

Are precipitation and snowfall droughts concomitant in semiarid mountainous areas?

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The current meteorological drought situation we have been facing in the Mediterranean regions during last years has also resulted in a shift in snowfall seasonal patterns. Particularly, in the Sierra Nevada mountain range, an alpine-climate area in the semiarid southern Spain very close to the Mediterranean, this has been also translated in very different snowpack evolution on an annual basis. For instance, 2019-2020 had shallow snowpacks with three clear accumulation-ablation cycles, in 2020-2021 snowpacks were thicker but with a shorter duration, or in 2021-2022, the first big accumulation cycles took place in March. Traditionally, meteorological droughts have been defined using the whole precipitation amount, without discriminating between rainfall or snowfall. However, snowfall is the main determinant of snowpack evolution and should be used for defining "snowfall droughts", whose hydrological impacts can be amplified throughout the watershed in mountain areas.

This work proposed to analyze the connection between precipitation and snowfall droughts. For that, the Standardized Precipitation Index (SPI), widely used in hydrology, and the Standardized Snowfall Index (SSI, defined as SPI but using snowfall data) are calculated in the study area on different time scales for a reference period of 50 years (1960-2020), establishing connection patterns among them.

The joint analysis of SSI and SPI on each time scale has allowed us to classify different situations according to the annual precipitation and snowfall. The results show the relevant seasonality of snowfall droughts in this area, and the importance of persistent precipitation drought. These conclusions highlight the need for specific snow drought indexes to foresee possible implications in hydrological drought management.