Current Results from Multi-mission Calibrations at the Permanent Facility for Altimetry Calibration in west Crete, Greece attaining Fiducial Reference Measurement Standards

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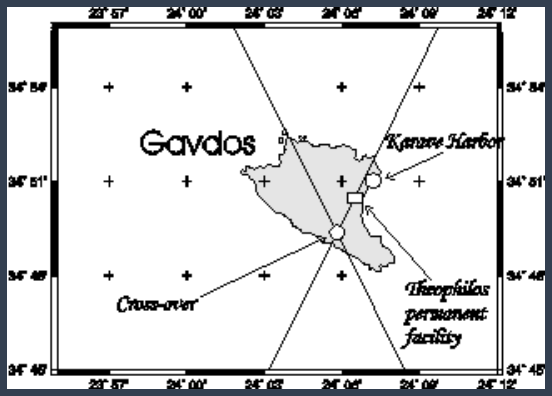
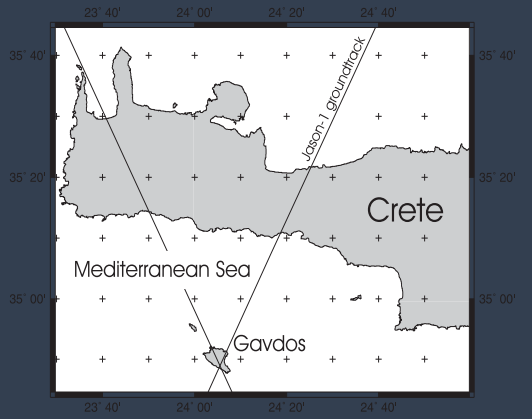
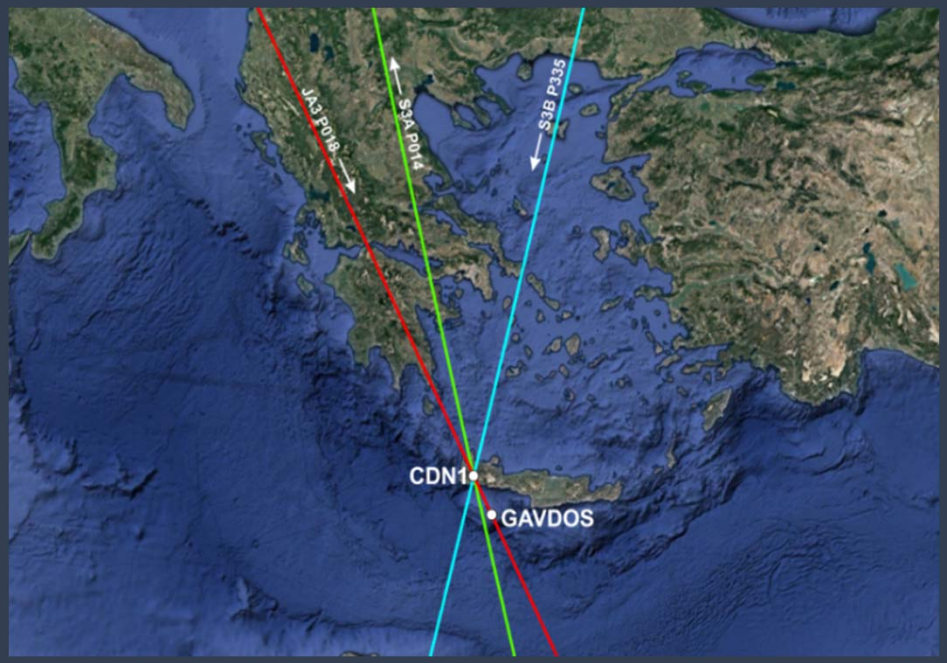
X. Frantzis, A. Tripolitsiotis

