

ALTIKA ALTIMETER

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DESJONQUERES

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AltiKa : a new concept

■ First Altimeter in Ka-band

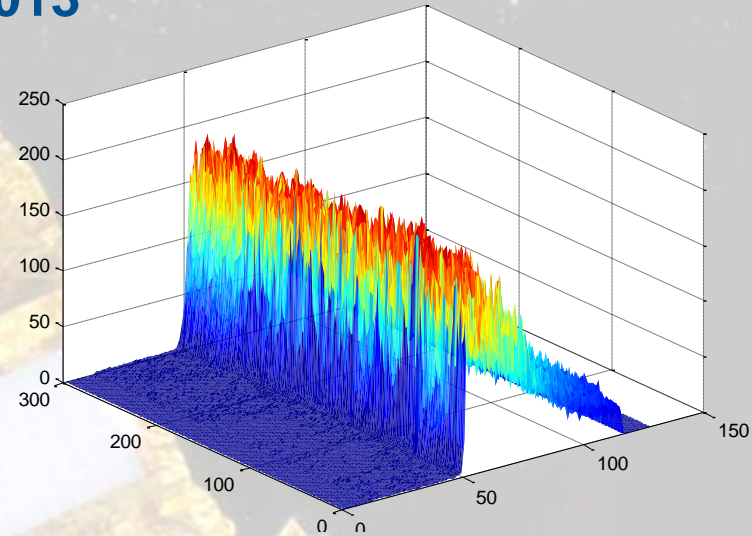
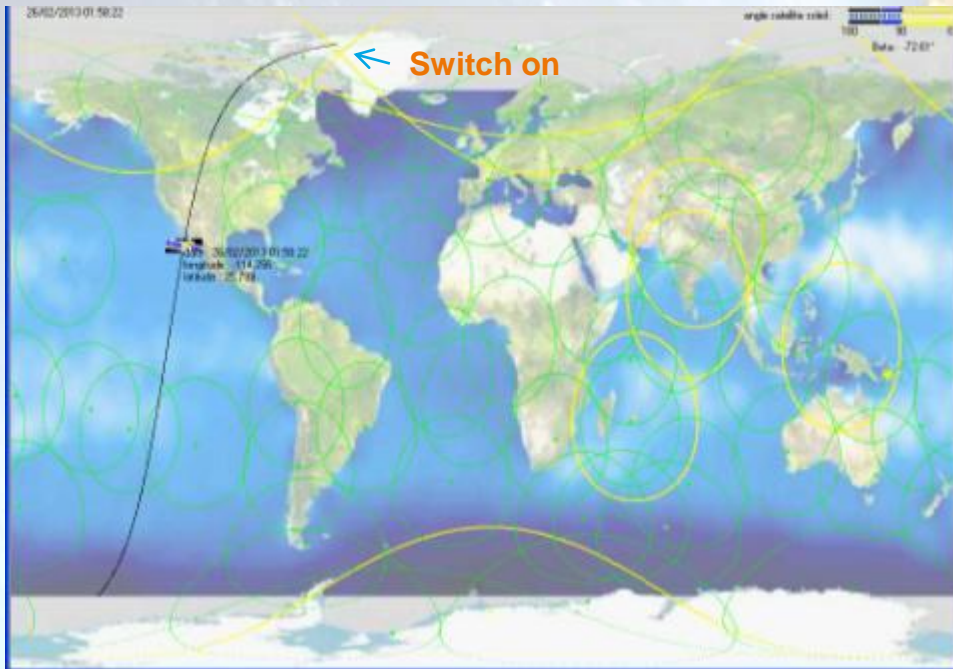
■ Single frequency Ka-band altimeter with an enhanced bandwidth

- ◆ reduced ionosphere effects authorizes mono-frequency altimeter (7 times lower than Ku band)
- ◆ 480 MHz bandwidth : better vertical resolution => error budget improvement
- ◆ Ka-band and increased PRF (4 KHz) : improved spatial resolution and reduced 1Hz noise
- ◆ Smaller footprint
- ◆ Ka-band limitations : sensitivity to atmospheric water content

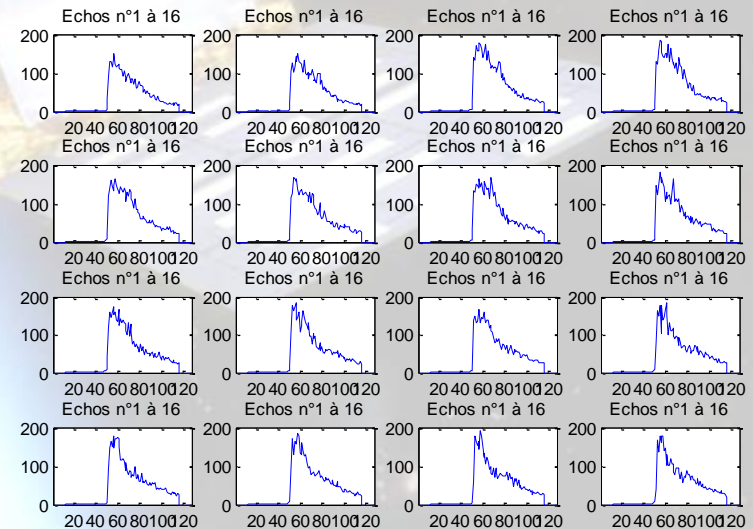
SARAL – First in flight AltiKa altimeter measurements 26th of February 2013

AltiKa switch ON : 01h42min UTC

Position on orbit of the first acquired
Altimeter data



Some waveforms above the sea



In flight assessment phase : altimeter activities

□ Calibrations

- ✓ In routine 3 calibrations per day (PTR and LPF)
- ✓ 20-March-2013 : Succession of PTR during 200 minutes
- ✓ 27-March-2013 : Expertise LPF (long acquisition)
- ✓ Several gain steps calibrations :
 - ALK CNG I²+Q² on 11th of April
 - ALK CNG I&Q on 14th of April
 - ALK CNG I²+Q² on 17th of April
 - ALK CNG I&Q on 20th of April
 - ALK CNG I&Q on 16th of July
 - ALK CNG I²+Q² on 17th of July

