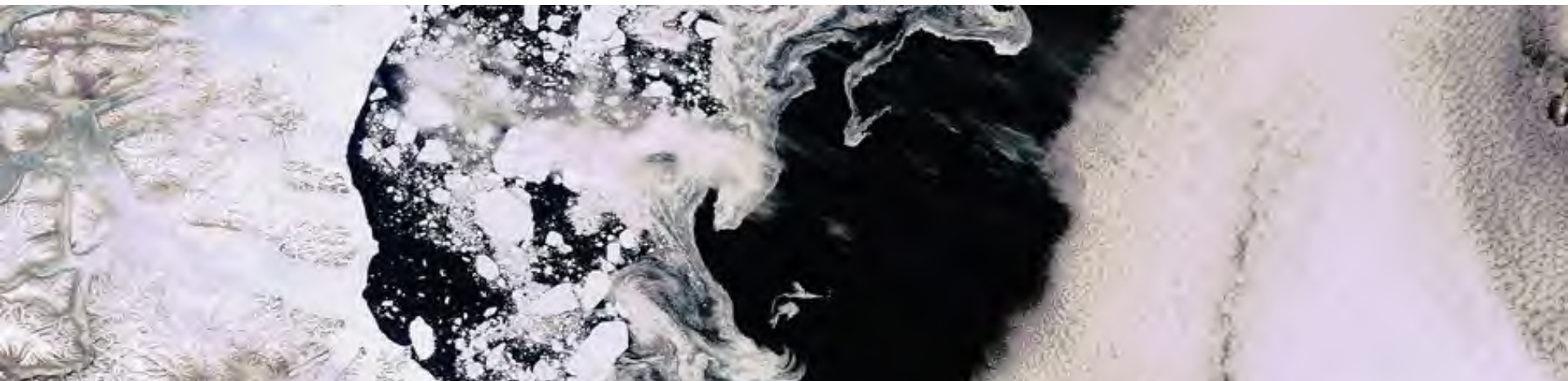


Bathymetry from satellite altimetry

Pau Gallés

isardSAT[®]



1. Introduction

- Approach
- The Principle

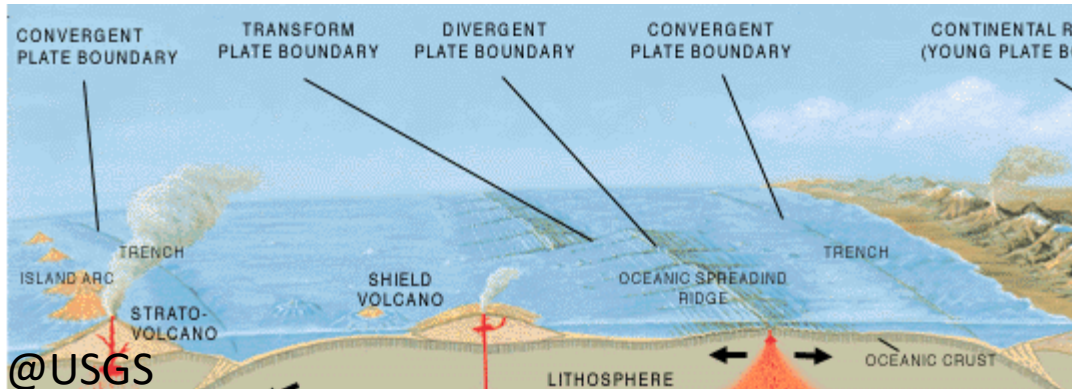
2. Method

- Sea surface height
- Gravity anomalies
- Bathymetry

3. Results

4. Ongoing tasks

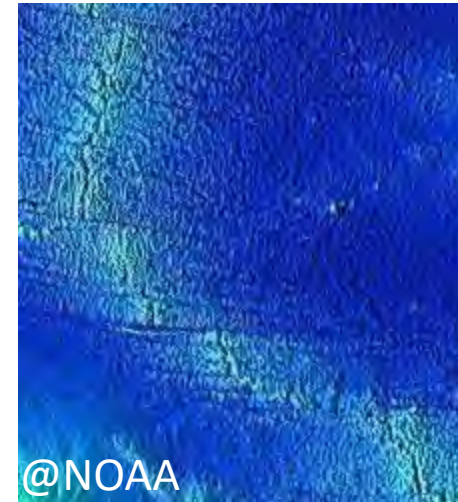
- Our approach
 - Open ocean bathymetry
 - Optimized local calculations
 - New SAR mode