Gavdos/Crete Permanent Cal/Val Facility





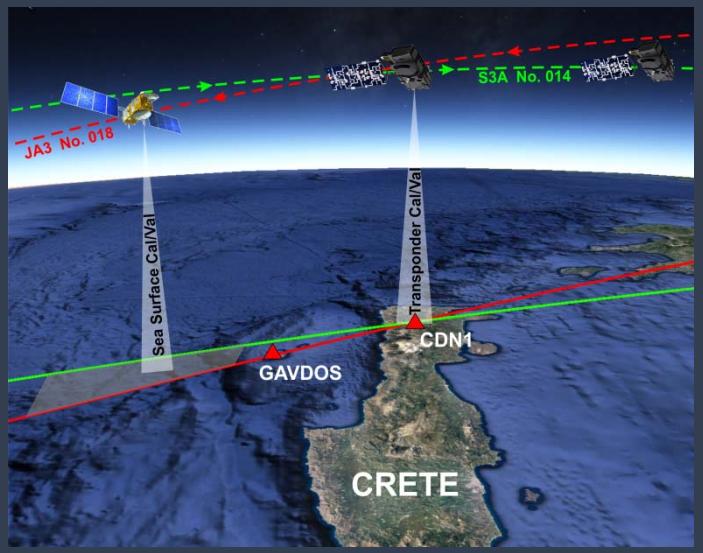
Land & Sea Calibrating Regions



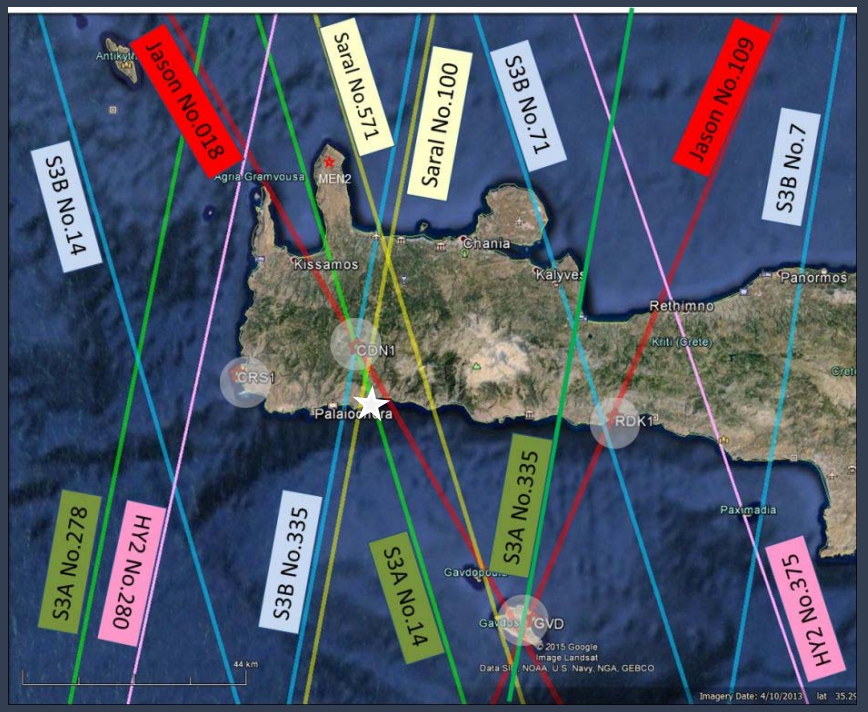
Transponder at CDN1 Cal/Val

Gavdos sea-surface Cal/Val

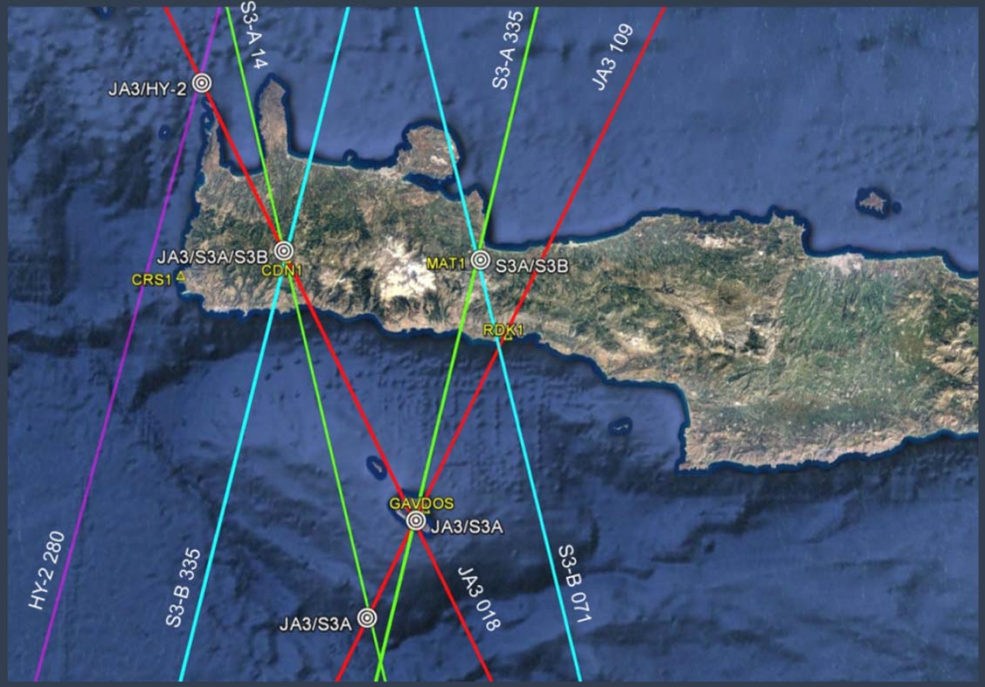
Groundtracks around Crete & Gavdos

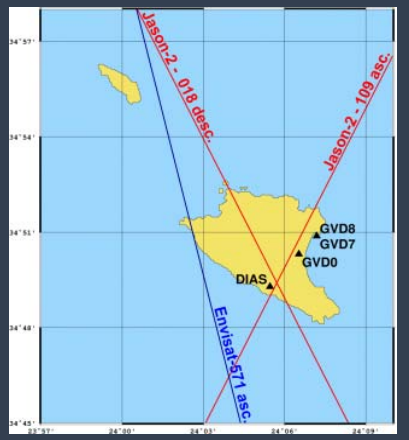


Transponder & Sea-Surface simultaneous

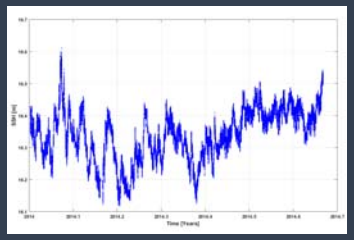


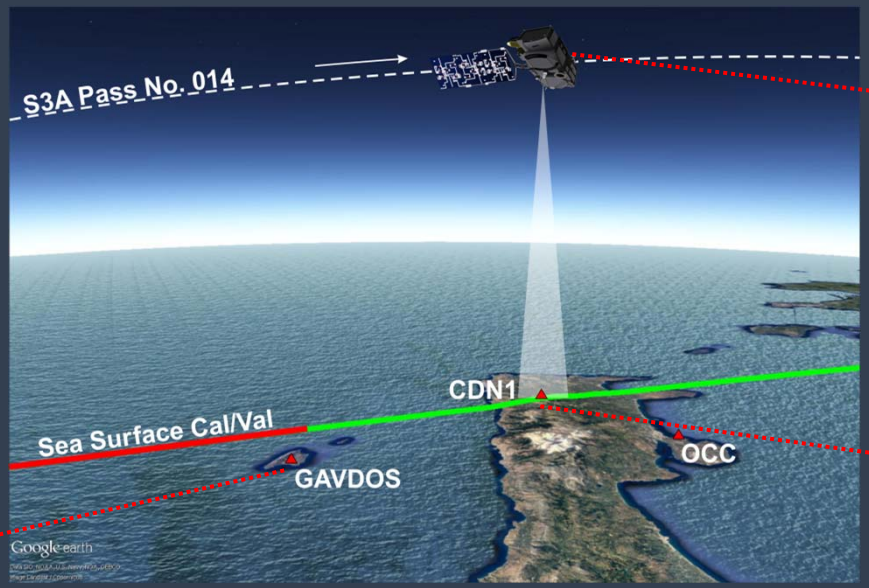
Major Cal/Val and crossover sites

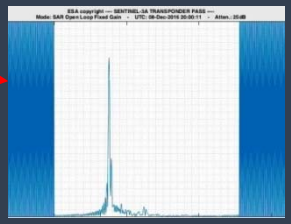




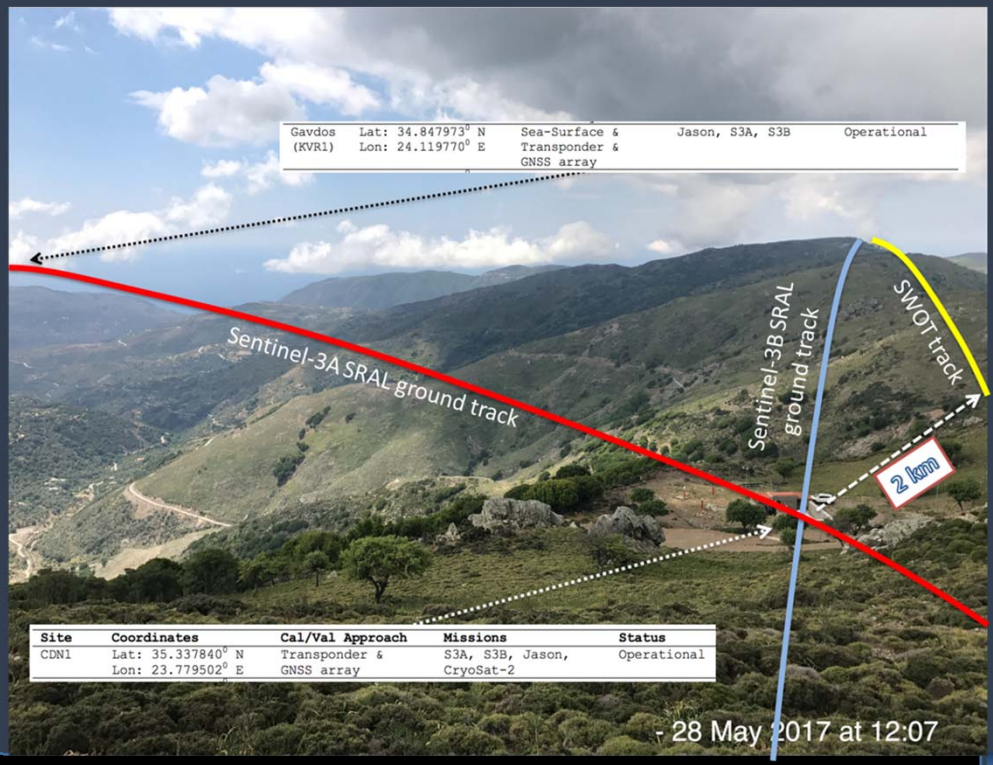
Simultaneous Transponder & Sea Cal/Val



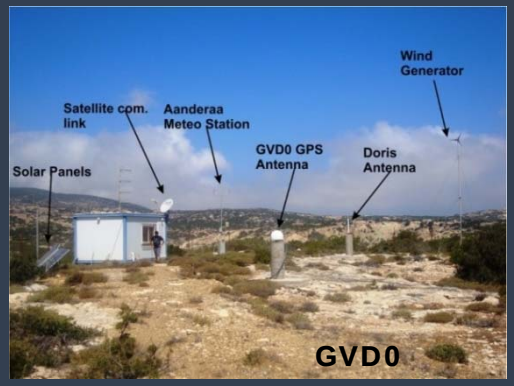


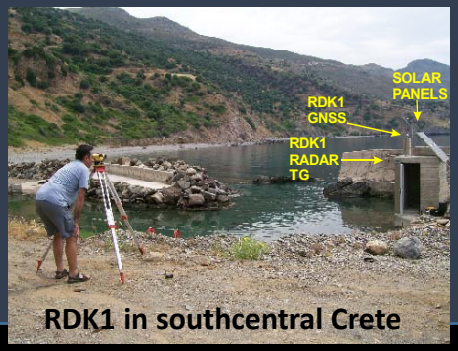


Transponder CDN1 Cal/Val Facility

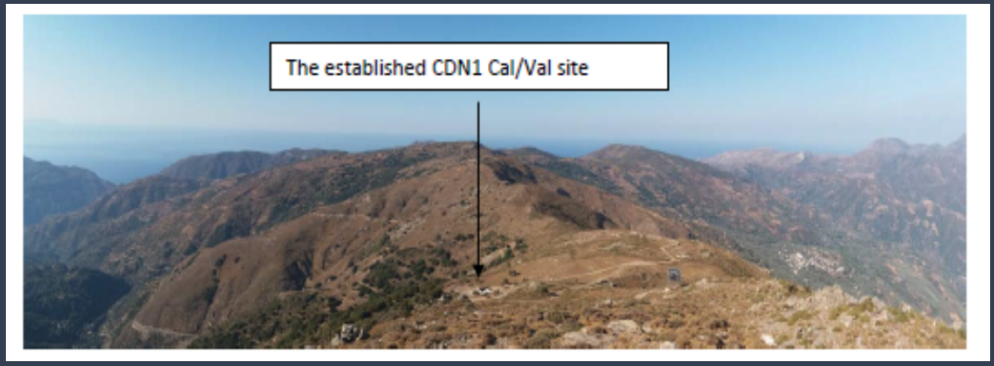


Sea-surface Cal/Val Facilities

