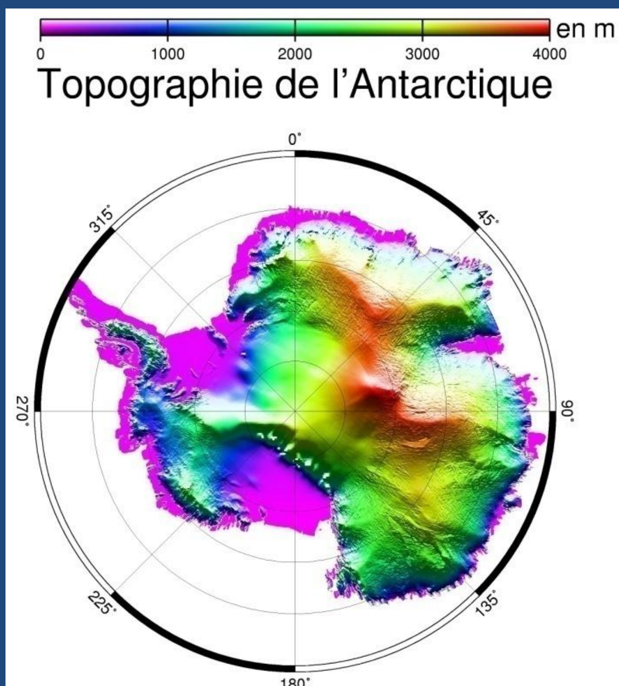
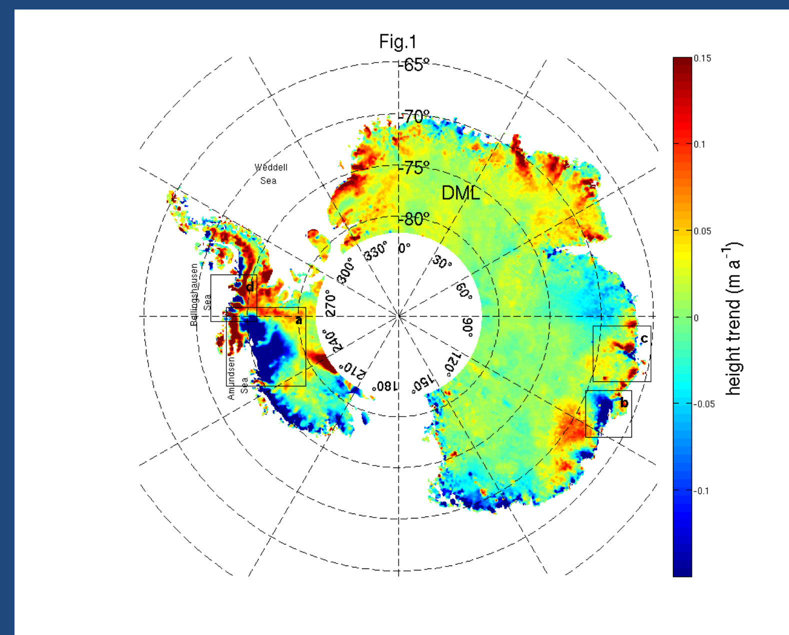
Tentative for a first steep to understand the ka measurements

(look for the new impacts on the measure)

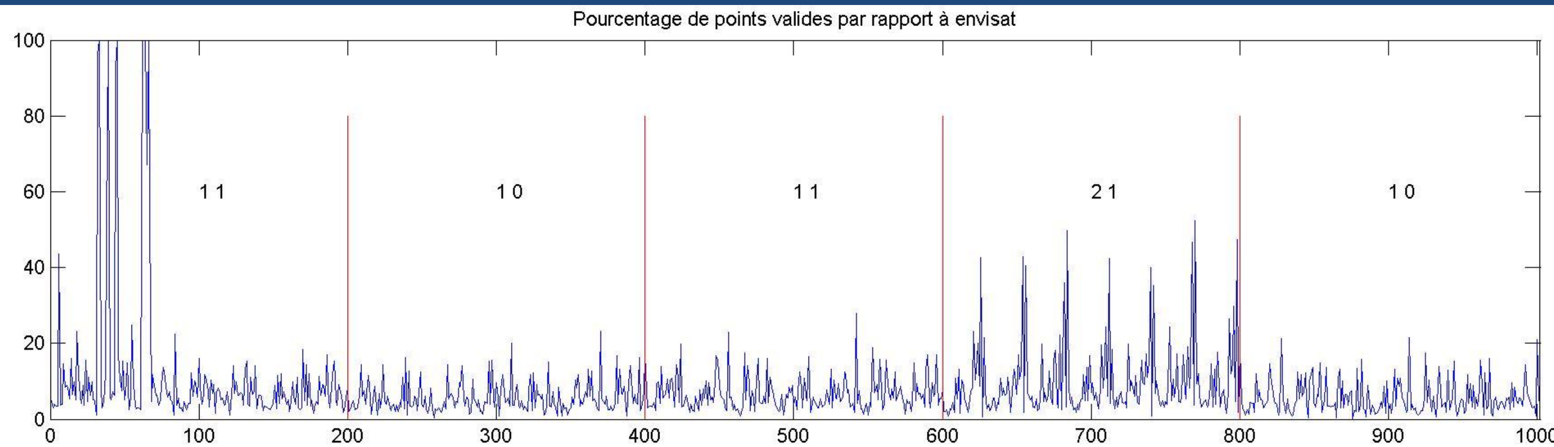
F. Rémy, D. Blumstein, A. Michel, T. Flament

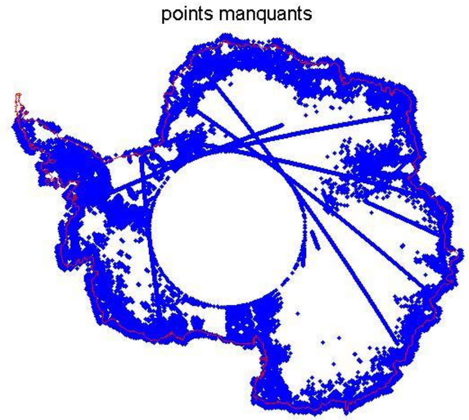


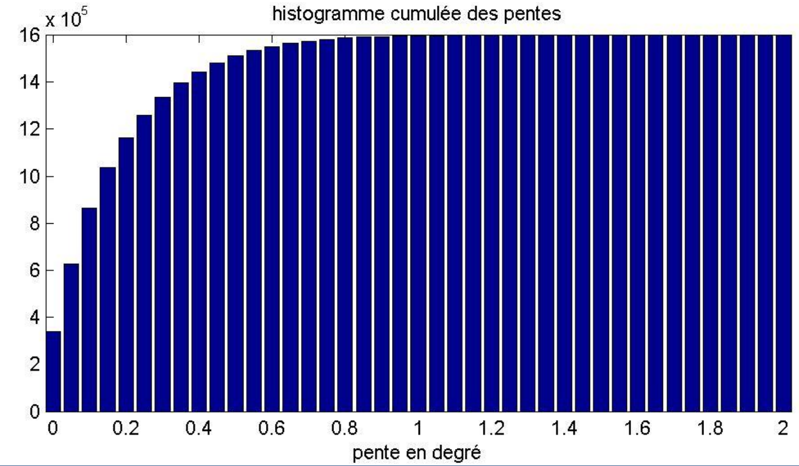


Envisat topography of the Antarcica ice sheet and volume change (m/y)

