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Mean dynamic topography by an iterative combination technique

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Geodetic MDTs are based on measuring the Mean Sea Surface Height (MSSH) and computing a gravimetric geoid. The three independent quantities, mean sea surface height h, geoid N and mean dynamic topography Dt, are related by the equation h= N + Dt. However, it is misleading to see the task as optimal estimation of two quantities from three, with one constraint, because the geoid is not directly observable. Computing a geoid involves an integral of gravity over the Earth's surface. To complete this integral at sea, gravity must be interpolated into the gaps between ship-tracks. The roughness of the gravity field means that global gravity models fail to supply the resolution needed for interpolation. We have shown that analytical interpolation results in geoid errors of many decimetres over the gaps. The initial concept involving the three data streams geoid, MSH and MDT - becomes non-viable because of data gaps. Our Iterative Combination Technique (ICM) generates mutually compatible grids of gravity and MDT. In principle, the gross errors from unconstrained analytical interpolation into data gaps would eventually get corrected by the mutual consistency ICM algorithm. The ICM converges rapidly, with rms value falling of 3mm in the MDT after 10 iterations. The difference between our final GRACE corrected ICM MDT and GRACE corrected OCTAS composite MDT results with a standard deviation of 5.4cm.