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Detailed Analysis of ECMWF Surface Pressure Data

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Investigations of temporal variations within the gravity field of the Earth led us to the analysis of common surface pressure data products delivered by ECMWF. We looked into the characteristics of global as well as spatially and temporally confined phenomena being visible in the data. In particular, we were interested in the overall data quality, the local and temporal signal-to-noise ratio of surface pressure data sets, and the identification of irregular data.

To this end, we analyzed a time series of a full year of surface pressure operational analysis data and their nominal standard deviations. The use of pressure data on a Gaussian grid data allowed us to remain close to the internal computations at ECMWF during data assimilation. Thus, we circumvented potential interpolation effects that would otherwise occur in cylindrical projections of conventional map products.

The results obtained by us demonstrate the identification of a few distinct outliers, data quality effects over land or water and along coastlines as well as neighborhood effects of samples within and outside of the tropics. Small scale neighborhood effects depend on their geographical direction, sampling distance, land or water, and local time. In addition, one notices large scale seasonal effects that are latitude and longitude dependent. As a consequence, we obtain a cause-and-effect survey of pressure data peculiarities.

One can then use background corrected pressure data to analyze seasonal effects within given latitude belts. Here time series of pressure data allow the tracking of high and low pressure areas together with the identification of their actual extent, velocity and life time. This information is vital to overall mass transport calculations and the determination of temporally varying gravity fields. However, one has to note that the satellite and ground-based instruments and the assimilation software being used for the pressure calculations will not remain the same over the years. This has to taken into account for actual quality assessments of ECMWF data.