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Extended Grosswetterlagen: A new synoptic type classification for Central Europe accounting for both circulation and air mass characteristics

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The 29-type Hess-Brezowsky Grosswetterlagen (GWL) classification of synoptic types over Central Europe (CE) has been used widely in synoptic climatology for many years. A manual daily catalogue has been created back to 1881 and is maintained to the present day at DWD, capturing significant aspects of historical weather variability in a readily understandable way. The GWL types are separated according to flow direction, the position of dominant high (low) pressure systems and low-level (anti)-cyclonicity over CE, giving the types an empirical nomenclature which is easy to assimilate. Nevertheless, the classic GWL approach does have one specific weakness in that air mass properties over CE associated with any particular type are not directly addressed. Air mass, i.e. the ambient temperature and moisture of the lower troposphere, is an integral part of a synoptic type, just as circulation is, and plays a hugely significant role in determining local weather conditions, including surface temperatures, cloud and rainfall amounts. While the classic GWLs correlate with certain air masses to a degree, there is no consistent guidance for classifying different air mass situations with respect to a given circulation, leading to considerable within-type variability. The nomenclature-driven classification approach thus yields a GWL catalogue which is quite inhomogeneous over time and is in need of improvement. Similarly, most other known synoptic classification schemes, including many objective-automatic ones, usually focus empirically on either circulation or air mass aspects separately, but rarely attempt to assimilate both together. Hence there remains a major need for a holistic synoptic classification system, addressing air mass and circulation together, while maintaining the classic GWL's strength of having a straightforward nomenclature. Hence, an improved 47-type GWL system for CE, referred to as Extended Grosswetterlagen (EGWL), is proposed. This system is based on the nomenclature of the classic GWLs, but splits several of the original types into two or three and defines new suffixes to address specific air mass and circulation situations. An optimal balance is found between the desire for accuracy in capturing many possible combinations of air mass and circulation and the contrasting need for limiting type numbers for usability, thereby grouping certain similar types together where possible. The 47 EGWLs improve on the classic GWLs very significantly in terms of air mass separation and reduced within-type variability. Detailed climatological mean composites show that the EGWLs are strongly distinguished from each other and have characteristic properties which should be very useful for descriptive studies in synoptic climatology, based on historical reanalyses, and in operational meteorology, such as for summarising current medium-range ensemble forecasts.