Earth Parameter and Orbit System - Orbit Computation (EPOS-OC) software - a tool for space geodesy research at GFZ

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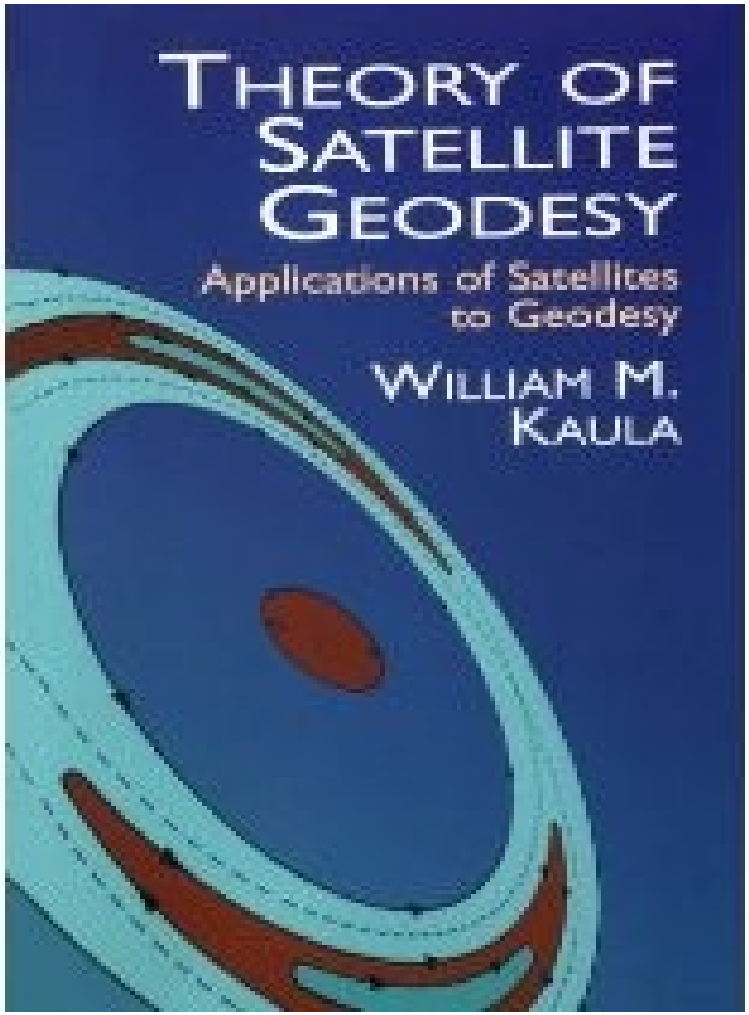
Overview

- Introduction
- Parameters estimated using EPOS-OC software
- Observation types processed
- Satellite analyzed
- Some examples of altimetry satellite precise orbit determination
- Current activities and near plans
- Conclusions

Introduction

EPOS-OC

- Multi parameter type
- Multi observation type
- Multi satellite



Other dynamic method systems

GINS

DOGS

GEODYN

BERNESE

MSODP

GIPSY-OASIS

The main parameters, that can be estimated using EPOS-OC software

- Earth gravity field coefficients
- Ocean tide coefficients
- Atmospheric tide coefficients
- Earth orientation parameters (x-, y-pole coordinates, UT1-UTC, Length-of-day)
- Station coordinates and velocities
- Earth's geocenter coodinates
- Satellite state vector (cartesian coordinates and velocities, Keplerian elements)
- Air drag factors
- Solar radiation pressure factor
- Transversal, normal, radial empirical accelerations
- Manoeuvre velocities or accelerations
- Thruster calibration parameters
- Accelerometer calibration parameters
- Satellite center of mass correction
- Station range and time biases, frequency offset, frequency and range bias drift, tropospheric refraction scale, electromagnetic bias
- GPS sender and receiver clock errors

