S3NG-T swath altimetry performance assessments with the CNES simulator RADARSPY

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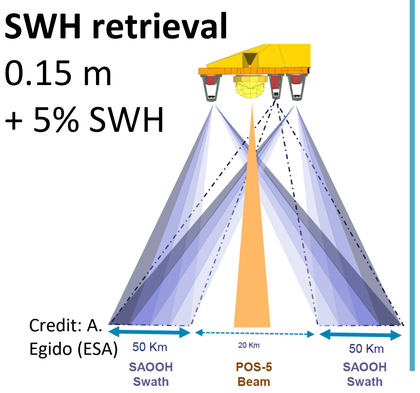
S3NG-T: an ESA operational <u>swath altimetry</u> mission

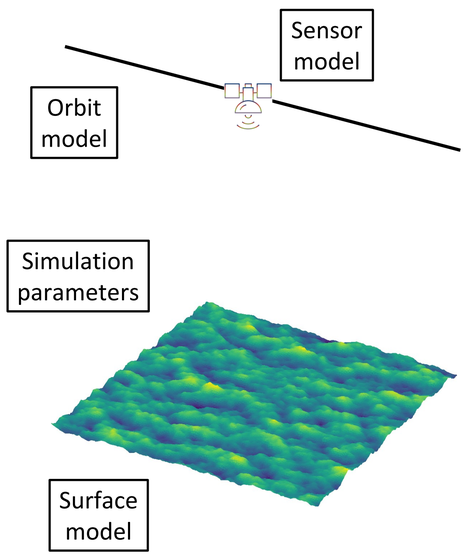
SSH random noise
< 10 cm @ 1x1 km²

SWH retrieval
0.15 m
+ 5% SWH

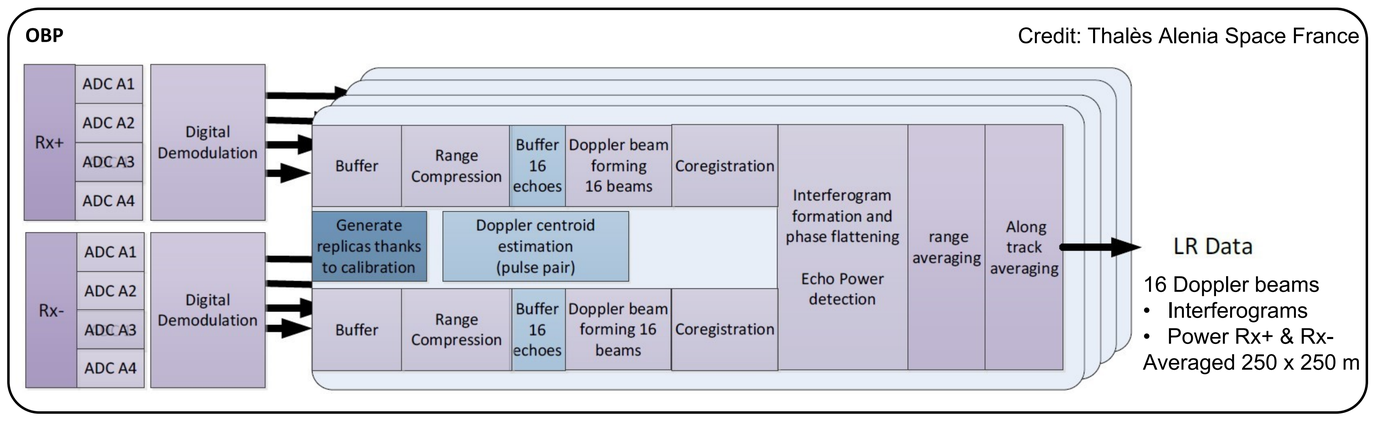


Radarspy

Simulation



Processing



Scenarii

Carrier frequency	35.7 GHz
PRF	10 kHz
Sampling frequency	250 MHz
Chirp bandwidth	200 MHz
Emitted power	1500 W
Pulse length	6.667 µs
Macroburst	192 pulses
Altitude	814.5 km

Noise factor	4.3 dB
T_eq ocean	204 K
T_ref	290 K
Loss Tx + Tx chain	2.68 dB
Loss Rx	0.88 dB
Atmospheric loss	1 dB
SNR margin	3 dB

SWH impact

Elfouhaily wind sea of SWH

0.5 m | 2 m | 4 m | 8 m

Swells

λ=500m, SWH=6m

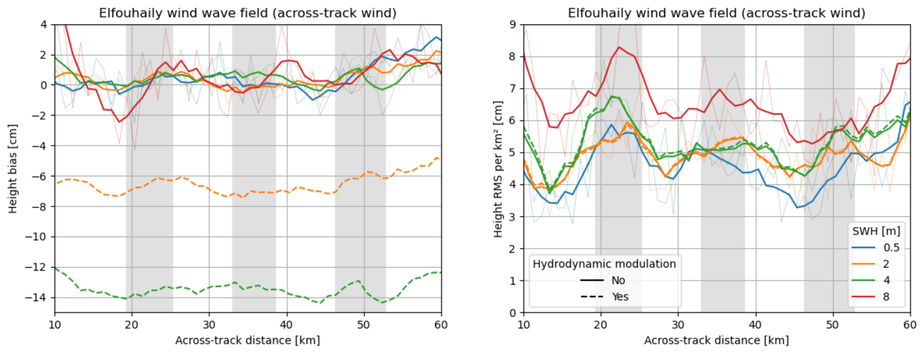
Hydrodynamic modulation

Add a $\Delta\sigma_0$ such that $\frac{\Delta\sigma_0}{\sigma_0} = -4\beta\frac{h-\bar{h}}{\mathrm{std}(h)}$

