

Interactive comment on “Impact of spatial data resolution on simulated catchment water balances and model performance of the multi-scale TOPLATS model” by H. Bormann

Anonymous Referee #1

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General comments

- This paper describes the effects of different spatial scales of input data on the water balance and model efficiency as simulated by a grid-based hydrological model (TOPLATS). This subject is within the scope of HESS and can be important when appropriate spatial scales have to be chosen for spatially distributed water balance models. This type of model seems to be particularly important when coupled with water quality and/ or ecological models to support water management e.g. in relation to the water framework directive. The paper is well written and logically organised. Some textual comments can be found below in the ‘Technical corrections/ typing errors’ section. Individual scientific questions/ issues can be found in the ‘Specific comments’ section. Some more general comments will follow in this section.

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- The review of studies looking at the sensitivity of model results to varying spatial resolution and of studies about TOPLATS applications is mainly summarizing what these studies have done, but is lacking a bit the results and more importantly a comparison of the different studies. For example, a table with the main characteristics of TOPLATS studies and some more discussion in section 2.1 would certainly improve this part of the paper (see also specific comment for page 2186-2187).

- The correlation analysis in section 4 is not convincing since univariate correlations between catchment properties and water balance components are investigated assuming linear correlations. However, it is clear from the catchment properties and water balance components considered that there are interdependencies between different catchment properties on the one hand (e.g. land use classes and topographic index) and water balance components on the other hand (e.g. stream flow and surface runoff). Therefore, please discuss more extensively the added value of this analysis and the underlying assumptions (linearity and univariate approach).

- A weak point of this study is that the results are model dependent and may be only extended to other catchments using the same model and maybe even having a similar size and climatic regime. The latter point refers to the dependence of the results of this study on the response time of the catchment to the climatological variability (see also specific comment for page 2185, line 20). The author briefly discusses this point in section 5, but only for other model types. I would recommend to include a discussion about the transferability of the results to catchments of different size and with a different climate.

Specific comments (p = page, l = line)

- p2184, l11: which “... differences ...” do you mean?

- p2184, l17-24: this part of the abstract is unclear and could be understood only after reading the main text. I would suggest the author to clearly indicate in which way the changes induced (of what?) by aggregation of the land use scenarios are comparable

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with water balances compared to the current land use, and what has been done in the correlation analysis (e.g. changes in input data as a result of what?)

- p2185, l5: could you provide a reference for the WFD?
- p2185, l20: “This depends ... catchment properties”. Firstly, does “... variability ...” refer to temporal variability and “... distribution ...” refer to spatial distribution.? Secondly, other factors influence the sensitivity of model outputs to changes in spatial data resolution as well, in particular the size of the catchment (and thus response time of the catchment) and the climatological variability (both in time and space). Please consider these aspects in this paragraph.
- p2186-2187: I would suggest the author to include some more references (and discussion) to studies investigating the appropriate spatial scales of hydrological variables for a particular research purpose and area, e.g. [Booij, M.J., 2003. Determination and integration of appropriate spatial scales for river basin modelling. Hydrological Processes, 17, 2581-2598], and [Skoiien, J.O., Blöschl, G. and Western, A.W., 2003. Characteristic space scales and timescales in hydrology. Water Resources Research, 39(10), art. no. 1304].
- p2187: please provide an outline of the paper at the end of the introduction (possibly in combination with lines 11-15)
- p2188, l1-2: could you provide a reference for the SVAT approach?
- p2188, l16: “An exponential ... is assumed.” Does that mean that the saturated conductivity decreases exponentially with depth?
- p2188, l17: “... soil water flow ...”, is that the percolation from Table 1?
- p2188, l20-23: plant growth is described by development functions in lines 20-21, but is not simulated in line 23? Please explain
- p2188, l24-25: who extended the topographic wetness index to the soil-topographic

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index?

