Standing Committee on Satellite Missions (CSM)

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Major tasks of CSM for period 2017/18

- Evaluate the contribution of current and near-future missions to GGOS 2020 goals (first update early 2017);
- Revise the inventory/repository of current and near-future satellite missions (reduced list by mid of 2017);
- Develop and update a CSM section on the GGOS website for public access (first version in spring 2017);
- Support and advocate new missions;
- Expand the role of CSM beyond gravity field satellites (e.g. altimetry, geodetic satellites, etc.) working with the PLATO Committee (end of 2017)

Activities and next steps

- Updating inventory/repository of current and near-future satellite missions and
- Evaluation of satellite contribution to GGOS 2020 goals

Refined versions of both documents have been prepared and are now evaluated by CSM members until mid of May

Satellite contributions to GGOS goals

No.	Description	GGOS 2020 goal	SLR	LLR	VLBI	GNSS	DORIS	Combination (currently achievable)	Remarks Combi-nation	Gravity	Altimetry incl. ice altimetry	SAR
ITRF-001-DER	Ref. frame by dynamic Earth model	---	---	---	---	---	---	---	---	---	---	---
ITRF-002-ORI	Deviation ITRF origin and CoM	< 1 mm	5 mm	n/a	n/a	< 8 mm	n/a	No combination Prec. see SLR				
ITRF-003-PRE	Precision of coordinates of ITRF stations	1 mm (horiz.) 3 mm (vert.)	< 8 mm	1-4 cm	2 mm (horiz.) 5 mm (vert.)	2-3 mm (horiz.) 4-6 mm (vert.)	0.5-2 cm	Combination (Prec. see space techn.)	Problem: local ties			
ITRF-004-SCA	Scale of ref. frame	1. 0.1 ppb 2. 0.01 ppb/yr	0.5 ppb	n/a	0.5 ppb	n/a	n/a	Combination VLBI + SLR	Larger differen. between VLBI and SLR			
ITRF-005-ACC	Access to ITRF	---	---	---	---	---		---	---	---	---	---
ERF-001-EOP	EOPs	1. Prec.: 1 mm (~ 2 µs resp. 30 µas) 2. Temp.res.: 1 hour 3. Latency: 1week 4. Near real-time: 3 mm	Precision weekly solutions: PM: ~ 0.2 mas LOD: ~ 0.03 ms Temp. res.: daily estimates Latency: 2 days Near real-time: n/a	Selected Nights UT0 < 0.1 ms VOL < 1 mas Nutation 0.05-0.2 mas Precess. <0.05 mas/yr Latency: occasionally	Precision of current 24h-sessions: PM: ~70 µas UT1-UTC: 3-10 µs nutation: 50-60 µas Temp.res: Precision of subdaily estimates much worse, no 1 hourly nutation estimates possible! Latency: ~30 h (for VLBI intensives only)	Precision for daily param.: PM: ~30 µas PM rate: ~150 µas/d LOD: ~ 10 µs Temp.res.: 1 hour (no official product, only CODE internal solution) Latency: 11-17 days Near real-time: PM: ~50 µas PM rate: ~250 µas/d LOD: ~ 10 µs	PM: 0.2-0.3 mas Temp.res. daily Latency: occasionally	Combination PM, LOD: dominated by GNSS UT1-UTC, nutation: VLBI Temp. res.: 1hr not available Latency: 30 days (C04) Near real-time: not available	Accuracy is less for older data			
ICRF-001-DET	Coordinates of ICRF sources	1. 25 µas 2. 3 µas/yr		Lunar orbit 1 mas	RA/DE prec. 40 µas Axis stab.: 10 µas No info concerning proper motion (µas/yr) available	n/a	n/a	No combination				
GRAV-001-GEOID	Static geoid accuracy	1. 1 mm at 10 km res. 2. long-term stability: 0.1 mm/yr at 10 km [see remarks]							*GGOS goals should be relaxed to 10mm and 1mm/yr*	GOCE+ GRACE 1 cm at 100 km res.		

