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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Linking economic and social factors to peak flows in an agricultural watershed using socio-hydrologic modeling" *by* David Dziubanski et al.

Anonymous Referee #3

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This is an interesting paper that explores the feedbacks between land-use management changes, driven by economic and social factors, and the hydrological system of an intensively managed agricultural watershed. An agent-based model ABM considers two agent types: a reactive city agent (providing financial incentives for agricultural conservation practices based on prior flooding impacts) and farmer agents that maximise profits, subject to conservation and risk-aversion attitudes. A simple semi-distributed model is used to simulate the hydrological system, perturbed by farmer agent conservation practices through changes to the SCS-CN parameter. The purpose of the modelling is to bring understanding of the impacts of land use decisions on downstream flood impacts. The manuscript reads reasonably well, although some key details re-

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Discussion paper

garding the ABM are omitted (description of equation 2) and the scenario outcomes could be made more succinct.

Remarks:

1. Paragraph starting line 71: The authors need to make a stronger case for the use of ABM over, for example, top down approaches using differential equations. This should be followed up in the conclusions.

2. Comment [Section 2.5]: The ability to reproduce an historical set of flood peaks does not indicate a model has the correct sensitivity for impact assessment (i.e. the selection of CN parameters). However, it is recognised that the method employed is typical of operational practice, and limitations are recognized in the conclusions.

3. Paragraph starting line 616: I am unclear how much feedback between there is between the hydrological system and the city agent. The conservational goal of the city (Eq. 7) appears unresponsive to flooding with a value of $\sim$1,100 Ha, after the initial introduction of the conservation scheme.

4. Line 113: The results are presented in form of reductions to peak flows [i.e. this represents land use decision making]. However, it may have also been interesting to evaluate reductions in flood damages, given that this is the objective of the city agent [line 223].

5. In Figs 5-8, results are presented as reductions in the "mean 90th percentile discharge". I am unclear what this represents and why this value was chosen (is this the peak discharge or taken from a flow duration curve).

6. Line 363: "Rules governing agent decision making need to realistically capture human behaviour without creating an excessively complex model". Could the authors make some comment on this highly parameterized ABM in this regard? Also I note in the conclusions that there are arguments for introducing further decision processes / state variables.

7. Section 2.7.1, Farmer agent land use decision process. I found this difficult to follow without referring to the Supplementary Material. The first two paragraphs [p 18] could be moved to a methodology section. The rationale for Eq 4 (the profit function) with the use of a polynomial is unclear in the main manuscript, and I also wonder whether this is a representation of the cognitive process of the farmers (e.g. line 697 states for a rise of $1 in corn prices, 10-15% of land is converted back into production and line 354 “Either 10% or 20% of the total field size is converted into native prairie vegetation” – these seem to provide a more appropriate basis for forming a profit rule).

8. The catchment area is ∼56,200 Ha (line 426), but 100 farmers are allocated 121 Ha each (line 485). Eq 7 uses Atot, the total land area of the catchment. This appears inconsistent.

9. I am not clear on the large fluctuations in land area for example in Figs 6 c,d and Figs 8 c,d, prices appear more volatile in years after 2000.

10. Fig 8: Caption “Yearly crop yields are plotted as bars”; crop prices are displayed on figure.

11. The historical scenario needs to be more clearly defined (line 122 and 635) for the interpretation of fig 9 in the Historical Comparison. I interpret this as prices/yield/subsidies use the input time series in the historical scenario (Section 4.2), but land cover can change on an annual basis according to the model.

12. Section 5 Model Calibration and Validation: This should be moved prior to the results section. It is interesting to note that conservation area was more sensitive to crop prices in the mid-1990s than in 2010s, despite the higher price volatility in the latter.

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