Statistic for the lost point (with respect to EnviSat)



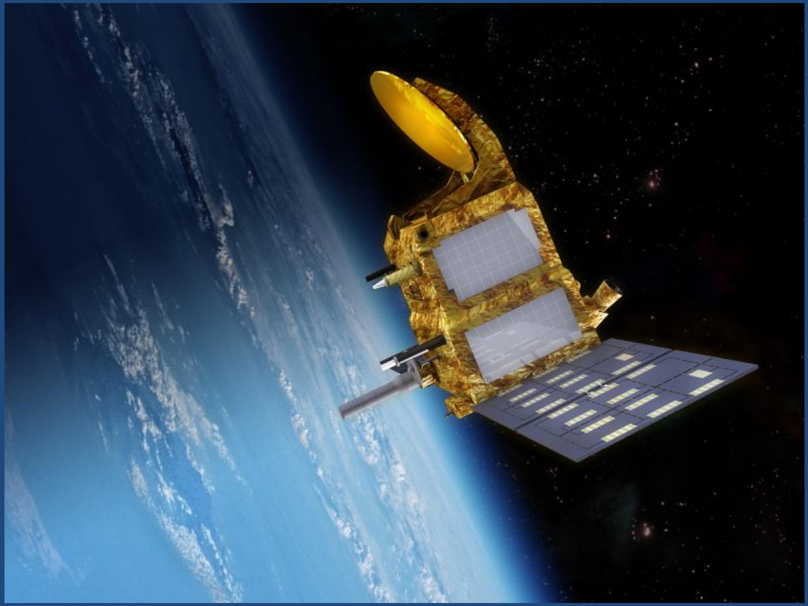


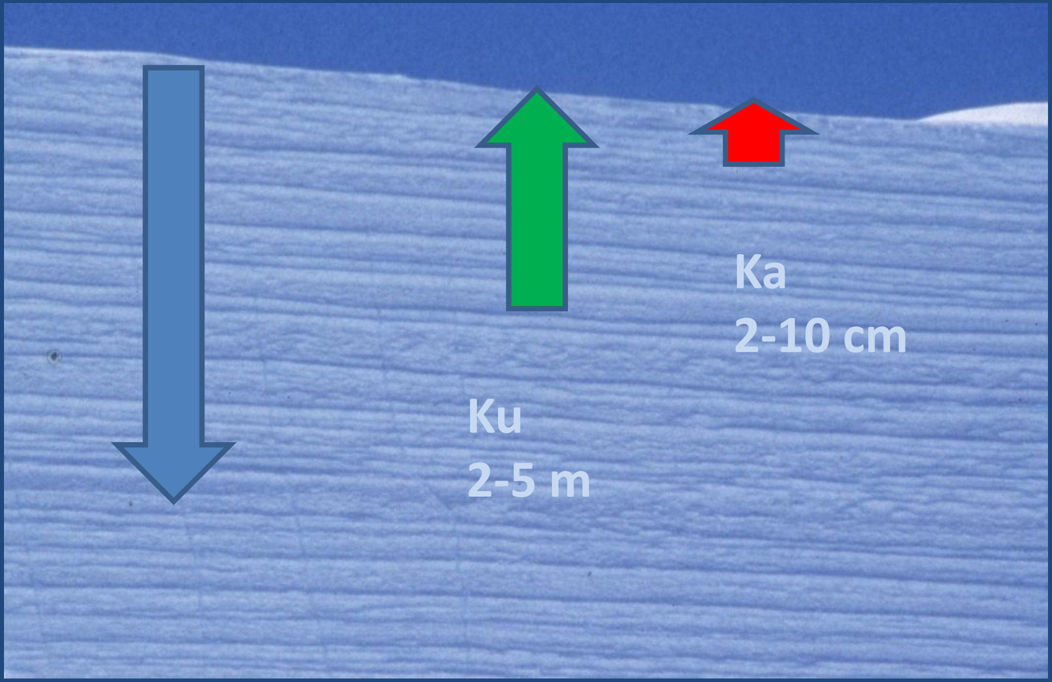


Between 15% and 20 % of data previously observed by EnviSat are not observed by Altika
Less by Ice-1 but also a lot of lost point due to the smaler antenna aperture

The radar wave penetrates into the dry and cold snowpack

This penetration induces few problems
1- The surface is underestimated
2- Artificial temporal variation in height due to change of the snowpack characteristics
3- differences at cross-over





In Ka band (37 GhZ) is assumed to be 3 (or 9 or 27) times letter than for ku (13.6 GhZ)

