ASCAT BACKSCATTER PROCESSING STATUS

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Outline

- History of main processor upgrades
- On-going processor changes
- Future developments
- Consistency of data record and re-processing status and plans

History of main processor upgrades

Routine product generation and dissemination started on February 2007 with provisional calibration

ASCAT L1b products declared **operational** 03/04/08, including

- First full 3-transponders absolute calibration,
- Format change (header and auxiliary data records)

Tuning of the calibration on 09/12/08 as a reference to start adapting the existing ERS-based geophysical parameter retrieval models to ASCAT data, and used for first re-processing of the mission

Implementation of **dynamic (orbit-based) Power-to-s0 normalisation** on 10/09/09 and start of non-frozen eccentricity orbit phase on 17/09/09

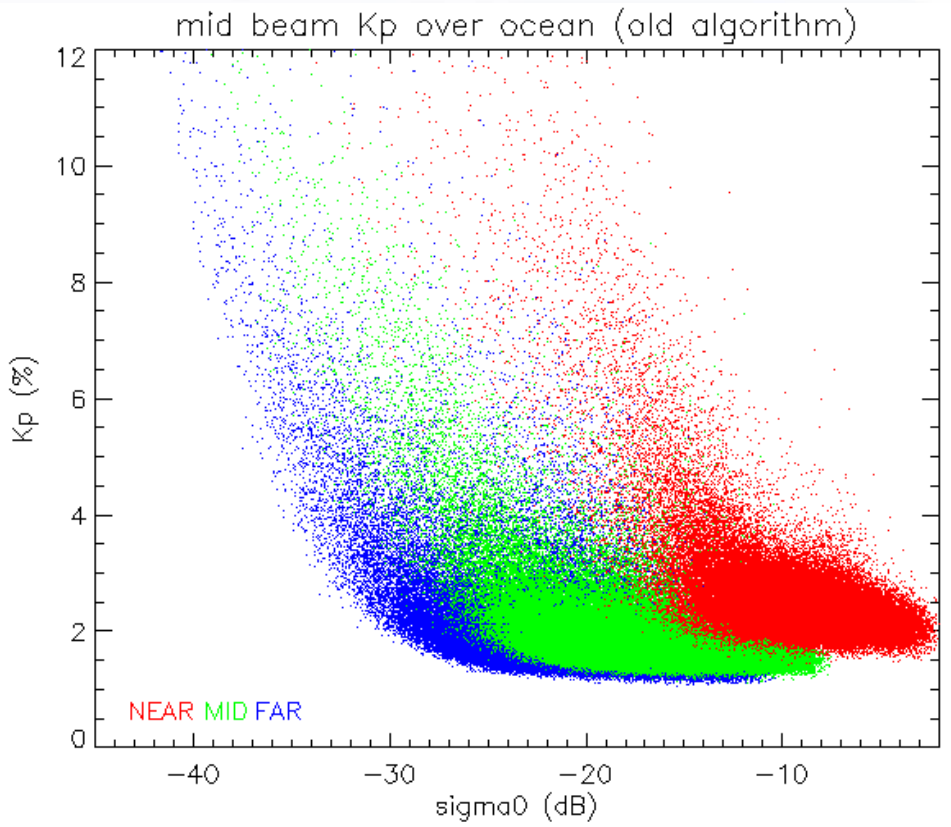
Current version of L1b processing facility is **7.3**

V7.4 – NEW KP ALGORITHM

OLD

Improved calculation of on-board correlation coefficients ρ_{ij} and implementation of their use on the backscatter variance estimation

The Kp values from the new algorithm should be slightly higher than those given by the current algorithm.



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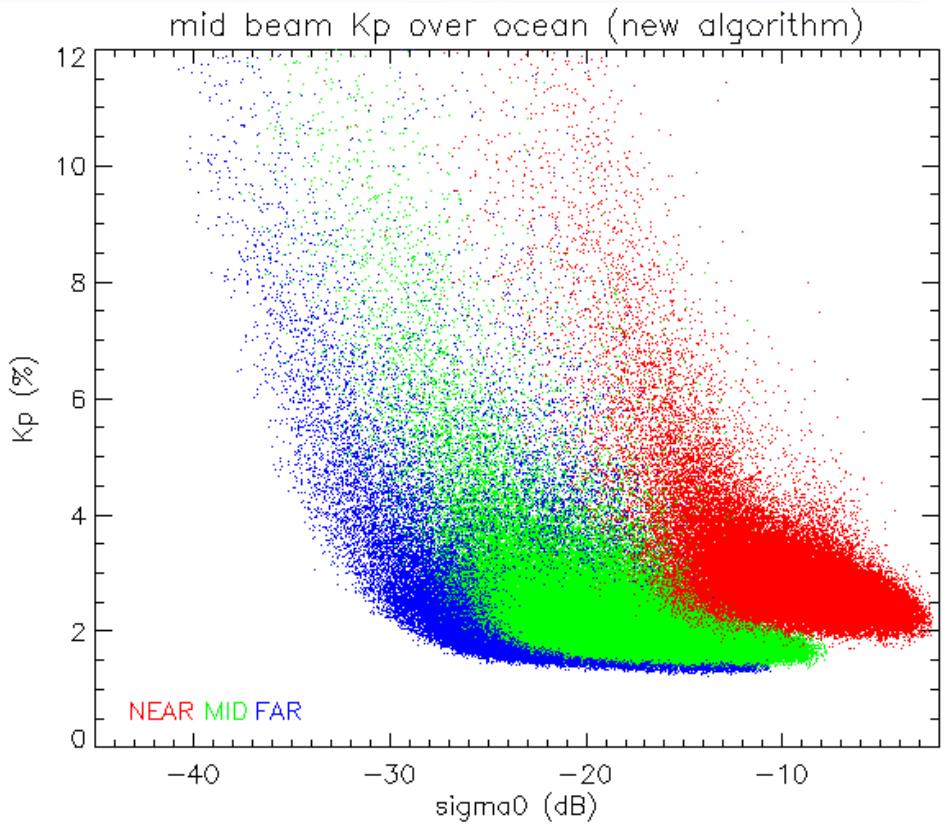

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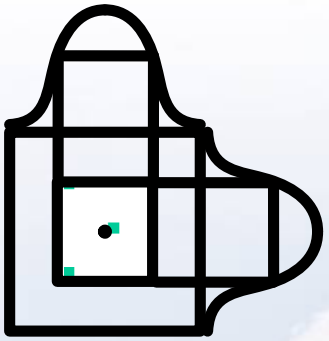
V7.4 – Hamming filter correction for 12.5 km product

