ABSOLUTE CALIBRATION OF σ^0 FOR EUROPEAN and CHINESE SATELLITE ALTIMETERS USING PASSIVE CORNER REFLECTORS

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Abstract

Satellite altimetry provides the means for global monitoring of sea level, sea ice and inland waters with accuracy of mm/yr. Absolute calibration of satellite altimeters by external, permanent and independent ground facilities is necessary to safeguard accuracy and reliability of those satellite observations for climate change monitoring. The main objective of the Dragon V project (ID 59198) is to standardize procedures for calibration/validation of European and Chinese satellite altimeters. Such procedures are to follow the guidelines prescribed by the strategy for Fiducial Reference Measurements for Altimetry, developed by the European Space Agency. One of the fundamental quantities that needs to be calibrated in satellite altimetry is the backscatter coefficient (sigma-naught); a parameter related to wind observations at sea; an indispensable parameter for climate change models. At the moment, there is no European or Chinese Cal/Val facility exclusively dedicated to sigma-naught calibration. This work presents the first steps towards design, implementation and validation of corner reflectors for absolute and direct sigma-naught calibration of satellite altimeters. First, the pros and cons of corner reflectors are given and compared against active transponders. Then, the geometrical shape of the corner reflector is examined as it controls performance characteristics, such as radar cross section with respect to radar elevation and azimuth, maximum gain achieved, side lobe attenuation, its durability to outdoor conditions, etc. Finally, the need for designing a corner reflector capable to support sigma-naught calibration for multi-mission and multi-frequency satellite altimeters is presented.

Objectives

1. **Upgrade** Cal/Val services with sigma-naught (σ0).
2. **Incorporate** corner reflectors (CR) along with transponders for range calibration.
3. **Increase** reliability of Cal/Val by combining different results.

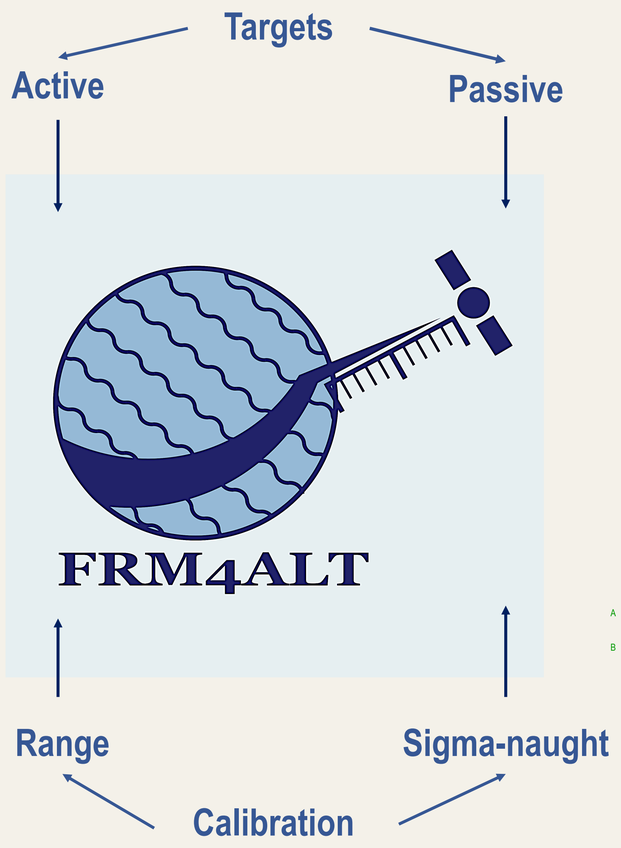


Figure 1

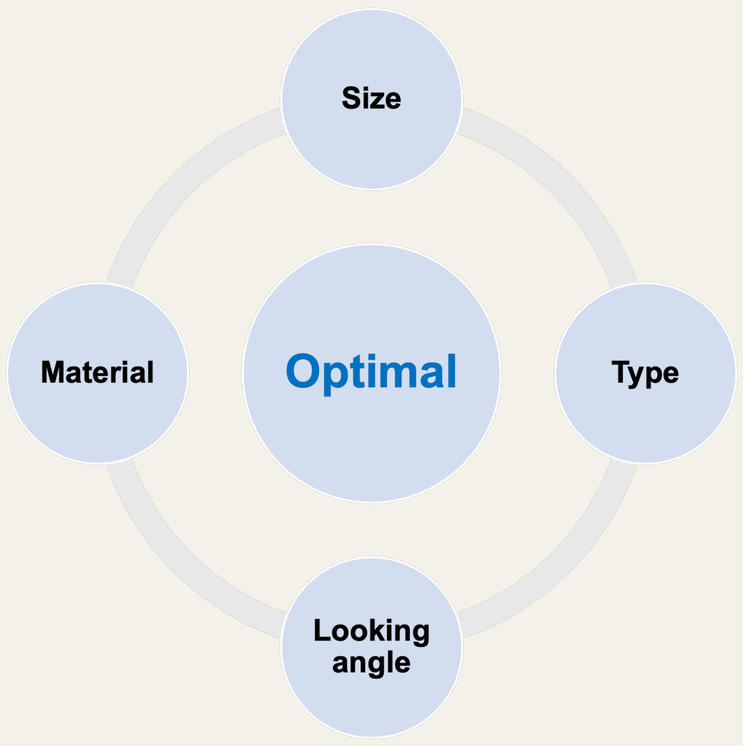
Methods - Workplan

- **Review** of previous works on radar Cal/Val using passive targets.
- **Design** and **construct** the optimal **CR** for altimetry Cal/Val.
- Identify **ideal location** for CR deployment.
- Analysis of **CR echo** on altimeter's records.
- **Comparison** against conventional sea-surface and transponder **Cal/Val**.

