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Study of the seasonal gravity signal in superconducting gravimeter data

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Abstract

Thanks to their high sensitivity and their long-term stability, superconducting gravimeters (SG) are able to record surface gravity changes on a wide frequency band (periods from a few seconds to secular variations). We focus in this presentation on the seasonal gravity changes measured by about 20 worldwide SG. We model all well-known sources of long-term gravity changes, i.e. solid Earth tides, polar motion and length-of-day as well as global atmospheric, tidal and non-tidal ocean loading effects. These corrections lead to gravity residuals characterized by a strong seasonal signal with an amplitude of a few microgals. We compare these residuals with loading estimates from global hydrology (snow and soil-moisture) models. For more than half of the analysed SG, we are able to show a good correlation between the gravity residuals and the estimated continental water storage loading effects. For the other instruments, the discrepancies may be associated with local hydrology effects, which cannot be taken into account in global continental water storage models.

Keywords: Superconducting gravimeters; Continental water storage; Hydrology loading

1. Introduction

Most of geodetic observations show large annual or seasonal variations which are most likely due to changes of continental water storage. A review of environmental loading effects on geodetic measurements can be found, for example, in van Dam and Wahr (1998). Dong et al. (2002) studied large scale seasonal deformation with worldwide GPS stations. Our goal is to perform a similar study on gravity changes measured by superconducting gravimeters (SG). van Dam et al. (2001) have computed the induced gravity changes due to soil-moisture and snow loading for most of the GGP (Global Geodynamics Project, Crossley et al., 1999) sites. However they did not compare their model to gravity observations; we propose here to compute this loading using two different hydrology models, and to compare it with SG observations. We are presenting in Section 2 the processing of gravity data as well as our models of long-period gravity changes, including the estimate of their precision. We discuss our results in Section 3. Concluding remarks are given in Section 4.

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