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High resolution 3D seafloor topography by Kalman filtering of gravity information

Lucia Seoane (1,3,4) and Guillaume Ramillien (2,3,4)

(1) Université Paul Sabatier (UPS) Toulouse, France (Lucia.Seoane@get.omp.eu), (2) Centre National de la Recherche Scientifique (CNRS), France (Guillaume.Ramillien@get.omp.eu), (3) Géosciences Environnement Toulouse (GET) - UMR 5563, (4) Observatoire Midi-Pyrénées (OMP)

An iterative Extended Kalman Filter (EKF) approach is proposed to recover a regional set of topographic heights composing an undersea relief, by the successive combination of large numbers of gravity (and geoid height) anomalies measured at sea surface, e.g. by altimetry satellite-derived grids and/or along depth sounding tracks, as well as taking the a priori error uncertainties into account. The integration of the non linear Newtonian operators versus the radial and angular distances (and its first derivatives) enables the estimation process to accelerate and requires just a couple of iterations, instead of summing Legendre polynomial series or using noise-dependent and unstable FFT decomposition. EKF recovery of the uncompensated sea floor topography is particularly efficient for inverting noise-free simulated gravity data as absolute errors remains less than a few meters. The EKF approach is applied to the real case of recovering high resolution (less than 1 km reached by an optimal sampling) bathymetry around the Great Meteor [27°W - 30°W ; 29.5°N - 31.5°N] and New England seamounts in the Atlantic Ocean by combining geoid/gravity and depth sounding data sets.