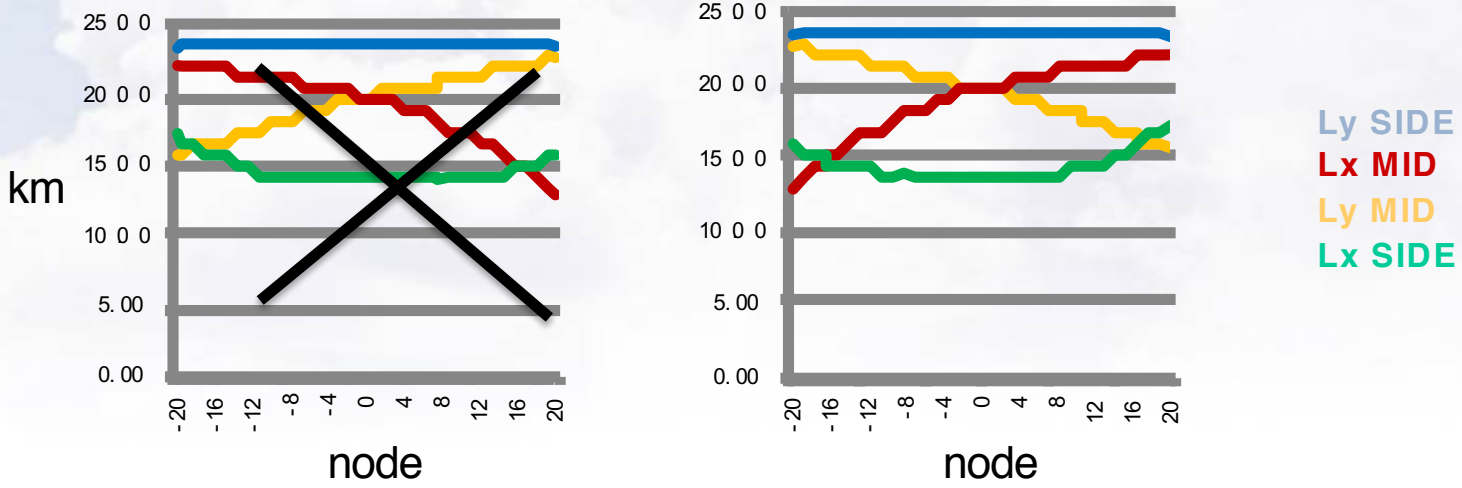
Applied until now with reverse across-track node order from far to near swath

No significant effects expected on backscatter or kp



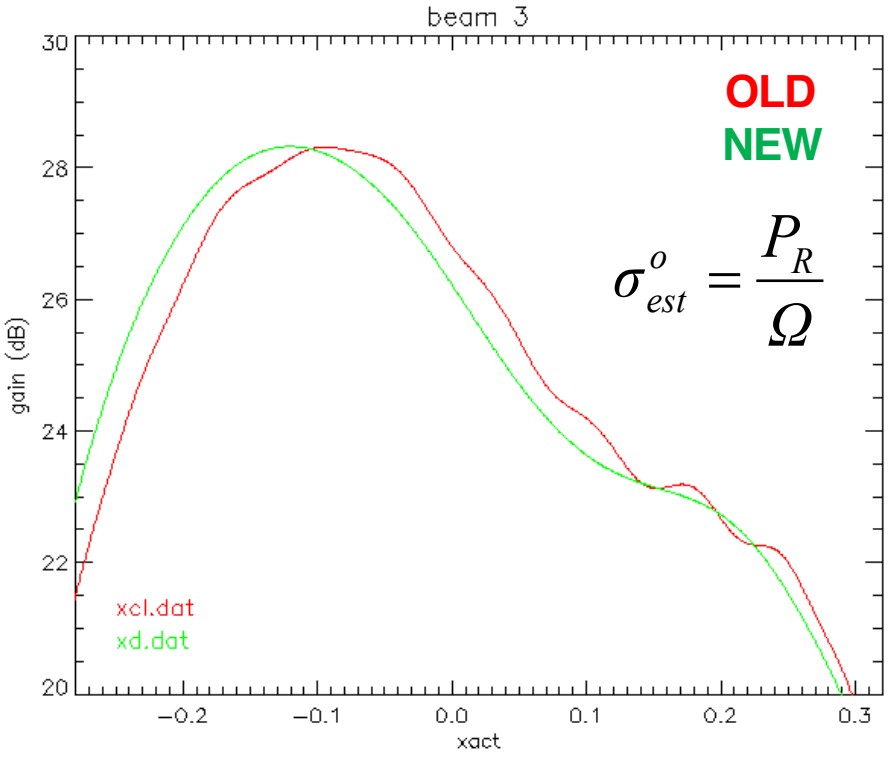
$$Wx = \alpha_X + (1-\alpha_X)\cos\left(\frac{\pi x}{L_X}\right)$$

$$Wy = \alpha_Y + (1-\alpha_Y)\cos\left(\frac{\pi y}{L_Y}\right)$$

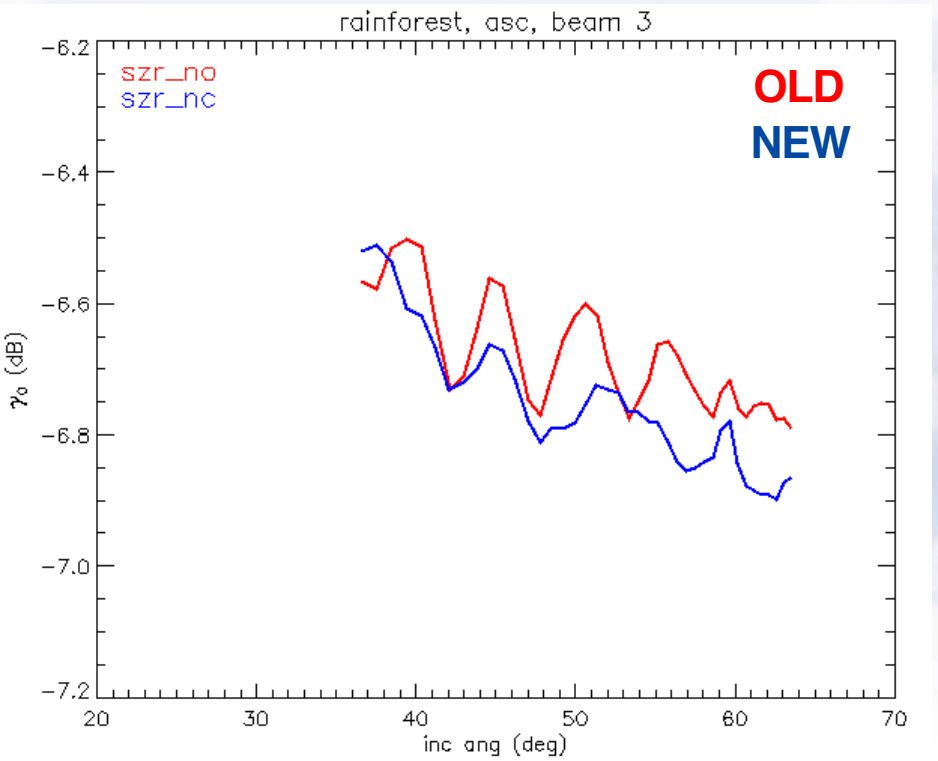


V7.4 – NEW BACKSCATTER CALIBRATION

Oscillations w.r.t incidence angle observed over ocean, rainforest and sea ice: systematic azimuth de-pointing effects between ascending and descending passes – now removed before gain pattern estimation



