Author's response (AR) to reviewer #2 (J. Juilleret):

We would like to thank the reviewer for his insightful comments.

1) Introduction Despite the effort, I found that the paper lack the "state of the art" on HRU, consequently I suggest that the authors highlight the previous similar studies concerning HRU and how different sources of information can contribute to the development of perceptual models in their introduction. I kindly ask them to better explain difference between HRU and HSA, limits and advantage of the HRU approach. I would like that the authors better explain why their method is innovative and better adapted in karstic and/or mountainous environment. Link to that, explain why traditional methods tend to focus on geology, geomorphology and not soil. What is the reason? (Suggestion: lack of soil map, if maps exist difficulties to translate the soil map unit classification into pedohydrological concept). Please provide references in your general assertion like karst water is used for water supply in Vienna, in karstic areas soils tend to be shallow, etc...

AR: We will revise the introduction to address the remarks above. The basic studies of mapping HRUs in the context of the Dominant Processes Concept (DPC) have already been referred to, and we will extend the description. We will add some more literature for a more comprehensive state-of-the-art overview. The HRU (surface runoff and contaminant transport) and HSA concepts are similar, but we have no hard data about distributed erosion paths and no hard data about contamination loads, which we will mention. A statement about the challenges with soil data and the difficulties of translating existing soil maps into dominant processes descriptions will also be added. Reference to the literature regarding the Vienna Water supply will be given.

2) Case study area Please specify where the Hochschwab massif is in a general map representing Austria. Add references on the vegetation cover. I miss a more information (map) from the key lookout points in the polygons (number, position). I don't consider this request as mandatory, however it will be appreciate, indeed if the information is available, it will help to appreciate the advantage in time and space to cover the entire zone.

AR: The catchment can be identified by the coordinates in the left upper corner, but we will add a small inset map of Austria within Fig. 1 for clarity. While a number of vegetation data sets are available in Austria, their resolution is relatively low. In this study, vegetation was therefore mapped as part of the field efforts. We will add a comment for clarification. The location of the lookout points had not been logged during the survey, but that's a very good point for future applications of the method.

3) Method of process based mapping of surface runoff propensity Inverse the order (i), (ii) and (iii). Indeed, in the article you follow the inverse order.

AR: The presentation will be reversed as suggested.

3a) Geology I suggest that the authors develop the methodology to assess the karstification potential of the bedrock. I understood that the "Rock Quality Designation (RQD)" was used but the link between this method and the 3 geology classes (limestone, dolomite, calcareous sandstone), however it is unclear. Provide more details.

AR: Regarding karstification potential and hence, water infiltration/retention potential, three classes were identified from a regionalization procedure (RQD) out of a number of geologic formations. This had been done in previous studies providing the “hydrogeological map”. Uncertain boundaries were checked during the field mapping. A more detailed description will be added to the manuscript.

3b) Soils. Please better explain the "visual assessment" of the soils. What is the threshold between deep vs shallow soil? Provide a thickness range. Do they authors assess the texture of the soil (clay, silt, sand)? Or do they just classify between fine (< 2mm) and coarse (> 2mm)? If so; why do they consider that it’s important? Why the authors did not use the available soil map? Why the author did not use of soil survey to complement the visible soil profiles in the polygons? I think that it would have been be more relevant than the use of the TDR. Please explain better how you obtain the three infiltration capacity classes, it’s not clear.

AR: As mentioned in the manuscript, mapping of soil depths is limited to available slope cuttings (point data) and extrapolated into space by sedimentation considerations based on morphology and geology (weathering, land and rockslide). A detailed mapping at the catchment scale would be very difficult, among other things, due to floating rocks. The threshold between deep and shallow soils was approximate. Soil depths were mapped at the mapping points, which are often also slope cuttings. For description the limits <0.1m, 0.1 – 0.5m, >0.5m and > 1m were used. Soil depths larger than 1m were an indication of large storage, and only if a large areal extent could clearly be identified (e.g., by evident debris), it was used as additional information to confirm the extent and classification of the polygon. We will add this information for clarification.

From soil physical considerations it can be assumed that a higher fraction of fine material increases storage capacity and decreases permeability (related to soil physical parameters such as field capacity and hydraulic conductivity). 2 mm is often used in soil mapping as a threshold for fine and coarse material (e.g. in the mapping guide of AG BODEN (1994) used in Germany and Austria). For example, soils with a very large fine material fraction (> 80%, corresponding to “loam”) were directly classified into low infiltration capacity (GIN). We will give more information on this in the manuscript.

AG BODEN: Bodenkundliche Kartieranleitung. - 4. Auflage; Bundesanstalt für Geowissenschaften und Rohstoffe und geologische Landesämter der Bundesrepublik Deutschland, Hannover, 1994.

