Precision Orbit Determination summary

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Contributions

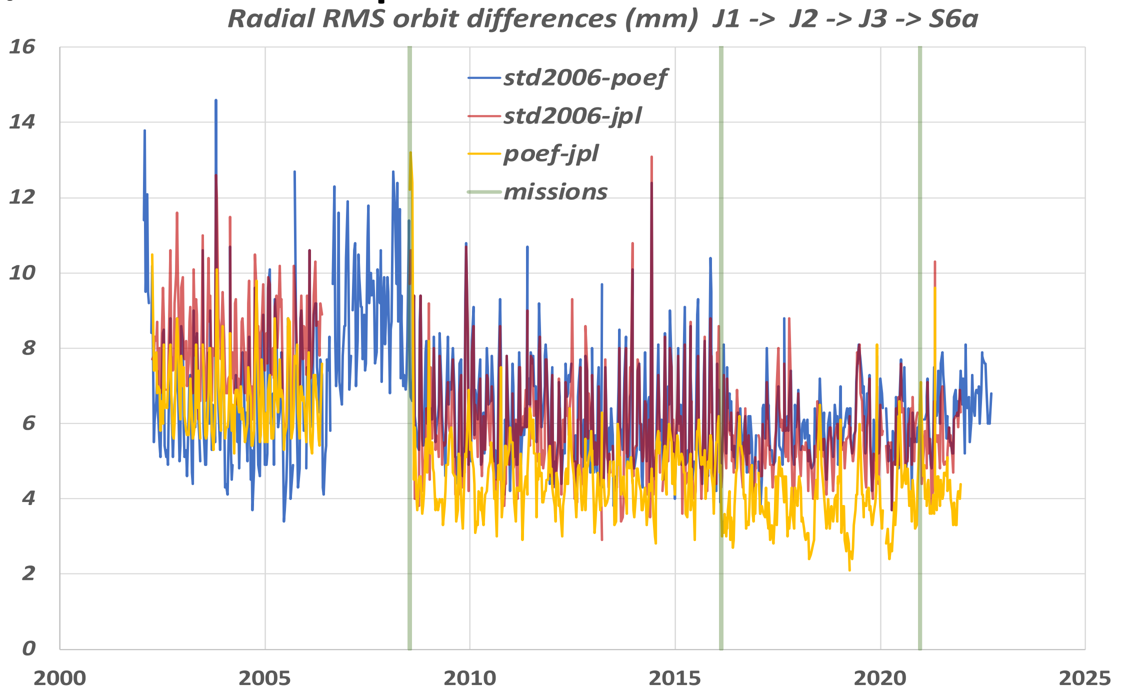
12 orals, 5 posters, 1 forum

- Reference altimetry missions:
  - **CNES:** Jason-1 (V. Debout, CS-SI) & Jason-3, Sentinel-6 MF (A. Couhert)
  - **GSFC:** T/P, Jason-1/-2/-3), Sentinel-6 MF (F. Lemoine)
  - **JPL:** Sentinel-6 MF (S. Desai)
  - **ESA:** Sentinel-6 MF (F. Gini)
  - **CPOD:** Sentinel-6 MF (H. Peter)
  - **DLR:** Sentinel-6 MF (O. Montenbruck)

- Complementary analyses:
  - **GPS block IIIA antenna calibration** (A. Conrad, CU Boulder)
  - **GPS satellite attitude modeling** (G. Katsigianni, CLS) & **attitude-dependent errors in Jason-3 POD** (C. Kobel, AIUB)
  - **DORIS satellites for ITRF2020** (H. Capdeville, CLS)
  - **SLR systematic errors** (D. Arnold, AIUB) & **SLR-based reevaluation of the Earth's GM** (M. Cherrier, CNES/CLS)
  - **Orbit accuracy of the altimetry constellation** (S. Rudenko, DGFI-TUM)
  - **COST-G Time-Variable Gravity field modeling** (A. Jäggi, AIUB)
  - **Solar Radiation Pressure modeling** (F. Mercier, CNES)
  - **Copernicus POD Service** (J. Fernandez, GMV)

