

## ***Interactive comment on “Spatial sensitivity analysis of snow cover data in a distributed rainfall–runoff model” by T. Berezowski et al.***

### **Anonymous Referee #2**

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#### General comments

This paper presents a spatial sensitivity analysis method for a single parameter in a spatially distributed hydrological model. The method is applied for analyzing the spatial sensitivity of the snow cover fraction in a WetSpa model of the Biebrza catchment in Poland. The paper addresses an interesting and novel topic that contributes to the current practice of parameter sensitivity analysis in hydrological models. However, the readability of the introduction and results and discussion sections should be improved and some aspects of the methodology should be explained better. Publication in the HESS journal is recommended after the following comments have been addressed.

#### Specific comments

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1. The introduction refers to some interesting publications, however the content is not always logically structured which hampers the readability of the introduction.

a. A better differentiation should be made between previous methods applied to quantify the spatial sensitivity of parameters in hydrological models and the spatial data that could be applied for spatial sensitivity analysis (rainfall, Land surface temperature, impervious surfaces, et. . .).

b. Regarding the spatial sensitivity analysis methods the advantage of the presented LH-OAT compared to the methods used in the referenced studies should be addressed more clearly.

c. The authors should more clearly state for which purposes the spatial sensitivity analysis can/should be applied. Is the method for example suitable to locate areas which are, from a hydrological point of view, most or least suitable for deforestation, urbanization,..? This topic is now briefly addressed in section 3.3 but should also be addressed in the introduction.

d. The sentence: “.. i.e.: is the uncertainty in different zones of the model dependent on the spatial patterns in the SCF” is unclear to me.

## 2. Methods:

a. The LH-OAT method is explained in section 2.4.1 while the spatial approach of the sensitivity is explained in section 2.4.3. I find this division somewhat confusing. It would be interesting to know what the  $e_i$ ,  $f_i$ ,  $j$  values used in this paper are while reading 2.4.1. The  $p$  number of parameters in section 2.4.1 is for the spatial sensitivity analysis the number of snow zones? The authors might consider combining 2.4.1 and 2.4.3.

b. Do I understand correct that for each LH sampling the SCF is calculated by multiplying the SCF derived from the MODIS SCF by the  $e_i$ ? This would mean that for the sensitivity analysis the MODIS SCF is used only for the temporal dynamics? The SCF magnitude is sampled random between 0 and 1? If this is true this should be explained

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better in the data section about the MODIS SCF and/or around equation 1.

c. Figure 5 contains some interesting information regarding the methodology however some aspects remain unclear to me:

i. In the caption, check the references to left, right, left column, central column, right column? Is this correct?

ii. Do the  $j$  snow zones refer to the 524 snow zones in the catchment? This is not clear.

iii. Do the 3 first rows refer to the simulations for the 524+1 for the first LH sample? Does the last row in the figure shows the first calculation of the second LH which also contains 525 calculations? This is not clear.

iv. From section 2.4.3 I understood the perturbation factor  $f_i$  was 1%, in the third row, the figure in the second row shows a perturbation factor of -1%? Why is this factor negative in this case?

### 3. Results and discussion

a. Separating this section in a results part and discussion part could improve the readability of this section. Consider this option.

b. I understand you want to focus the sensitivity analysis on the spatial aspect but I would find it interesting to add a t-Q graph with the bounds from the SCF sensitivity analysis.

c. Fig 6. the dates in the x-axis is not clear. Does the series start at the first of November, what is the time between the stripes?

d. Discuss more in detail the maps representing the model output sensitivity to SCF presented in Figure 7. e.g. What does a high or low  $SE\%$  value indicate? Why is the legend different for the figures in the last row?..

e. Section 3.3 would fit better in a separate discussion section. Additionally, a discus-

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sion about the number of simulations required for a spatial sensitivity would be interesting. The number of simulations applied in this study (52500) is difficult to achieve for some models. How could the number of simulation be reduced: e.g. less LH samples, less zones, which would be the better option?...

#### Technical corrections

1. I can understand that you use abbreviations in the tables but avoid too many abbreviations in the text. Replace eg. SA, RF, por, res, f\_cap, p\_ind, slp, r\_c, low dep, i\_min, i\_max, etc by their full name.
2. Add space after (Beven and Freer, 2001) L19, p 11989
3. Change the scales in e.g. 1:26000 (without spaces) L28 p 11995, etc.
4. P 12001 L 4: consider changing “Table 3 shows..” by “The last column of table 3 shows. . .”
5. P 12001 L6: consider changing “slp is very important for..” by “ The slope has a large impact on the hydraulic parameters in the WetSpa model..”
6. P12002 L24: change “..SCF zones occurring in the flat ..” by “SCF zones situated in the flat. . .”
7. P12003 L5: relationship strength = correlation?
8. P12003 L6: change “.. has stronger relationship with parameters important for groundwater..” by “.. has a stronger relationship with parameters that are related to the groundwater flow..”
9. P12005 L11: change “According to the Eq. (1)..” by “According to Eq. (1)..”

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