→ Then let see

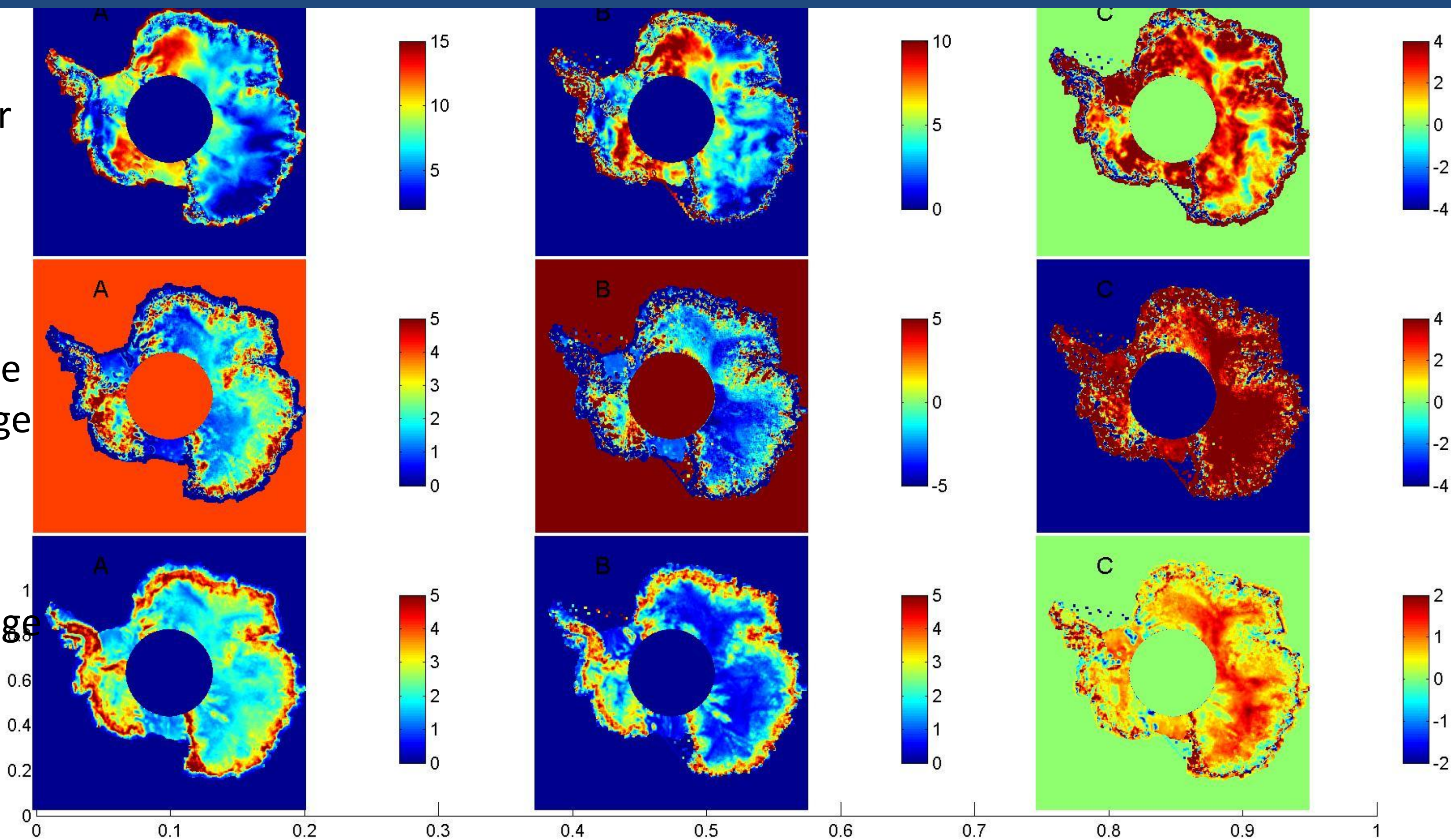
Comparison of waveform shape parameter corrected from antenna pattern and surface slope

EnviSat Ku | AltiKa Ka | difference

Backscatter (dB)

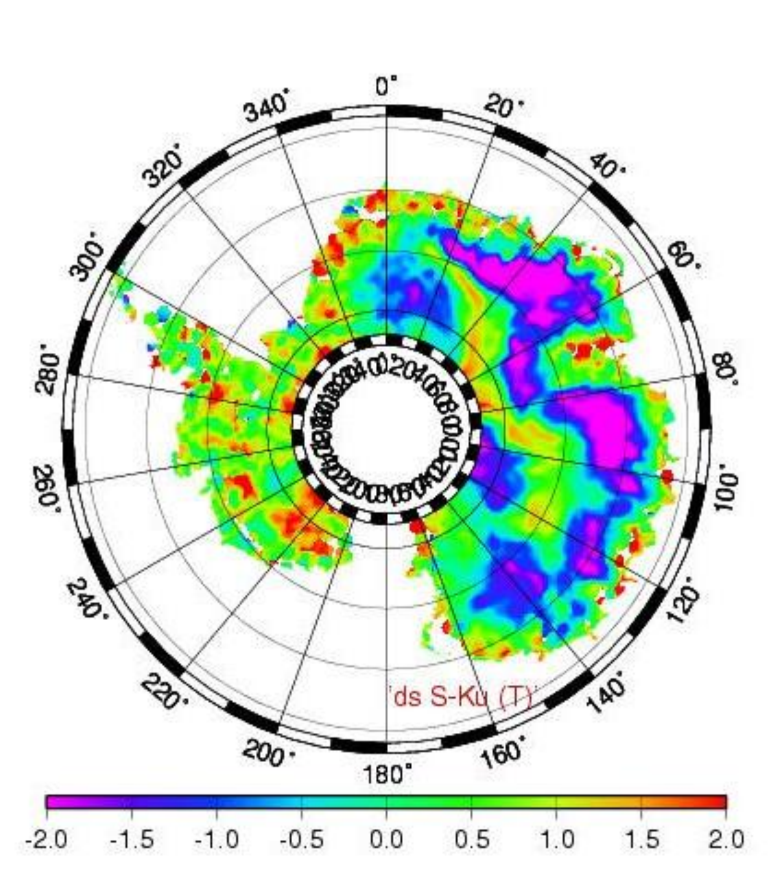
Slope of the Trailing edge (s-1)

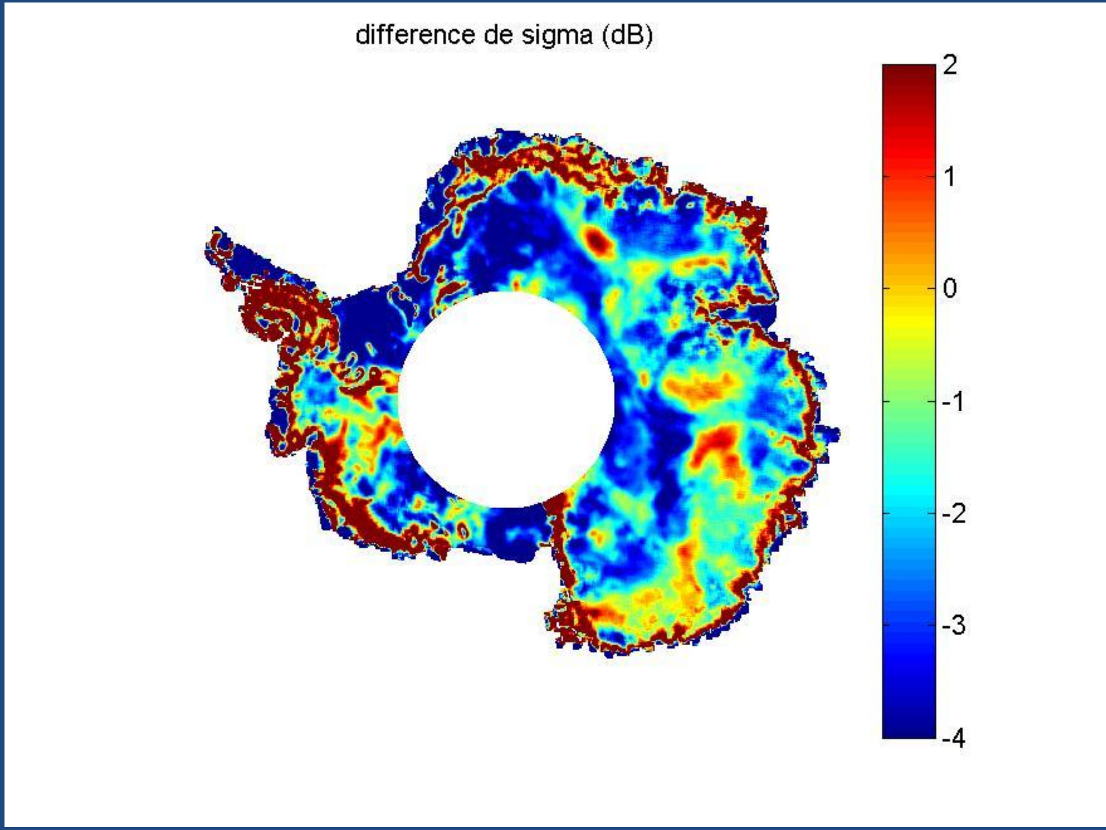
Leading edge (m)