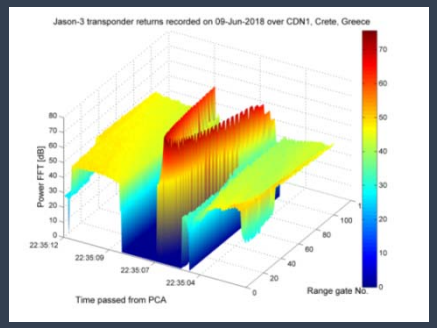




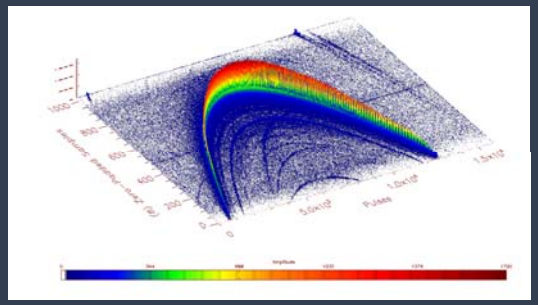
CDN1: ESA S-3 Altimeter Calibration



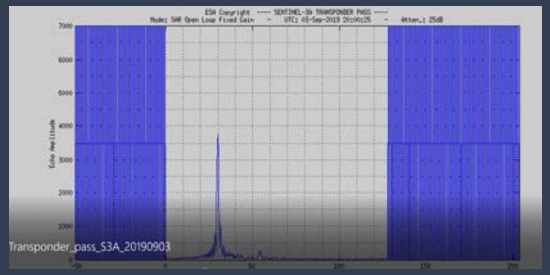
Transponder Calibrations

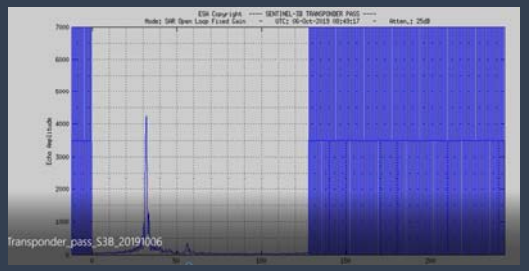


Jason-3, 9-June-2018



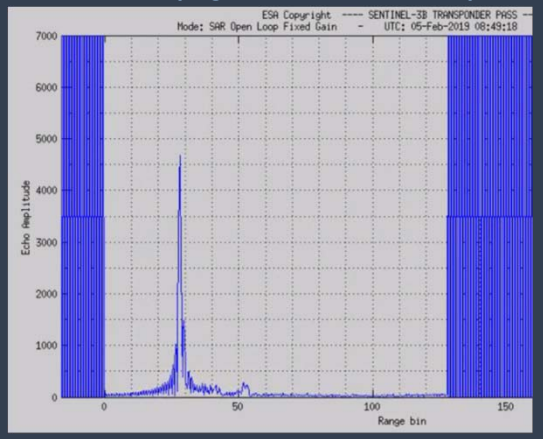
CryoSat-2, 20-Sept-2019



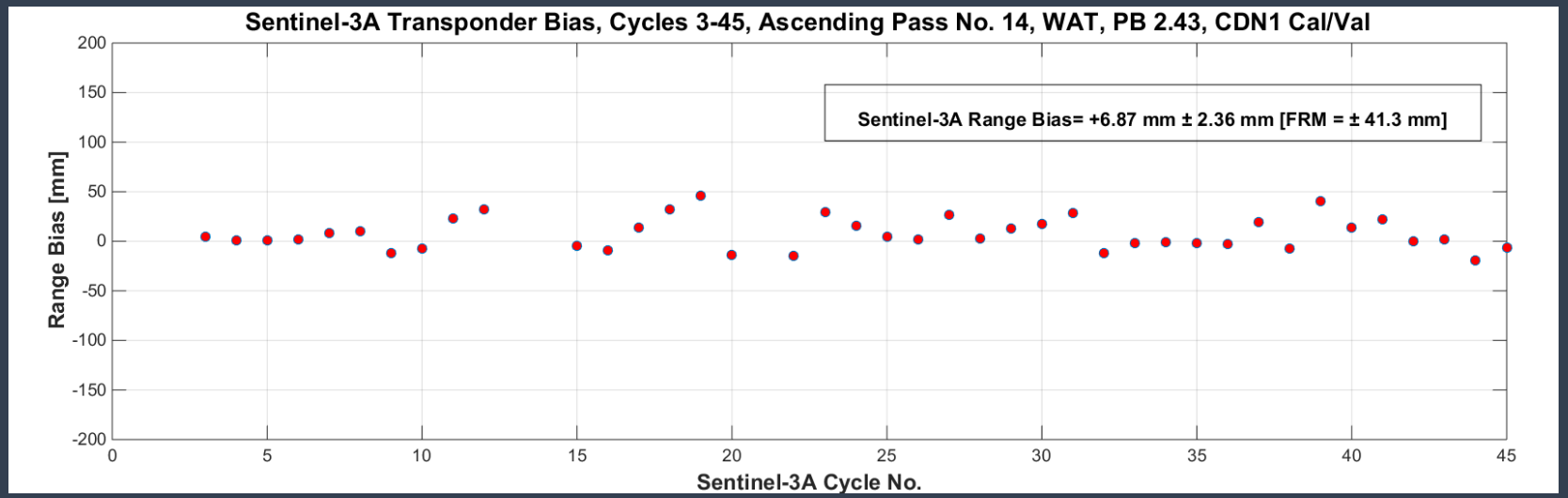


Sentinel-3A (3-Sept-2019) & **Sentinel-3B** (right, 6-Oct-2019)

Sentinel-3B (nominal orbit), 5-Feb-2019

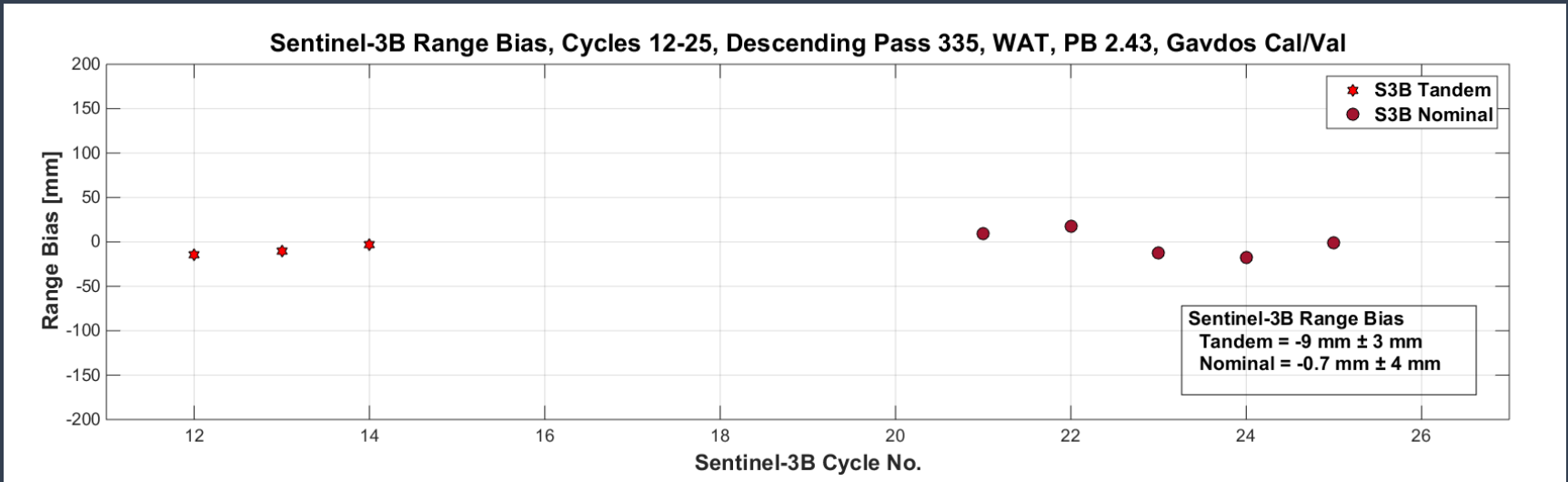


S3A Transponder Cal/Val (CDN1): Pass No.14



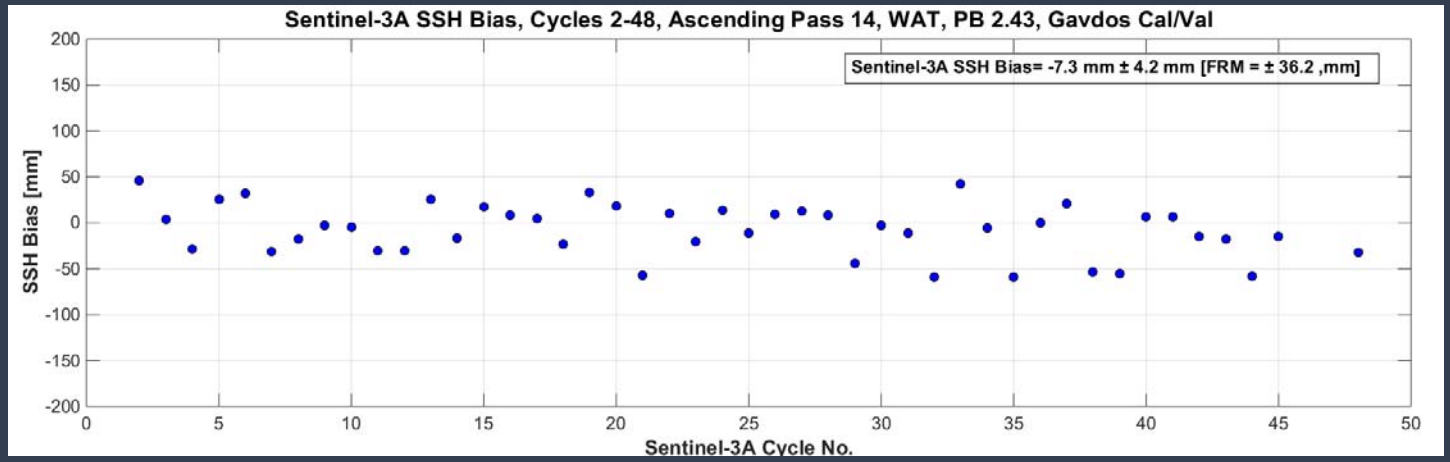
- S3A Ascending Pass No. 14, Cycles: 3-45
- NTC, Processing Baseline: 2.43,
- Transponder Range Bias **B= +6.8 mm ± 2 mm (FRM Uncertainty ± 41 mm)** ,

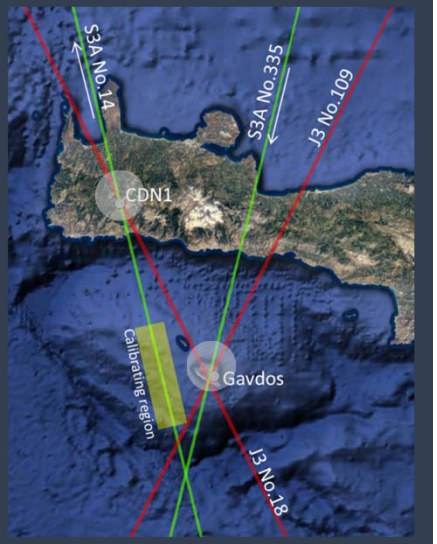
S3B Transponder Cal/Val (CDN1): Pass No.335



