First Saral/AltiKa results: Overview of the altimeter in-flight performances and comparison with the Ku-Band

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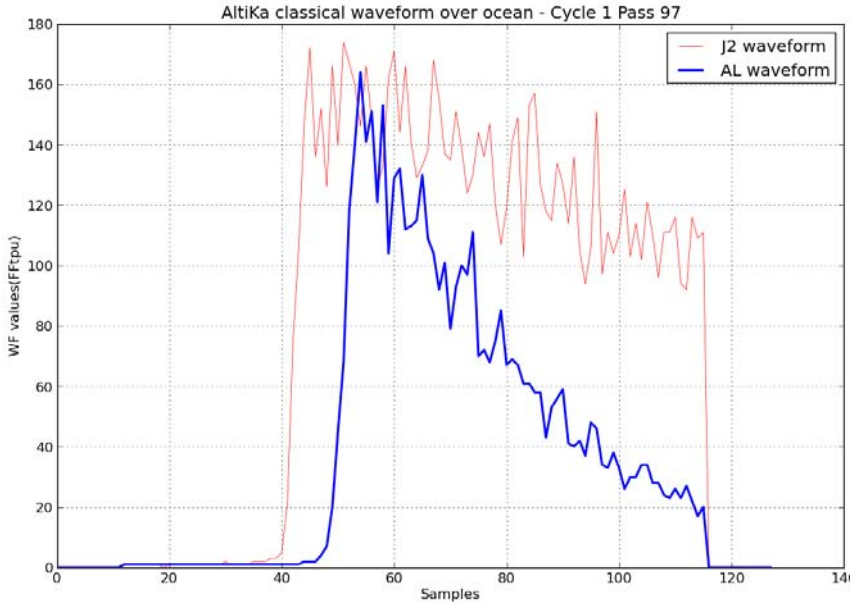
Summary

1. The Saral/AltiKa mission and altimeter characteristics
2. Performances of the AltiKa altimeter
3. Impact of rain cells on the AltiKa measurements
4. Ka-Band / Ku-Band : focus on the Sigma0, wind speed and the SSB

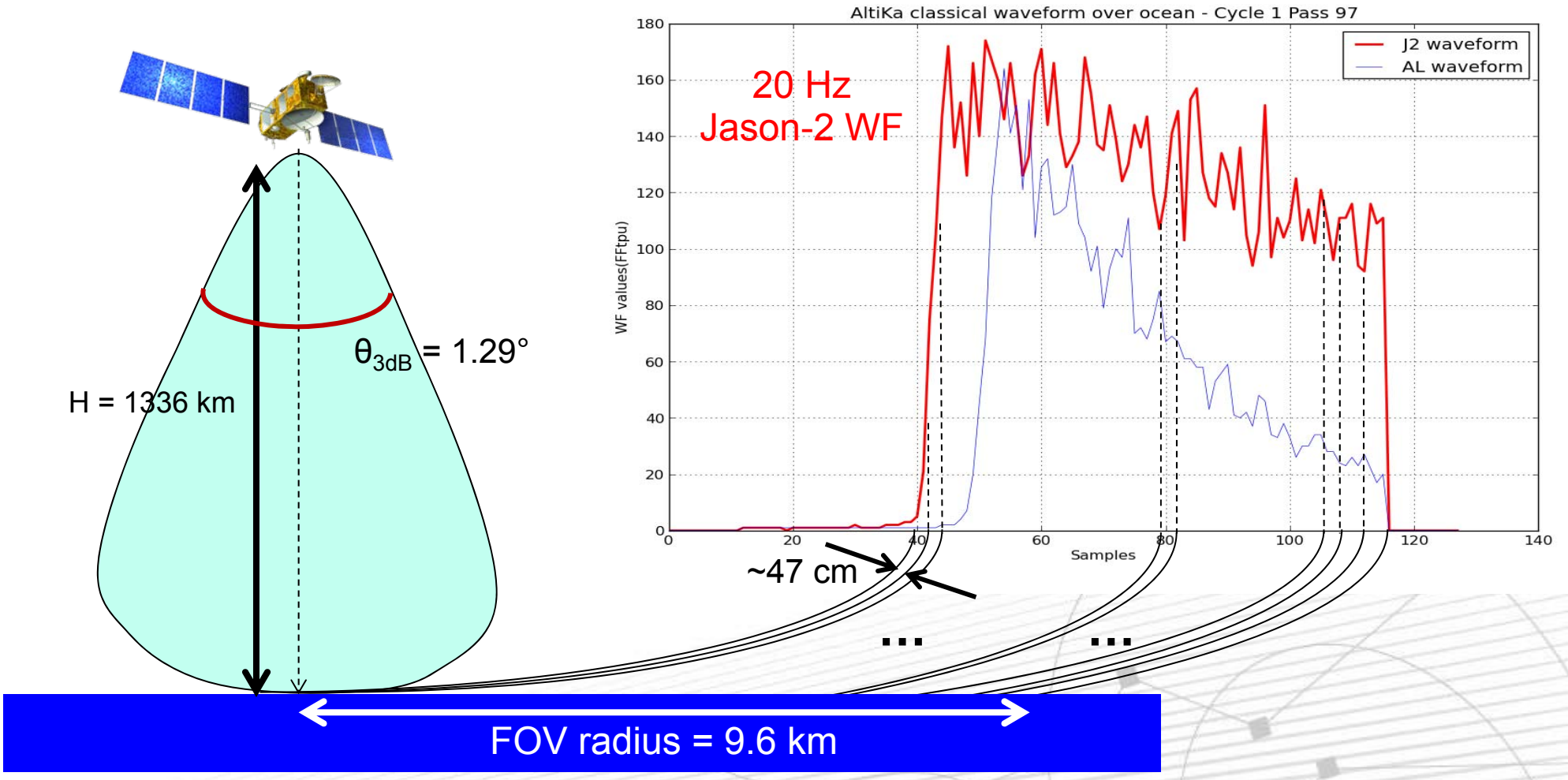
The Saral/AltiKa mission and altimeter characteristics