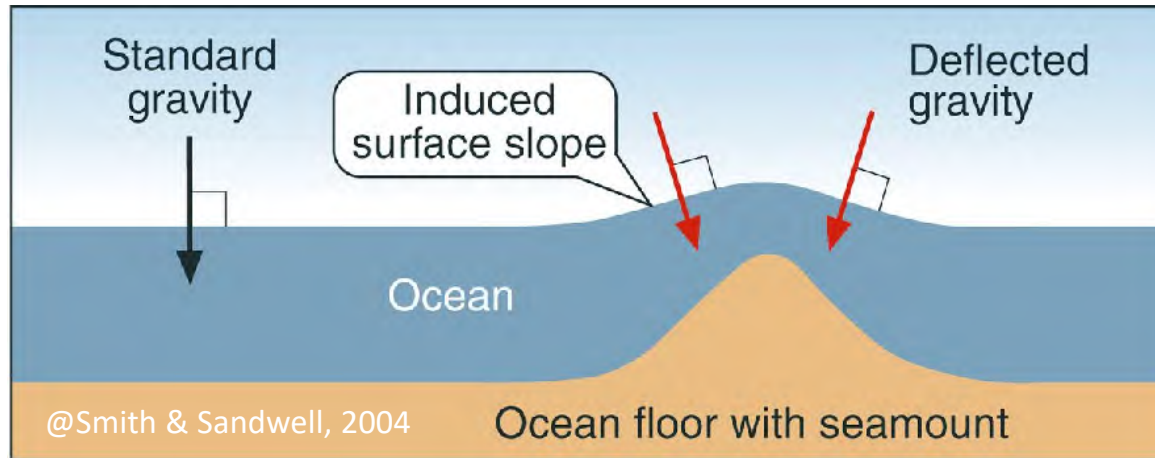
@USGS



@NASA

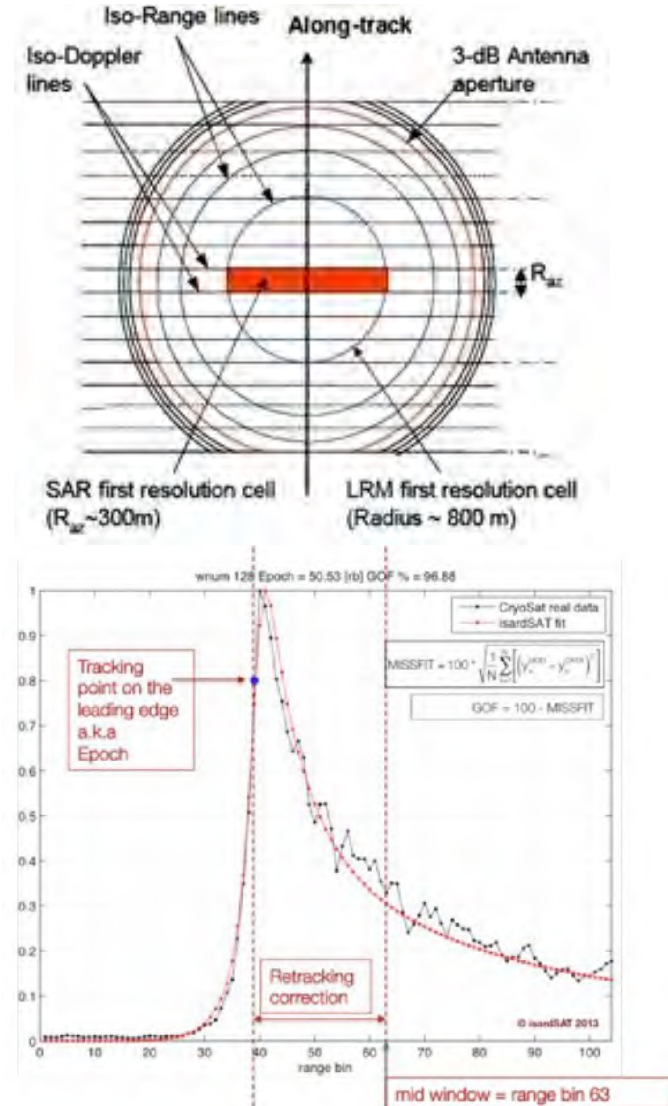


- Geological features
 - Plate tectonics
 - Mid-ocean ridges
 - Volcanic chains
 - Submarine landslides
 - Submarine canyons
 - ...



