Geophysical Research Abstracts
Vol. 17, EGU2015-9458, 2015
EGU General Assembly 2015

Impact of improved models for precise orbits of altimetry satellites on the orbit accuracy and regional mean sea level trends

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Precise orbits of altimetry satellites are a prerequisite for investigations of global and regional sea level changes. We show a significant progress obtained in the recent decades in modeling and determination of the orbits of altimetry satellites. This progress was reached due to the improved knowledge of the Earth gravity field obtained by using CHAMP (CHAllenging Mini-Satellite Payload), GRACE (Gravity Recovery and Climate Experiment) and GOCE (Gravity field and Ocean Circulation Explorer) data, improved realizations of the terrestrial and celestial reference frames and transformations between these reference frames, improved modeling of ocean and solid Earth tides, improved accuracy of observations and other effects.

New precise orbits of altimetry satellites ERS-1 (1991-1996), TOPEX/Poseidon (1992-2005), ERS-2 (1995-2006), Envisat (2002-2012) and Jason-1 (2002-2012) have been recently derived at the time intervals given within the DFG UHR-GravDat project and the ESA Climate Change Initiative Sea Level project using satellite laser ranging (SLR), Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS), Precise Range And Range-Rate Equipment (PRARE) and altimetry single-satellite crossover data (various observation types were used for various satellites).

We show the current state of the orbit accuracy and the improvements obtained in the recent years. In particular, we demonstrate the impact of recently developed time-variable Earth gravity field models, improved tropospheric refraction models for DORIS observations, latest release 05 of the atmosphere-ocean dealiasing product (AOD1B) and some other models on the orbit accuracy of these altimetry satellites and regional mean sea level trends computed using these new orbit solutions.