In flight assessment phase : altimeter activities

□ Tracking modes

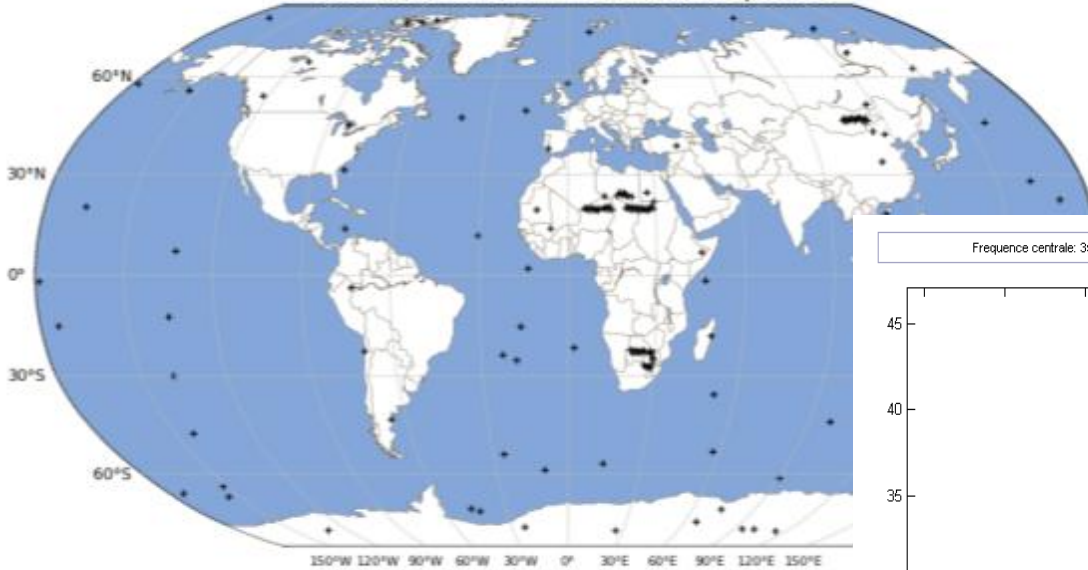
- ✓ Cycle 0 start on 12-March-2013 at 20:07:31 and will not be processed at level 2 (last less than 2 days)
- ✓ Cycle 1 start : 14-March 05:39 - 5 sub cycles in different tracking configurations
 - 14/03 → 21/03 : Diode Acq – Median tracker
 - 21/03 → 27/03 : Diode Acq – EDP tracker
 - 28/03 → 03/04 : Diode Acq – Median tracker
 - 04/04 → 10/04 : Diode+DEM
 - 10/04 → 17/04 : Diode Acq – EDP tracker
- ✓ HD : burst data

- ✓ Cycle 2 : Diode Acq – Median tracker (18/04 → 23/05)
- ✓ Cycle 3 : Diode Acq – Median tracker and EDP tracker from June, 6th to June, 20th
- ✓ Cycle 4 : Diode Acq – Median tracker (27/06 → 01/08)
- ✓ Cycle 5 : Diode Acq – Median tracker (01/08 → 05/09)
- ✓ Cycle 6 : Diode Acq – Median tracker (05/09 → 10/10)

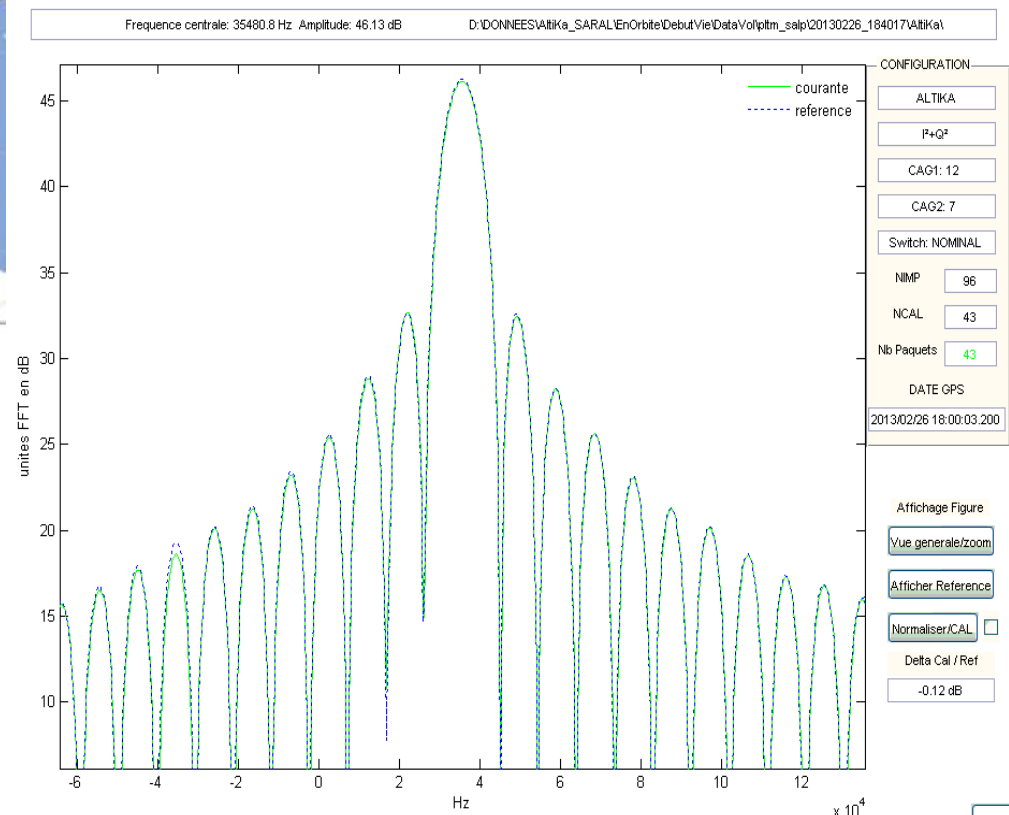
□ Cross maneuvers

Routine calibrations : PTR

ALTIKA - Cycle998 : From 26/02/2013 to 23/04/2013
Localisation of the PTR calibration sequences



