#### COPERNICUS POD SERVICE

#### **GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY**

# **COPERNICUS POD SERVICE** REPROCESSING OF THE COPERNICUS SENTINEL-1,-2,-3 ORBITS

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Emilio J. Calero<sup>(1)</sup>

Jaime Fernández <sup>(1)</sup>

Heike Peter <sup>(2)</sup>

Pierre Féménias (3)

 <sup>(1)</sup> GMV AD., Isaac Newton 11, 28760 Tres Cantos, Spain
 <sup>(2)</sup> PosiTim UG, In den Löser 15, 64342 Seeheim-Jugenheim, Germany
 <sup>(3)</sup> ESA/ESRIN, Via Galileo Galilei, I-00044

Frascati, Italy



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#### **AGENDA**

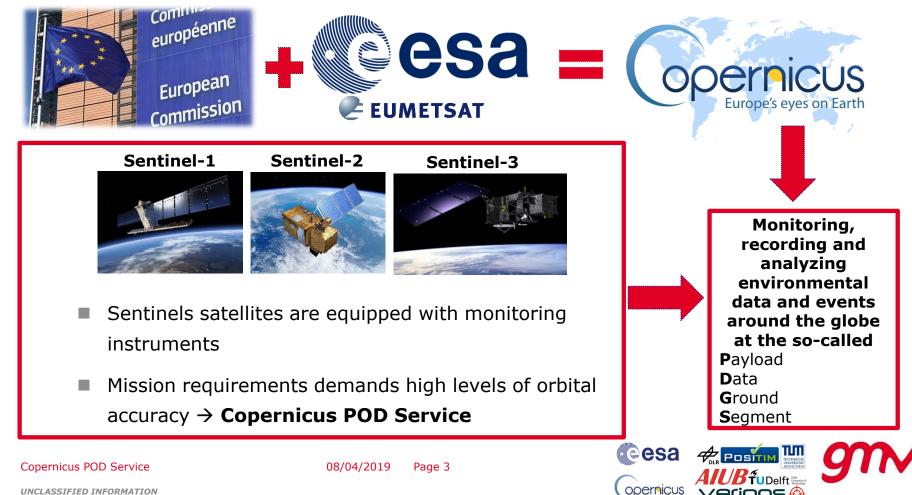
Overview of Copernicus POD Service

- Reprocessing campaign
  - Ambiguity-fixing techniques
  - GPS orbits and clocks in ITRF14/IGS14
- Results

Conclusions



# **OVERVIEW OF CPOD SERVICE**



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#### REPROCESSING

- During the lifetime of the CPOD Service (~6 years), the orbital models, the geodetic standards and the POD techniques evolve
- Using the latest state-of-the-art techniques, consistent and improved orbit time series are generated
- Two reprocessing have been done in the frame of this activity
  - POD processing with integer ambiguity resolution
  - POD processing with consistent GPS products aligned to ITRF14/IGS14
- Corrected ARP location for Sentinel-1A and -1B has been used during the reprocessing

	New ARP (mm)	Operational ARP (mm)	∆ <b>ARP (mm)</b>
X	-937.1	-976.2	39.1
Y	332.1	286.9	45.2
Z	131.0	124.1	6.9

#### This is not an official reprocessing requested by ESA or others



## **REPROCESSING – AMBIGUITY FIXING**

- This reprocessing is characterized by the usage of ambiguity fixing algorithms during the POD processing → PCO/PCV maps are recalibrated using this new configuration
- PCO/PCV maps remove the offset between the antenna reference point (ARP) and the antenna phase centre
  - PCO (Phase Centre Offset) accounts for a systematic bias
  - PCV (Phase Centre Variations) maps account for the azimuth/elevation variations
- New PCO/PCV values have been estimated processing one year of data (2017/12/01 - 2018/11/30)
  - The PCO is estimated during the determination process
  - The PCV maps are generated from the assessment of the phase residuals

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# **REPROCESSING – REPROCESSED GPS ORBIT AND CLOCK PRODUCTS**

IGS orbit & clock final products switched from ITRF08 to ITRF14 on 2017/01/29

- It yields inconsistencies
- Reprocessed GPS orbit & clock products at POSITIM
  - Whole time series of GPS orbits/clocks consistently aligned to ITRF14/IGS14
  - 36-hour coverage (vs. 24-hour coverage of IGS Final products) → tailored to the NTC products determination arc
- Operational PCO/PCVs maps have been used, except for S-1, which uses the generated during the Ambiguity Fixing Reprocessing (to be consistent with the ARP)





