

Sentinel-3 External Calibration Results

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isardSAT[®]

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- **Calibration framework & reference sites**

Core calibration sites and nominal performance baseline

- **Performance analysis of key sites**

Range, datation and radiometric behaviour (CDN1, CRM1, Catalina, Leonessa)

- **Expansion of the calibration network**

Introduction of new CR sites and extended geographical coverage

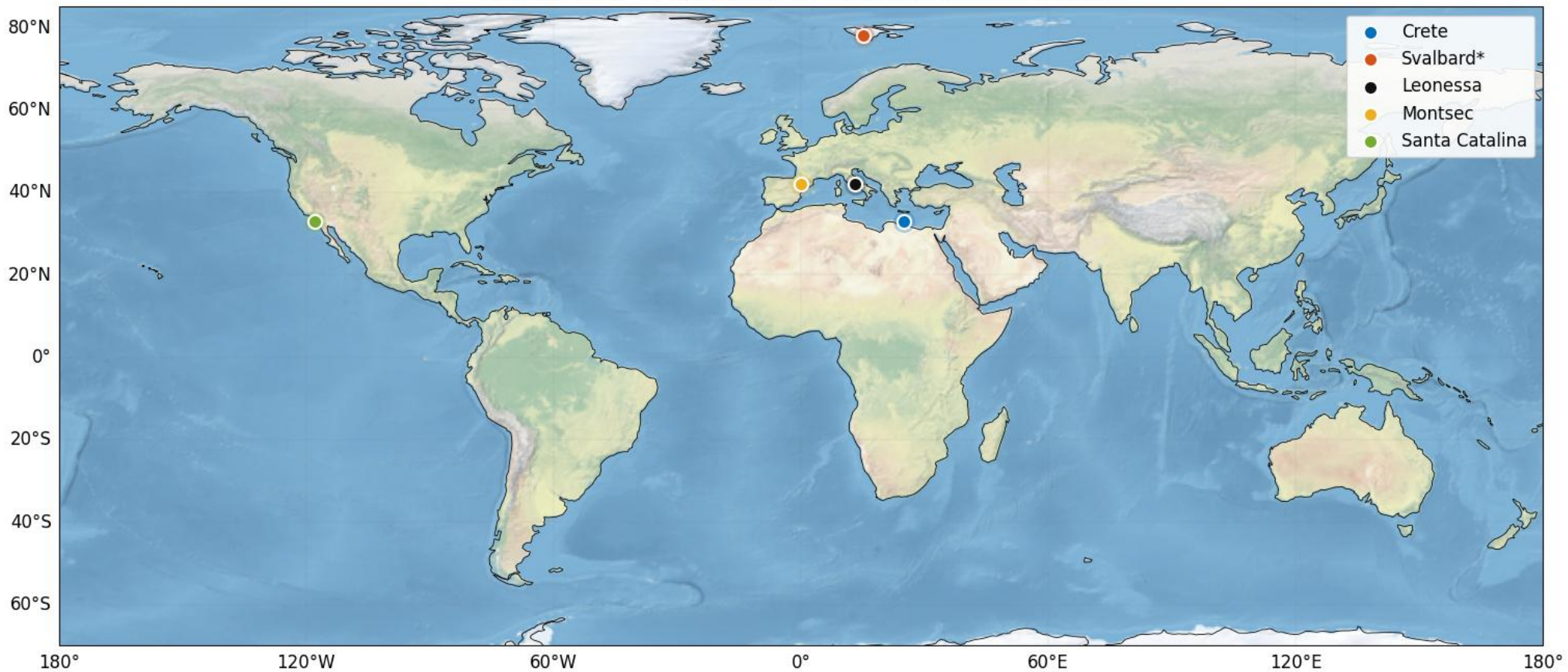
- **Global performance assessment**

Stability (range/datation) and signal quality (PSLR, resolution)

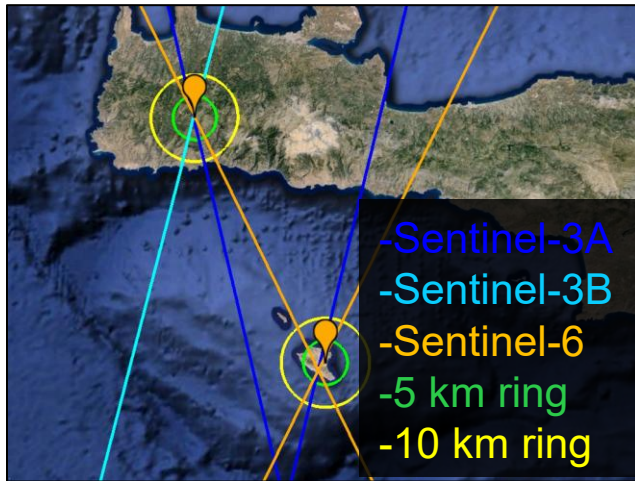
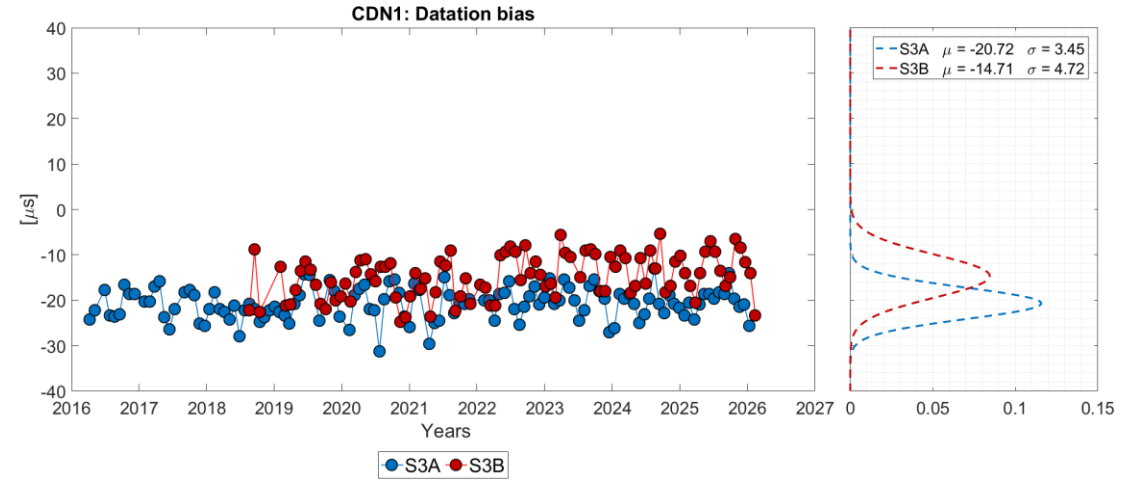
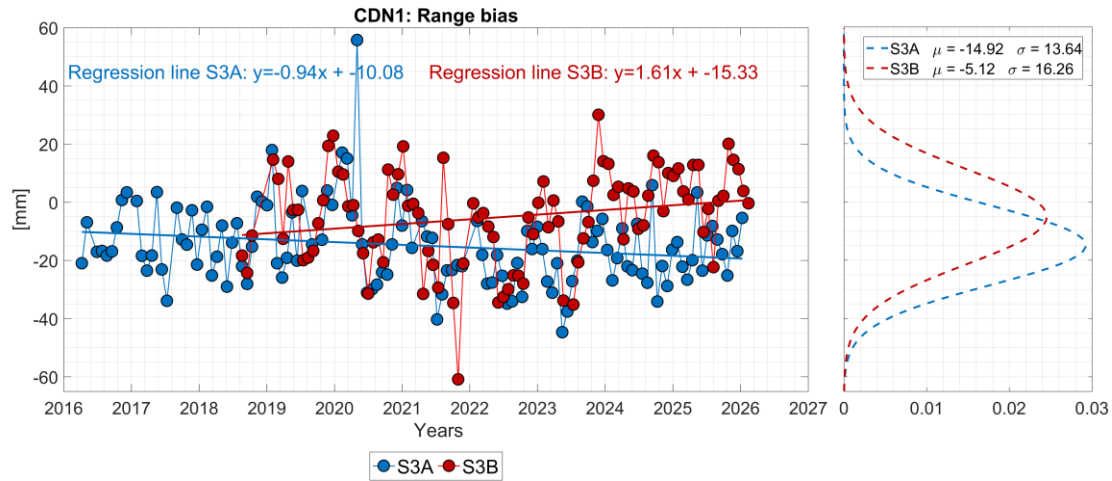
- **Readiness of the extended network**

