Additional response to referee #1 and #2 comments (05/05/2015)

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'Influence of solar forcing, climate variability and atmospheric circulation patterns on summer floods in Switzerland'

J.C. Peña, L. Schulte, A. Badoux, M. Barriendos, A. Barrera-Escoda

Note: Due to a technical error at Copernicus only the improved figures were posted for the discussion but not the textual response to the reviewers. Resulting from this error the Editor contacted the authors and asked for improvement. The authors improved the paper without noticing the mistake. After detecting the error and misunderstanding the authors felt that some additional changes and improvement (regionalization of the flood areas) should be included to the former revised manuscript. Therefore, we submit now a second revised manuscript and a short additional response to the reviewer.

Additional response 05.05.2015:

In the 2nd revised manuscript (05.05.2015) we have introduced an improved explanation (text and Fig. 1) of the regionalization of the Switzerland based on the flood damage index INU. We introduced in section 4 (Results, P.9, L.20-30 and P.10, L1-11) the following text:

"The regionalization of Switzerland is based on the application of a PCA to the flood matrix. The 2D-plot of the two principal components (not rotated; see Fig. 1a) accounts 22% of the total variance. When the factors are inverted and rotated by 90º, they display approximately the geographic location of the cantons. Two different dynamics related to the principal moisture sources can be inferred from the sample distribution. The Factor 1 is related to a disposition North/South of the cantons, indicating a lower/greater influence of the Mediterranean Sea. The second Factor is explained by West/East cross section suggesting the higher/lower influence of the Atlantic moisture source.

We used the scree-test to extract the most relevant components (see Fig. 1b) and we performed an Equamax rotation in order to achieve the final regionalization of Switzerland considering the two cross sections. The analysis revealed five principal components accounting for 45% of the total variance. Each region is defined by a component (see Fig 1c): the region 1 is composed by the Valais and the western cantons; the region 2 is defined by the western part of the northern slope of the Alps and the western Swiss plateau; the region 3 represents the south-eastern cantons Grisons, Uri and Ticino; the region 4 is the Swiss Jura and the eastern Swiss Plateau; and finally, the region 5 is the eastern part of the northern flank of the Alps. Thus, the rotation improves the division of regions that appear vaguely defined in Fig. 1a. For instance, Uri (UR) marks the transition between the regions 3 and 5 and finally is added to region 3. Moreover, the cantons located in northern and north-western Switzerland, which in Fig. 1a apparently define a single cluster, are split into two areas (region 1 and region 4) after the rotation. This separation distinguishes probably between the flows from the west-northwest and those from the north."

In the section 5 (Discussion, page 14, L. 9-20) the new text is:

"The hydro-climatic regionalization performed by the PCA shows two patterns of spatial variability related to the two principal moisture sources that affect Switzerland: Mediterranean and Atlantic humidity supplies. The first pattern is related to the North-South cross section while the second pattern is defined by the West-East cross section (see Fig. 1a). Taking into account these findings, the final classification presents five different regions (see Fig. 1b and Fig. 1c). The two cross sections stress the regionalization based on the INU index. The three physiographic units, the Jura, Swiss Plateau and Alps are related to different sources of humidity. The northern slope of the Alps and the Swiss Plateau are divided into three regions linked to the proximity to the Atlantic fluxes. In addition, the region 2 (particularly the Bernese Alps) marks the intersection of both patterns: on one hand the Atlantic flux and on the other hand the moist Mediterranean air masses that flow across the Alps and encounter the cooler Atlantic air at the northern Alpine slope (Pfister, 1999)."

In the section 6 (Conclusions), point number 1 (P.23, L.25-30):

“1. The hydro-climatic regionalization shows two patterns of spatial variability related to the principal moisture sources that affect Switzerland: Mediterranean and Atlantic humidity supplies. The first pattern is defined by a North-South cross section, while the second is linked to a West-East cross section. Taking into account these findings, the final classification presents five different regions that are consistent to other hydrographic classifications developed for Switzerland.”

Finally, we have improved the Figure number 1.