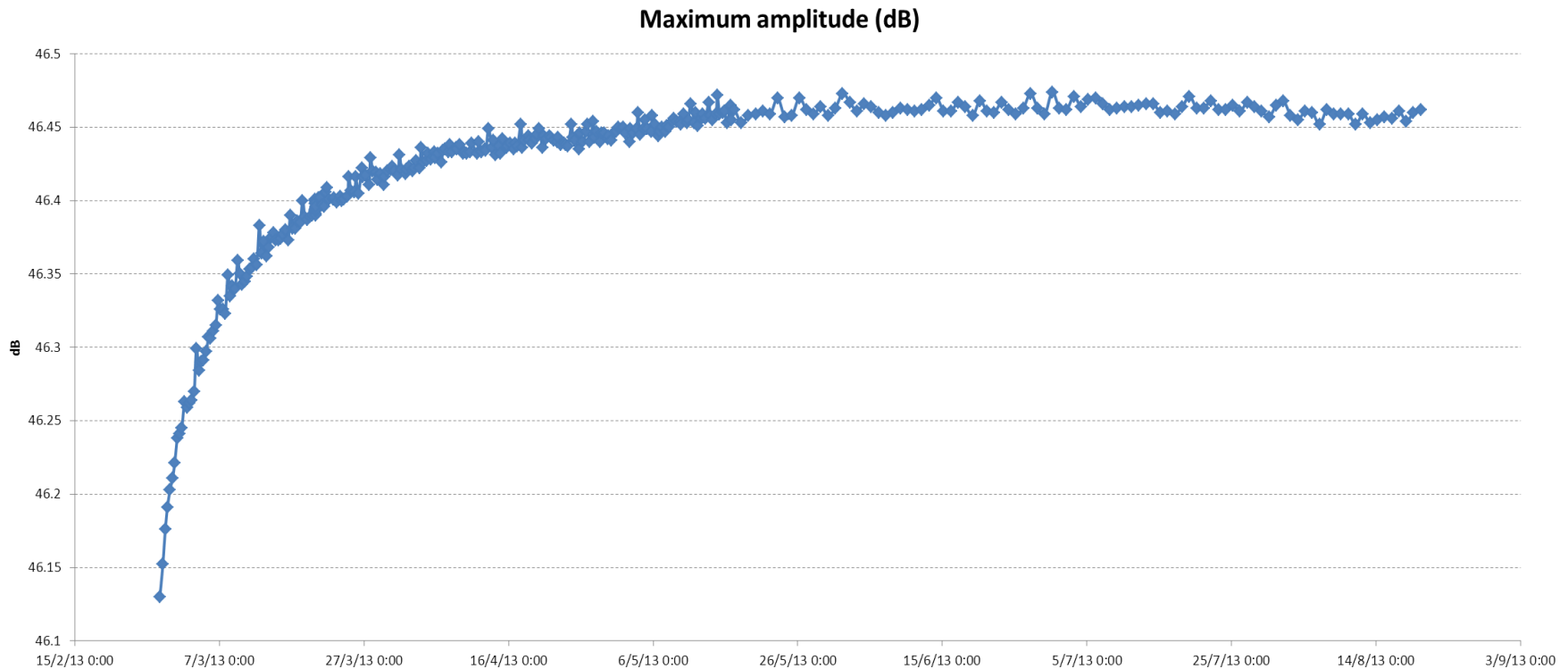
First in-flight AltiKa calibration



PTR analysis

Routine PTR : Expected evolutions

In the ground processing (P1) PTR parameters are averaged on 3 days basis to reduce the noise

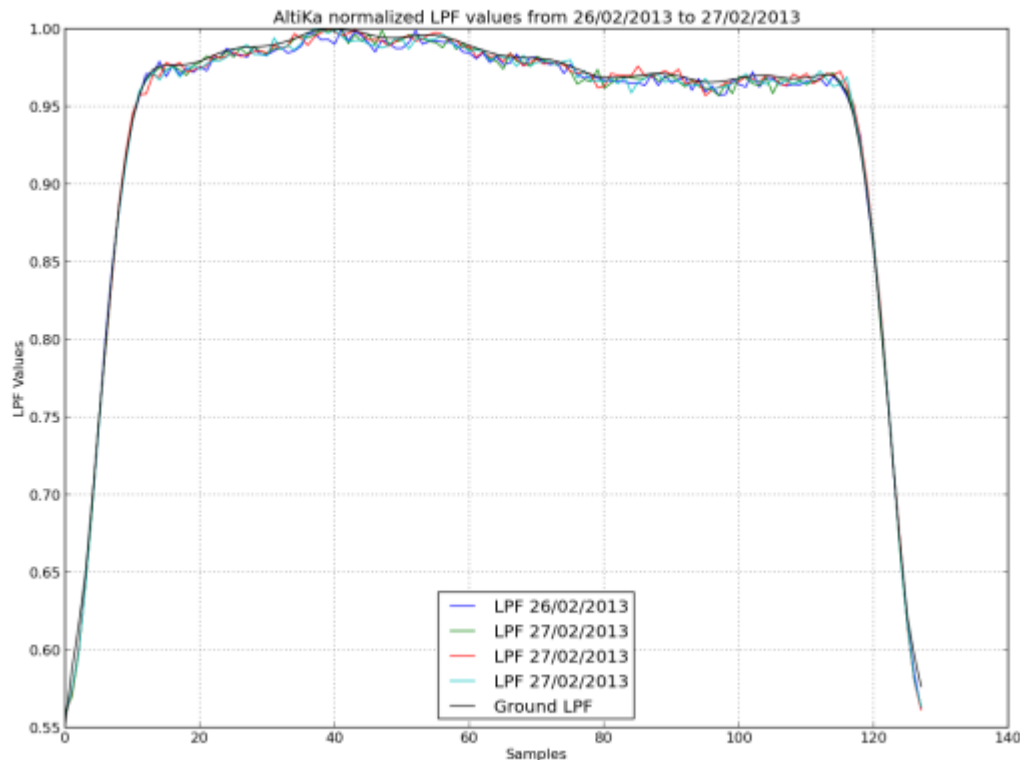


LPF analysis

Routine LPF : Very good stability since launch

Example : first data

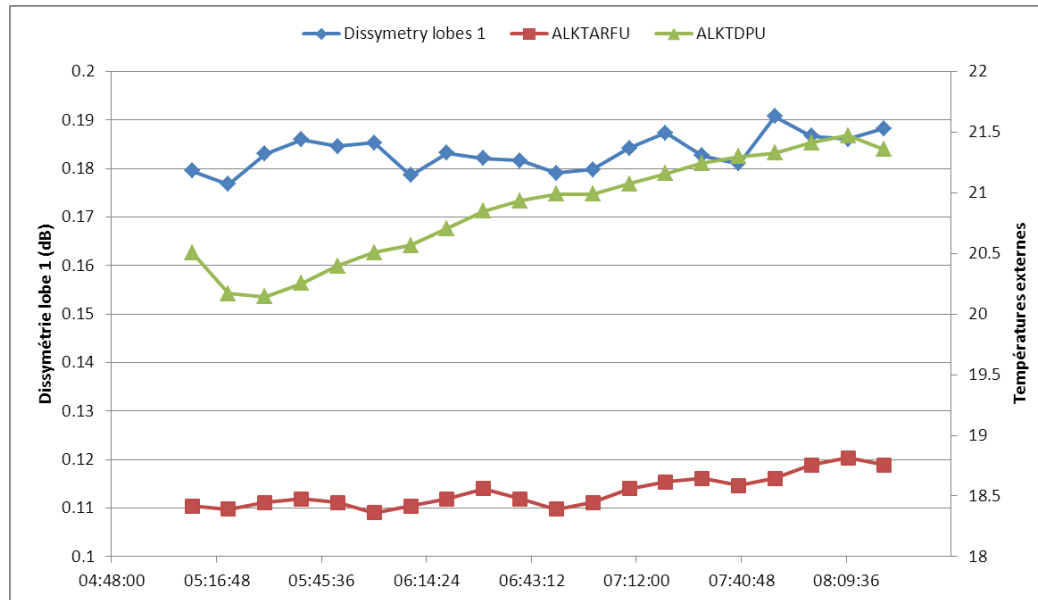
In the ground processing (P1) LPF parameters are averaged on 7 days basis to reduce the noise



Expertise calibrations : 200 min PTR

Objective : to assess the altimeter stability within temperature range

Principle = 1 calibration in both I^2+Q^2 and I&Q modes every 10 minutes during 200 minutes



