Starlab Space

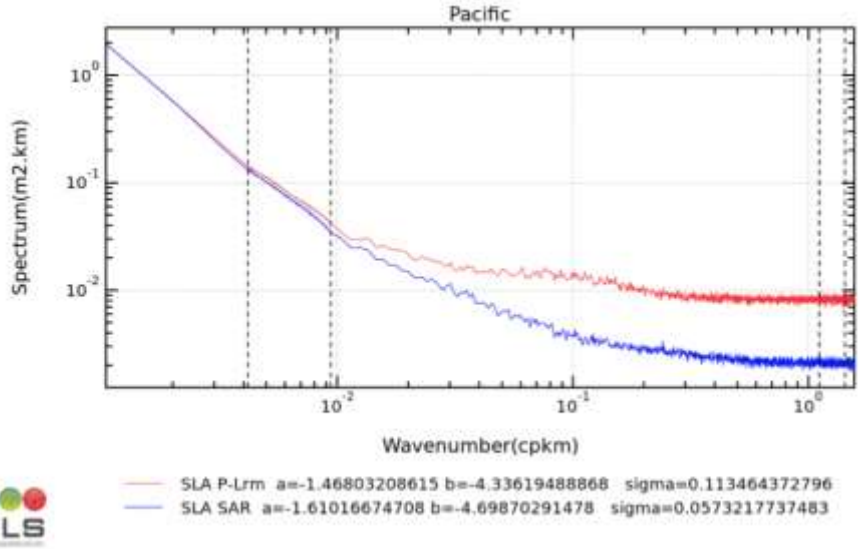
WP 7.2: GMES (Copernicus) land and ocean

LOTUS – RV4, Brussels
04/02/2016

Starlab
Living Science

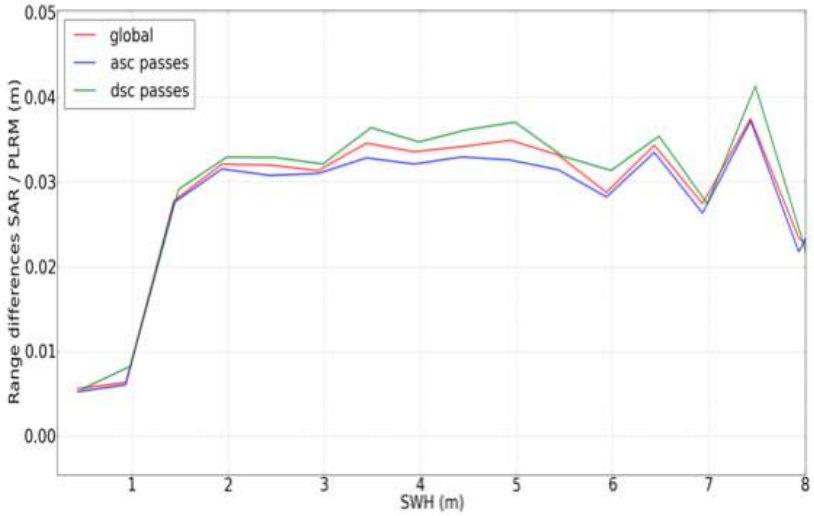
Open Ocean – Major improvements (1)

SLA



- No spectral hump between 10 and 30 km

Better accurate observations to capture oceanic structures below 100 km

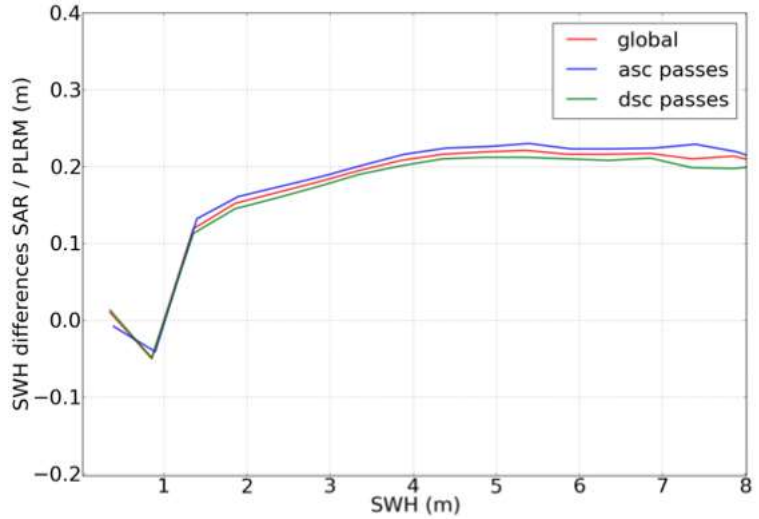


- No residual errors correlated to:
  - **Mispointing**
  - **Radial velocity**
- No dependency for **SWH higher than 2m**