Current limitations and path towards operational calibration

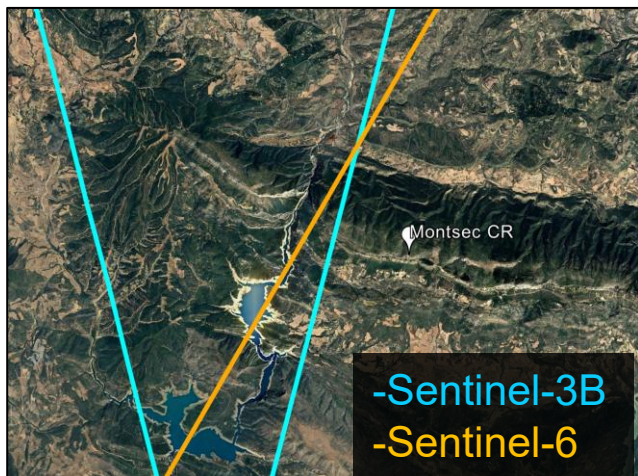
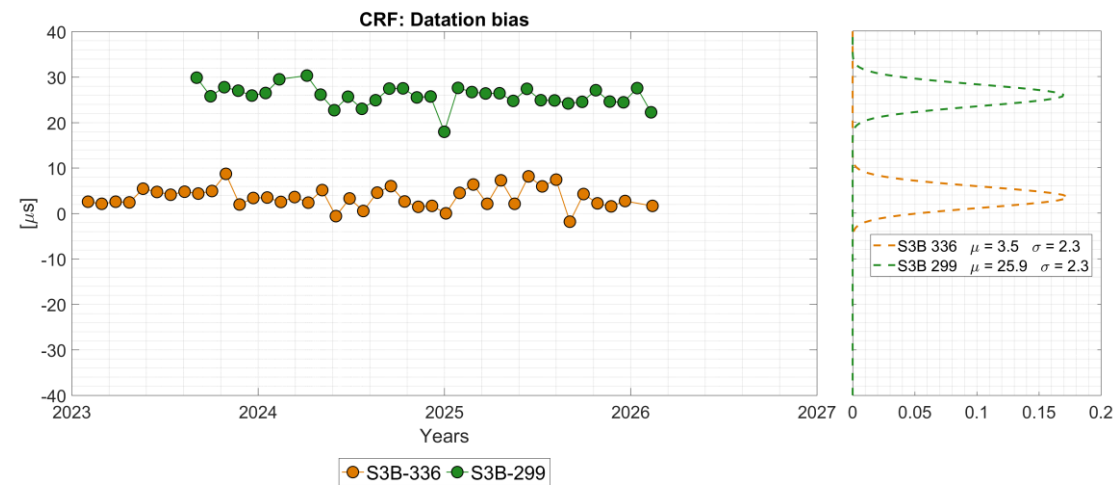
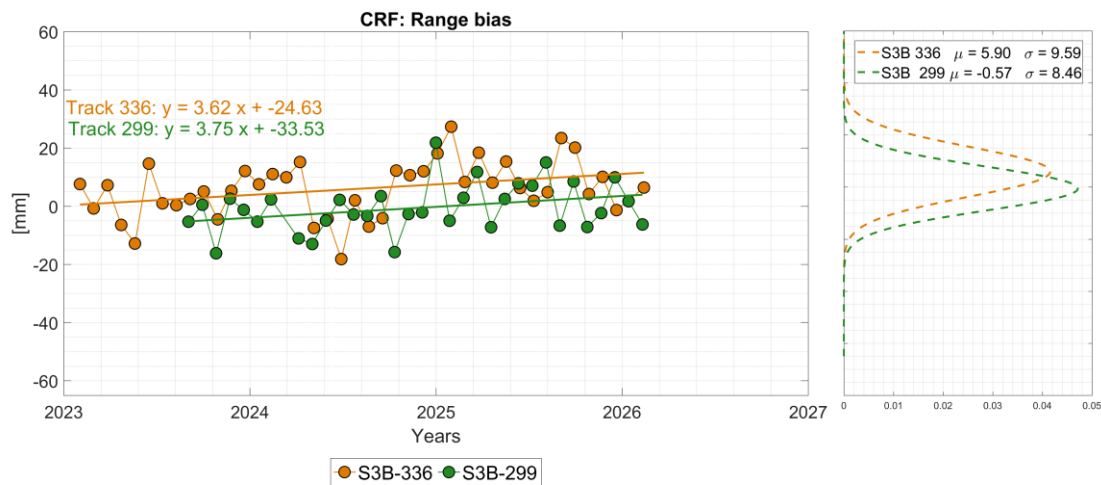
Sentinel-3 Nominal Calibration Sites



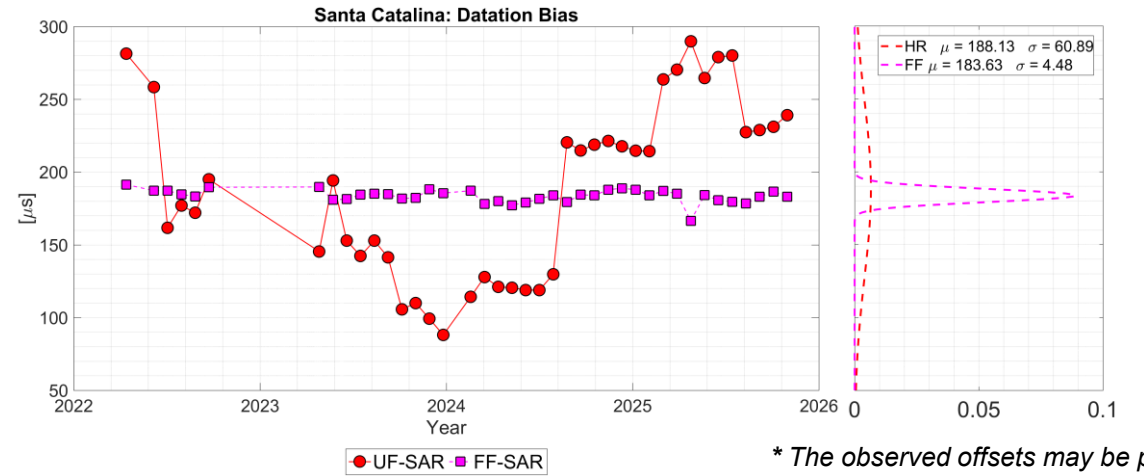
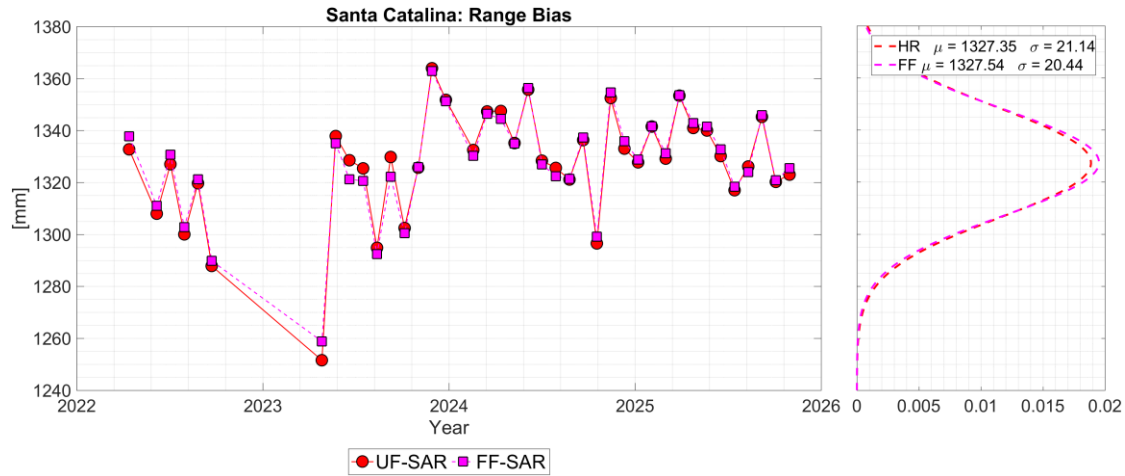
Site Location	Svalbard*	Crete	Catalina	Leonessa	Montsec
Period	2019-2023	2016-	2022-	2023-	2023-
Bands	Ku	Ku	Ku & C	Ku	Ku
Antenna gain [dBi]	35.8	75-80	30.3 / 28.0	33.7 Tx., 31.3 Rx.	-
Beamwidth [°]	2.5	1.2	3 for Ku, 5 for C	3.2 Tx., 4.6 Rx.	-
Antenna diameter [m]	0.61	1.0	0.61	Horn antenna, 0.3	-
Auxiliary equipment	-	GNSS x2 Meteo x2, Radiometer	GNSS station	Automatic positioning & control system.	GNSS station
Manufacturer	ULMO	TUC	JPL	Refurbished by RAME	isardSAT
Missions	S3A, S3B	S3A, S3B	S3A	S3A, S3B	S3B



