The SAMOSA project

Development of SAR Altimetry studies over Oceans, coastal zones and inland Water

SAMOSA Project Team:
SatOC – Project Lead
DMU – Inland and Coastal Waters
DTU – Geodesy, Airborne SAR
NOC – Open Ocean and Coastal Waters,
Retracker development and assessment
STARLAB – Altimeter Waveform Theory

Project funded by ESA under the STSE programme:

STSE
Support To Science Element

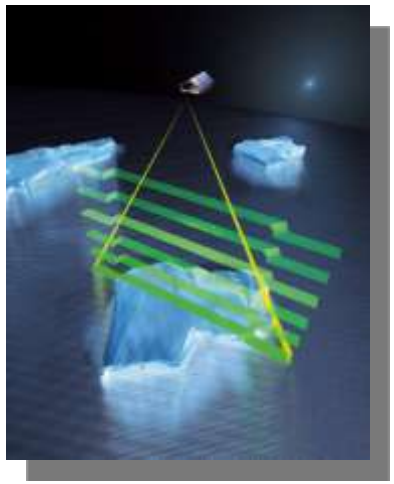
SAMOSA

SAMOSA Motivation and Mission

MOTIVATION

- CryoSat-2 → SIRAL
  - First SAR altimeter on board a Satellite

- Sentinel 3 – SRAL
  - Need to develop processing software for SAR mode



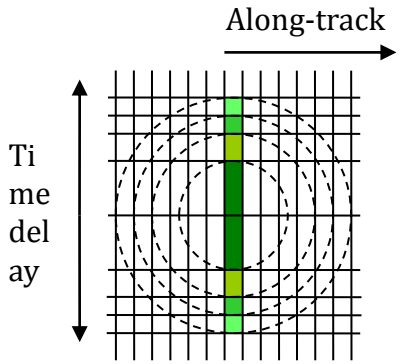
MISSION

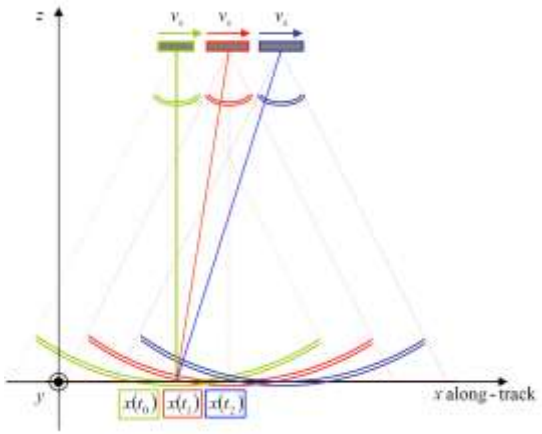
- To quantify the improvements of SAR altimetry compared to conventional altimetry for observations over ocean, coastal zones and inland waters

IMAGES COURTESY OF ESA

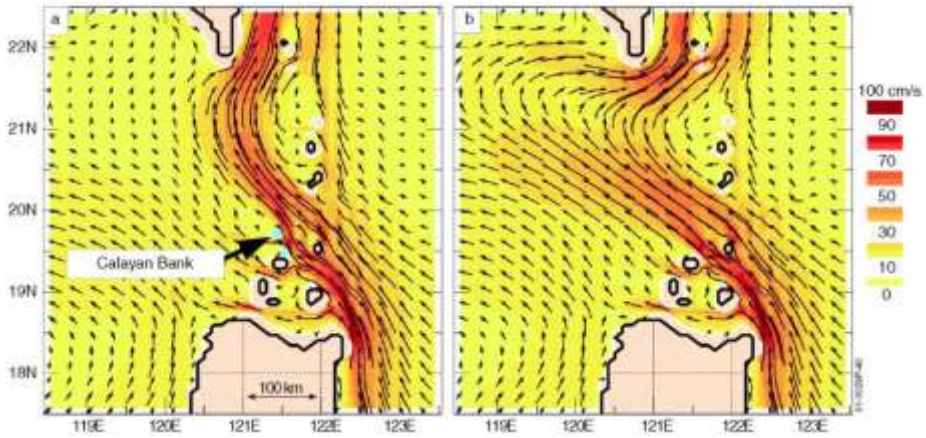
SAMOSA SAR Mode Altimetry

- By increasing the pulse repetition frequency and introducing Doppler processing, we expect to achieve:
  - Increased along track resolution
  - Smoothed speckle noise
  - Improved signal to noise ratio
  - Improved precision in height, SWH and σ^0
- Better representation of coastal features
- Better retrieval of sea floor topography
- Better mapping of inland water features