POD status

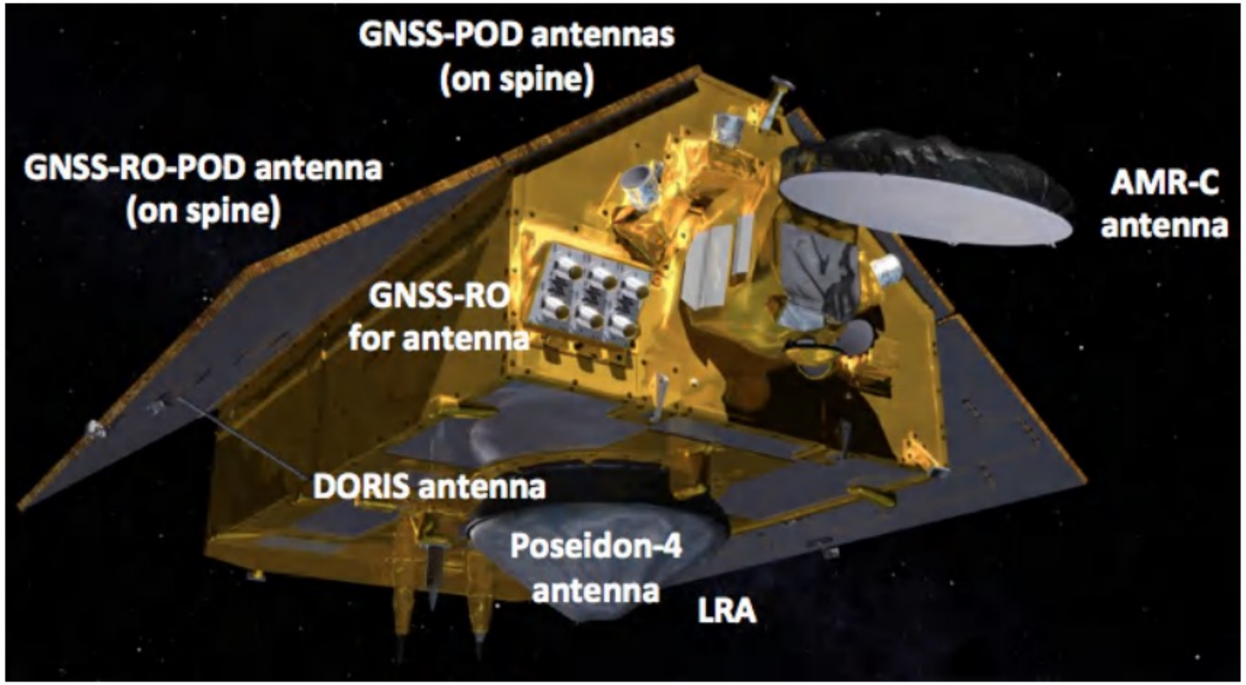
- Copernicus missions POD and CNES/JPL/NASA POD productions are nominal
  - Current set of orbits agrees well avg. radial RMS:
    - 8-12 mm (J1); 6-8 mm (J2); 5-7 mm (J3 & S6A)
  - GSFC STD-2006/JPL RLSE-22A/CNES POE-F continue using ITRF2014 for now until the new ITRF2020 is thoroughly evaluated
  - Jason-1 CNES POE-F reprocessed orbits are now available
- CNES POE-G Standards in preparation for 2023



(Lemoine et al. 2022)

S6 MF a new laboratory for metrology in orbit

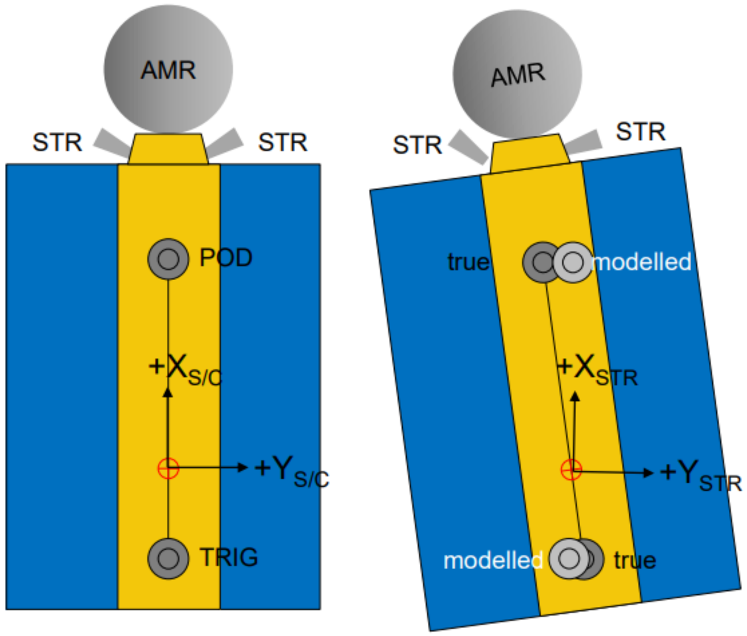
- Thanks to the co-location of POD instruments, GNSS (GPS+Galileo), DORIS and SLR, with the inclusion of three GNSS receivers and antennas, we can verify the stability of the platform with an unprecedented accuracy



