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Interactive comment on "Improving estimates of water resources in a semi-arid region by assimilating GRACE data into the PCR-GLOBWB hydrological model" *by* N. Tangdamrongsub et al.

Anonymous Referee #2

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Tangdamrongsub et al. show the improvement of a regional hydrologic model using GRACE DA. Using GRACE data the authors can show the decline of water storages. The study further shows the importance of including error correlations in the DA scheme. The authors successfully show the added value of a GRACE DA including error correlations and therefore provide a valuable tool for regional groundwater estimation and data scarce region. However, I do have some open issues regarding GRACE processing models, the available groundwater data and geology, as well as the error estimation. Overall, I congratulate the authors for a well written and structured paper and suggest the paper for publication after addressing the below mentioned comments.

Different GRACE gravity field models are available, CSR (this study, p6, l227ff), GFZ,

JPL, CNES/GRGS (Sakumura et al 2014). Why was CSR selected and how are the differences between the different GRACE processing models for the study region. I understand that the focus of the article is on the added valued of the DA, however it would be interesting to see whether GRACE is actually providing added value based on the variability in GRACE processing models.

Groundwater head data can be quite complex depending on the well depth and the aquifer being pumped. So far the authors only use head data without information about the aquifer systems. Different aquifer systems also result in individual specific yields. This needs to be addressed. based on a quick literature search hydrogeologic studies (e.g. Ma et al. 2005) are available for the region. Please, do provide information on whether the wells access the same aquifer. Further, groundwater heads were converted to units of storage using a scale factor (p.8, l301ff) as specific yield data were not available. Ma et al. 2005 (and probably more papers as well) provide aquifer properties for the Shiyang basin. Given that the wells are in the same aquifer system, please, show how your units of storage compare to literature values for the region.

Regarding the precipitation errors the RMS of TRMM was used (p12, l440). As the authors also compared TRMM to station data, was that error included as well?

Minor comments: - The abstract is a bit too extensive, please, shorten. - p2, l57-59. Provide reference - Fig. 1. Include all symbols in the figure caption (crosses). Since color is used, the river networks could also be added (1b). - p6, l208/209. Please, explain 'the sum of different states'. What are e.g. '4 interception' states? - p9, l331ff. What exactly was done with the NDVI values? Was the growing season length determined as the period above and below 0.2? If it was only used for visualization in Fig. 14, the section can be shortened to a couple of lines. - Fig. 14a. Is the GW head relative to amsl? What is the depth to the surface?

Sakumura, C., S. Bettadpur, and S.Bruinsma (2014), Ensemble prediction and intercomparison analysis of GRACE time-variable gravity ïňĄeld models, Geophys. Res.

Lett., 41, 1389–1397,doi:10.1002/2013GL058632.

Ma J.Z., Wang X.S., and W.M. Edmunds (2005), The characteristics of groundwater resources and their changes under the impacts of human activity in the arid Northwest China âĂŤ a case study of the Shiyang River Basin, Journal of Arid Environments, Volume 61, Issue 2, Pages 277-295, ISSN 0140-1963, http://dx.doi.org/10.1016/j.jaridenv.2004.07.014.