- S3B Descending Pass No. 335
- NTC, Processing Baseline: 2.43,
- Transponder Range Bias **B= -0.7 mm ± 4 mm (FRM Uncertainty ± 41 mm) ,**

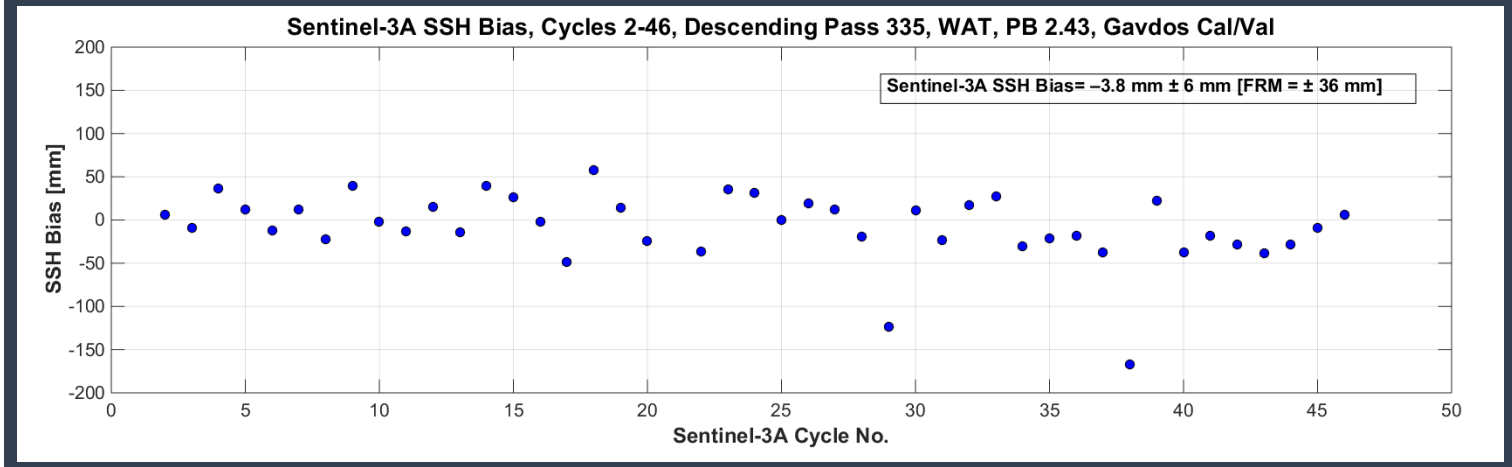
S3A SSH Bias: Pass No. 14 (Ascending)

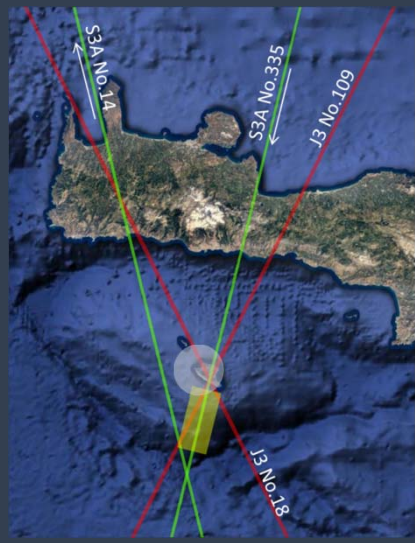




- S3A Ascending Pass No. 14, Cycles: 2-48
- WAT, NTC, Processing Baseline: 2.43,
- Sea-Surface Height Bias **B= -7 mm ± 4 mm (FRM ± 36 mm)** ,

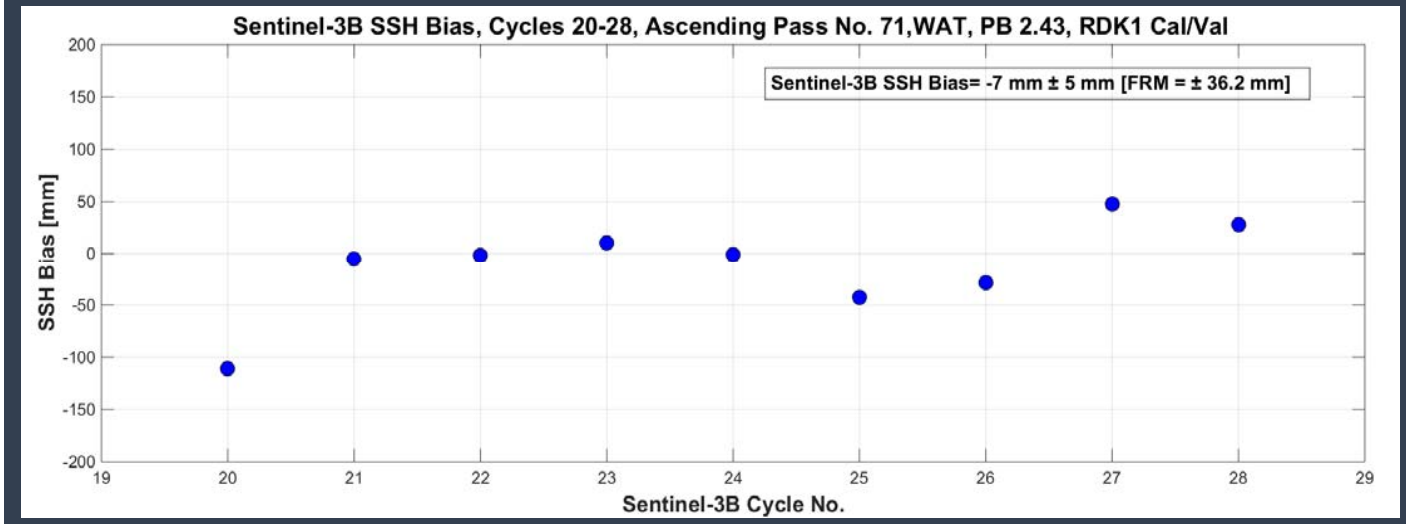
S3A SSH Bias: Pass No. 335 (Descending)

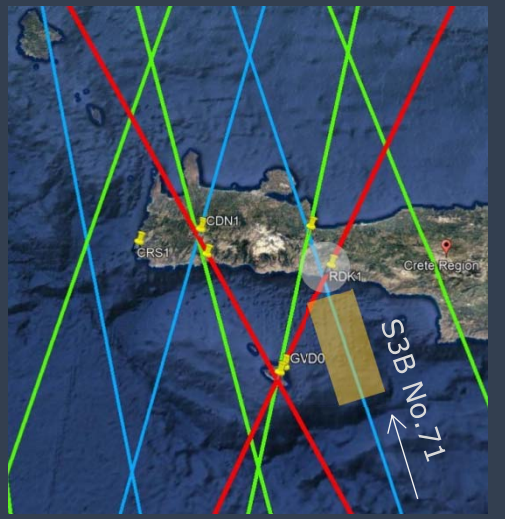




- S3A Descending Pass No. 335, Cycles: 2-46
- WAT, NTC, Processing Baseline: 2.343,
- Sea-Surface Height **Bias B= -3.8 mm ± 6 mm** (FRM ± 36 mm) ,

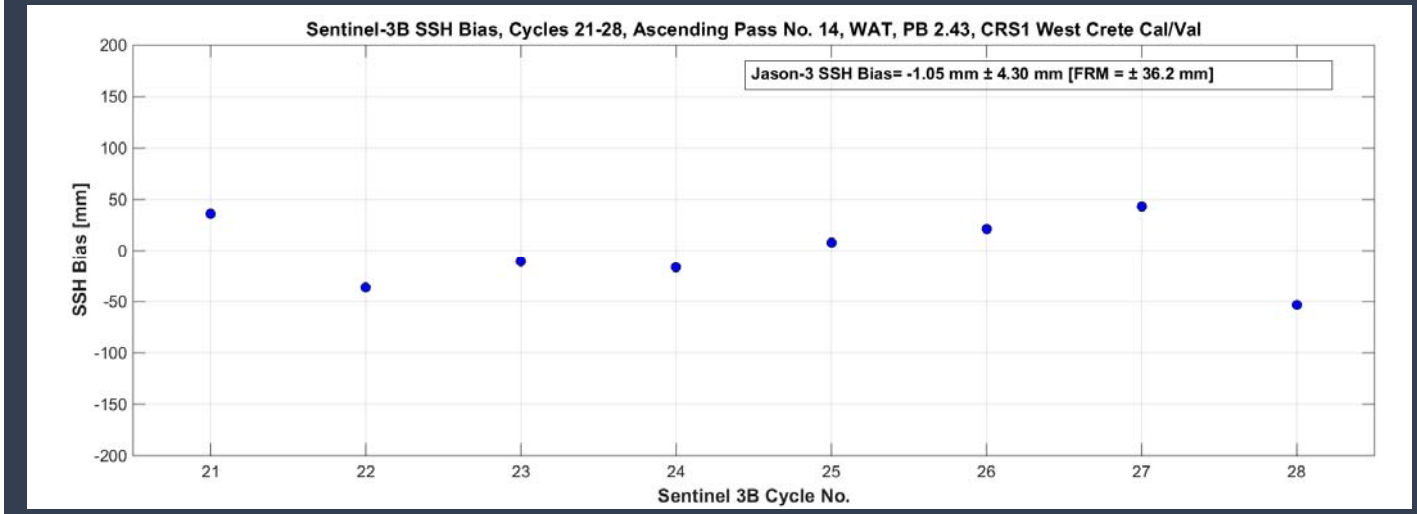
S3B SSH Bias: Pass No. 71 (Ascending)

