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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Influence of solar forcing, climate variability and atmospheric circulation patterns on summer floods in Switzerland" *by* J. C. Pe na et al.

Anonymous Referee #2

Received and published: 10 February 2015

Greetings to the authors of the manuscript "Influence of solar forcing, climate variability and atmospheric circulation patterns on Summer floods in Switzerland", submitted to HESS.

The paper is carefully written, easy to follow and addresses very pertinent hydroclimatic questions. The authors use very well known statistical methodologies for data analysis in the geosciences and rely on widely used data sources.

However, a number of critical issues require some attention:

1) Both the data and the methods should be taken with a "grain of salt". The reconstruc-

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tion of geopotential height fields up to several centuries back is essentially a statistical extrapolation of XX century reanalysis data, under the assumption of stationarity. As such, the "atmospheric circulation patterns" identified for a climatology spanning several centuries are actually a loop of XX century cycles and may not fully capture the actual dynamics that might have taken place in the past.

The reviewer understands that the authors had the best intention in using such reconstructions and knows that these had been produced with the best knowledge available to their authors, under assumptions that they had made clear themselves. However, these caveats should be clearly mentioned in this manuscript, so that the reader is made aware that the statistical reconstructions and analysis of atmospheric data are not necessarily related to physical phenomena.

2) On the so-called "Summer NAO":

This issue is also not the authors' fault but is very critical to the paper:

Some geostatistical literature jumps into unfounded interpretations from statistical results without showing proper understanding about the physical processes. There, geospatial patterns are obtained and interpreted as being what they are not. One of them is the so-called "Summer NAO".

The authors, who clearly strived to make a thorough analysis, have clearly fallen victim of such ill-advised literature. However, now the authors have the chance to set the record straight prior to final publication. It would be a shame to see such interesting and well-written work marred by such a blunder that had not even been introduced by the authors in the first place.

What is then the problem with the "Summer NAO"?

In a nutshell: the first principal component of the geopotential height field at 500 hPa (Z500) only represents the NAO if the analysis is performed for the Winter. In fact, that is the only season in which the NAO is the dominant circulation pattern. Over Summer

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the NAO is definitely not dominant. Instead, other processes take over. As such, it is their imprint, not of NAO, that is seen in the first principal component of the Summer climatologies of Z500.

In detail: There is a fundamental problem in the identification of the large scale atmospheric driver North Atlantic Oscillation (NAO). The authors mention a positive anomaly (high-pressure) centre over the North Sea (between Scandinavia and the British Isles), and a negative anomaly (low-pressure) centre over the Mediterranean. Actually, the centres of action of the NAO lie over the Atlantic, not over the North Sea or the Mediterranean sea. The actual, physical high-pressure centre is the "Azorean High", over the North Atlantic area around the Azores archipelago, and the low-pressure centre is the "Icelandic Low", over the North Atlantic area around Iceland. The high-pressure centre close to Scandinavia is known as the Scandinavian High and represented by the Scandinavian Oscillation (SCO) Index. More on it can be found in a rich atmospheric science literature of rather quickly at major oceanic and atmospheric agencies, e.g. NCEP and NOAA http://www.cpc.ncep.noaa.gov/data/teledoc/telecontents.shtml).

As noted before, when performing Principal Component Analysis for the extraction of EOF of the sea level pressure fields, the NAO pressure anomaly pattern will only be dominant during Winter (e.g. December to February, northern hemisphere). During Summer other patterns take over, e.g. the SCO. This is why the first EOF over Summer is no longer NAO-related, rather having completely different centres of action. Calling that "Summer NAO" is thus plain wrong.

This being said, the solution to this problem is within the authors' reach: first and foremost, the authors should remove the ill-named Summer NAO or SNAO, and then reinterpret the Summer patterns in the light of mechanisms that actually play a dominant role at that time.

Again, it is very important to make it clear that these patterns are largely based on information statistically extrapolated from the XX-century, so that the results are put in

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the right perspective.

3) On calling EOF of the geopotential height field "atmospheric circulation patterns".

In fact, per se they are not. Rather, as computed in the paper, they are geospatial patterns that explain the low-frequency statistical variability of the geopotential height field anomalies relative to the climatological average taken in the analysis (which is then directly related to atmospheric pressure field anomalies). These patterns can then be used to inform about the dominant wind patterns and thus circulation regimes.

A proper name for these geospatial patterns is "teleconnection patterns", as this is ultimately about statistical teleconnections in the atmosphere, i.e. the identification of statistical properties that inform about the spatial coherence of a certain field.

4) On the general absence of physics behind the statistical analysis

This is a recurrent problem in geostatistical and climatological studies, especially when teleconnection patterns are taken into consideration (e.g. NAO, SCO, EAWR, MJO, AMO, among others).

Purely statistical patterns are interpreted as being a physical signature, when they are not. Whilst addressing the fundamental processes behind would make for a completely new study, a brief word on potential mechanisms at play along with supporting physical arguments would be very welcome.

5) Correlation is not causation

Finding some correlations between potential drivers (e.g. solar activity, atmospheric patterns) and floods is a worthy task and it is clear that the authors have taken it with care. However, it should be clearer to the reader that these do not mean that there is any causal link between the processes. Conversely, the absence of correlations does not necessarily mean that the processes are not related at all.

At most, correlations indicate the existence of a "statistical connection", which has the

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good use of assisting the researcher in formulating hypothesis to understand a certain problem. However, without a physical reasoning, correlations are just that: statistical connections. Therefore, care must be exerted when talking about "influences" when discussing correlations.

6) On Vb tracks and floods of Mediterranean origin, p. 13867:

Actually, Vb are a local symptom of a broader synoptic situation generally coming from the Atlantic and then collecting additional moisture and energy from the Mediterranean (Blöschl et al. 2013 - http://www.hydrol-earth-syst-sci.net/17/5197/2013/hess-17-5197-2013.pdf).

7) New vs. known facts

The paper would benefit from a clearer distinction between the knowledge revisited by the authors and their innovative contributions. Having extensively accompanied the relevant literature, one can see how the authors innovated, but that might not be that clear to the less informed reader.

The verdict:

All in all, despite the raised issues, and given the interest, quality and relevance of the study, the reviewer would not dismiss the paper. Rather, the reviewer would recommend a careful revision addressing these raised concerns.

The reviewer looks forward to the revised version of the manuscript.

Thank you for your attention and best wishes.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 13843, 2014.