 2-m temperatures differ dramatically between ERA-40 and JRA-25 and differ by considerably more than the 1000-hPa equivalents.

We therefore modify our conclusion. First, note that PP09 did not conclude that reanalyses should not be used. We concluded that if they are used they should be used independently, with results compared across the products. We stand by this conclusion and restate that using a single reanalysis of 2-m temperatures is not advisable. We agree with Brands et al. (2012) that if the 2-m air temperatures are used to drive systems that are not responsive to extremes, then the three reanalyses are much more similar than implied by PP09. However, for many applications the temperatures experienced at the tails of the distribution are important and under these circumstances our original conclusions hold that the 1000-hPa temperatures compare much more closely between the three reanalyses that the 2-m air temperatures.

In summary, PP09 concluded that "the probability distribution functions of the 2-m air temperatures from the three reanalyzes are sufficiently different that either the 2-m air temperatures should not be used or all three products should be used independently in any application and the differences highlighted." We continue to believe this is good practice: using several reanalyses where possible, or bias correcting the 2-m temperatures as suggested by Weedon et al. (2011).

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