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Surface cyclones in the ERA40 data set (1958-2001) – novel identification method and global climatology

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A novel method is introduced to generate climatological frequency distributions of meteorological features from gridded data sets. The method is used here to derive a climatology of extratropical cyclones from sea-level pressure (SLP) fields. A simple and classical conception of cyclones is adopted where a cyclone is identified as the finite area that surrounds a local SLP minimum and is enclosed by the outermost closed SLP contour. This cyclone identification procedure can be applied to individual time instants and easily interpretable climatologies of cyclone frequency, f_c, are obtained by simple time averaging. In combination with a conventional cyclone center tracking algorithm, that allows the determination of cyclone life times and the location of cyclogenesis and cyclolysis, frequency fields can be obtained for special categories of cyclones that are generated in, move through or decay in a specified geographical area.

The method is applied to the global SLP data set for the time period 1958-2001 from the latest European Centre for Medium-range Weather Forecasts (ECMWF) reanalyses (ERA40). In the Northern Hemisphere (NH) and during winter, the cyclone frequency field has three maxima in the Pacific storm track (with f_c up to 35%), the Atlantic storm track (with f_c up to 32%) and the Mediterranean (with f_c up to 15%). During the other seasons the f_c values are generally reduced in mid-latitudes and the subtropical monsoon areas appear as regions with enhanced f_c. In the Southern Hemisphere (SH) the seasonal variations are smaller with year-round maxima of f_c in the belt from 50 to 70S (along the coast of Antarctica, with maximum values of almost 40%) and to the east of the Andes (with f_c up to 35% during summer).

Subsets of cyclone frequency fields are calculated for several subjectively chosen regions of cyclone genesis, passage and lysis. They show some interesting aspects of the behavior of extratropical cyclones: cyclones that decay along the US west coast, for instance, have a short life time and originate almost exclusively from the eastern North Pacific, whereas long-lived and long-distance Pacific cyclones terminate further north in the Gulf of Alaska. The cyclone variability within the 40-year period, and the relation to the large-scale flow (e.g. to the leading modes of variability) and potential trends are also discussed.