Geophysical Research Abstracts
Vol. 14, EGU2012-14152-1, 2012
EGU General Assembly 2012

Simulation, prediction and analysis of Polar Motion with a dynamic Earth system model

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Variations of Earth rotation are associated with the redistribution and motion of mass elements in the Earth system. On seasonal to inter-annual time scales, the largest effects are due to mass redistributions within atmosphere and hydrosphere. In order to study the Earth's reaction on geophysical excitations, the dynamic Earth system model DyMEG has been developed. It is based on the balance of angular momentum in the Earth system which is physically described by the Liouville equation. This coupled system of three first-order differential equations is solved numerically in DyMEG.

Simulations of polar motion and length-of-day variations are performed with DyMEG for time spans of up to 200 years using angular momentum variations from five ensemble runs of a consistently coupled atmosphere-hydrosphere model as model forcing. Besides, deformations induced by tides, loading and variations of Earth rotation are considered. In particular the contribution focuses on the simulation results of the Earth's free polar motion (Chandler oscillation). It is shown that the simulations over 200 years (1860-2059) are capable of exciting realistic variations of the Chandler oscillation. The application of an adaptive Kalman filter on DyMEG allows for the simultaneous simulation of Earth rotation and the estimation of critical model parameters, such as physical Earth parameters (e.g. Love numbers). The results of the estimated parameters will be presented and discussed with respect to values that can be found in the literature.