Beam 3: Ω w.r.t elevation



Beam 3: γ0 over rainforest (asc) (1 month)

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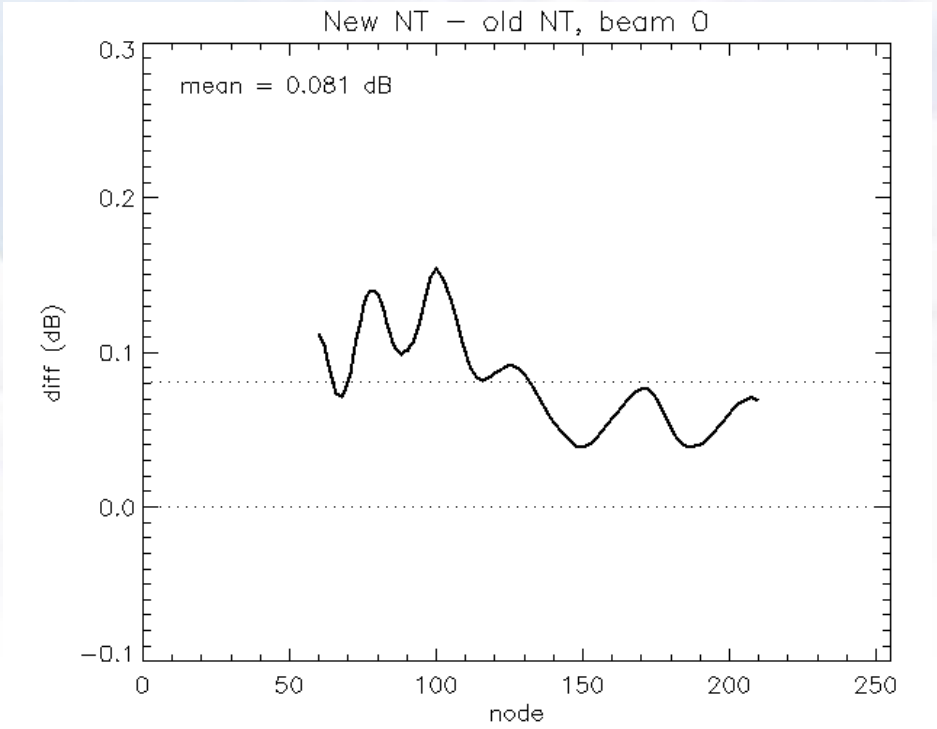
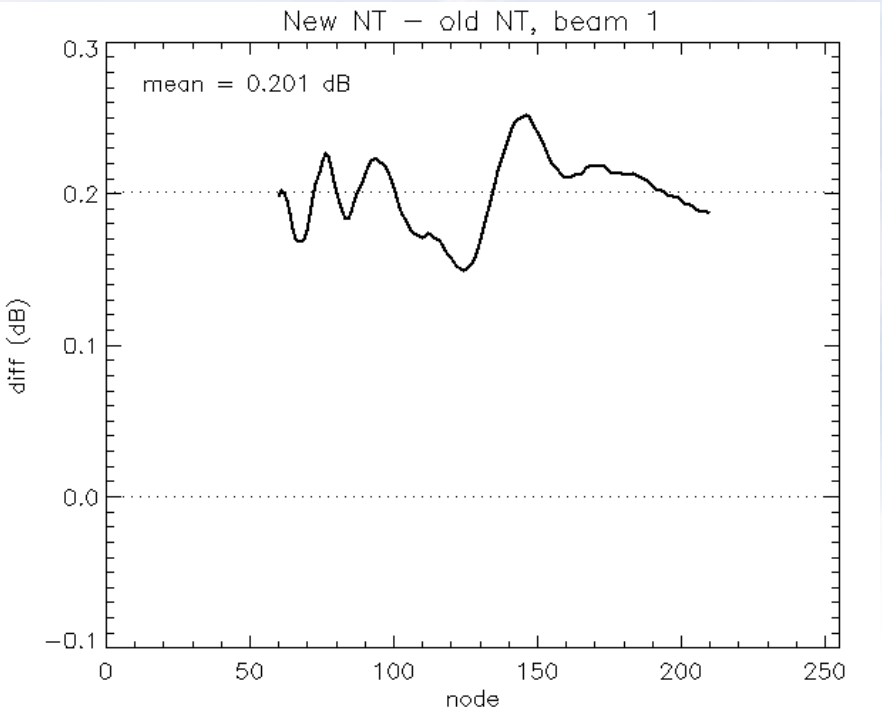
V7.4 – NEW BACKSCATTER CALIBRATION

Beam	LF (0)	LM (1)	LA (2)	RF (3)	RM (4)	RA (5)
Backscatter correction (dB)	0.081	0.201	0.113	0.075	0.070	0.074

In September 2009, calibration change in Mid Left Beam (poster by Julia Figa-Saldaña)





Future processor developments

- Level 1A improvements:
  - Handling of data gaps
  - Better flagging of instrument changes in near real time
  - Faster geolocation
  - Receive filter shape correction refinement
- Level 1B improvements:
  - Overall quality flag refinement
  - Line of backscatter triplet nodes generation on a fixed time-based grid
  - Format optimisation of the full resolution geolocated sigma0 product for near real time use
    - Field sizes
    - Addition of a swath grid for re-sampling

    (example test data available – contact Craig Anderson)
- New format available for backscatter data as of Setp 2011: netCDF

Full ASCAT backscatter data record to date

- ✓ Reprocessed data 2007 –> 2008
- ✓ Operational data 2009 Jan –> June
- ✓ Operational data 2009 July –> August (fast NTG)
- ✓ Operational data 2009 Sept –> now (dynamic NTG and non- frozen eccentricity orbit)

All with Dec 2008 calibration, no other significant changes in L1b processor!

What is this record useful for?

Consistency of processing configuration allows assessing instrument stability/system performance in the long term (poster by Julia Figa Saldaña)

Other events influencing the consistency of the data record

- ✓ Change in Mid Left Beam calibration: increase of 0.1 dB over all incidence angles
- ✓ Manoeuvre record (provided in back-up slides)

Reprocessing overview

Phase 1 of ASCAT sigma0 and soil moisture reprocessing completed and delivered on 07/12/09 (years 2007 and 2008)

http://www.eumetsat.int/Home/Main/News/OperationalNews/715844?l=en

Phase 2 reprocessing planned for sigma0, winds and soil moisture back to January 2007. Planned for 2012.