- Saral/AltiKa was launch on the **February 25th, 2013 @ 12:31:00** on the ENVISAT orbit.
- The AltiKa altimeter :
  - ✓ is the **first in-flight altimeter in Ka-Band** ➔ reduced ionosphere impacts ➔ Mono frequency instrument
  - ✓ has a higher bandwidth ➔ improved vertical resolution (~ 30 cm w.r.t. 47cm for J2)
  - ✓ operating at 4 KHz ➔ improved spatial sampling
  - ✓ has a smaller waveform footprint (5.7 km w.r.t. 9.6 km for J2) ➔ improved coastal approach
  - ? has higher sensitivity to atmospheric water

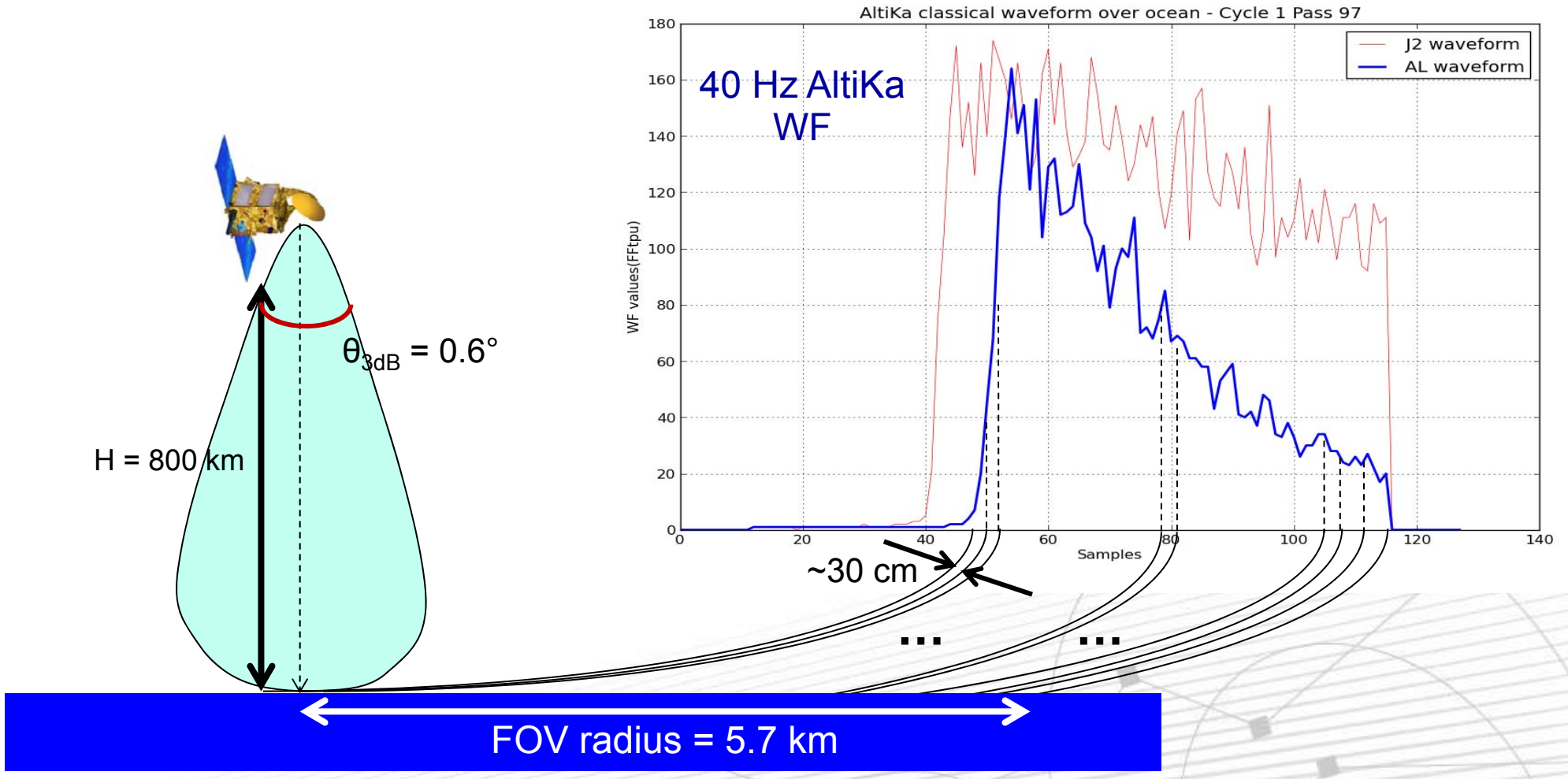
	AltiKa	Jason-2 (Ku)
Frequency	35.75 GHz	13.575 GHz
Bandwitdh	480 MHz	320 MHz
PRF	~4 KHz (variable)	2 KHz
Antenna Beam	0.6°	1.29°
WF rate	40 Hz	20 Hz



The Saral/AltiKa mission and altimeter characteristics



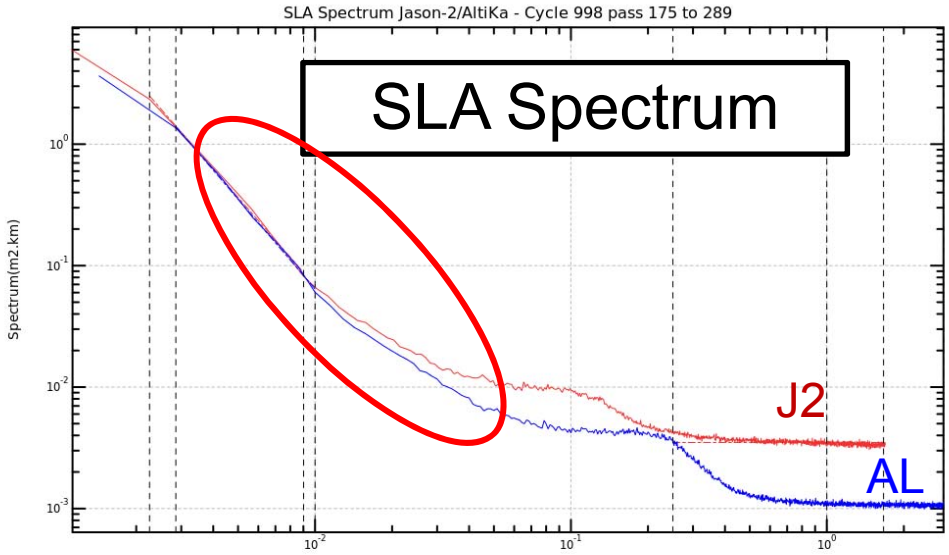
The Saral/AltiKa mission and altimeter characteristics