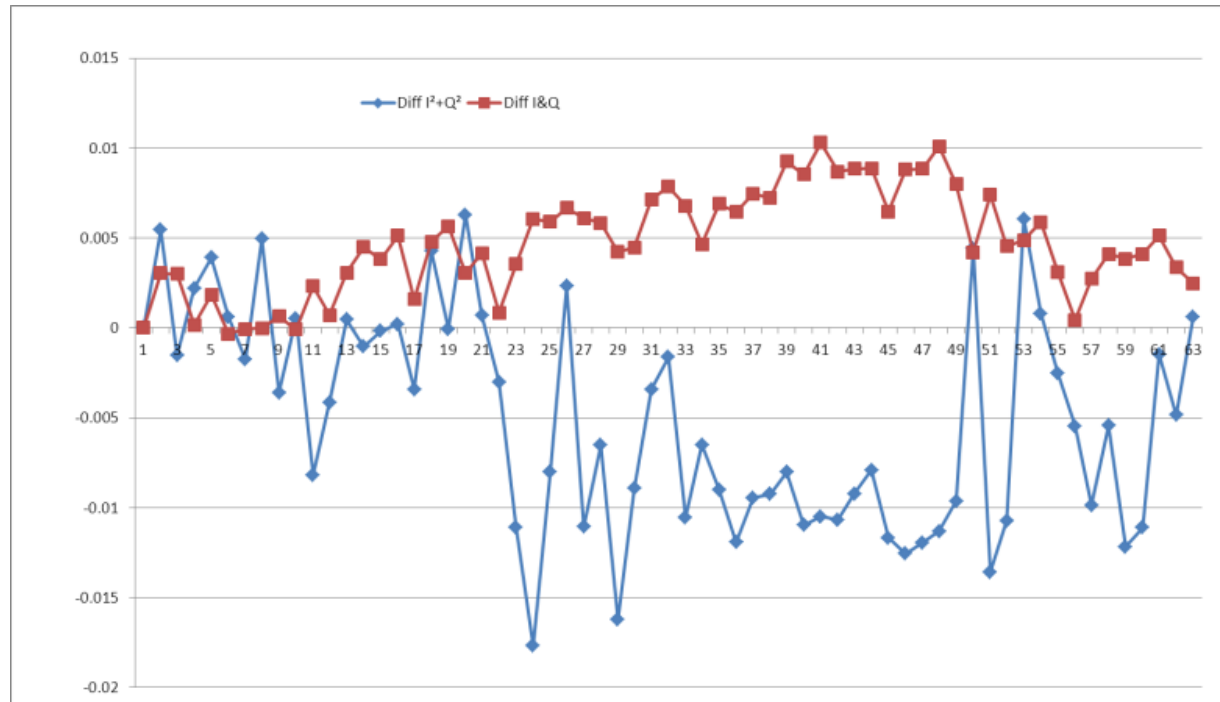
Example : value of first secondary lobe dissymmetry

Conclusion :

- Very good stability of the PTR characteristics : instrument stability is estimated at 0,03 mm
- No need to change the thermal control, T variability has no impact on the PTR
- I&Q PTR are a little less noisy
 - from September I&Q PTR will be performed systematically in addition to I^2+Q^2
 - I&Q PTR might be used in the future instead of I^2+Q^2

Expertise calibrations : CNG

Objective : to estimate the 62 gain steps values (2 commandable amplifiers on board)
CNG cal performed in each I²+Q² and I&Q modes to assess stability and noise



- Very good stability (of the order of 0.01 dB !!). Better in I&Q
- Will be performed every 3 months in I&Q in routine and the values will be updated in the altimeter characterization file

Range Trackers

Acquisition: 2 Modes

- ◆ Autonomous Acquisition: OK
- ◆ Diode Acquisition : OK and Faster, also used on Jason-2 – used as soon as Diode has converged

Algorithms in Autonomous Tracking Mode:

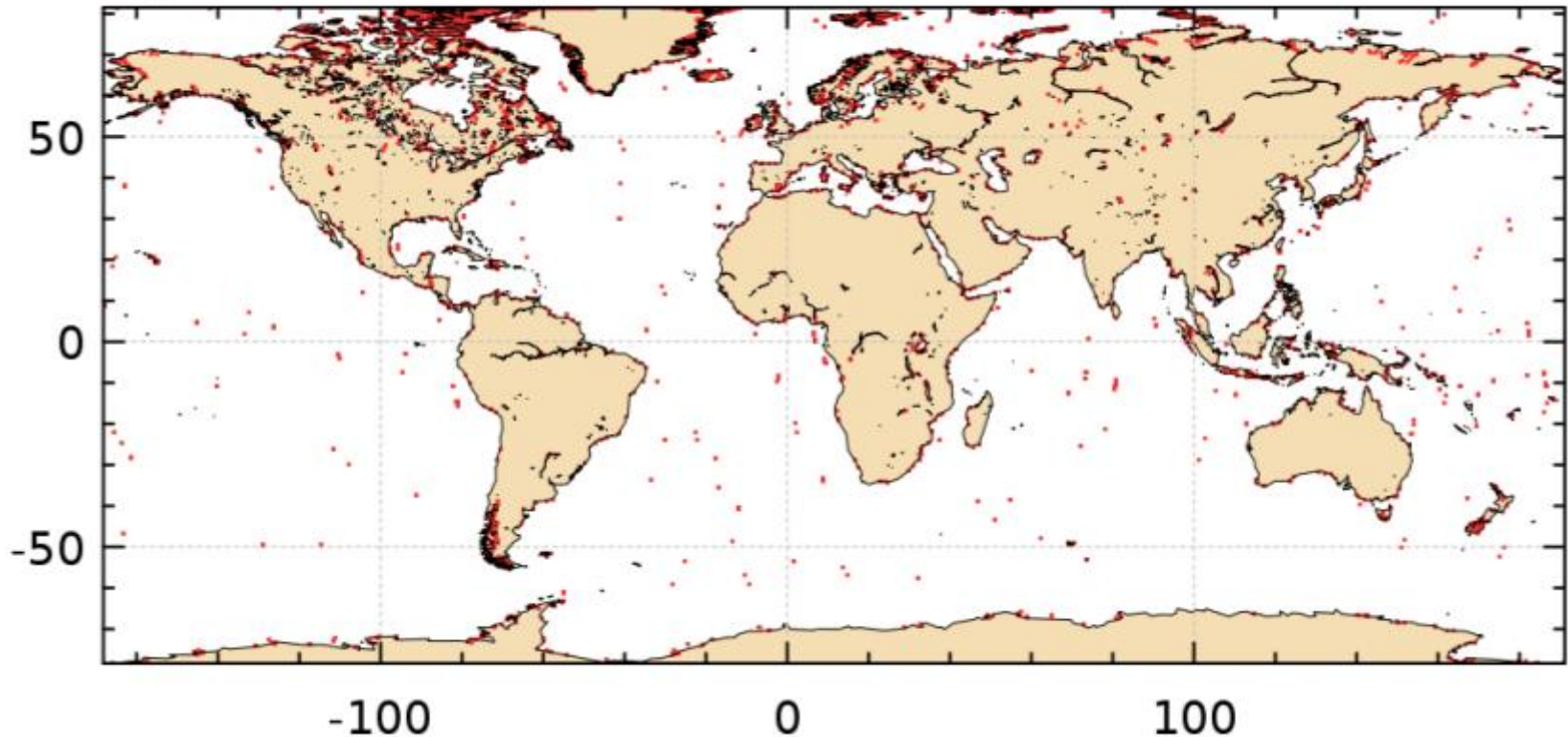
- ◆ Median
- ◆ EDP (Earliest Detectable Part)

