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Seasonal predictability of European summer climate re-assessed

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Current state-of-the-art prediction systems show seasonal predictability in various areas, including large parts of the North Atlantic, but their prediction skill for European summer climate is still very limited, particularly during the summer season. To improve the seasonal predictability of European summers, we propose to include a mechanism into the prediction that connects areas of high predictability with the summer climate in Europe. This mechanism, as already introduced in the literature, has its origin in the tropical North Atlantic in spring, where either warm or cold sea surface temperatures are connected with the European climate by an upper-level wave-train. This wave-train generates a zonal sea level pressure gradient, that in turn influences the climate over central Europe in the following summer. This east-west pressure gradient is opposed to the summer North Atlantic Oscillation which has a north-south pressure gradient and an impact on northern and southern, rather than on central Europe. We examine the seasonal driving mechanisms of European summer climate in the ERA-Interim Reanalysis and find that the proposed mechanism is dominant in 14 out of the examined 35 years (1982-2016). To verify whether this mechanism can act as a source of seasonal predictability, we analyse the mixed resolution hindcast ensemble simulations generated by MPI-ESM, including a 30 members ensemble starting every year in May. We test every ensemble member for the proposed connection between the tropical North Atlantic in spring and the summer European climate, and find that the mechanism is only represented in individual ensemble members. In fact, we show that, if a prediction is conducted with only those selected members and in the selected years in which the mechanism is dominant, the seasonal predictability can substantially be improved in the North-Atlantic-European sector, especially in the areas where the mechanism is likely to show a prominent signal.