Similar Sea State Bias (SSB) between LRM and SAR

Open Ocean – Major improvements (2)

SWH



- Residual error correlated with SWH close to 2.5% SWH
- Bias on SWH to 15cm at 2m and around 20 cm for wave height higher than 4 meters

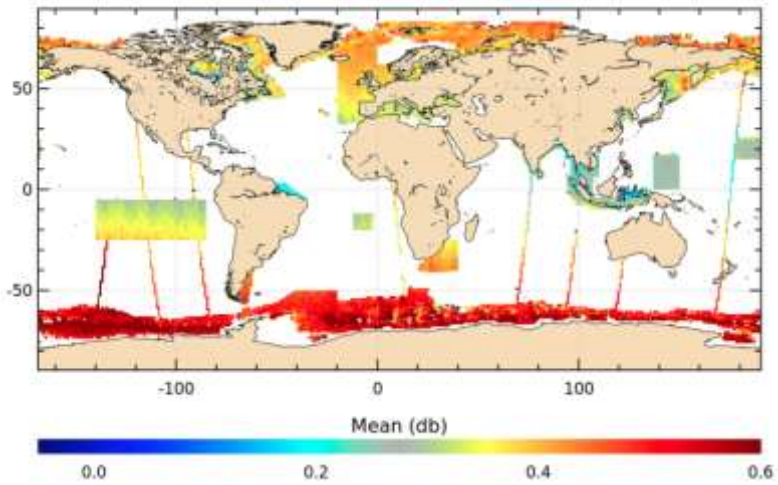
Under investigation (higher amount of data needed)

- Good agreement between both processing, (0.2dB magnitudes)

Sigma-0

- No residual errors correlated to:
  - Across-track mispointing (roll)
  - Significant wave height (SWH)

Good agreement between LRM and SAR



Maps of difference between PLRM and SAR sigma-0

Open Ocean – Limitations

- **Improved resolution** in the along track direction (300m)

High resolution, accuracy, precision and better resolve fine-scale features

- Measurements **potentially affected by sub-mesoscale structures** (from 0.1 to 1 km) like swells, which are, on the contrary, averaged out and undetected in low-resolution mode observations.

Unknown how retrieved SSH and other parameters are impacted by the presence of directional ocean waves, in particular, those whose wavelengths are close to the SAR along track resolution

- Further investigations to address the **sensitivity of the long-wavelength surface waves** on SAR-mode and a corresponding **corrections**