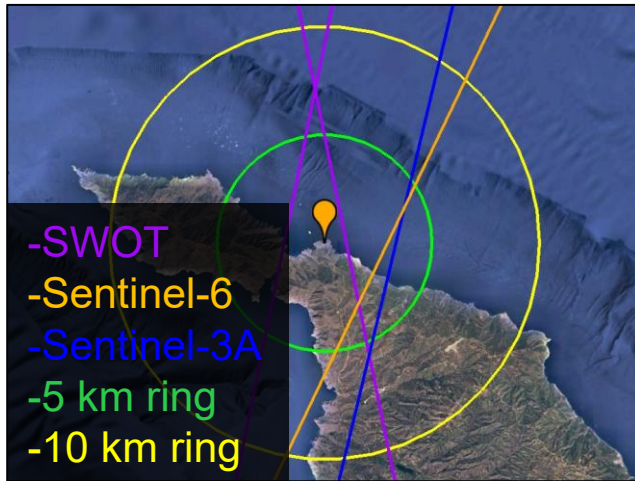
		CDN1	Range bias [mm]	Datation bias [μ s]
S3A	124 passes	Mean	-14.91	-20.68
		Standard Deviation	13.63	3.43
S3B	97 passes	Mean	-5.11	-14.71
		Standard Deviation	16.26	4.72



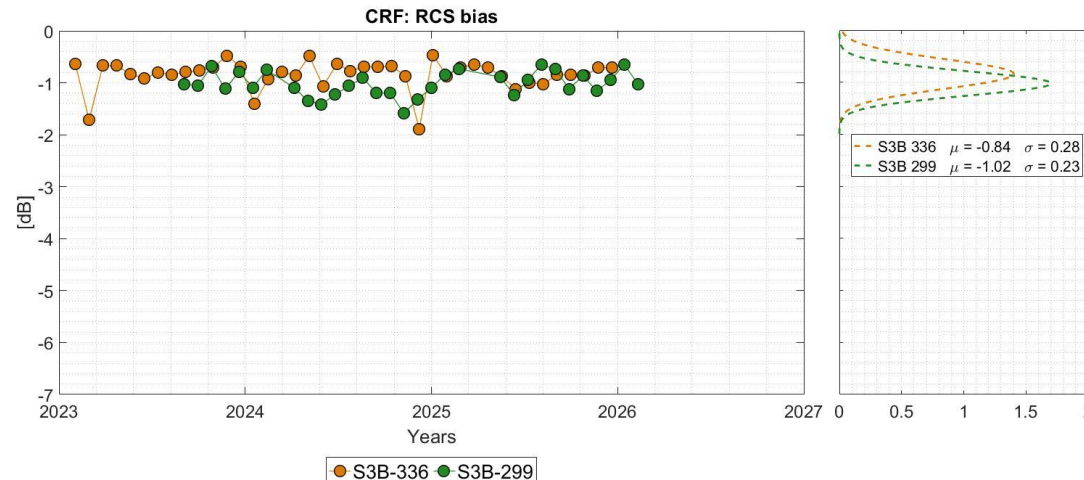
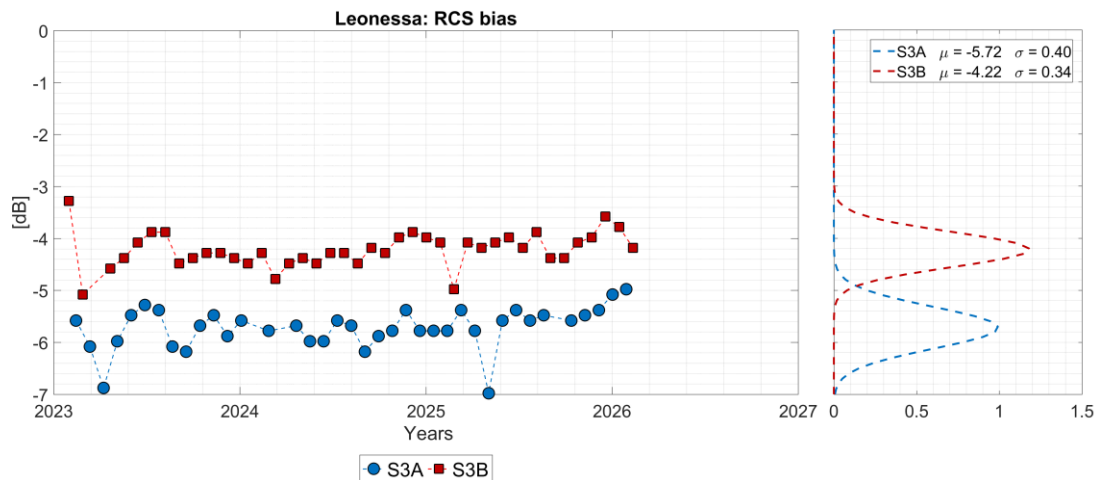
		CRM1	Range bias [mm]	Datation bias [μ s]
S3B 336	41 passes	Mean	5.96	3.49
		Standard Deviation	9.59	2.30
S3B 299	33 passes	Mean	-0.57	25.85
		Standard Deviation	8.46	2.34



* The observed offsets may be partially explained by uncertainties in the TRP position and internal delay calibration.



		Santa Catalina		Range bias [mm]	Datation bias [μ s]
UF-SAR	40 passes	Mean	1327.34*	188.12*	
		Standard Deviation	21.13	60.88	
FF-SAR	40 passes	Mean	1327.53*	183.63*	
		Standard Deviation	20.43	4.47	



Both Leonessa and CRM1 show stable RCS with low standard deviation (<0.35 dB)

Leonessa			RCS [db]
S3A	41 passes	Mean	-5.68
		Standard Deviation	0.33
S3B	41 passes	Mean	-4.22
		Standard Deviation	0.33

CRM1			RCS [db]
S3B 336	41 passes	Mean	-0.84
		Standard Deviation	0.28
S3B 299	33 passes	Mean	-1.02
		Standard Deviation	0.23



Uscla (France)



ALX1/2 (Crete)



Utah (USA)