Corner Reflector versus Transponder

	Transponders	Corner Reflectors
Type	Active	Passive
SNR	High	Low
External Power Need	Yes	No
Applicable	σ^0 & range	σ^0 & range
Moveability	Low	High
Multi-Frequency	No	Yes
Stability Error Source	Electronic	Mechanical
Cost	High	Low

Criteria for Corner Reflector Design



Selection Result of Corner Reflector Design

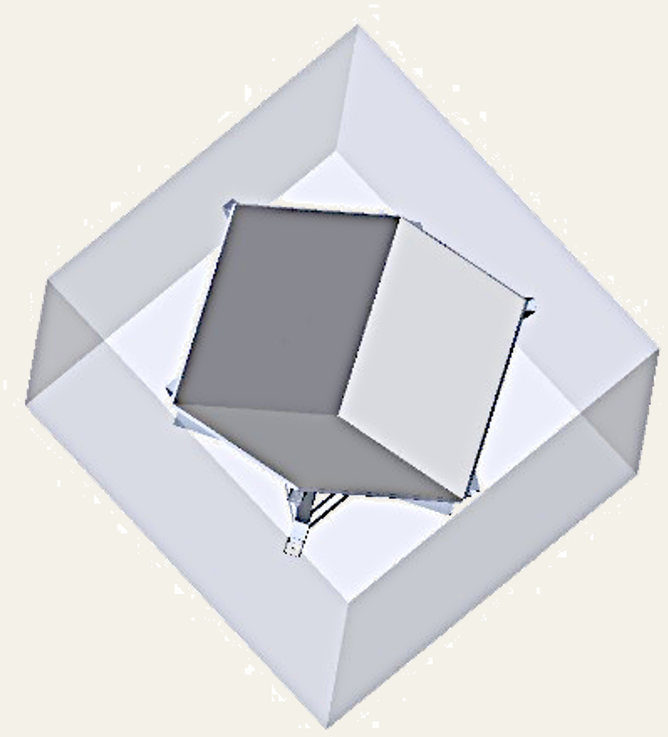


Figure 2

Rectangular Trihedral Corner Reflector Looking at Zenith

Types of Corner Reflectors

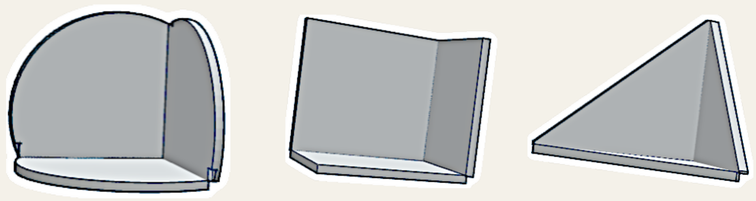


Figure 3

Corner Reflector Integration

GVD1 → Multiple sites → COR1

Active Range Calibration → Sea Surface Calibration → Passive Range Calibration

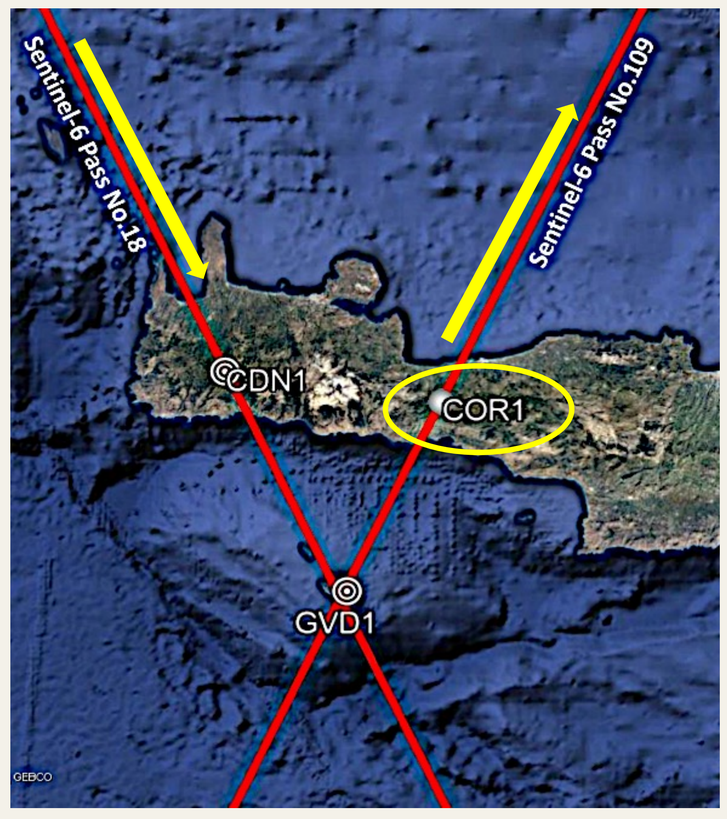


Figure 4

Conclusion & Future Plans

- Ideal **CR** type is the **rectangular**;
- Corner reflectors **complement** active transponders;
- **Holistic design** to cover present and future altimetry needs;
- **Location** for **CR** deployment identified;
- Survey for **CR manufacturing** vendors;
- **CR deployment** in Q2 2023.

Major References

• Jauvin, M., Yan, Y., Trouvé, E., Fruneau, B., Gay, M., & Girard, B. (2019). Integration of corner reflectors for the monitoring of mountain glacier areas with Sentinel-1 time series. Remote Sensing, 11(8), 988.

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Acknowledgements

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