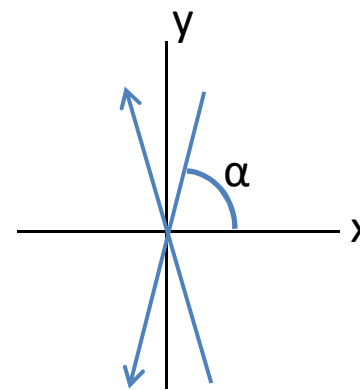
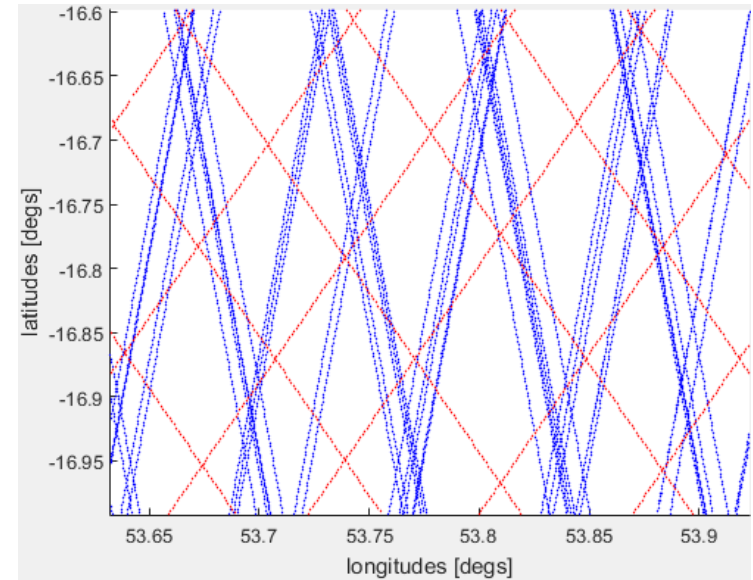
- **Seafloor topography creates gravity anomalies tilting the ocean surface** (measurable by radar)
 - Ocean surface tilts can be interpreted as an anomaly in direction of gravity (deflection of the vertical)
 - Measured deflections converted to gravimetric anomalies through Laplace's Equation
 - Bathymetric maps obtained exploiting correlation of bathymetry with gravity (inverse transfer function)

- 2 modes: LRM, SAR
- Delay Doppler
 - LRM resolution cells are rings.
 - SAR mode also has along track divisions generating greater amount of resolution cells.
- Retracking
 - Analytical models for the waveform fitting

