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## Timing matters – the importance of “when” droughts and temperature anomalies occur in the Iberian Peninsula

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Mediterranean ecosystems and their different vegetation types are adapted to the annual cycle between wet and cool winter periods and dry and hot summers. Within this cycle, productivity is strongly driven by water availability but also temperature. With climate change, the Mediterranean area, and especially the Iberian Peninsula is expected to receive less precipitation. Future projections of temperature distributions of the Iberian Peninsula predict shifts toward a higher mean (+2 °C) and maximum (+4 °C) temperature. As a result, an increase in drought frequency and duration can be assumed. The response of the vegetation, especially with respect to the different components of the carbon cycle [net ecosystem exchange (NEE) and its components gross primary productivity (GPP) and ecosystem respiration (Reco)] and plant stress are still not well understood for these ecosystems. One of the biggest unknowns is the impact of the timing of temperature and precipitation anomalies on the carbon balances of these ecosystems.

We present results from different studies focusing on the Iberian Peninsula showing the importance of the timing of temperature and water availability anomalies and how they influence the carbon balance of those ecosystems. While the impact of a strong compound heat and drought event during the summer period had only a very small impact on the carbon balance of the ecosystem a positive temperature anomaly during the winter period of 2015/16 caused a strong increase in ecosystem productivity. The differences in the ecosystem responses are a result of the different ecosystem conditions and limitations. During summer the analyzed ecosystems are already under conditions of strong water limitation and reduced ecosystem productivity (senesced grass layer and stressed trees) and thus the response to the compound event was low. While during winter, large parts of the Iberian Peninsula are temperature limited, and increased temperatures relieved this limitation and increased LAI i.e. fraction of absorbed photosynthetic active radiation. On the other hand, the timing of precipitation, that controls the water availability in the soil during the spring and autumn periods have a large impact on the annual carbon

balance of these ecosystems as they can reduce or increase the growing season length, and thus the carbon sequestration of these ecosystems. A recent study indicates that the impact of warm winters is not only increasing GPP but also Reco with important memory effects (i.e. increase of Reco later in the season). As a result, winter warming might lead to increased carbon uptake during winter but leads to a reduction in net carbon uptake for the whole year. Given the predictions of warming winters in the Mediterranean areas, this might cause more implications for the carbon balance as compared to summer heatwaves and droughts.