A new look at Atlantic-European weather regimes: physical processes governing their life cycles and applications

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The large-scale midlatitude flow is dominated by Rossby wave activity along the upper-level midlatitude wave guide and jet stream. In the Atlantic-European region this activity occurs in preferred quasi-stationary, persistent, and recurrent states, so-called weather regimes. Weather regimes explain most of the atmospheric variability on sub-seasonal time scales.

An extended definition of year-round Atlantic-European weather regimes based on 37 years of ERA-Interim reanalysis data helps to elucidate the physical processes governing their life cycles. A specific focus lays on the role of atmospheric blocking and of diabatic outflow driven by cloud-condensational processes at distinct weather regime life cycle stages.

Weather regimes help to assess the potential for extreme weather as discussed exemplarily for atmospheric river occurrence in Europe. Also they help to understand multi-day volatility in continent-scale, near-surface wind speed with important implications for the planning of wind farm deployment across Europe. Finally, a recent forecast bust demonstrates the challenges in predictability imposed by the multi-scale interactions governing weather regime life cycles.