Indeed, qualitative confirmation of less volume in ka (Lew)

Backscatter difference S-Ku and Ku - Ka





Diminuation of specular echoes with radar wavelength (8 cm, 2.2 cm, 0.8 cm)

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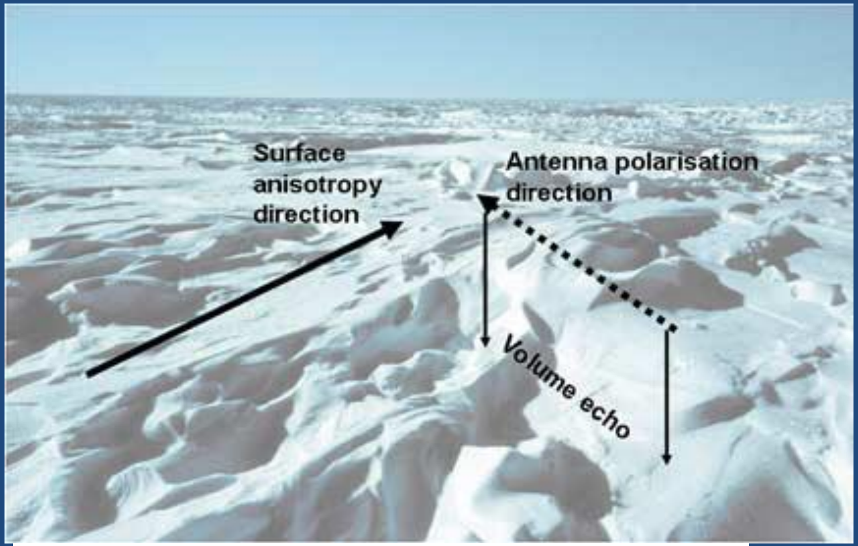
Cross-over analysis

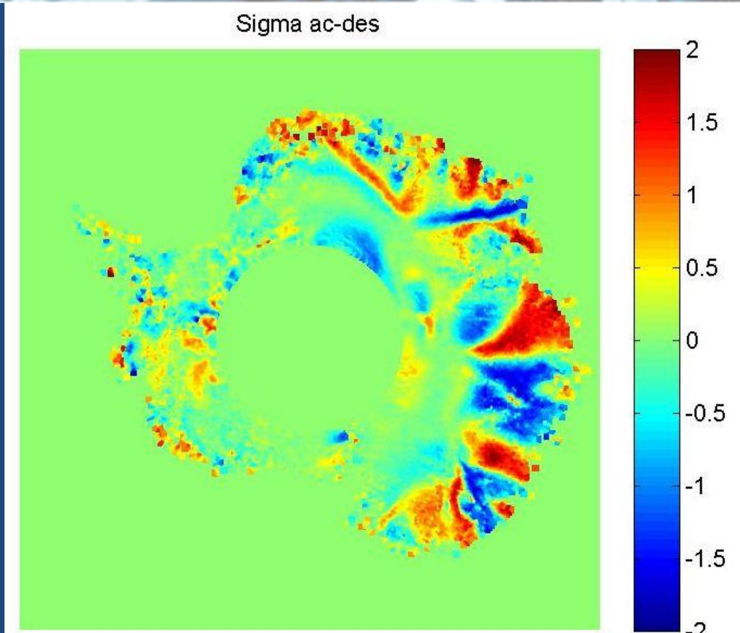
Important signal due to a complex interaction between the antenna polarization and surface anisotropy

