CONTRIBUTIONS OF GRM TO THE OCEAN TOPOGRAPHY EXPERIMENT (TOPEX)

Robert Stewart
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109

The permanent shape of the sea surface, the time-averaged mean sea level, is comprised of: (a) an ellipsoidal component due to the mean mass of a rotating earth; (b) spatial undulations due to the inhomogeneous distributiion of mass in the earth; and (c) spatial undulations due to permanent ocean currents. The amplitude of the three components are in the ratio 10^4: 10^2: 1 m, the first two components comprising the marine geoid, and the third being the permanent topography of the sea surface.

The TOPEX satellite is designated to map on a global grid the mean sea level averaged over a three to five year period with an accuracy of a few centimeters, using a radar altimeter in an accurately determined orbit. An improved understanding of earth's gravity field, such as that expected from the Geopotential Research Mission, will contribute to the TOPEX mission by contributing to the calculation of an accurate orbit (ephemeris), and by improving the accuracy of the calculation of permanent currents.

An accurate ephemeris results from numerical integrations of the equation of motion for the satellite using knowledge of gravity, air drag, and radiation pressure, subject to the constraints imposed by Tranet and perhaps other tracking data from the satellite. Of the many sources of error in the calculation, gravity errors dominate. For example, the vertical component of the Topex ephemeris, which is expected to be known with an accuracy of around 13 cm, should have gravitational errors amounting to 10 cm.

Calculations of permanent currents from the TOPEX maps of mean sea level require a marine geoid having an accuracy of much less than 10 cm over wavelengths ranging from a few hundred kilometers to tens of thousands of kilometers. The shorter wavelengths yield the circulation around bathymetric features, and the longer wavelengths yield the gyre-scale flow around and between ocean basins. Of the two extremes of scale, the gyre scale and longer are perhaps the most important. The gyre-scale currents are not well known, they make a large contribution to the topography, and they involve important global processes. Hence, this places a high premium on the accuracy of the longer-wavelength components of the geoid.