

## Comments and suggestions to the author(s)

The paper provides a new rainfall-runoff model for the assessment of water depletion in Northern Iraq, for which GRACE and auxiliary data were combined. The applied method sounds interesting, but it is not clearly described in some points. In our opinion, in the presented way, it is not completely sufficient for determining mass variations (water mass depletions) of different catchments in Northern Iraq. In addition, some of the numerical results and figures are questionable and should be re-considered. There seem to be some inconsistencies in the paper. For all these reasons, the paper requires **major revision**.

In the following, our comments to the authors are given in detail.

### General comments

- 1) The method should generally be explained in more detail, especially the assumptions/constraints, etc. The way of GRACE processing using the mascon approach is only vaguely given. Moreover, GRACE is used for calibration and data reduction. Does this not imply internal correlations?
- 2) The limitations and error contributions of the various model reductions and assumptions should be given explicitly. Only then the usefulness and quality of the proposed “rainfall-runoff” model can be evaluated.  
Did the authors compare their results with independent GRACE-based estimates of mass changes in that region (see, e.g., Sneeuw et al. 2014 for lake Urmia).
- 3) Throughout the paper starting with the abstract, the authors use different (partly incomplete) units for representing mass variations. For example, mass loss is represented sometimes in mm and sometimes in km<sup>3</sup>, for the first probably mm in EWH is meant, where the second is a volume change. It should be used consistently.
- 4) On page 11539 (lines 8-9), the reason for selecting the weight 1/2 for the lake mass of Urmia and 1/3 for lake Razazzah is not obvious. Do these coefficients come from some empirical model?
- 5) Are the estimated lake mass variations reliable and accurate?
- 6) For the snowfall and snowmelt calculations, the authors used the GLDAS model. How reliable is that model for such calculations?
- 7) For groundwater level estimation, how many stations are used and how reliable are the data?

### Details

- 8) All abbreviations (e.g. GRACE) should be explained at the first time of appearance. For example, GRACE is explained more often, see page 11535, line 28. But other abbreviations were never defined, e.g., WGHM, GGP and SD, etc.
- 9) All data used, incl. background models should be summarized in a table.
- 10) On page 11537 (line 12), there is one more “and” that should be removed.
- 11) The word “River” is sometimes written in capital and sometimes in small letters.
- 12) In the section 3.1, the title “GRACE mass calculations” should be changed to “GRACE mass variation calculation” or to something similar.  
In addition, it should be said which GSM model from which analysis center has been used in the GRACE calculations.

- 13) On page 11543 in the formula section, punctuation should be used at the end of the formulas.

### **Figures**

- 14) In Fig. 1, the legend for the colours should be included to specify the range of rainfall and topography variations.
- 15) For Fig. 6, it should be explained how to read and how to understand what is shown there. What can be learnt from such a representation?
- 16) The x-axis of Fig. 8 is not labelled and has to be corrected for the starting year (year 2004 is used two times).
- 17) The words “Left” and “Right” in the caption of Fig. 9 are differently used as in Fig. 5.
- 18) The residuals in terms of EWH that are represented in Fig. 10 are rather big. Any explanation for this? Did the authors consider soil moisture at all levels down to the depth of 2 m?

### **Literature**

N Sneeuw, MJ Tourian, O Elmi, S Roohi, Q Chen, B Devaraju: A spaceborne multi-sensor approach to monitor the desiccation of Lake Urmia in Iran. Presentation at German Geodetic Week 2014, Berlin, October 2014.