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Hydrology and Earth System Sciences Discussions

Interactive comment on "Accessible integration of agriculture, groundwater, and economic models using the Open Modeling Interface (OpenMI): methodology and initial results" *by* T. Bulatewicz et al.

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The authors present a way to build an interdisciplinary integrated model with modest software development effort. Existing programs are linked as 'black boxes' using the Open Modeling Interface (OpenMI), an existing model-linking framework. The authors build an agricultural-groundwater-economic model of a region in Kansas to investigate the effects of 2 policy scenarios. The paper is clear and well written and presents its case effectively.

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Interactive Discussion

Discussion Paper

Comment 1

The paper is about linking models; the specific set of models integrated serves as an example. The paper presents a literature review of integrated modeling, but no mention of past literature is made on the disciplinary topic, i.e. combined water and economic models. It would be useful to provide the context for the integrated modeling described here, i.e. what forms of component integration have other hydro-economic models used in the past and how is the 'black box' integration used here different? A recent literature review of this field [Harou, et al., 2009] adopts the terminology of Braat and others [Braat and Lierop, 1987; Cai, et al., 2003] in differentiating between holistic (endogenous, fully integrated) or compartmental (modular) modeling approaches. Interestingly, the current paper presents a hybrid between these 2 model types. The 'wrapper' program does the integration so that the individual disciplinary models can stay independent (and easier to manage). The disciplinary context of this paper's integration innovation should be addressed (e.g. in section 2.2).

Comment 2

In the example provided, integrated modeling using openMI is relatively straightforward because 'full model reuse' (connecting the different models as black boxes) was chosen. This may leave the reader with the impression that most agricultural-groundwater-economic models can be connected in this way. This is not true in light of the following:

1. Many hydro-economic models use multi-period optimisation for the water resource and/or economic submodels. In such cases using OpenMI may be either impractical or impossible.

2. The individual models in this study have the same spatial scale (parcel) and time scale (annual). However in irrigated agriculture surface water is often also used. Groundwater and surface water may have significant interactions. This complicates integrated modeling considerably as surface water storage and flow have spatial and temporal scales different from those of groundwater. OpenMI can address surface

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water – groundwater interaction but likely not by using ‘full model reuse’. Connecting such models using OpenMI becomes an advanced modeling and software engineering project.

The authors should make clear what specific attributes of the models they connected in this paper made the relatively easy OpenMI ‘full model reuse’ possible and in what other cases linking ‘black boxes’ may not be possible.

Comment 3

I agree with Peter Gijsbers’ comment that the problem that occurred when linking the models (error compounding) should be mentioned in the conclusions, both its impact on the case study and the general challenge it poses in integrated modeling.

Conclusion

The authors have created a practical tool for water policy evaluation by linking trusted components with relatively little new programming required; this is a genuine contribution to the field.

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