



The effect of atmospheric loading on the terrestrial reference frames

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Variations in air pressure continuously load and deform the solid Earth, affect the gravity field and the geocenter, and force variations in the Earth's rotation. The displacements of the Earth's surface range from several centimetres at time scales of several hours to days to 1 - 2 cm at seasonal time scales with large spatial variations. In order to determine unbiased regularised reference coordinates, the displacements induced by air pressure loading have to be taken into account in the determination of the reference frame - similar to ocean tidal loading and Earth tides. For that, sufficiently accurate models predicting the load-induced displacements are required.

We have studied in detail the seasonal and secular signals that can be expected in the time series of reference coordinates due to atmospheric loading. For that, the full ERA-40 Reanalysis Dataset provided by the ECMWF has been utilised to compute the spacio-temporal pattern of the 3-d loading signal, and these predictions have been subjected to a detailed analysis of the spatial and temporal characteristics. The spatial pattern of the seasonal air pressure loading as well as the temporal variations in that pattern is used to assess the magnitude of the seasonal signal to be expected and to identify the loading signal in observed variations in the solid Earth's shape. The temporal variation in the spatial pattern of the mean surface pressure (on annual to decadal time scales) and the associated loading signal is used to assess potential contributions of air pressure loading to the secular velocity field of the Earth's surface.