Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-404-SC1, 2017

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Quantifying hydrologic connectivity of wetlands to surface water systems" *by* Ali A. Ameli and Irena F. Creed

E. Sudicky

2edsudicky@aquanty.com

Received and published: 6 January 2017

General Comments: It would be more appropriate and robust to use HGS as a fully-coupled model than to represent groundwater with a steady state analytical solution. There is a large and growing body of literature demonstrating the application of fully integrated numerical models at the basin scale. The authors linking of a transient surface flow model to a steady-state groundwater model makes little sense. Moreover, how is the linking actually performed? Is a fluid balance maintained? Is there any justification for using a simple 2-layer model for the subsurface, especially when there doesn't seem to be any hydrostratigraphic data? In fact, the scarcity of data is a major problem to have any faith in the model.

A recent publication by Liu et al., (2106) demonstrates the application of a transient

fully-integrated surface and subsurface flow model (HGS) to investigate wetland connectivity including key components of the transient water balance (precipitation, evapotranspiration, and snowmelt). This simulation domain is very similar in scale to that mentioned by the authors in their response to Reviewer 2's comments where they state that HGS was unable to solve this type of problem. HGS is regularly applied to very complicated surface and subsurface problems at a variety of scales. Considering that the authors only used 22,383 nodes in their 2D mesh for this study, it is likely that with training and support it would have been possible to apply a much higher resolution fully-integrated HGS model to this domain as models on the order of 1 million nodes are now routine (e.g., Hwang et al., 2015).

Specific Comments: P1 L14-17 – See Liu et al., (2016) for a similar study using a fully-integrated surface water and groundwater model P2 L21-24 – Golden et al., (2014) primarily focused on finite-difference models such as MODFLOW which are unable to achieve local mesh refinement without incurring a high node count. Unstructured finite element methods with 3D triangular prism or tetrahedral meshes are able to achieve local mesh refinement to resolve local features with many fewer nodes than would be required for an equivalent finite difference mesh. P2 L27 – See Liu et al., (2016) P4 L18-19 – It is unclear how such a relation is established P4L20 – Can a steady-state watertable, in fact steady-state subsurface flow, be supported? Are winter processes such as soil freeze/thaw and snowmelt important in this basin? There is no discussion of this, and would appear to be neglected entirely. P4L22 – One observation location situated 60 km outside of the simulated watershed does not support the use of a steady-state groundwater assumption. P4L25 – While it may be true that there is a connection between groundwater and wetland water levels, using observations from 500 km outside the watershed is extremely weak support for this assumption. Are these systems similar enough to justify this assumption? P4 L28 – 2 layers is not enough capture the details of the hydrostratigraphy P5 L22 – The HGS reference suggests that a rather old version of HGS was used. Many feature and numerical performance enhancements, including parallelization, have been made to the code since

2008. The author should contact the developers to upgrade to a current version of the code (Aquanty, 2016). P5 L25 – The coarse mesh discretization (22,383 nodes) is highly inappropriate for the stated objective of representing 130,157 wetlands. P5 L34 – How is the connection between the HGS model and the 3D analytical model achieved? This is crucial. How can transient surface flow and steady-state saturated zone models be linked. This seems incompatible. No details are provided. Is the linking mass conservative? How is the unsaturated zone dealt with for infiltration (or exfiltration)? It seems to be neglected. Section 2 – Parameterization of the groundwater model needs to be described in more detail. P7 L3 – Do the calibrated saturated hydraulic conductivity values make sense compared to the type of geologic material or available data? P7 L29 - What units is the Manning coefficient being reported in? P7 L30 – Rill storage seems very small when considering the element sizes in the model. Is a value of 1 mm physically realistic? P9 L18 - How is it possible to mix a steady-state model with a transient model? This is incompatible and it is unlikely that mass balance will be preserved. P11 L8 – The authors should provide a definition of "semi-coupled". Table 4 – Units Figure 3 – What is the rationale for blank portions in Figure 3a) Figure 5 – What is the purpose of showing the simulated hydrograph if not to compare it to observed data.

Overall, the paper is technically weak and rejection is recommended.

References:

Aquanty Inc. (2016). A three-dimensional numerical model describing fully-integrated subsurface and surface flow and solute transport.

Golden, H. E., Lane, C. R., Amatya, D. M., Bandilla, K. W., Kiperwas, H. R., Knightes, C. D., & Ssegane, H. (2014). Hydrologic connectivity between geographically isolated wetlands and surface water systems: a review of select modeling methods. Environmental Modelling & Software, 53, 190-206.

Hwang, H. T., Park, Y. J., Frey, S. K., Berg, S. J., & Sudicky, E. A. (2015). A simple

iterative method for estimating evapotranspiration with integrated surface/subsurface flow models. Journal of Hydrology, 531, 949-959.

Liu, G., Schwartz, F. W., Wright, C. K., & McIntyre, N. E. (2016). Characterizing the Climate-Driven Collapses and Expansions of Wetland Habitats with a Fully Integrated Surface–Subsurface Hydrologic Model. Wetlands, 1-11.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-404, 2016.