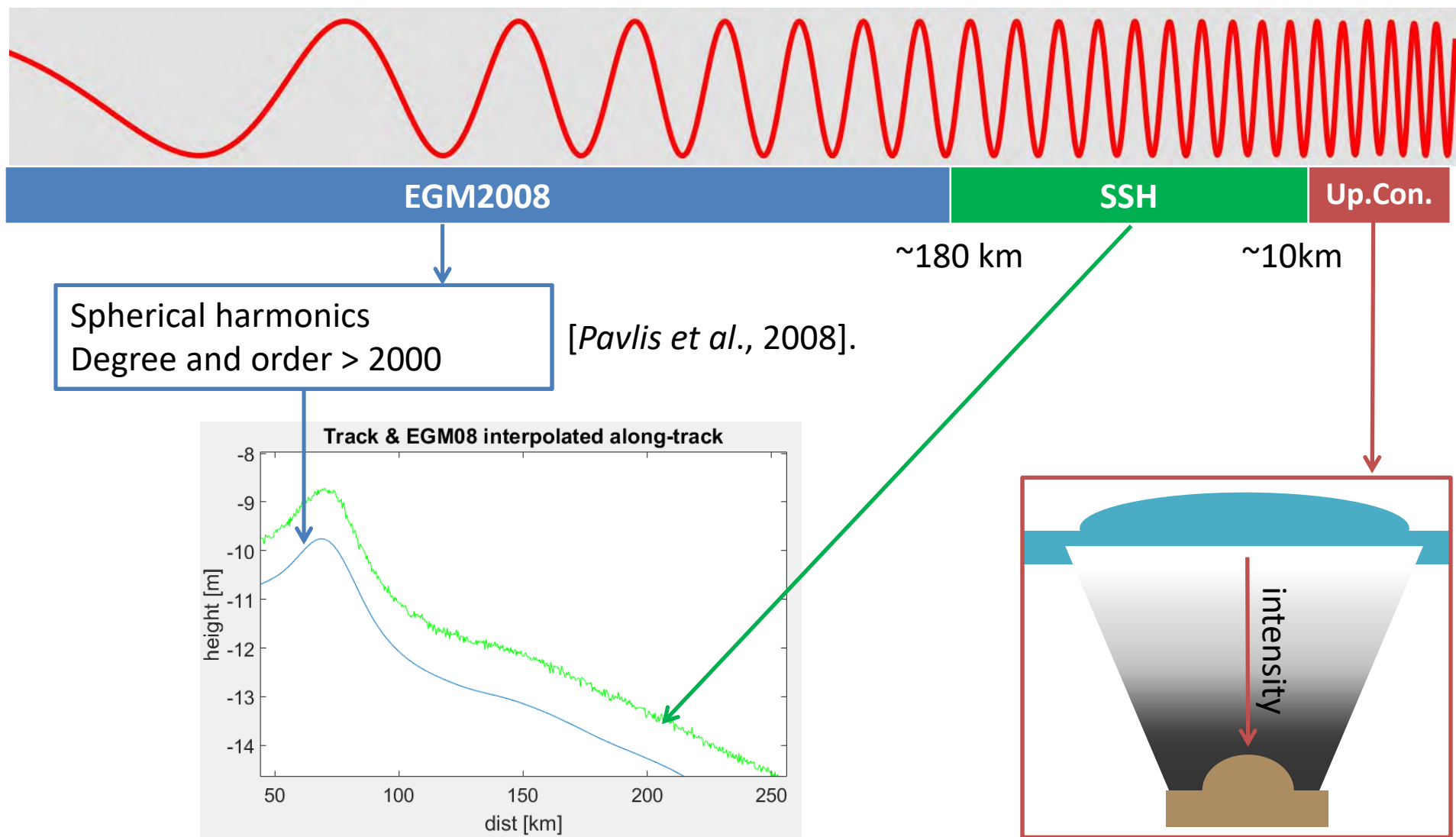


<http://www.altimetry.info/>

- Data pattern
 - Cryosat2 > N-S
 - Jason1 > E-W
 - Multi satellite > slopes
- Geophysical corrections
- Permanent effects
 - Average data
 - Filter long wavelengths



