

Interactive comment on “When is water withdrawal data enough?” by Benjamin L. Ruddell

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Reply to comment by M. Heistermann

My main takeaway from both reviewers' comments is that I failed as an author to communicate the topic and expectations properly for this opinion, and I may have misled the reader as a result. The failure began right at the title, “When is water withdrawal enough?”, which was simple, short, and rhetorically evocative. I meant it rhetorically, but it was taken topically and literally, and this left the reader with the initial impression that this was an analysis of where exactly hydrologists and water resource engineers can use water withdrawal data. That was not my main point. This article is written primarily to the *non* hydrologist or water resource engineer who is working on systems involving water use at census and macro scales. Accordingly, I propose this revised title, which is much longer and literal, but hopefully more adequately precise for this

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audience:

“How should a future water census address consumptive use? (and where can we substitute withdrawal data while we're waiting?)

The opinion makes two main points, which I repeat here for emphasis:

1. The way we're measuring consumptive use in the water census context is poorly understood and therefore prone to abuse, and needs to be improved in the future using a more detailed water census data model.
2. Since we don't have that data today, we should sometimes be using census water withdrawal data in place of consumption data in several specific instances where this is a valid substitution. . . and this choice should be accepted by hydrologists as long as it is properly qualified. This is because the withdrawal data is of higher quality and is less misleading, as compared with presently available consumption data at census scales.

M. Heistermann's comment is helpful in several ways, but most importantly by highlighting that this is an issue that professional hydrologists and water resource engineers will see in a different light than some other scientists- that is, it is a judgment that requires detailed context and professionalism. If one's business is to precisely estimate and employ water balances for a critical task, one will naturally have both the need for, and the means to obtain, the correct data for the engineering or modeling task at hand. These professionals will normally be working at fine scales on projects that require a great deal of precision- and will not be relying on coarse scale water census data. I have attempted to rewrite the opinion to emphasize the census scale, and also to clarify the types of researchers and research questions that might be well served by use of mesoscale withdrawal data- for instance, economists or macroeconomic planners evaluating long term water supply infrastructure capacity needs for a State or river basin. “For what purpose?” This opinion focuses on census scale applications, and this

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should now be clearer in the revision. Thank you for helping me reach the intended audience, provide context, and qualify claims that were objectionable to the professional hydrologist.

At the same time, I really do intend to opine about the appropriateness of simple net consumptive use (SNCU), so I will re-emphasize the point here. The SNCU assumptions fail to capture the most common cases of human water use in the economy, and we need a more detailed data model. I have tried to clarify the requirements of this more detailed data model in my revised opinion, as well as spending more ink on the identification of the SNCU assumptions and why they matter.

I will disagree on one minor point, which is the usage of Coupled Natural Human Systems (CNH). It may be true that the term has outgrown the original use intended by Liu et al. 2007 and contemporaries, but it is one that I like very much. This wording, as I have used it, forces hydrologists and other natural scientists to place the human element within the framework, and even to view the hydrological system as a peripheral boundary condition or approximate constraint on the “primary” subsystem of interest, which is more often than not the human subsystem. Non-hydrologist CNH researchers are among the most likely to benefit from my opinion expressed here. CNH problems are among the main applications of census scale water data.

I have tried to rely on logic and explanation more than detailed referencing, and have attempted to minimize the external references required for this opinion. It is not a review article or scientific analysis, so it is important to economize. But more importantly, it is important that the opinion is self-explanatory as much as possible.

One way that this opinion could be expanded and improved is to flesh out the European, East Asian, and other global contexts by comparing data availability and quality in these regions and nations. This is however outside the scope of my current opinion. I expect that the general conclusions of this opinion are valid worldwide, although there are a few cities and nations where current water data availability and quality rivals or exceeds

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that of the United States.

I am thankful the M. Heistermann put in so much thought to the comment, and I recommend it to any reader of the opinion. The caveats and exceptions raised are greatly clarifying, and entirely correct, and will therefore allow the reader to reach their own informed judgments on the topic.

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