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Effect of neglecting high frequency non-linear motions induced by non-tidal ocean loading on estimating the geocenter motion from a geodetic network

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We study the effect of mismodelling geophysical processes that lead to non-linear site motions in the analysis of space geodetic data such as GPS. We focus on the effects of non-tidal ocean loading and atmospheric loading on a global set of geodetic stations. We investigate their consequences on estimating the geocenter motion from the geodetic network.

Ground displacements at each geodetic site induced by atmospheric and ocean loading are computed by convolving surface mass or pressure variations with Green functions to derive the vertical and horizontal displacement. The displacements resulting from atmospheric loading are computed using the surface pressure variations provided by the European Center for Medium-range Weather Forecasts (ECMWF) model (1.5° spatial and 3h time sampling). The ocean response is taken into account assuming both an inverted barometer and a non-inverted barometer response of the ocean to changes in the atmosphere. The first is derived from the atmospheric model. The latter is computed using the sea surface height variations from the Hydrodynamic Unstructured Grid Ocean global barotropic ocean model (0.25° spatial and 3h time sampling).

Following an analysis of the spatial and temporal distribution of the atmospheric and non-tidal ocean deformations spanning a global network from 2002 to 2011, we compare modelled displacements with existing geodetic time series. We estimate the difference in reduction of the weighted variance of the geodetic time series corrected for the non-tidal ocean loading using the two ocean models. To investigate the effect of neglecting the high frequency site motions caused by non-tidal ocean loading on the determination of geocenter motion, we compute the deformation in both the center of mass and center of figure reference frames. We then compute the time variable translation of the geocenter and subsequently compare this to what is obtained from a six parameter transformation to align our geodetic network to the International Terrestrial Reference Frame.