$$e_x = \frac{e}{\sqrt{2} \cos \alpha}$$

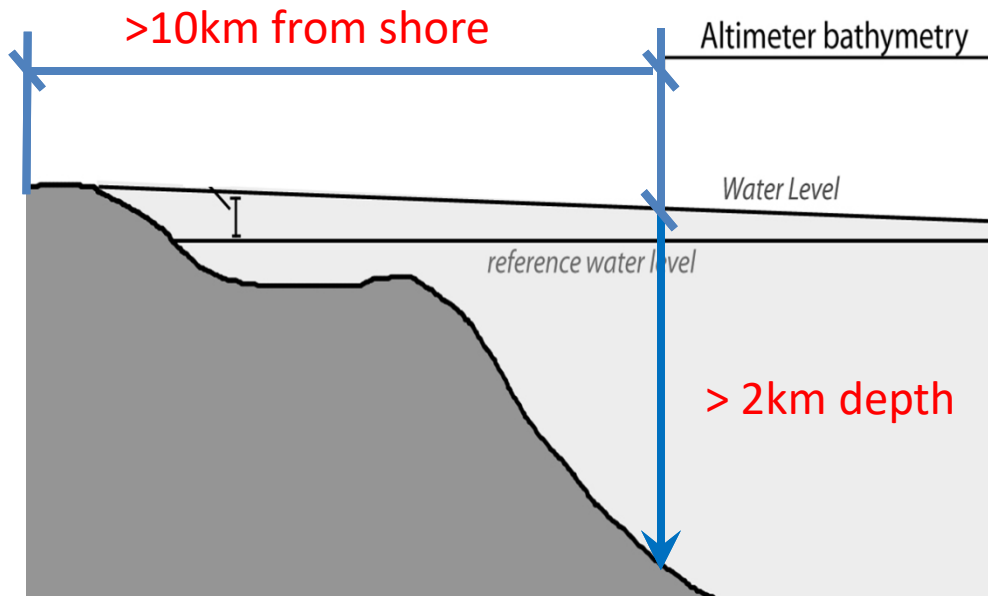


- Remove – Restore
- DOV
- Planar approach

$$f(\Delta g) = -i \frac{\gamma}{|k|} (k_x F(\eta) + k_y F(\xi))$$

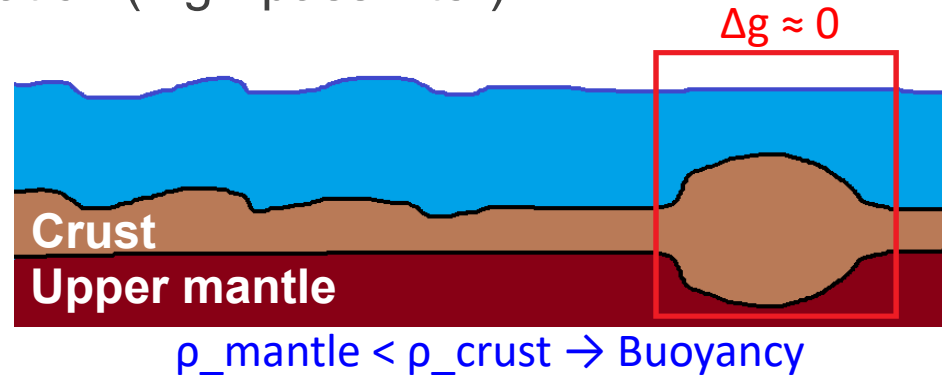
$$|k| = \sqrt{k_x^2 + k_y^2}$$

Sandwell & Smith (1997)

