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The "changing hydrology" of Mediterranean mountain areas

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Mediterranean regions are characterized by unevenly distributed water resources that mainly depend on runoff generated in mountain areas. Therefore, improved understanding of the hydrology of Mediterranean mountain areas may help to anticipate the hydrological consequences of both climate and land cover changes.
One specific feature of Mediterranean mountain areas is that they share hydrological processes of both wet and dry environments in a seasonal pattern that leads to notable particularities in hydrological behavior. More accurate understanding of the variability of the main hydrological processes will thus help in the evaluation of hydrological models under differing environmental scenarios, even if the lack of hydrological data in most areas of the Mediterranean basin greatly impedes the analyses of changes in water resources at relevant scales. The limited number of hydrological studies of climatic regions other than humid temperate ones has often resulted in the unverified extrapolation of findings to other climatic areas. In regions with greater climatic seasonality (like Mediterranean areas), results obtained in humid regions may only be suitable for short wet periods of the year. During dry periods, some hydrological processes characteristic of humid conditions may be temporarily absent, triggering a different combination of hydrological processes. This increases the complexity of the rainfall-runoff relationship. In Mediterranean mountain regions, the high seasonality of the climate is often combined with great spatial heterogeneity of the landscape, which dramatically enhances the non-linearity of the catchment's hydrological behavior.
The objective of this work is to review some characteristic features of the "changing hydrology" of Mediterranean mountain areas based on results obtained in small research catchments. Some non-linear or threshold effects observed at different temporal and spatial scales are presented. Results show that the evapotranspiration dynamics in combination with the seasonal dynamics of rainfall, cause the succession of wet and dry or very dry periods during the year. This seasonality of the Mediterranean mountain climate has a strong influence on the spatio-temporal dynamics of both soil moisture and the water table. The succession of dry and wet periods and the characteristic occurrence of wetting-up transitions between the two increase the complexity of the rainfall-runoff relationship in Mediterranean mountain areas by triggering a different combination of hydrological processes that depend on catchment wetness conditions. Implications of the "changing hydrology" of Mediterranean mountain areas for hydrological modeling, as well as the potential use of inter-annual variability of rainfall-runoff relationships for evaluating hydrological effects of future climate change are also discussed.