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The relation of extreme North Atlantic blocking frequencies, cold and dry spells in ERA-40 in winter

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One of the most prominent features of mid-latitude atmospheric variability is blocking. Blocking events are anti-cyclones with an equivalent barotropic signature and persistent in time. The longer than synoptic day-to-day time scales has led to intrinsic interest during the last decades aiming to expand the predictability beyond classical numerical weather prediction.

The study aims to present the extreme behavior of blocking and to investigate relations to other extreme events, like cold and dry spells. To assess the behavior of blocking events we developed a new event-based method. The method identifies 500-hPa geopotential height maxima and tracks these relative maxima with a next-neighborhood search in time. This new method agrees with the reference grid-point based method in the deduced climatological pattern of blocking frequency.

Applying the method to ERA-40 data in winter for the Atlantic-European region we found a trend towards a reduction of blocking episodes. The mean surface temperature and precipitation shows a clear response: winters with an increased number of blocking events are associated with negative temperature anomalies over central to eastern Europe and dryer conditions, whereas southern Europe experiences warmer and wetter conditions during such episodes. Using extreme value statistics, we show evidence that cold spells and to some extent dry spells are strongly associated with extremes in blocking frequency over central Europe. We also showed that cold spells need time to establish during blocking events, thus return periods of cold spells are longer than those for blocking events.