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Discussions



# *Interactive comment on* "Uncertainty analysis of a spatially-explicit annual water-balance model: case study of the Cape Fear catchment, NC" *by* P. Hamel and A. J. Guswa

**Anonymous Referee #4**

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Review of Hamel and Guswa, "Uncertainty analysis of a spatially-explicit annual water-balance model: Case study of the Cape Fear catchment, NC"

This paper investigates the predictive power and performance of a relatively simple hydrological model approach that represents an example of what is typically used in water resources management and eco-hydrological investigations. The authors identify a clear knowledge gap regarding for instance how well such models can independently (without calibration) reproduce historical (runoff) data, and investigate systematically the predictive power and applicability of the considered model to various cases, including relatively small sub-catchments. The paper is well written, has a logical structure



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with well underpinned conclusions. The results are relevant for a relatively wide range of research (and practical) applications.

In addition to some specific comments presented below, I would suggest that the authors enhance the analysis and discussion on the general relevance of the findings (as explained in more detail in the overall comments).

Overall comments

1. In order to get an up-front overview of the approximate magnitude of the different water balance components of the Cape Fear catchment and its sub-catchments, it would be good if absolute discharges, alternatively some measure of estimated average yields (and/ or estimated AET) would be presented (e.g., in a table - one could include predicted AET etc in Table 2). This would help understanding the discussed sensitivity to P input (see also 2 below).

2. In the very first part of the results section, the authors state that "water yield predictions are very sensitive to climate inputs". This is generally the case, however the actual sensitivity can be expected to be strongly related to the water balance characteristics of the catchment; the authors state that in the considered case, a 10% increase in P resulted in a 30% increase in yield. For instance, in a hypothetical catchments where AET would (almost) equal P, the yield would be much smaller than AET and P (since the long-term yield is roughly equal to P-AET), and it could increase by hundreds of percent, given even relatively modest changes in P. The reader is informed about the (average?) sensitivity in the Cape Fear catchment, however it would be good add a discussion on the variability in sensitivity among sub-catchments, as well as how typical/ representative the situation in Cape Fear catchment is. This is important not least for the reason mentioned in the manuscript, namely that the climate sensitivity provides context for identified uncertainties in the modelled water yields. As indicated above, such a discussion could depart from the typical magnitude of different water balance terms under different climate conditions (and the implications on the sensitivity on yield



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through the equation yield or runoff=P-AET).

3. For better understanding of the reasons behind identified systematic differences between the lumped model and the spatially explicit model (secton 3.2), it would be helpful to present the numerical value of the lumped w (omega)-parameter, comparing it with the average w in the spatially-explicit model (averaged over all considered grid cells). This could provide a basis for enhancing the general discussion (starting on p. 11018, row 22) on this topic, for instance by including concrete examples.

Specific comments

Title: NC should probably be written out for non-US readers

Abstract: Estimation methods for PET and AET are central to the study. The terms / one of the terms could be mentioned.

p.11003, line 28, reference Budyko (1979) is not included in the reference list p. 11004, line 36 “their conclusions are often context specific”. What is the difference compared to the present study? Would be good to clarify - you mention lack of uncertainty analysis in a separate statement. p. 11005, line 20: “The Budyko curve is a unique empirical function that relates the ratio of actual to potential evapotranspiration (averaged over a catchment and over many years) to the ratio of precipitation to potential evapotranspiration”. Confusing, should be AET/P and PET/P to be consistent with Eq (1) and Fig. 1? p.11011, line 12: PET is not part of Eq. (3) p.11016, line 13 “Our results suggest that the sensitivity of water yield to Z is low compared to the climate inputs”. The generality of this statement could be further investigated, see overall comment 2 above. It would also provide insight regarding to which extent the first conclusion (p.11023, “-In the Cape Fear catchment, the InVEST model was most sensitive to uncertainty in the precipitation forcing”) can be expected to be relevant for other catchments.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 11001, 2014.