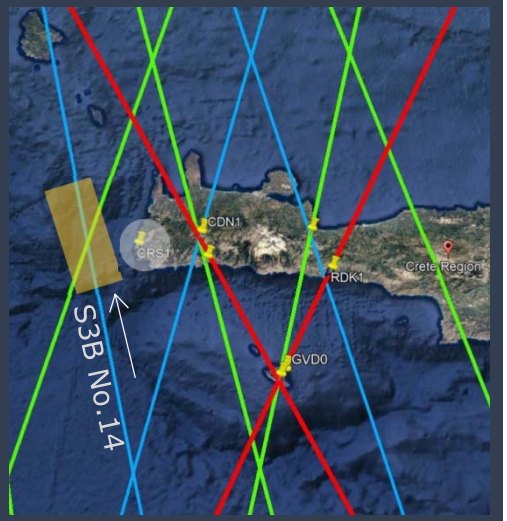




- S3B Ascending Pass No. 71, Cycles: 20 and 28
- WAT, NTC, Processing Baseline 2.43,
- Sea-Surface Height Bias B= -7mm ± 5 mm (FRM ± 36 mm) ,

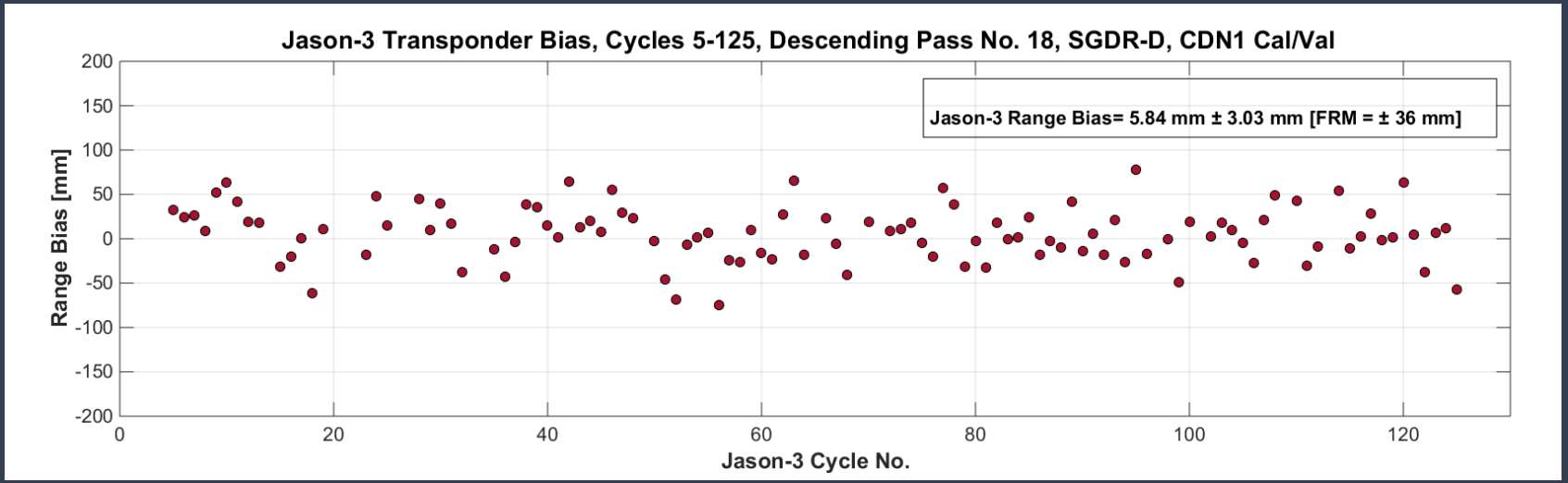
S3B SSH Bias: Pass No. 14 (Ascending)





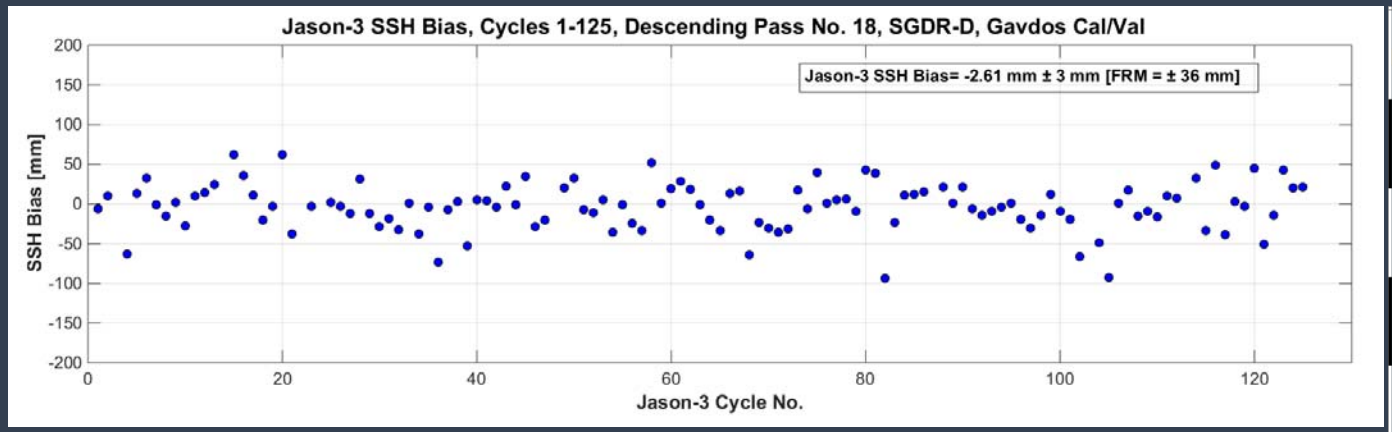
- S3B Ascending Pass No. 14, Cycles: 21-28
- WAT, NTC, Processing Baseline: 2.43,
- Sea-Surface Height Bias B= -1 mm ± 4 mm (FRM ± 36 mm) ,

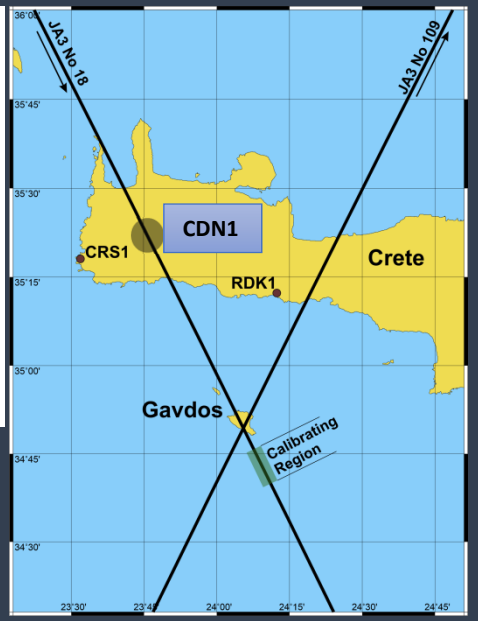
JA3 Transponder Cal/Val: Pass No.18



- Jason-3 Descending Pass No. 18, Cycles: 5-125
- SGDR-D, POE,
- Transponder Range Bias **B= +5.8 mm ± 3 mm** (FRM ± 36 mm) ,