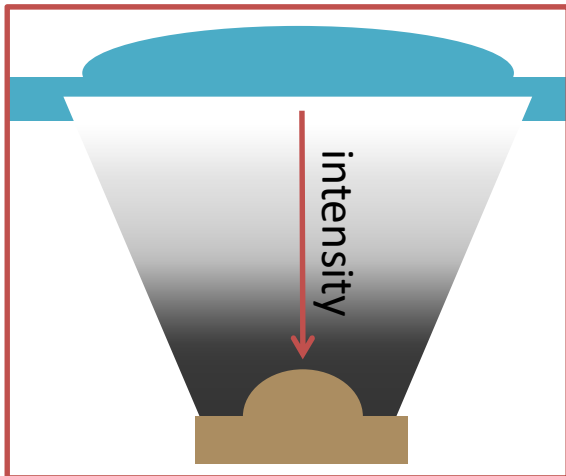


- The approximation is good when local undulations are small compared with a constant regional depth
- The lack of land data effects about 10 km from shore

- Isostatic compensation (high-pass filter)



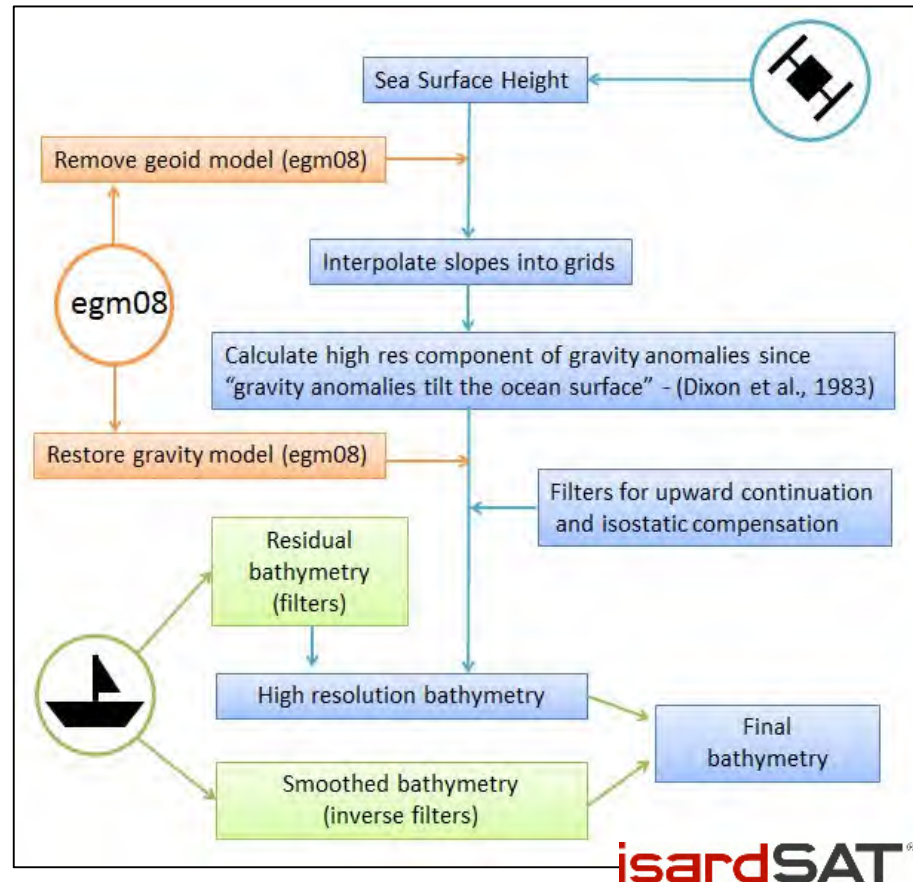
- Upward continuation (low-pass filter)

