



Global surface mass time variations by using a two-step inversion for cumulating daily satellite gravity information

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We propose a new method to produce time series of global maps of surface mass variations by progressive integration of daily geopotential variations measured by orbiting satellites. In the case of the GRACE mission (2002 - 2012), these geopotential variations can be determined from very accurate inter-satellite K-Band Range Rate (KBRR) measurements of 5-second daily orbits. In particular, the along-track gravity contribution of hydrology is extracted by removing de-aliasing models for static field, atmosphere, oceans mass variations (including periodical tides), as well as polar movements. Our determination of surface mass sources consists of two successive dependent Kalman filter stages. The first one consists of reducing the satellite-based potential anomalies by adjusting the longest spatial wavelengths (i.e. low-degree spherical harmonics less than 5-6). In the second stage, the residual potential anomalies from the previous stage are used to recover surface mass density changes - in terms of Equivalent-Water Height (EWH) - over a global network of juxtaposed triangular elements. These surface tiles of $\sim 40,000$ km x km are imposed to be identical and homogeneously-distributed over the terrestrial sphere, however they can be adapted to the local geometry of the surface mass. Our global approach was tested by inverting simulated hydrology-related geopotential data, and successfully applied to estimate time-varying surface mass densities from real GRACE-based residuals. This strategy of combined Kalman filter-type inversions can also be useful for exploring the possibility of reaching better time and space resolutions for hydrology, that would be hopefully brought by future low altitude geodetic missions.