

Interactive comment on “Global-scale analysis of river flow alterations due to water withdrawals and reservoirs” by P. Döll et al.

Anonymous Referee #3

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General comments

The authors assessed the anthropogenic alteration of river flow regimes by water withdrawals and reservoir operation. The assessment was based on simulation results of the latest version of the WaterGAP model. The authors derived some implications of the impact of anthropogenic alteration on aquatic ecosystem. The assessment contains considerable uncertainties and some of the conclusions and implications need more careful examination. Nonetheless this report is worth publishing, because this is one of the earliest attempts to quantify the anthropogenic impact on global hydrological cycle. To enhance the strength of this report, it would be nice if the authors examine the following points.

C2078

Specific comments

P4781 L17 “subtracting total consumptive water use from water stored in lakes. . .” How did you set the volumetric capacity of lakes? The whole water body of lakes can be used as water resources? Are lakes depleted when overexploited?

P4781 L23 “Global consumptive water use has more than doubled between 1951 and 2002...” You described that you used domestic, industrial and livestock water use of the year 2002 and 1961-1990 climatic data to estimate irrigation water use. How did you estimate water use between 1951 and 2002?

P4782 L9 “If on any day there is not enough water available in surface waters to satisfy the consumptive use, the model will take out this consumptive water use later in the year or in the next year. This approximates withdrawals from renewable groundwater resources. . .” First, this assumption seems to carry over not only groundwater but also river discharge. Why it approximates renewable groundwater? Second, this is a big assumption because water deficit in dry period is canceled out by surface water in wet period even if there is no reservoir. In other words, this assumption acts as virtual reservoir, dumping temporal variation of surface water and water demand. If you agree this, you need to mention this in text. Here a question came to my mind: What happens if you disabled this carry over assumption?

P4783 L1 “The new reservoirs and regulated lakes data set was derived by adding additional reservoirs from a preliminary version of the GRanD database. . .” GRanD database needs to be further explained. You mentioned that GRanD database provides 6568 reservoirs and 52 regulated lakes, but the number of reservoirs is far below the total number of dams and reservoirs in the world (45000-60000). Which types of reservoirs does GRanD database cover? Are there any geographical biases?

P4783 L22 “The reservoir operation algorithm of Hanasaki et al. (2006) was implemented in WGHM for the 1074 global reservoirs and regulated lakes” How did you select 1074 out of 6568+52 reservoirs and lakes?

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P4783 L26 "Different from Hanasaki et al. (2006) ..." Until I read Hanasaki et al. (2006) very carefully, I couldn't understand what is different at all. You need to add a brief description of the algorithm of Hanasaki et al. (2006) and list up what points are different from their original algorithm.

P4785 L25 "Richter et al. (1997) require daily discharges, ... Therefore, we only considered indicators that are based on monthly and annual river discharge estimates" What is the spatiotemporal scale of the original works of Richter et al. (1997) and Black et al. (2005)? Because the discussion of aquatic ecosystem is scale dependent, you need to explain the logic here more carefully.

P4794 L23 "while irrigation has lead to a decrease of only 1.5% as compared to only rainfed agriculture" I'm wondering this is attributable to the carry over assumption of water deficit. The model of Rost et al. (2008) didn't adopt this assumption, while your model did. Usually the amount of water withdrawal from streamflow adopting the former modeling falls below that of the latter.

Technical corrections

P4812 Figure 9. Some of the legends of lines are missing in the figure of the Missouri and Colorado River.

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