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Dynamics of the 2016 late summer heat wave over Europe

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Heat waves have manifold socio-economic and health impacts. Observations showed for Europe a "likely increase" of heat waves since the middle of the 20th century according to the 5th IPCC (Intergovernmental Panel on Climate Change) report. It is therefore very important to understand the processes leading to extremely high temperatures. Here we want to study the processes contributing to the late summer heat wave over Europe in 2016. We will diagnose the evolution of processes from the planetary-scale to the synoptic and the meso-scale that lead to this high temperature event. The processes on the synoptic- and meso-scale, viz. temperature advection, vertical motions, and diabatic processes will be investigated, following both a Lagrangian and Eulerian approach.

Europe was affected by an unusually late heat wave during the late summer and early autumn 2016. Primarily, Spain and Western Europe were affected by high temperatures. For example, Seville (Spain) and Trier (Germany) observed the highest September temperature on record, topping at 44.8°C and 34.2°C respectively. The heat wave was marked by three distinct peaks, accompanied by record-breaking values of 500-hPa geopotential height and, to a lesser extent, 850-hPa temperatures. All three periods were associated with upper-level ridges, embedded in eastward propagating, high-amplitude Rossby wave packets (RWPs) arriving in western Europe. The RWPs originated in western North America. A Lagrangian trajectory analysis revealed that air masses during the peaks of the heat wave originated either from maritime or from continental regions or they stalled in the target region over several days. Subsidence and ensuing adiabatic warming was exceptionally high for the first two peaks in Bordeaux (France) and Seville. Material changes in temperature of the subsiding air parcels arriving at the lower troposphere were about 20-30°C during 2-3 days before the peaks of the heat wave. Near-surface diabatic processes, like surface sensible heat fluxes due to enhanced solar radiation, seemed to be the main reason for the last peak of the heat wave in Trier. The processes of this heat wave will be compared to the very prominent heat waves of 2003 and 2010.