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Corrections of geodetic time series for atmospheric and induced oceanic loading obtained by combining dynamic and inverted barometer ocean's responses to atmospheric changes

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A model describing the response of the ocean to pressure forcing is required to model atmospheric loading effects. The Inverted Barometer (IB) hypothesis is classically chosen, in which atmospheric pressure variations are fully compensated by static sea height variations. This approximation is valid for periods exceeding typically 5 to 20 days. At higher frequencies, dynamic effects cannot be neglected. The aim of this paper is to compute atmospheric and induced oceanic loading over the whole range of frequencies and to compare it with time series of vertical displacement estimated at geodetic sites using Global Navigation Satellite Systems (GNSS) measurements.

Ground displacements of each geodetic site induced by atmospheric and oceanic loading are computed by convolving surface mass or pressure variations with Green functions for the vertical displacement. The displacements resulting from atmospheric loading are computed using the surface pressure variations provided by the ERA-interim model (1.5° space and 3h time sampling) from the European Centre for Medium-range Weather Forecasts (ECMWF). The ocean response is taken into account assuming an inverted barometer or a dynamic response of the ocean to changes in the atmosphere. The first one is obtained by setting to zero the pressure variations over the oceans. The latter is computed using the sea height variations from the global barotropic ocean model named Toulouse Unstructured Grid Ocean model (TUGO-m, 0.25° grid and 3h time sampling). We combine the atmospheric loading with the induced oceanic loading estimated from the two models filtering out short and long periods of the ECMWF+IB and EMCWF+TUGO-m loading time series, respectively, and summing the resulting time series.

Using the combined ocean's responses, when correcting the geodetic time series for loading effects, will reduce the weighted variance of the geodetic time series at most sites, the largest reductions being expected along the Baltic sea. The geodetic signals will be attenuated at all frequencies.