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# Environmental benefits of traditional irrigation ditches in the Sierra Nevada (Spain) ecosystem by analysing the spatial-temporal evolution of NDVI on different time scales

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In Mediterranean mountain regions, traditional irrigation systems still persist in areas where the modernization approaches do not succeed in being operational. It is common that these systems alter the soil uses, vegetation distribution and hydrological natural regime.

This is the case of the extensive network of irrigation ditches in the Sierra Nevada Mountain Range in southeastern Spain (an UNESCO Reserve of the Biosphere, with areas as Natural and National Park), which originated in Muslim times, and is still operational in some areas. These ditches have contributed to maintaining local agricultural systems and populations in basins dominated by snow conditions, and they constitute a traditional regulation of water resources in the area. The network is made up of two types of irrigation ditches: “careo” and irrigation ditches. The first, the "careo", collects the meltwater and infiltrates it along its course, maintaining a high level of soil moisture and favouring deep percolation volumes that can be later consumed by the population through springs and natural fountains. The second, the irrigation ones, are used to transport water from the natural sources to the agricultural plots downstream the mountain area. In 2014, several irrigation ditches were restored in the Natural Park. This is a chance to further explore and quantify the role of this network in the hydrological budget on a local basis.

The aim of this work is to evaluate to what extent the existence of these intermittent water networks affects the evolution of the surrounding vegetation. For this, one of the restored systems, the Barjas Ditch in the village of Cañar, with a successful water circulation along its way, was selected from the increase of the soil water content in the ditch influence area and, indirectly a differential development of vegetation. Two analyses are performed using remote sensing information. The Normalized Difference Vegetation Index, NDVI, which is a spectral index used to estimate the quantity, quality and development of vegetation that can therefore be used indirectly as an indicator of the state of soil moisture, was used as the indicator of evolution. For this purpose, a historical set of LandSat satellite images (TM, ETM+ and OLI) has been used. On the one hand, a global analysis on the whole mountainous range was carried out, comparing NDVI patterns in areas affected and non-affected by the ditches. On the other hand, the restored Barjas ditch is used to assess vegetation changes before and after the restoration.