Diode/ MNT: Coupling the navigator data with a Onboard DEM File

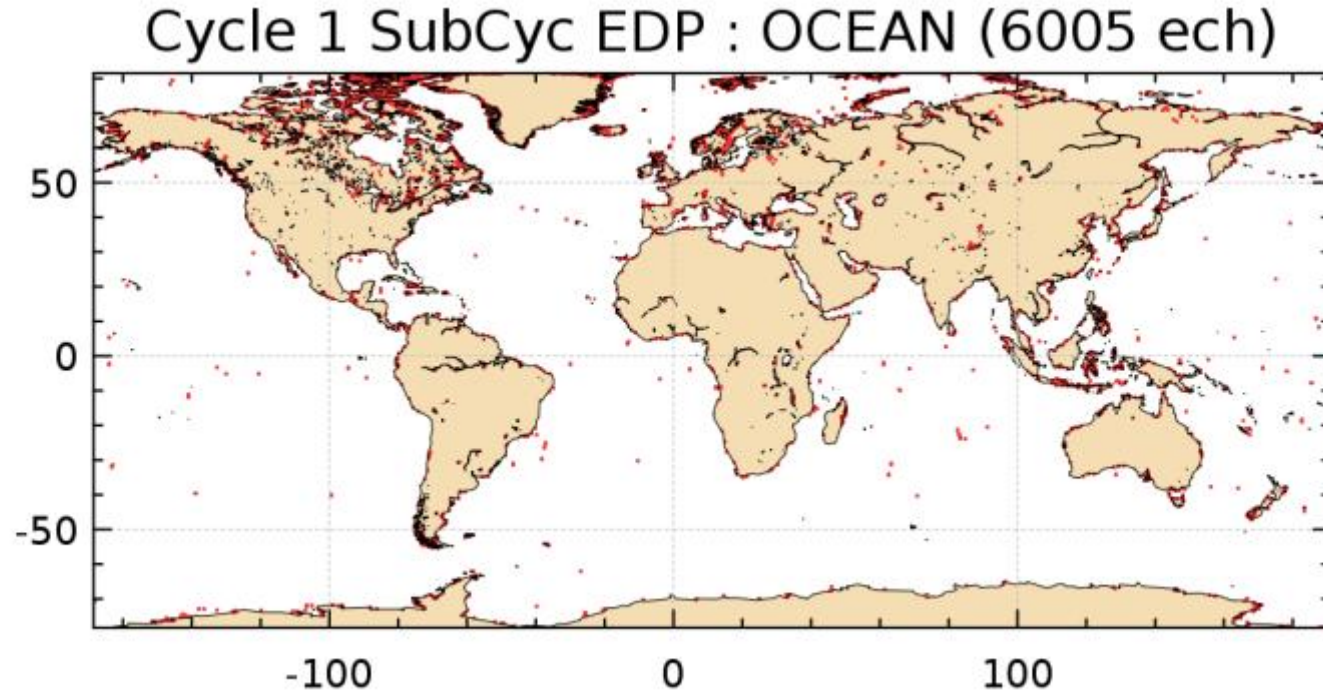
This DEM file has been developed by taking into account different data bases for different types of surface. Due to system constraints the update of the whole onboard MNT (4MBytes) is not feasible

Missing measurements with median discriminator on ocean

Cycle 1 SubCyc MEDIAN : OCEAN (5159 ech)



Missing measurements with EDP discriminator on ocean



As expected, EDP is more sensible to relief => can track on land or iceberg instead of ocean

⇒ It seems that median shall have better behaviour for ocean surfaces

⇒ On going analysis on continental ice areas

DEM analysis

1. Over Ocean

- Good behavior, in particular for transitions and in case of rain cells

1. Over Groenland :

- Height anomaly : differences about 50 m with 10m variation, related to an error of reference of the input data : BAMBER is referenced to WGS84 ellipsoid, and not to the geoid as expected

3. Over Antarctic :

- One part of the on board DEM is false (problem on the surface mask)
- Differences between reference and actual ground tracks on this surface with terrain slopes => difficult validation. To be completed once the orbit will be corrected.

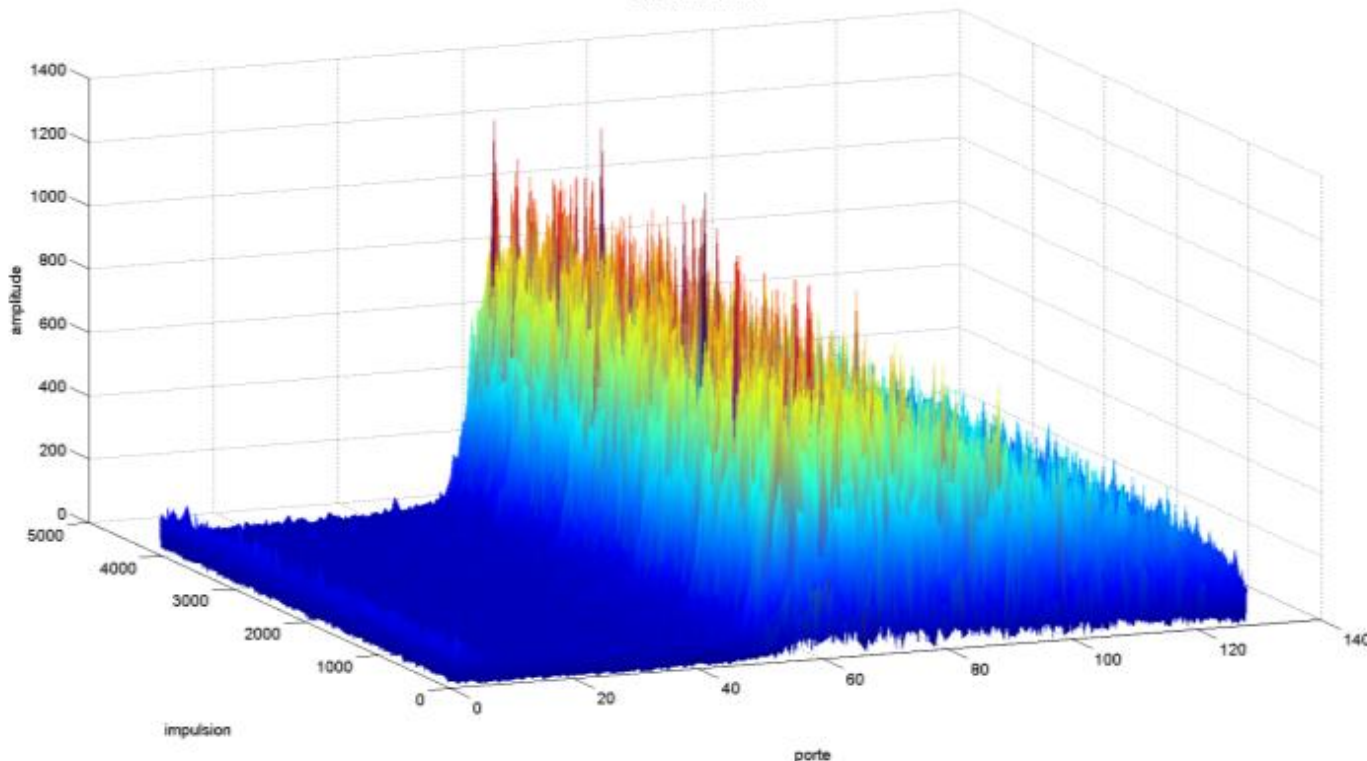
4. Over hydrologic areas :

