A Slepian framework for an inverse problem in physical geodesy

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We are interested in a geodetic inverse problem that consists in finging a distribution of point masses (characterized by their intensities and positions), such that the potential generated by them best approximates a given potential field. On the whole Earth a potential function is usually expressed in terms of spherical harmonics which are basis functions with global support. The identification of the two potentials is done by solving a least-squares problem. When only a limited area of the Earth is studied, the estimation of the point-mass parameters by means of spherical harmonics is prone to error, since they are no longer orthogonal over a partial domain of the sphere. The point-mass determination problem on a limited region is treated by the construction of a Slepian basis that is orthogonal over the specified limited domain of the sphere. We propose an iterative algorithm for the numerical solution of the local point mass determination problem and give some results on the robustness of this reconstruction process. We also study the stability of this problem against added noise. Some numerical tests are presented and commented.