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Interactive comment on "Climate or land cover variations: what is driving observed changes in river peak flows? A data-based attribution study" *by* Jan De Niel and Patrick Willems

Anonymous Referee #1

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I have read the manuscript entitled "Climate or land cover variations: what is driving observed changes in river peak flows? A data-based attribution study" with interest. The topic of the manuscript is suitable for the journal. Indeed, it has been widely referenced but the need to know the significance of drivers for floods in different areas still exists.

In this case, 29 catchments in Flanders were selected for the analysis of the influence of catchment characteristics, climate and land use variables on floods. In general, the objective of the paper is clear, "to investigate the (relative) importance of climate variability and land cover changes related to changes in river peak flows", and results

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obtained are interesting. However, in my opinion, the authors should work further on the analysis and discussion of those results, trying to better explain the dependencies between drivers and floods, but specially the influence of interactions between drivers, that explain up to the 32% of the variability on river peak flows.

The abstract is clear and concise but it lacks some general conclusion.

Introduction is well structured, follows a clear central theme and mentions many references, that could be used to enrich the text extracting some information from them that could help esblishing the state of the art in the topic. Little is said in the introduction about the significance (in other studies) of one of the main drivers in this study: catchment characteristics, in my opinion some references should be included on this.

The case study is not sufficiently described. In my opinion, a general description of the area, considering average climate, geology, slopes, hydrology, vegetation should be included (are they spatially variable?), in order to have a general idea on the study area characteristics and the representativeness of the selected catchments.

- Table 1 includes the period and the number of years of discharge data for each gauging station. These information is repetitive and in my opinion not needed, as data used are those from 1992 to 2015 for all stations. Eliminating those columns may leave space enough for including data on fig. 3 (soil texture) in this table.

The methods section needs to be explained further as some questions are not clear enough: - Is daily discharge data an adequate time resolution to explore river peak flows in catchments smaller than 100 km2? Many of the catchments included in this study are quite small, so that discharge response, especially during peak flows, could be lower than the daily scale proposed; could the authors justify that the selected scale is adequate for the analysis of high flows?

- Using a figure/example/scheme could help understanding better the estimation of peak flow anomalies in section 3.2.

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- In section 3.3. The consideration of characteristics other than climate and land use in the analysis is interesting; however, the authors should justify the inclusion of catchment characteristics on the analysis and the selection of the included characteristics. Why those and not others? The general description of the area may help on this, if the selected characteristics are the ones that show higher variability in the area...

- Nothing about soil is said in this section

- Some information is repeated in section 2 and section 3.3. The authors should decide where to include the completed information just once. For example: P3L7-9: "For land cover, the 30 classes from the ESA CCI Land Cover project (www.esa-landcover-cci.org) were regrouped into the 6 IPCC land categories, i.e. cropland, forest, grassland, wetland, settlement and other land...". P4L19-22: "Land cover and land cover changes have been described in the past through the ESA CCI project (www.esa-landcover-cci.org): .... The 22 land cover categories (or 30, when including 'level 2' or 'regional' labels) identified in this project are grouped into the six IPCC land categories, i.e. settlement, agriculture, grassland, forest, wetland and other area."

- In table 2 soil textures are included. However, nowhere in the text or in other figures and tables the authors talk about textures. They base their analysis in soil textures or in soil classes?? This should be clarified and corrected.

The first part of the Results section, that referred to steps followed "Prior to the first step of the model building process", should not be included in this section but in methodology as no results are explained here (P5L26-P6L4).

- Is it possible to consider at the same time variables that change spatially but not on time (catchment characteristics) and variables that change on space and time? How should results be considered? Catchment characteristics explain a high % of the variability in flood records, however, they are supposed to change only spatially, from one catchment to another, not for the same catchment from one year to the next. However, climate or landuse, explain less variability, but they change from one catchment to an-

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other and also in the same catchment on time. How should these be considered when analyzing results? Some discussion on this point would be interesting.

