

When Old Gravity Meets New Gravity

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Abstract

Airborne gravity surveys are relatively expensive and are rarely repeated over the same region within a short period of time. As technology advances, newer surveys benefit from improved gravimeters, positioning systems, sampling strategies, and data processing. But when new observations become available, what should we do with the old ones? Are they still useful, or should they simply be replaced?

This study explores this question using two airborne gravity surveys over Kalimantan, Indonesia, acquired more than a decade apart. The first survey was conducted in 2009-2010 using an S-99 gravimeter, while the second was carried out in 2021-2022 using a GT-2A gravimeter. Besides being collected with different generations of instruments, the two surveys differ in sampling characteristics and spatial coverage, providing a practical example of how gravity observations accumulated over time may be brought together.

As expected, the newer survey shows better internal consistency. After crossover adjustment, the mean absolute crossover discrepancy is approximately 1.8 mGal for the newer dataset, compared with 2.9 mGal for the older dataset. However, being older does not necessarily make a gravity dataset obsolete. Comparisons between the two surveys show that much of the regional gravity signal remains consistent, while systematic differences can be identified and reduced before the datasets are combined. Bringing the two surveys together also improves the spatial sampling of the regional gravity field, increasing their usefulness for subsequent regional gravity and geoid modelling.

These results suggest that the value of airborne gravity data should not be judged by age alone. Instrument performance, survey geometry, internal consistency, spectral characteristics, and compatibility with newer observations are equally important. For regions where gravity observations have been collected through different campaigns and generations of instruments, new surveys therefore do not necessarily have to replace old ones. Sometimes, old and new gravity can work better together.