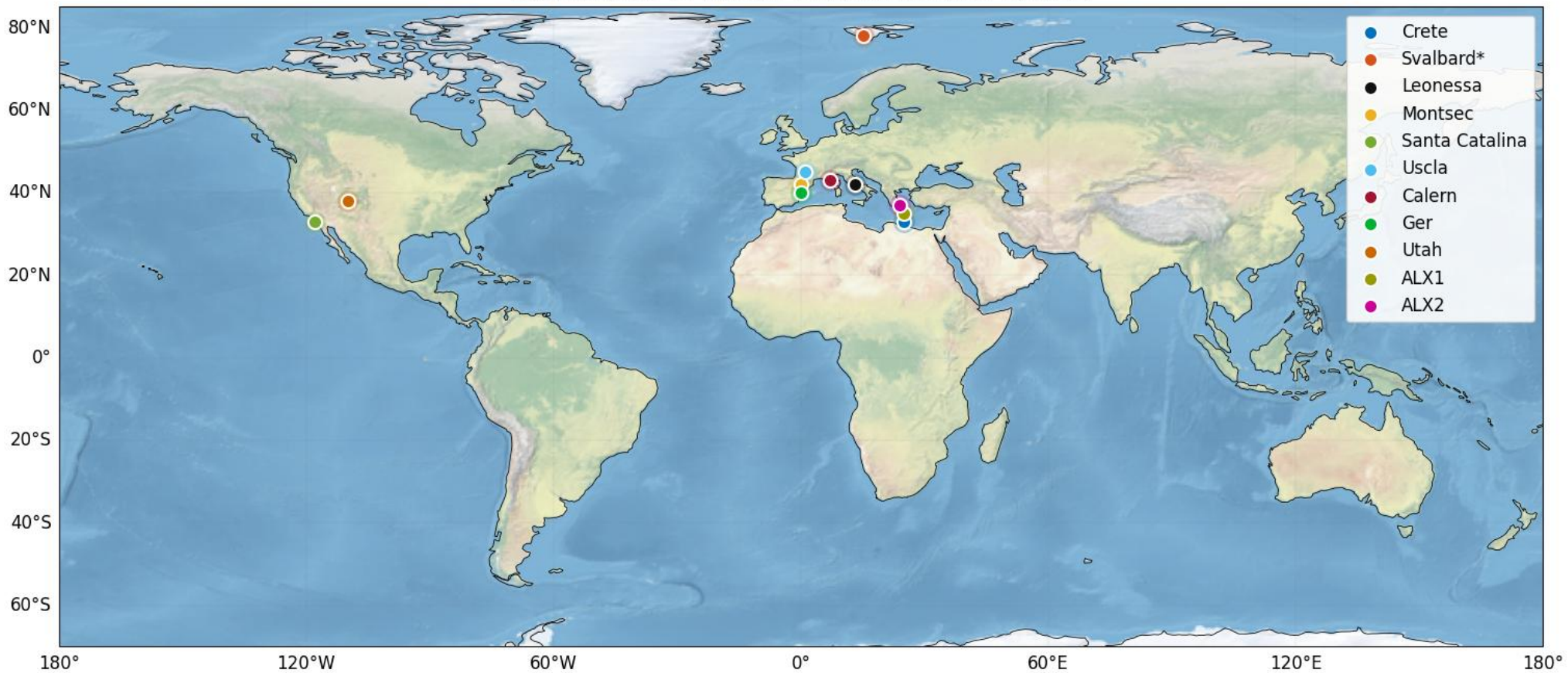
Ger (Catalonia)



Calern (France)

- New calibration sites significantly extend the geographical coverage of the network

Sentinel-3 New Calibration Sites



Stability (relative analysis)

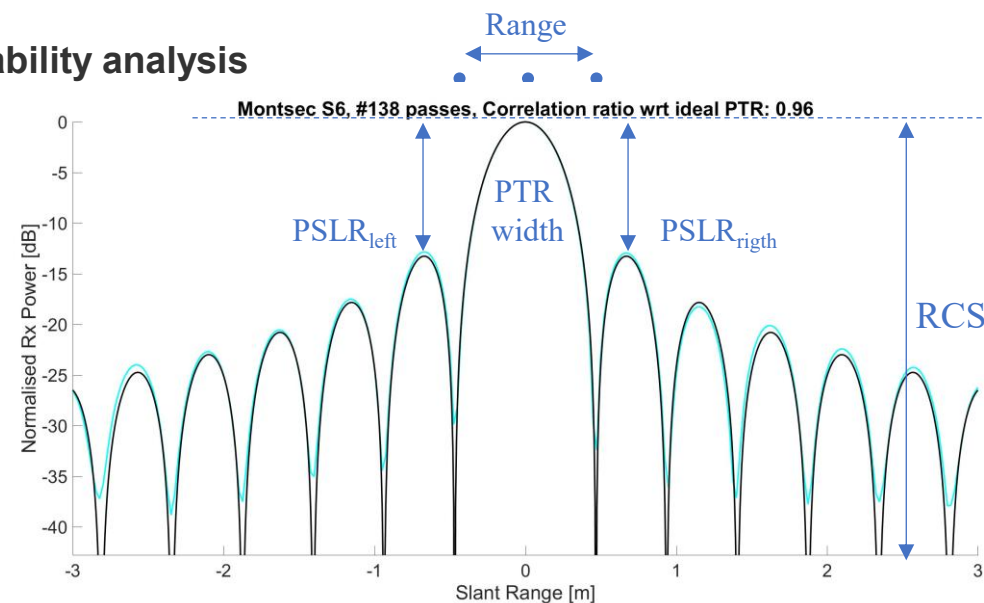
- **Range bias (relative)**
Mean removed due to uncertain CR position → relative stability analysis
- **Datation bias (relative)**
Mean removed → focus on temporal consistency

Signal Quality

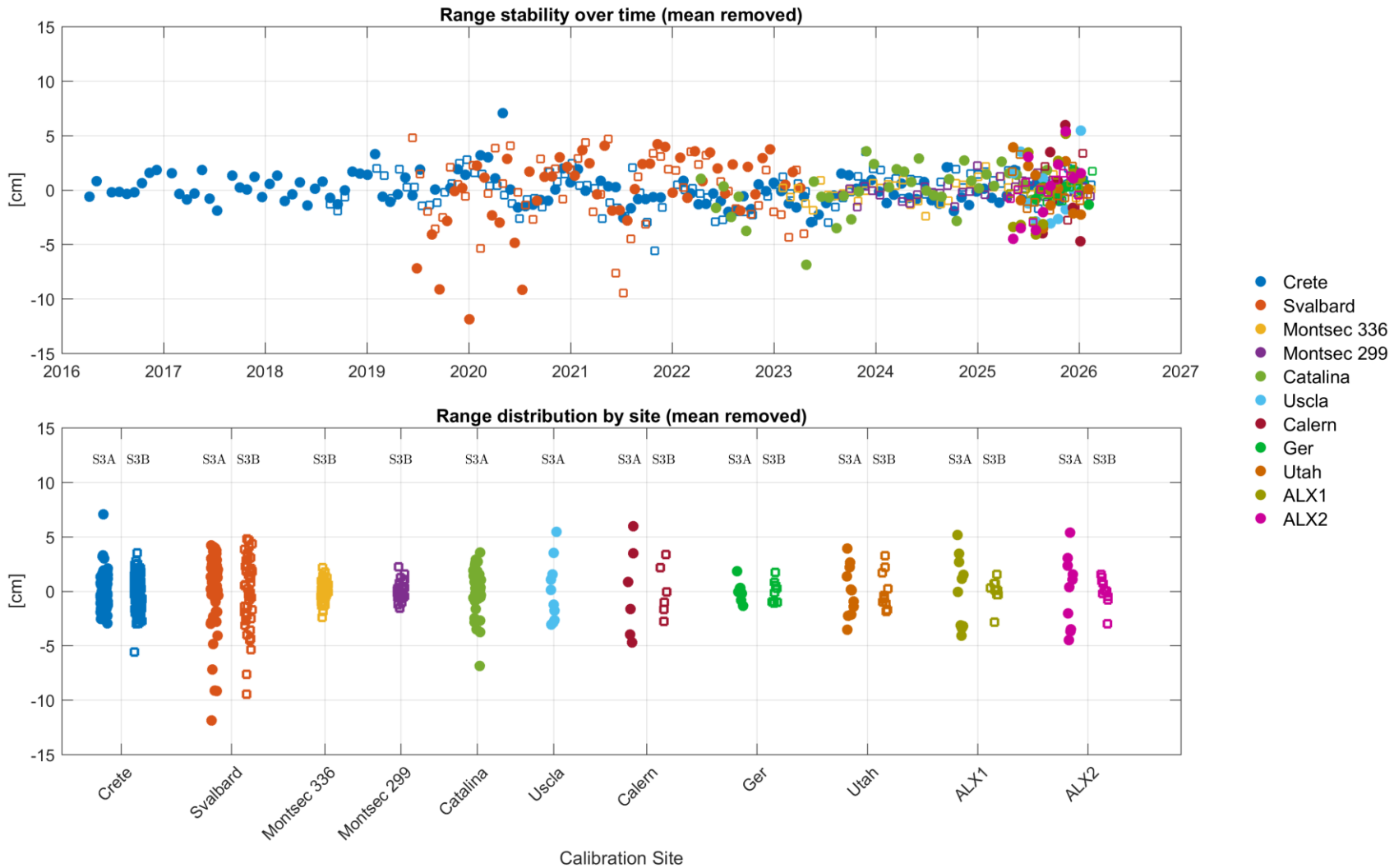
- **PSLR**
sidelobe level indicator
- **Range resolution (δr)**
target sharpness