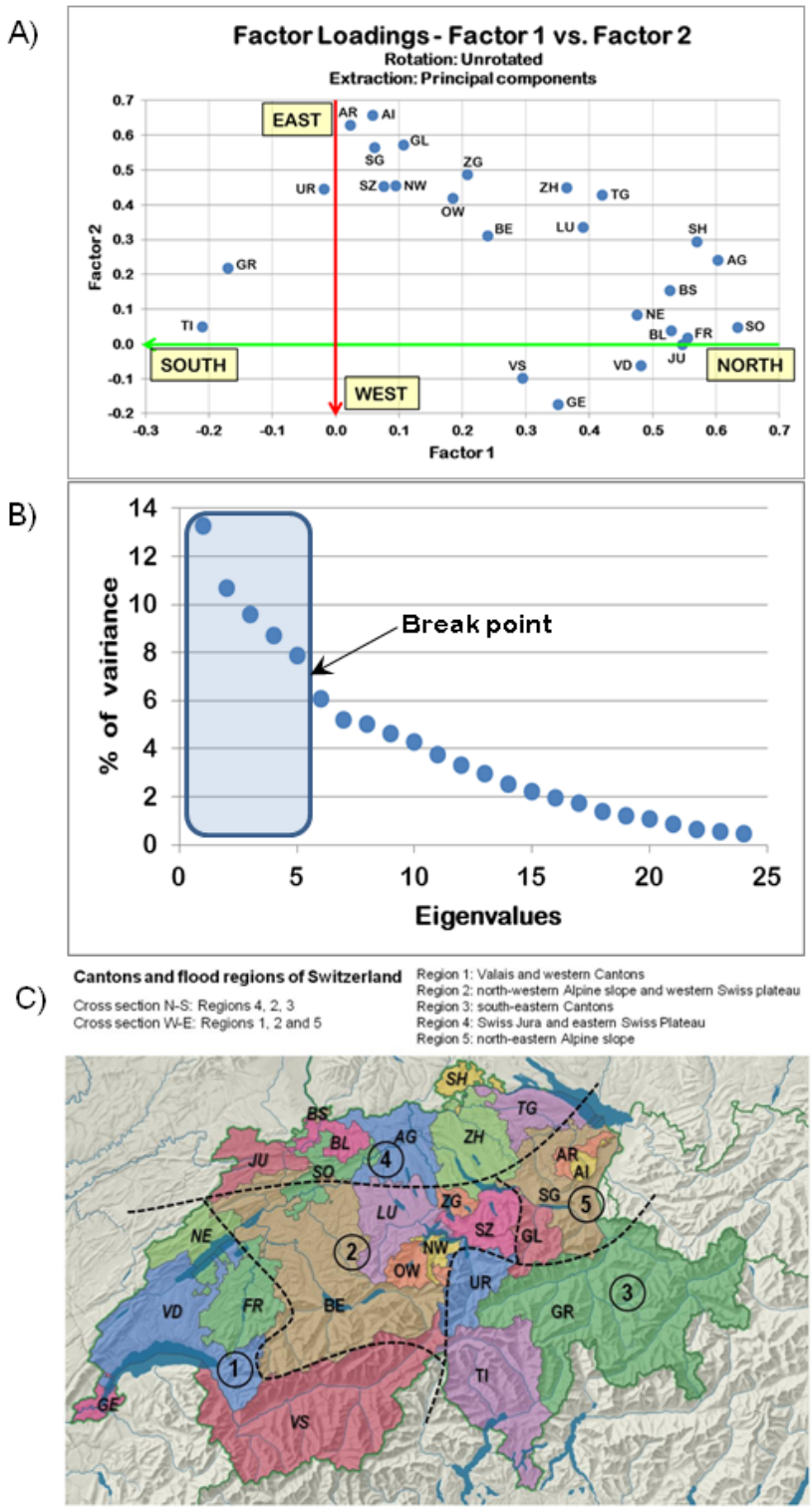

Fig. 1: A) Factor loadings of Factor 1 versus Factor 2 after the application of the PCA to the flood matrix without rotation. B) Scree-test and number of components selected. C) Regionalization of Switzerland according to the PCA applying the Equamax Rotation. Dotted lines are the limits of the regions (DEM from Atlas of Switzerland, 2004; map modified).