Sea State Bias **β = 0.035**

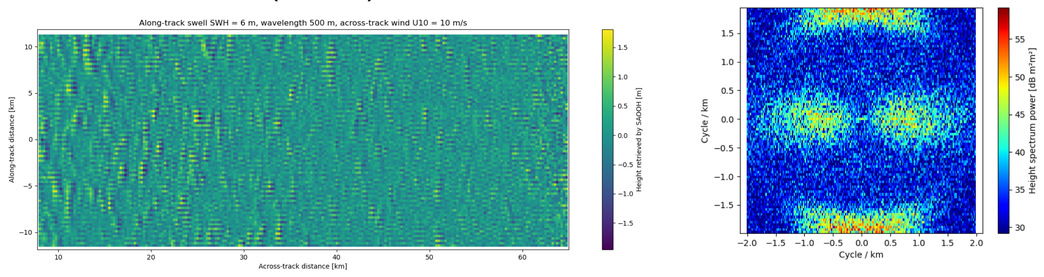
SSB = -β * SWH — 2 m | 4 m

Results: SSH retrieval



- Sea State Bias retrieved
- SSH random noise OK

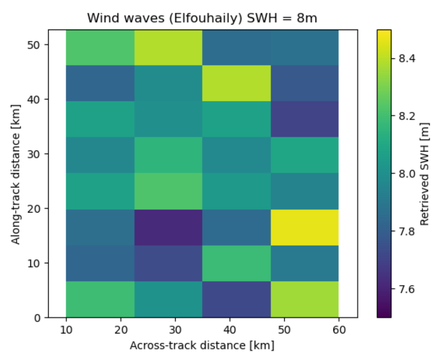
Resolved swell (500m)

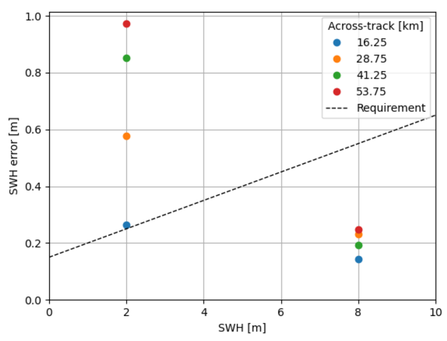


Results: SWH retrieval

Volumetric decorrelation from coherence γ_{tot}

- $\gamma_{tot} = \frac{I}{\sqrt{P_+P_-}}$, $\gamma_{vol} = \frac{\gamma_{tot}}{\gamma_{geom}\cdot\gamma_{noise}\cdot\gamma_{instr}}$
- $\gamma_{vol} = e^{-\frac{(2\pi\cdot\kappa\cdot SWH/4)^2}{2}}$ with $\kappa = \frac{b\cdot f_c}{c\cdot r\cdot\tan(\theta_{Earth})}\cdot\frac{H_{sat}}{H_{sat}+R_{Earth}}$



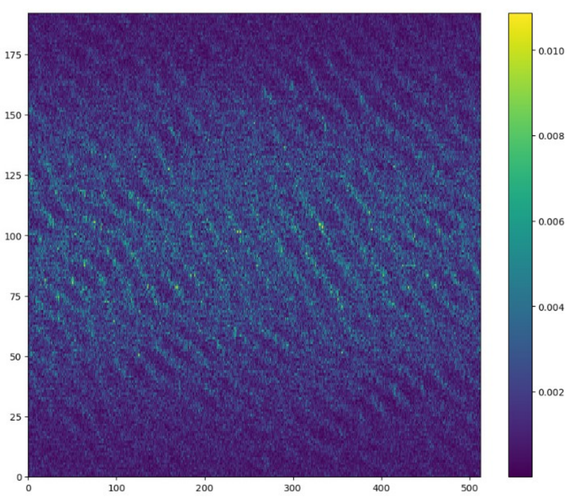


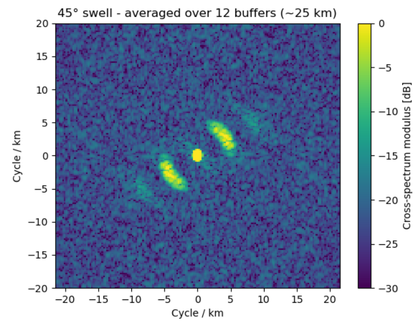
Performs well at high sea states

➢ Complementarity w/ nadir altimeter

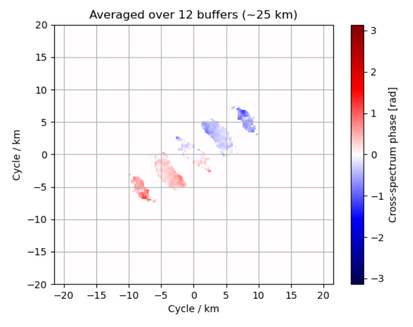
Wave mode

- Before/after cross-spectra of intensity
- Image extent ~ 4x4 km
- Posting: ~7.6 m (across-track) x ~20 m (along-track)
- Incidence angle ~ 4°
- Δt ~ 0.15 s (~1 km)
- Averaged over ~ 2 km





Cross-spectrum Modulus



Cross-spectrum Phase

a Sopra Steria company