Recommendations

Double-check star sensor alignment matrix for suspected biases on S6 MF

- The metrological of the GNSS data from the three receivers and antennas possibly reveals that there is a 0.43° yaw bias (also pitch?) in the attitude of the spacecraft as defined by the quaternions
  - ⇒ Reprocess the quaternions for S6 MF with this correction
  - ⇒ Make sure the ground software for S6B avoids a similar problem

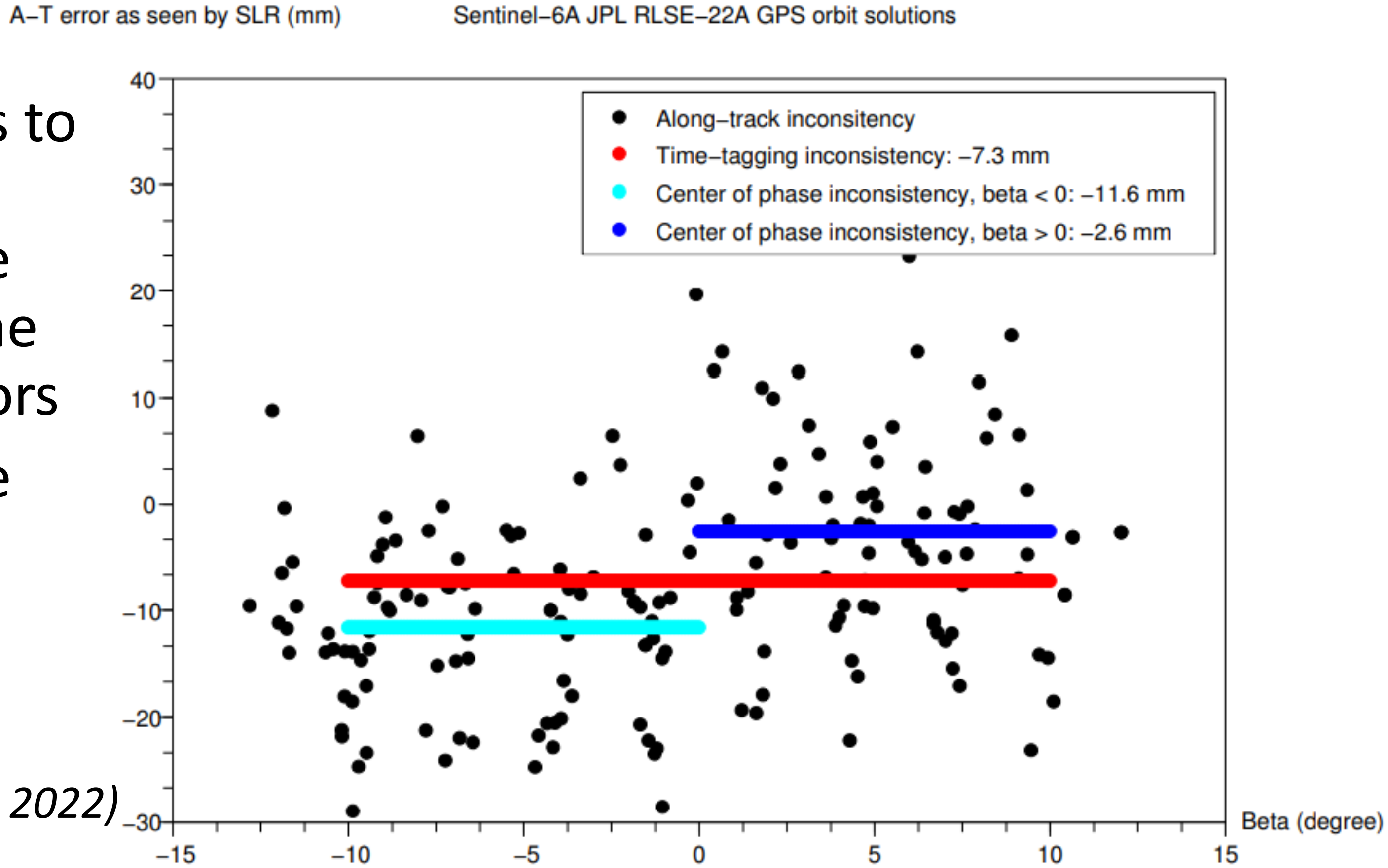


(Montenbruck et al., 2022)
(Desai et al., 2022)

Measure S6B TRIG-PODRIX timing bias with signal simulator (e.g. during ground s/c tests)

- TRIG/PODRIX time tag too large/small by 1.2 µs or shared contributions (SLR analysis suggests dominating contribution of TRIG time stamping error)