- on going analysis

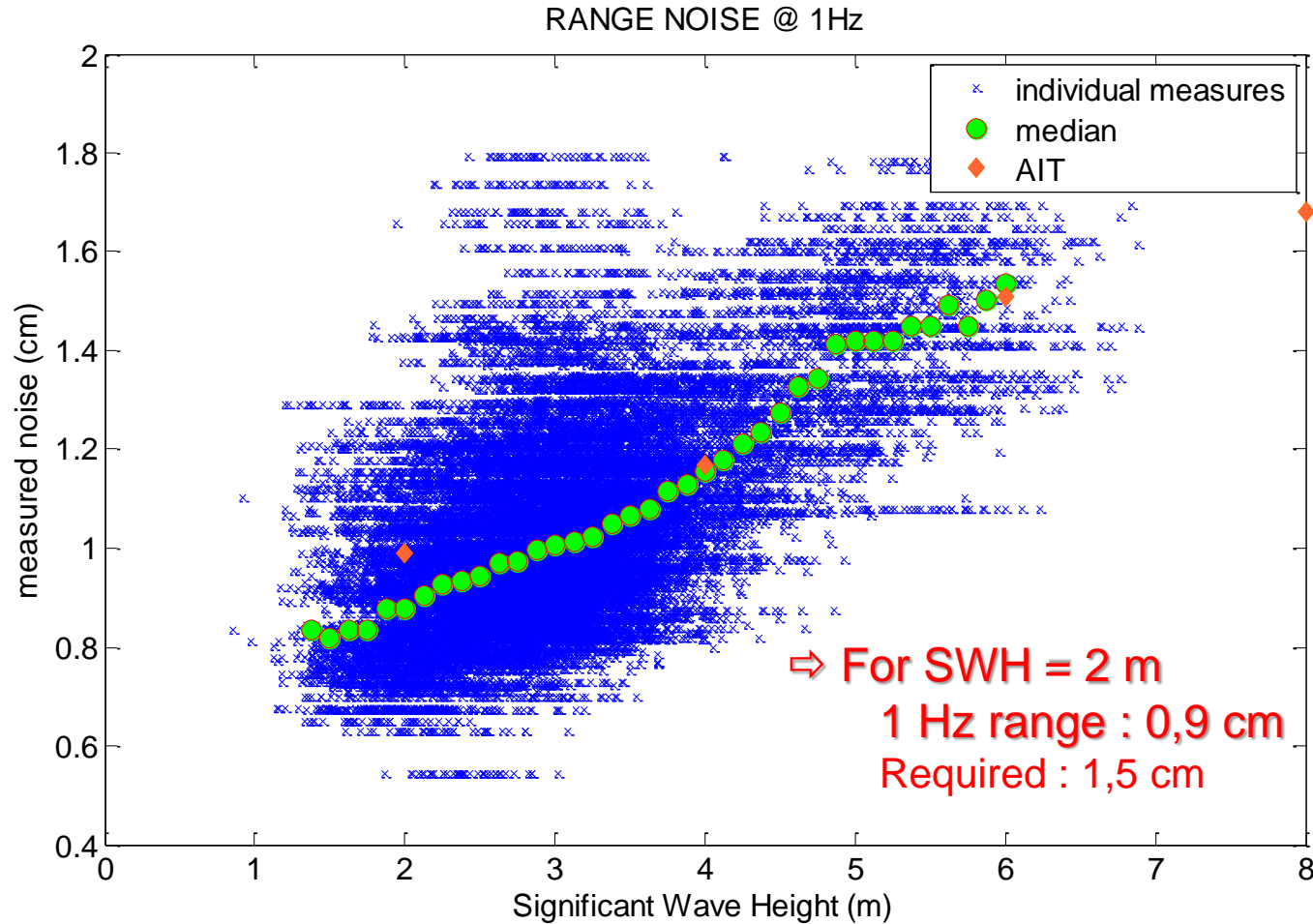
High rate date (“HD mode”)

- Principle : to record data at the PRF rhythm – limited to about 1 second of data. Time tag precision of the order of 1 second (difference between the command and the actual waveforms dates) – akin ENVISAT burst
- Will be performed again for expertise :
 - For correlation analysis in Ka-band (for different wave and wind conditions)
 - For analysis on transitions areas (coast, ice ...)