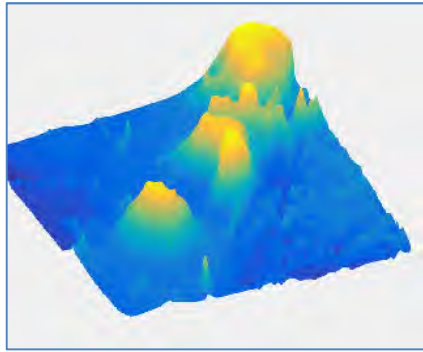


$$g_{\text{bathy}} = g_{\text{geoid}} \cdot \text{Bandpass}(k) \exp(2\pi k d \vec{i})$$

- Unknown Density

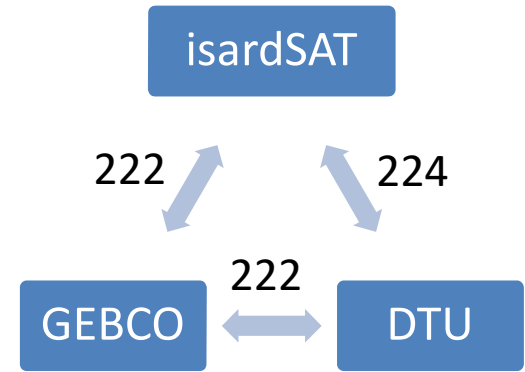
$$Bouguer_{cntt} = 2\pi G\rho$$





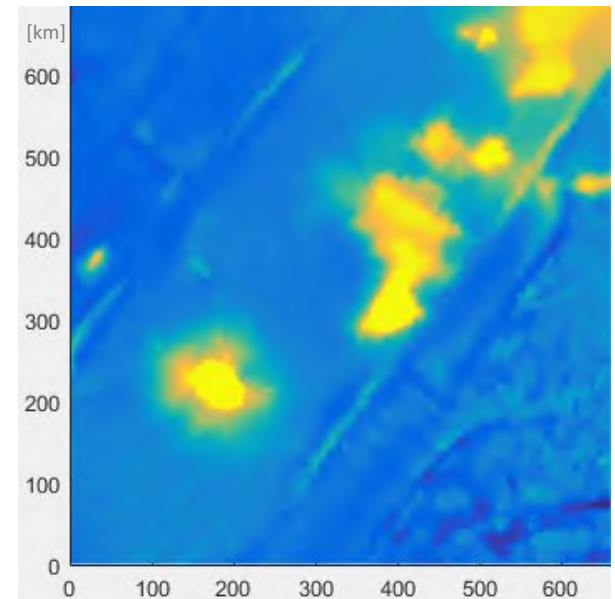
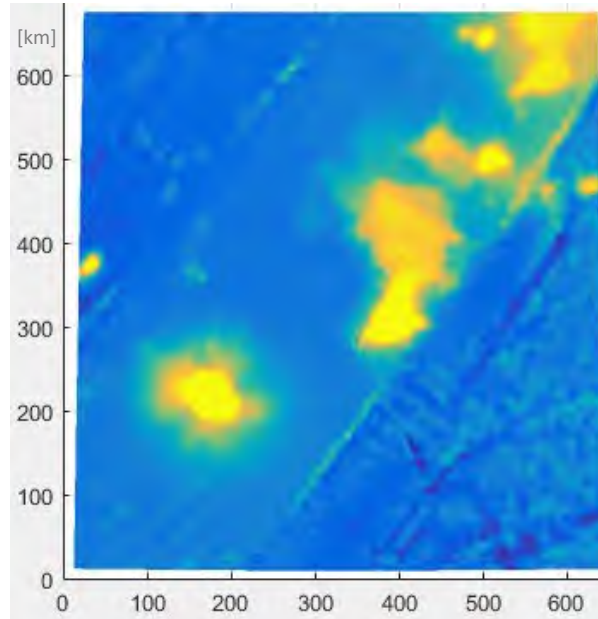
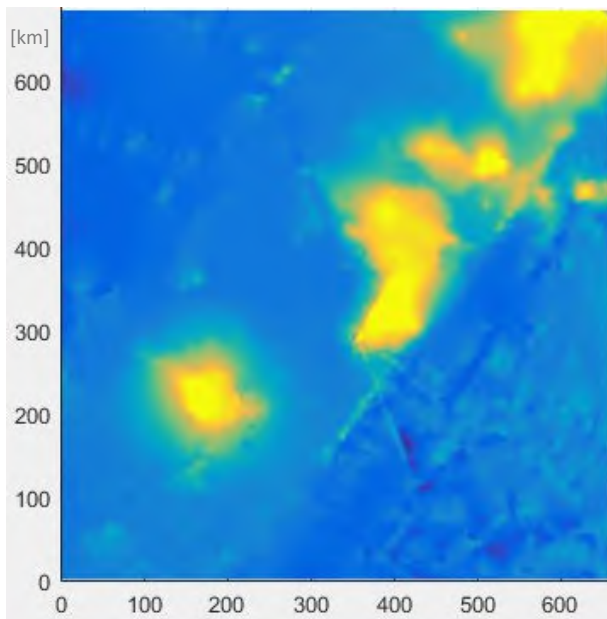
isardSAT

RMS
[meters]