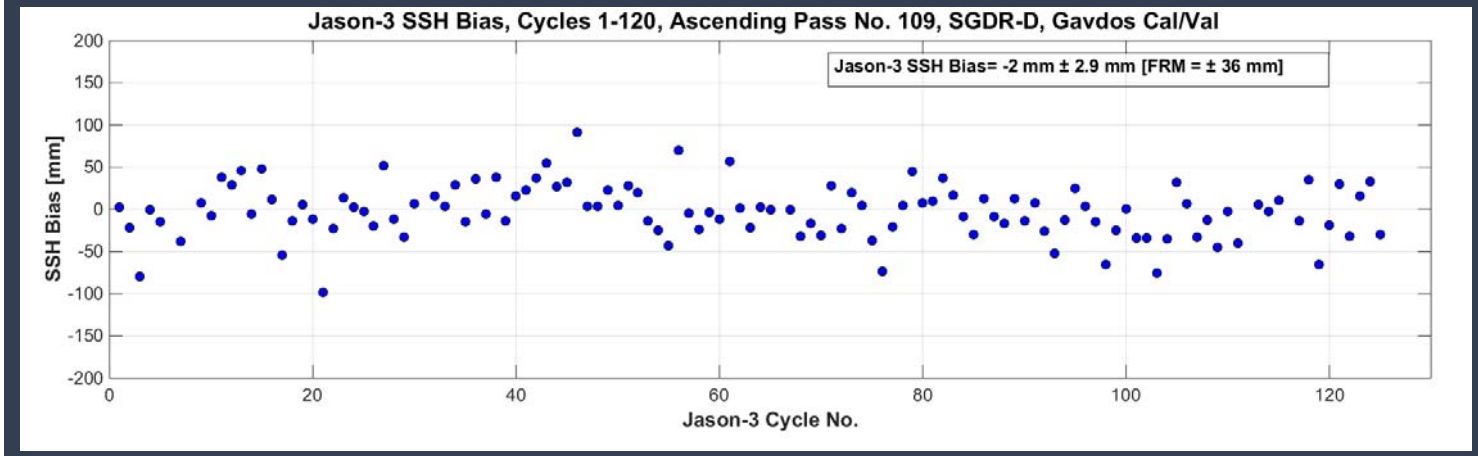
JA3 Sea-Surface Cal/Val: Pass No.18

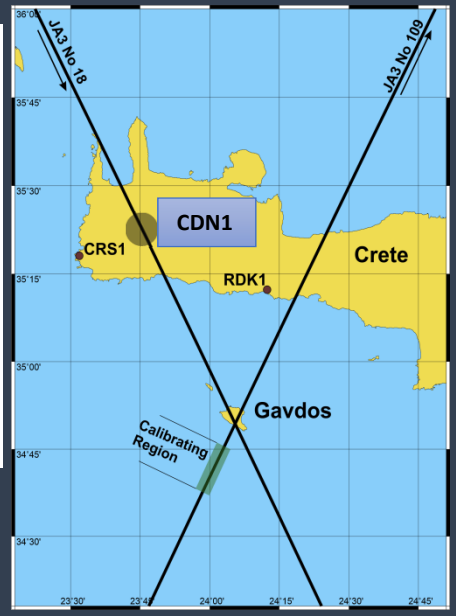




- Jason-3 Descending Pass No. 18, Cycles: 1-125
- SGDR-D, POE,
- Sea-Surface Height Bias **B= – 2.6 mm ± 3 mm** (FRM ± 36 mm) ,

JA3 Sea-Surface Cal/Val: Pass No.109

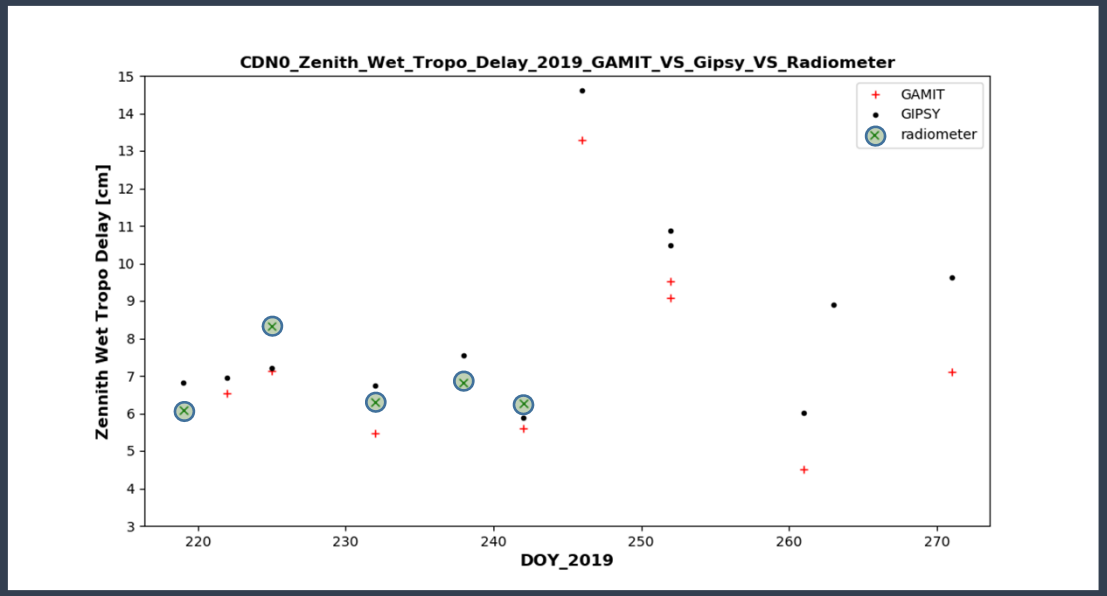




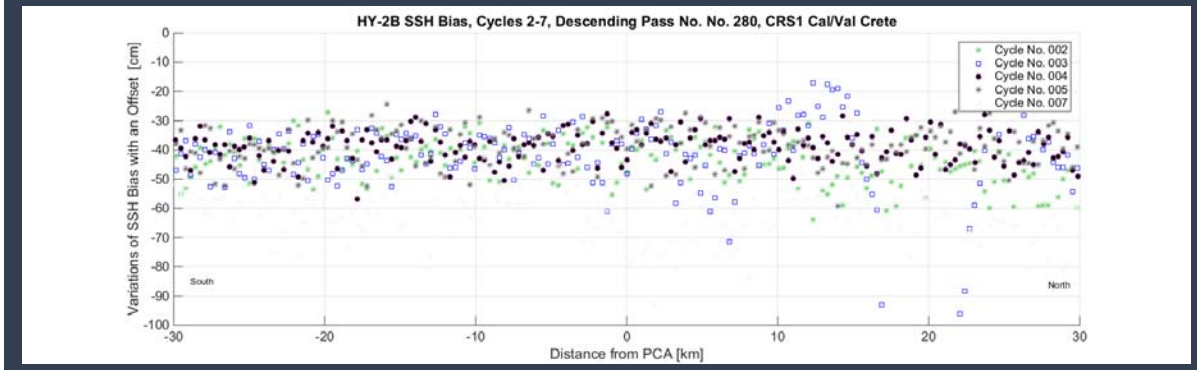
- Jason-3 Ascending Pass No. 109, Cycles: 1-120
- SGDR-D, POE,
- Sea-Surface Height **Bias B= -2 mm ± 3 mm** (FRM ± 36 mm) ,

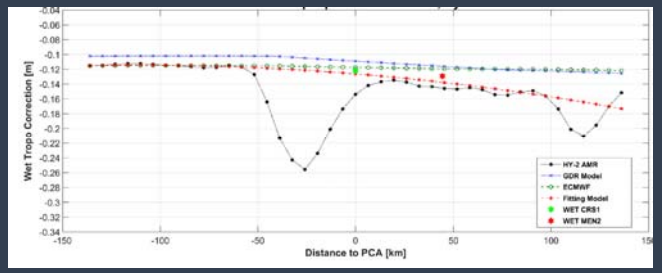
Radiometer set up at CDN1 Cal/Val:

Radiometer Operational at CDN1 Cal/Val



HY-2B Bias, Preliminary results @ CRS1 Cal/Val





- HY-2B Descending Pass No. 280, Cycles: 2-7,
- Preliminary Results,
- NIC still needs to be applied properly,
- **Bias seems stable at this stage.**

Cal/Val Summary

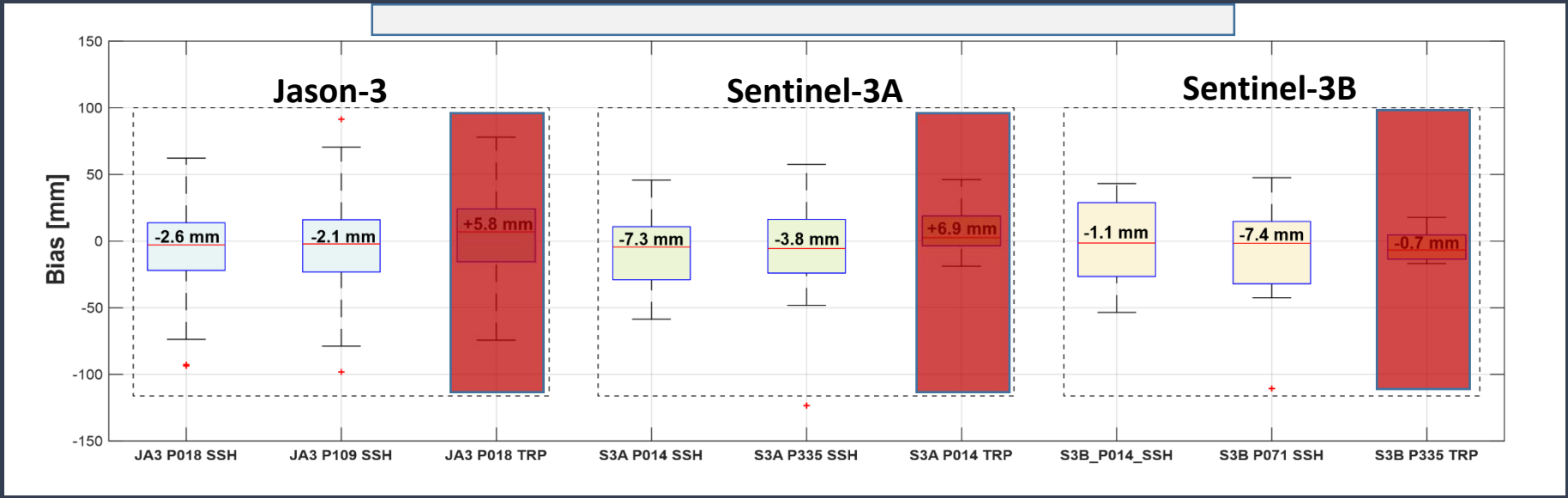
Sea-Surface Cal/Val

Satellite	Ascending	Descending	Average	Cycles
Sentinel-3A	-7 mm (No.14)	-2.4 mm (No.335)	-4 mm	2-48
Sentinel-3B	-7 mm (No.71)	-1 mm (N0.14)	-4 mm	20-28
Jason-3	-2.0 mm (No.109)	- 2.6 mm (No.18)	- 2 mm	1-124

Transponder Cal/Val

Satellite	Data	Descending	Cycles
S-3A	SAR, NTC, PB 2.43	+ 6.8 mm (No. 14)	3-43
S-3B	SAR, NTC, PB 2.43	- 9.0 mm (No. 14)	3 [Tandem]
S-3B	SAR, NTC, PB 2.43	- 0.7 mm (No. 14)	5 [Nominal]
JA-3	SGDR-D, POE	+ 5.8 mm (No.18)	5-125

Cal/Val Summary in Boxplots



Acknowledgements

- European Union;
- European Space Agency
  - SERAC (Pierre Féménias);
  - Craig Donlon
- CNES.

