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Recovering regional time variations of the gravity field from GRACE orbit observations using an energy balance approach

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We present a new approach to estimate time variations of the Earth's gravity field from GRACE orbit observations at unprecedented spatial resolutions of 100-200 km. It is based on the energy integral equation and similar to the "mascons" methods proposed previously by other authors, and thus this kind of method offers an interesting alternative to the global spherical harmonics giving access to surface water mass redistributions at smaller spatial scales. Our method consists of two steps: (1) computation of the potential anomalies due to continental hydrology and observed at satellite altitude using the principle of conservation of energy and correcting from the potentials of known water mass reservoirs (i.e., atmospheric mass from ECMWF re-analysis, MOG-2D ocean mass and FES2004 tides models); (2) inversion of these anomalies for estimating surface density function change in terms of independent equivalent-water heights by applying efficient strategies of matrix regularization. Tests of feasibility have been made by inverting 10-30 days of GRACE orbit data pre-processed using the GINS software developed by GRGS. The method has been successfully applied to recover the water mass variations over the whole South America at a 1-degree resolution, and provided realistic results comparable to global hydrology model and classical monthly global solutions.