SAMOSA SAR Mode Altimetry



The current field across a section of the Kuroshio current showing the importance of accurate sea floor mapping

ERS-1 SAR image showing several phenomena that can in principle be observed by DD altimetry. Note in particular the bright signature of katabatic winds, the small-scale eddy made visible by spiral patterns of surface slicks, and the train of internal waves south of the Messina Strait.

SAMOSA OBJECTIVES

Perform a scientific study of the **potential improved capability of SAR** data **compared to conventional altimetry** over water surfaces:

1. Reduce SARM data to LRM data:
2. To develop a **theoretical model** for the SAR altimetry mode echoes over water surfaces
3. To define a **new re-tracking method** for the SAR altimetry mode
4. To evaluate the SAMOSA re-tracker with **ASIRAS, computer simulated** and **Cryosat-2** data
5. To perform **a scientific study** of the potential capabilities of SAR altimetry data to characterise **coastal zones, estuaries, rivers and lakes**

SAMOSA Agenda

3. **SAR Mode Altimeter Detailed Processing Model (NOC)**
4. **Assessment of SAR Mode Data Over Water ("SAMOSA1")**
   - SAMOSA1 model basics, producing LRM from SAR Mode (STARLAB)
   - Retracking: Range Retrieval Performance (NOC)
   - Application to airborne SAR (ASIRAS) data (DTU)
5. **Refined SAR Waveform Model ("SAMOSA2")**
   - Theoretical model overview (STARLAB)
   - Numerical assessment of performance (STARLAB)
   - 2nd generation SAMOSA retracker – assessment of performance (NOC)
6. **SAR Mode Altimetry over Inland Waters (DMU)**

3. Detailed Processing Model – Key Features (NOC)

4. Development and Assessment of New Applications for SAR Mode Data Over Water

4.1 Overview to theoretical basis (STARLAB)

Producing “Pseudo” Low Rate Mode from SAR Mode

Basics of “SAMOSA1” waveform model

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4.2 Range retrieval performance in LRM, SAR and "Pseudo" LRM mode: Results from Computer Simulated Products and Cryosat-2 (NOC)

4.3 Retracking application to ASIRAS airborne data (DTU)

5. Further Development of SAR Waveform Model and Retracking Applications

5.1 Refined Model Overview (STARLAB)

5.2 Numerical Assessment of improvements from refined “SAMOSA2” model (STARLAB)

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5.3 Range retrieval performance of 2nd generation retracker, including mispointing. Results from computer simulated products and Cryosat-2 (NOC)

6. SAR Mode Altimetry over Inland Waters (DMU)

SAMOSA Summary

- Developed and tested methodology to reduce SAR mode to LRM
- Two new SAR Altimeter waveform models,
  - SAMOSA1: Circular antenna pattern, Gaussian surface, ….
  - SAMOSA2 includes full list of “tuneable” realistic features
  - plus ESA model developed for in house validation
- Developed and tested SAR retracker – applied to simulated data, airborne and Cryosat-2 data
  - Confirmation of improvement in accuracy of range retrieval (SAR mode)
  - Performance for SWH retrieval unclear, different results obtained from simulated data and initial analysis of Cryosat-2 data
- Inland waters – confirmation of expectations of improved performance
  - 60% / 75% /85% of simulated waveforms valid for re-tracking (with modified DMU system) in wetland / estuarine / inland lake scenarios
  - Successful recovery of small scale features

SAMOSA Further Work

- Efficient implementation of SAMOSA2 model.
- Validation and testing against wider range of Cryosat-2 data (co-located with reference data)
  - Investigate SWH and σ^0 performance
  - Look at real small scale features.
  - Any relevant data issues to be aware of?
- Cross-validate with Sentinel-3 simulator on same scenarios.
- Testing against alternative re-tracking approaches.
- Update DPM.
- Validate RDSAR on real data to prepare for Sentinel-3 mode transition (SAR-LRM).
- Link to Coastal Altimetry developments – processors, geo-corrections
  - Test approach with Cryosat-2 data.

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