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Spatiotemporal evolution of forest cover and of historical climate data: a case study in the Mediterranean basin

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A consequence of climate change, less investigated from the hydrological point of view, is the alteration of the frequency and intensity of forest disturbances that can reduce forest productivity, change the distribution of tree species, and shift their range and density. Based on this, this study evaluates the ability of remnants of native forests to resist or adapt to a changing climate. The case study is the island of Sardinia, located within the Mediterranean basin. Sardinia covers a latitudinal gradient of 300 km; and it is one of the least populated and the most forested regions in Italy. It is considered one of the most important biodiversity reservoirs inside the Mediterranean hotspot. From one hand Sardinia is experiencing a decreasing pressure on forests due to human factors, from the other, some studies demonstrate that winter precipitation and runoff are decreasing alarmingly, and this can have an impact on forests. Based on the above, this study aims, through the analysis of 20 years of satellite images (MOD44B), to evaluate forest cover changes and to detect any possible relationship with some of the most important climate variables such as precipitation (96 years daily data), air temperature and vapor pressure deficit (40 years of data). Results indicate that in the last 40 years Sardinia has experienced a simultaneous increase in air temperatures ($0.026 \text{ }^{\circ}\text{C}\cdot\text{y}^{-1}$) and VPD ($0.001 \text{ kPa}\cdot\text{y}^{-1}$) combined with reductions in both total precipitation ($-14.03 \text{ mm}\cdot\text{y}^{-1}$) and winter precipitation ($-12.09 \text{ mm}\cdot\text{y}^{-1}$), and that the areas with a mean annual precipitation lower than 700 mm went from the 26% in the period 1922-1979, to 63% during 1980-2018, and in effect 1980 was detected as changing point for annual precipitation. These climatic variations have led to an important reduction of the tree cover in some historical forests of Sardinia, and in the broad-leaved ones particularly. The reduction in TC shows a positive correlation with mean annual precipitation ($\rho = 0.66$) and altitude (0.72), while negative correlations were detected with temperature ($\rho = -0.57$) and VPD ($\rho = -0.48$). Results highlight that forests are adapting to climate change, and this may have an impact on local water resources.