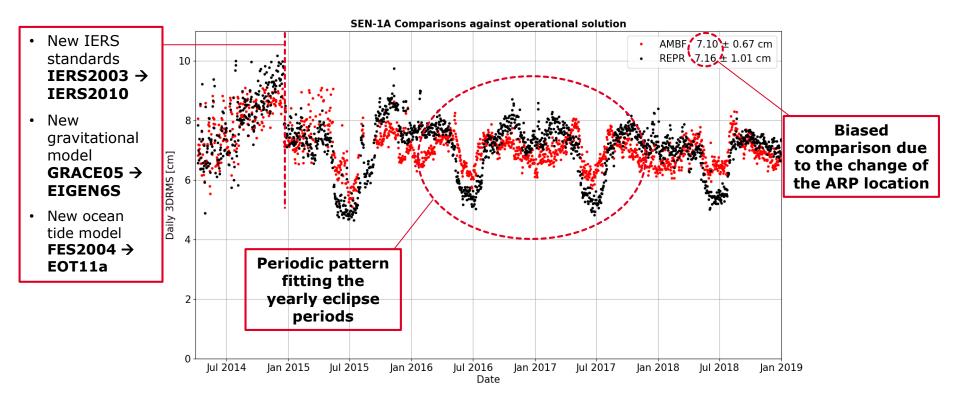
#### RESULTS

- Three solutions are considered:
  - **OPER**: Operational solution
  - **AMBF**: Solution generated within the Ambiguity Fixing reprocessing
  - **REPR**: Solution generated with the reprocessed GPS products





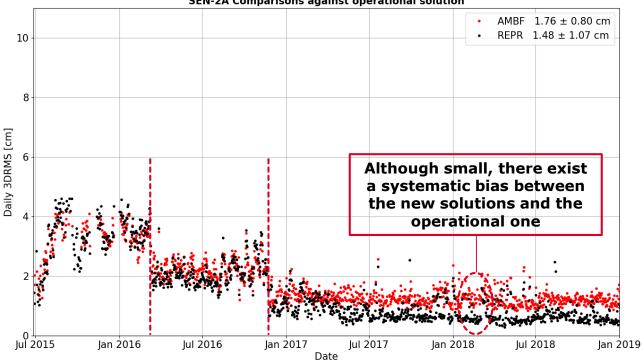
# **RESULTS – VS OPERATIONAL ORBIT (I)**







# **RESULTS – VS OPERATIONAL ORBIT (II)**



SEN-2A Comparisons against operational solution

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## **RESULTS – VS OPERATIONAL ORBIT (III)**



SEN-3A Comparisons against operational solution

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#### **RESULTS – OVERLAPS**

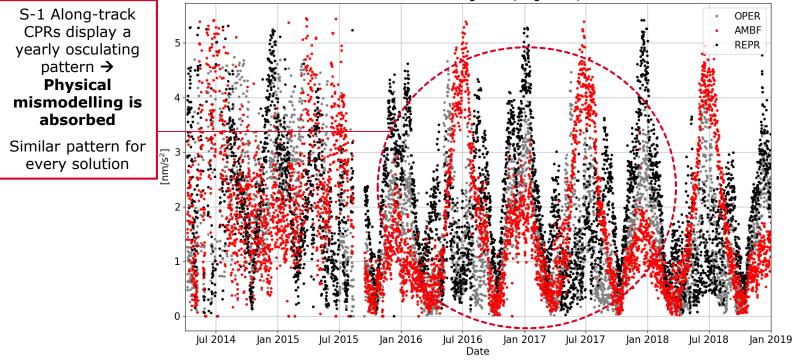
1-POINT 3DRMS OVERLAPS [cm]				
	OPER	AMBF	REPR	
	mean ± StD	mean ± StD	mean ± StD	
S-1A	$0.70 \pm 0.37$	$1.12 \pm 0.58$	0.68 ± 0.32	
S-1B	$0.79 \pm 0.39$	$0.99 \pm 0.46$	$0.67 \pm 0.31$	
S-2A	$0.85 \pm 0.49$	$0.91 \pm 0.47$	0.67 ± 0.33	
S-2B	$0.64 \pm 0.31$	$0.84 \pm 0.43$	$0.61 \pm 0.29$	
S-3A	$1.10 \pm 0.55$	0.77 ± 0.38	$1.14 \pm 0.58$	
S-3B	$1.06 \pm 0.48$	0.72 ± 0.33	$1.20 \pm 0.60$	

- The REPR solution performs better than the others for S-1 and S-2, being the AMBF solution the worst one in those cases
- For S-3, the AMBF solution shows the highest levels of consistency
  The rate of the S-3 measurements is consistent with the GPS clocks

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# **RESULTS – OTHER POD METRICS (I)**



SEN-1A CPR Along-track (magnitude)

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# **RESULTS – OTHER POD METRICS (II)**

