Dynamics of the Record-Breaking February 2019 Western European Block

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Abstract:

In late February 2019, an atmospheric blocking event established over Western Europe, and was responsible for a wintertime maximum temperature exceeding 20°C in the UK for the first time. In this talk, some of the dynamical processes that contributed to the onset, maintenance, and decay of the block are discussed, focusing on: (1) the flux of vertically-averaged 500-150 hPa potential vorticity (VAPV) anomalies; and (2) diabatic contributions towards the blocking lifecycle. VAPV anomalies are identified in ERA5 reanalysis as local deviations in PV from the instantaneous zonal mean after removing the climatological background state. Meanwhile, diabatic processes contributing to the block's dynamics are diagnosed in the Met Office Unified Model (MetUM) using a set of PV and potential temperature diabatic tracers.

It is found that diabatic processes are very important for block onset. The PV of air parcels that reside in the mid-upper troposphere of the block at onset has been modified by diabatic processes in the MetUM by up to -1.0 pvu in the preceding 2-3 days. These air parcels are also diabatically heated by >20 K over the same time period, which is consistent with warm conveyer belt ascent. The main sources of this negative PV change and diabatic heating are from parameterisations of microphysical and convection processes in the MetUM. Once the block has been established, an anticyclonic synoptic-scale eddy is responsible for the flux of anomalously anticyclonic VAPV into the block from the north, and in the following days further anticyclonic influx comes from the southwest. In the mature block, contributions from convection and microphysics parameterisations decrease until eventually diabatic processes provide a source of positive PV to the block through longwave cooling. The block decays when the VAPV flux also changes signs and provides positive PV to the blocking region. This work provides an insight into the relative importance of different maintenance mechanisms throughout the lifetime of this extreme blocking event, and therefore motivates a better understanding of how well these processes are predicted, in order to provide an accurate forecast of its lifetime.