New China Altimeter:

"Guanlan"

«Watching the big waves»

Backup Slides

Laws of Monitoring Sea Level & Climate Change

Accuracy	In scientific and monitoring data we produce and evaluate.	Science
Accuracy	Information presented to the Public for understanding effects of sea level rise to their lives.	People
Accuracy	In helping make the **right** Decisions, and put into action the **right** Policies.	Future

Long-term, Consistent, Continuous Sea Level record only when:

- **Monitoring of data quality we produce,**
- **Proper Archiving (data bases),**
- **Seamless Distribution of Retained Data,**
- **Monitor Performance of Observing Systems.**

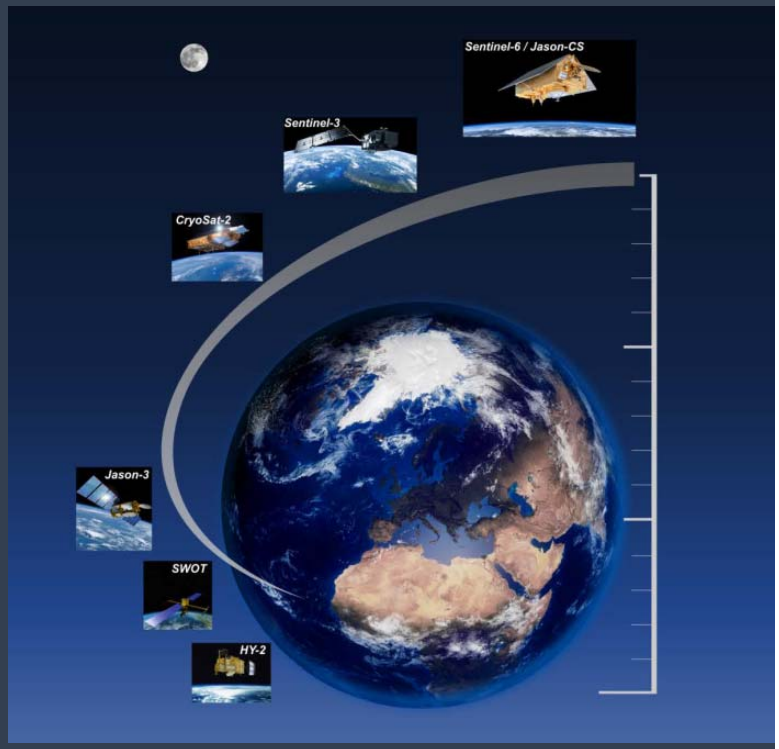
Fiducial Reference Measurements for Altimetry

New Strategy to achieve:

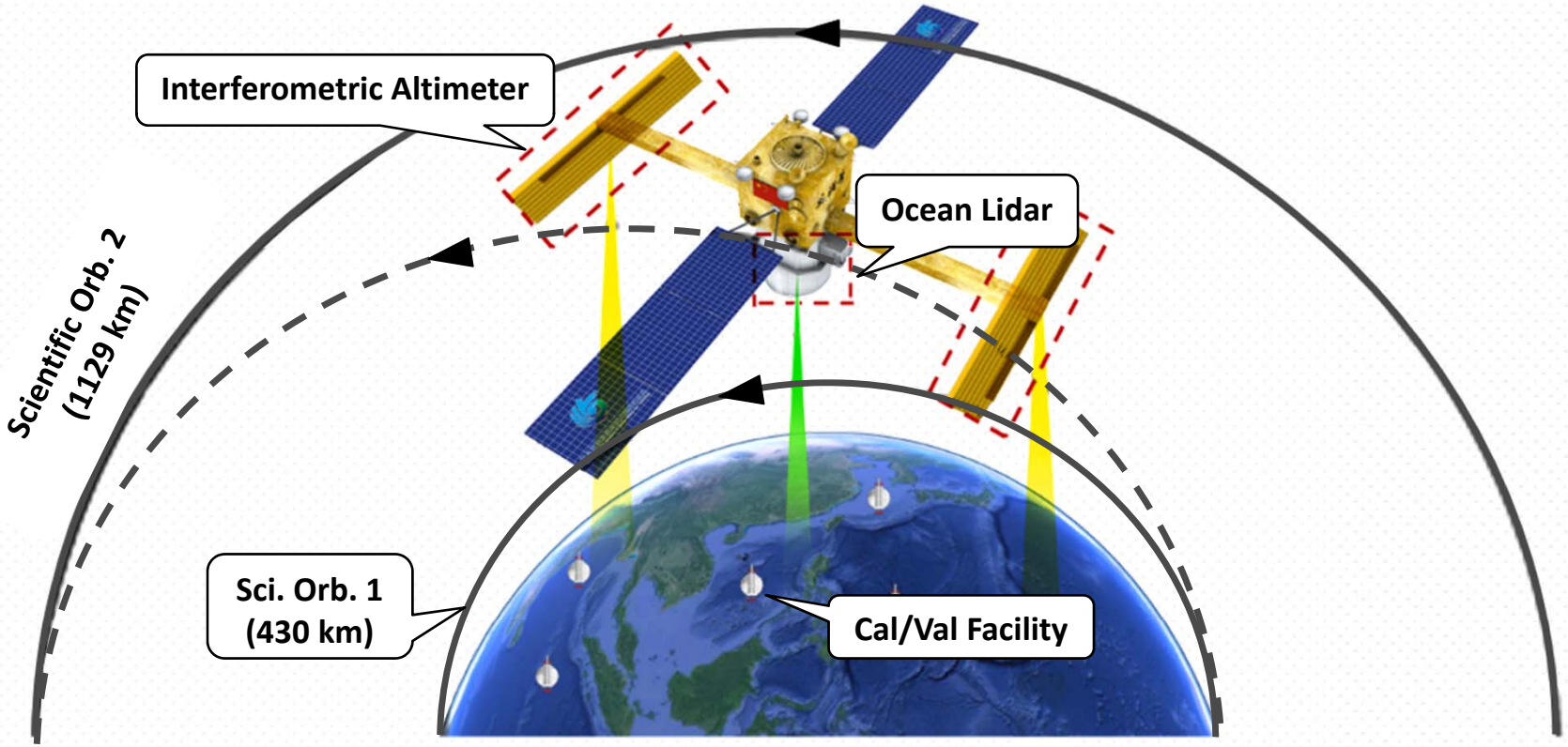
- Reliable,
- Long-term,
- Consistent, Redundant,
- Undisputable altimetry products.

ESA Effort to reach:

- Uniform and Absolute,
- Standardization of Earth observation,
- Uncertainty on Metrology Standards,
- Trust on data we produce,
- Correct information to Pubic,
- Right decisions for Policies.

