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Hydrology and Earth System Sciences Discussions



# *Interactive comment on* "Streamflow droughts in the Iberian Peninsula between 1945 and 2005: spatial and temporal patterns" *by* J. Lorenzo-Lacruz et al.

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The authors want to express our gratitude for the interesting comments and observations received from the reviewer, all of them aimed to improve substantially the quality of our work and the clarity of the presented results. Following we include a detailed letter where we respond to every suggestion and concern of the reviewer, explaining all changes introduced in the revised version of the manuscript. General Comments

At catchment level, the study analyzed the temporal and spatial variability of streamflow drought in Iberian Peninsula. Adequate historical daily streamflow data spanning



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Interactive Discussion

Discussion Paper

from 1945 to 2005, recorded from 187 flow gauging stations was used. The daily streamflow series were aggregated to monthly values that were further transformed to Standardized Streamflow Index (SSI). Principal component analysis (PCA) was performed to all standardized variables that were comparable in both spatial and temporal scales. While focusing of prior set threshold levels, regions with homogenous level were identified. About 10 principal components (PCs) which explained 70% and 60% of the precipitation and streamflow respectively were identified throughout the Iberian Peninsula. The study verified a worsening situation with respect to drought duration and magnitude. Generally, the study's contribution in improving the knowledge as well as the suitable approach in analyzing streamflow drought not only in Iberian Peninsula alone but also in other regions in the world is pronounced.

Specific Comments

Daily data versus monthly data Page 7 line 8-9 The study aggregated the average daily streamflow to average monthly streamflow series. This process is associated with loss of information such the dimensional determinism (Salas et al., 2005). Although, the use of daily data would have required the use of computers with large space and speed in order to perform all the computations. The study should have commented something in this regards.

We conducted this study using monthly data considering the nature and characteristics of hydrological droughts, and regardless the processing capacity of our computers. The beginning and the end of a dry episode are difficult to determine and its impacts grow slowly in magnitude. These impacts may accumulate over long time periods and they can span for years (Mishra y Singh, 2010). This is the reason why we used monthly data for the analysis, since daily data may be redundant and not necessary for streamflow drought detection. We added the next paragraph in the revised manuscript to clarify this point:

We conducted our analysis using monthly data due to the characteristics of hydrolog-



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ical droughts. Drought episodes are recognized to be difficult to pinpoint in time and space, the effects grow slowly in magnitude and its impacts may accumulate over long periods of time (Mishra & Singh, 2010). For these reasons we considered monthly data more suitable for drought characterization than daily data.

Slopes (terrain) Page 12 line 4 and 7 Although it may not be of significant importance, the study should have defined the meaning of steep slope (for example slope> 10%, steepest slope>20). By defining these terms it becomes easy to reproduce a similar study somewhere else.

When we talk about "steepest slope" we referred to the most pronounced slopes among the different regions. The values of the mean slopes (%) of each hydrological region are shown in figure 3, allowing the comparison with other regions elsewhere.

Natural flow characteristics and quality In a situation where droughts characteristics are increasing in complexity, it is likely that the natural characteristics of the river flows are impacted and it threatens the sustainability of the ecosystem (Katambara and Ndiritu, 2009). In addition, as the flows decrease the return flows that are normally of higher concentrations are expected to be diluted by the receiving waters, this is likely not the case and it affects the sustainability of the ecosystem. It not the objective if this study, however, discussing this issue in the recommendation may be necessary.

We added the next paragraph in the discussion:

In unregulated basins, increasing drought duration and magnitude are affecting the maintenance of ecological flows and threatening the maintenance of riparian and river associated ecosystems. The absence of reservoirs to smooth the impacts of drought on naturalized streamflows increases the vulnerability of these basins to the occurrence of droughts.

Technical corrections

Streamflow homogeneously distributed Page 1 line 2-3 The study indicates that the



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streamflow are uniformly distributed across the study area. It will be clearer if the streamflow gauging stations where the data was recorded from are considered to be uniformly distributed within the study area.

We rephrased the sentence:

Streamflow series belonging to 187 homogeneously distributed gauging stations across the study area were used to develop a streamflow index.

SS Page 10 line 5 SS should be replaced by SSI.

We corrected this mistake.

REFERENCES

Mishra, A.K. y Singh, V.P., (2010): A review of drought concepts. Journal of Hydrology 391, 202-216.âĂČ

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