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Discussions

Interactive comment on "A dynamic water accounting framework based on marginal resource opportunity cost" *by* A. Tilmant et al.

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Summary

This paper describes a water accounting method that uses the marginal resource opportunity cost to describe the economic costs and benefits of water system operation and infrastructure decisions. The method involves considering hydrologically connected water uses as part of an economic system, where downstream water users engage in hypothetical contracts with upstream users to 'purchase' their use of water. The method maintains not only a 'water balance' at each node in the system but also accounts for the flow of economic value from one user to another, allowing for the determination of 'value added' at each node.

Comments

This method of water accounting is an interesting and useful approach for classifying the values of water storage and use in a connected system. The emphasis on the marginal value of use, rather than average use (called water productivity here in page 11738, line 18) is an important distinction to make and, combined with the design of value flows through the system, forms the main contribution of the method. This method could be useful as a way to value not only storage infrastructure and instream flows, but also ecosystem services and (the theoretical costs of) operational constraints. A few specific comments follow:

1 - I understand that an optimization-based model can simultaneously solve for allocations and marginal costs (page 11741, line 9-10), but why are simulation-based methods much more computationally demanding, especially in large networks? It makes sense to use an optimization method here, because the goal is to maximize the economic benefits in the system, but for a different objective, such as evaluating the change in economic benefits under certain operational rules, wouldn't simulation-based methods better accommodate potential if-else rules which sometimes exist in the real world? When would these computational challenges begin to overtake the benefits of flexibility which exist with simulation-based methods?

2 – In the 'optimal' solution (i.e. maximizing economic benefits) provided by the SDDP algorithm, are the MROC prices at each node the same for a given time-step? This seems to be the solution given my understanding of the theory, as well as what is suggested via equations 7-9. From those equations, if the MROC price was higher at node 2, it would suggest the RBA would want to 'buy' more spillage from reservoir 1 so they could 'sell' more water to reservoir 2. If this is the case, it might be worth mentioning somewhere in the text. If it is not the case, the authors should address the reasons that the results do not correspond to intuition here.

3 – I found the inclusion of the 'RBA' to be an interesting part of this analysis. It seems to be a necessary artifact of the accounting method to allow for different prices at different nodes during the same timestep, but it is suggested that the RBA would serve

some real-world service in coordinating efficient economic decisions within the basin. It would be interesting to see some further discussion of this potential role of economic incentives for the RBA. Would a strictly profit-seeking motive for the RBA be enough to encourage more efficient decisions within the basin? Or would the purchase/selling prices for the RBA need to be regulated in some way?

4 – In the paragraph starting on page 11750, line 9, the irrigation schemes are referred to as having an ‘opportunity cost’, while other uses of water are referred to as having ‘value’. Is this because the value of that irrigation is less than the MROC of the water at that node? If the basin wide allocations are economically efficient (an assumption explicitly made in the paper), shouldn’t the algorithm allocate less water to irrigation?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 11735, 2014.