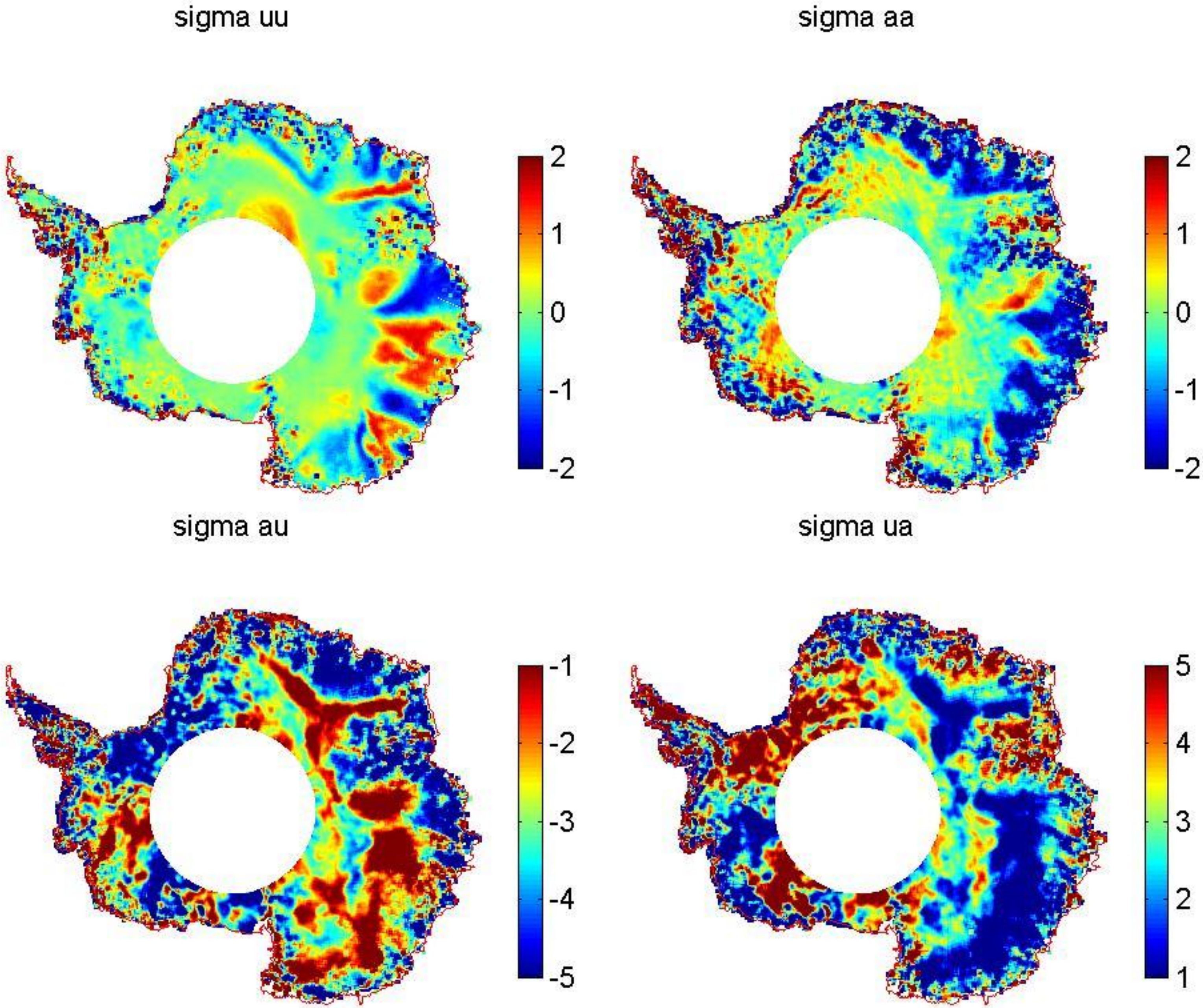
Surface anisotropy due to katabatic wind

→ Induces a modulation of volume echo

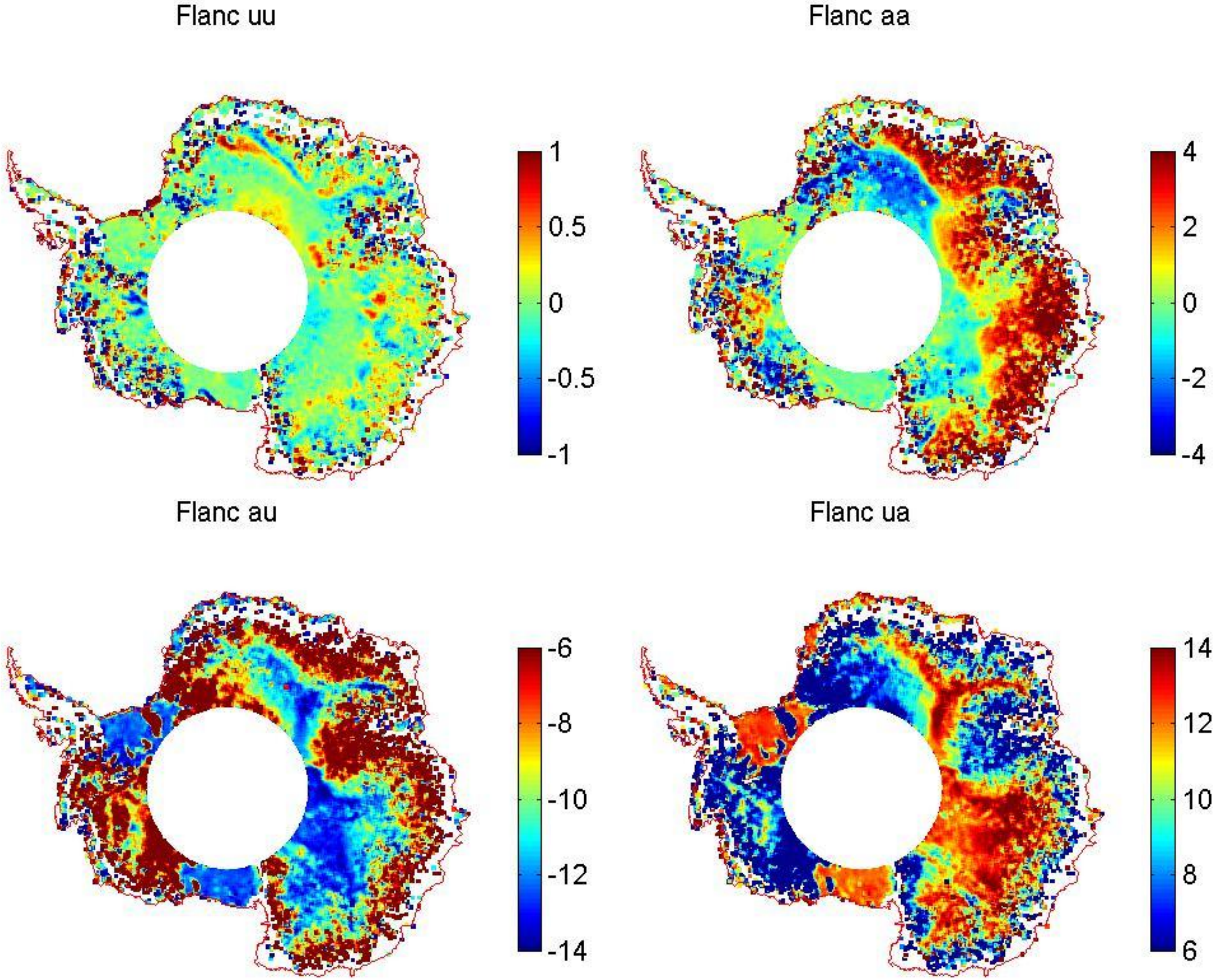


Up to 2 dB difference between ascending and descending passes
→ Up to 1 m in height