- Main driver: consistent ASCAT geophysical data records for ERA CLIM
- Agreement at ASCAT Science Advisory Group level on the Reprocessing Product Requirements
- Pre-condition: Validation of calibration results over natural targets

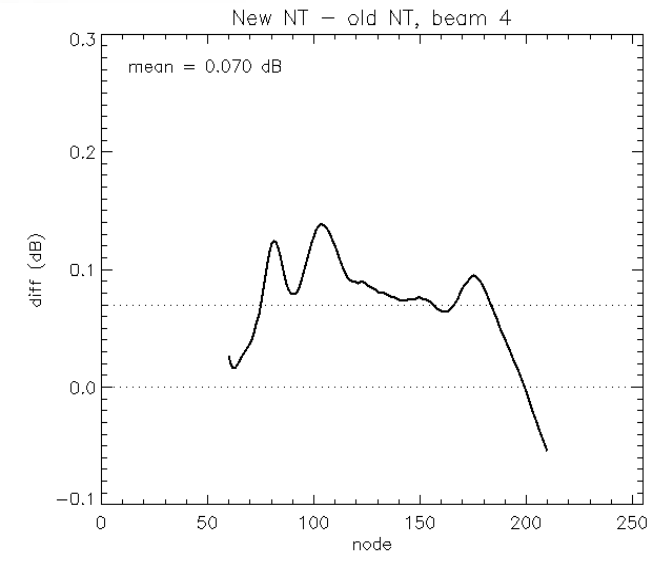
Phase 2 reprocessing overview – key issues

The requirements on the climate data record accuracy and stability are formulated on geophysical parameters over natural targets (e.g. winds over ocean, soil moisture over land, sea ice coverage)

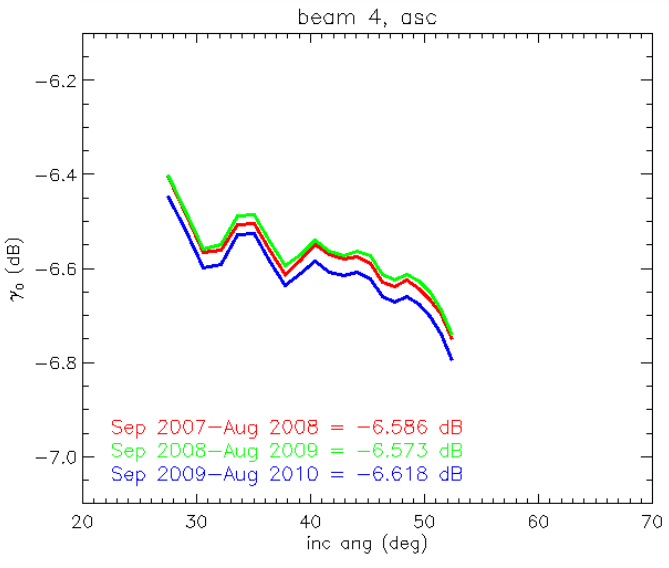
On the other hand, the radar backscatter is the reference property of the Earth surface which can be most directly related to the measurement system. Therefore, our first goal is to provide a consistent radar backscatter record, and to be able to monitor it independently of natural targets (transponder calibration campaigns).

We need to ensure that measurement system changes estimated idependently can be validated and are understood in terms of observability over natural targets, in order to be able to give estimates on the accuracy and stability of our geophysical data records

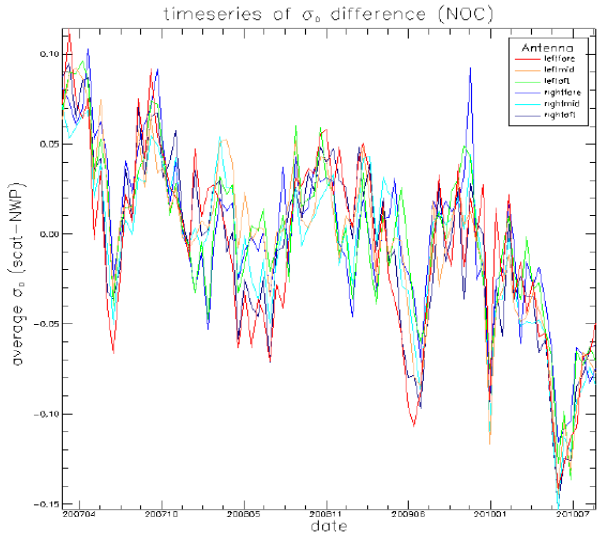
Phase 2 reprocessing overview – key issues



transponders



Rain forest



Ocean

(provided by J. Verpeek, KNMI)

Validation of calibration results over natural targets is going to be our next challenge in preparing for the next reprocessing effort

On the positive side, the radiometric accuracy under discussion is beyond what the measuring system was specified to provide!

Thanks

see backup slides for more details

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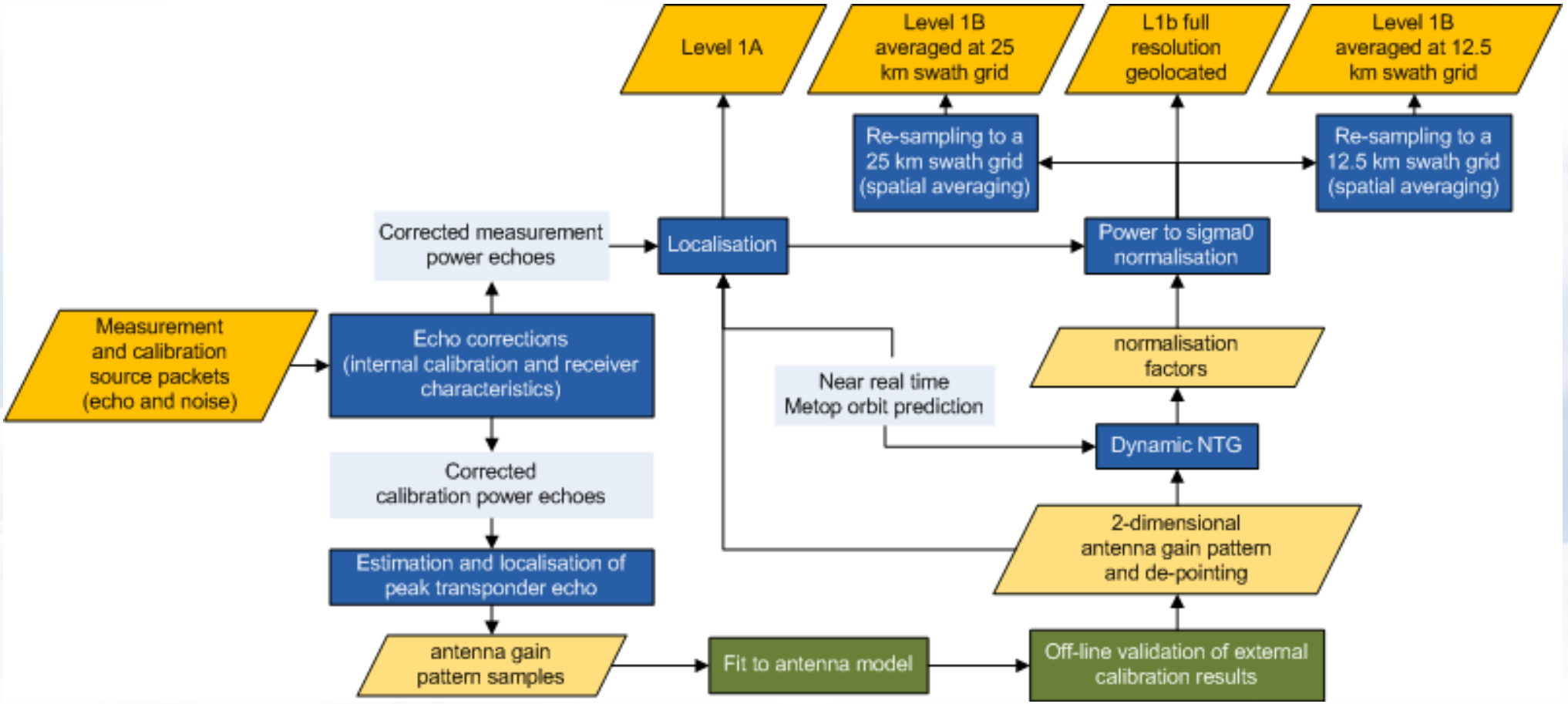
Functional overview