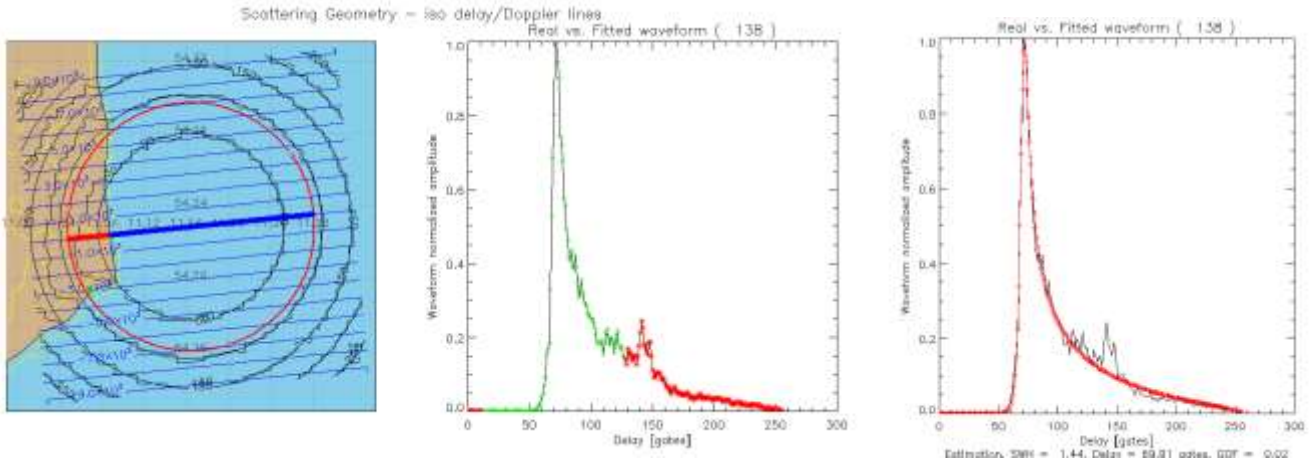
Open Ocean – Recommendations

- **Clear benefits of using SAR-mode** and its potential interest for the development of new marine applications

- Need to go a step further in **operating SAR-mode over 100% sea surfaces** (Sentinel-3 and next Sentinel-6)

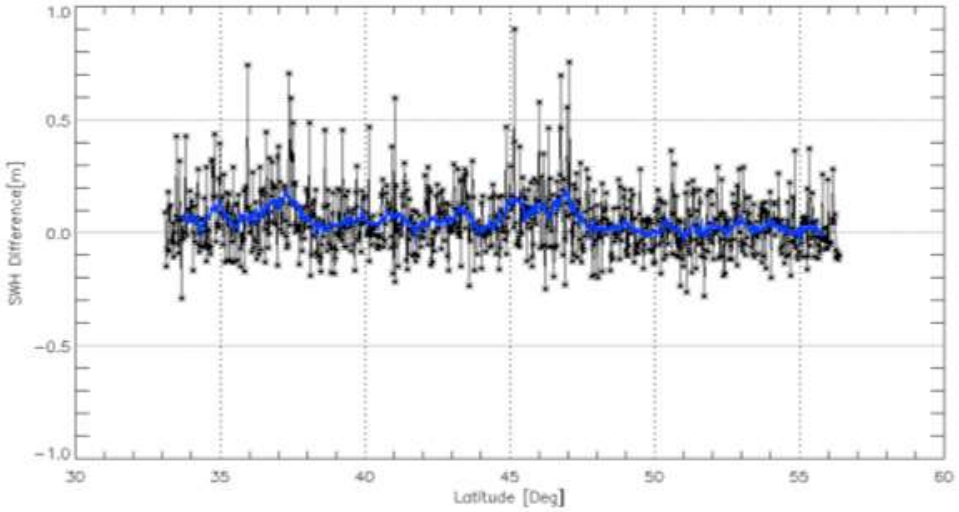
- To deliver such operational services, structured process has to be establish:
  - Develop a **level-2P** production system to prepare the generation of the level-3 along track products for the Copernicus Marine Service (CMS)
  - Generating **level-3** products for data assimilation systems for CMS
  - Generating **level-4** products for various applications (currents, climate…)

Coastal area – Major improvements



Waveforms coastal pre-processing and retracking

- Better retracking and physical parameters estimation in Coastal areas when **land perturbations in the across-track direction**