Observation types, that can be processed using EPOS-OC software

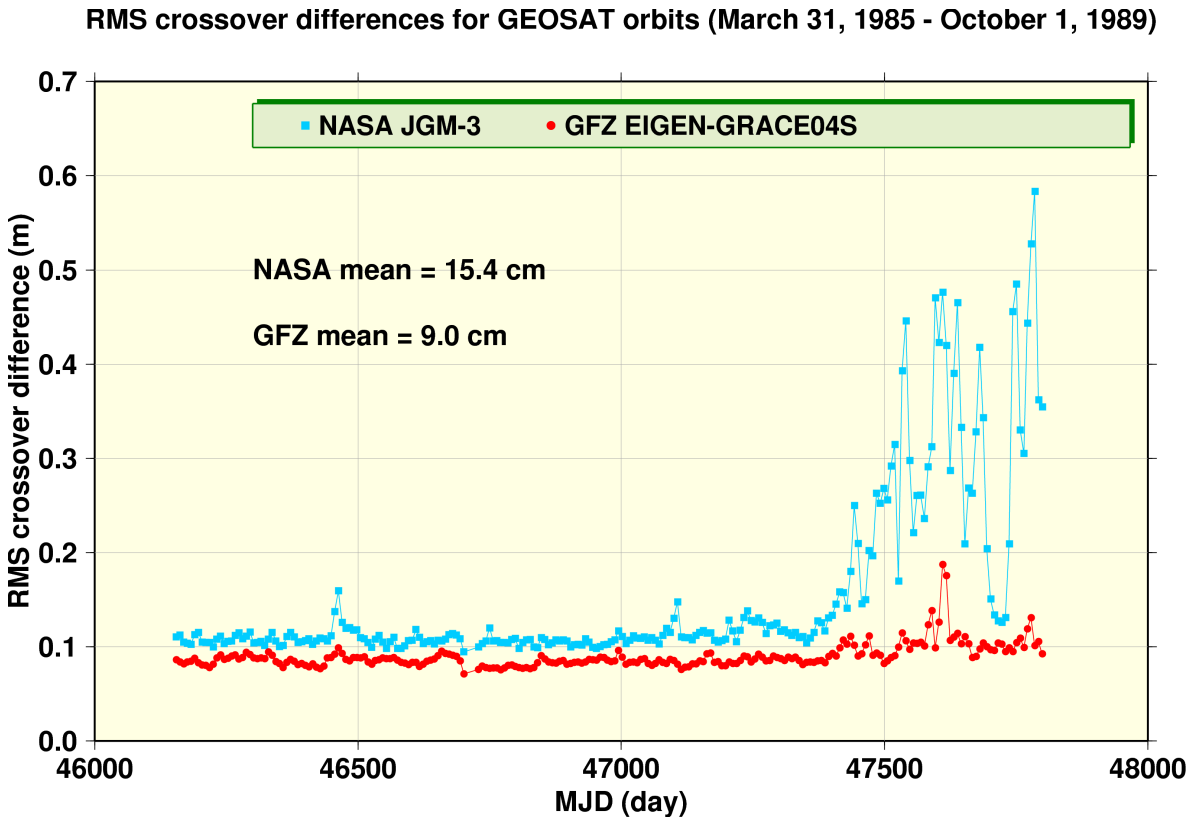
- Laser range
- Doppler Orbitography Integrated by Satellite (DORIS)
- Global Positioning System (GPS)
- Altimeter range
- Altimeter crossover
- Doppler
- Precise Range and Range-Rate Equipment (PRARE) range
- PRARE Doppler
- K-Band
- Optical bearing
- Position and velocity
- Condition equation

List of satellites and observation types recently processed at GFZ Section 1.2

- Lageos-1, Lageos-2, Etalon-1, Etalon-2 (SLR)
- ERS-1 (SLR, altimeter crossover)
- ERS-2 (SLR, altimeter crossover, PRARE range and PRARE Doppler)
- TOPEX/Poseidon (SLR, DORIS)
- GEOSAT (Doppler, altimeter crossover)
- GPS (GPS, SLR)
- GRACE-A and GRACE-B (GPS, K-Band, SLR)
- GOCE (GPS, SLR)
- TerraSAR-X and TanDEM-X (GPS, SLR)
- SAC-C (GPS)

