



Quantitative Impact of Surface Pressure Variations on the Earth Gravity Field

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The actual gravity field of the Earth depends, apart from several other factors, also on the local and time-dependent mass distribution of the atmosphere. To this end, we analyzed the typical characteristics of surface pressure data provided by the European Centre for Medium-Range Weather Forecasts and assessed their influence on the results currently obtained by GRACE.

The surface pressure data are available in various formats and allow us to estimate the key parameters of the mean values and dynamics of the atmospheric mass distribution: local distributions as well as diurnal and seasonal effects together with their lower and upper bounds, variances, and error bars. It turns out that the characteristics of the tropical zone are different from mid-latitudes and circum-polar areas. In addition, some effects differ over land and sea, notably over high mountain ranges. Therefore, we can simplify our task by condensing the data into a few compact geographical and time-span classes that can be treated efficiently.

When we look at the impact of the derived atmospheric classes on the gravity field computation we can constrain their potential effects by simple first order estimates based on their spatial / temporal resolution, their dynamics, and their signal-to-noise levels. This allows us then to look at the maximum variation of spherical harmonic coefficients that are commonly used by the geodetic community. On the other hand, we can also estimate the typical impact of probable scenarios versus time: the comparison of several months of surface pressure data tells us what short-time and/or seasonal variations have to be considered. As a result, we summarize the most important findings.