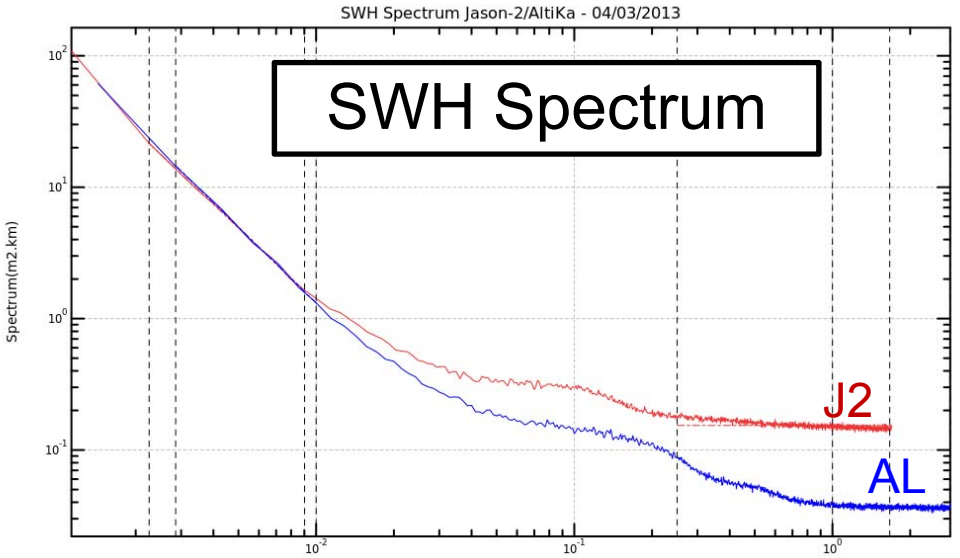


- The combination of the **the higher PRF, higher bandwith and consequently a smaller waveform footprint** allows SARA/AltiKa to have **better performances than Jason-2**.

Performances of the AltiKa altimeter (1/2)

- The MLE-4 retracker implemented in the ground segment combined to the excellent quality of the altimeter measurements provide very good performances on each geophysical estimate (cf N. Picot's talk on the CalVal results).





AltiKa **SLA** Noise @ 40 Hz = 5.5 cm

Jason-2 **SLA** Noise @ 20Hz = 7.7 cm

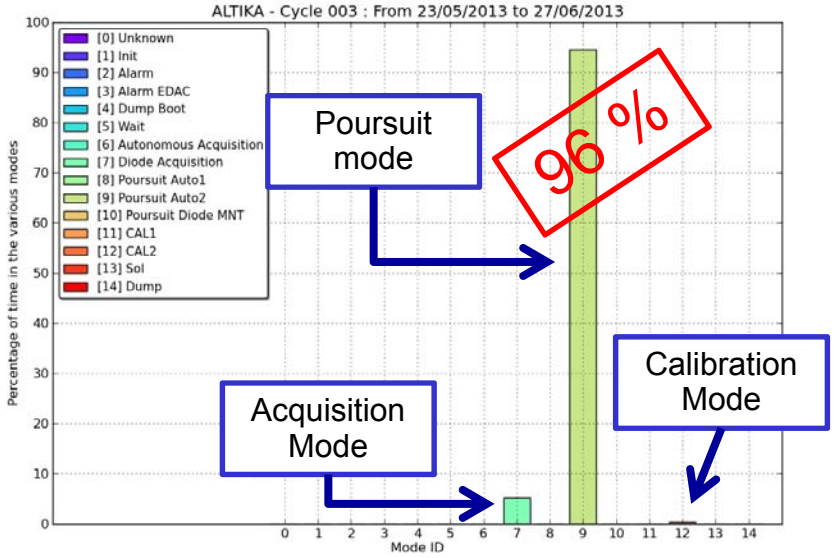
AltiKa **SWH** Noise @ 40 Hz = 50.9 cm

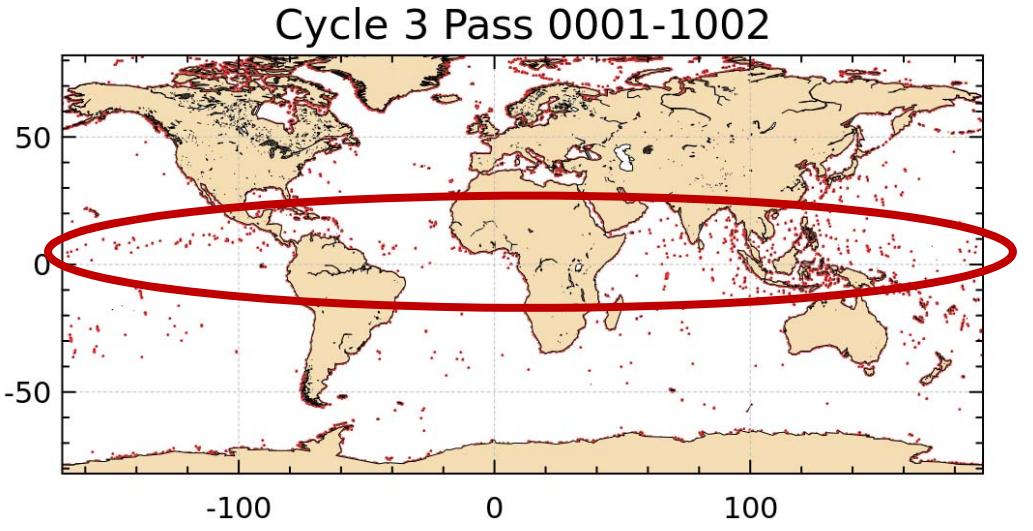
Jason-2 **SWH** Noise @ 20Hz = 32.4 cm

- The linear energy cascade of the SLA spectrum is better fitted by AltiKa (wavelength > 50 km) than Jason-2 (wavelength > 90 km)
- Spectral hump still present but shifted to shorter wavelength (mainly due to the smaller waveform footprint) ➔ **Notice that this hump can be reduced by an appropriate editing and/or more clever processing technics** (See P. Thibaut/G. Dibarboure talk in the errors session).

