Copernicus POD Service COPERNICUS SENTINEL-6 MICHAEL FREILICH POD

Presenter: Jaime Fernández (GMV) H. Peter (POSITIM), M. Fernández (GMV), P. Féménias (ESA), C. Nogueira (EUMETSAT)

COSPAR 2022, Athens, Greece 17 July 2022



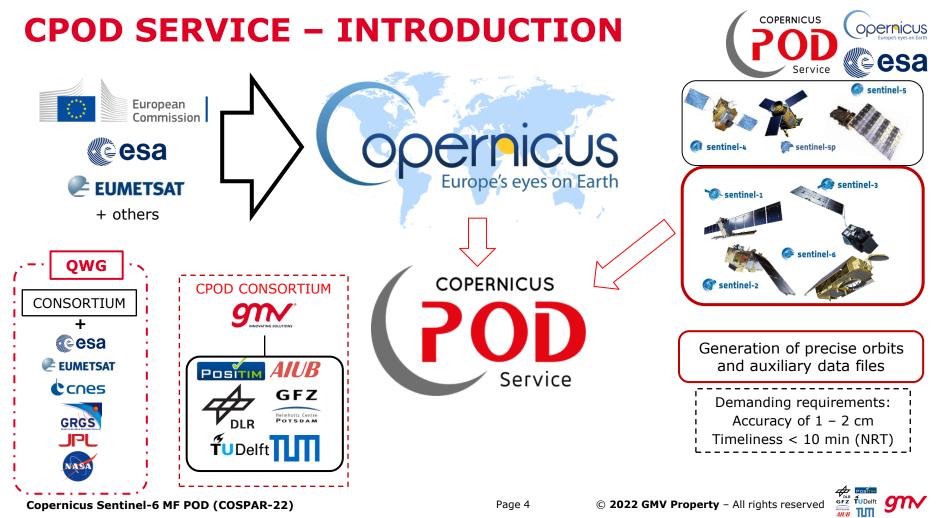
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Agenda

- 1. Introduction to CPOD Service
- 2. Sentinel-6A POD Calibration and characterization activities

Introduction to CPOD Service



Copernicus Sentinel-6 MF POD (COSPAR-22)

CPOD SERVICE – INTRODUCTION



RESOURCES IN THE CLOUD

Machines

RAM memory

23

Cores

10

80

120 GB

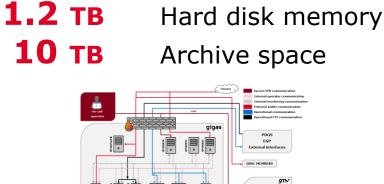
DATA AND PRODUCTS

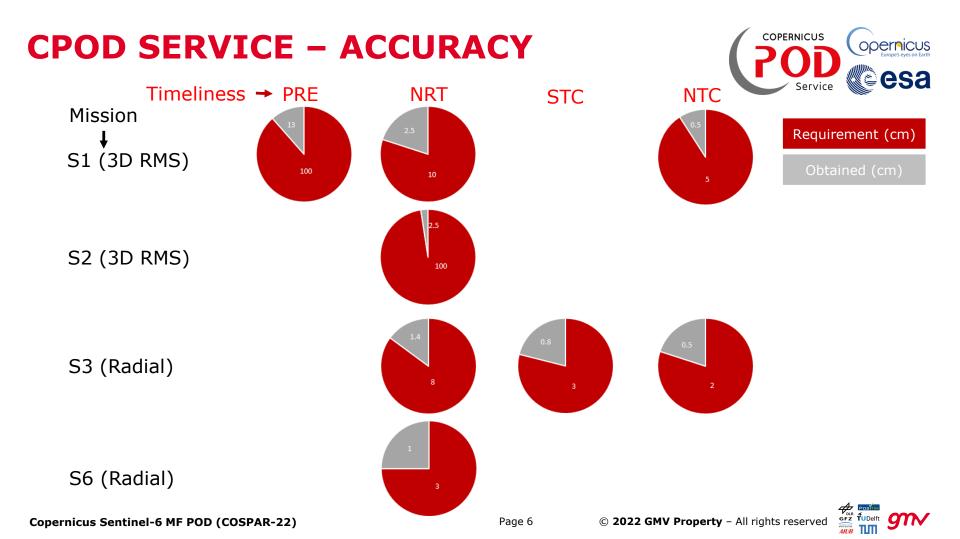
- **4 Missions** (S1, S2, S3, S6)
 - Satellites (S-X A/B)
 - 4 Timeliness (pre, NRT, STC, NTC)
 - **100,000** Orbital products/year

