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Impact of climate change disturbances affecting Mediterranean plant communities, ecohydrology dynamics and forest water balance

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In recent years, a big concern has arisen over large-scale climate-induced reductions on forest growth and survival (Allen et al., 2015), and their impact on the water cycle (Mekonnen & Hoekstra, 2011). Specifically, the higher drought frequency under warmer temperatures (known as "hotter-droughts" or "global change-type droughts") has been related to irreversible changes in the ecosystems composition, including massive tree mortality in forests throughout the world. These effects could be exacerbated under dry and semi-arid climates as the Mediterranean, which is already subjected to drought limiting conditions. During the last decades, hotter-droughts have affected several ecosystems in southeast Spain, sometimes combined with extensive wildfires, aggravating the negative impacts on these ecosystems. Here, we analyze four case studies of these impacts:
1) Aleppo pine (Pinus halepensis) forests die-off. Extensive pine mortality rates affected large forests of southeast Spain as a consequence of the extreme drought event occurred in 2014. Severe outbreaks of bark beetle accompanied these events. Afterwards, pine hydric status was slowly recovered in some cases. However, in the most intensively damaged pine populations a subsequent die-off occurred during the following years, independently of precipitation regime. Our results indicate a lack of functional recovery related to non-structural carbohydrates pools and the tree weakness and poor growth due to pest outbreaks.
2) Combination of drought and wildfires affects recovery capacity in resprouter species. Many Mediterranean species are able to resprout immediately after fire. The combination of both stressors in a short period of time may produce decay processes in widespread species such as kermes oak (Quercus coccifera). Our results show that individuals affected by drought suffered intense die-off processes in terms of leaf withering and shedding, and loss of aboveground biomass. As a consequence, these shrubs will be more vulnerable in the case of a subsequent wildfire, delaying the recovery capacity and consequently affecting ecosystem resilience (Muñoz, 2019).
3) Changes on species composition and implications on ecohydrological processes. In the same line, plant mortality was observed in some shrubland functional groups in semi-arid communities after the extreme drought event of 2014 (Ruiz-Yanetti, 2017). Plant mortality promoted changes in plant cover affecting ecohydrological processes such as interception, net precipitation and the ratio between the green and blue water (Vicente et al., 2018).
4) Future scenarios in a global change context. At local scale, specifically in Alicante province (SE Spain), it has been observed a negative trend in precipitations (−9.4 mm/decade) over the last six decades, until 2012, and a significant positive increment of the mean temperature (+0.18 ºC/decade). According to future climate scenarios, changes in the frequency, intensity, size, and temporal distribution of climate extremes are expected to occur in this region, and it will imply different effects on water balance of forests, from deep recharge to changes in phenological processes, as it has been already observed (Moutahir, 2016).
With these studies, we pretend to deepen the knowledge of Global Change impacts on Mediterranean dry and semi-arid ecosystems related to ecosystem resilience and to forest ecohydrological dynamics