CONFRONTING SUPERCONDUCTING AND ABSOLUTE GRAVITY MEASUREMENTS WITH MODELS

T. F. Baker, M. S. Bos[1] and S. D. P. Williams
Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, CH43 7RA, UK.
([1] now at DEOS, Delft University of Technology, Netherlands)

Confronting measurements with models provides both a test of the available models and also allows an essential test of the accuracy of the observations. In the following, 2 distinct types of gravity measurements are compared with models: (a) O1 and M2 observations from the superconducting gravimeters in the GGP network are compared with models of the Earth's body tides and models of ocean tide loading and (b) absolute gravity measurements near tide gauges are used for correcting secular trends in relative mean sea levels for vertical crustal movements and for testing models of post-glacial rebound.

(a)10 recent ocean tide models have been used to compute the O1 and M2 ocean tide loading and attraction at 15 GGP stations. The European GGP stations provide a valuable network over a relatively small area, which can be used for checking the accuracy of individual stations, testing the body tide models and testing the different ocean tide models. For example, the M2 ocean tide models of Schwiderski, FES94.1, TPXO.5 and NAO99b give a poorer fit to the European observations than the other ocean tide models. For a few of the European and global GGP stations there are discrepancies of the observations (after correction for ocean tide loading and attraction) of up to 0.3% with respect to the Dehant, Defraigne and Wahr elastic and inelastic body tide models. This is consistent with the present uncertainties in calibrations, using parallel recording with FG5 absolute gravimeters, which have quoted accuracies in the range 0.1% to 0.4% for individual stations (Meurers, 2001). The results for both the European and global GGP stations are more fully described in Baker and Bos (2002).

(b) In order to separate height variations of the land at a tide gauge from climate related changes in mean sea level, accurate measurements of land movements are required. In the UK, measurements have been made over the last few years at the tide gauges with the longest mean sea level time series using episodic GPS, continuous GPS and absolute gravity (for case studies of CGPS and absolute gravity at UK tide gauges see http://imina.soest.hawaii.edu/cgps_tg/). For absolute gravity it was decided to concentrate on the tide gauges at Newlyn in south west England and Lerwick in the Shetland Islands, which are situated on bedrock. These tide gauges are part of the Global Sea Level Observing System (GLOSS) coordinated by the Intergovernmental Oceanographic Commission. The measurements have been made with the POL absolute gravimeter FG5-103. The gravimeter has been taken regularly to fundamental gravity stations in Europe and USA (including the GGP stations at Boulder, Wettzell and Bad Homburg) in order to intercompare with other absolute gravimeters.

As well as providing corrections for the land movement component of changes in mean sea levels, the FG5 results can also be used to test models of post-glacial rebound. In particular the absolute gravity measurements show clear evidence of subsidence in the Shetland Islands, which is consistent with the post-glacial rebound model of Lambeck and Johnston (1995). For further details of the results see Williams, Baker and Jeffries (2001).

References

Baker, T. F. and M. S. Bos (2002). Validating Earth and ocean tide models using tidal gravity measurements.

Submitted to Geophysical Journal International.

Lambeck, K. and P. Johnston (1995). Land subsidence and sea level change: contributions from the melting of the last great ice sheets and the isostatic adjustments of the Earth, in *Land Subsidence*, edited by Barends, Brouwer and Schroder, pp. 3-18, Balkema, Rotterdam.

Meurers, B. (2001). Superconducting gravimetry in geophysical research today. Journal of Geodetic Society of Japan, **47**, 300-307.

Williams, S. D. P., T. F. Baker and G. Jeffries (2001). Absolute gravity measurements at UK tide gauges. Geophysical Research Letters, **28**, 2317-2320.