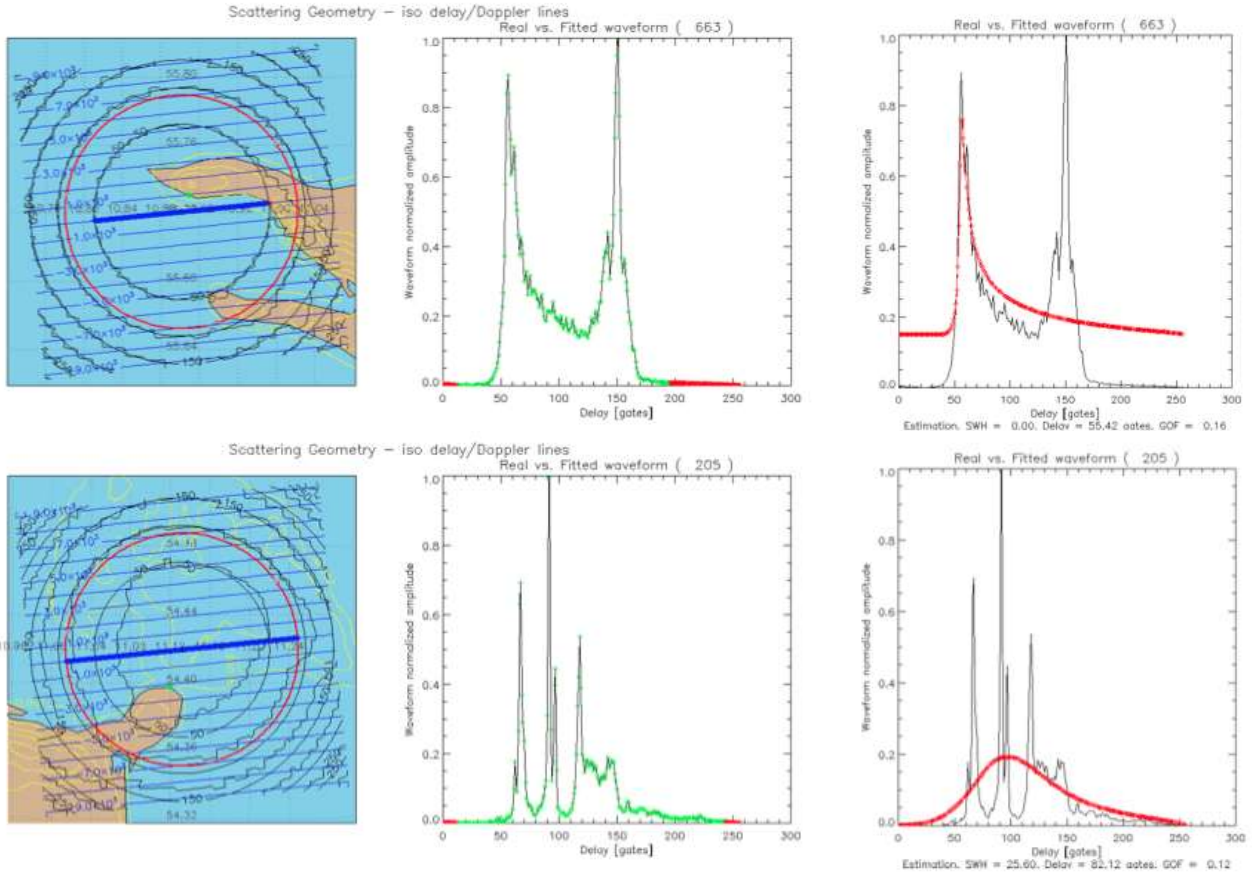


Good correspondence of both methods:

- Coastal pre-processing + SAMOSA retracker

- CPP retracker

Coastal area – Limitations



- Waveforms perturbed by **land in the along-track direction**

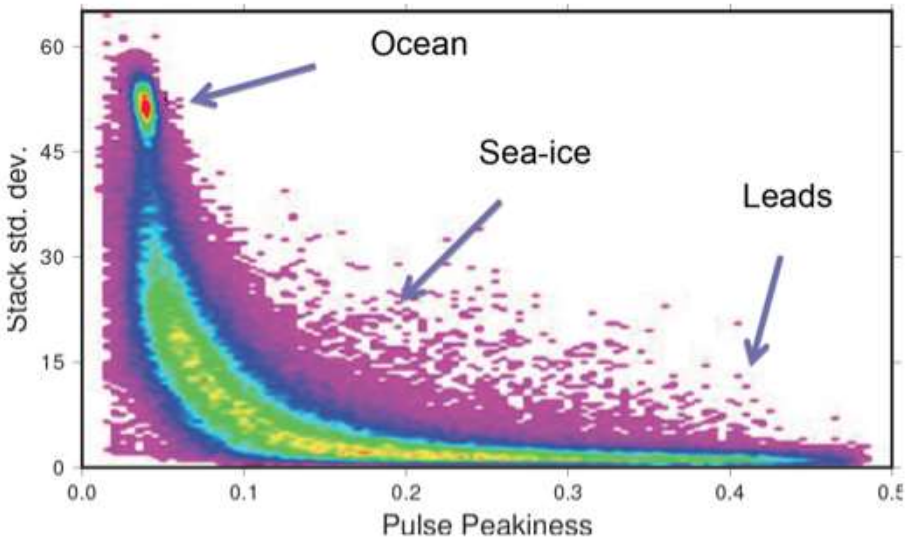
- Waveforms perturbed by **Shallow water**

