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Predicted increase in aridity could drive post-fire recovery of Mediterranean forests towards open shrublands

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Recent observations suggest that repeated fires could potentially drive succession to shrublands, while the classic description of succession in Mediterranean forests includes a climax state of oak forests. Shrubland vegetation is more flammable and regrows quickly after a fire, leading to a feedback mechanism that may favour shrubland persistence. Environmental change, in particular increased aridity conditions, may strengthen this feedback by increasing fire frequency, as well as by differential impact on early- and late-successional species. However, whether the fire-vegetation feedback is (or could become) strong enough to maintain shrublands as an alternative stable state to forests remains poorly understood.
To assess how the combined action of fires and water scarcity modulates the long-term successional dynamics of Mediterranean ecosystems, we developed a dynamical plant competition model, including different plant fire-responses and stochastic fires. The model was calibrated with observational data from sites in Southeast Spain and Southern France, spanning up to 100 years of vegetation dynamics in the presence and the absence of fire. Our results showed that the Mediterranean oak forest was very resilient to the separate action of fires and increased aridity. However, water stress could convert the forests into degraded open shrublands by reducing post-fire recovery, with a possible tipping point between forest and shrubland at intermediate stress levels. Our model results show that the projected increase in aridity in the Mediterranean basin may reduce the resilience of oak forests against wildfires and drive post-fire ecosystem dynamics toward open shrubland. Increased aridity exerts its main effect in fire-prone communities by limiting post-fire recovery. Thus, fire-related responses need to be appropriately represented in models attempting to predict the fate of Mediterranean-type vegetation under climate change scenarios.