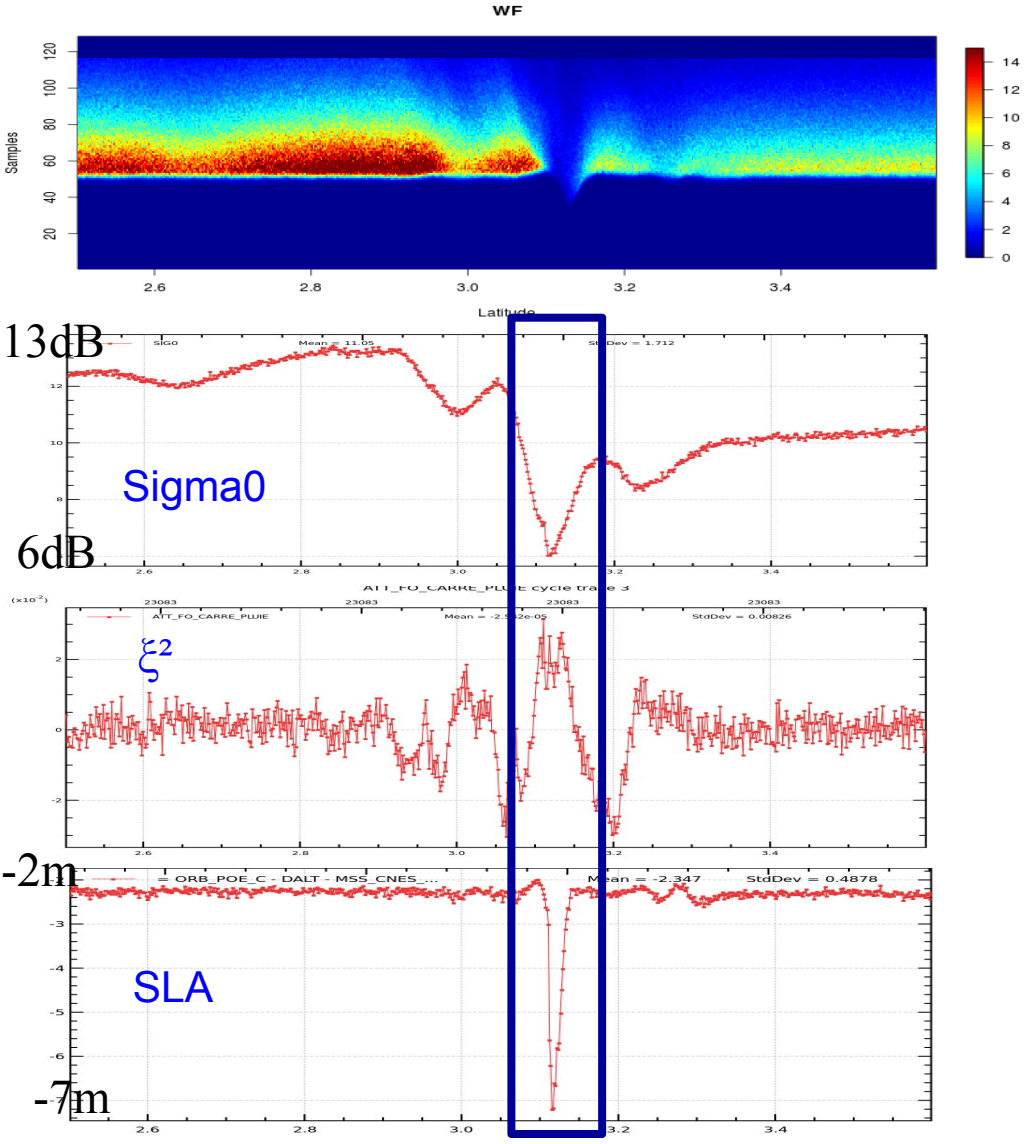
Performances of the AltiKa altimeter (2/2)

- AltiKa has the same tracking mode as Jason-2 which provides very good geographical coverage: **Median tracker mode**
- The altimeter acquires data **96 % of the time** (all surfaces combined)
- **Data lost** due to rain **over ocean** is lower than anticipated **< 0.1%** thanks to margins into the link budget**.**