Further investigation needed

Coastal area – Recommendations

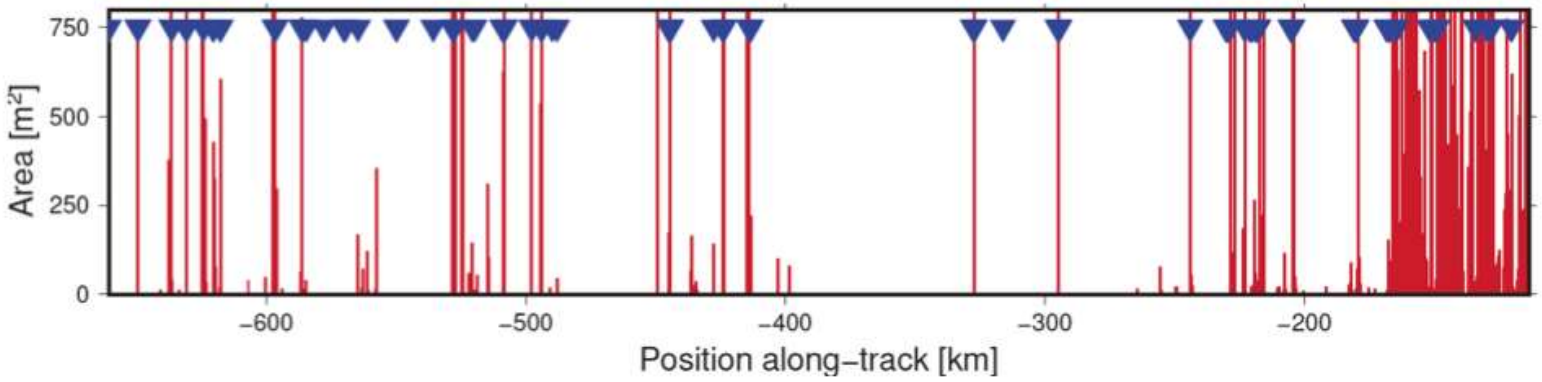
- **Major improvements in Coastal altimetry**, when perpendicular to the coast
- No lost of accuracy, precision regarding the CPP retracker
- **Additional improvements** required to address the complete issue of coastal areas with this methods
- However, current version ready for **implementation at operative level**
  - To be integrated in global open ocean products (Level-2, level-3, level-4) or **introduction of new dedicated coastal products**

Polar Ocean – Major improvements



- Increased spatial resolution (300m)
- Multilook processing for increasing the effective number of look in a stack
- Pulse peakiness (PP) and stack standard deviation (SSD) used for lead clasification

Better leads detection



Polar Ocean – Limitations

- With Sentinel-3 SAR mode, it will be possible to determine accurate sea level changes in Artic Ocean **up to the inclination of Sentinel-3 (81.5N)**.

Above this latitude, not possible to study sea level variations in Artic Ocean

Polar Ocean – Recommendations

- **Major improvements** for Polar Ocean sea level research

- However, some areas will not be covered by sentinel-3 (**up to 81.5N**) and no possibilities to retrieve sea level variations at these latitudes

- To deliver such operational services, structured process has to be establish:
  - Develop a **level-2P** production system to prepare the generation of the level-3 along track products for the Copernicus Marine Service (CMS)
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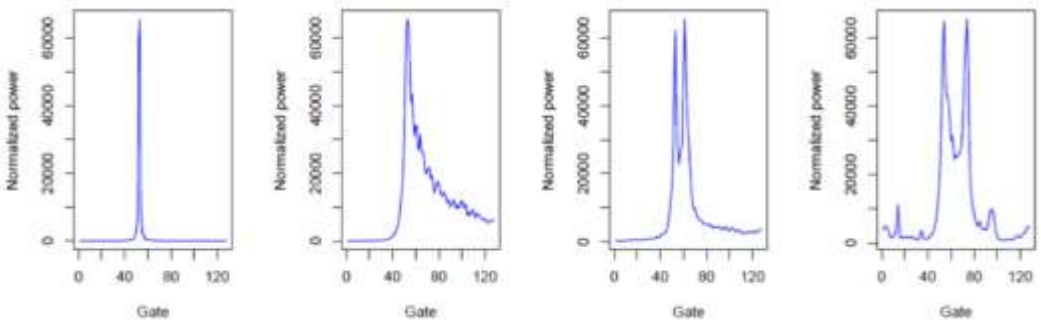
River and lake levels – Major improvements



Specific process for SAR-mode data has been developed to **select the correct waveforms and estimate the corresponding water level**.

