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Regional gravity field analysis from airborne gravimetry

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The processing of airborne gravity data traditionally consists of several independent steps such as filtering, gridding and cross-over adjustment. Each of these steps may introduce errors that accumulate in the course of processing. We present a new approach for regional gravity field analysis from airborne gravity data, that combines the separate processing steps into one inversion technique. The approach uses a spectral representation of the Earth's gravity field in terms of a series of harmonic base functions, expressed in a local Cartesian reference frame. The parameters of this representation are estimated using least-squares techniques. Special emphasis is put on the proper modelling of data noise. We propose a method to estimate data noise from the analysis of the residuals of a preliminary least-squares solution. The obtained noise model is used as input of a frequency-dependent weighting scheme, which replaces the traditional method of low-pass filtering and cross-over adjustment. To suppress model errors at the highest spatial frequencies, Tikhonov regularization is applied, using cross validation to determine the regularization parameter from the observations only. The performance of the developed technique is assessed using simulated data and compared with the classical approach of processing airborne gravity for a high-resolution survey flown over a geophysical test site in Canada.