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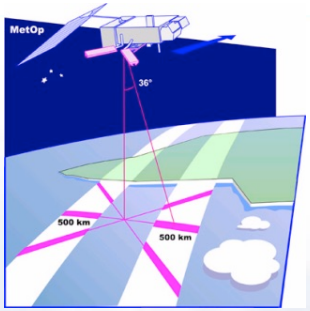
Operational implementation overview



X-BAND

Front-End Processor

EPS main acquisition station (Svalvard)

Metop raw data

Metop raw data

Metop raw data

PRODUCT GENERATION FACILITY

ASCAT L0

ASCAT L1B

ASCAT PRODUCT PROCESSING FACILITY

CORE GROUND SEGMENT 1 (CGS1) (operations)

CGS2 (validation)

CGS3 (system integration)

ASCAT L1B

MONITORING and CAL/VAL

ASCAT L1B

ARCHIVE (UMARF)

EPS Ground Segment at EUMETSAT, Darmstadt

EUMETCast Uplink (Usingen)

GTS

NOAA (via transatlantic link)

Algorithm overview

$$S = \frac{1}{PGP}\left[\frac{E}{h_{RX}} - NP\right]$$

$$\sigma_0 = \frac{S}{\Omega}$$

$$\sigma_{0NODE} = \frac{\sum W_0 \sigma_0}{\sum W_0} \qquad W_o = W_x W_y$$

$$W_x = \alpha_X + (1-\alpha_X)\cos\left(\frac{\pi x}{L_X}\right)$$

$$W_y = \alpha_Y + (1-\alpha_Y)\cos\left(\frac{\pi y}{L_Y}\right)$$

$$Kp = \frac{\sqrt{var(\sigma_{0NODE})}}{\sigma_{0NODE}}$$

E: raw echo

S: corrected echo

PGP: Power Gain Product (internal calibration)

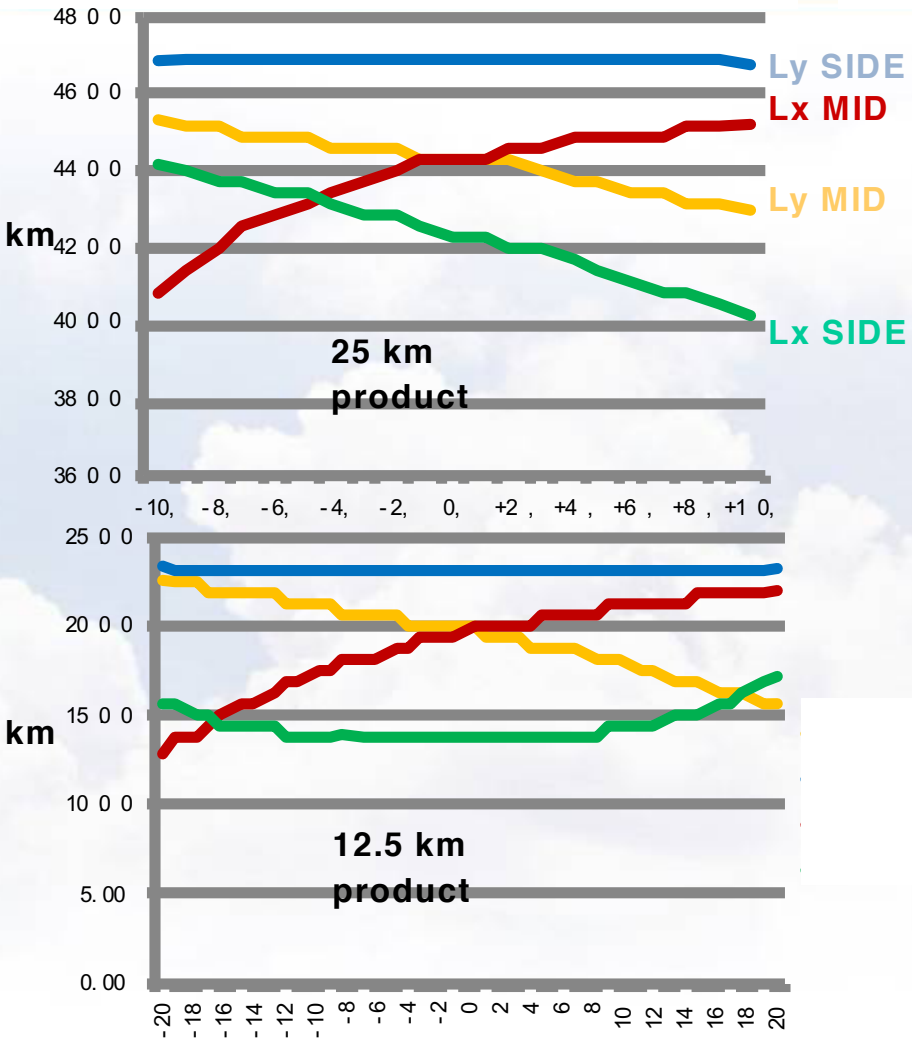
NP: Noise Power

h_{RX}: Receive filter shape

Ω: Power-to σo normalisation factors

W_o: weighting function for spatial averaging

Hamming spatial averaging



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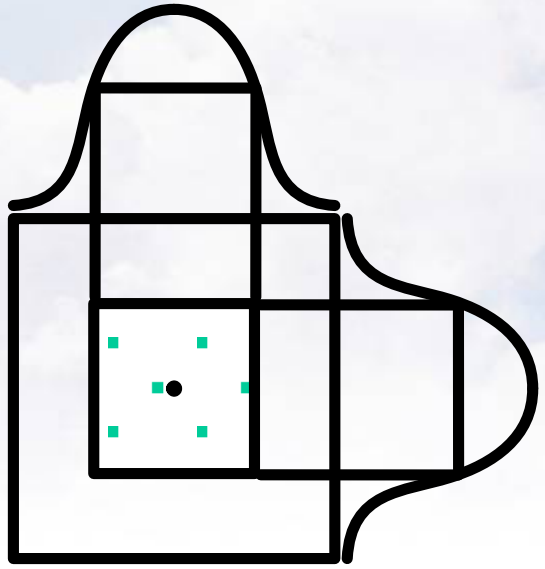