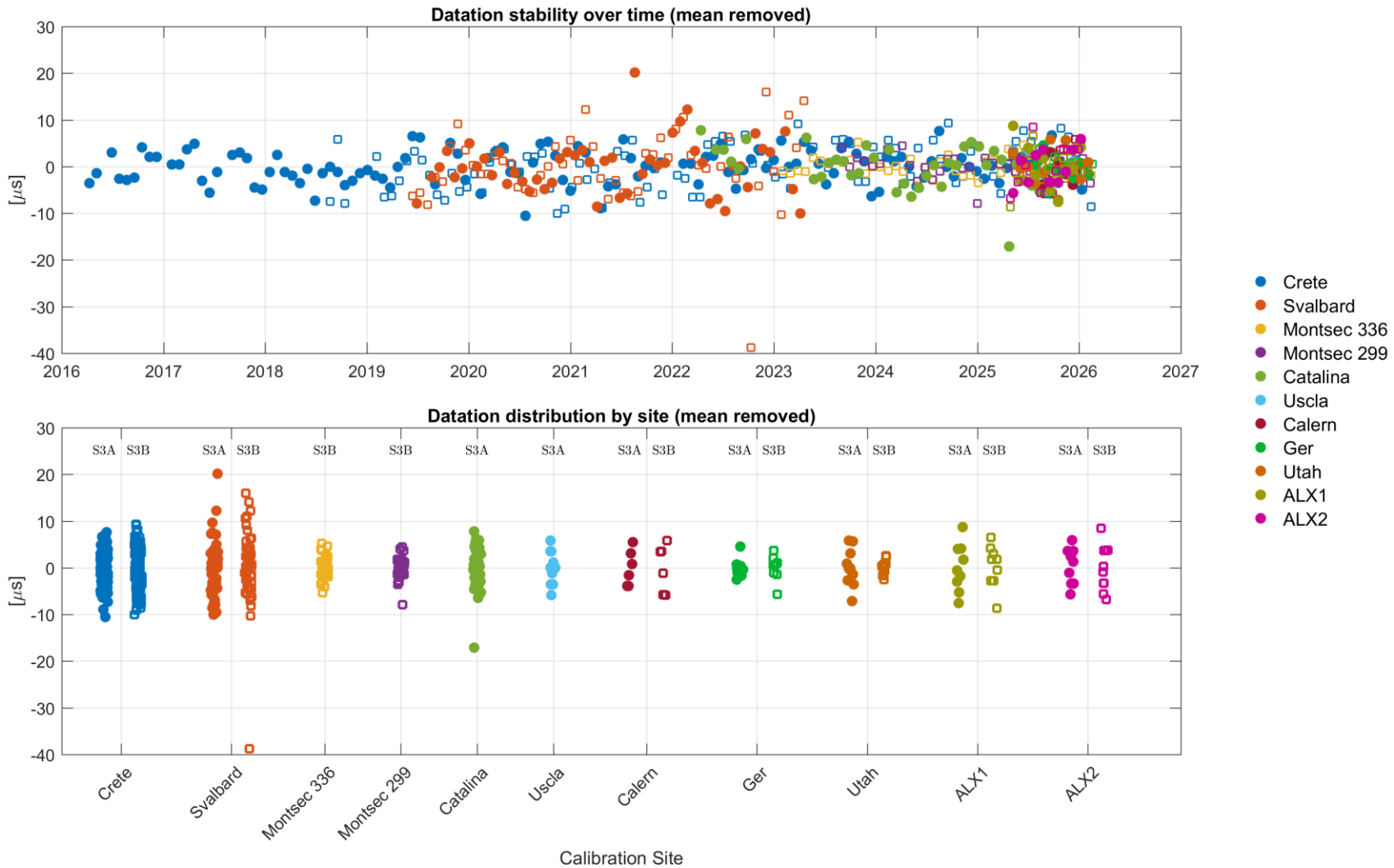
Radiometric Response

- **RCS**



Ideal Values
 Correlation: 1
 PTR width: 0.415 m
 PSLR ratio: 13.26 dB





Stability (relative analysis)

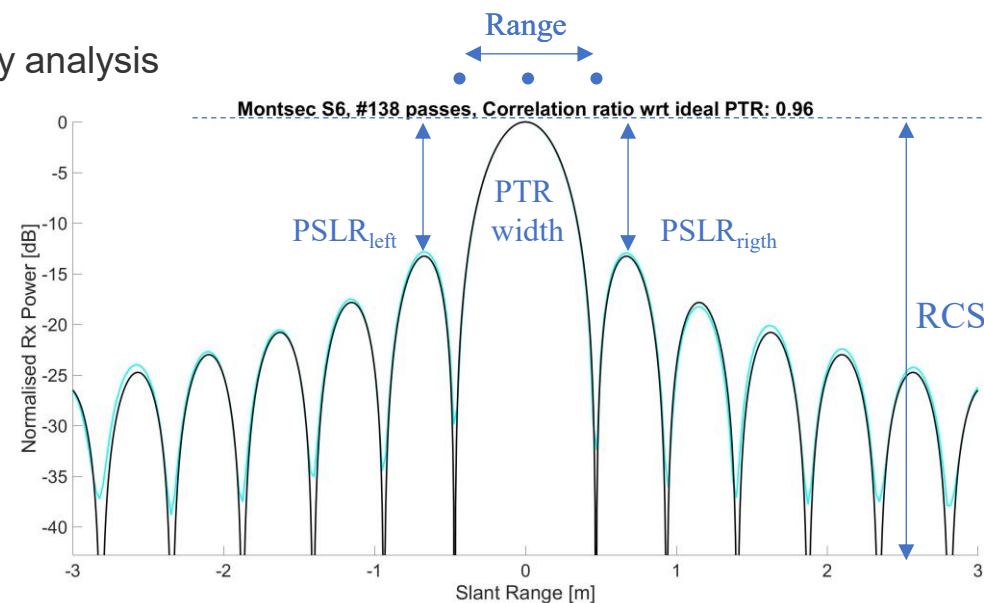
- Range bias (relative)
Mean removed due to uncertain CR position → relative stability analysis
- Datation bias (relative)
Mean removed → focus on temporal consistency

