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Interactive Comment

Interactive comment on "Global-scale modeling of groundwater recharge" *by* P. Döll and K. Fiedler

Anonymous Referee #2

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General comments:

The paper is significant and of broad international interest. It is well written and clear in structure. The long-term average groundwater recharge equals usually the renewable groundwater resources; therefore its quantification is very important for the assessment and management of available water resources at a global scale. The authors show the large spatial variability of long-term average groundwater recharge and stress its importance for semi-arid and arid areas where groundwater recharge accounts for a lower fraction of total runoff. The novelty of the paper is restricted to an update of a former version taking into account more streamflow gauges for calibration, using two different precipitation data sets as input and applying a modified approach to calculate groundwater recharge in arid and semi-arid regions. Most important in the assessment of groundwater recharge is the method for partitioning of percolation into interflow and base flow. This is done in the WGHM model using a heuristic approach assuming factors to be multiplied with the total runoff based on the physiographic characteristics of the cell. It becomes not clear if those factors are just guessed or if they were included in the calibration of the model. Also the linearity (except for arid and semi-arid cells) and the time independence of this partitioning are critical assumptions. In addition there is some incorrectness in the mathematics, which needs to be clarified (see below). On the whole I would recommend accepting the manuscript for publication in HESS subject to some revision. Detailed comments are given below.

Detailed Comments:

1. p.4078: It becomes not clear how the factors for calculating fg are estimated; just guessed, calibrated etc.? Also the linearity of the approach is not very reasonable. One idea for improvement of a later version would be to use thresholds similar as applied for the semi-arid areas which need to be exceeded to produce groundwater recharge. This would also reduce the occurrence of abrupt changes at the boundaries between the different climates.

2. p.4080, l.18/19: Where comes the rule "Precipitation $<=$ Potential Evapotranspiration"; for the definition of semi-arid/ arid region from?

3. p.4082, l.10: The unique distribution of precipitation for all wet days is a very simple approach and might suffice with this linear approach. However, if the groundwater recharge algorithm is modified in the future to a non-linear approach e.g. using thresholds a non-unique distribution of daily precipitation should be applied to avoid biased estimation.

4. Fig.4: This figure seems to show the ratio of CRU to GPCC mean annual precipitation. The description in the figure caption is not clear here.

5. Equations 2 and 3: Those equations seem unrealistic. Assuming the following values: P0=100mm, T=10°C, Tmean=13°C, CR=0.90 using Eq. (2) and (3) would lead

to a correction of Pc=265mm which seems much too high?

6. Fig.5b: It becomes not clear which difference is shown here between CRU data and mean values or between GPCC data and mean values? I would guess it is the maximum of both differences. This should be made clear in the figure caption.

7. p.4088, l.23-25; p4089, l.17-18: How is model efficiency defined? I would assume the Nash-Sutcliffe efficiency criterion is meant here? If yes, please call it that way or provide an equation or a reference. The Nash-Sutcliffe efficiency measure is independent of scaling of the target variables. So, the result should be identical no matter if mm/yr or if km3/yr are used as flow units.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 4069, 2007.