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SZR (12.5 km) PRODUCT ESTIMATED RESOLUTION

Spatial Resolution SZR

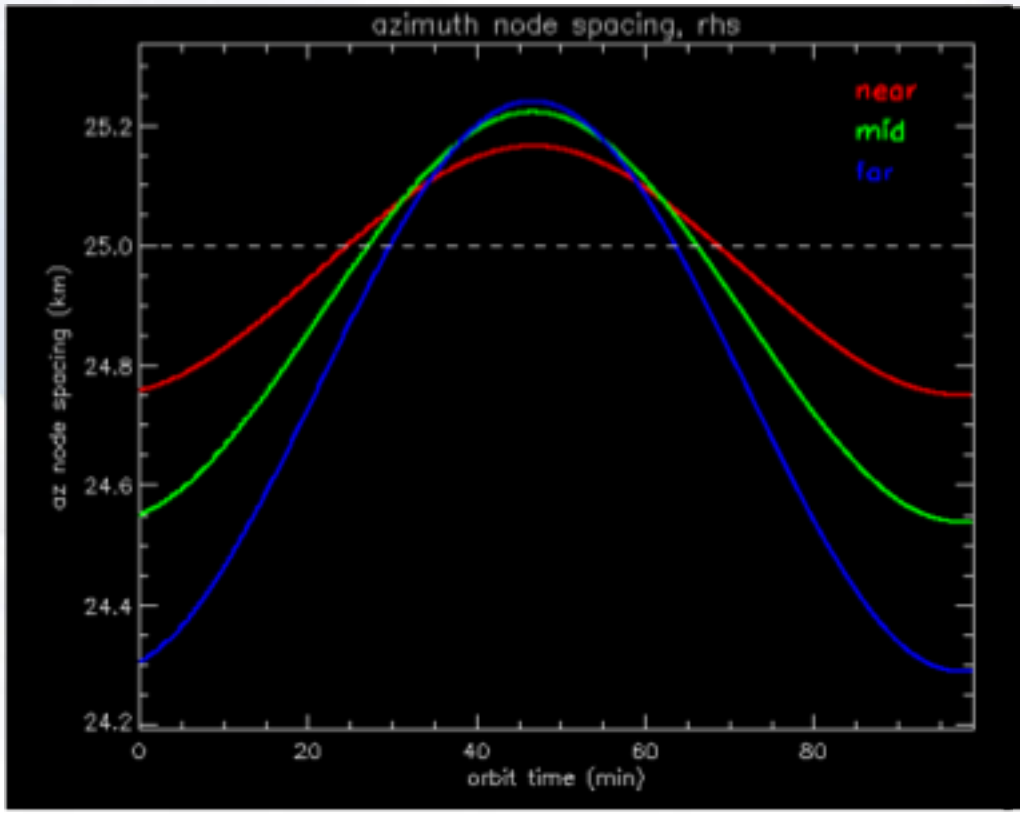
ASCAT FM2 performance budget (MO-TN-DOR-SC-0259)

Left Swath Distance to near swath	ANTLF		ANTLM		ANTLA		
	AC	AL	AC	AL	AC	AL	
0	25.34	24.79	26.95	24.76	25.28	24.78	km
50	25.13	24.79	25.83	24.73	25.07	24.78	km
100	25.34	24.78	25.12	24.69	25.26	24.78	km
150	25.98	24.77	24.85	24.76	25.91	24.77	km
200	26.73	24.76	24.76	24.69	26.66	24.75	km
250	27.47	24.74	24.74	24.78	27.42	24.74	km
300	28.24	24.73	24.72	24.76	28.17	24.72	km
350	28.99	24.73	24.72	24.74	28.92	24.72	km
400	29.81	24.73	24.83	24.7	29.72	24.72	km
450	30.9	24.74	24.79	24.79	30.82	24.73	km
500	32.15	24.75	24.79	24.86	32.07	24.75	km
550	33.71	24.78	24.8	24.93	33.63	24.77	Km

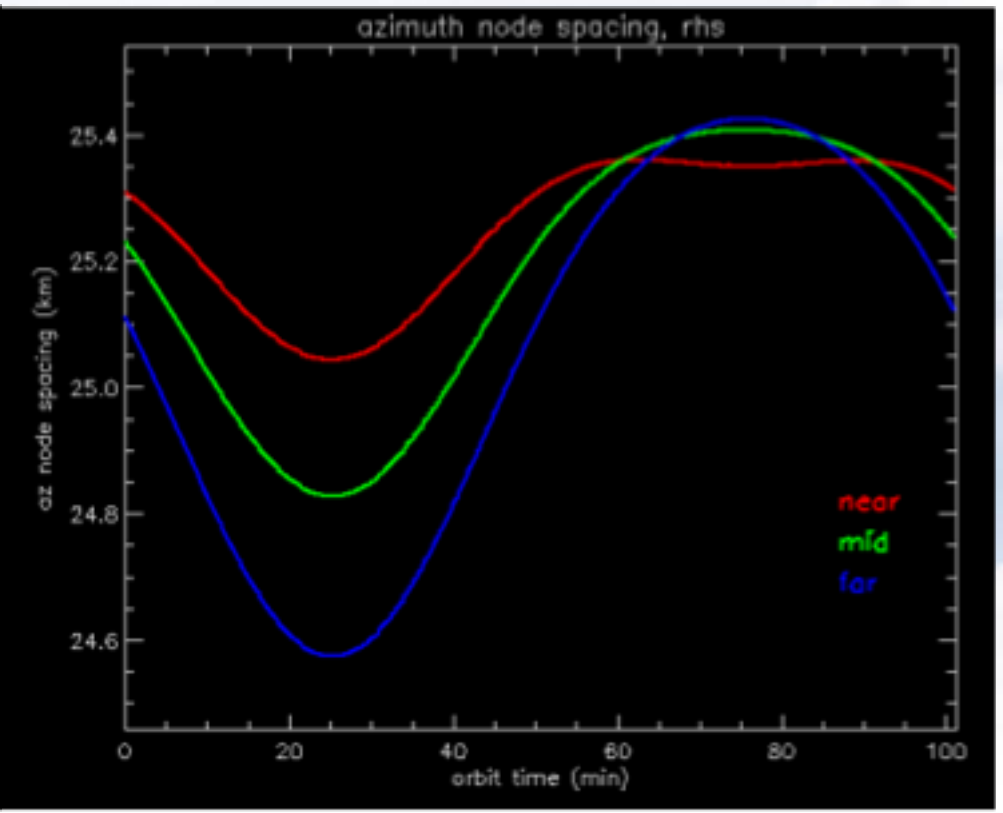
Fix time grid for sigma0 triplet lines of nodes