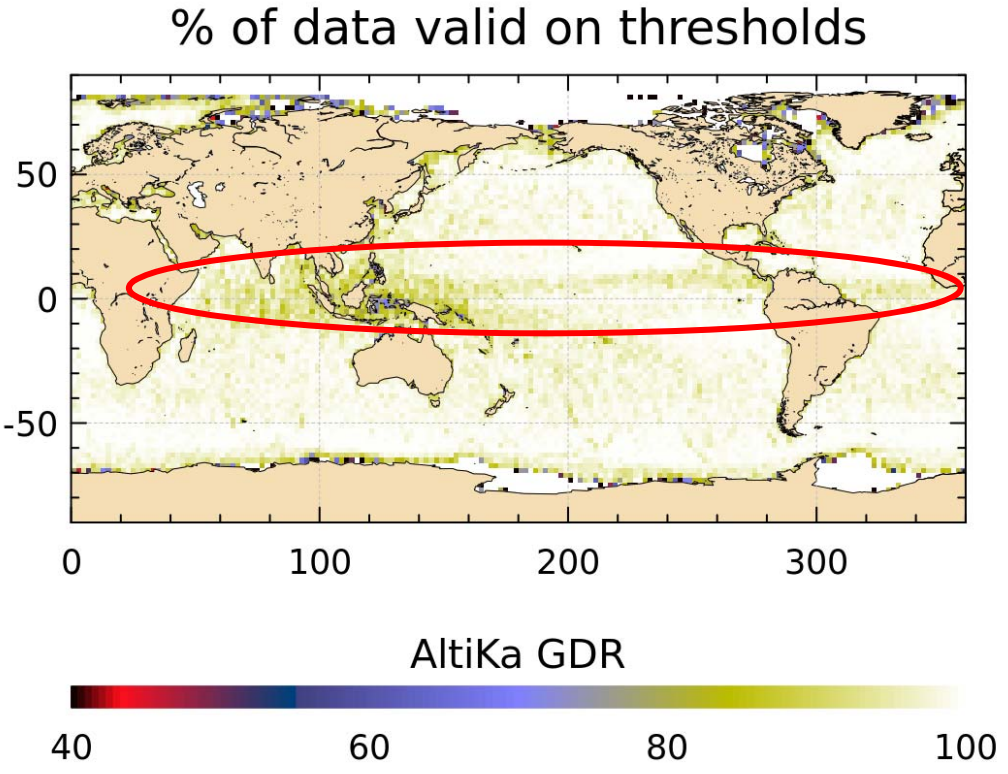




Impact of rain cells on the AltiKa measurements

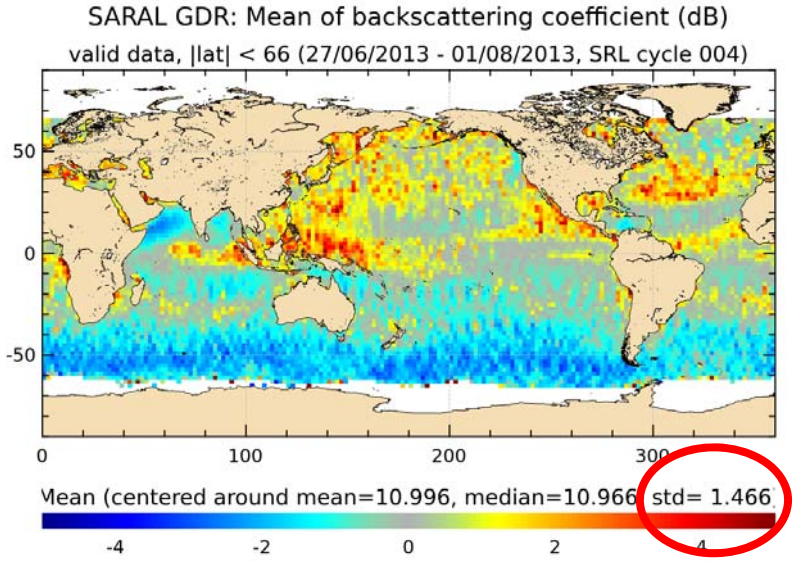


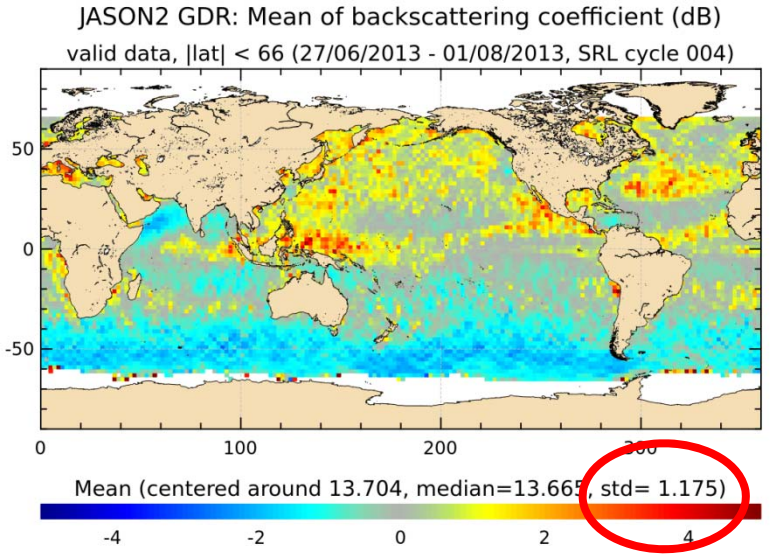
- Rain cells impact measurements (strong attenuation + waveform shape perturbation) but very locally mainly due to the small size of the waveform footprint.

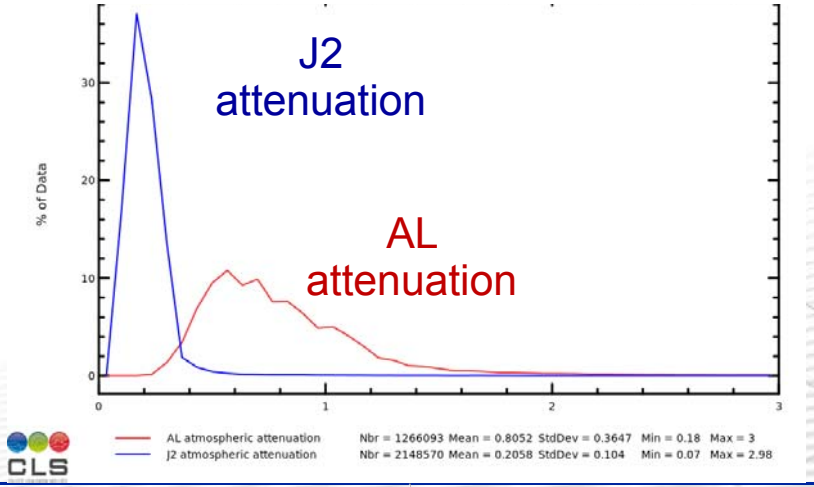


Ka / Ku Band : Focus on sigma0 (1/3)

