GeOGEM - Simulations to the tides of ancient oceans and the evolution of the Earth-Moon-system

Authors:

Petra Nerge, University of Hamburg, Department of Informatics, Research Group Scientific Computing

Prof. Thomas Ludwig, University of Hamburg, Department of Informatics, Research Group Scientific Computing

Prof. Maik Thomas, Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences

Dr. Johann Jungclaus, Max-Planck-Institute of Meteorology Hamburg

Prof. Jürgen Sündermann, University of Hamburg

Prof. Peter Brosche, University of Bonn

Abstract:

During the last decades Earth system research concerning rotation, figure and gravity field focused on the short scales of decade's right up to hours. However, there are still considerable deficits in the understanding of Earth's history on the geological time scale. The limited availability of geological proxy data has so far prevented a detailed quantification of the transfer of angular momentum in the Earth-Sun-Moon-system mainly due ocean tides far back in the Earth's history. Considering recent paleontological data, advances in numerical modelling and in high performance computing, the new DFG-project GeOGEM will strive to reduce these deficits. Firstly, self-consistent geological data on ocean tides, Earth's rotational parameters and orbital elements of the Moon are provided by recent research on the sediment layers of South Australia for the Neo-Proterozoic 620 Ma back. Recent paleogeographical maps with detailed information that reached back to the Neo-Proterozoic are made available.

For a time slice of the Neo-Proterozoic ocean (620 Ma b.p.), we will reconstruct the spatial and temporal characteristics of the tides by means of simulations with the three-dimensional baroclinic Max-Planck-Institute-Ocean circulation model MPI-OM forced by the complete tidal potential expressed by the ephemerides. The numerical results will be evaluated with the recent geological proxy data to the tidal spectrum of the Australian continental plate.

Subsequently, the evolution of the ocean tides under the influence of the continental drift from the Neo-Proterozoic till today will be simulated. In this process a focus will be on the transfer of angular momentum between Earth and Moon in order to explain physically the observed increase of the length of the day of about 2 hours, the decrease of the length of the month of about 1 day and therewith the dynamical evolution of the Earth-Moon-system.

The simulations require exceptional performance in computing and storage that is provided by the facilities and competences of the German Climate Computing Centre (DKRZ). The involved research groups with their expertise in geology, ocean and Earth physics, and computing science will ensure an efficient development of the project.

The oceanographical data and the ensuing data to the celestial mechanics will be stored and made available at DKRZ.

The project will last from November 2011 till December 2014.