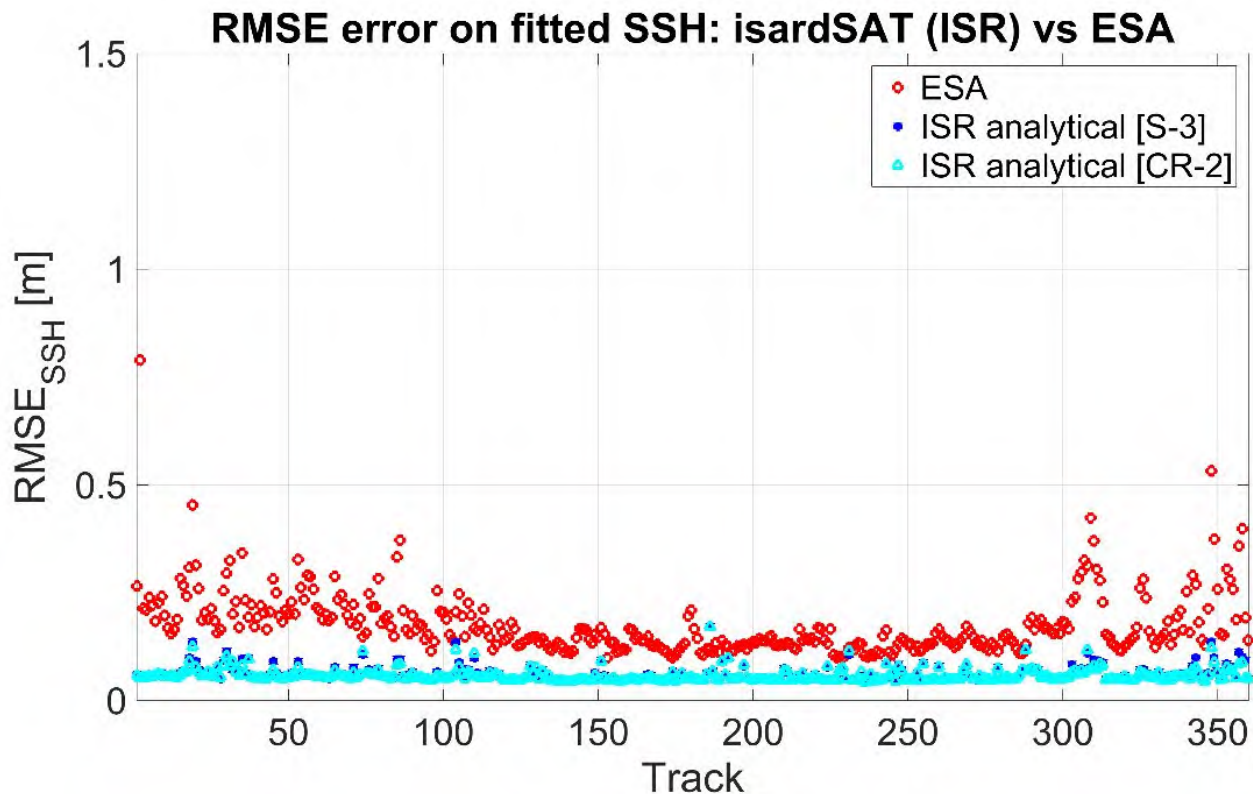


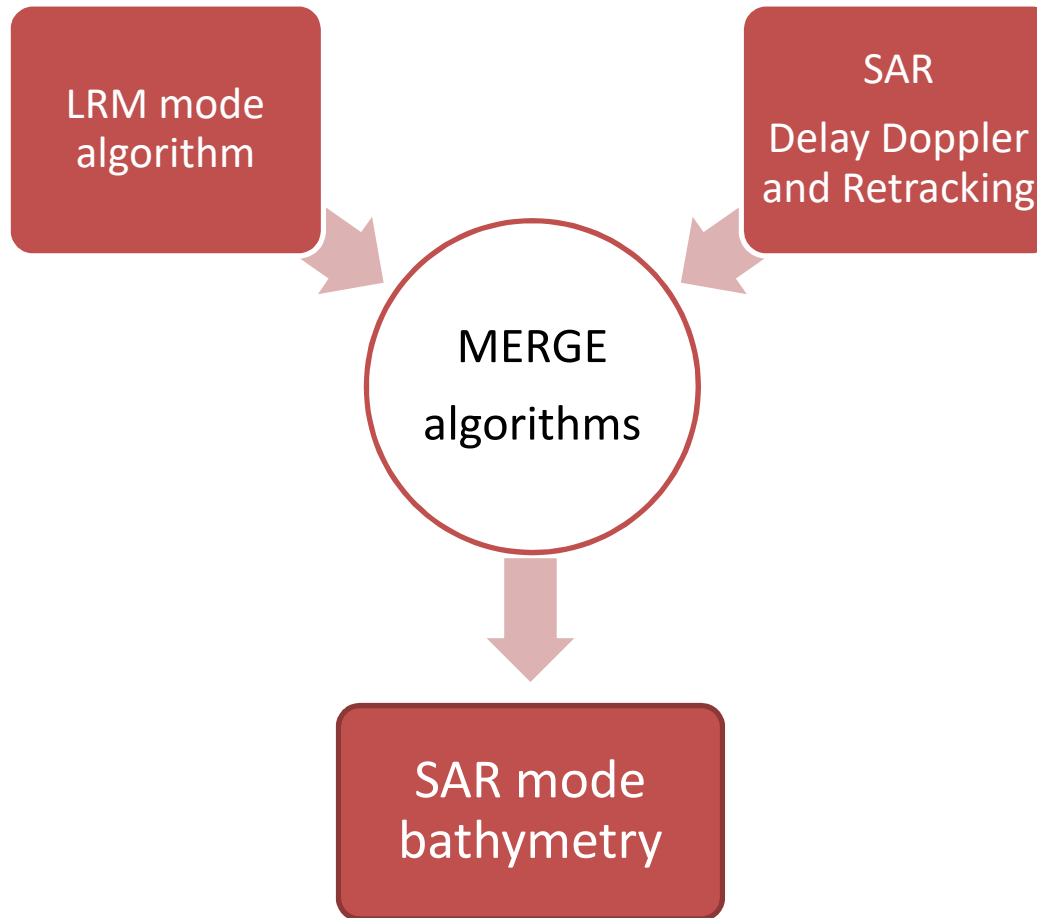
GEBCO

DTU



- Central Pacific
- RMSE against its fitted version





THANK YOU!

pau.galles@isardsat.cat

bernat.martinez@isardsat.cat

laia.romero@isardsat.cat