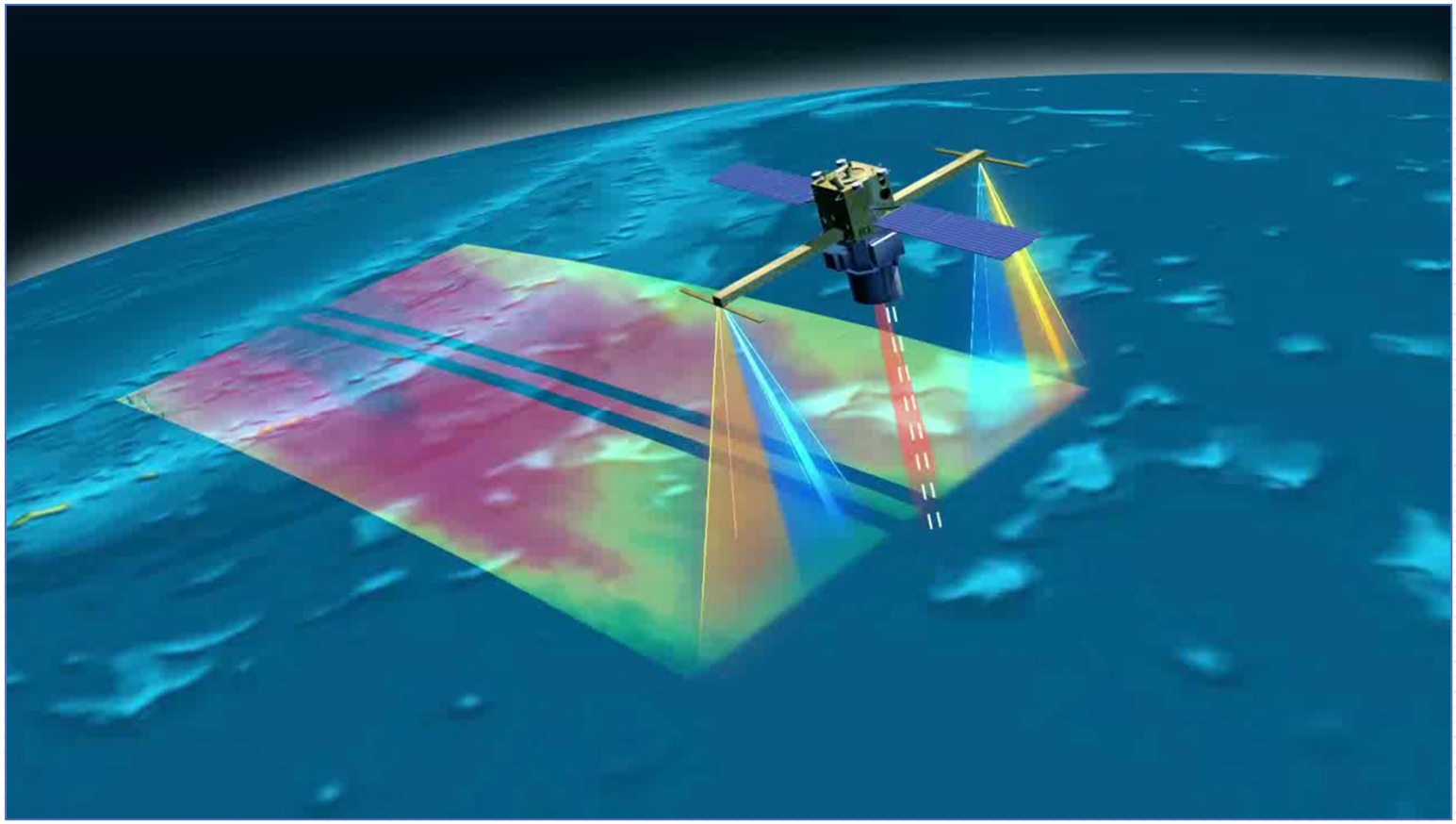


“Guanlan” Satellite Components

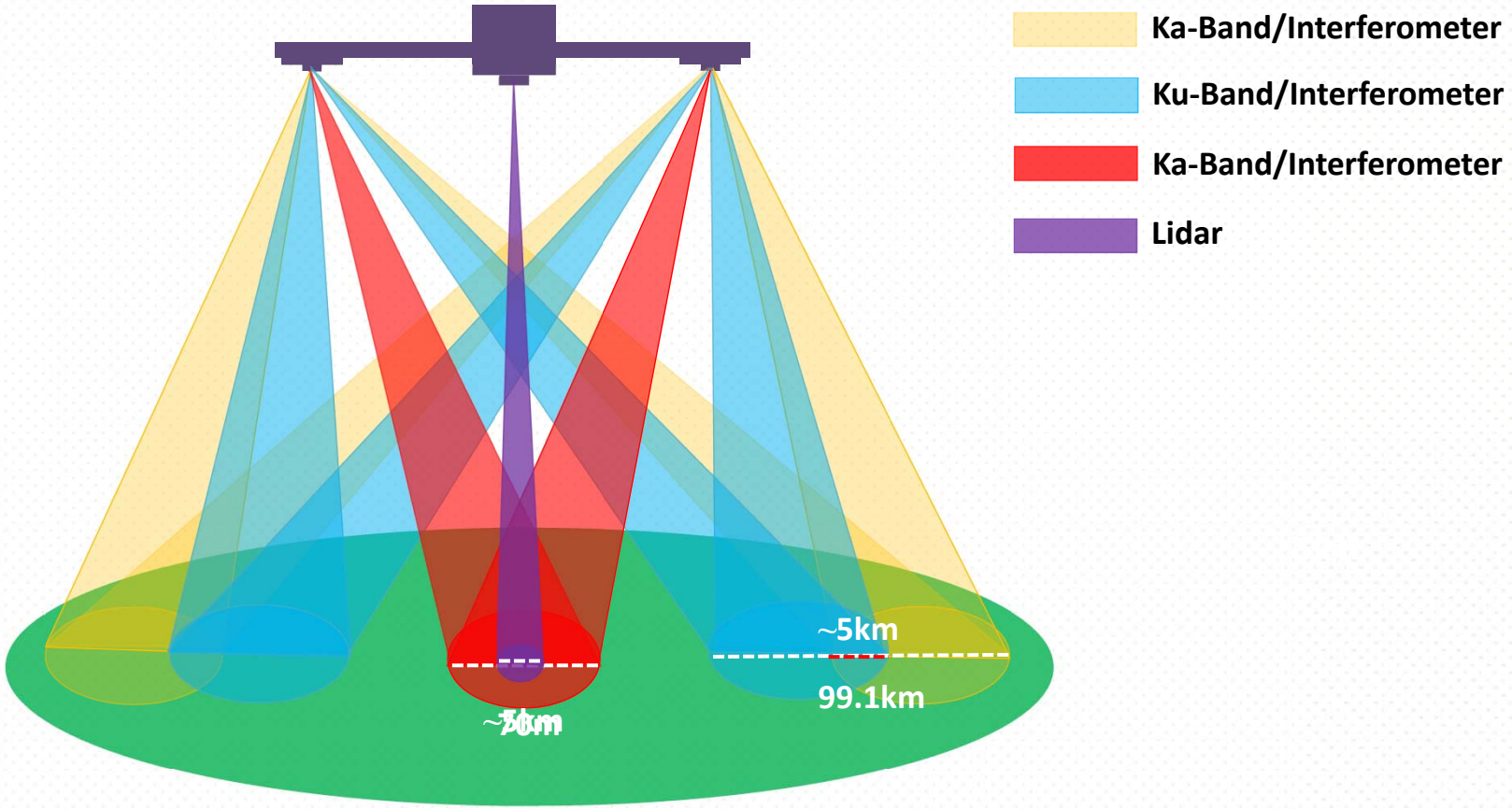


Schematic Performance of Guanlan

- SWOT + Guanlan + other interferometric altimeters missions, bring the altimetric oceanography from a meso-scale period to a sub-mesoscale era.



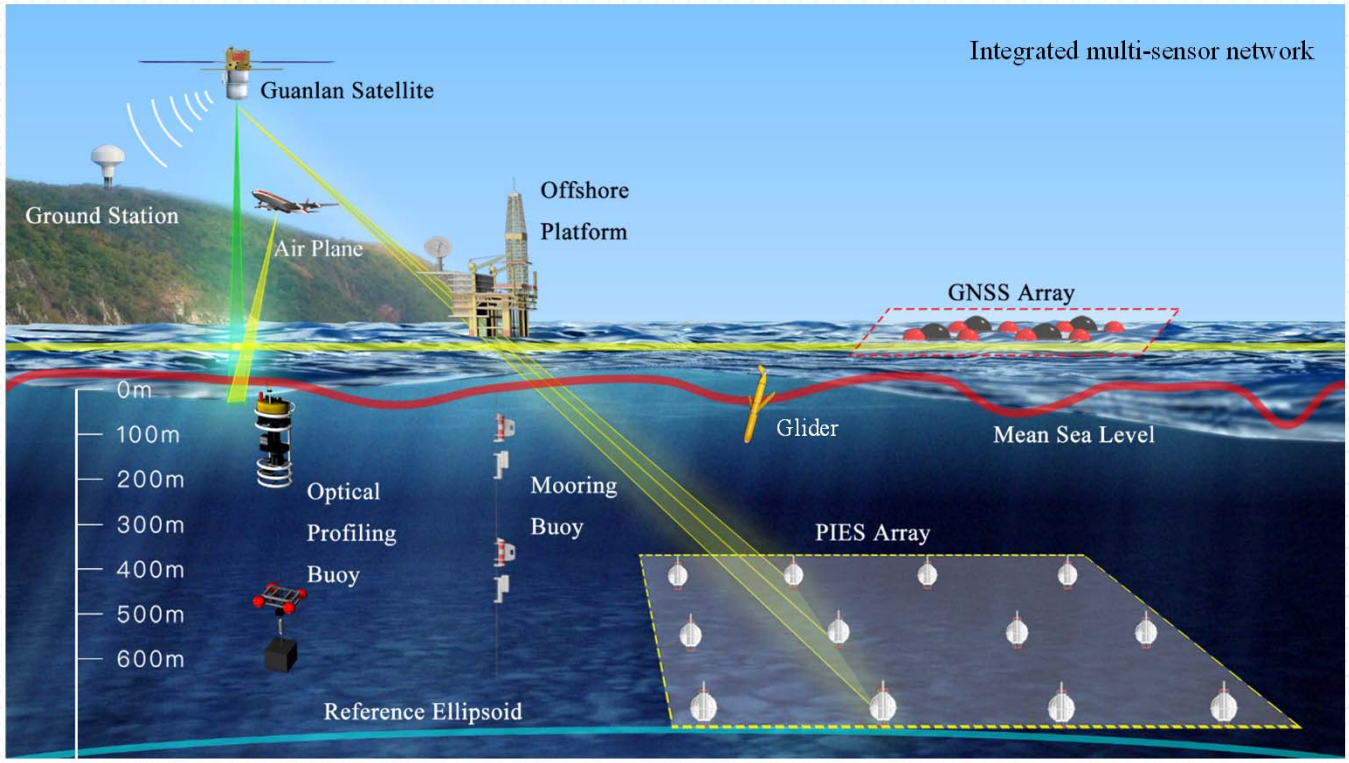
Measurement Scheme of Guanlan



- The dual-frequency interferometric altimeter has:
  - a wide swath of ~100 km with an overlap of ~5 km (between Ka- and Ku-band), and
  - a nadir swath of ~5 km (Ka-Band).
- The Ocean lidar (Blue + Green) has a nadir footprint of ~70 m.

Calibration and Validation of Guanlan

- Calibration of SSH: ground CAL before launch + in-orbit CAL after launch.
- Calibration of Ocean Lidar: Airborne lidar.



Calibration/validation facility for the Guanlan Interferometric Altimeters and Lidar