NASA GSFC STD2006_cs21 orbit standards

(2023-10)

This document summarizes the std2006 orbit standards (2023-10) applied to the latest computation of precise orbits for the TOPEX/Poseidon, Jason-1, Jason-2, Jason-3 and Sentinel-6A satellites (October 2023). The exported orbits using the standards are named std2006_cs21.

Geopotential	
Static Gravity Model	GOCO05s (*Mayer Gürr, GOCO Team, 2015; Fecher et al., 2017*) GM: 398600.4415D+9 m^3/s^2.
Time-variable gravity	• GSFC 4x4 biweekly solution series (tvg0075) from 21 SLR/DORIS satellites spanning 1992.9-2020.7; from 2020.7 forward GSFC 4x4 model derived from GSFC model tvg0075. • Annual terms from GOCO05s for $L \geq 5$.
Atmospheric/oceanic non-tidal gravity	GFZ AOD1B RL06 90x90@3hrs dealiasing products with IB correction assumed over oceans (mean pressure and tidal signal removed from data) (*Dobslaw et al., 2017*)
Solid Earth tides	From IERS 2010 conventions (*Petit and Luzum, 2010*)
Ocean tides	GOT4.10c 50x50 (*Ray et al., 2013*).
Air tides	Removed from Atmospheric gravity and applied separately, up to 20x20 for 12 terms, *Dobslaw et al. (2017).*
Ocean Pole tide	(*Desai, 2002*) Applied to 60x60.
Third Body	Sun, Moon, Planets (mass properties from DE403 ephemeris).
Relativity	Lense Thirring & Schwarzschild applied.

Reference Frame & Displacement of Reference points	
SLR	ITRF2014 (SLRF2014 (v200428))
DORIS	ITRF2014 (DPOD2014.V5.5 (*Moreaux et al., 2018*))
Earth tide	IERS2010
Solid Earth tides	From IERS 2010 conventions
Ocean loading	GOT4.10c (*Ray et al., 2013*).
Geocenter motion	annual model (*Altamimi et al, 2016*)
Tidal Geocenter	GOT4.10c tidal variations
Mean Pole	IERS (2018) linear mean pole (*Ries and Desai, 2017*).
Precession/nutation	IAU2000
EOP	Daily values, IERS Bulletin A
High Freq. EOP	Diurnal and semidiurnal variations in polar motion & UT1 due to ocean tides.

Surface forces and attitude	
Total solar irradiance	1360.45 W/m^2 (*Kopp and Lean, 2011*)
Albedo/IR	*Knocke et al. (1988).*
Atmospheric drag	MSIS86 (*Hedin, 1987*).
Radiation Pressure (micromodels)	• TOPEX: tuned 8-plate macromodel (derived from *Marshall & Luthcke, 1994; Marshall et al., 1995*). Jason-1,2,3 & Sentinel-6A macromodels originally from CNES (*Couhert et al., 2023)* • Jason-1: GSFC tuned 10-panel macromodel. • Jason-2: GSFC tuned 10-panal macromodel • Jason-3: 10-panel macromodel • Sentinel-6A: 6-panel macromodel
Radiation pressure scale factor (C_R)	Pre-estimated per arc in separate OD run without empirical accelerations and then applied, following *Flohrer et al. (2011)*.
Attitude:	• TOPEX: attitude model for most arcs; quaternions available for only 11% arcs having off-nominal attitude. • Jason-1, Jason-2, Jason-3: body quaternions and solar array quaternions. • Sentinel-6A: body quaternions corrected for yaw bias of -0.43° (*provided by the Copernicus POD group, Sept. 2023*).

Tracking Data, Corrections, Parameterization & Modelling					
Tracking Data	SLR: Imported from the NASA CDDIS or the EDC data centers (*Noll et al., 2019*). DORIS: Imported from the NASA CDDIS or the IGN data centers. • TOPEX, Jason-1 : DORIS V2 data. • Jason-2 DORIS RINEX data (T2L2-corrected; *Belli et al., 2016; Belli & Exertier, 2018*). • Jason-3, Sentinel-6A: DORIS RINEX data.				
Troposphere models	SLR: *Mendes and Pavlis (2004*); DORIS: VMF1 (*Boehm and Schuh, 2004*)				
Parameterization	• Dynamic orbit modelling. • Drag/8 hrs + OPR alg. & crs-track /24 hrs + DORIS time bias /arc.				
SLR station biases	Modelling per gsfc2020, bias strategy adapted from the ILRS data Handling file dated 2020-06-16 (w. T2L2-derived time bias corrections).				
DORIS-related parameters	Estimate measurement bias and troposphere bias per station-pass.				
DORIS data *a priori* edits	Selected subset of edit conditions identified in DPOD2014 SINEX "DATA_REJECT" section (such as "corrupted data" or "antenna tilt")				
Satellite Center-of-mass	Time-variable: Mass & post-launch center-of-gravity are routinely updated by the satellite operators.				
SLR LRA:	• TOPEX: LRA station-dependent model by receiver type. (*Marshall et al., 1995*). • Jason-1: 49 mm range cor., GSFC-tuned vector offset (*Luthcke et al., 2003)* + GSFC elevation-dep. phase model • Jason-2: 46 mm range cor., GSFC-tuned vector offset (*Luthcke et al., 2003)* + GSFC elevation-dep. phase model • Jason-3: 46 mm range cor., GSFC-tuned vector offset (a-priori from *Couderc, 2015*) + GSFC elevation-dep. phase model • Sentinel-6A: 46 mm range cor., vector offset (*Cullen, 2021*)				
DORIS phase center:	Starec: **(***Tourain et al. 2016***);** Alcatel: 2017 Updated phase law (*Manfredi et al., 2016*)				
SLR data weight	All satellites: 10 cm.				
DORIS data weight:	TOPEX	Jason-1	Jason-2*	Jason-3*****	Sentinel-6A*****
	2 mm/s	3 mm/s	$1/(\sin(e))^{-1/2}$	$1/(\sin(e))^{-1/2}$	$1/(\sin(e))^{-1/2}$
	*****Apply elevation-dependent data weighting.				
DORIS SAA modelling	• TOPEX: none: • Jason-1: downweight 12 DORIS SAA sites; Use corrected data (*Lemoine & Capdeville., 2006*). • Jason-2: none. • Jason-3: downweight 10 DORIS SAA sites.. • Sentinel-6A: downweight 10 DORIS SAA sites.				

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