Along track node grid spacing for SZO product within an orbit

Current (constant distance)



Proposed (fixed time grid)



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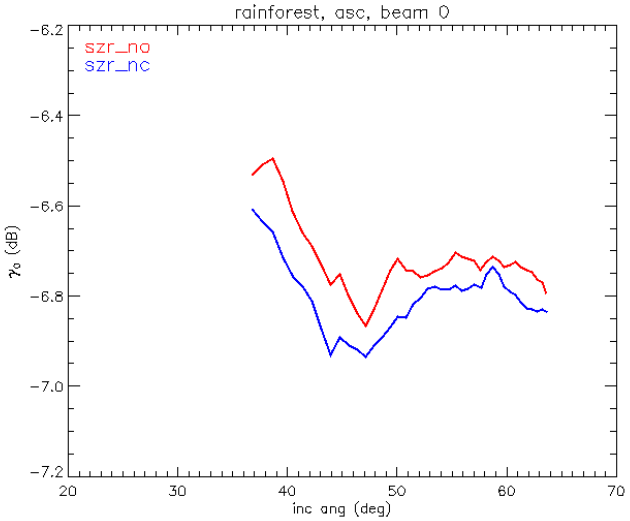
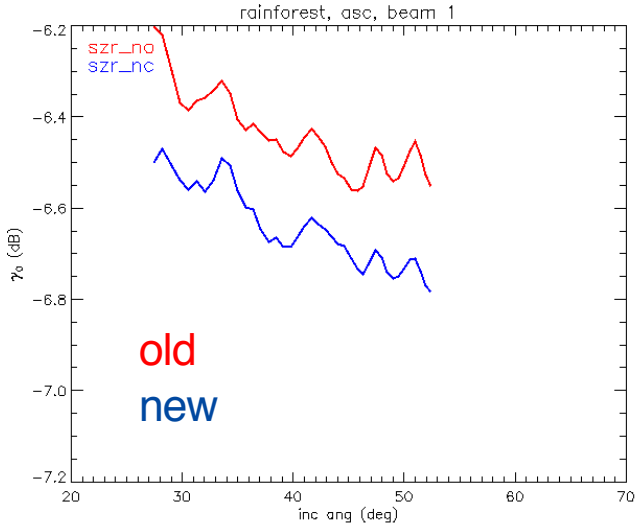
METOP-A MANOEUVRE HISTORY

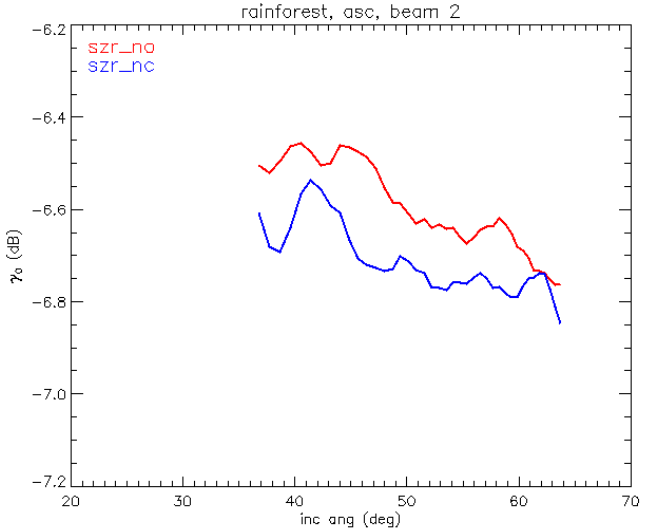
2006/10/21 18:58:08	OOP	GEO	performed by ESOC
2006/10/22 06:30:43	IP	GEO	performed by ESOC
2006/10/22 07:20:35	IP	GEO	performed by ESOC
2006/11/02 15:06:32	IP	YSM	
2007/04/19 14:05:56	IP	YSM	
2007/04/19 14:56:40	IP	YSM	
2007/07/12 14:48:18	IP	YSM	
2008/01/31 14:38:03	IP	YSM	
2008/04/08 13:26:21	OOP	GEO	
2008/04/09 03:48:39	OOP	GEO	
2008/04/09 03:48:39	IP	YSM	
2008/04/24 14:46:31	IP	YSM	
2008/10/23 14:30:02	OOP	GEO	
2008/10/30 14:11:05	IP	YSM	
2008/10/30 15:01:42	IP	YSM	
2009/01/22 14:11:17	IP	YSM	
2009/09/17 14:17:41	OOP	GEO	
2009/12/10 15:31:21	IP	YSM	
2010/06/10-13:31:46	IP	YSM	
2010/10/05-12:16:45	OOP	GEO	
2010/10/06-03:29:03	OOP	GEO	
2011/03/31-13:13:19	IP	YSM	
2011/05/01-03:28	IP	YSM	Collision avoidance manoeuvre

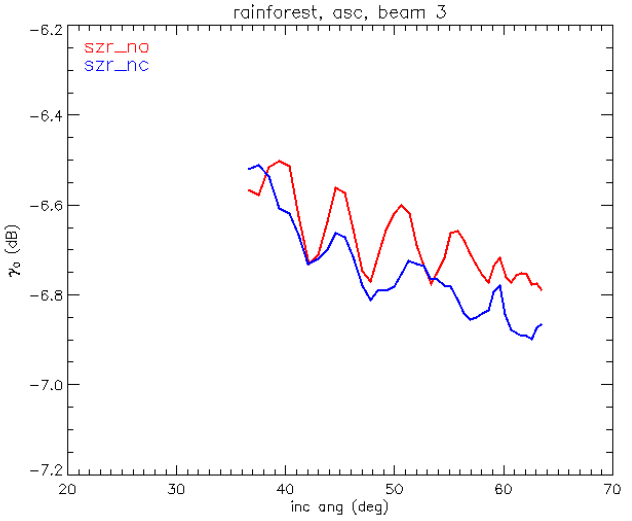
YSM: Yaw Steering pointing mode
GEO: Geocentric pointing mode
IP: In Plane manoeuvre
OOP: Out of Plane manoeuvre