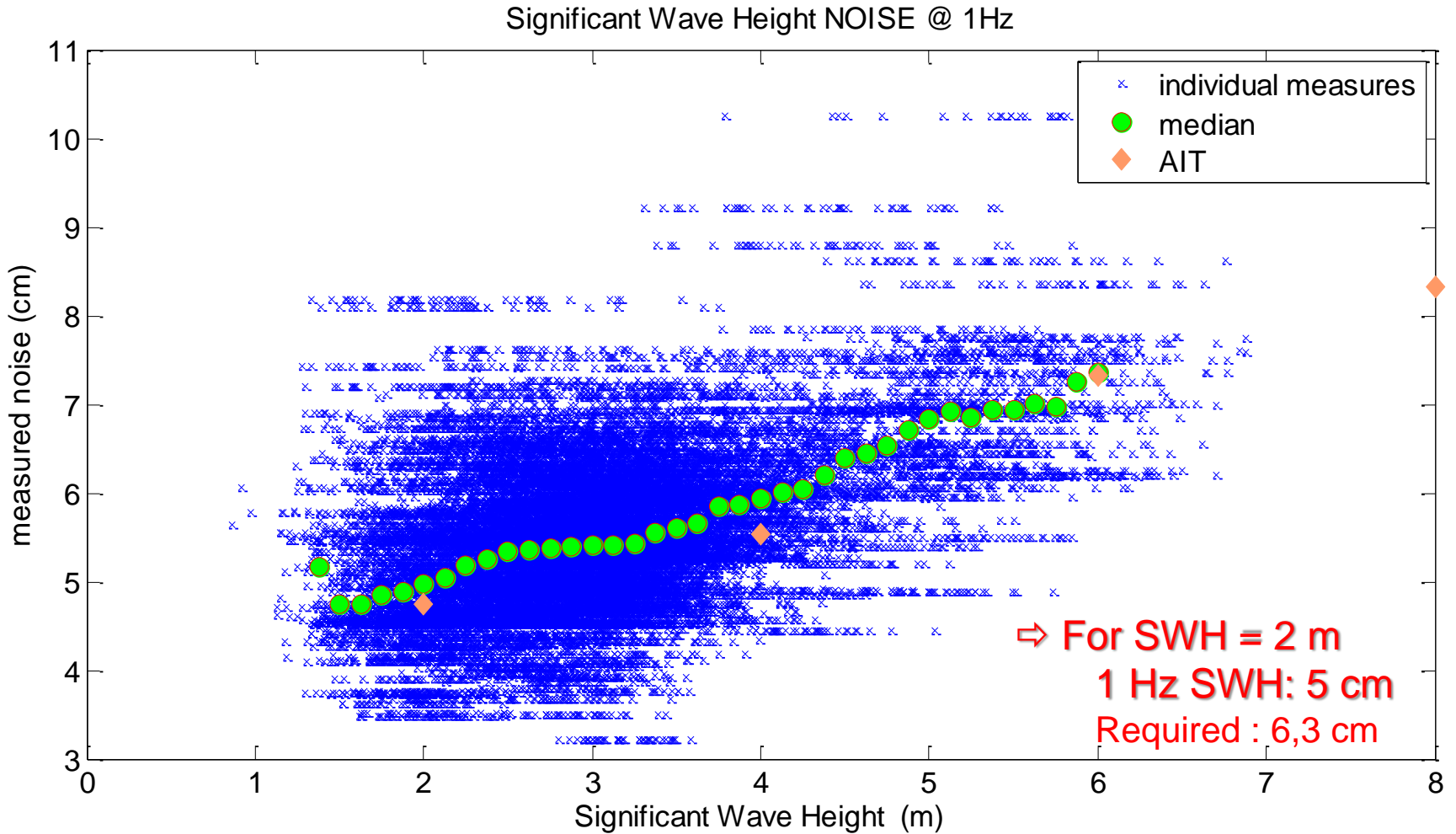
echos HD à la PRF



Altimeter performances – range noise

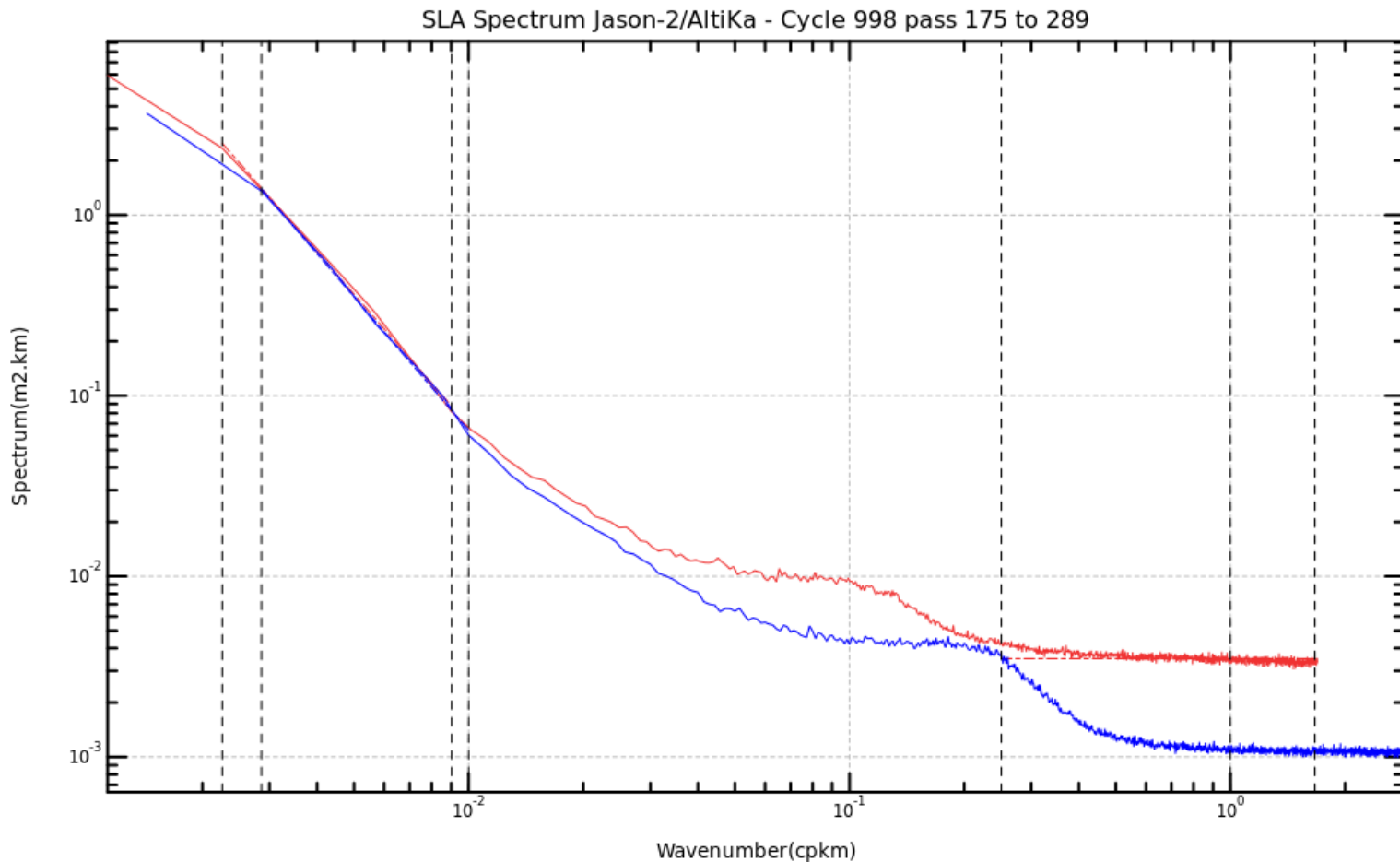


Altimeter performances – SWH noise



Altimeter performances

SARAL 40Hz spectrum compared to Jason-2 20Hz spectrum



— Jason-2 Edit a=-2.41681077813 b=-5.99983925407 sigma=0.076962938649
— AltiKa Edit a=-2.45716226043 b=-6.10631082494 sigma=0.055389755955

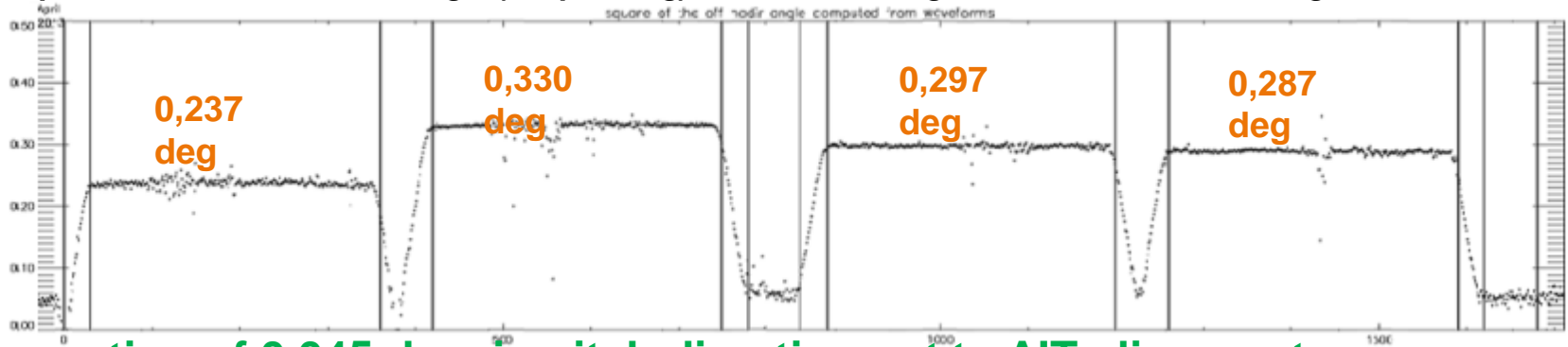
NADIR pointing of altika rf beam : X-cross calibration maneuvers



