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Insensitivity of evapotranspiration to seasonal rainfall distribution directs climate change impacts at water yield

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Over the past century, climate change is affecting precipitation regimes across the world. In the Mediterranean regions there is a persistent trend of precipitation and runoff decreases, generating a desertification process. Given the past winter precipitation shifts, the impacts on evapotranspiration (ET) need to be carefully evaluated, and the compelling question is what will be the impact of future climate change scenarios (predicting changes of precipitation and vapor pressure deficit, VPD) on evapotranspiration and water yield?
Looking for the key elements of the climate change that are impacting annual ET, we investigate main climate conditions (e.g. precipitation and VPD) and basin physiographic properties contributing to annual ET. We propose a simplified model for annual ET predictions that accounts for the strong meteo seasonality typical of Mediterranean climates, using the steady state assumption of the basin water balance at mean annual scale.
We investigate the Sardinia case study because the position of the island of Sardinia in the center of the western Mediterranean Sea basin and its low urbanization and human activity make Sardinia a perfect reference laboratory for Mediterranean hydrologic studies.
Sardinian runoff decreased drastically over the 1975-2010 period, with mean yearly runoff reduced by more than 40% compared to the previous 1922-1974 period, and most yearly runoff in the Sardinian basins (70% on average) is produced by winter precipitation due to the seasonality typical of the Mediterranean climate regime. The use of our proposed model allows to predict future ET and water yield using future climate scenarios. We use the future climate scenarios predicted by Global climate models (GCM) in the Fifth Assessment report of the Intergovernmental Panel on Climate Change (IPCC), and we select most reliable models testing the past GCM predictions with historical data. Contrasting shifts of precipitation (both positive and negative) are predicted in the future scenarios by GCMs but these changes will produce significant changes (level of significance > 90%) only in runoff and not in ET. Surprisingly, we show that ET is insensitive to intra-annual rainfall distribution changes, and is insensitive to VPD scenario changes.