Hydrol. Earth Syst. Sci. Discuss., 10, C7907–C7909, 2014
www.hydrol-earth-syst-sci-discuss.net/10/C7907/2014/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "A global water cycle reanalysis (2003–2012) reconciling satellite gravimetry and altimetry observations with a hydrological model ensemble" *by* A. I. J. M. van Dijk et al.

Anonymous Referee #2

Received and published: 16 February 2014

An interesting study is presented that provides the first (as far as I know) global scale reanalysis of the water cycle. The authors have put effort in using as much data sources as they could. The authors are not reluctant to use a data source for which error structures are not fully statistically derived. Instead they rely on 'expert judgment' of the time series and use their own hydrological common sense to get a feeling for the uncertainty of a number of time series. This makes the amount of data sources used larger, and therefore the reanalysis more robust. The treatment of the data sources prior to assimilation looks good. The authors try to make modeled data equivalent to

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

GRACE observations by using similar treatments (e.g. Gaussian smoother).

Below I provide my main comments, most related to estimation of errors:

1. A lot of assumptions about data errors (systematic, random, as well as error structure in space and time) are made. As mentioned, I think this is good, since they would remain unused if the authors would not have considered them, but how do these assumptions on errors impact your results? In fact the conclusions drawn from this paper are difficult to judge, as they could easily change significantly if other assumptions on errors would have been made. To name a few: all models are forced by the same forcing (combination of Princeton forcing and TRMM). This makes the outputs more correlated and therefore could result in underestimation of errors. Second, GRACE models are also dependent on the same data. Are the errors of GRACE data also underestimated because of this?

   Hence, the sensitivity of the results to the chosen error sizes as well as the chosen error structure (non-correlated in space and time, which is doubtful to my mind) should at least be properly discussed. E.g. is the conclusion that 0.39 mm yr-1 of ocean mass increase is missing from the water balance not an effect of uncertainty in the errors and therefore in the assimilation gains? Or even an effect of the length of the time series (only 10 years)?

2. In more detail, triple collocation requires that errors do not vary over time and errors are not correlated in time (p. 15487, l. 14-17). For GRACE errors, this could be true, but for the hydrological models this could be very wrong, especially in areas where storage change is strongly dependent on rainy seasons. In these seasons, the hydrological models will produce much larger errors in the rainy season than outside. Again, if not considered the effect of this assumption is an important point for discussion.

3. There's no mentioning of spatial correlation in errors. Is this considered by the

HESSD

10, C7907–C7909, 2014

triple collocation technique? If not, again implications on results need to be discussed.

4. Section 2.5, p. 15489, l. 19-22. A linear relationship between river levels and discharge is assumed. It is not clear to me why this was necessary. In somewhat broader rivers you may expect that the relationship (i.e. a rating curve) reads as $Q = a(h - h_0)^b$. And therefore, $\log Q = \log a + b \log(h - h_0)$. So a linear relationship between $\log Q$ and water levels may be assumed and h_0 tuned to make the relationship linear. Why was this reasoning not used?

5. In section 3, many observations in the results are made that remain unexplained. Please consider hypothesizing what the observations may imply.

I have made detailed annotations in the manuscript. Please refer to my annotated manuscript for the remainder of my comments.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C7907/2014/hessd-10-C7907-2014-supplement.pdf

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 15475, 2013.