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Suitability of various sea-level pressure datasets for synoptic studies in European regions

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The aim of this study is to compare atmospheric circulation in two long datasets: the reconstructed "EMULATE" (EMSLP) dataset spanning back to 1850, and the NOAA "20th Century Reanalysis" (20CR) available since 1871, with several reanalyses in the latter half of the 20th century. Circulation is described by indices of flow strength, flow direction, and relative vorticity, calculated using mean daily sea-level pressure (SLP) fields in a 5x5 degrees latitude/longitude grid. The indices were used to classify daily circulation into pre-defined circulation patterns. We have performed the analysis in six European regions: the British Isles, the Baltic region, Central Europe, Eastern Europe, Western Mediterranean, and Central Mediterranean.
Atmospheric circulation is generally less vigorous in the EMSLP dataset compared to the reanalyses – flow strength and vorticity are lower, resulting in more days with unclassified circulation, namely in the Mediterranean. Also the time persistence of circulation (expressed as lag autocorrelation of indices with lags from 1 to 5 days) is mostly greater in EMSLP. The ECMWF ERA-Interim reanalysis also has many unclassified days, and its SLP fields are sometimes even smoother than those of EMSLP. The best accord of circulation indices and patterns exists between the NCEP/NCAR and the ECMWF ERA-40 reanalyses. Concerning the interannual variability of circulation, EMSLP and 20CR correspond with each other very well over the British Isles; however, in other regions some of the decadal-scale trends of flow strength and vorticity found in one dataset are missing in the other. The EMSLP seems to be a valid representation of atmospheric circulation over large parts of Europe, and although its strength (together with 20CR) lies in its long time span, their use for long-term trend analysis remains debatable. Circulation indices and patterns proved to be simple yet efficient means to compare different sea-level pressure datasets.