Project: **499**

Project title: **GFZ - Erdsystem-Modellierung**

Project lead: **Maik Thomas**

Report period: **2016-01-01 to 2016-12-31**

Numerical Simulation of High-Frequency Ocean Bottom Pressure Variability

Within the two recently started peer-reviewed projects **ASPIRE** ("Atmosphere-Induced Short Period Variations of Earth Rotation", jointly funded by Deutsche Forschungsgemeinschaft und Fonds zur Förderung der Wissenschaft (Austria), Förderkennzeichen: DO1311/3-1) and **GRACE-FO** ("Realisierung der Deutschen Projektanteile der GRACE-Follow On Satellitenmission", funded by the German Ministry for Education and Research, Förderkennzeichen: 03F0654A), we started to perform new simulations of the time-evolution of the global ocean bottom pressure field. The numerical experiments carried out with the Ocean Model for Circulation and Tides (Thomas et al., 2001 and the current ocean component of the MPI Earth System Model, MPIOM (Jungclaus et al., 2013).

In the past period of 2016, the DKRZ computing resources have been used to complete the Work Packages Sensitivity Analysis for Wind Forcing (WP1) and Multi-Decade Simulations Covering the Era of Geodetic Satellites (WP2) of the original proposal:

Sensitivity Analysis for Wind Forcing (WP1):
To test and tune the self-attraction and loading parametrizations, in particular the vertical momentum transfer parametrization in response to time-variable surface winds, we simulate a global ocean bottom time-series at 3-hourly temporal resolution over the time period 1976 - 2015 with a MPIOM TP10 configuration that has been modified to also respond dynamically to atmospheric surface pressure variability. The results have been evaluated both against globally distributed in situ ocean bottom pressure observations, and (for a sub-set of experiments) also against global sea-level anomalies from the Jason satellite altimetry missions, as well as against range-rate residuals of the GRACE satellite gravimetry mission.

Multi-Decade Simulations Covering the Era of Geodetic Satellites (WP2):
Satellites equipped with laser retro-reflectors have been launched already in the year 1976, and it is custom in the geodetic community to re-process the whole time-series of available observational data with updated correction models. Thus, model-based correction models as aimed for in the **GRACE-FO** and **ASPIRE** projects need to cover more than 4 decades with high spatial and temporal resolution. Based on the model configuration specified within WP1, we finished long-term simulations over that period based on 3-hourly ECMWF reanalysis forcing data sets. The simulation results from WP1 and WP2 are going to be used for de-aliasing of non-tidal ocean mass variability of the next reprocessing of the GRACE satellite record as well as for the assessment of the oceanic contributions to the excitation of polar motion and nutation during the VLBI observation period. Results obtained from this long-term simulation are highlighted in one talk and five posters in three different sessions at the General Assembly 2016 of the European Geophysical Union in Vienna. The following publications summarize our results:

Dobslaw, H., Bergmann-Wolf, I., Forootan, E., Dahle, C., Mayer-Gürr, T., Kusche, J., Flechtner, F. (2016): Modeling of present-day atmosphere and ocean non-tidal de-aliasing errors for future gravity mission simulations. - Journal of Geodesy, 90, 5, p. 423-436.
doi: 10.1007/s00190-015-0884-3

Flechtner, F., Neumayer, K.-H., Dahle, C., Dobslaw, H., Fagiolini, E., Raimondo, J.-C., Güntner, A. (2016): What Can be Expected from the GRACE-FO Laser Ranging Interferometer for Earth Science Applications? - Surveys in Geophysics, 37, 2, p. 453-470.
doi: 10.1007/s10712-015-9338-y

Zhang, L., Dobslaw, H., Thomas, M. (2016): Globally gridded terrestrial water storage variations from GRACE satellite gravimetry for hydrometeorological applications. - Geophysical Journal International, 206, 1, p. 368-378. doi: 10.1093/gji/ggw153

Dobslaw, H. (2016): Homogenizing surface pressure time-series from operational numerical weather prediction models for geodetic applications. - Journal of Geodetic Science, 6, 1, p. 61-68. doi: 10.1515/jogs-2016-0004

Bergmann-Wolf, I. (2016): Oceanographic applications of GRACE gravity data on global and regional scales, PhD Thesis, Berlin : Freie Universität, 140 p.