Signal Quality

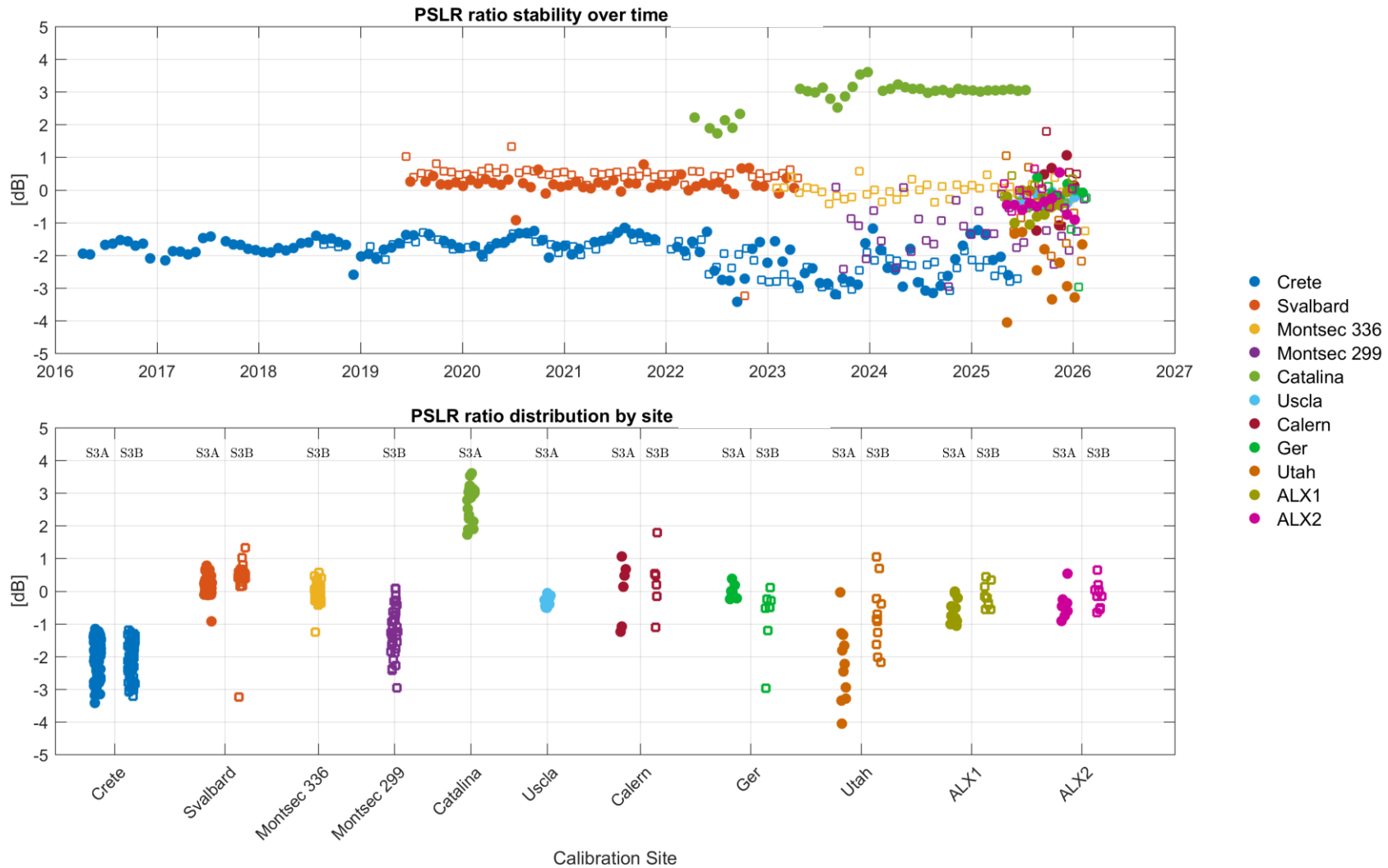
- **PSLR**
sidelobe level indicator
- **Range resolution (δr)**
target sharpness

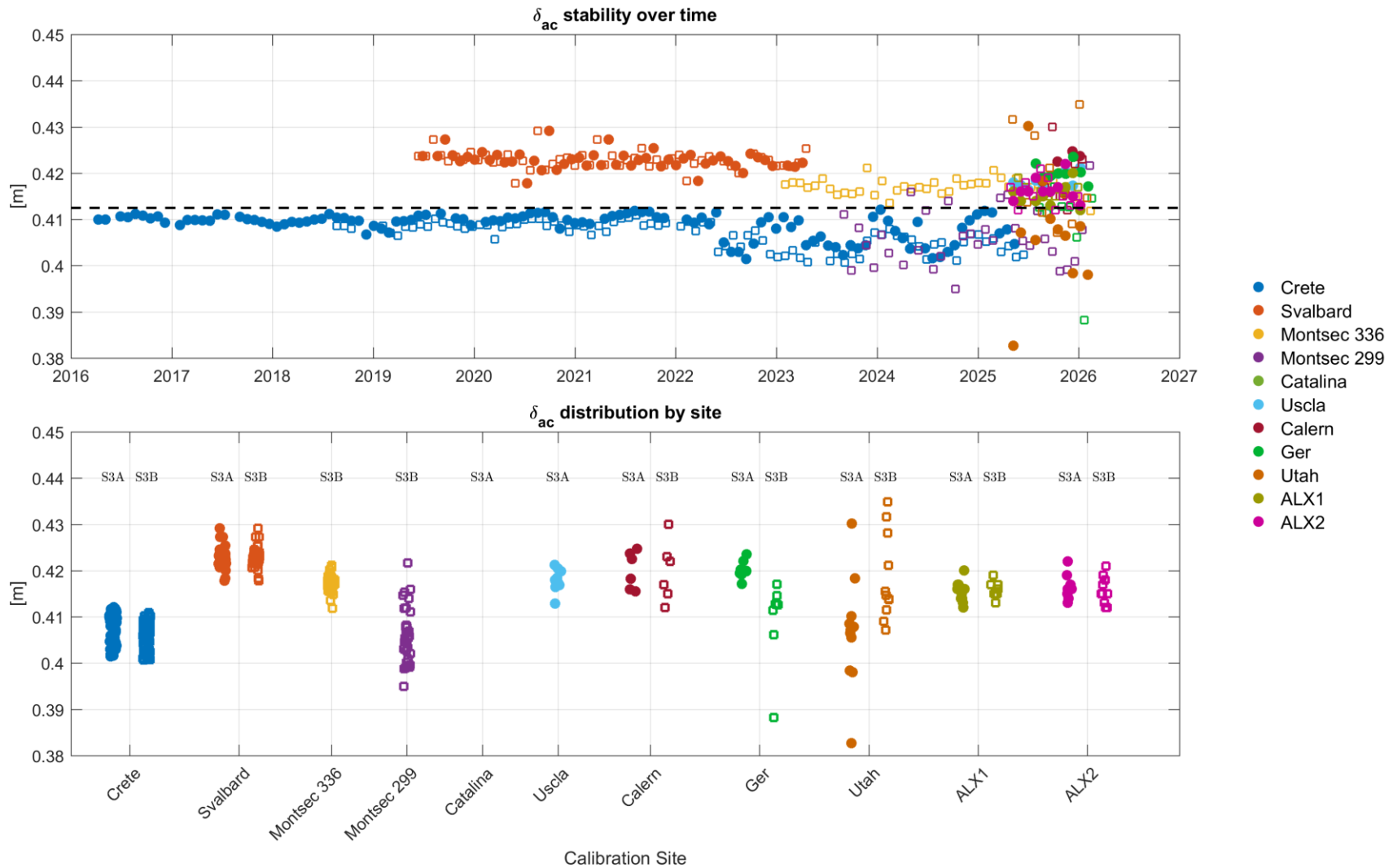
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