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Changes of the Hydrologic regime over the last 90 years in the Flumendosa basin, Sardinia.

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Besides their moderate total annual precipitation amounts, semi-arid regions are typically marked by strong seasonality and interannual variability in precipitation. In particular, the Mediterranean climate type is marked by a cool, wet winter and a hot, dry summer. In these climate ecosystems, where vegetation growth is minor during the winter months much of the precipitation recharges sub-surface and surface reservoirs. However, in the late winter and early spring, when growth conditions are favorable, much of the precipitation can be depleted by transpiration and, furthermore, runoff reduced directly by the increased vegetation cover.
In Mediterranean regions we see strong evidence that climate changes are already taking place. Brunetti et al. (2000) and Dunkeloh and Jacobeit (2003) have shown a strong decreasing trend in winter precipitation amounts over much of the Mediterranean for the past several decades. Additionally, there is evidence of shifts in how the precipitation is distributed across the winter and spring months, and also strong multi-year modes of variability in spring precipitation.
Given that most of the runoff to surface reservoirs occurs in the winter months and that spring hydrologic response is likely to be influenced strongly by vegetation (depending on overlap between rainy- and growing-seasons) these precipitation changes can be considered hydrologically important.
Case study is the Flumendosa basin (Sardinia, basin area of about 1700 km2), which is characterized by a reservoir system that supplies water to the main city of Sardinia, Cagliari. Data are from 42 rain stations (1922-2008 period) over the entire basin and data of runoff are available for the same period. Interestingly in the Flumendosa reservoir system the average annual input from stream discharge in the latter part of the 20th century was less than half the historic average rate, while the precipitation over the Flumendosa basin has decreased, but not at such a drastic rate as the discharge, suggesting a marked non-linear response of discharge to precipitation changes.
Trends in precipitation series were examined using the Mann-Kendall non-parametric trend test. The test shows a sequence of alternating decreasing and increasing trends in monthly precipitation, statistically significant. In autumn and winter months rains are decreasing, while an increase of monthly precipitation is estimated in the spring and summer months.
The analysis of the mean seasonal precipitation climatology confirms the same behavior, highlighting a clear change of the rain regime for the period before and after 1980. Hence, in late 30 years the rain decreased during the winter months (i.e. less recharges to the reservoirs), and increases during spring and summer months, when the evapotraspiration is higher (i.e. recharges to the reservoirs doesn't increase).
The interannual variability in precipitation totals leads to strong variability in annual runoff ratios, with drier years characterized by streamflows of only 10% of annual precipitation and wet years yielding more than 60%. From the preliminary analysis of the annual runoff and monthly precipitation data, the reduced seasonal precipitation amplitude is negatively influencing the runoff.