



# COMPARAISON IMAGERIE SAR ET ALTIMÉTRIE POUR LA DÉTECTION DES LEADS

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# DONNÉES : TERRASAR-X

## AO DLR « TSX-New-Modes-2013 »

-> Projet OCE2395:

Cross-comparison of altimetric high resolution missions with TerraSAR-X Wide ScanSAR : understanding sea ice structures, river behaviour and small scale ocean signals

=> On peut demander l'acquisition d'images

 Doc: TS-PDS-PL-4003  
Issue 2.2  
Date: 27.09.2011

**User License for the Utilisation of  
TerraSAR-X / TanDEM-X Data and Products  
for Scientific Use**

between  
**DLR**  
and  
**the Principal Investigator**

\_\_\_\_\_

Proposal ID: \_\_\_\_\_ Issued on \_\_\_\_\_

As the duly empowered representative of \_\_\_\_\_  
I hereby declare to have read and approved the terms and conditions and unconditionally accept that any activity related to the project be governed by them.

Date: \_\_\_\_\_

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

# DONNÉES ALTIMÉTRIE : SARAL/ALTIKA

Lancé en février 2013

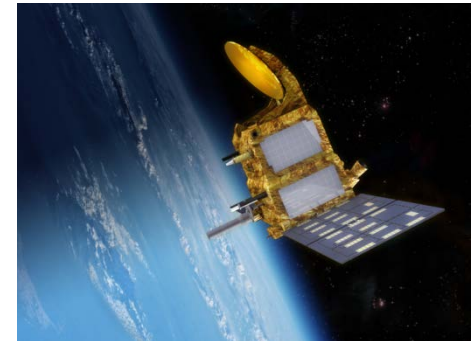
Principales caractéristiques :

Bande Ka

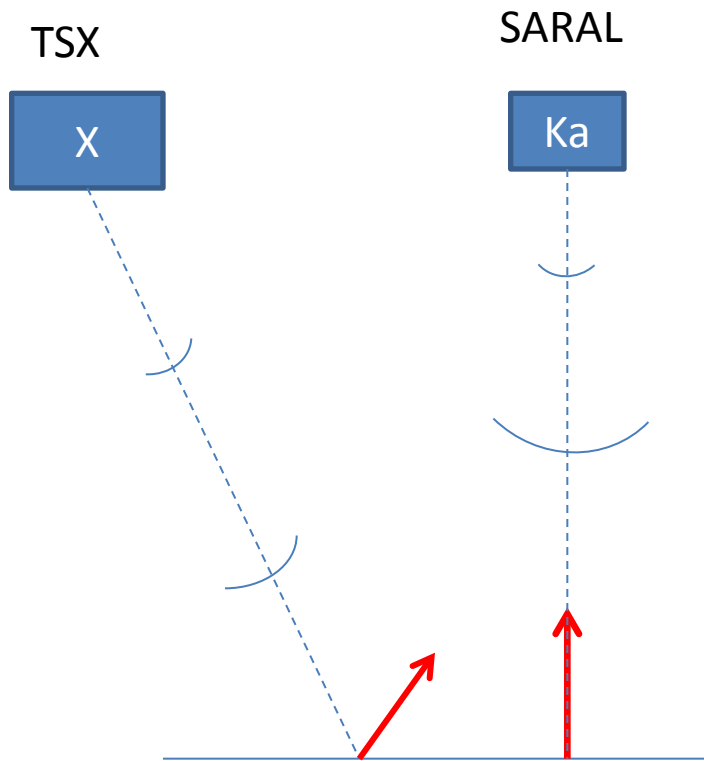
- Empreinte réduite (5km de rayon) => meilleure résolution spatiale
- Plus faible pénétration qu'en Ku

Largeur de bande 480Mhz -> meilleure résolution verticale (31cm)

