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Forward modeling of atmospheric, oceanic and hydrological loading effects in GPS processing

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The dynamics of the surface geophysical fluids (atmosphere, ocean, continental hydrology) induces global mass redistributions at the Earth's surface, and therefore deformations of the Earth crust. The vertical and horizontal displacements can be modeled using outputs of general circulation models through a convolution with the appropriate Green's functions, describing the elastic response of the Earth to any surface loading.
In general, all these non-tidal loading effects are not forward modeled in GPS processing. We investigate here the impact of the forward modeling of atmospheric loading using operational ECMWF surface pressure field, assuming an inverted barometer (IB) or a dynamic ocean response to pressure changes (TUGO-m), hydrological loading using GLDAS/Noah model or the latest global GRACE mascon solution produced by NASA Goddard Space Flight Center.
We show that the forward modeling of loading effects reduces significantly and systematically the variability of daily GPS solutions for both the horizontal and vertical components of a global network and over a 11-year period (2005-2015) processed using the latest GAMIT/GLOBK software.
Due to missing components in the GLDAS/Noah model (surface and ground water), the annual component is better reduced when the continental hydrology is derived from the latest GRACE mascon solution.