

## ***Interactive comment on “Simulation of the time-variable gravity field by means of coupled geophysical models” by Th. Gruber et al.***

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Received and published: 20 September 2011

The manuscript by Gruber et al. provides insightful information on the Earth’s temporal gravity variation modelling. Temporal variations are caused by a variety of phenomena that redistribute mass within the Earth and on or above its surface. In this paper the authors present a model as realistic as possible of the time-variable gravity field, that can be used to perform simulation studies on future satellite gravity field missions. This interdisciplinary study is based on coupled geophysical models for each component of the Earth mass system (i.e. atmosphere, ocean, continental hydrology, ice, solid Earth). The paper is well organized and in general well written. The title well represents the content of the paper; the interpretations and conclusion adequately support the evidence presented. All parts of the manuscript and illustrations are necessary to

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show the results and to understand the main points.

However, I have two main concerns that I believe should be addressed before this manuscript is considered for publication:

1) Temporal gravity changes caused by terrestrial mass displacements can occur in various forms: abrupt, periodic or quasi-periodic, and secular. Their effect at the earth's surface can be local, regional, or global, whereby the depth of the source of the gravity change generally increases with the size of the affected area. In general, long term forces cause viscous deformations, whereas short-term (quasi-) periodic forces cause elastic deformations. Abrupt local processes mostly lead to permanent changes. In the Introduction there is a lack of discussion within time variable gravity sources in terms of their signal strengths and time variability. An overview of the extent and variability of the several processes that cause mass redistribution in the Earth system could help the reader to understand why some processes of terrestrial mass displacements, such as Earth's free oscillations or volcanic eruptions, are not included in the model.

2) In applying load Love numbers  $k_n$  to consider changes in geoid caused by deformation due to load, there can be errors if  $k_n$  is not calculated exactly. The authors should give additional information in Section 7.2 on how Love numbers are computed and how errors on their computations affect the model presented.

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Interactive comment on Earth Syst. Sci. Data Discuss., 4, 27, 2011.

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