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Interactive comment on "HydroSCAPE: a multi-scale framework for streamflow routing in large-scale hydrological models" *by* S. Piccolroaz et al.

Anonymous Referee #2

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Dear Dr. Moussa,

This is an evaluation of the paper entitled "HydroSCAPE: A multi-scale framework for streamflow routing in large-scale hydrological models" (HESS-2015-371) submitted to Hydrology and Earth System Sciences by Dr. Piccolroaz et al. on August 24 of this year. In it, the authors present a hydrologic model that they named HydroSCAPE, and which uses the Width Function Instantaneous Unit Hydrograph (WFIUH) for flow routing in medium-sized watersheds and larger.

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Discussion Paper

The study is both original and scientifically relevant as far as I can judge based on my knowledge of the topic, and provides a relatively new perspective that we have already seen applied in other fields of science, but now applied to watershed modeling. Given the importance of this contribution and the quality of the presentation, I recommend the paper for publication provided the authors apply a series of minor corrections to clarify some matters.

Hoping that this review may prove helpful in your decision, I remain yours faithfully.

Suggestions for improvement:

1. p. 9058 l. 2: Please rephrase. Rather than being two separate equations, the kinematic wave equation is itself an approximation (simplification) of the Saint-Venant equation assuming uniform flow and a friction slope equal to the slope of the channel bed.

2. p. 9058 l. 10: "0.1 to 0.5 degrees" Please indicate the corresponding ground-projected area in km x km.

3. p. 9059 l. 23-26: I mentioned above that this paper provides a relatively new perspective. That being said, this paper appears to be very much an extension of last year's paper by Hallema and Moussa (2014) with regard to the application of the WFIUH and spatial subdivision of the watershed. Instead of describing the flow nodes, that paper refers to the flow vectors connecting these nodes, which they call land surface components and channel components, but represent essentially the same substance. The main differences I think are the size of the watershed used in the case study and the use of macrocells. Please cite and elaborate.

4. p. 9062 l. 4 "where streamflow is desired" Suggest: "where we want/need to calculate streamflow"

5. p. 9062 l. 25 "depends on the partitioning of hydrological fluxes" Explain which processes this refers to, i.e. the Hortonian mechanism, subsurface flow, etc.

6. p. 9063 l. 18 “In agreement with the WFIUH theory, stream hydrodynamic dispersion is neglected” Not sure if that requirement was explicitly defined for the WFIUH theory, suffice it to state that WFIUH simply does not account for hydrodynamic dispersion.

7. p. 9067 l. 4 “Relevant flood events” Suggest: “Substantial flood events”

8. p. 9067 l. 16 “multi-site model calibration” I gather from section 3.3 that the model is calibrated with regard to the Ponte Nuovo station alone, which would make this a mono-site calibration. Multi-site calibration implies that the model parameters have been calibrated to optimize performance at multiple sites at once, for example by optimizing average NS for all stations. This does not seem to be the case here.

9. p. 9075 l. 20-25 and Table 2. As stated in this paragraph, the watershed model inherits parameters (and values of corresponding state variables) from the ‘sub’ models so to speak, but would the authors consider that consequentially, errors inherited from these underlying models can accumulate rapidly? The authors show this already given the near optimal Nash-Sutcliffe coefficient at Ponte Nuovo and lower performance for other flow stations. I think that Table 2 can list more criteria than the Nash-Sutcliffe coefficient alone, such as the (relative) peak flow and volume errors. This will help identify the strengths and points of improvement for this approach.

10. p. 9075 l. 25-27 “Parsimony is important for a meaningful and reliable parameter estimation procedure and uncertainty analysis, especially when dealing with large-scale and complex basins.” If anything, basin models are often more accurate than models of smaller headwater catchments because of more and better quality data. Generally speaking however, it is more correct to assume that parsimony is equally important at all scales, whether for a hillslope runoff model or a soil infiltration model.

Reference: Hallema, D. W., and Moussa, R., 2014. A model for distributed GIUH-based flow routing on natural and anthropogenic hillslopes. Hydrological Processes 28: 4877-4895. doi:10.1002/hyp.9984

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