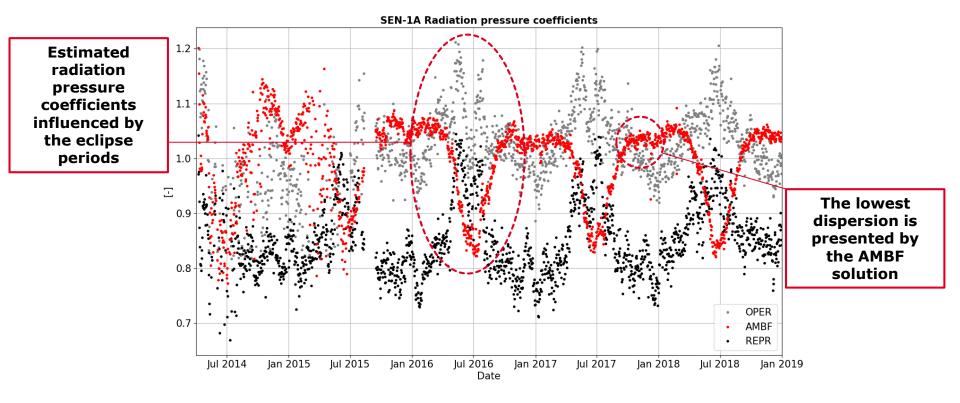
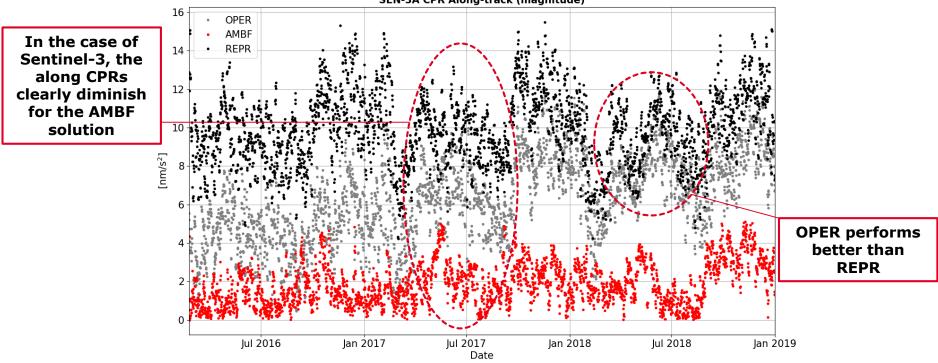


 Image: Copernicus
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# **RESULTS – OTHER POD METRICS (III)**

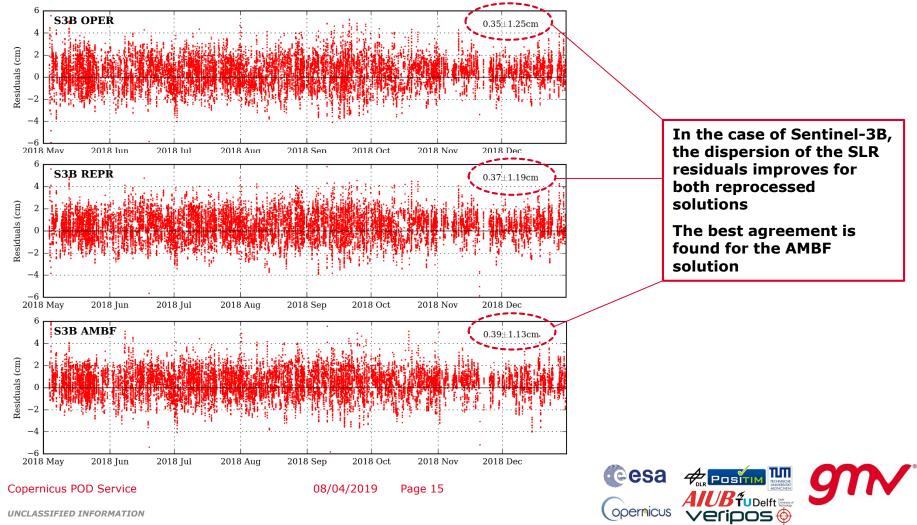


SEN-3A CPR Along-track (magnitude)

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#### **RESULTS – SLR VALIDATION**



#### CONCLUSIONS

- The CPOD Service has carried out two reprocessing campaigns
  - (1) including integer ambiguity resolution
  - (2) consistent GPS products aligned to ITRF14/IGS14
- New PCO/PCVs maps have been generated as a former stage in the ambiguityfixing reprocessing
- Systematic biases have been found between the reprocessed orbits and the operational ones. Their causes are not still clear
- Some estimated parameters reveals an improvement for the ambiguity-fixing reprocessing
- An improved performance has been shown for S-3 by assessing the orbit overlaps as well as the SLR residuals
- Uncertainties in the results. Improvements are still required



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08/04/2019 Page 16

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# Thank you! Comments? Questions?

**CPOD** Team

