



Does the Mediterranean Sea influence the atmospheric dynamics of the European summer climate? The anomalous summer 2003 as a testbed

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The European summer 2003 marks a notable anomaly and presents a rare opportunity to investigate dynamical interactions in the otherwise variable European climate. Not only air temperature and the hydrological cycle over the continent showed distinct signals, also the Mediterranean sea surface temperature (SST) was exceptionally warm during the period.

The traditional view on the role of the Mediterranean Sea in the climate system highlights the influence of the large-scale atmospheric circulation on the Mediterranean. Whether the Mediterranean acts back on the atmospheric dynamics in the region, and if yes, via what mechanisms, is of central importance for the understanding of the European climate system and its predictability. In the literature, this question has been treated, for instance, in the context of Sahel rainfall predictability. The case of the extremely anomalous summer 2003 allows for tackling the issue with regard to the European summer climate under realistic boundary conditions.

Past studies that use global atmosphere-only models and prescribed global sea surface temperatures for this purpose drew partly contradictory conclusions. This is due to the fact that global SSTs explain the exceptional summer 2003 conditions only to a certain extent, and stand-alone atmosphere models struggle to reproduce the event in its specific characteristics.

In the present study we take advantage of a newly developed regional coupled atmosphere-ocean model consisting of the regional climate model REMO and a regional version of the global ocean model MPI-OM. This allows for a controlled experimental setup that simulates the summer 2003 realistically and allows for investigating the regional impact of the Mediterranean Sea on the European summer climate. The regional coupled simulations are compared to atmosphere-only runs, and various experiments are performed with changed Mediterranean SSTs and different initial conditions.

A careful analysis of ocean-atmosphere interactions is presented. The results suggest that the influence of the Mediterranean Sea on the atmospheric circulation over the European continent is limited, but its importance for the moisture balance and its role in the regional hydrological cycle is substantial.