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ATMOSPHERIC BLOCKING : LINKAGES TO TEMPERATURE EXTREMES AND UPSTREAM LATENT HEATING

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en salle de conférences Joël Noilhan

Résumé :

Atmospheric blocking, referring to the formation of large-amplitude synoptic-scale quasi-stationary anticyclones in the middle and upper troposphere, is a key component of extratropical weather variability. In this presentation, two aspects of this phenomenon are discussed. In the first part, the relationship between atmospheric blocking and temperature extremes in Europe is systematically characterized. To this end, conditional blocking frequencies during extreme temperature events at various locations in Europe are calculated. This Eulerian analysis is

complemented by a Lagrangian investigation of typical transport patterns and physical processes affecting air masses associated with temperature extremes. European cold temperature extremes are most frequently induced by the advection of cold air masses from the Arctic and Russia, associated with blocking anomalies upstream over the North Atlantic and over northern Europe. The large-scale flow conditions during cold extremes are similar at many locations in Europe. Hot temperature extremes in northern and central Europe typically occur in the vicinity of a blocking anticyclone. They are generally associated with weaker horizontal transport, but strong adiabatic warming due to subsidence and local temperature increase caused by enhanced radiation and surface heat fluxes. This characterization of synoptic-scale forcing mechanisms can be helpful for better understanding and anticipating European temperature extremes and their long-term changes.

In the second part of the presentation, a Lagrangian approach is used to quantify the climatological relevance of diabatic heating along trajectories that enter blocking anticyclones. It is shown that 30-45% of the air masses involved in Northern Hemisphere blocking are heated by more than 2 K (>7 K in the median) in the 3 days prior to their arrival in the blocking region, and this number increases to 60-70% when considering a 7-day period. This reveals that, in addition to isentropic advection of air with low potential vorticity, cross-isentropic ascent from lower levels due to latent heating in clouds is of first-order importance for the formation and maintenance of blocking, a process that is not accounted for in current theories. Amplified latent heating in a warmer climate may modify the occurrence of blocking via this mechanism.

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