Hydrol. Earth Syst. Sci. Discuss., 2, S725–S729, 2005
www.copernicus.org/EGU/hess/hessd/2/S725/
European Geosciences Union

Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrological response to different time scales of climatological drought: an evaluation of the standardized precipitation index in amountainous mediterranean basin" *by* S. M. Vicente-Serrano and J. I. López-Moreno

S. M. Vicente-Serrano and J. I. López-Moreno

Received and published: 22 September 2005

We are very grateful for the positive comments done by the Dr. Martín-Vide to the manuscript about its high applied interest and also for the proper methodology used. We also want to thank him for the suggestions done to improve the manuscript. These suggestions will be taken into account in the revised version of the manuscript. They are addressed below:

1. The study basin is not well characterised.

The Dr. Martín Vide suggests to include more indications of slopes, lithology, vegetation cover, etc. This will be added to the paper in the revised version of the manuscript.

2. The discussion section is not very rich in ideas, relationships between the results and the geographical characteristics of the basin, comparisons with other studied areas, etc.

In this case, we believe that the discussion section highlights the factors, which drive the uncertain response of water resources to climatic drought. It implies the necessity to carry out similar approaches than presented here before to use SPI for drought monitoring.

Moreover, in relation to the results obtained in the paper we have also included other comments about the influence of the geographical characteristics of the basin on the reservoir management (see paragraph 2, page 1232):

"However, a noticeable seasonality was found in the SPI's usefulness to monitor droughts. There are monthly variations in both the strength of the correlations and the most suitable SPI time scales, resulting from several features of the hydrological behaviour of the basin. Thus, the large hydrological importance of snow accumulation and melting processes in the area (López-Moreno and García-Ruiz, 2004) determines the progressive increase in the optimum SPI time scale for explaining the river discharges and the low importance of the SPI at short time scales, during late winter and spring. At the end of spring and during early summer, the high precipitations registered in the area, when the soil moisture in the basin is still high, produce a fast hydrological response to SPI (time scale of 1-2 months). Also, a new rise is observed in the correlation coefficients at large time scales as a consequence of snowmelt and the water stored in the soils during the previous months. In August and September, the reserve of water in the basin is usually exhausted. Thus, the hydrological response is highly governed by the stormflow (short SPI time scale) and is subject to great uncertainty. The hydrological response of autumn seems to be mainly governed by both the moisture conditions found at the beginning of the season and the short scale precipitation conditions. This explains the high correlation coefficients from 1 to 7 month SPI time scales. Finally, during winter wet conditions dominate the catchment, which explains

HESSD
2, S725–S729, 2005

EGU

the better response of river flows to shorter SPI time scales."

Also paragraph 2, (page 1233) deals about the factors that explain the response of reservoir storage levels:

"Seasonal variability in the response of reservoir storages to SPI seems to be related to the fluvial regime received and the annual pattern of reservoir management. In summer the reservoir storages do not show correlations higher than 0.55 with the SPI. On the contrary, however, during the autumn and winter the correlations between the SPI and the hydrological variables are more robust and even higher than 0.8. In summer, the contribution of the rivers with regard to the water supplied for irrigation is very low. Thus, the water volume during this season depends more on the stored level reached at the end of spring, determined by the hydroclimatic characteristics of the previous year (López-Moreno et al., in press) than to the precipitation conditions during the current or the previous two or three months. In autumn, the water level depends on the stored volume at the end of the irrigation season (September) and the magnitude of the inflow discharges. The former responds to the hydroclimatic conditions at large scale (López-Moreno et al., in press), and the latter is highly determined by the SPI at short scales. However, water stored in winter basically depends on the hydroclimatic conditions since the beginning of the filling period. Thus, the SPI at short time scale progressively loses importance and increases the correlation coefficients with the SPI at larger time scales."

We believe that these comments are enough to explain the response of the reservoir storages and the river discharges to the different time scales of SPI. Moreover, regarding to the comments done by the reviewer 2, we will include other aspects related to the different response as a function of the dry and humid periods. This will add more details and will enrich the discussion in relation to the SPI-water resources relationships.

The scarcity of previous works on this topic hinders the comparison with other results obtained for other areas. Our results partially agree with the general assumption: river

HESSD
2, S725–S729, 2005

discharges are more related to shorter time scales of SPI than the reservoir storages. This comment previously had not been confirmed with many empirical studies.

3. The optimum would have been to analyse two basins in the same mountainous area or in other Mediterranean ranges. Also he indicates that in the present form at least as hypothesis for future research in the same field, what elements are more important to explain the specific results, apart from precipitation.

The discussion about the fact to include two or more basin in the present manuscript was addressed in the response to the reviewer 2:

"With regard to the unique use of one catchment, the main purpose of this paper was to check the validity of several statements, which are frequently accepted about the usefulness of the SPI to identify droughts in different subsystems of the hydrological cycle. In order to address this goal, it was correlated SPI series at different time scales (from 1 to 24 months) with river flows and reservoir storages at monthly level. This procedure provided a large amount of information. Thus, it was required a noticeable synthetic capacity and the use of relatively complex graphs (i.e. Figs 4 and 6) to show properly the results. Moreover, this paper did not aim to provide optimal SPI time scales for monitoring hydrological droughts in different basins. In the discussion, we outline the necessity to carry out similar analysis than here in other mountainous areas, before to use SPI for monitoring droughts. We considered that the introduction of more basins in the study would imply to enlarge unnecessarily the paper, as well as to introduce a greater complexity for interpreting the results. The Upper Aragón river basin represents well the characteristics of a mountainous Mediterranean catchment in both: climate and land-use/ land cover conditions. The selection of the basin was based on the quality of the data available, and on the knowledge about its environmental and hydrological characteristics, analyzed by the authors in previous works (López-Moreno et al., 2002 and 2004; Vicente-Serrano et al., 2004)."

With regard to point out the elements that are more important to explain the specific

HESSD

2, S725–S729, 2005

results, apart from precipitation, in the line 24 (page 1231), regarding to the river discharge response, we stress that:

"In other basins with different characteristics (size, shape, slope, lithology, climate, land cover, etc.) different time scales of SPI could be better to monitor droughts. In any case, more research is necessary to establish proper relationships between the characteristics between basins characteristics and their response to different time scales of SPI."

Regarding to the reservoir storages response (line 9, page 23):

“However, it is necessary to consider that the characteristics of the reservoir (capacity or impounded ratio index), the use which receives (irrigation, hydropower generation, both) and the management pattern applied can produce a large variability in the response of the water stored to SPI at different scales.”

4. In relation to the specific comments

The corrections and grammar suggestions, and also the minor comments in relation to the inclusion of more information in the paper, will be taken into account in the revised manuscript. In relation to the most important aspects:

1. The quality of the river discharge data has been addressed in previous papers (See Lopez-Moreno et al., 2002; 2004). The Yesa reservoir data has been carefully tested and no-trend in the amount of water diverted through the canal has been found. 2. The mean duration of dry-spells, according to the time scales of SPI, will be added in the section 4 of the revised manuscript. 3. The highest daily precipitation values recorded in the area will be included.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 1221, 2005.