

World Gravity Standards

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In order to use gravity anomalies in geodetic computations and geophysical interpretations, the observed gravity values from which anomalies are derived should be referred to one consistent world wide system. We are very fortunate that we have one unique reference system available. The International Gravity Standardization Net 1971 was adapted by the International Union of Geodesy and Geophysics at Moscow in 1971 [Morelli, et al, 1974]. The network was a result of extensive cooperation by many organizations and individuals around the world. The final results were produced by a small subgroup of Special Study Group No. 5 of the International Association of Geodesy. This network contains more than 1800 stations around the world. The data used in the adjustment included more than 25,000 gravimeter, pendulum and absolute measurements. It was claimed that "standard errors for IGSN 71 gravity values are less than ± 0.1 mgal." It certainly was a tremendous improvement over the old "Potsdam system."

At the XVIth General Assembly of the International Association of Geodesy in 1975 a resolution was passed, and Working Group No. 2: "World Gravity Standards" was established to maintain the IGSN as the international gravity reference standard and to provide advice and assistance to the International Gravity Bureau in problems related to gravity standards. The Earth Physics Branch of Energy, Mines and Resources in Canada was requested to set up a technical service for the maintenance of IGSN. This service involves the use of existing EPB facilities to maintain a data bank of observations related to IGSN, and station descriptions. New data will be transmitted to EPB through the International Gravity Bureau in Paris, who will also act as the central distribution agency for revised IGSN information.

As you might be well aware, there have been many new absolute measurements of gravity since the adoption of IGSN 71. The most extensive comparison of the new absolute measurements and the IGSN 71 values was reported by Cannizzo, Gerotti and Marson [1978]. They reported results of 25 absolute gravity measurements carried out at 17 stations in Europe using new Italian transportable apparatus in 1976 and 1977. They concluded that the accuracy of the new absolute measurements is $10 \mu\text{gal}$. Figure 1 shows the gravity differences between gravity

values of IGSN 71 and new absolute measurements [Cannizzo, et al, 1978]. Most of the gravity differences are less than 0.1 mgal, which was the claimed accuracy for IGSN 71 gravity values. It seems that there is no linear scale difference but some local systematic differences.

During 1977 Marson and Alasia [1978] measured absolute gravity at six stations in the U.S.A. The preliminary analyses of the results show a good agreement with IGSN 71 values. There have been also other absolute measurements such as Hammond, et al [1978] and Arnautov, et al [1977]. All comparisons have shown reasonable agreements between new absolute values and the IGSN 71 values.

The effect of new absolute gravity measurements in the IGSN 71 values have been studied [Uotila, 1978]. From these studies it has been concluded that it is not useful to make a global readjustment of the IGSN 71 in the near future. The IGSN 71 serves as a good standard for relating gravity measurements to the absolute system in world wide bases as far as computations of mean anomalies and production of gravity anomaly maps are concerned. The Working Group No. 2 has further recommended that the IGSN 71 values should not be fixed in new local, national or continental adjustments, but entered properly weighted using their variance-covariance matrix.

There has been some discussion to produce gravity station networks, where the accuracy of the gravity values would be about $10 \mu\text{gal}$. If we wish to have that level accuracy of the gravity values in a network, we must have much more accurate measurements of gravity differences between the stations than currently are available or have many more measurements of gravity with a good absolute apparatus. In order to improve the accuracy in measurements of gravity differences, we must establish good calibration lines with more accurate gravity values than currently are available. We have to observe or model also gravity variations caused by local and global environmental factors, such as tides, water level, etc. There is much to be done before we can have a large net of gravity stations with $10 \mu\text{gal}$ accuracy.

References

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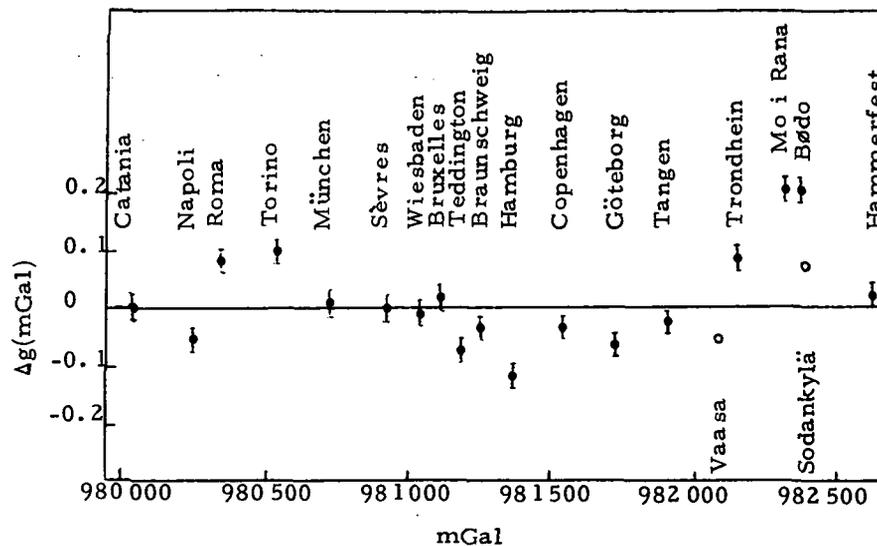


Fig. 1 - Gravity difference ($g_{IGSN\ 71} - g_{abs}$) with indication of the standard deviation: • with reference to IGSN 71, ◦ with reference to Finnish net.

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