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Middle-term evolution of river discharges, climatic variables and land-uses in mediterranean mountainous environments

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Mediterranean countries have historically faced water availability issues due to their specific type of climate. A greater water demand caused by growing industries such as tourism and agricultural practices, together with a predicted reduction in precipitation may lead to a decrease in surface water. In additon, it has been demonstrated that forest expansion reduces the availability of water in a given basin. In Spain, the expansion of forested areas observed over the last few decades is thought to be intensifying such water availability problems. Mountainous regions are especially sensitive to environmental changes and therefore particularly suitable to study the evolution and present state of water resources together with the factors that take part in water yield and consumption.

The objective of this work is to analyse the evolution of river discharges and its relation to the behaviour of the main climatic variables and land-cover changes in two non-regulated catchments characteristic of Mediterranean mountains environments, in North-central Spain.

The water discharges, precipitation and temperature data series have been analysed to determine their trends and variability in a representative period. Next, land-uses within the catchments have been mapped using aerial photos and ortho-images for the years 1957 and 2002 respectively. Finally, multiple linear regressions of the normalised variables were developed in order to estimate the relationship between their evolutions. River discharges gauged in the two catchments show a decreasing trend

over the studied period as well as a change in the monthly regime of the streams such as the disappearance of the spring peak. These changes are thought to be caused by the tendencies observed for the main climatic variables: precipitation reveals a decreasing trend over time which affects primarily the winter and spring seasons; moreover, the temperatures evolution shows a positive trend since the early 70's, statistically significant in the spring months. Land-use changes could have taken part, as well, in the loss of river discharges. During the second half of the twentieth century, natural expansion of forest and mountainous shrubs due to the abandonment of agricultural activities, together with the forestation practices undertaken by public administrations, have clearly increased the extension of ground covered by plants. Multi-variable analysis of the normalized variables however, doesn't indicate that land-use changes are significantly influencing the reduction of water discharges. Precipitation, on the contrary, was found to strongly correlate with the stream-flow evolution, and thus is thought to be the main variable influencing the loss of water discharge.

Key words: water discharges, temperatures, precipitation, land-cover, Mediterranean mountains