Geophysical Research Abstracts
Vol. 13, EGU2011-6886, 2011
EGU General Assembly 2011

Accessing the accuracy of models by the integration of observations and models in a least squares adjustment model

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The Earth orientation parameters (EOP) and the time variable gravity field coefficients vary due to mass redistribution of the Earth's subsystems caused by, e.g., atmosphere, oceans, hydrology, cryosphere. The influence of the major subsystems (atmosphere, oceans and hydrology) is quantified by models; it is expressed in terms of geophysical excitation functions (CHI). The EOP, the second degree gravity field (GFC2) coefficients and the CHI are all functionally related to the unknown tensor of inertia of the Earth. We assume that inconsistencies between the observed EOP and GFC2 and the modeled CHI are solely caused by insufficient modeled contributions such as unavailable excitation functions for minor Earth's subsystems. The consistency between data and models is usually described by calculating correlation coefficients and RMS values, without taking stochastic prior information into account. In our paper we present an advanced estimation method for a highly consistent combination of the observations and models which allows a comprehensive quality assessment.

The combination method is based on a least squares adjustment that treats the numerical model data as pseudo-observations. Stochastic prior information for the modeled data as well as missing covariances of the EOP are obtained from a careful analysis of empirical auto- and cross correlation functions. Based on this stochastic prior information, a least squares adjustment including a variance-covariance estimation yields the unknown tensor of inertia and the residuals of the observations and the model data. As the residuals determine the results of the variance-covariance component estimation, the variance components can be seen as measures for the consistency of the data. We present the method in detail as well as some results which are obtained using different stochastic models in order to illustrate the impact of stochastic prior information.