- Danish lakes and small lakes
  - **Better accuracy** using Cryosat-2 than EnviSat or AltiKa, regarding in situ measurements

- Amazon river
  - **Lower errors** relatively to AltiKa data when meaning values found over the river (drifting track pattern)

River and lakes level – Limitations

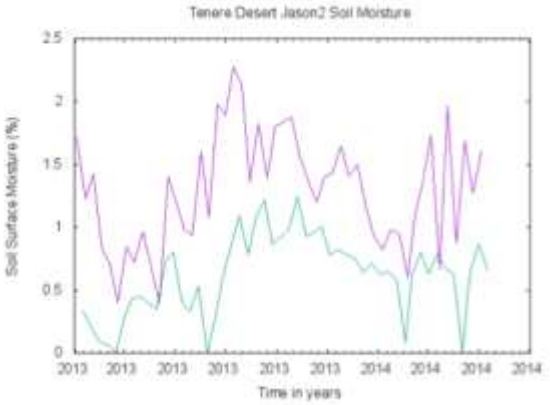
- Chao Phraya, Thailand
  - Due to the complexity of the river system, not quality measurements for this test dataset

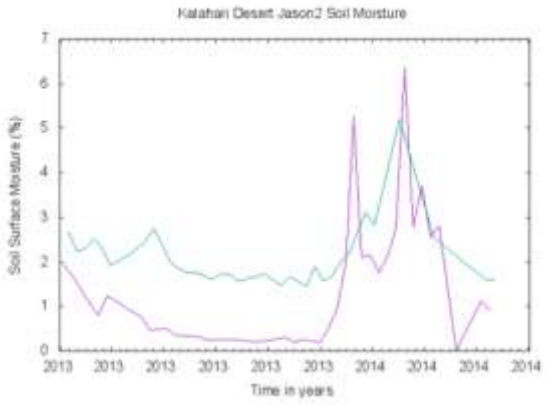
River and lakes level – Recommendations

- **Great potential** of SAR altimetry for inland water
- Derived water levels for the individual crossing are significantly **more stable**
- Still perturbation from the surrounding land → **Further research is recommended**
- Additionally, Sentinel-3 with a **repeat orbit** (27 days) would improve inland water levels estimation, in particular **for rivers** where levels are evolving along the river.
- However, several water basins estimation are already exploitable operationally, as demonstrated in the **river and lake level service AltWater**

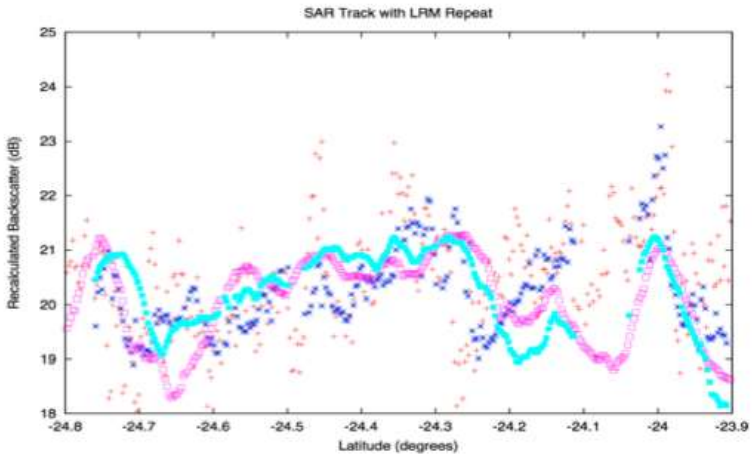
Soil moisture – Major improvements (1)

- Rebuild of the **Dry Earth ModelS** (DREAMS) for Cryosat-2 over three test areas (Simpson, Tenere, and Kalahari deserts)