- P6L10: “The final model, with 26 terms in 9 predictors. . .”. Which terms and predictors? The 9 predictors that in figure 5 are higher than the 50%? And terms? I would appreciate if the authors could specify a bit more.

- Figure 6 needs more explanation and discussion in the text. Which are the most problematic catchments? Can those worse results be related to some specific aspect/characteristic of the catchment?

- What about interactions between variables? How do they work? Which are the most significant? Does the same landuse change have same results in different climatic conditions? And for different chatchment characteristics? And what about climate variability? Has the same effect under forest or under agricultural land? What else can be extracted from figures 7 and 8?

- Figure 8 footnote should be corrected: “Increasing settlement area will, in most cases, lead to increased 5 peak flows”. This is not what the figure shows but what the authors read from the figure. The figure shows boxplots shoing the results given by the model for all the catchments when increasing (or reducing?? See the text of P6L18) settlement percentage to reduce (or increase?) forest. . ..

- What does figure 8 really show? Contradictions are found in the text: P6L18: “1% of the total area from settlement to forest, grassland and agriculture, respectively” P7L17: “1% increase in urbanization could lead in some cases to a 5% increase in river peak flows”

- In this figure (8) it can be observed that changes in peak flows vary depending on which type of landuse is reduced to increase settlements. Could the authors say something about that? What do other authors say about it?

The discussion and conclusion section repeats 3 times that the model explains the

60% of the flood variability, but it does not discuss which could be the reasons why in some catchments the fitting or the consistency is not good. - In P6L29-30 the authors say “Since the explanatory variables all have a smooth variation over time, it is a priori almost impossible for any simple regression model to mimic these step changes”. However, there are important changes in landuse around the year 2002.

- The comment on the time span used in the analysis (P6L32-P7L3) is not a conclusion and in my opinion, should not be included neither as a discussion.

- As the author say “Obviously, given the complexity of these environmental systems, the simple linear model will not be able to capture/describe all effects – indeed, it was seen that interaction effects between catchment characteristics, land cover and climate variability are equally important in explaining changes in river peak flows.” In my opinion a deeper analysis of results and discussion on this part would notably improve the impact of the paper.

- P7L16-17: “The model also showed that, for most of the considered case studies, deforestation indeed leads to increased peak flows” where can this effect be seen? Deforestation? Or decreasing forest to increase settlement, agriculture or others?. “Moreover, 1% increase in urbanization could lead in some cases to a 5% increase in river peak flows”. Can these results be analyzed a bit more? In which cases? Which characteristics have those catchments??

Other comments:

- Which is the resolution of the DTM mentioned in section 3.3? In P4L6 the authors say “The slope at every point in the catchment are calculated”, which is the resolution of those points? (1x1; 5x5, meter?)

- P4L15. “W; (NW, N), (NE; E; SE), (S; SW); U; C; A, with N, E, S and W referring to wind directions”. Please consider re-writing this sentence. Comma and semi-colon are arbitrary used. Parenthesis do not help understanding groups.

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- In figure 3 the word fraction should be replaced or accompanied by classes not to create confusion with soil fractions (sand, silt and clay)

- Figure 3. Information included in this figure can be moved to table 1

- Reference list needs revision. For example: - “IPCC, 2014”: review formatting. doi included corresponds to: IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324.

- “Blöschl, G., Ardoin-bardin, S., Bonell, M., Dorninger, M., Goodrich, D., Gutknecht, D., Matamoros, D., Merz, B., Shand, P. and Szolgay, J.: At what scales do climate variability and land cover change impact on flooding and low flows ?, Hydrol. Process., 1247(March), 1241–1247, doi:10.1002/hyp, 2007.” doi is not complet. https://doi.org/10.1002/hyp.6669 and journal volume is 21.

- Mediero et al., 2015. Last author surname is not complete, lacks first letter.

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