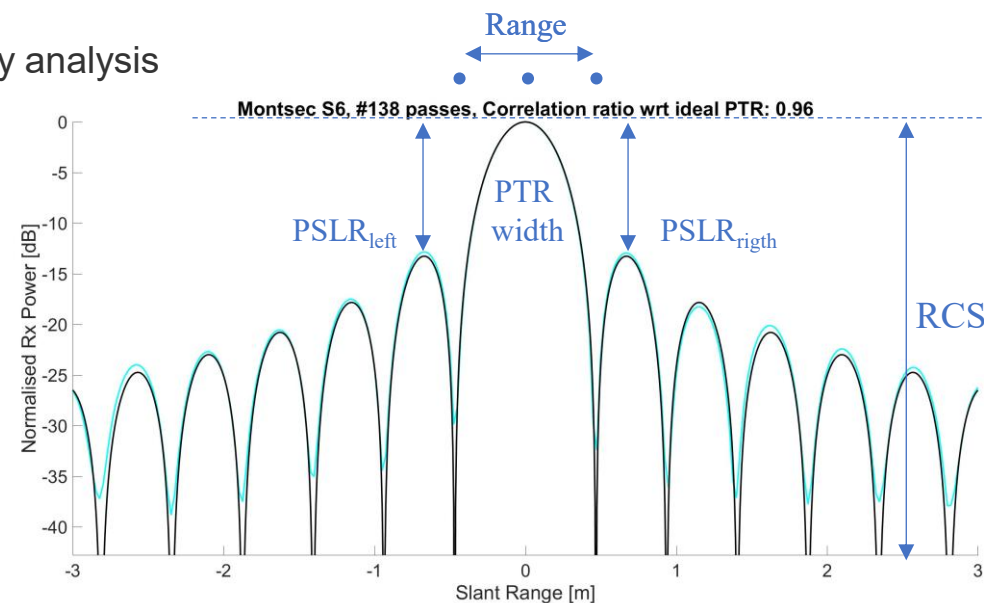
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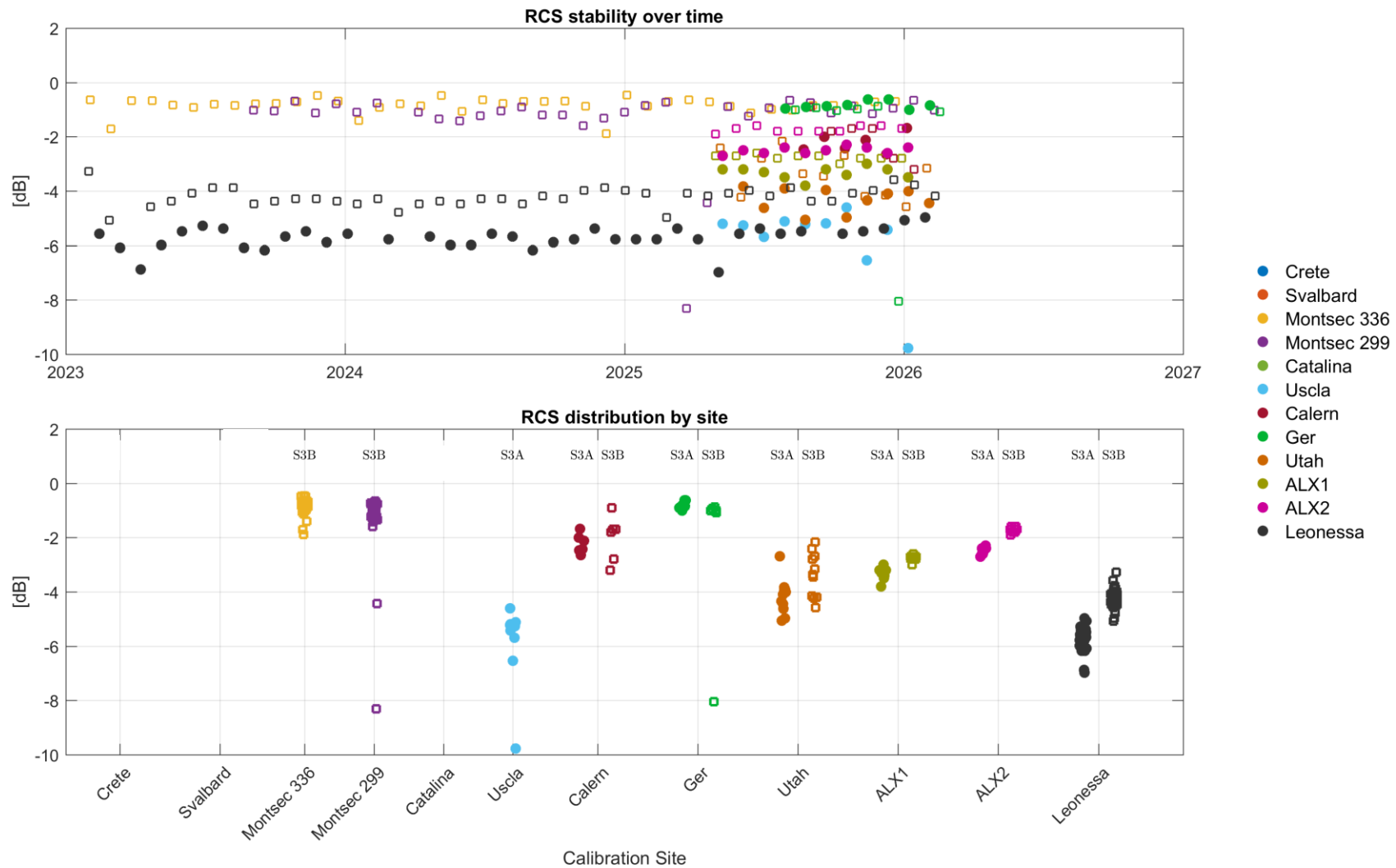
- PSLR
sidelobe level indicator
- Range resolution (δr)
target sharpness