- In flight assessment : $\sigma 0_{Ka} = \sigma 0_{Ku}$ [Jason] – 2,5 dB





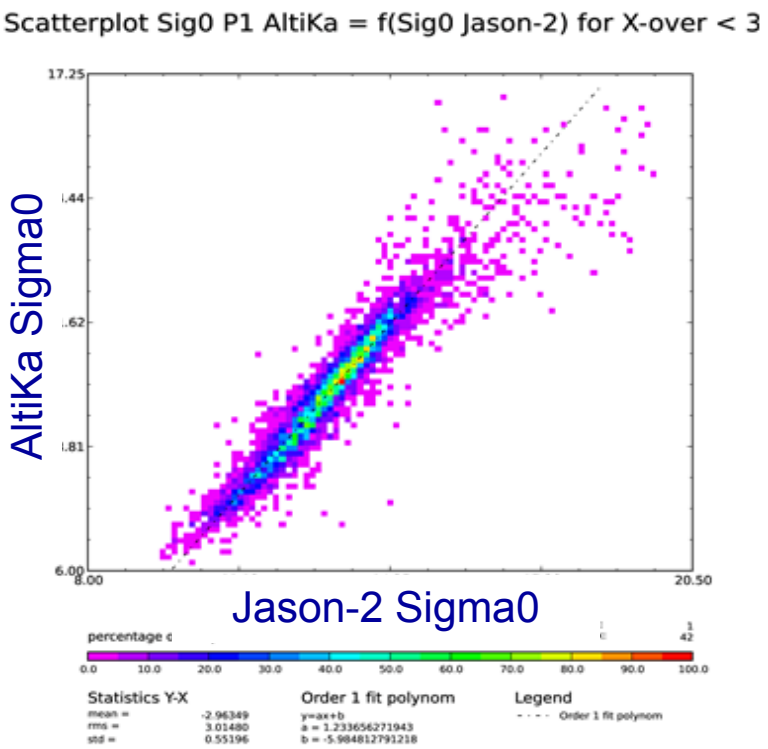


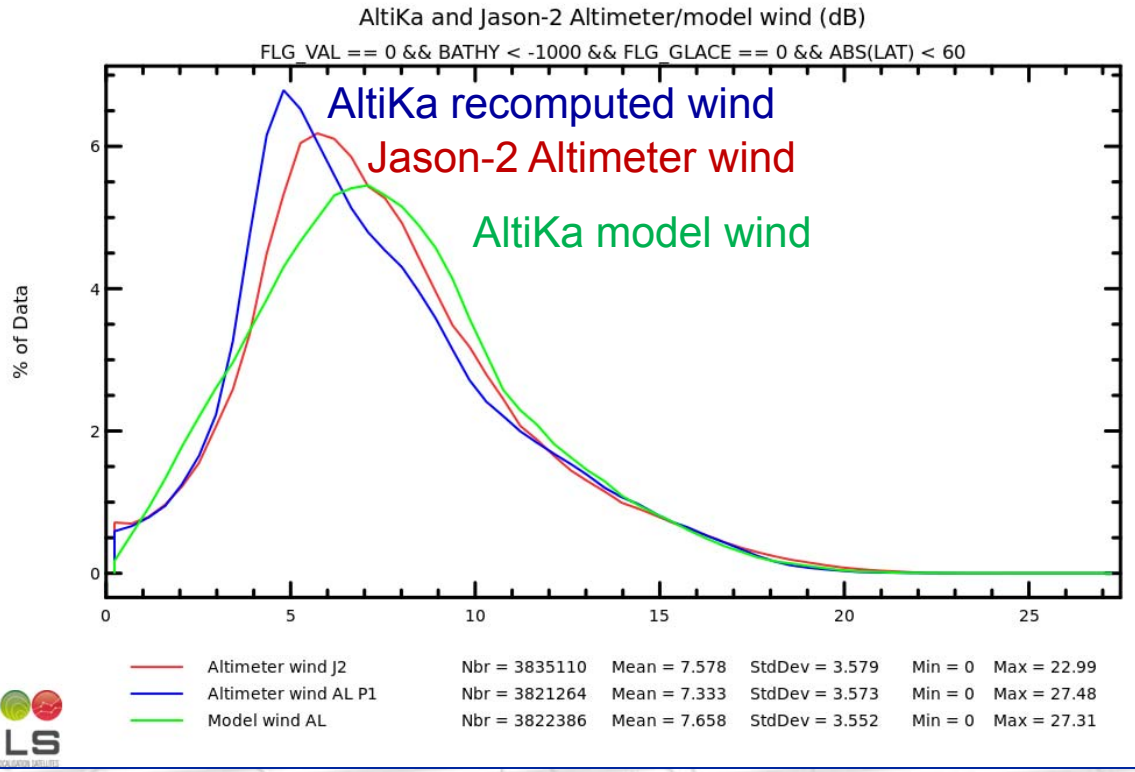
- Atmospheric attenuation is currently around 0.8 dB in the AltiKa GDR products w.r.t. to 0.2 dB for Jason-2 ➔ slightly lower than expected (~ 1 dB) but an update of this correction will be applied with the Patch 2 (See E. Obligis talk)

Ka / Ku Band : Focus on sigma0 (2/3)

- GDR Sigma0 scatterplot between AltiKa and Jason-2 made from crossovers < 3h shows an almost linear dependency.
- Computation of an altimeter wind through the Collard algorithm (used in Jason-2) with a recalibrated AltiKa sigma0 on a Jason-2 Sigma0 using a linear regression demonstrates that **the wind / sigma0 / SWH relation has to be recomputed for the Ka-Band**.