  - Attitude flip maneuvers (thanks to the project team) at low beta angles are useful to disentangle center of phase errors from time tagging, dynamic modeling errors

  ⇒ Should be reconducted for the commissioning phase of S6B

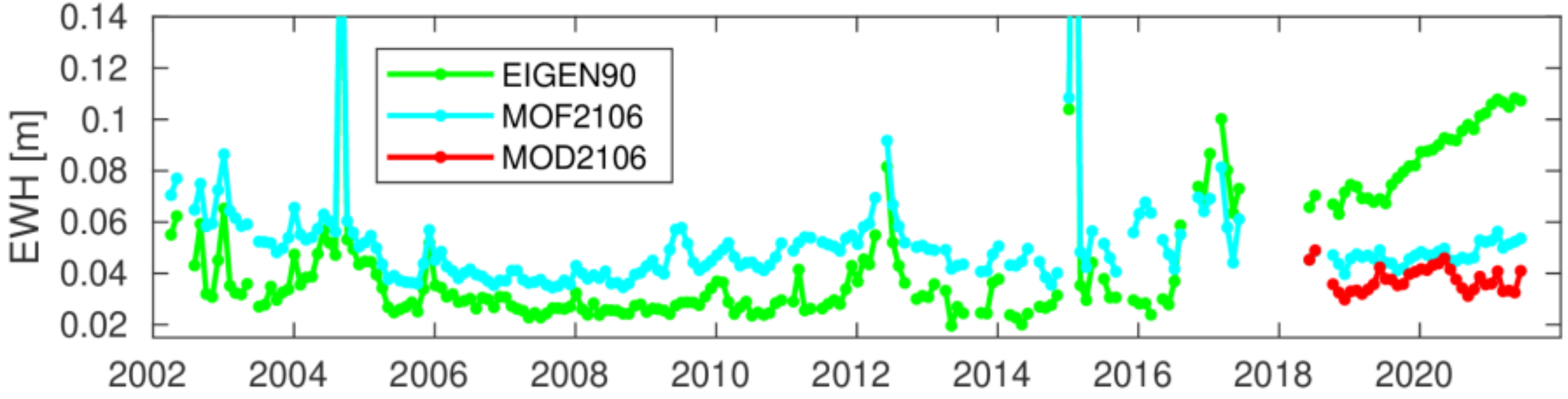


(Couhert et al., 2022)

Consider use of products from Time-Variable Gravity COST-G Service for POD

- A model fitted to COST-G* GRACE-FO gravity fields (red) reveals large prediction errors for the EIGEN90 model (green) over the last years

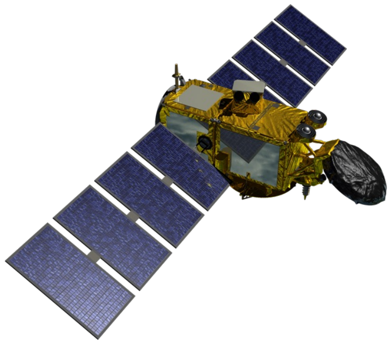
  => Its use would be beneficial for the whole altimetry constellation



(Jäggi et al., 2022)

