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Asymmetric European summer temperature predictability from wet and dry Southern winter/springs

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The mega heat waves that struck Western Europe in 2003 and Russia in 2010 are believed to provide a foretaste of future European summer climate. Our ability to anticipate such events remains poor , limiting adequate society adaptation. A deficit of precipitation in the preceding winter and spring seasons favours summer heat waves, but apart from several case studies, conditions under which the identification of spring surface moisture deficits can provide useful seasonal predictions and the driving predictability mechanisms remain to be investigated. By analysing 64 years of observed temperature and precipitation (ECA&D) we show that rainy winter/spring seasons over Southern Europe inhibit hot summer days while anomalously dry months are followed by either a high or a low frequency of hot days, generalizing recent results obtained over south-eastern Europe. Further, observations indicate that summer hot day frequency is more sensitive to occurrence of specific weather regimes in initially dry cases than wet cases, inducing this asymmetry in summer heat predictability. Indeed, both the initial soil moisture conditions and specific atmospheric weather regimes are found to be critical for the occurrence of hot extremes. Then, by analysing simulations from the Coupled Model Intercomparison Project (13 CMIP3 and one CMIP5), we show that projected drier conditions over Southern Europe are likely to induce a widening in the hot summer days frequency distribution, as the initially-wet winter/spring seasons are likely to become rare. Thus even though more hot days are expected, predictability from preceding rainfall should not improve. This limitation may even be underestimated by the CMIP3 ensemble, since models that best reproduce the asymmetry over the historical period predict drier springs in Southern Europe and warmer summers in Continental Europe than other models.