SLR – for validation

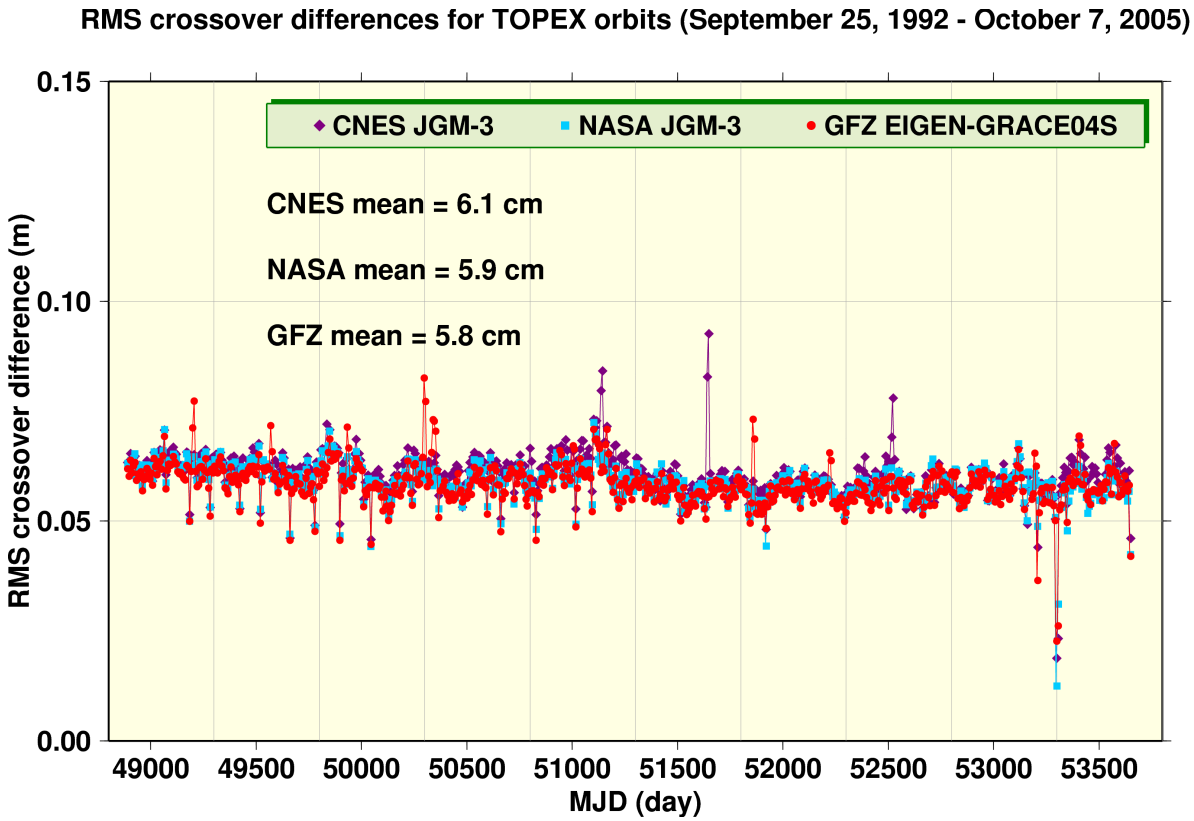
An example of GEOSAT POD



Orbit	Release date	Geopotent. model	Ocean tide model	Station coordinat.	Average values of RMS SXO differ. [cm]
NASA	1997	JGM-3	Schwiderski	JGM-3	15.4
GFZ	Dec.. 2006	EIGEN-GRACE04Sp	FES2004	GFZ estim.	9.0

Rudenko et al. (2007)