Inventory of current satellite missions

Mission	Mission type /Measurement technique	Geodetic Parameter	Inclination/Altitude	Accuracy	Spatial Resolution (half wavelength)	Temporal Resolution	Applications	Operation Period	Remark
Gravity Field									
CHAMP	Gravity field: GPS high-low tracking (Magnetic field) (Atmosphere Sounding)	Spherical harmonic coefficients (gravity field) Low-degree harmonics (ref. frame)	87° 250-474 km	10 cm geoid height 5 mGal grav. anom. at D/O 100	200 km (D/O 100)	Static Time-variable grav. field (low degrees)	Global gravity field	2000–2010	
GRACE	Gravity field: K-band microwave low-low tracking + GPS high-low tracking (Atmosphere Sounding)	Spherical harmonic coefficients (gravity field) Low-degree harmonics (ref. frame)	89.5° 350 km	10 cm geoid height 5 mGal grav. Anom. at D/O 180	120 km (D/O 180) 200-400 km	Static ~1 month (week/day)	Global/regional gravity field; height systems; oceanography (MDT) Land hydrology, cryosphere, ocean, geophysics	2002–	
GOCE	Gavity field: satellite gravity gradiometry + GPS high-low tracking Drag-free control	Spherical harmonic coefficients (gravity field)	96.7° 230 - 260 km	2 cm geoid height 1 mGal gravity anomalies	70-80 km (D/O 250-280)	Static	Global/regional gravity field; height systems; oceanography (MDT), geophysics	2009–2013	
GRACE-FO	Gravity field: K-band microwave low-low tracking + GPS high-low tracking Laser Ranging Interferometry (LRI) demonstrator	Spherical harmonic coefficients (gravity field) Low-degree harmonics (ref. frame)	89.5° 490 km, decaying	At least as good as GRACE	120 km (D/O 180) 200-400 km	Static ~1 month (week/day)	Global/regional gravity field; height systems; oceanography (MDT) Land hydrology, cryosphere, ocean, geophysics	2018 –	
Satellite Laser Ranging (SLR)									
LAGEOS-1	Satellite Laser Ranging	• EOPs: Polar motion, LOD • Terrestrial station coordinates & velocities • Geocenter, low-degree SHC • Satellite orbits • SHC (gravity field) [*]	110° 5850 km	1 cm	point	ITRF, EOP: week	Monitoring of ITRF and Earth rotation: station coordinates, EOPs Scale of ITRF Origin of ITRF and variation w.r.t. CoM Orbit determination of satellites Global gravity field (low-degree coeff.) [#]	1976 –	
LAGEOS-2	SLR	[*]	53° 5625 km	1 cm	point	ITRF, EOP: week	[#]	1992 -	
Ajisai	SLR	[*]	50° 1485 km	1 cm	point	ITRF, EOP: week	[#]	1986 -	
Etalon-1	SLR	[*]	65° 19105 km	1 cm	point	ITRF, EOP: week	[#]	1989 -	
Etalon-2	SLR	[*]	65°	1 cm	point	ITRF, EOP: week	[#]	1989 -	

Inventory of current satellite missions (2)

Further satellites equipped with retro-reflectors, GNSS, gravity field missions, altimetry missions, SWARM, LLR reflectors on the Moon, Sentinels, etc. http://ilrs.gsfc.nasa.gov/missions/satellite_missions/
GNSS missions, GPS, Glonass, Galileo, Beidou, etc. http://www.igs.org/ http://www.gps.gov/systems/gps/space/ https://www.glonass-iac.ru/en/ http://en.beidou.gov.cn/ http://www.esa.int/Our_Activities/Navigation/Galileo/What_is_Galileo
Remote sensing missions, ERS, Envisat, SRTM, Radarsat, Landsat, TerraSAR-X, Sentinels, etc. http://www.satimagingcorp.com/satellite-sensors/
Altimetry missions, ERS, Envisat, Seasat, Geo-Sat, GFO, TOPEX/Poseidon, Jason, IceSat, CryoSat, Saral, HY-2, Sentinel 3, etc. http://www.aviso.altimetry.fr/en/missions.html http://www.altimetry.info/missions/
Missions with a DORIS receiver, Envisat, SPOT, TOPEX/Poseidon, Jason, Cryosat, Saral, HY-2, Sentinel 3, etc. http://ids-doris.org/doris-system/satellites.html

Activities – next steps

- Website – refinement in agreement with the whole GGOS web representation, work has been started

www.ggosdays.com/en/bureaus/bno/committee-satellite-mission/

- Contribution to ESA's Earth Explorer 9 call
  - E-GRASP/Eratosthenes (co-location of geodetic transmitters in space)
- Exchange with PLATO – to be started
- Next CSM meeting along IAG Scientific Assembly in Kobe, Japan, July/August 2017