Abstract. Knowledge of the earth's gravity field continued to increase during the last four years. Altimetry data from the GEOS-3 satellite has provided the geoid over most of the ocean to an accuracy of about one meter. Increasing amounts of laser data has permitted the solution for 566 terms in the gravity field with which orbits of the GEOS-3 satellite have been computed to accuracy of about one to two meters. The combination of satellite tracking data, altimetry and gravimetry has yielded a solution for 1360 terms in the earth's gravity field. A number of approaches to the computation of the geoid agreed with tide measurements to 5 cm (Schwiderski, in press), and models for six additional constituents have been computed by Estes (1977). Highly precise values for effects of gravity coefficients of specific order have been obtained by analysis of resonance effects on satellite motion (King-Hele, et. al., 1978, Klíkocniň, 1978, Reigber in press) and evaluated by Wagner (in press). Such results are useful in evaluation of general solutions based on less sensitive data.

A number of outstanding problems need to be addressed in the course of further refinement of our knowledge of the gravity field:

1. changes in the atmospheric drag due to solar radiation and changes in magnetic flux affect the motion of satellites in ways which can be misinterpreted as effects of the earth's gravity field. The effects of direct solar radiation and earth's albedo on the more complicated satellite satellite configuration can similarly be misinterpreted.
2. Other smaller effects which must be accurately modeled or determined include
   a. crustal motion,
b. polar motion and earth's rotation,
c. solid earth, ocean and atmospheric tides,
d. ionospheric effects on electronic measurements,
e. tropospheric effects on measurements, and
f. ocean topography on geoids computed from altimetric data.

3. The separation of gravity coefficients computed from observed satellite motion is made difficult by the limited number of satellites with different orbital motion for which accurate observations are available because satellites with different orbital inclinations or orbital periods are sensitive to different orders and degrees of gravity coefficients. Yet, apart from resonance effects, satellite motion is insensitive to high order terms in the earth's gravity field. Separation of the coefficients is possible through the use of altimetric data over the oceans and gravimetric data. But such data are not available in many regions, and the precision of such data is insufficient to compute accurate satellite orbits.

4. Neglect of systematic instrument and environmental effects, truncation of the gravity field representation, and other model errors have generally yielded standard errors of solutions for gravity coefficients which are overly optimistic. As a result, solutions based on combinations of various types of data have usually required the use of arbitrary weights for the different data classes employed in order to obtain a reasonable contribution to the solution from each set of data.

5. The computation of the gravity field from observed satellite motion is a costly undertaking. The high cost is one factor which limits the number of coefficients used to define the gravity field in such computations, and the frequent use of an inconsistent number of gravity parameters for different data which are then combined in a single solution.

6. Instrument limitations for lasers include weather and the cost of installations. S-band radars require a transponder on the satellite, have limited availability due to their heavy workload, and are subject to ionospheric refraction errors. Doppler receivers require a transmitter on the satellite and are of lower precision than lasers on S-band radars.

Solutions to many of these problems will be addressed by the panel members. Gaposchkin and Smith will discuss primarily advanced computational techniques; Fishell and Reigber will discuss advanced measurement techniques, and Whitehead will address the topographic effects on the ocean geoid.

References

GRAVITY FIELD DETERMINATIONS

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<tr>
<th>AGENCY</th>
<th>DESIGNATION</th>
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*104 density squares

TABLE 1

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