Radiometric Response

- RCS



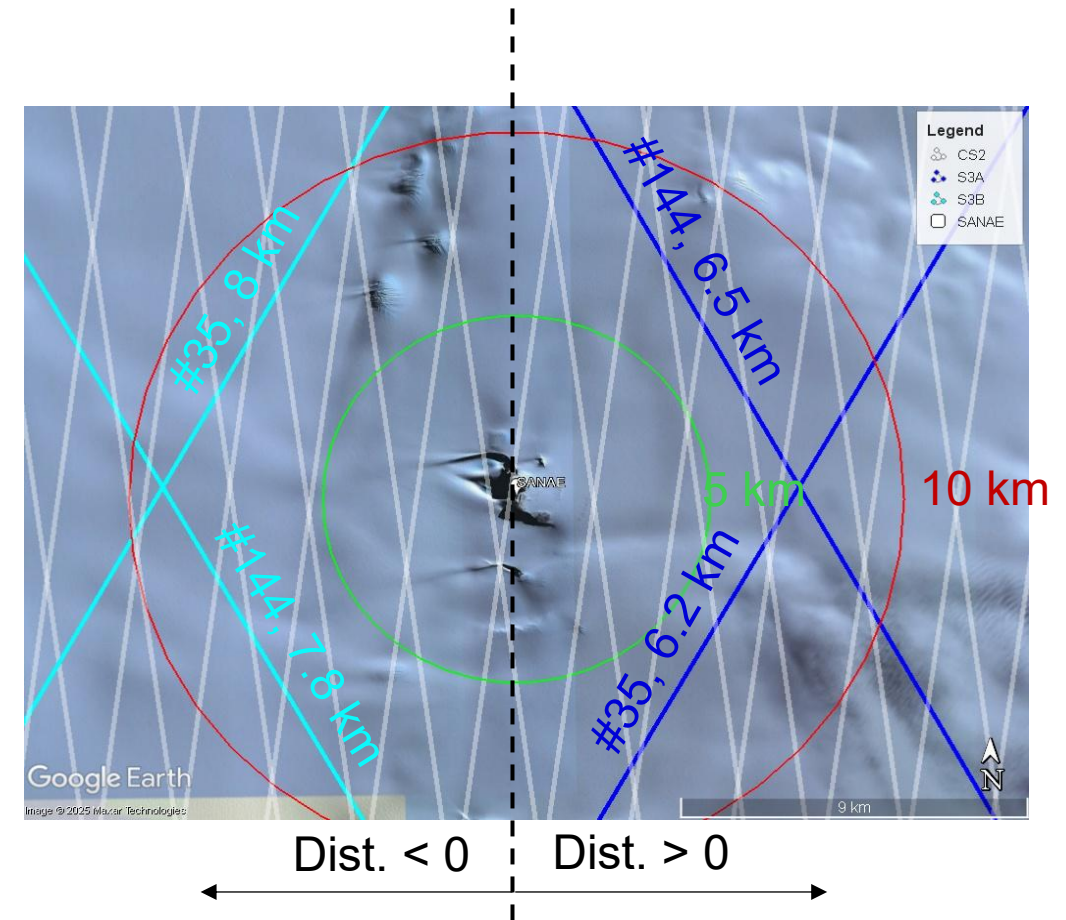
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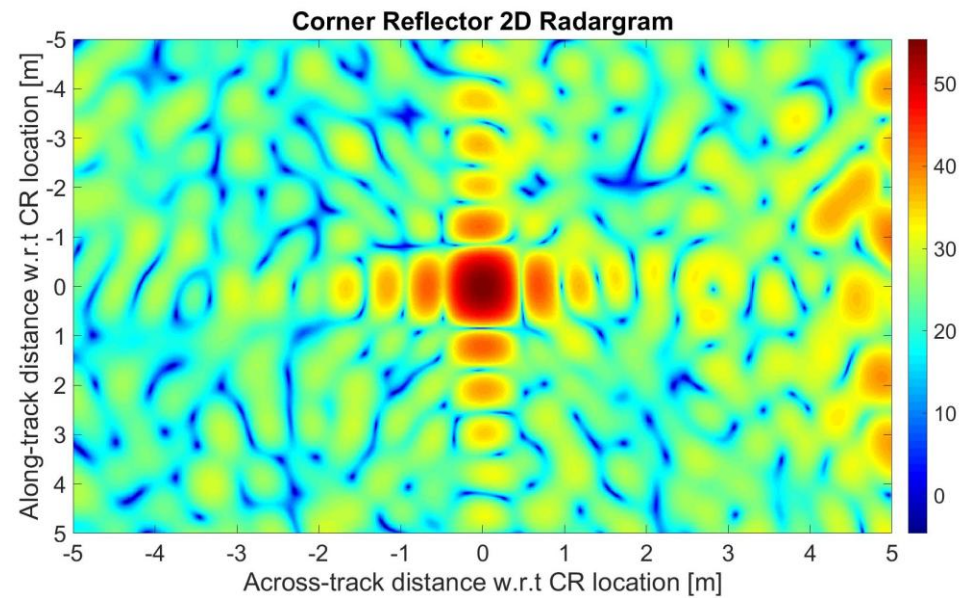
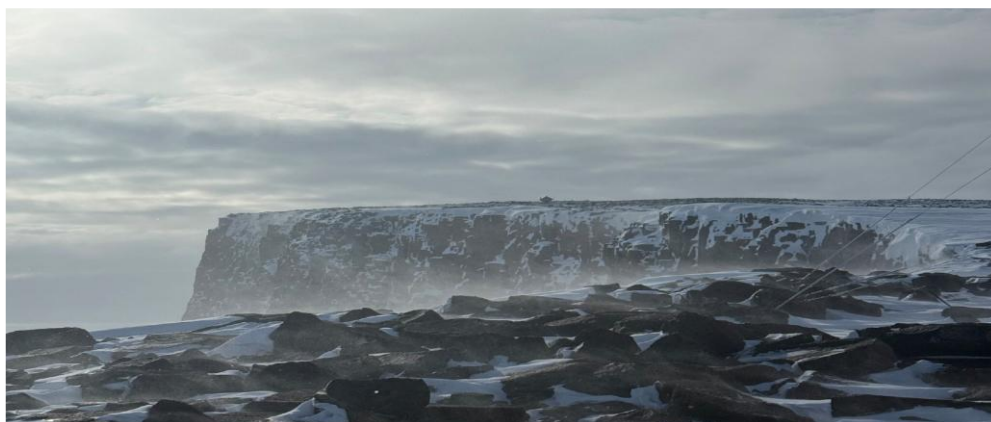
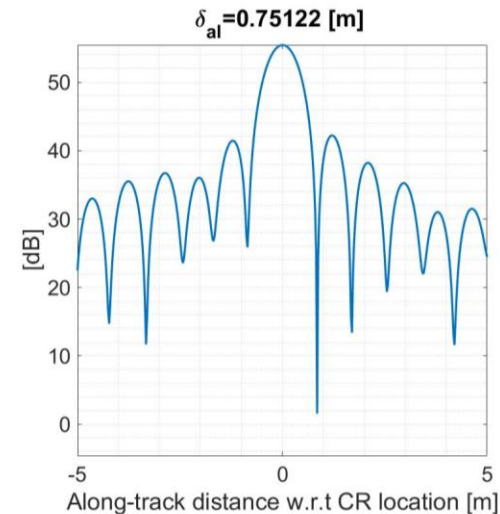
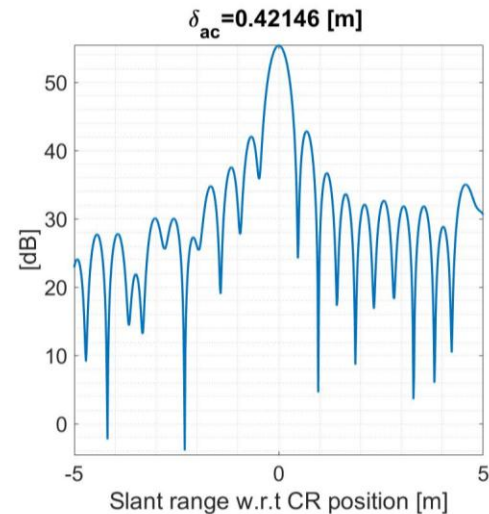
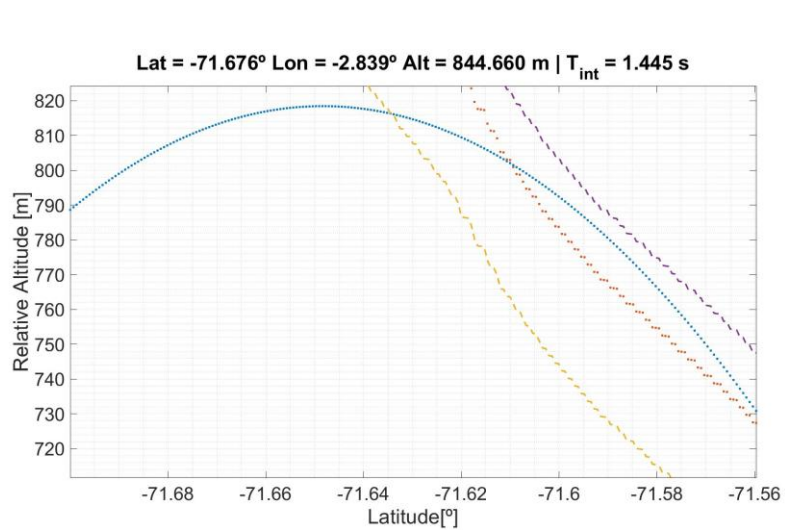


Site	In-Situ GNSS	Precision	Stability	Readiness
Crete (GR)	✓	High	High	Operational
Svalbard (NO)	-	Polarisation problems	-	Not used
Montsec (CAT)	✓	High	High	Operational
Ger (CAT)	✓	Improving	Good	Ready
Catalina (US)	✓/Partial	Uncertain	Moderate	Under assessment
Uscla (FR)	-	Limited	Good	Not ready
Calern (FR)	-	Limited	Good	Not ready
Utah (US)	-	Limited	Moderate	Not ready
ALX1 & ALX2 (GR)	-	Limited	Good	Not ready
SANAE (ANT)	-	-	-	-

SANAE IV Corner Reflector

- isardSAT has **deployed** a new permanent CR at the Antarctica scientific **SANAE IV base station**.
- It is a large reflector (RCS up to 60 dBSm for Ku-band), to mitigate the impact of the ice background clutter.





- The calibration network is robust and operational based on nominal sites (Crete, Montsec).
- The expansion introduces valuable geographical coverage, improving global representativeness.
- Long term calibration is key to ensure retrievals quality.
- New sites currently provide mainly relative performance due to lack of in-situ measurements.
- New accuracy can be significantly improved with better CR positioning and in-situ corrections.
- Radiometric results (RCS) reveal additional variability, requiring further investigation.



- Even if not following FRM standard (lack of permanent GNSS), the corner measurements (ALX, USCLA, CALERN,...) can provide good monitoring data for PTR shape parameters -> FRM standard should take this into account.
- Further studies are needed to assess the distribution of the network of corners and total number needed. The set up of the minimum might be different for different mission requirements.
- Update tracking in SANAE: OLTC or Transponder mode for S3A and S3B cross overs. We are currently just able to track SANAE corner with half of one of the four passes available.
- Investigate the differences (range and σ_0) observed between sites to clarify their source.
- Keep and expand the use of the current calibration capabilities for Sentinel-3C in coordination with the needs of other altimetry missions (CRISTAL, S6, S3NG, S6NG).

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