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8 Engineers @ GMV







S-6A @ CPOD SERVICE

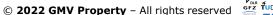
Operational products

- Restituted orbits in near-real time (GPS only):
 - Timeliness (Req. / mean Q1 2022): 10 / 5.8 min
 - Accuracy (radial; vs. COMB; Reg. / mean Q1 2022): 30 / 9.5 mm

Non-operational products

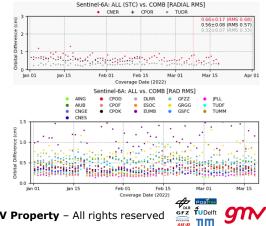
- NRT orbits (GAL only). Accuracy (radial; vs. CNES POE; Q1 2022)
 - GPS only: 10.0 mm
 - GAL only: 9.5 mm
- STC orbits (GPS+GAL): **5.6 mm** (mean of radial RMS; mean Q1 2022)

NTC orbits (GAL only): **3.8 mm** (mean of radial RMS; mean Q1 2022)



Sentinel-64 5.79±0.44 (RMS 5.8) lan 15 Feb 15 Mar 01 Mar 15 Sentinel-6: ROE AX vs. COMB [RADIAL RMS] Sentinel-6A overage Date (202)

Sentinel-6: ROE_AX Timeliness





Sentinel-6A POD – Calibration and characterization activities

SENTINEL-6A SATELLITE

EVOLUTION OF ALTIMETRY SATELLITES



	Topex / Poseidon	Jason 1	Jason 2	Jason 3	Sentinel-3	Sentinel-6
Reference Altitude (km)	1336	1336	1336	1336	814	1336
Inclination (deg)	66	66	66	66	98.6	66
Mass (Kg)	2400	500	510	550	1250	1192
POD	GPS, DORIS, SLR	GPS, DORIS, SLR	GPS, DORIS, SLR	GPS, DORIS, SLR	GPS, DORIS, SLR	GNSS, DORIS, SLR
Years	1992 - 2005	2001 - 2012	2008 - 2019	2016	A: 2016 B: 2018	2020
Picture						



Copernicus Sentinel-6 MF POD (COSPAR-22)

Configuration:

- POD SW:
- Observations:
- GNSS products:
- Determination arc: ٠
- Gravity field model:
- Ambiguity fixed solutions ٠
- Estimated orbital parameters (**step #1**)
 - State-vector, CD, CR
- Estimated orbital parameters (**step #2**) ٠
 - State-vector
 - \succ CD = 1.0 fixed (almost no drag!)
 - \succ CR = fixed to different values depending on configuration

Solution	Current	Upd3	CNES	
CR	1.0	0.95	0.98	

- > CPR (constant per revolution): 6 empirical parameter sets consisting of:
 - Along-track constant, sine and cosine
 - Cross-track constant, sine and cosine