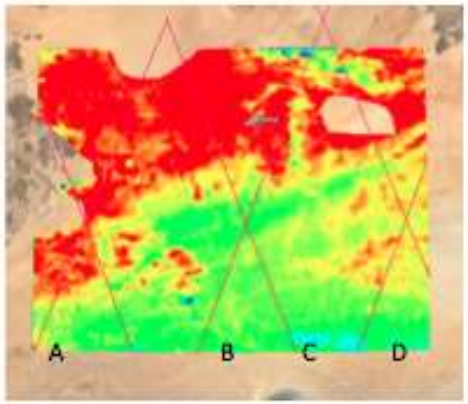


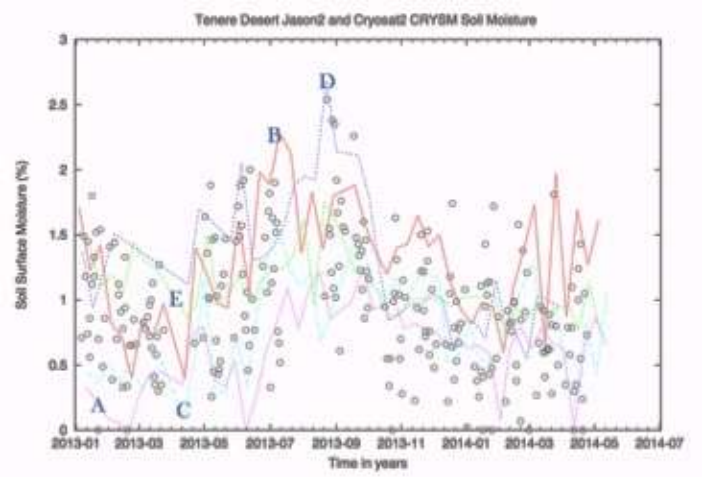
- **Significant yearly soil moisture dependence** for two track of Jason-2 in Tenere and Kalahari deserts



- **Good agreement** between Cryosat-2 SAR mode and LRM mode over the Gibson desert (Cryosat-2 SAR-mode availalble)

Soil moisture – Major improvements (2)



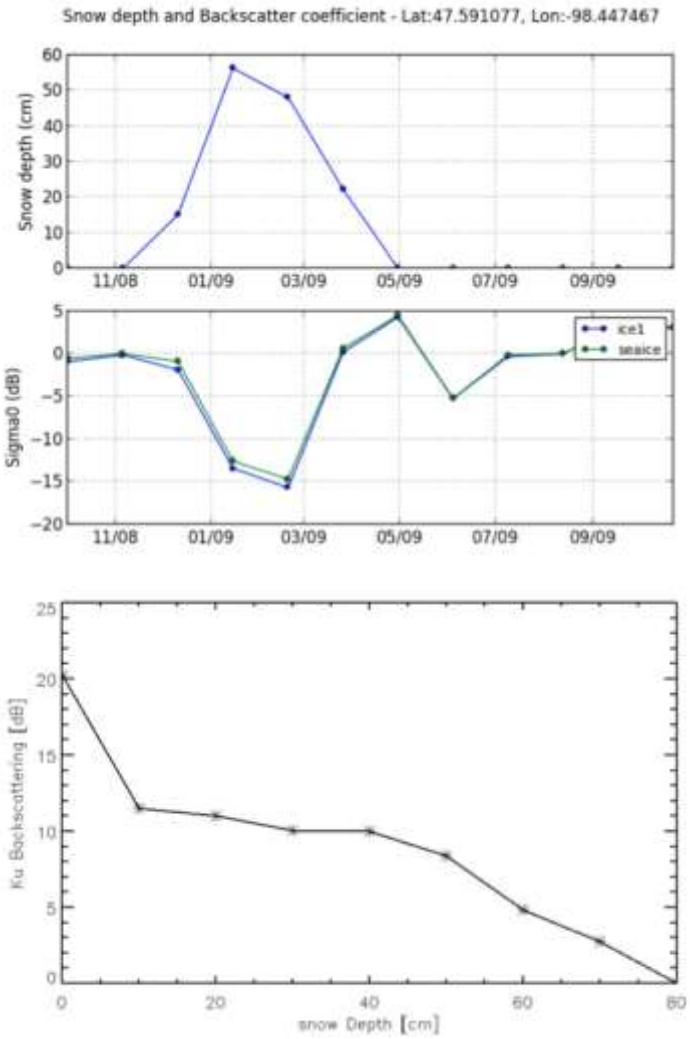


- **Good results of validation** of Soil moisture from CryoSat-2 (E) regarding Jason-2 reference tracks (A, B, C, D)
- Similar good results over the Kalahari desert

