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Interactive comment on "Quantification of Drainable Water Storage Volumes in Catchments *and* in River Networks on Global Scales using the GRACE and/or River Runoff" *by* Johannes Riegger

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This is interesting work showing how GRACE and discharge data can be used to estimate drainable storage in river basins and river networks. Although the ideas are interesting and the data-analysis well developed, there are some major reservations I have with the approach and the paper.

1. I fail to see why knowing the drainable storage of catchments and river networks itself is so interesting. In applications of hydrology one is generally interested in discharge anomalies (high flow, low flow), evaporation anomalies (agricultural drought) and flooded areas. So, I feel that the necessity of this work should be re-stated. In fact,

the main, and very interesting, contribution is that GRACE data alone (together with recharge [precipitation surplus would be a better term] estimates from e.g. moisture convergence) can be used to estimated river discharge in ungauged basins.

2. Similarly, in stressing better the necessity of the approach, it should be made clear why large-scale hydrological models could not be used to do the job. Note that some of these models (such as WaterGap and PCR-GLOBWB) have groundwater parameterizations and are able to reproduce the amplitude and lags observed in GRACE (see e.g. Wada et al., 2012; Water Resour. Res., 48, W00L06). If the amplitude and phase shift between recharge and runoff are informative about storage and hence discharge, GRACE anomalies could be used to calibrate these models as well, with the added advantage that a) we do not need to assume linearity between storage and discharge; b) these models deal with temporarily unconnected storages as well.

3. Modelling the effect of the drainage networks as a linear storage-outflow relationship may be valid for the Amazon where during peaks the whole basin turns into a huge flooded area resembling a lake. But in many rivers of the world, e.g. the Danube, the Rhine, the Nile, water during high stages is confined in the channel or in narrow valleys and the lag between catchment discharge and discharge at the basin's outlet is more of a travel-time phenomenon then a storage attenuation phenomenon. In this case, a routing routine such as used in many global hydrological models would be more suitable, with the unknown parameters the channel and floodplain resistance parameters (e.g. Manning coefficient).

4. More generally: the approach seems to be valid in large humid basins, without cold-region processes, where all active stores are permanently connected to the discharge mechanism, while routing is such that the drainage network can be represented by a storage-outflow relationship. This makes the applicability of the approach somewhat limited.

5. The writing should definitely be improved. For instance, the abstract reads like an

extended summary with an introduction and is too long and too specific. Also, the use of the English language should be checked by a native speaker. Suggestions for improvements and some other small remarks are given in the annotated manuscript attached.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-38/hess-2018-38-RC1-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-38, 2018.