

## ***Interactive comment on “Reconstruction of global gridded monthly sectoral water withdrawals for 1971–2010 and analysis of their spatiotemporal patterns” by Zhongwei Huang et al.***

### **Anonymous Referee #2**

Received and published: 10 January 2018

#### GENERAL COMMENTS

This manuscript reconstructs gridded monthly water withdrawals globally for 6 sectors for 1971–2010 in a spatial resolution of 0.5°×0.5 degrees. The authors make this water withdrawal dataset publicly available, which makes the manuscript more valuable and is in the line of the open-access philosophy of HESS.

Such a detailed global dataset is indeed to my knowledge the first in its kind and very useful. The statement at the end of the document (page 14 lines 3–5) "In whole, despite the uncertainties and limitations, this study is of great significance not only for cross-comparison and validation for modeling and analyzing the impacts of human water use,

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but also for investigating water use related issues at finer spatial, temporal and sectoral scales" is very true.

I also appreciate that the authors include an extensive part in their manuscript on uncertainty (Section 4), as they acknowledge the uncertainty and limitations of their study.

The manuscript is novel, well written and in the scope of HESS. I recommend for moderate revision, as some issues need to be additionally addressed/discussed first.

#### MODERATE COMMENTS

1) The authors use as basis FAO AQUASTAT data and state-scale estimates of USGS for the US as basis for downscaling. Yet, on page 3 Lines 1–15 they argue that particular countries provide more detailed (especially spatially) data than the FAOSTAT data. This is indeed true for Germany as the authors point out, but also for many other European countries. These data (and additionally from Canada, China, ...) could have been used to optimise the downscaling methodology the authors use. Why was this choice made for the US but not for these other sources? I find this a bit a missed opportunity. I acknowledge that this means a lot more work, but you could have used all best data available instead of the US selection. Nevertheless, this does not have to be done within this paper, but maybe in future work. Please discuss shortly in the limitations section (section 4) of your manuscript.

2) SPATIAL DOWNSCALING TECHNIQUES: For some sectors (domestic, irrigation, livestock) the downscaling techniques are state of the art, for other sectors (electricity for cooling, mining and manufacturing) they are very rough. The three latter are based upon population-density maps. This is a very rough approach, as these sectors are in my opinion not always highly correlated with population densities. Water abstractions for cooling can very well be concentrated outside urban centres, for security reasons (e.g. nuclear power plants) and the availability of large water quantities (e.g. along rivers). Nuclear water abstraction which can be substantial can thus be concentrated as point intake in a more rural area. Manufacturing industries have in developed countries

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often moved outside urban centres (where in the past they were often in city centres). Last but not least, mining activities often take place in remote areas, and large water abstractions can be very concentrated on a small rural spatial scale. When you produce a 0.5\*0.5 degree geodataset, these considerations can be very relevant. I acknowledge that the authors briefly describe limitations on page 12 lines 24-27. They also say this is a topic for further research. But please elaborate more on this, in the line with the argumentation I just made.

3) MISSING SECTOR TOURISM: The authors include 6 sectors, the ones which are typically identified for abstracting water. However, as in most studies, some particular water abstraction sectors are excluded. As indicated in the publication <https://doi.org/10.1016/j.ecoser.2015.08.003> , an important generally neglected sector is tourism. This includes water abstractions for snowmaking, which during winter months in mountain areas can be the largest regional water user (<https://doi.org/10.2166/wst.2009.211> ). This water is generally taken from surface water, and is not accounted for in municipal water abstraction statistics. But this also includes water abstractions for hotels/swimming pools/spas both in winter and summer tourist areas (e.g. <https://doi.org/10.1016/j.tourman.2013.05.010> ). These water users often have own private water abstractions, which are not accounted for in domestic/municipal water use statistics. E.g. in Mediterranean regions during summer months these water abstractions can become shortly the dominant water use. Another touristic water user are golf courts (e.g. <https://doi.org/10.1094/ATS-2009-0129-01-RS>). These touristic water abstractions can on a local (0.5\*0.5 degree) and temporal (monthly) level be very significant. Please include in your discussion section a short subsection on this topic, based upon my input. Future research should include the sector tourism.

4) SECTORS FORESTRY and AQUACULTURE: As indicated in the publication <https://doi.org/10.1016/j.ecoser.2015.08.003> , these sectors also account for water abstractions. Again, on a global level they may not be very significant in quantity, but on

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a local (0.5\*0.5 degree) and temporal (monthly) level, they can be very significant. Is forestry accounted for in your irrigation sector? Aquaculture can be very significant in a country like China. Please include in your discussion section a short subsection on this topic.

5) DOMESTIC WATER ABSTRACTION: Please define in your paper what you mean with this. There is often confusion in the terminologies domestic and municipal water abstractions. There is a difference in water abstractions by households (generally defined as domestic water abstractions) and municipal water use, which additionally includes water use by shops, schools, public buildings ... and even for the cleaning of streets or public parks. As I understand your definition of "domestic sector" also includes these water users. Include a definition.

#### MINOR COMMENTS

Page 2 line 19: You discussed the impact on the hydrological cycle and humans. Please add a sentence about the negative impact on the environment

page 2 Line 22 'We focus in this study on water withdrawal' - This is a choice, as also water consumption is an important statistic of water use. Water stress e.g. can be computed with both, as discussed in a recent publication <https://doi.org/10.1016/j.scitotenv.2017.09.056>

Page 3 line 7: Please add that also other selected European countries provide more detailed water use statistics (especially spatial data)

Page 3 Lines 18, 19: GHM and LSM - define abbreviation first

Page 4 Line 14 ... (GCAM): please add ref

Page 6 Line 14: ... 30 urban centers ... : Urban water use characteristics can actually be quite different from rural water characteristics. By only down scaling based upon urban water use characteristics, the resulting dataset could be biased in temporal representation for more rural areas

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Page 8 Lines 17-21: Water abstraction for livestock: there are actually formulas that relate livestock water use to temperature.

Table 1: Please add a column with the spatial resolution of these datasets

Figure 3: (c) Electricity and not elecricity.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2017-551>, 2017.