Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2017-280-RC2, 2017

Hydrology and Earth System Sciences
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Discussions

Interactive comment on "A global hydrological simulation to specify the sources of water used by humans" *by* Naota Hanasaki et al.

Anonymous Referee #2

Received and published: 12 July 2017

GENERAL COMMENTS This manuscript presents an updated version of the H08 GHM that focuses on refining how human water abstractions are modeled at the global scale. Six water sources used for abstraction are focused on here: river flows regulated by large and smaller reservoirs, aqueduct transfers, desalination, renewable and nonrenewable groundwater. Model improvements are largely based on methodologies developed in other studies and results of simulated water fluxes for abstraction are validated against those reported in other peer-reviewed publications. The updated H08 GHM is then used to 1) estimate flows and stocks of natural hydrologic sources and 2) simulate the impact of human water use on natural hydrology both globally and within a subset of major watersheds. This updated model differs from existing GHMs in that no other GHM simultaneously incorporates groundwater recharge, groundwater abstraction, aqueduct transfers, local reservoirs, desalination and return flow/delivery loss into estimates of global water balances. The work presented here represents an important step forward for GHMs.

SPECIFIC COMMENTS

I am happy to see water infrastructure being more explicitly integrated into GHMs beyond reservoir operations. Aqueducts (Section 2.1.3) and desalination (2.1.5) are important components of human water use that need to be considered as they can have profound impacts on water availability at the regional scale. While I recognize that accounting for these types of infrastructure at the global scale is challenging, it seems that assuming "implicit aqueducts" (e.g., p. 6, lines 23-24) exist to meet water demands may lead to significant overestimation of this form of abstraction, especially given the order of water extraction (e.g., river, global reservoir, aqueduct, local reservoir…). Without any rationale for why this order was selected, I would argue that aqueduct transfers would be far less common than abstractions from local reservoirs. Additional justification on why this particular order was used, or why implicit aqueducts would be very common, would provide needed clarity on this.

What is the benefit of pursuing Option 1 (assuming an imaginary unlimited surface water source) vs. Option 2 (water deficits)? Section 3.4.1 seems to argue that temporal variability does appear in the model and simulates periods where water scarcity exists during which water may be unavailable. From this perspective, it would seem that aligning the model to always have access to an unspecified surface water would diminish this profoundly important problem of scarcity, where deficits are real and serious problems for many, including those irrigating with surface water who may face serious curtailments or crop failures.

Many municipal water systems have significant delivery losses (30-60%), particularly in low-income countries due to a lack of funds for infrastructure repair and deliberate vandalization. Even in the USA, many municipal systems report unaccountedfor water losses of higher than 10%. While I also do not know of any global inventory of water lost during delivery, there are rough estimates available (e.g., http://siteresources.worldbank.org/INTWSS/Resources/WSS8fin4.pdf) that might warrant a re-examination of the assumption that 0.1 and 0.15 (page 10, lines 6-7) are reasonable estimates for this parameter.

TECHNICAL CORRECTIONS

There is a typo on the first line of Section 2.1.7- “fulfil” should be “fulfill”

Figs 5, 6 and 12 are pretty cramped. Finding a way to make these easier to view would be very helpful. (Maybe this won’t be an issue if readers can access a high quality version online at publication).

Fig 11 would be even better if there was a nearby or integrated table that reminded readers what each of the three letter codes were. Or, alternately matched pie charts with map areas by a letter (and letters could be tied to region codes in table S2). Right now it’s hard to see what matches what section of the map.

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