3 X-cross calibration maneuvers have been performed

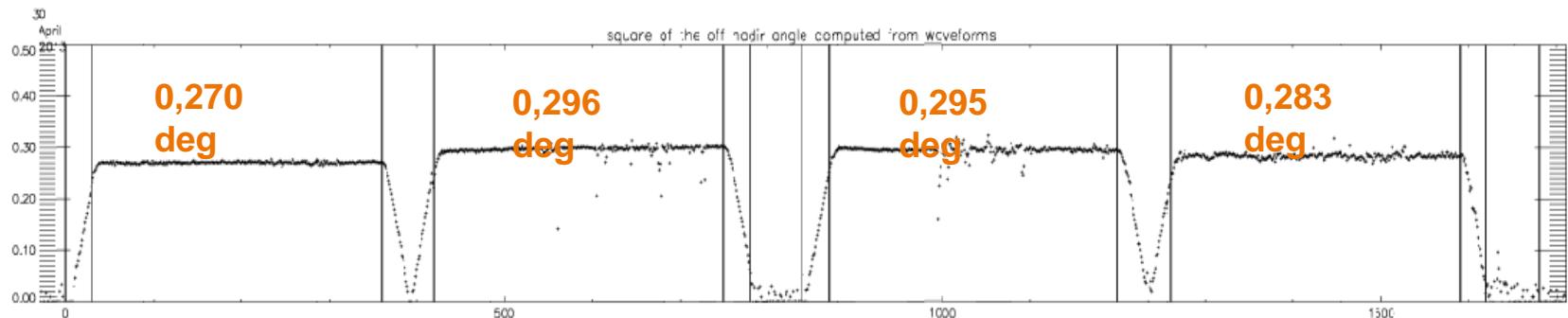
- ❑ 1st X-cross maneuver on April 19th : sequencer test over BIAK
- ❑ 2nd X-cross maneuver on April 22nd : -0,3 /+0,3 in pitch then -0,3 /+0,3 in roll

Square root of the off-nadir angle (mispointing) estimated through AltiKa echoes retracking



=> Correction of 0.045 deg. in pitch direction wrt to AIT alignments

- ❑ 3rd X-cross maneuver on April 30th :

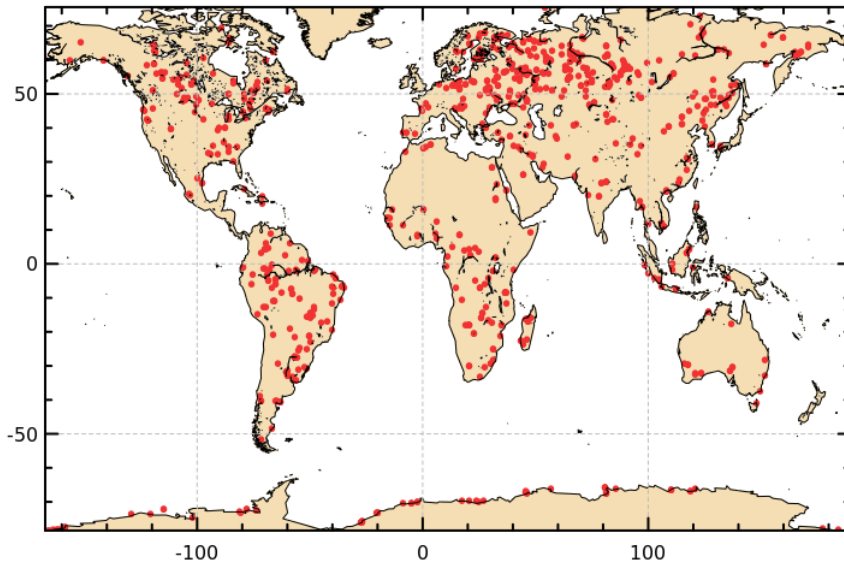


Very good pointing accuracy achieved : estimated to be better than 0.02 deg!

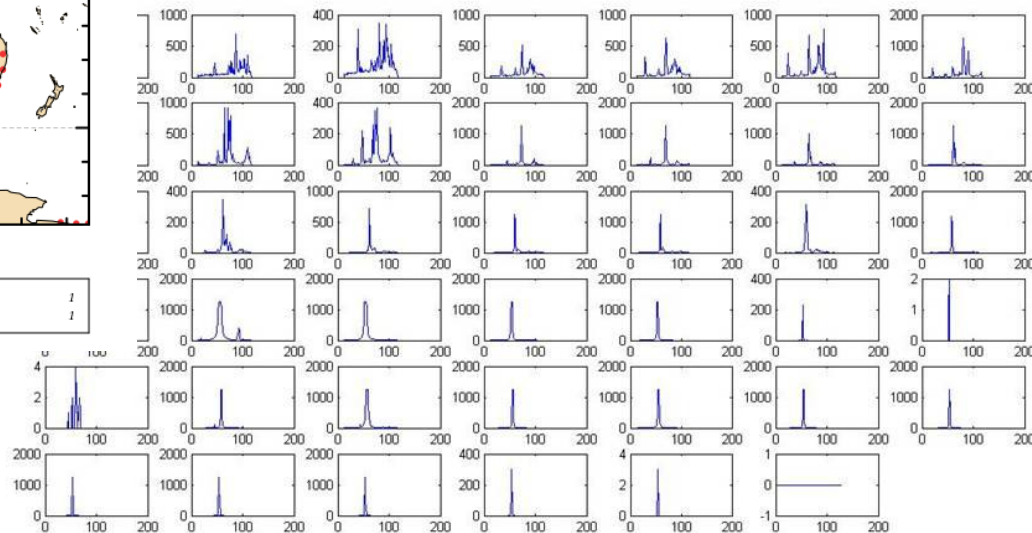
Null waveforms in level2 products

Level2 S-I/GDRs products contain a few waveforms with all gates at 0 (about 900 over a 35 days cycle : 900 out of 10^8 waveforms so 0,0007 % ...). This is currently under analysis, it seems to be related to a strong evolution of the backscatter – occurring over some inland waters.

AltiKa Null Waveforms on cycle 2 (SIGDR), Nb=864



Nbr :	864	Std Dev :	0	Min :	1
Mean :	1	Median :	1	Max :	1



Conclusion

- AltiKa is working properly
- Each Mode has been tested successfully
 - Recommendation : Operational mode = acquisition Diode with median tracker
- No functioning anomaly detected.
- Dedicated calibrations demonstrated a very stable behavior on orbit
- A very few data are lost by loss of tracking due to atmospheric attenuation.
- Performances are excellent !