

## ***Interactive comment on “Past terrestrial water storage (1980–2008) in the Amazon Basin reconstructed from GRACE and in situ river gauging data” by M. Becker et al.***

**M. Becker et al.**

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Dear Referee#1: We are very grateful with your review of our paper. It gives us very useful suggestions. We will try to take advantage of your advice to improve the manuscript. For an easier comprehension of our answers, your comments are reported below and our respond is given just after.

Referee#1: 1. The main hypothesis is that the gauge data are a good proxy for the GRACE total water content. The main justification given to sustain this hypothesis is that it has been demonstrated by previous studies that TWS are correlated with river

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water level fluctuations and the correlation between gauges and GRACE data. BTW, I hope that this correlation is done after the annual cycle has been removed. If it is not, it does not mean anything, as the annual cycle has only 1 degrees of freedom (the phase). So, if it is done with the annual cycle in, I think you should redo the table with the annual cycle out. The problem is the correlation between the gauge data and the value of GRACE away from the gauge data. I think that it should be checked by estimating the correlation between the EOF time series obtained from the GRACE data and from the gauge data only, or the variance explained by the reconstructed gauge data from GRACE.

It might be not clear in the paper, but we did not compute the scaling factor on the annual cycle : in effect, as we focus here on interannual time scale, we have removed the seasonal cycle from in-situ river level and GRACE data before computing this scaling factor. The seasonal cycle was removed by fitting 2 sinusoids with the periods of 12 and 6 months using a least squares procedure. Concerning the correlation between the gauge data and GRACE water storage, we indeed checked, as you proposed, that the time series of the GRACE EOFs are consistent with the time series of the gauge EOFs over the GRACE period. Actually, we did not add the figures because we thought that we had already too many figures. But we propose to add a comment on this matter in the revised manuscript.

Referee#1: 2. The second major hypothesis is the stationarity in time of the EOF modes. The test done by the authors is useful (though the last "holds" sounds a little bit optimistic to me). Still, I think it would also be interesting to show some of the major relevant variables in the area, to see if the climate regime has not changed (I mean the precipitation rate, the temperature, the precipitable water in the atmosphere, for instance). If those fields are not stationary, I am not sure that the EOF modes should be.

Thanks for the referee's suggestions. We have tested the stationarity in time of the EOF modes of the GPCC precipitation data and we confirm stationarity of the precipitation

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fields. This result was obtained by computing the precipitation EOFs for 3 periods : 1980-2008, 1990-2008 and 2003-2008. Of course, we will add these new figures in the revised manuscript.

Referee#1: 3. I do not think your method holds for an annual timescale, as correlation there does not mean that they see a common cause. I would be interested by a comment on that point in the paper.

Thanks for this comment which we agree with. We will add a discussion on that point.

Referee#1: 4. Is there a reason for which river altimetry data have not been used? I mean something like hydroweb...

Yes! We did not use altimetry data in this work because the time series start only in 1993. Thanks to the in situ data we could rebuild the TWS in the past until 1980 (which represents 13 yr more than a potential altimetry based reconstruction).

Referee#1: 5. I am not sure that fitting a sinusoid on the data is the best way to remove the annual cycle, as the system is most probably behaving like a capacitor. I think a composite annual cycle would be more appropriate.

Thanks for the referee's advice. Detection and estimation of pure frequencies from irregularly sampled time series is a frequent problem. We agree with the reviewer. To improve our reconstruction, we need to perform a correlation sensitivity analysis based on different methods of seasonal adjustment.

We will do our best to address your comments and concerns above in the revised manuscript. Thank you again for your comments.

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