ABSTRACT

The problem of interactions between earth tides and oceanic tides is rather complex as it involves effects of newtonian attraction, loading and associated change of earth potential, tangential pressure and friction on the moving ocean floor which are not always easy to evaluate, principally for coastal or island stations.

This paper takes advantage of two facts:

(1) By the end of 1983 the International Center of Earth Tides has collected and evaluated a considerable amount of data from 223 stations including those of the Trans World Profiles developed by the same group of authors (102 stations). This ensures, for the first time, a World wide distribution including the tropical areas and the southern hemisphere.

(2) In 1978-80, new oceanic cotidal maps of high quality, established by E.W. Schwiderski, became available.

We have calculated, for the eight principal tidal waves, the correlations between the observed gravity variations and those resulting from a calculation based upon the Schwiderski maps. This correlation is highly significant.

At the level of accuracy of the best transportable gravimeters the agreement is perfect except at a few places where effects of lateral heterogeneities in the mantle can perhaps be suspected.

These cotidal maps can therefore be safely used as working standards for other geodetic and geophysical applications.

INTRODUCTION

There are presently in geodynamics a number of problems where a very precise correction (or prediction) for tidal effects is needed:
gravimetry, altimetry, VLBI, laser ranging to the Moon and satellites, etc. As an example, in terms of the vertical component of gravity, "precise" means 1 μgal (=10^-8 ms^-2), and, probably soon, better than 1 μgal (Melchior, 1983). A working standard to be used as a model for such precise tidal computations is not easy to select because of the complication of ocean-continent tidal interactions which consist in a number of intricated effects. These are:

- the direct attraction of the periodically moving masses of water upon the ground based instruments
- the flexure of the ground under the load of these masses
- the change of the earth's potential due to this load deformation of the earth
- a modification of oceanic tide height due to the body tide of the ocean's bottom.

These interactions can be predicted using Farrell's procedure (1972) based upon Green's functions, provided that a good model of the various oceanic tidal components is available. Their evaluation depends upon the chosen rheological model of the earth's interior.

Thus, precision Earth Tide measurements carry much information about the tides of the Ocean, about heterogeneities in the lithosphere and mantle as well as about liquid core dynamics. All these informations are to be extracted now.

At first sight we believed that a model composed of homogeneous isotropic spherical layers is much more likely to be valid for the body tide, having significant displacements through most of the earth's volume, than for the load tide whose displacements are appreciable only in the lithosphere and upper mantle. Differences in lithospheric structure, as beneath ocean basins and continents, would therefore affect the load more than the body tide.

Near the load the surface deformation is very sensitive to the properties of sediments. At larger distances from the load one has to take into account structures down to generally a depth two or three times the horizontal distance between the load and the point of observation. Lack of knowledge of these lithospheric features is the reason why the loading effects are presently not accurately predictable. Eventually these features must be determined in order to produce correct tidal predictions for precision measurements.

However, the most recent results, derived from world wide tidal gravity measurements, lead Melchior and De Becker (1983) to conclude that some anomalies observed in specific tectonic areas could be due to very deep lateral heterogeneities.

TRANS WORLD TIDAL GRAVITY PROFILES

There was a considerable handicap to the use of such a method of