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Downward Continuation of Gravity Anomaly in Linear Learning Approach

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Downward continuation of gravity anomaly is a classical problem in physical geodesy and it gains increasing significance due to the development of airborne and satellite gravimetry. It is an inherently unstable inverse problem and typical approaches solving it include iteration methods and regularizations. In this work, "learning" approaches are applied to overcome the unstability. It is hypothesized that the downward continuation process is an integration whose template depends on latitudes, resolutions, longitude differences and target heights, as the upward continuation template does. Downward continuation template is learnt from designed training set with multivariable least square regression and applied to the real problem. The training sets are established through the priori gravity field model, e.g. EGM2008 and EIGEN-5C and are under the same condition as the real observations are. The attribute vectors are the gravity anomaly on the observed height and the target is the downward continuation correction to the ground. The validation of training set is tested by the upward continuation with Poisson integral. An experiment is operated with the airborne and land gravity in State of Minnesota in USA. The upward continuation RMS of gravity anomaly simulated by EIGEN5C is less than 1 mGal and the training set, on which the downward continuation integration template is learnt, is validated. The RMS of downward continuation with test simulated data is less than 1 mGal. And finally the RMS of the downward continuation of real airborne gravity data in Minnesota with the learnt template is less than 4 mGal.