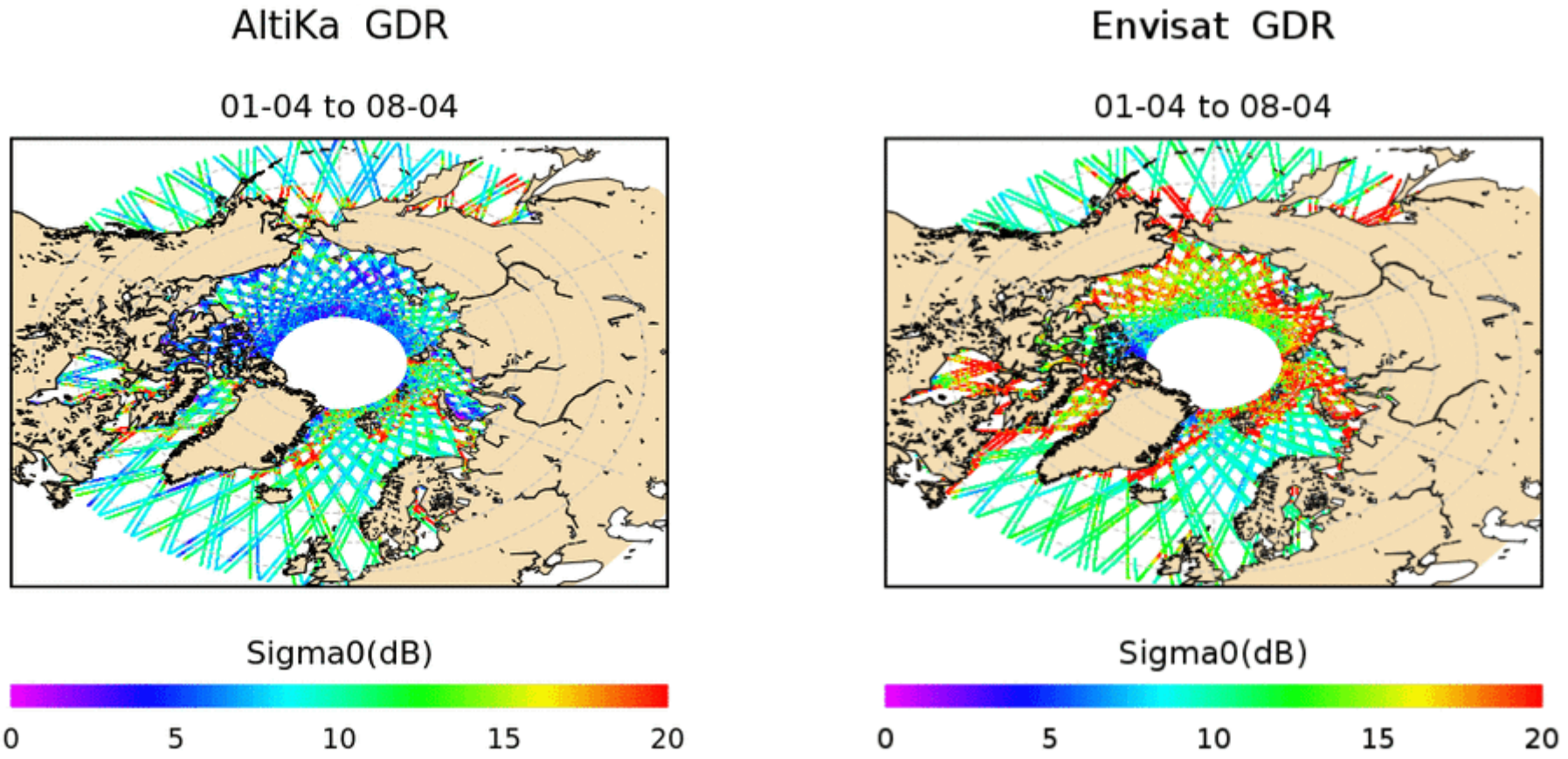
➔ This will be done in 2014 through colocation with ASCAT wind speed measurements.





Ka / Ku Band : Focus on sigma0 (3/3)

- Focus Sigma0 Ku / Ka on the artic ocean and sea ice ➔ Different behavior in Ka / Ku band on sea ice : $\sigma 0_{Ka} < \sigma 0_{Ku}$ over sea ice.



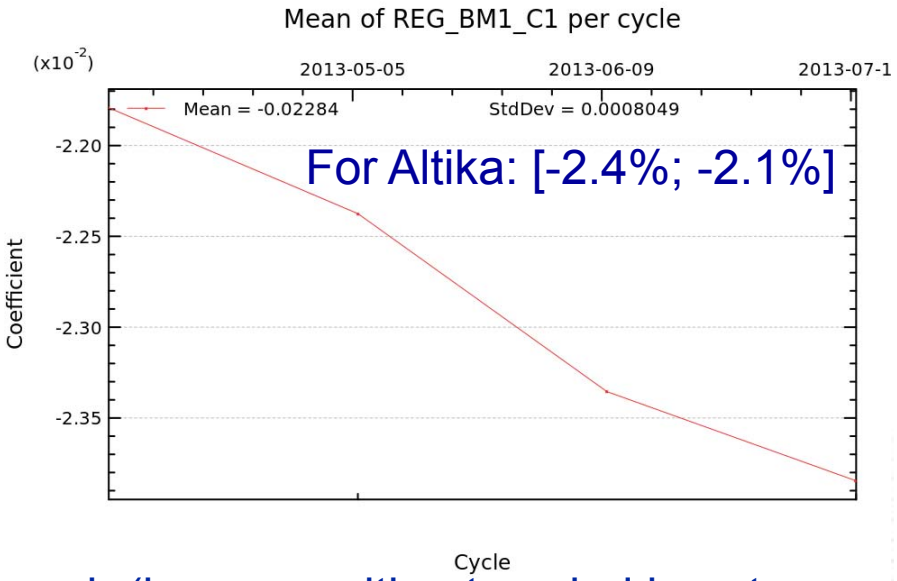
Ka / Ku Band : Focus on SSB (1/2)

- From literature, the SSB in Ka-band at the first order (SWH dependency) is expected to be < than the Ku Band SSB.

