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400 years of summer hydroclimate from stable isotopes in Iberian trees

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Tree rings are natural archives that annually record distinct types of past climate variability depending on the parameters measured. Here, we use ring-width and stable isotopes in cellulose of trees from the northwestern Iberian Peninsula (IP) to understand regional summer hydroclimate over the last 400 years and the associated atmospheric patterns. Correlations between tree rings and climate data demonstrate that isotope signatures in the targeted Iberian pine forests are very sensitive to water availability during the summer period, and are mainly controlled by stomatal conductance. Non-linear methods based on extreme events analysis allow for capturing distinct seasonal climatic variability recorded by tree-ring parameters and asymmetric signals of the associated atmospheric features. Moreover, years with extreme high (low) values in the tree-ring records were characterised by coherent large-scale atmospheric circulation patterns with reduced (enhanced) moisture transport onto the northwestern IP. These analyses of extremes revealed that high/low proxy values do not necessarily correspond to mirror images in the atmospheric anomaly patterns, suggesting different drivers of these patterns and the corresponding signature recorded in the proxies. Regional hydroclimate features across the broader IP and western Europe during extreme wet/dry summers detected by the northwestern IP trees compare favourably to an independent multicentury sea level pressure and drought reconstruction for Europe. Historical records also validate our findings that attribute non-linear moisture signals recorded by extreme tree-ring values to distinct large-scale atmospheric patterns and allow for 400-yr reconstructions of the frequency of occurrence of extreme conditions in summer hydroclimate. We will discuss how the results for Lillo compare with other records.