Galileo only; 30 seconds sampling

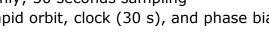
CAL/VAL ACTIVITIES @ CPOD SERVICE

CODE Rapid orbit, clock (30 s), and phase biases

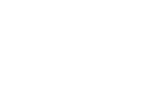
24 hours

NAPEOS

COST-G 2112





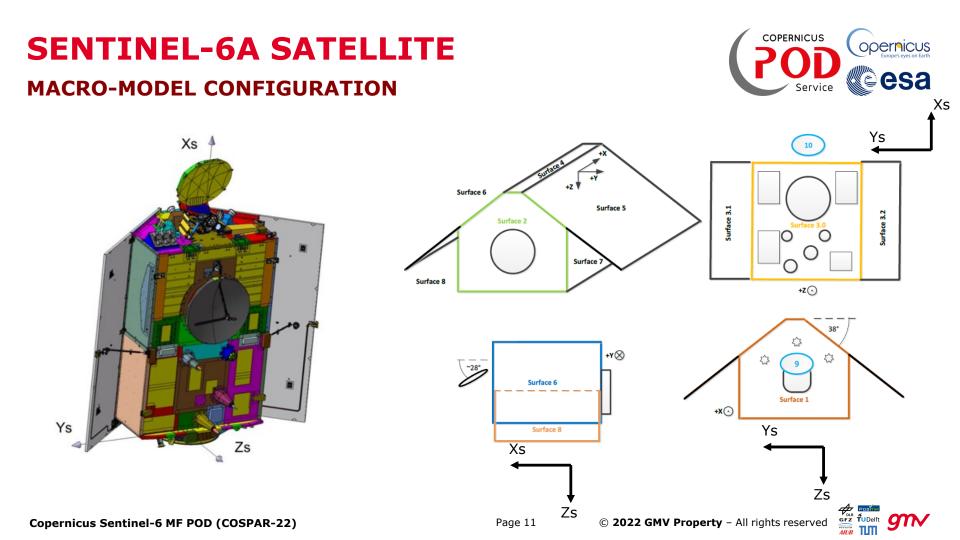




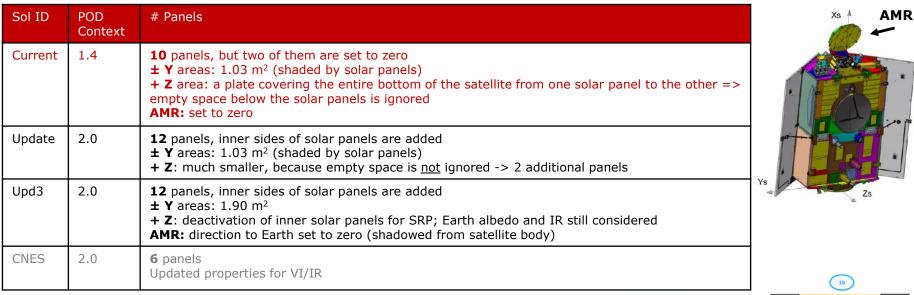


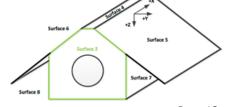
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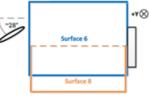
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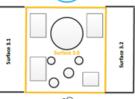


MACRO-MODEL CONFIGURATION









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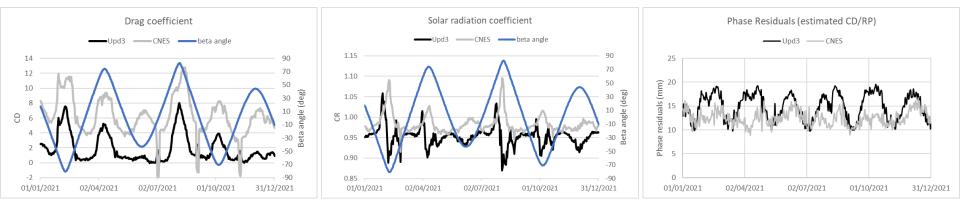
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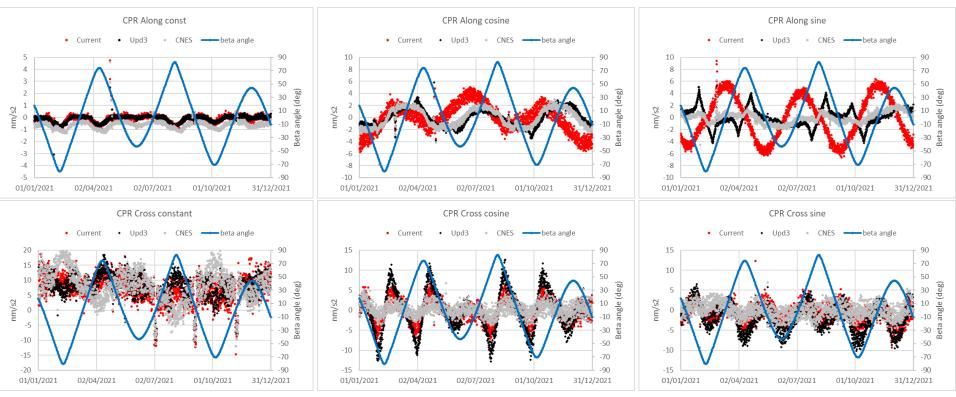


Step#1: Estimate CD, CR, without empiricals, to derive the mean of CR (days 23/Apr-13/Jul):

