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Decadal trend of precipitation and temperature patterns and impacts on snow-related variables in a semiarid region, Sierra Nevada, Spain.

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In the current context of global change, mountainous areas constitute singular locations in which these changes can be traced. Early detection of significant shifts of snow state variables in semiarid regions can help assess climate variability impacts and future snow dynamics in northern latitudes. The Sierra Nevada mountain range, in southern Spain, is a representative example of snow areas in Mediterranean-climate regions and both monitoring and modelling efforts have been performed to assess this variability and its significant scales.

This work presents a decadal trend analysis throughout the 50-yr period 1960-2010 performed on some snow-related variables over Sierra Nevada, in Spain, which is included in the global climate change observatories network around the world. The study area comprises 4583 km2 distributed throughout the five head basins influenced by these mountains, with altitude values ranging from 140 to 3479 m.a.s.l., just 40 km from the Mediterranean coastline. Meteorological variables obtained from 44 weather stations from the National Meteorological Agency were studied and further used as input to the distributed hydrological model WiMMed (Polo et al., 2010), operational at the study area, to obtain selected snow variables. Decadal trends were obtained, together with their statistical significance, over the following variables, averaged over the whole study area: (1) annual precipitation; (2) annual snowfall; annual (3) mean, (4) maximum and (5) minimum daily temperature; annual (6) mean and (7) maximum daily fraction of snow covered areas; (8) annual number of days with snow cover; (9) mean and (10) maximum daily snow water equivalent; (11) annual number of extreme precipitation events; and (12) mean intensity of the annual extreme precipitation events. These variables were also studied over each of the five regions associated to each basin in the range.

Globally decreasing decadal trends were obtained for all the meteorological variables, with the exception of the average annual mean and maximum daily temperature. In the case of the snow-related variables, no significant trends are observed at this time scale; nonetheless, a global decreasing rate is predominant in most of the variables. The torrential events are more frequent in the last decades of the study period, with an apparently increasing associated dispersion. This study constitutes a first sound analysis of the long-term observed trends of the snow regime in this area under the context of increasing temperature and decreasing precipitation regimes. The results highlight the complexity of non-linearity in environmental processes in Mediterranean regions, and point out to a significant shift in the precipitation and temperature regime, and thus on the snow-affected hydrological variables in the study area.