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- Title and Author Search

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## A summer climate regime over Europe modulated by the North Atlantic Oscillation

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**Abstract.** Recent summer heat waves in Europe were found to be preceded by precipitation deficits in winter. Numerical studies suggest that these phenomena are dynamically linked by land-atmosphere interactions. However, there exists as yet no complete observational evidence that connects summer climate variability to winter precipitation and the relevant circulation patterns. In this paper, we investigate the functional responses of summer mean and maximum temperature (June–August,  $T_{\text{mean}}$  and  $T_{\text{max}}$ ) as well as soil moisture proxied by the self-calibrating Palmer drought severity index (*scPDSI*) to preceding winter precipitation (January–March,  $P_{\text{JFM}}$ ) for the period 1901–2005. All the analyzed summer fields show distinctive responses to  $P_{\text{JFM}}$  over the Mediterranean. We estimate that 10 ~ 15% of the interannual variability of  $T_{\text{max}}$  and  $T_{\text{mean}}$  over the Mediterranean is statistically forced by  $P_{\text{JFM}}$ . For the *scPDSI* this amounts to 10 ~ 25%. Further analysis shows that these responses are highly correlated to the North Atlantic Oscillation (NAO) regime over the Mediterranean. We suggest that NAO modulates European summer temperature by controlling winter precipitation that initializes the moisture states that subsequently interact with temperature. This picture of relations between European summer climate and NAO as well as winter precipitation suggests potential for improved seasonal prediction of summer climate for particular extreme events.

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