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The impact of storm event likelihood on the forecast uncertainty over Europe at S2S time scales

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Weather forecasts at subseasonal-to-seasonal (S2S) timescales have little or no deterministic forecast skill in the troposphere. Individual ensemble members are uncorrelated and span a range of scenarios that are possible for the given set of boundary conditions. The uncertainty of such probabilistic forecasts is then determined by this range of scenarios – often quantified in terms of ensemble spread. For certain boundary conditions, the ensemble spread can be highly anomalous, with conditions associated with reduced spread sometimes referred to as „windows of opportunity“. Various dynamical processes can affect the ensemble spread within a given region, including extreme weather events present in individual members. For geopotential height forecasts over Europe, such extremes are mainly comprised of synoptic storms travelling on the North Atlantic storm track.

We use ECMWF re-forecasts from the S2S database to investigate the connection between storm characteristics and increases in ensemble spread in more detail. We find that the presence of storms in individual ensemble members at s2s time scales forms a major contribution to the geopotential height forecast uncertainty over Europe. In our study, we quantify the magnitude of this contribution and analyse the underlying dynamics, using both Eulerian and Lagrangian frameworks. We further show that certain atmospheric conditions, like various blocked weather regimes, are associated with reduced geopotential height ensemble spread over Europe due to changes in the North Atlantic storm track and associated anomalies in storm density. This connection sheds light on the occurrence of some “windows of opportunity” in the troposphere on S2S time scales.