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Inverse Gravimetric Problem: Faroe Islands gravity data revisited

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The isostasy was discovered because the correction of the direction of the plumb line for the effect of the Himalayan mountain range, and a geophysically realistic assumption on the mass density, did not remove (as expected) the correlation with the visible topography. Conversely, from the triple (gravity observations; visible source geometry; mass density) one can uniquely conclude that "the visible topography is compensated in depth by a correlated mass deficit".

Similar can be done in a more complex setting where the "known geology" which is quantified by the "known source geometry of the geological units", and the realistic constraints on the mass density, can be subtracted from the measured anomalous surface gravity signal; the geological stripping. Furthermore, the transformation of the surface gravity anomalies to the horizontal gravity gradients yields additional constraints in this setting. In a way it is strange. Such pure gravity transformation from gravity anomalies to the gravity gradients is not adding new information to the system. Nevertheless, in a triplet (surface gravity; "known geology"; "unknown geology") the mapping of the "known geology" (which implicitly is a "shallow source") and "the unknown geology" (which implicitly is a "deeper source") has different influence (weight) in the two types of the surface gravity signals (free air gravity anomalies and the horizontal gravity gradients). Thus, the transformation can be used to extract the gravitational response of "the unknown geology" without additional assumptions.

In this contribution we will revisit the area around the Faroe Islands to do the improved separation of the gravitational signal from "the known sources" from the gravitational signal from "the unknown sources". The surface gravity anomaly signal and the bathymetry model is DNSC08 (Andersen and Knudsen, 2008), which was used as a "fill in" in the latest compilation of the global geopotential model EGM2008 (Pavlis et al., 2008). The mass density of the "known geology" for different units is not imposed, but estimated. One additional constraint is that the known sea water depths impose that the physical sources of the gravitational signal are at a certain minimum distance from the surface. This can be used for de-noising of the marine gravity data to be used in improving the above modelling.