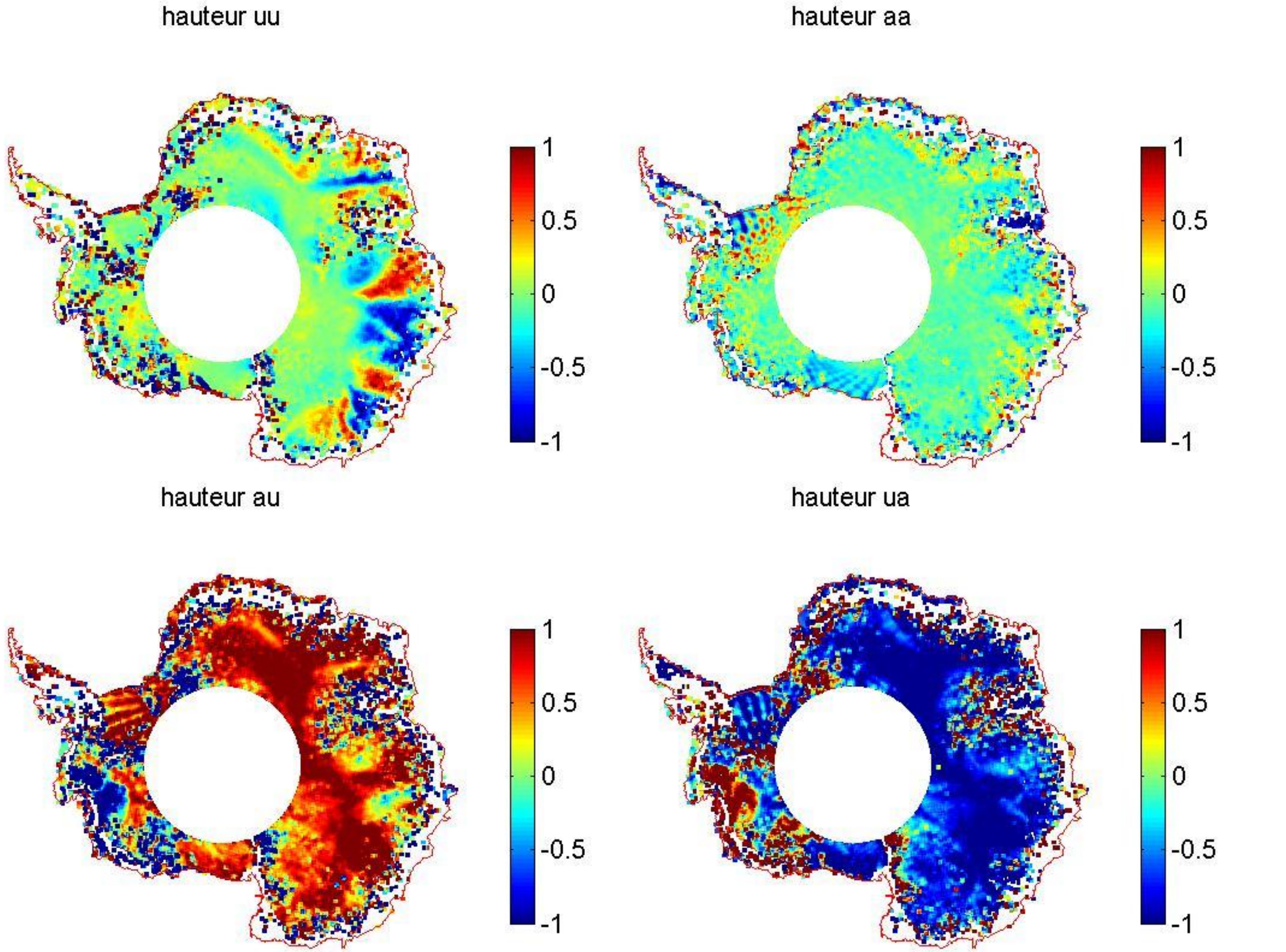




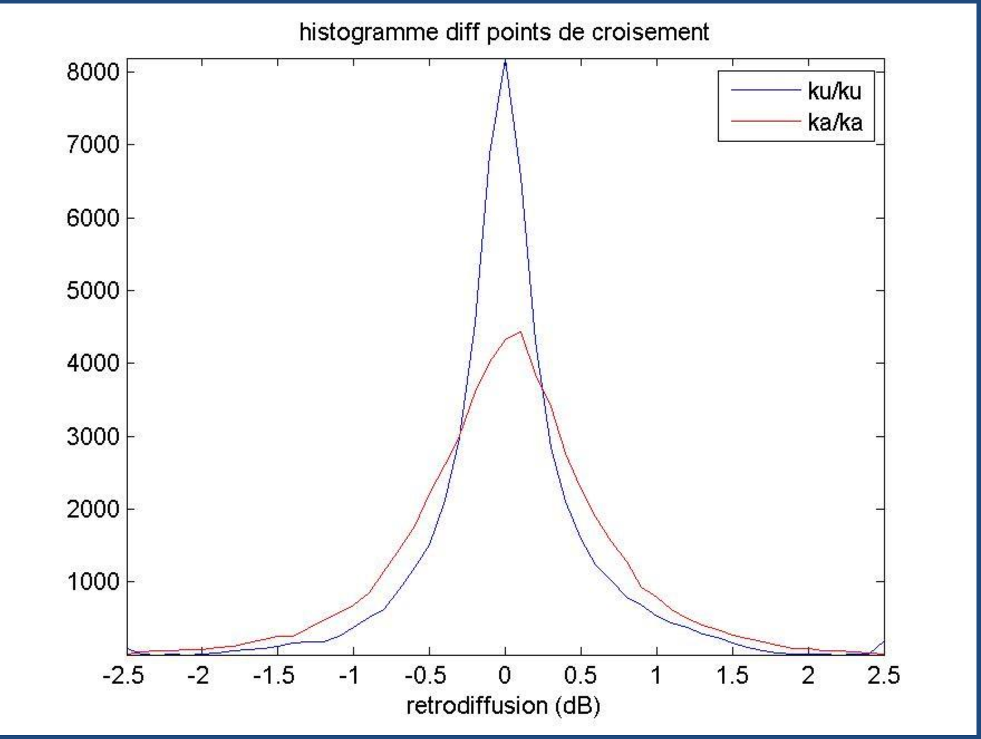
→ Ku and Ka : Same magnitude, then the volume echo is also important in ka band