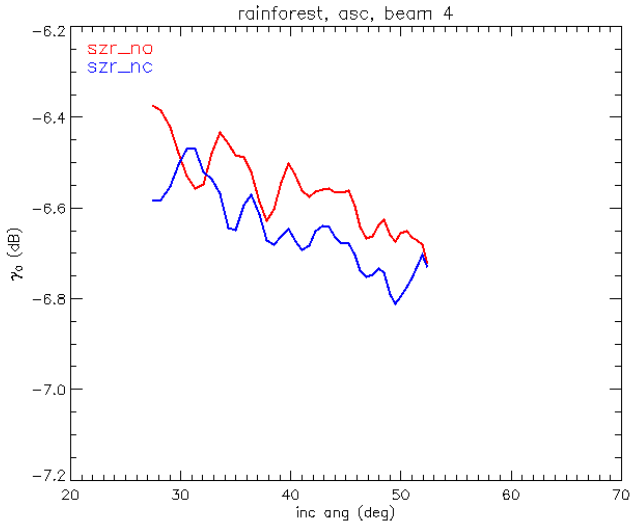
Cal 2010: rainforest γ^0 patterns

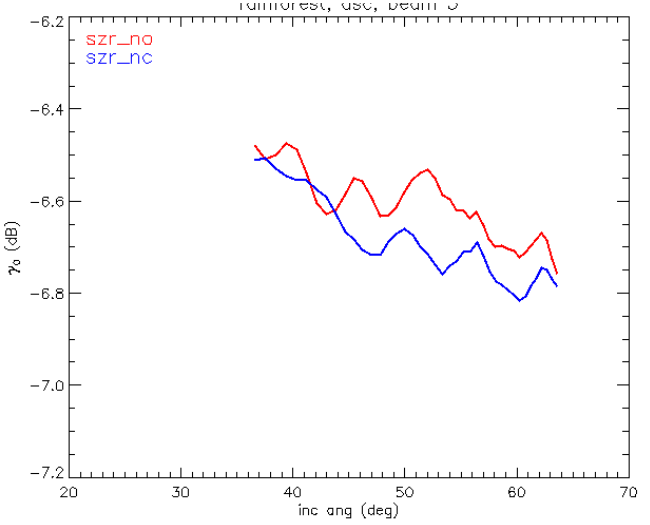












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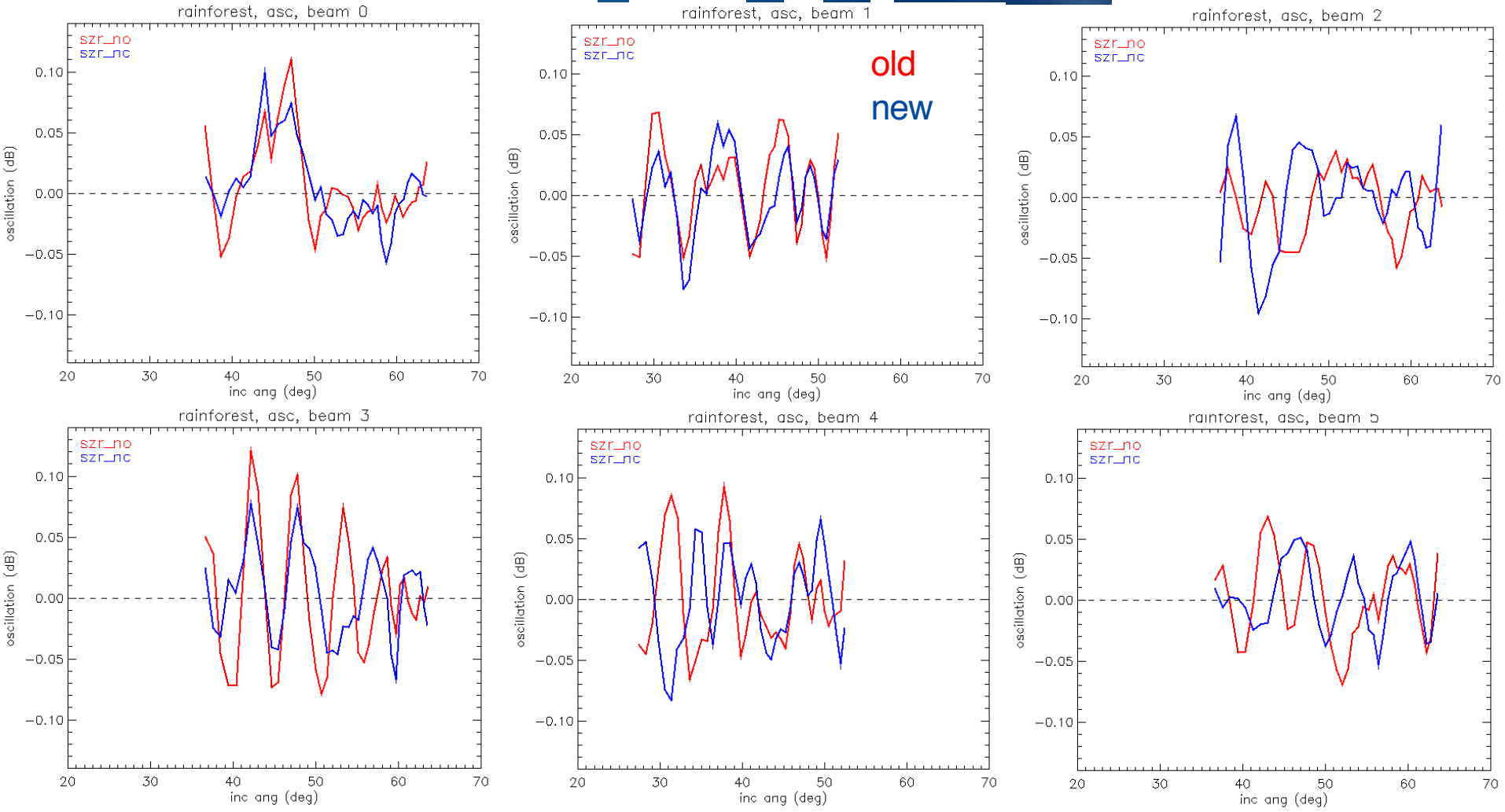
Cal 2010: rainforest γ^0 patterns (average removed)



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Analysing possible changes

$$\sigma^o_{est} = \frac{P_R}{\Omega} = \frac{P_T K G^2 \sigma^o_{true}}{\Omega}$$

$$K = \frac{F\,\lambda^2}{(4\pi)^3 R^4}$$

What other changes are plausible in the measuring system that might artificially result in apparent changes in the measured NRCS?

σ^0_{true} is the true NRCS from the ocean
P_R is the received power
P_T is the transmitted power
R is range
λ is the signal wavelength
F is the measured footprint
G is the true instrument gain
K contains then the measurement geometry, including orbit and attitude (pointing)
Ω is the normalisation factors, calculated with given settings of measuring geometry and radar signal transmission, propagation and receiving