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Modeling Airborne Gravimetry with High-Degree Harmonic Expansions

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Since its official unveiling at the 2008 General Assembly of the European Geosciences Union, EGM2008 has demonstrated that high-degree harmonic expansions constitute a useful and effective final representation for high-resolution global gravitational models. However, such expansions also provide a versatile means of capturing (modeling), inter-comparing, and optimally combining local and regional high-resolution terrestrial data sets of different types. Here we present a general recipe for using high-degree expansions to capture, downward-continue and assimilate airborne survey data. This approach relies on the production of two 'competing' high-degree expansions. A first, 'terrestrial-only' expansion incorporates EGM2008 globally, and high-resolution terrestrial gravimetry regionally. This expansion can be used to upward-continue the regional terrestrial data to the flight level of the airborne survey, such that the terrestrial gravimetry outside the survey area can be merged with the airborne data inside the survey area, all at flight level. Harmonic analysis of this merged data set, also at flight level, yields a second 'airborne-augmented' expansion, which closely matches the 'terrestrial-only' expansion outside the survey area, but which also closely reproduces the airborne survey data inside the survey area. Capturing the airborne and terrestrial data in this way means that downward-continuation of the airborne data, as well as spectral/spatial comparison (and ultimate combination) of the airborne data with the terrestrial (and satellite) data, can all be achieved through spherical- and ellipsoidal-harmonic synthesis of these two competing expansions, and their spectral combination. This general approach is illustrated with a worked example.