Also, impact on trailing edge is very important



Happily, impact on height is reduced



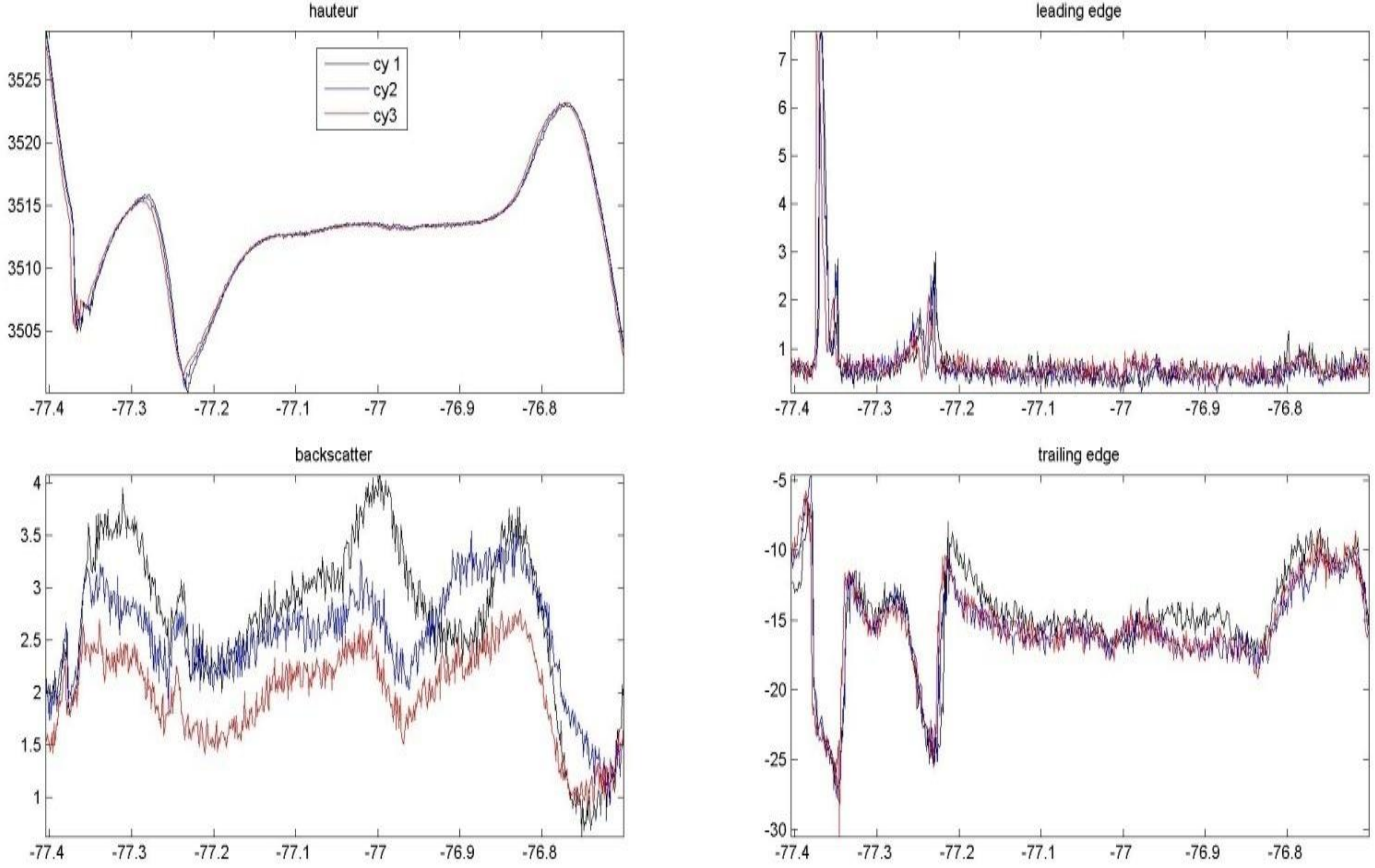
Histogram of the backscatter difference between ascending and descending tracks

→The impact of polarization is more important for ka-band than for ku.

→ However, the induced impact on height is weak

The volume echo seems then to be due to ice grains scattering from the upper subsurface