A soil map does not exist in this high Alpine region.

Infiltration class see 3d).

3c) Vegetation. Please provide more information on your choice between dense and sparse. Any references?

AR: The method of Markart & Kohl (2004) was used here. “Sparse” vegetation is mainly assigned to the typical high alpine grassland above the karstic bed-rock (mostly as a mosaic pattern). Sparse vegetation was assigned to an area not fully covered by vegetation, i.e. the canopy cover was less than about 90 % in terms of ground area. This information will be added in the revised manuscript. ET and interception processes are of minor importance.

3d) Infiltration capacity. I agree that there is always subjectivity when the field experimentalist propose his perceptual model of a catchment, but in your case you should make effort in such a way that everybody can reproduce your decision tree. This paragraph lacks the methodology on how the *authors make the synthesis of the mapped properties. A clear methodology should be provided to obtain the different classes of each polygon.*

AR: As the infiltration capacity was classified in the field by the field experimentalist based on the combination of the different indicators and by the use of soft data and expert knowledge, there is no *a priori* decision tree. We gave two examples and the typical scale of the polygon lumping in our description to clarify the method. We will add the sequence of the mapping process in more detail as follows: After the "reading the landscape" step the field experimentalist reached the area of interest. Note that, in some cases with limited sight of line, the borders of the homogeneous area (polygon) could no longer be identified. The location of the field experimentalist was checked by GPS. Next, the field experimentalist confirmed the vegetation type and density and its relationship with other variables. Dense vegetation, for example, makes high infiltration capacity (HIN) less likely. Next he/she mapped the soils/debris/loose sediment and looked for appropriate and representative points or slope cuttings where he/she could map the soil depth and check the fine material fraction by sieving (> 80% is directly classified to GIN). Based on the soil type so identified, the spatial homogeneity was carefully checked for extrapolation to the mapped area. Only if the spatial extent of large soil depths could be clear identified, it was used for further classification of the polygon.

Most of the mapped properties so far are related to a certain underlying lithology, so the occurring geologic type (what the field experimentalist could see in the field) must be consistent with this, so was cross-checked with the hydrogeological map. Finally, any traces of surface runoff or erosion visible from a distance, the apparent existence of permanent flow anywhere in the polygon, and any temporary flow or very rare flow (e.g. due to infiltration excess) were used to verify the assessment. The resulting infiltration class is a synthesis of the properties above, i.e. the choice was made to be consistent with the various, complementary pieces of evidence.

Figure 2 and 5: add scale and orientation of the view

AR: A note will be added in the figure caption on the extent of, e.g., one of the polygons in the front in Fig. 2 and the length of the main flow path in Fig. 5. North arrows will be added.

Figure 3 : please make effort to have a real geological cross-section, bedding and fault are missing and the vertical limits between Dolomite, Calcareous Sandstone and Limestone units seems not natural to me.

AR: The cross section is indeed schematic. We will examine whether there is sufficient field information to add the information above to the cross section, but at this point this does not seem to be the case.

7) Discussion. Provide reference on the assertion that surface runoff propensity is at the pixel scale (10 m 10 m). Discuss not only the advantage of the methodology but also the limits (like subjectivity, compilation of knowledge in different disciplines) and how can you overcome the limits. You should also go beyond the case of study, explaining how field experimentalist are still essential into the understanding of catchment behavior, showing that even if there is subjectivity in their assessment, the role of the field experimentalist is crucial to the hydrological community in the understanding of hydrological basin and their prioposition of perceptual models.*

AR: The working grid size will be justified more fully in chapter 6 in terms of the processes captured and those missed. For the index we chose 10 m x 10 m as a compromise to represent the mapped polygons (smallest polygon A=450 m²) and computational costs. For typical HRUs in catchment modelling the grid size is usually larger, resulting in more pixels with mixed properties, e.g., geology, soils, and the associated infiltration capacity. We will more fully discuss not only the advantage of the methodology but also the limits in the revised manuscript.

We will note the important role of experimentalists, extend the reference to subjectivity, and make further comparisons with other disciplines relying on mapping (vegetation, geology). Of course, the crucial part of the mapping and the translation into hydrological process descriptions is an important part of the message.

8) Conclusion. Please provide some widening ideas on your method. As example, in flat areas the field person can be help by the use of drones, consequently the method can also be apply in other non-mountainous context. Provide some advice on how the method can be adapt in non-karstic context.

AR: Aerial photos such as from drones could be useful to resolve more spatial detail than the aerial photos used here, but visibility in the forests is an issue. We will add advice on how to transfer the method to non-karstic catchments as other properties and processes may gain more importance, e.g., lateral subsurface flow, shallow groundwater level fluctuations, connectivity of flow paths, runoff routing, etc.) and, briefly, how these could be captured.