The recent winter extreme weather event in Europe connected to atmospheric blocking

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Weather and extreme weather events in mid-latitudes are linked to the jet stream configuration and atmospheric blocking. Atmospheric circulation anomalies are often associated with temperature and hydrological extremes.

In January 2019, a significant snowfall event occurred in the Northern Alps. This study investigates synoptic conditions prior and during the event addressing the possible forcing mechanisms for the heavy snowfall occurrence. This case is linked to one of the typical weather regimes that comprises a blocking anticyclone over the Atlantic and enhanced meridional moisture transport and cold advection from the high latitudes to the Alps.

We analyzed the atmospheric conditions using the ERA-5 reanalysis dataset investigating geopotential height (GPH), pressure, temperature, and wind fields, respectively. For blocking detection, we applied a standard algorithm based on the reversal of mid-latitude GPH gradients at 500 hPa. We studied the evolution of surface conditions and snowfall impacts using the European daily high-resolution gridded dataset (E-OBS) and ZAMG SNOWGRID data, respectively.

Tropospheric analysis revealed that large-scale circulation in January 2019 featured a persistent blocking system remaining for several consecutive days over the North Atlantic. Heavy snowfall was forced by upper-level streams elongated southwards by the blocking high. A low-pressure system southeast of the blocking high, embedded in the strongly meandering jet stream's trough, modulated the moisture flow towards the mountains.

Prior to the blocking event, sudden stratospheric warming (SSW) has taken place at Northern high latitudes. We discuss initial atmospheric conditions including SSW, blocking, and impacts on surface weather in Europe, and particularly in the Alpine region.