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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Definition of efficient scarcity-based water pricing policies through stochastic programming" *by* H. Macian-Sorribes et al.

Anonymous Referee #1

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Summary

This study presents an approach to develop stepped water pricing functions from the results of a stochastic hydroeconomic optimization model. The hydroeconomic optimization is performed with the well-known SDP algorithm. The new thing here is that shadow prices or water values generated by the SDP are post-processed into pricing policies using a number of processing steps which are described in detail in the paper. It remains unclear, what the exact reasons are for having to do the post-processing? What impact would it have if the post-processing wasn't done at all or was done in a different way? Also, hydroeconomic modeling typically depends on a lot of input data

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which are always uncertain. No analysis is provided as to how model uncertainty impacts the performance of pricing policies. The study is interesting and relevant for the hydroeconomic modeling community but needs revisions.

Review Comments

1. I lack a better and more intuitive explanation why the MROC values generated by the SDP need to be post-processed before they can be used as pricing policies. If we assume monthly time steps in the SDP and if the SDP is run to steady state, then MROC will depend on the month of the year, the inflow class (Markov state) and the amount of water in storage. Given stationary climate and static economy, MROC will not change from one year to the next, i.e. users will know prices as dependent on storage and inflow in advance. Line 778/2-3 states "it will be neither operative, nor fair nor secure to implement a pricing scheme in which prices would vary at each time stage", however if prices should reflect scarcity, they must vary with time, inflow and storage. For instance, in the wholesale power market, prices are highly variable over short time scales. Why is this not feasible for water? This should be motivated and explained in much more detail and requires a major revision and extension of section 2.3.

2. The post-processing steps are listed in detail on page 779. It would be good to have a clear, consistent and transparent terminology. For instance, the terms "previous MROC", "combined MROC" and "final MROC" are introduced, but it is not really clear to me what precisely they represent. I am also unclear about the sorting in steps in 6b and 6c. From the SDP, we get a complete set of water values for all discretized storage and inflow states, so why do they have to be sorted? It seems that the aim of the procedure is to "downsample" the SDP results so that prices are constant over larger regions of the state space. As pointed out above, I am not sure I understand the rationale for doing this. At the end of page 779, it is stated that the post-processing must be re-done if performance is "inadequate". It would be good to define adequacy. How much additional cost / foregone benefit would one want to accept in order to keep

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prices stable?

3. P. 782: It seems that the objective in the case study was to obtain a pricing policy that would only depend on the combined storage of both reservoirs. Wouldn't it be a logical thing to then also design the SDP with one combined storage only? It also became clear from Fig 7 that the objective in the case study was to obtain a pricing policy that only depends on storage but not on the month of the year. Intuitively, one would expect that the water value must change in time. Having an empty reservoir at the beginning of the rainy season is much less critical than at the beginning of the dry season... Or are these reservoirs so small that they can anyway not be used for seasonal storage (does not seem to be the case from the info given in table 1)?

4. Water values or MROC depend on the inputs used in the hydroeconomic model. Some of these inputs (e.g. demand curves, return flow fractions etc.) are highly uncertain. It would be good to include an analysis how the uncertainties in model inputs translate into uncertainties in MROC and thus in the pricing policies, and how such uncertainties would impact on the performance of the pricing policy.

Details

1. 772/4: Maybe "scarcity-dependent" is better than "scarcity-based"

2. 772/15: "on" should be "in"

3. 772/17: This may be a bit of a Euro-centric view. In China and parts of Africa (e.g. Ethiopia), new hydraulic infrastructure is built at an unprecedented scale...

4. 774/4: delete "the" before "economic theory"

5. 780/13: "not" should be "no"

6. 782/24 ff: Why not also compare to the full set of MROCs as generated by the SDP? I guess you do it and call it "SDP" in fig 8, but it is in effect also a pricing policy...

7. 783/6: Why not use the same model as used for the SDP runs? Does the MATLAB

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model include more spatial/economic detail than the SDP scheme?

8. 783/last paragraph: One may conclude that the case study is not really well suited to demonstrate the methodology described in the paper, if differences in the performance of the various pricing policies are so small.

9. 783/24: “relocations” should probably be “reallocations”

10. 784/23-25: I do not understand this statement.

11. 785/Bullet 3: Does this mean that pricing policies change in time after all (drought/no drought)?

12. 785/786: Bullet 4 is not clear. An example may help.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 771, 2015.