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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Toward continental hydrologic–hydrodynamic modeling in South America" *by* Vinícius A. Siqueira et al.

Anonymous Referee #1

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This m/s presents a continental hydrological model for South America. It is forced by global rainfall and climate data and calibrated to streamflow records for a large number of stations. The agreement with recorded streamflow is presented, as well as that with satellite-derived evaporation (ET) and total water storage (TWS). The agreement with observed streamflow is better than that of an ensemble of 3 global models driven by the same precipitation estimates.

Overall assessment: This appears an overall competent and sound study, but I am missing some truly new scientific insights. The abstract suggests the main insights are (1) calibrating rainfall-runoff parameters is necessary to simulate discharge appropriately; and (2) implementing hydrodynamic routing is also important. I don't think either of those is really very novel. I do not think there was ever any doubt that pa-

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rameter calibration against streamflow records was going to improve the agreement with those same records (noting that the “appropriately” used in the abstract is obviously a subjective term, or at least one that would have to be purpose-specific). The second conclusion also hardly seems surprising and has been shown in previous studies, specifically for the Amazon basin. Indeed, the authors provide several literature references that offered those very conclusions.

On the positive side, I do think this is an interesting study that has the potential to be a valuable contribution. I thought some of the most interesting contributions from this study were:

1) There is a much larger set of streamflow gauging stations in existence in South America than is represented in global databases and typically used to calibrate global models;

2) The use of a large number of altimetry-derived water level records is interesting; and

3) The authors provide some interesting commentary on the hydrological conditions that likely explain consistently poor performance by global models in some of the basins in South America.

I was somewhat surprised that the majority of forcing and spatial parameterisation approaches used for the “regional” MGB model were, in fact, the same as used for global models. Furthermore, Fig. 11 appears to suggest that the inclusion of hydrodynamic routing was a minor factor in explaining the generally better performance. Therefore, it would seem that the larger number of streamflow gauges and their good use in a more intensive calibration were the real reasons for better performance. That in its own right is useful, as it sets a benchmark that global models should be able to achieve with appropriate parameter calibration.

What is unclear, however, is whether that would go at the detriment of the agreement with other observations of the water cycle, such as ET and TWS. It is common

that a heavy emphasis on streamflow calibration leads to deterioration in other terms. Therefore, I was surprised that the authors did not include the global models in their comparison against ET and TWS, to assess whether those were simulated better or worse. (The altimetry water levels are less relevant in such a comparison, as one would assume that better discharge simulation also produces better water level simulation. Nonetheless, a comparison with the global models might still have been of interest.)

In summary, the present m/s mainly seems to assert the common “our model is better than theirs”, which is not very insightful as it appears almost entirely due to calibration. There are however some good opportunities to make this a more valuable (and cited!) contribution:

1) Propose these model simulations, along with the station and altimetry records, as a benchmark for global models by making them directly available online to the global modelling community. To make the MGB model acceptable as a benchmark for an allround hydrological model, you should demonstrate whether the global models are also less effective in simulating ET and TWS. This would provide insight into whether only the streamflow simulations can be considered benchmark, or the other water cycle components as well.

2) Provide more discussion and emphasis on the understanding of the hydrological conditions of some of the “problem” basins, so that they might become a valuable “stress test” of hydrological model performance.

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