Geophysical Research Abstracts
Vol. 15, EGU2013-5258-1, 2013
EGU General Assembly 2013

Seasonal and short time gravity changes due to monsoonal rainfall in West Africa using a superconducting gravimeter

Basile Hector (1), Jacques Hinderer (1), Luc Séguis (2), Jean-Paul Boy (1), Marta Calvo (1,3), Marc Descloitres (4,5), Séverine Rosat (1), and Umberto Riccardi (6)

(1) University of Strasbourg, IPGS-EOST, STRASBOURG, France (basile.hector@unistra.fr), (2) HydroSciences Montpellier (HSM-UM2), Montpellier, France, (3) IGN, Madrid, Spain, (4) IRD, Cotonou, Benin, (5) LTHE, Grenoble, France, (6) Dipartimento di Scienze della Terra Universita "Federico II", Napoli, Italy

A superconducting gravimeter (SG) has been installed since 2010 in Djougou, northern Benin, within the framework of the GHYRAF (Gravity and Hydrology in Africa) project. This site was first measured with a FG5 absolute gravimeter four times a year from 2008 to 2011. It was then decided to install a superconducting gravimeter in order to monitor in a continuous way the strong annual monsoon signal with both local and non-local hydrological contributions within the humid sudanian zone of West-Africa. The area is also part of the long-term observing system AMMA-Catch, and thus under intense hydro-meteorological monitoring (rain, soil moisture, water table level, evapotranspiration, etc…).

We present here the results of the first two years relative gravity monitoring with SG-060 from GWR Instruments. FG5 absolute gravity data are used for calibration and drift estimate of the SG. As everywhere on the GGP (Global Geodynamics project) stations, the signal includes solid earth tides, ocean loading, polar motion, atmospheric pressure effects, drift and water storage changes (WSC). The barometric corrections are more complicated than for mid-latitude stations; indeed pressure effects are of major concern in the equatorial band, because they are governed by S1 and S2 thermal pressure waves. These waves dominate both the local Newtonian effect (an increase in local pressure decreases the gravity) and the smaller non-local loading effect (an increase in regional pressure decreases the gravity mostly by a subsidence effect of the elastic earth) because of their coherency at the regional scale.

We focus here on two predominant frequencies: first the seasonal cycle where we compare the seasonal gravity signal left in the residuals after correction for solid Earth and ocean tides, atmosphere, polar motion and long term drift to Water Storage Changes (WSC) computed from observations in soil moisture (using neutronic measurements) and water table variations.

Second we investigate the gravity signature of short term rainfall events. This includes both the rapid increase in gravity following a precipitation, and the slower decrease afterwards, related to evapotranspiration rates and underground water redistribution. In particular we will show the so-called 'shelter effect' which reduces the apparent rain-gravity admittance (in terms of μGal per mm of rain). We will try to derive a general model for our site from the analysis of numerous rain events during the summer monsoon.