An example of TOPEX/Poseidon POD

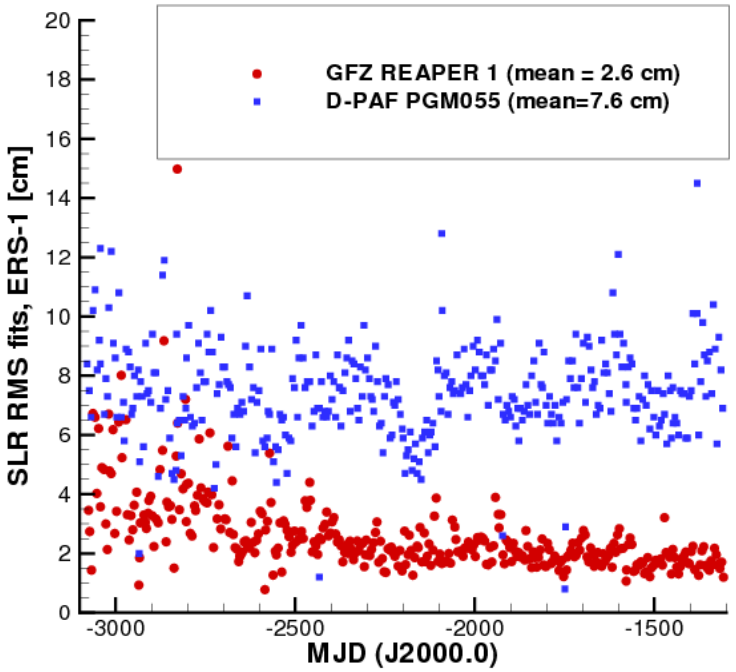


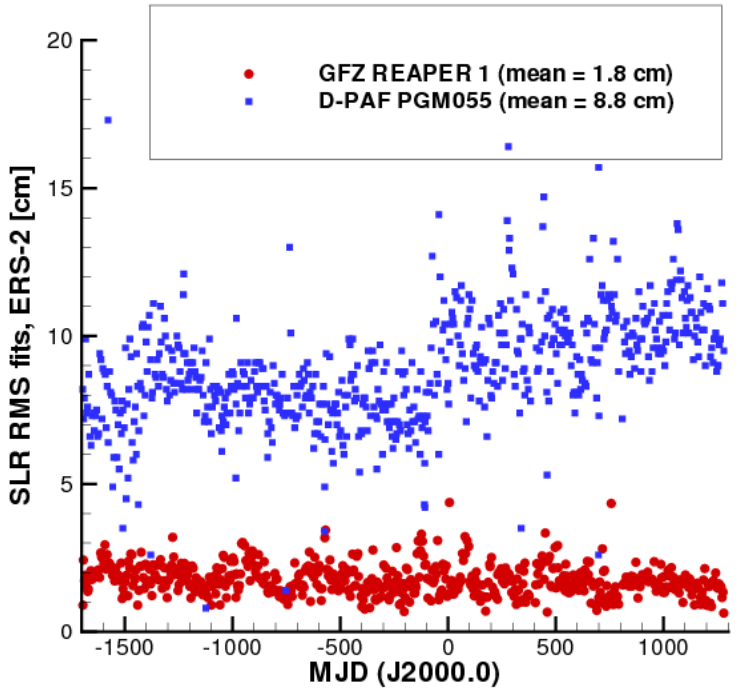
Orbit	Release date	Geopotent. model	Ocean tide model	Station coordinat.	Average values of RMS SXO differ. [cm]
NASA	2005	JGM-3	Schwiderski	JGM-2	5.9
GFZ	Dec. 2006	EIGEN-GRACE04Sp	FES2004	ITRF2000	5.8

Rudenko et al. (2007)

An example of ERS-1 and ERS-2 POD

SLR RMS fits of ERS-1 and ERS-2 GFZ REAPER and D-PAF orbits





Orbit	Release date	Geopotent. model	Ocean tide model	Station coordinat.	Average values of SLR rms fits (ERS-1/2)[cm]
D-PAF	1995-2003	PGM055	PGM055	PGM055	7.6 8.8
GFZ	Apr. 2011	EIGEN-GL04S	FES2004	LPOD2005	2.6 1.8

Rudenko et al. (2010)

Current activities and near plans in updating EPOS-OC software

Implementation and tests of the following models and input data:

- “IERS Conventions (2010)”
- SLRF2008 and DPOD2008
- Envisat, Jason-1 and Jason-2 macro- and attitude models, manoeuvre acceleration files
- Jason-1 South Atlantic Anomaly corrective model
- Update of input information on DORIS stations for 2006-2011
- Preparations for processing Envisat, Jason-1 and Jason-2 observations
- New ocean tide models (EOT10A and EOT11A)
- New planetary ephemerides (DE-421)
- NIC09 model for ionosphere correction for altimeter data
- IERS EOP 08 C04 (IAU2000A) series
- Tests of new gravity field models
- Other models and input data

Conclusions and Outlook

- EPOS-OC software is a capable tool to process different types of data, such as SLR, DORIS, GPS, Doppler, PRARE, altimetry crossover etc. of different Earth artificial satellites at altitudes from 295 to 20,200 km, such as Lageos-1, Lageos-2, Etalon-1, Etalon-2, ERS-1, ERS-2, TOPEX/Poseidon, GEOSAT, GRACE-A, GRACE-B, TerraSAR-X, Tandem-X, GPS etc. using up-to-date models and algorithms to derive different geodetic parameters, such as Earth orientation parameters, coordinates and velocities of tracking stations, gravity field coefficients and other and to compute precise orbits of these satellites
- The models, algorithms and input data of the EPOS-OC software are being updated and tested to include “IERS Conventions 2008”, SLRF2008, planetary ephemerides, new geopotential, ocean tide models, altimeter data corrections and other models, as well as to process additionally Envisat, Jason-1 and Jason-2 data
- DORIS-related models and input data are also being updated in the EPOS-OC software

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