Temporal variability

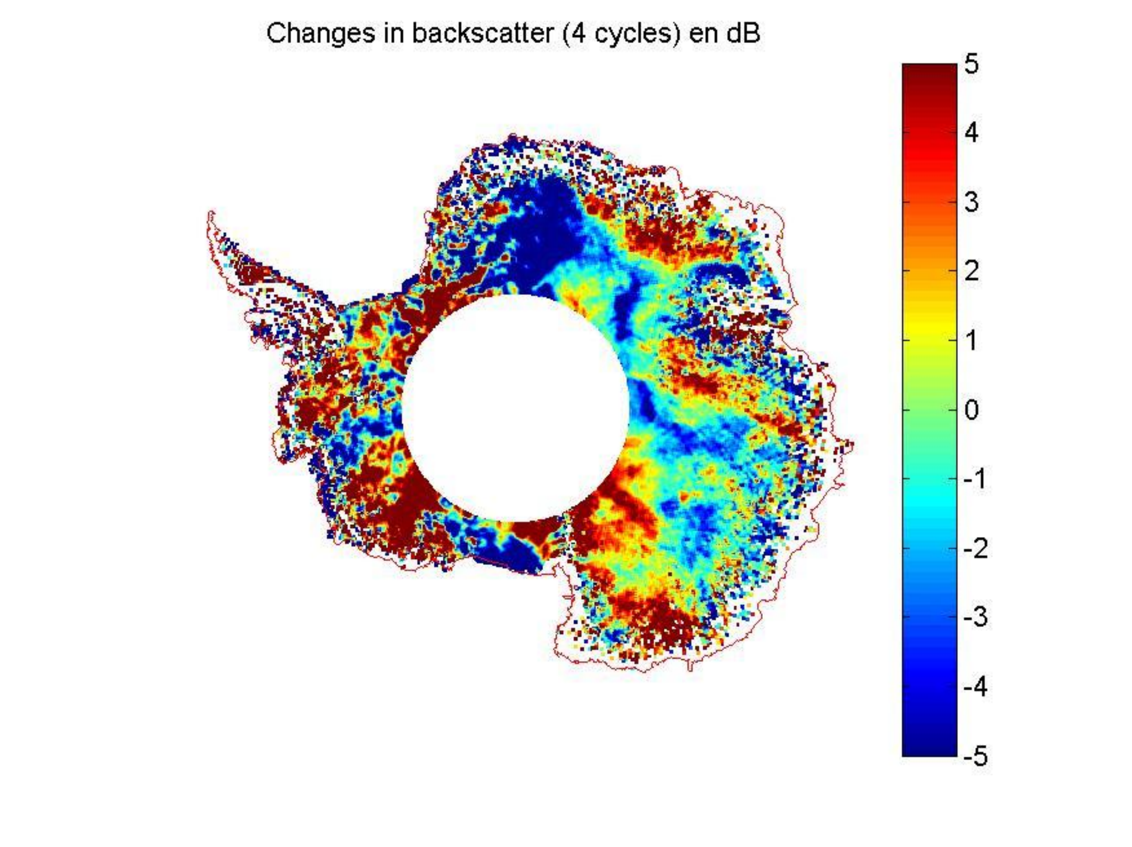


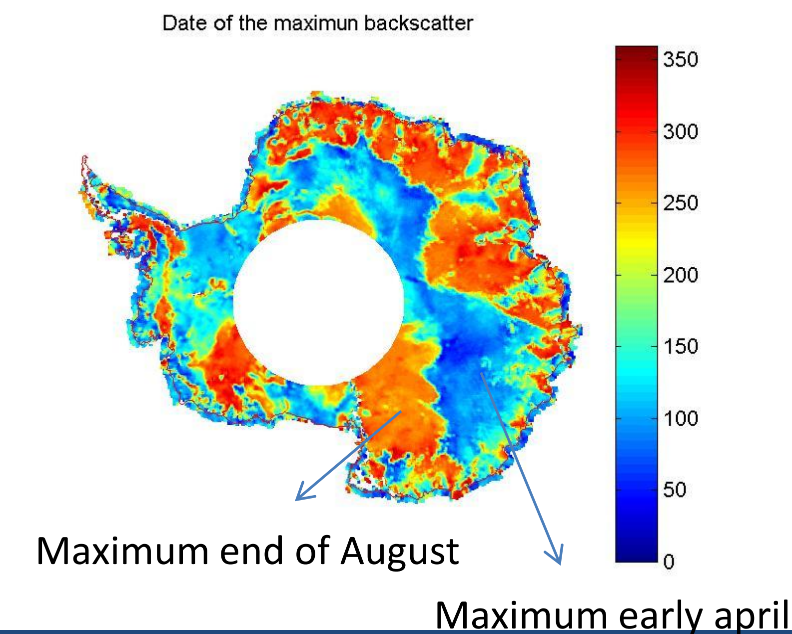
Temporal variations : crossover analyisis because of the orbit

$$P(EnvA,to) – P(altikaD,ti) = Pol1(\theta,dt?) + dP/dt*\Delta t$$

$$P(EnvD,to) – P(altikaA,ti) = Pol2(\theta,dt?) + dP/dt*\Delta t$$

Temporal variations

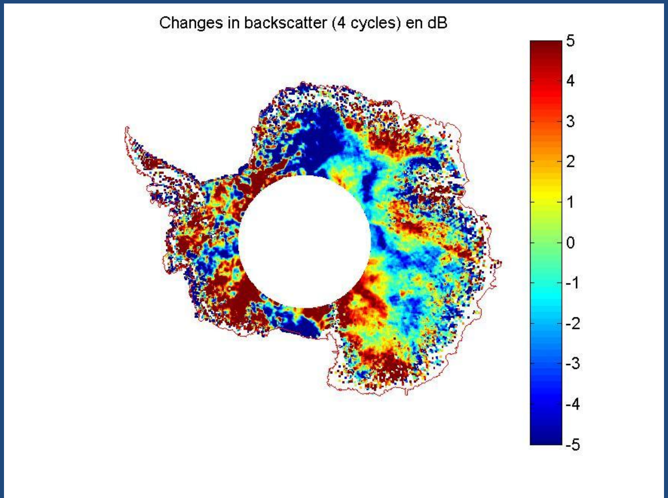


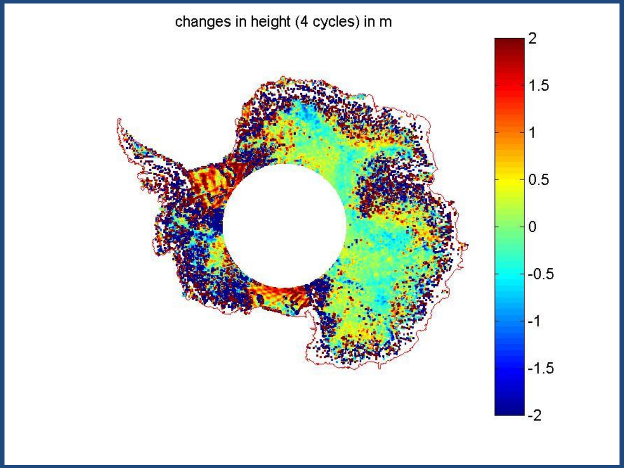


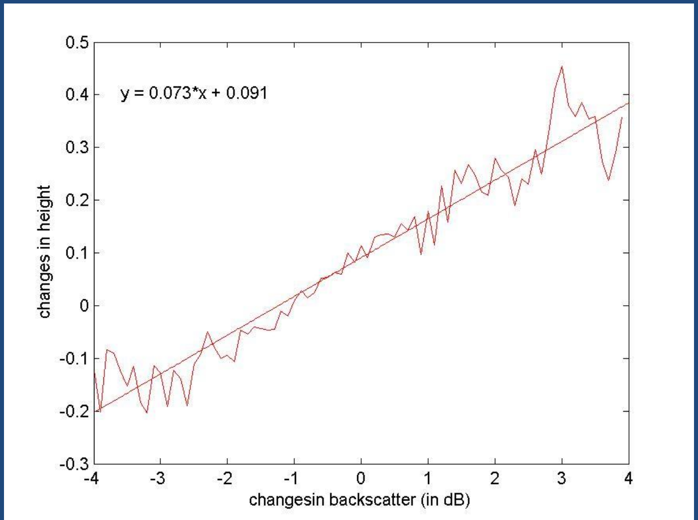
Date of the maximum of the seasonal Backscatter observed from Envisat
Ampltiude is 0.5 dB, 10 times smaller

Impact of short scale temporal variations of the snowpack on the heigth retrieval

A backscatter increase leads to a elevation increase:
Fluctuations of the signal come from the surface or upper subsurface







→0.075 m/dB for Ka band
around 0.7 m/dB in Ku

10 times less for Ka than for Ku but the fluctuations in ka are greater than in Ku…

Conclusion

Antarctica

-Important temporal changes in backscatter, up to ± 5 dB leading to changes in surface height of , up to ± 0.5 m

-- seems to be the same kind of physics (snow densification ?) with probably the same phase

-Ka changes in backscatter seem to be 10 times greater than for ku.

- The relatif impact on height is less important in terms of m/dB but the induced changes of elevation is of the same order of magnitude than for ku.

(meaning that we wil need also a long temporal survey to well correct).

General conclusion

1- Altika very good on snow surface and ice (few new results)

2- Large backscatter sensitivity in space over ice and snow (cf Kouraev, Zakharova/Guerreiro/Prandi), due to interaction between small wavelength and surface ice grain /snow metamorphism/ surface roughness/ wetness/ thin snow layer on ice…

→ need to develop a devoted electromagnetical model taking into account Tb and Bs

3- The smaller penetration (cf Denis) leads to a greater sensitivity to surface and subsurface echoes and thus leads to larger temporal fluctuations

→ Need to explore this for climate survey

Investigation over a flat area

Average value
for H(asc)ka- H(des)ku= 1.6 m
for H(des)ka- H(asc)ku= 1.7 m