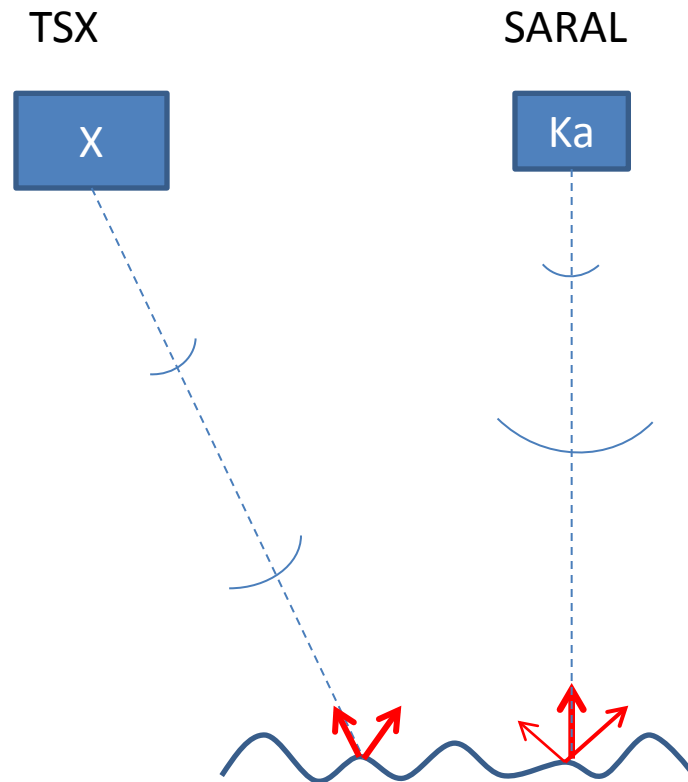
PRF=4kHz => meilleur échantillonnage spatial