Solution	Current	Upd3	CNES
CR	1.0	0.95	0.98

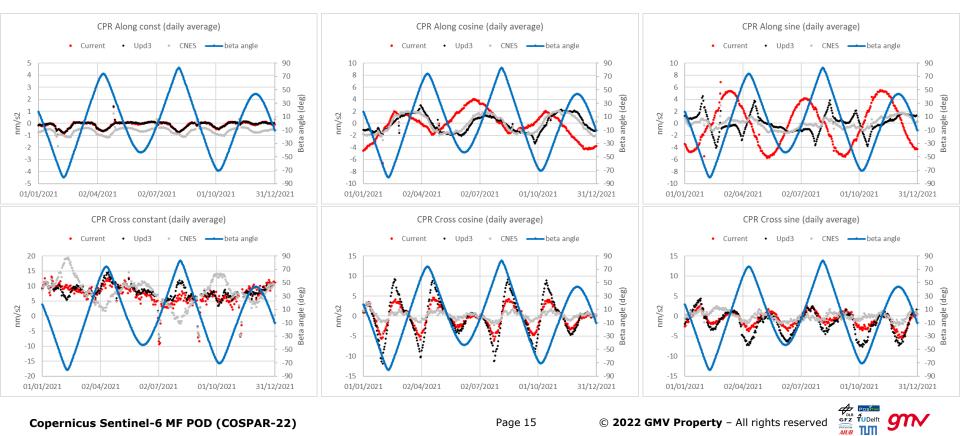
Satellite's Orbit Plane

Beta Angle (B)



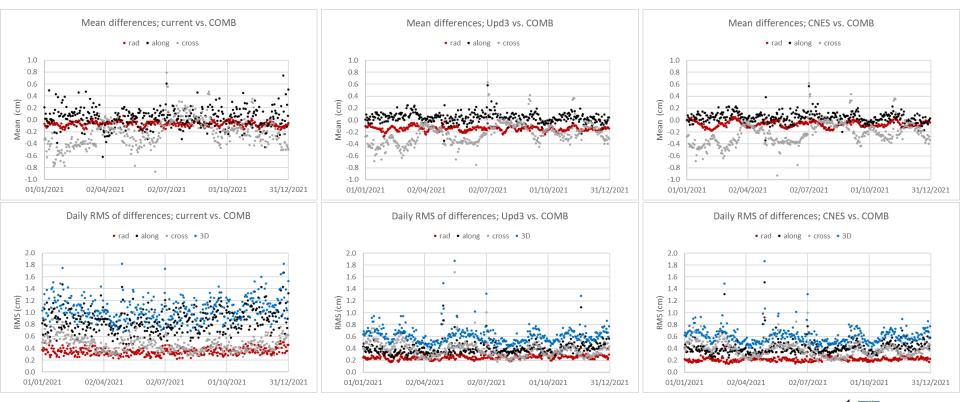
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CAL/VAL ACTIVITIES @ CPOD SERVICE COPERNICUS STEP 2 – CPRs (daily averages)



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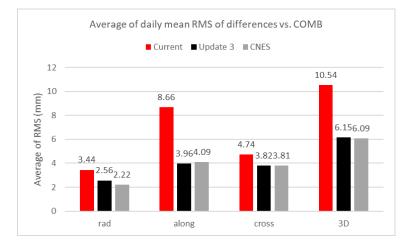
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GFZ TUDelft

QUALITY CONTROL; COMPARISONS / SLR

	Mean of daily RMS of differences vs. RSR#23 (Q4 2021)				SLR residuals (2021) one-way	
Solution	Radial (mm)	Along (mm)	Cross (mm)	3D (mm)	Mean (mm)	RMS (mm)
Current	3.44	8.66	4.74	10.54	2.0	8.9
Update 3	2.56	3.96	3.82	6.15	1.3	8.6
CNES	2.22	4.09	3.81	6.09	1.8	8.8



12 selected SLR stations, no range biases or station coordinate corrections estimated

SLR validation gives preference to **Update3** solution because of the lower mean and RMS Direct comparison vs. RSR, gives preference to **CNES** solution

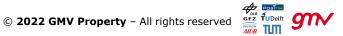


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Copernicus Sentinel-6 MF POD (COSPAR-22)

- Update of S-6 satellite macro model shows improvements but also deteriorations in the POD(-related) results.
- Shadowing effects have to be considered to reduce the signals in the empiricals.
- Fine-tuning of the macro model is on-going.
- No final conclusion which macro model should be used for the further processing.



Thank you

Copernicus POD Service

Jaime Fernández (GMV) Heike Peter (POSITIM) Marc Fernández (GMV) Pierre Féménias (ESA/ESRIN) Carolina Nogueira (EUMETSAT)

