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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Infrastructure sufficiency in meeting water demand under climate-induced socio-hydrological transition in the urbanizing Capibaribe River Basin – Brazil" *by* A. Ribeiro Neto et al.

Anonymous Referee #1

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1. Special issue

This paper is a potential contribution to the special issue entitled "Predictions under change: water, earth, and biota in the anthropocene". I understand my task as a reviewer not only to be to assess the quality of the paper, but also whether it fits the "project" of the special issue, which can be summarised as understanding coupled natural-human systems.

The paper provides a rather conventional case study of a river basin in Brazil, with a

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focus on future expected impacts of climate change on future precipitation and hence water availability, as well as of changing future water demand. What it basically does is to apply the outcomes of an existing climate model (Chou et al. 2012) as an input into a rather simple hydrological model that converts expected future rainfall into runoff, the outcomes of which feed a water allocation model. The water allocation model routes available water in rivers to user groups, whose future water demand is extrapolated and interpolated from expected future population and economic growth. The paper thus develops two linked models, but it should be realised that this link is unidirectional. Thus hydrology and water allocation are not dynamically linked: water allocation does not evolve and change as a result of changes in water availability.

Given the above I conclude that this paper does not make a significant nor original contribution to the theme of the special issue to which it has been submitted – it does not contribute to a better understanding of how societal and natural systems are dynamically linked and how this coupling can be modelled.

With respect to the scientific merits of the paper, irrespective of the theme of the special issue, I have the following remarks.

2. Concepts

Central in the title and the introduction of the paper is the concept of "socio-hydrological transition" (p.2796 line 10; p. 2798 line 21; p. 2811 line 3), and "climate-induced socio-hydrological transition" (p. 2799 line 25). I find it problematic that this potentially very interesting but at the same time complex concept is not defined in any way. What is it? How can we recognise and measure it? Can we anticipate and steer it? There is also no reference to a rapidly growing body of scientific literature on "transitions" (e.g. J. Rotmans).

Another concept used in the title is "Infrastructure sufficiency". This concept is only used once in the text (p. 2799 line 24) but is not explained. A cursory look at this concept, which I am not familiar with, may convey the message that insufficient water

HESSD
11, C709–C713, 2014

can be mitigated by “sufficient” infrastructure. This may be true up to some point only. I in fact like the topic of storage and how it impacts on water availability. So the paper could have critically looked at the storage ratio or residence time as an interesting indicator for absorbing climate shocks (I understand the average residence time of the water stored in reservoir is more than one year (809x106m3/663x106m3/yr), which I think is an important given, and shows that the river flow is highly regulated).

So two concepts central to this paper are not at all defined nor operationalised.

3. Climate

I am not a climatologist. But I am surprised about the apparent contradiction in the paper concerning the future climate in 2070-2100. First, we are told that “The results of the Intergovernmental Panel on Climate Change (IPCC) GCM ensemble do not agree on the trends of projected change of the rainfall and air temperature in large parts of Brazil.” (p. 2799 lines 12-14). Second, we are told that the rainfall and air temperature calculated with the ETA-CPTEC/HadCM3 result in a reduction of river discharge from 20.98 to 6.84 m3/s, i.e. a reduction of two thirds (p. 2806 lines 7-8). We need to know more about the (un)certainty of the data used.

Fortunately, in the last paragraph some caveats are posited (page 2811 lines 1-22). But for me this is too little too late.

4. Modelling

Modelling paper of this type should robustly validate the model; the more so if the model is applied to scenarios that fall outside the parameter range for which it was calibrated. This is so because the reader should be convinced that the model yields the correct results because it simulates the important processes correctly. Unfortunately this was not done in this paper. In fact, and in so far as I can verify, there have been no papers in international peer-reviewed journals about the hydrological model applied (MOD-HAC). Further, the fact that the hydrological model requires (only) three types of input

HESSD
11, C709–C713, 2014

variables, namely “mean rainfall, potential evapotranspiration and streamflow”(p. 2803 line 27), and that the “model has 14 parameters that can be calibrated automatically” (p.2804 line 4) leaves one wondering: isn’t this a typical case of equifinality. Moreover, I find it strange that streamflow is used as an input variable. Given the above, my conclusion is that the outcomes of this model must be interpreted with extreme care.

It is not clear that the streamflow data used for the modelling exercise (refer to Table 3) have been corrected for upstream abstractions (i.e. have been naturalised). Further, it remains unclear why the periods for which the three drainage areas have been calibrated are as they are. The authors should be straightforward in explaining what data are available. I do not understand the explanation given on p. 2805 lines 20-22.

The model performance during the calibration period is not critically discussed in section 4. In fact Table 3 should lead to some serious discussion – why does the model perform so badly in the lower part of the basin? The authors cannot skirt that question!

5. Results

One of the dynamic responses to the water scarcity situation in the Capibaribe River Basin is the controversial interbasin transfer project of water from the Sao Francisco. This project, and the heated societal debates it engendered, is in fact a beautiful case of the societal feedback that socio-hydrology posits to exist and to be salient. What a missed opportunity that no literature on this interbasin transfer project is referred to and discussed (see e.g. Pena de Andrade et al. 2011). It is not clear whether the additional water availability of this IBT has been included or excluded in the model.

Reference

Pena de Andrade, José Geraldo , Paulo Sergio Franco Barbosa, Luiz Carlos Alves Souza, Daniel Lucas Makino, 2011. Interbasin Water Transfers: The Brazilian Experience and International Case Comparisons. Water Resources Management Volume 25, Issue 8, pp 1915-1934

HESSD

11, C709–C713, 2014

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 2795, 2014.