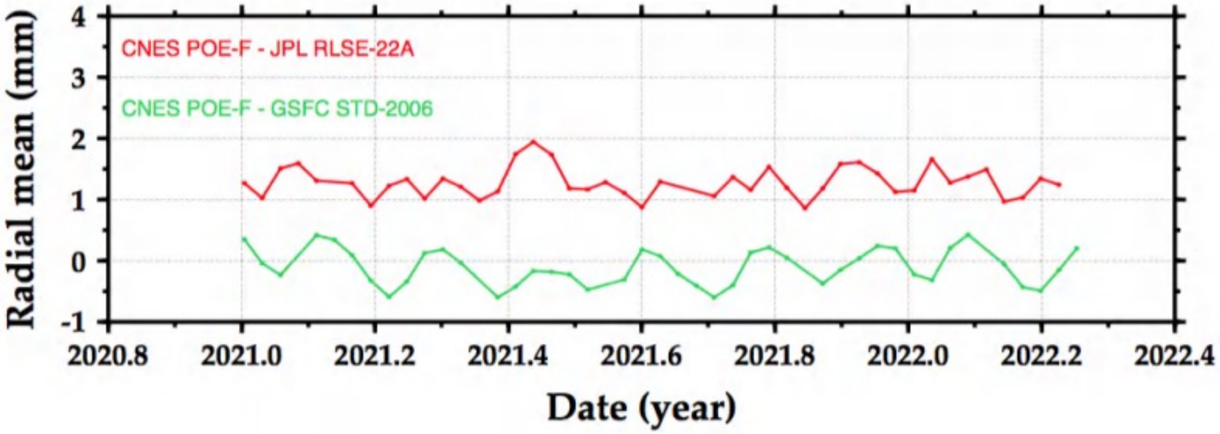
*COST-G is an international service of the International Association of Geodesy operated by the Astronomical Institute of the University of Bern

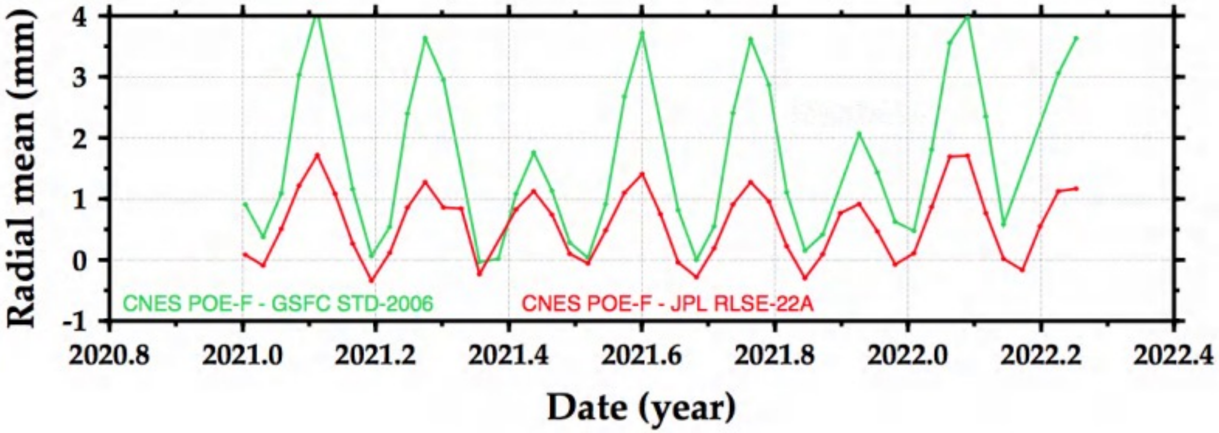
Challenges for S6 MF remain with the Radiation Pressure modeling



Jason-3

Sentinel-6 MF





(Couhert et al., 2022)

Multi-constellation GNSS receivers should be the baseline for future altimeter missions

- In terms of independent SLR residuals RMS, combined Galileo+GPS orbits seem to perform better than individual GPS-only or Galileo-only solutions (to be further assessed)
- It's a vanguard for the proposed ESA Genesis mission which is a multi-technic geodetic mission to improve the ITRF

	Galileo	GPS	Galileo + GPS
SLR res. Mean (mm)	1.4	1.4	1.5
SLR res. RMS (mm)	8.1	9.3	7.8

(Gini et al., 2022)