- p2189, l1: for which purpose are the scales appropriate?
- p2189, l8-11: did Endreny et al. investigate different resolutions? Could be interesting for this study as well
- p2189, l24-25: what do you mean with "... strongly limit ... on scale."?
- p2189, l26: in the preceding paragraphs, I don't see the application of TOPLATS to a wide range of temporal scales? Could you please clarify this?
- p2191, l19-20: are small homogeneous areas shrinking?
- p2192, l3-10: some parts of the description of the parameter estimation is also in section 2.1. Please avoid this overlap and possibly move sentences not related to calibration to section 2.1
- p2192: which performance measure/ variable at which temporal and/ or spatial scale has been used in the calibration (of the two parameters) and why (related to research aim)?
- p2193, l9-10: please mention explicitly the grid sizes considered (they are in the abstract). And thus the model grid sizes also range from 25 to 2000 m resolution?
- p2194, l6: which biases do you mean?
- p2194, l21-24: is the example for the Dill catchment or the upper Dill catchment?
- p2194, l22: what is a significant difference?
- p2196, l10: is evapotranspiration negatively or positively correlated with the transmissivity?
- p2196, l13-16: please discuss the finding that the correlations vary from catchment to catchment. Could we have expected this behaviour or not? Do similar findings occur in the literature? Etc.

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- p2197, l4-5: I don't understand this sentence, please explain
- p2202: why is it that 7 land use classes exist for the land use classification and 6 for the 3 land use scenarios?
- p2203: what is the coefficient of determination (model efficiency has been referred to in the text)?
- p2204: there aren't any model efficiencies for the Dill catchment with a grid size of 25 m?
- p2205: what is Qt?
- p2206: what is the difference between the land use classes on the one hand and forest and agriculture on the other hand?
- p2210 etc.: please clearly define in the captions and/ or text what is meant by stream flow, runoff, surface runoff and discharge
- p2212: why is the model performance increasing from a grid size of 1000 m to a grid size of 2000 m for the calibration of the Dill catchment and the calibration and validation of the Aar catchment?
- p2217: why not a graph for the Aar catchment, isn't there any difference?

Technical corrections/ typing errors (p = page, l = line)

- p2184, l9: "... that model performance measures and simulated water balances ..." instead of "... that both model performance measures as well as simulated water balances ..."
- p2184, l15: where is "... too ..." referring to?
- p2185, l15-16: is it "... Kuo et al., 2003 ..." (in text) or "... Kuo et al., 1999 ..." (in references)?
- p2186, l2: "... for instance ..." instead of "... for instances ..."

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- p2186, l2: "... at micro-scale ..." instead of "... in micro-scale ..."
- p2186, l7-8: "Based on experience of the user and data availability, the appropriate data resolution ..." instead of "Based on experience of the user the appropriate and data availability, data resolution ..."
- p2186, l9-10: please reformulate this sentence
- p2187, l4: "... the effect of a decreasing number ..." instead of "... the effect of decreasing number ..."
- p2187, l9: omit "... of ..."
- p2187, l21: "... the question of the influence ..." instead of "... the question on the influence ..."
- p2187, l26: is it "... Peters-Lidard et al., 1995 ..." (in text) or "... Peters-Lidard et al., 1997 ..." (in references)?
- p2188, l7: omit "... in ..."
- p2188, l27: is it "... Peters-Lidard et al., 1995 ..." (in text) or "... Peters-Lidard et al., 1997 ..." (in references)?
- p2189, l4: "Pauwels and Wood ..." instead of "Pauwels et al. ..."
- p2190, l4: do you mean stream gauging stations?
- p2191, l4: "... at 25 m resolution ..." instead of "... in 25 m resolution ..."
- p2192, l24: omit "... on ..."
- p2192, l29: "... are shown ..." instead of "... are show ..."
- p2194, l5: omit second "... the ..."
- p2194, l17: "... does not have a major influence ..." instead of "... does not have major influence ..."

- p2194, l18: omit second "... the ..."
- p2195, l15: I would prefer the use of land use fractions (see line 21) instead of land use statistics (see also e.g. p2216-2217, captions of Fig. 10 and 11)
- p2196, l20: "... slightly ..." instead of : "... slight ..."
- p2197, l11-12: "Therefore, the results need to be verified for models rather focusing on lateral processes which should be more sensitive to a smoothing of the topography." might be more clear than "Therefore for models rather focusing on lateral processes which should be more sensitive to a smoothing of the topography the results need to be verified."
- p2197, l18: "... author thanks ..." instead of "... authors thank ..."
- p2200, l18: is it "... Sivapalan et al., 1985 ..." (in references) or "... Sivapalan et al., 1987 ..." (in Table 1)?
- p2201: "Sivapalan et al." instead of "Sivapalan"
- p2203: move "Val." a few lines down
- p2210-2215: Figs. 4-5, 7-9 and 11 are too small
- p2210: "... simulated discharge ..." instead of "... simulated data ..."?

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 2183, 2005.

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