Soil moisture – Recommendations

- **ESA SMALT** project already demonstrated the generation of soil moisture products from satellite radar altimetry
- During the LOTUS project, the methodology to estimate soil moisture through the **DREAMS model continued to mature**
- Next step, include third party data, to allow **generation of DREAMS over wetter areas**
- Potential soil moisture products within **1-2 years of Sentinel-3 data acquisition**
- Potential products with **far finer spatial sampling along track** than other remote sensing techniques, with a precision about 0.1dB, complementary of other remote sensing techniques

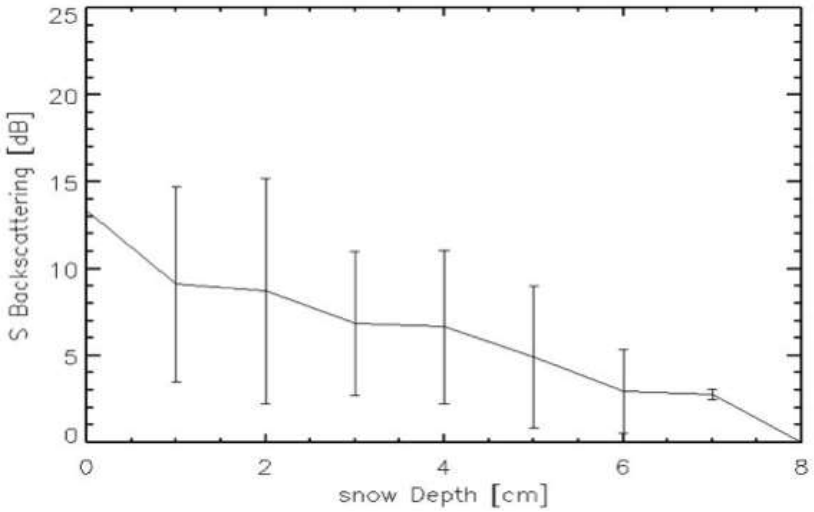
Snow depth – Major improvements



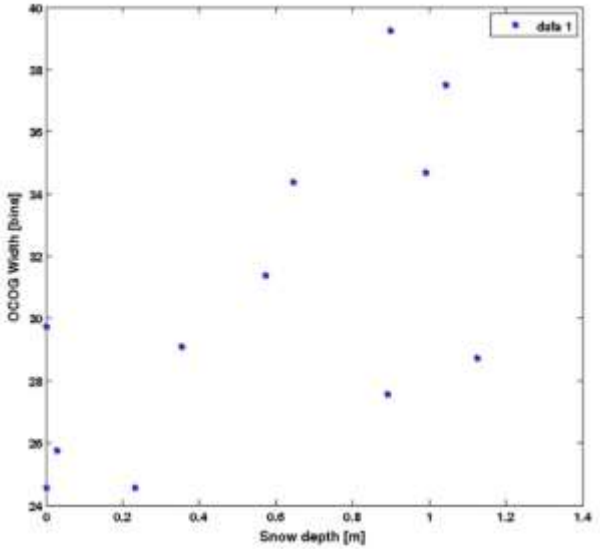
- Identification of a **strong trends** in snow depth retrievement from altimetry (Sigma-0).

- Potential direct relation between snow depth and sigma-0

Snow depth – Limitations



- **Envisat**
  - **High variability** in snow depth/sigma-0 regarding snow depth model outputs.



- **Cryosat-2**
  - Not any relation between snow depth and sigma-0 with the non repeat pass of Cryosat-2

Snow depth – Recommendations

- Snow depth estimation using altimetry is **not yet mature** to be developed at operational level
- However, interesting results shows the **potential of SAR altimetry** for snow depth retrievement
- **Waiting for Sentinel-3** for further investigation

Thank you for your attention