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Hydrology and Earth System Sciences Discussions

Interactive comment on "Interannual variability of winter precipitation in the European Alps: relations with the North Atlantic Oscillation" *by* E. Bartolini et al.

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GENERAL COMMENTS

The paper investigates the variability of winter precipitation in the European Alps, in particular it shows that selected large-scale climate anomalies are not able to explain the inter-annual variability in winter precipitation in this region. Although regions north and south of the Alps do show relationships with the large scale patterns, the Alps are in a transition zone where no statistically significant correlations can be found. Trends in gridded precipitation data were also analyzed.

The message of the paper is clear and relevant to the geosciences community looking at these issues. Other studies have addressed the topic of precipitation and climate indexes in Europe, but this one is first to my knowledge which uses a long and large scale gridded database to illustrate the connections statistically. The paper is well written and enjoyable to read. Most importantly, the methods are good. I commend the authors for trying different combinations, averaging schemes, etc. of the precipitation indexes, as well as filtering the NAO index to include only extreme values. All of this gives the results confidence and authority.

However, I would like to raise a general discussion point regarding the use of gridded datasets, such as the CRU TS 1.2, to time series analyses of the kind conducted here. I understand the CRU TS 1.2 precipitation data are station data interpolated onto a regular grid. In this process, spatial interpolation takes precedence over temporal coherence, in other words the monthly time series at a grid point are not checked for consistency. This becomes an issue with long records, such as the one used here, where the station density may vary not only in space but also in time. In particular in the European Alps, station density is low by definition, and high altitude stations were only included in more recent decades. The issue of representativeness is especially relevant for the high altitude regions of the Alps, where station data themselves grossly underestimate precipitation and their records are I believe not corrected in the CRU TS 1.2. In other words, the authors are working with data that have limitations in particular in the Alps. I think in their paper, they should present more of their thoughts on what kind of errors or influences this may bring into the analysis.

The second discussion issue relates to changes in time. How good is the gridded record of precipitation over Europe in the early period compared to the recent one? Could other anthropogenic effects, such as landuse changes, urbanisation, etc. have influenced the precipitation record to the point that they interfere with large scale climate effects? What if the correlation between large scale climate indexes and precipitation in the early record is different from the recent record, what kind of inference

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may we be able to make from that? These are questions that I think are worthwhile to explore, perhaps the authors can consider that. I think they are in a position to provide insightful answers.

SPECIFIC COMMENTS

The authors are aware of the problem of consistency and conduct a test of the gridded data versus observations at nine stations. Although the fits are generally quite good, it is noteworthy that they are worst in the two highest laying stations. It should also be said that the authors are comparing here station point precipitation with areally (grid) averaged precipitation, which on a monthly basis is probably not bad, but in principle is not correct. Note that the correlation coefficient is not a good measure for identifying bias, e.g. the station Saentis (which by the way is a chronically complicated record), has a good linear relationship between observations and gridded data, but a consistent under or over estimation (it is not clear because the axes titles on Figure 1 are missing). Perhaps the authors could also add the slope of their constrained regression to Table 1 to identify the level of over or under estimation.

It is of course very unlikely that a strong relationship between precipitation mean or variance (summer or winter) and altitude at the scale of the European Alps can be found. The authors make reference to that on page 2051. Nevertheless I think it is illustrative to show that to readers of HESSD. Could the authors consider if a scatter-plot of the variance and mean versus altitude and/or versus each other would be of added value to their paper?

In interpreting the spatial maps in Figures 2-7 the authors often refer to the European Alps. Is it possible to include a polygon outlying the area they refer to as the European Alps in those Figures (or at least some of them). As the authors correctly point out, the mountain range does generally lie in the statistically insignificantly correlated area. However it is quite relevant that there are areas, such as the southern slopes that the authors refer to, which do show some significance. The study is heavily based on the

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interpretation of the spatial fields in Figures 2-7. The colour schemes cannot be read printed black-and-white. Is it possible to recolour the figures?

As the authors correctly point out on page 2053, when analyzing trends in the data the chosen period will play an important role. For example, we show some effects of this for precipitation in Birsan et al. (2005), Fig. 6, in the Swiss Alps. Therefore comparisons between results of other studies with different periods are rather meaningless. Also, the gridded dataset used in the study is an interpolated product. The fact that the authors found statistically significant trends in the gridded data in the Eastern section of the Alps but not in the station data (page 2054, line 16) should be a cause for concern. Is it not possible that the trend is a by-product of the spatial interpolation and changes in the station density there?

I would not refer to a decrease in precipitation as a drought (page 2054, line 21) unless you first define what a drought is.

Do not use precipitation in plural (page 2047, lines 5 and 12).

REFERENCES

Birsan, M.-V., Molnar, P., Burlando, P., Pfaundler, M. (2005) Streamflow trends in Switzerland. Journal of Hydrology, 314, 312-329.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 2045, 2008.