

Comments on the paper entitled “The response of Iberian rivers to the North Atlantic Oscillation” by Lorenzo-Lacruz et al. (2011)

I. General comments

The paper is well written and organized. From an originality standpoint, although the analytical methods used are not novel, they are applied adequately. And although the results are not novel, they are of great interest for the region studied. Thus, the paper contributes to a better understanding of the relationship between NAO and the spatio-temporal variability of monthly mean streamflow in this region. However, in its current version, the paper still has some weaknesses.

While the authors only analyze the effect of NAO on the interannual variability of monthly mean streamflow in IP, they do not explain in sufficient detail, in the Introduction section, why they restricted their analysis to this particular climate index, even as they recognize the effect of ENSO on the variability of precipitation in Spain and Europe in general. Other indices, such as AMO and AO, may also affect this variability. Furthermore, because the authors did not analyze all the interesting results deriving from Figures 2 and 3, the ensuing discussion on the relationship between NAO and the spatio-temporal variability of monthly mean streamflow is too brief and incomplete. The Results (sections 4.1 and 4.2) and Discussion sections must be expanded to provide more in-depth analysis and interpretation.

II. Specific comments

1. Introduction

Page 4461, lines 25-29; Page 4462, lines1-10

This paragraph should probably be moved to section 3.2 (page 4464) and the introduction should be reworked accordingly.

2. Study Area

Page 4463, Study area

The text in this section and in Figure 1 does not provide sufficient information on the various watersheds and stations analyzed. A table containing the following data should be provided as a complement to Figure 1 (see example below).

Table 1

No	Watershed name	Geographic region	Surface area	Mean altitude	TAP	Number of natural and regulated stations
1	Cantabrian	AT				
2						
3						
4						
5						
6						
7						
8	Jucar	ME				
9						
10						
11						
12						
13	Sado	AT				

AT = Atlantic Region; ME= Mediterranean Region; TAP = Total annual precipitation.

3. Dataset and Methodology

Page 4465, lines 15-20

Sequences (duration) of missing data in the time series must be provided. Do they span more than two consecutive years?

Page 4466, lines 1-6

This section on standardization seems unclear.

- 1) Were all these probability distributions applied to each station?
- 2) If not, how is it possible to compare series which were standardized according to different probability distributions?
- 3) What is the rationale for using GEV's for monthly flow data? This distribution is generally used for extreme flows.

Page 4467, line 20

Applying the term “non-stationarity” to correlation coefficients does not seem appropriate. This term is generally used for moments of a statistical series, such as the mean or the variance.

Page 4467, line 22

- 1) It would be useful to clearly define the term “moving-window correlations”.
- 2) Why the use of 21 years in deriving these correlations?

Page 4468, line 11

Which criterion is used to determine the number of significant principal components?

4. Results

Sections 4.1 and 4.2.

These two sections should be merged into a single one.

Figures 2 and 3

- 1) Map titles and legends are illegible. This must be improved.

- 2) The order of maps in Figures 2 and 3 must be modified to be consistent with the way months are grouped into seasons. Maps should be arranged as follows:

Map of December	Map of April	Map of August
Map of January	Map of May	Map of September
Map of February	Map of June	Map of October
Map of March	Map of July	Map of November

- 3) All points corresponding to non significant correlation coefficients should be removed to make maps more legible and easier to describe.
- 4) The legend pertaining to correlation coefficient values is not precise. For instance, does the size of the circle corresponding to a coefficient of 0.5 also represent all values larger than that threshold? Class limits for the coefficients of correlation must be defined.

Text in sections 4.1 and 4.2

The description of results presented in Figures 2 and 3 is short and does not address all of the important features observable in these two figures. Here is one possible example of how these two figures could be described:

- In winter, NAO is negatively correlated with many stations at the IP scale, although this correlation is not homogeneous for the four winter months (Fig. 2). In December, at the beginning of the season, a difference is observed between the southern and central sectors (many stations correlated with NAO) and the northern sector of the IP (few stations correlated with NAO), whereas in March, at the end of the season, the opposite is true.
- During spring-summer (April to July), the number of stations which show a significant correlation with NAO decreases throughout the IP. Furthermore, in July, this correlation becomes positive, particularly in the Northwest.
- During summer-fall (August to November), the number of stations which show a significant correlation with NAO increases gradually at the

beginning of the season to reach a maximum in October, month during which the correlation is negative, as in winter. In addition, a difference is once again observed between the southern and northern sectors of the IP, as during the month of March. Thus, March and October are characterized by the same North-South difference. Finally, in November, the number of stations significantly correlated with NAO decreases with respect to October, and these stations are concentrated in the southwestern sector of the IP.

The spatio-temporal distribution of lagged correlations is similar to that just described, with the following differences:

- In winter, the contrast described above for December is observed, although the number of stations which are significantly correlated with NAO decreases in the southern and central sectors. In contrast, in March, the North-South difference disappears as a result of the increase in the number of stations statistically correlated with NAO.
- During spring-summer, the number of stations which are significantly correlated with NAO increases in April and, to a lesser extent, in May. The most notable fact is the disappearance of positive correlations in July.
- During summer-fall, as in the previous season, the number of stations which are significantly correlated with NAO decreases, this decrease being particularly strong in October. In November, there is a slight North-South difference which is opposite to that observed in December.

Page 4493, Fig.7

Why choose the month of March, which is characterized by a North-South difference? The months of January or February should have been used instead. In addition, given the symbols used, it is not possible to see whether or not coefficients of correlation are higher than during other months.

5. Discussion

Page 4474, section 5.2 Spatial and temporal variability

This whole section must be reworked, as the authors did not provide an adequate description of the spatio-temporal variability of correlations in the Results section. They need to address all the factors which may affect the spatial and temporal variability of streamflow.

Factors to consider when dealing with temporal variability

1. Season-to-season variability
2. Month-to-month variability during a given season
3. The North-South contrast observed in March and October
4. The change in the sign of correlations during spring-summer
5. Interannual changes in correlation (before and after 1970)

Factors to consider when dealing with spatial variability

1. West-East contrast (Continental effects?)
2. North-South contrast (Latitude effects?)
3. Any orographic effect

The conclusion section must be reworked to include a discussion of the foregoing

III. Technical corrections

Page 4460, Line 20

Add “spatio-temporal” before “variability” (“the spatio-temporal variability”)

Page 4468, line 16

Replace “lineal” with “linear”.

- 1) Figure 3: The title of the map for the month of March is incorrect. Change “March NAO – March streamflow” to “March NAO – April streamflow”.

Page 4486, Table 1

To be consistent with season definitions, the table must start with December and end with November.

Page 4492, Fig.6

Y-axes must be labelled (legend).

Page 4493, Fig.7

- 1) Y-axes must be labelled (legend) and years must appear below the figures.