Geophysical Research Abstracts, Vol. 8, 02853, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02853

A search on the gravity / height ratio induced by hydrological, atmospheric and ocean tidal loading processes; theoretical investigation and numerical applications.

C. de Linage, J. Hinderer and J.-P. Boy

Ecole et Observatoire des Sciences de la Terre/Institut de Physique du Globe de Strasbourg (UMR 7516 CNRS/ULP), Strasbourg, France (Caroline.De-Linage@eost.u-strasbg.fr / Fax: +33390240291 / Phone: +33390240050)

Ground gravity measurements are very often collocated with measurements of surface vertical displacements. It is therefore interesting to link together these two different observables in the ratio dg/dh (in microGal/mm).

This ratio can be derived for any physical process involving the deformation of a gravitating Earth's model and for various rheologies (elastic, visco-elastic). In this study, we focus on three different types of surface loads: hydrology, atmospheric pressure and oceanic tides and, according to the variability of these loads, we will restrict our search to a purely linear elastic rheology.

On one hand, we theoretically investigate the spectral features (on the basis of a spherical harmonic decomposition) of the dg/dh ratio and show the sensitivity to the source in terms of the degree n for each contribution. In general, gravity changes are caused by three separate contributions: the direct Newtonian attraction effect, the effect due to the vertical motion in the Earth's gravity field and the term due to the redistribution of the masses; only the two last ones are dependent on the elastic behaviour.

On the other hand, we use recent numerical models that provide predictions of snow cover and soil moisture (e.g. from LaDWorld model), surface atmospheric pressure (e.g. ECMWF model) or water height on the oceans (e.g. TPX06 ocean tides model) in order to compute in each case the dg/dh ratio by least squares regression on a time period and with a sampling adapted to the restitution of the main variability of each

phenomenon.

We link in each case the mean value of the dg/dh ratio to a spectral degree of the source and to a typical spatial size for the investigated process.

The computations done for the hydrology load show that the geographical variations of the dg/dh ratio with respect to the mean value on different large areas (such as Amazonia, South-East Asia, Australia and Europe) are explained by the size of the hydrological basins since the more located the source is, the higher the absolute value of the dg/dh ratio is; this ratio is also in general much larger than the classical free air gradient (- 0.3 microGal/mm).

In the case of the atmospheric loading, we consider two hypotheses for the ocean's response to atmospheric forcing namely the non-inverted barometer response (NIB) and the inverted one (IB) highlighting the effect of the oceans-continents limit on the dg/dh ratio.

We finally examine the dg/dh ratio due to ocean tidal loading in different coastal regions, both for the total tide and for some specific tidal constituent of fixed frequency.

We conclude that the dg/dh ratio is indeed a useful parameter which may characterise a given physical process but its interpretation should be very careful in practice because of the strong influence of local effects on gravity variations which are not necessarily taken into account in the global loading models.