- The computation of a 1 parameter SSB model (BM1) on the same period verifies it :

$$SSB_{Ka}(SWH) < SSB_{Ku}(SWH)$$

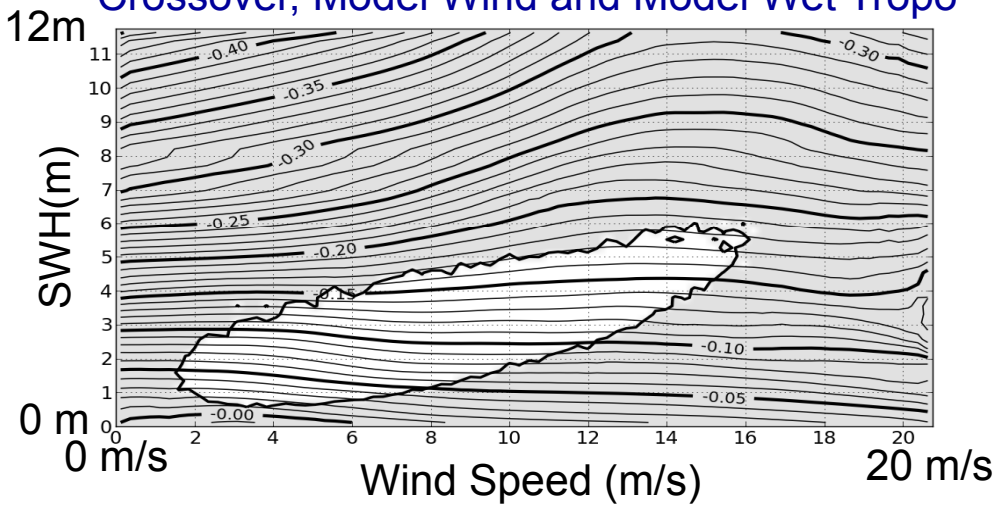
2.28% < 3.07%

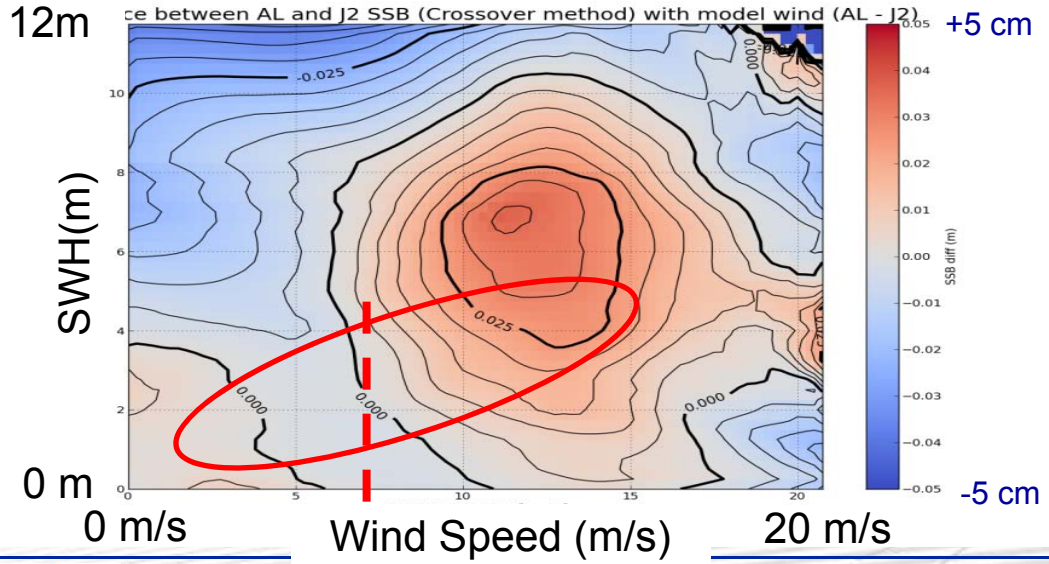


- In order to compare a 2-parameter SSB (SWH, Wind) between Ka and Ku-Band, a Crossover method is performed:
  - 4 first cycles of AltiKa GDR
  - ECMWF model wind is used for a first approach (because altimeter wind is not currently tuned in AltiKa GDR products)
  - Model wet tropospheric correction is taken into account because the radiometer one is not optimized
  - A Jason-2 SSB is recomputed with the same method on the same period in order to compare the results
  - **A strict editing is performed on the 2 missions** in order to have only "Brownian" ocean conditions.

Ka / Ku Band : Focus on SSB (1/2)

SSB AL cycle 1 to 4
Crossover, Model Wind and Model Wet Tropo





- The computed **SSB solution for AltiKa is similar to the Jason-2 one for wind < 7 m/s.**
  For wind > 7 m/s, $|SSB_{Ka}| < |SSB_{Ku}|$

- This is a preliminary solution on only 4 cycles of data.
  A more complete solution will be computed on 1 year of data to take into account seasonal variations of SWH and winds. It will use also an optimized radiometer wet tropospheric correction (will be included in future GDR Patch 2/ Patch 3) and a fine tuned altimeter wind.

Conclusions

- **AltiKa altimeter has a very good behavior**, is stable and provides high precision measurements (better than Jason-2)
  - **AltiKa SLA noise @ 40Hz ~ 5.5 cm** < Jason-2 SLA noise @ 20Hz ~ 7.7 cm

- **In flight SNR is better than expected** because of margins in the link budget ➔ very few data are lost due to atmospheric attenuation.

- **$\sigma 0_{Ka} = \sigma 0_{Ku}$ [Jason] – 2,5 dB** and has a different behavior from the Ku Band.
  - $Std(\sigma 0_{AltiKa}) > std(\sigma 0_{Jason\text{-}2})$
  - Relation between altimeter wind and [SWH, Sigma0] has to be recomputed

- At the first order, **SSB in Ka Band has a lower SWH dependency**. Preliminary results show that the SSB in Ka-Band seems to be less sensitive to the high winds than the Ku-Band:
  - **$SSB_{Ka} \sim SSB_{Ku}$ for winds < 7 m/s**
  - **$SSB_{Ka} < SSB_{Ku}$ for winds > 7 m/s**

Thank you for your attention