# GÉOMETRIE D'ACQUISITION



Surface spéculaire

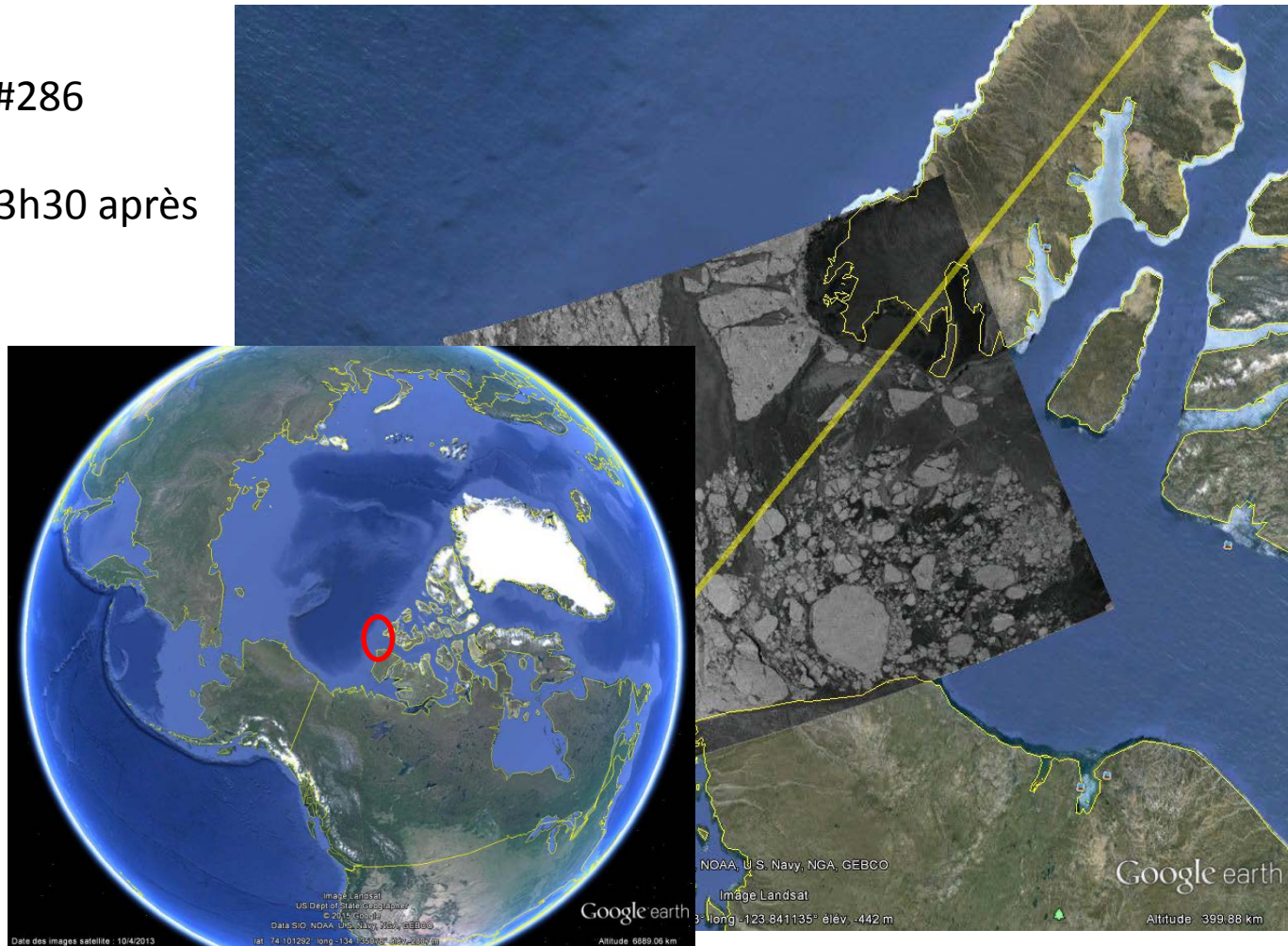


Surface rugueuse

# EXEMPLE: 2015-11-29 MER DE BEAUFORT

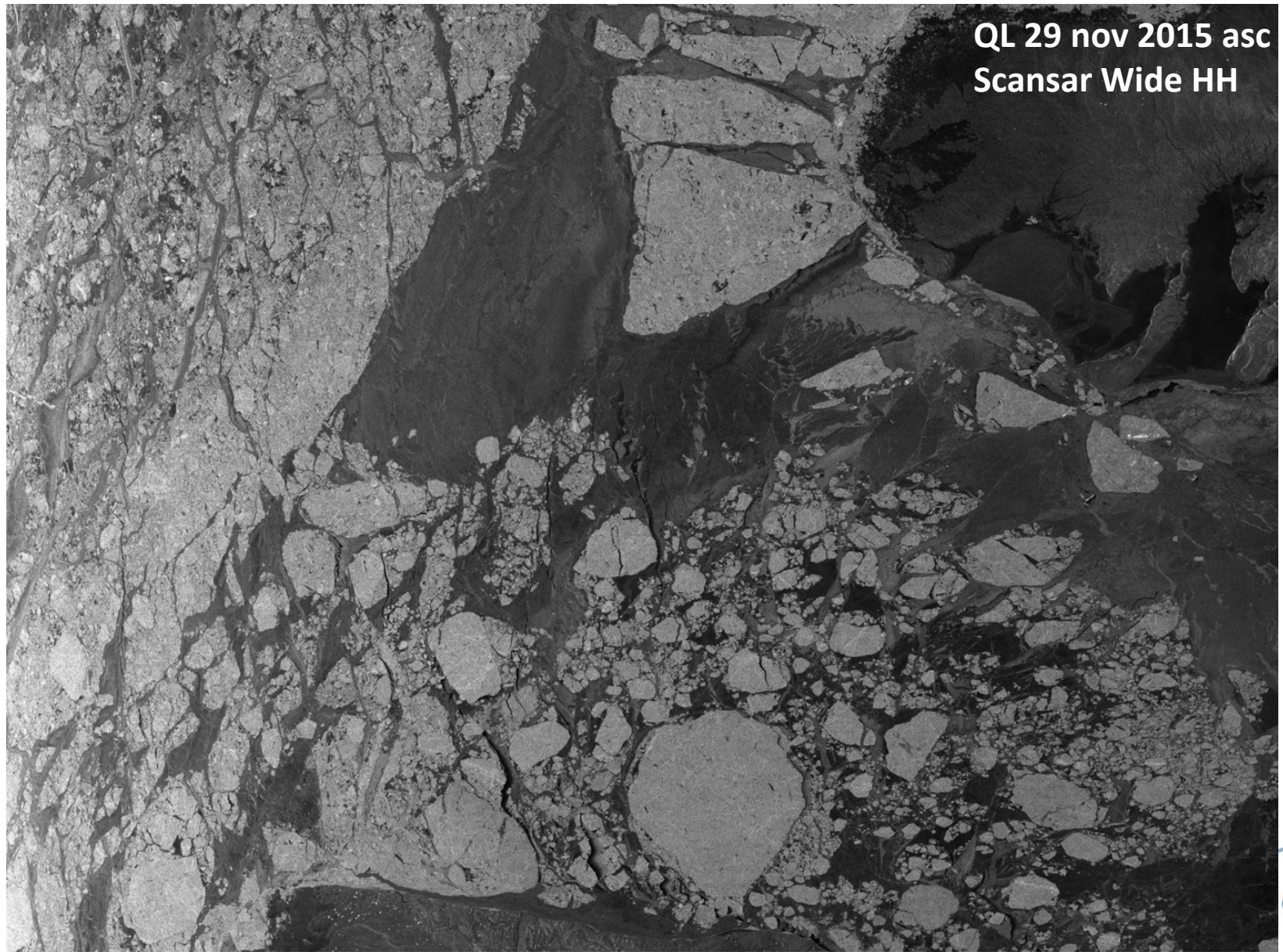
SARAL/AltiKa :  
Cycle#29, trace#286

Passage SARAL 3h30 après  
TerrasAR-X



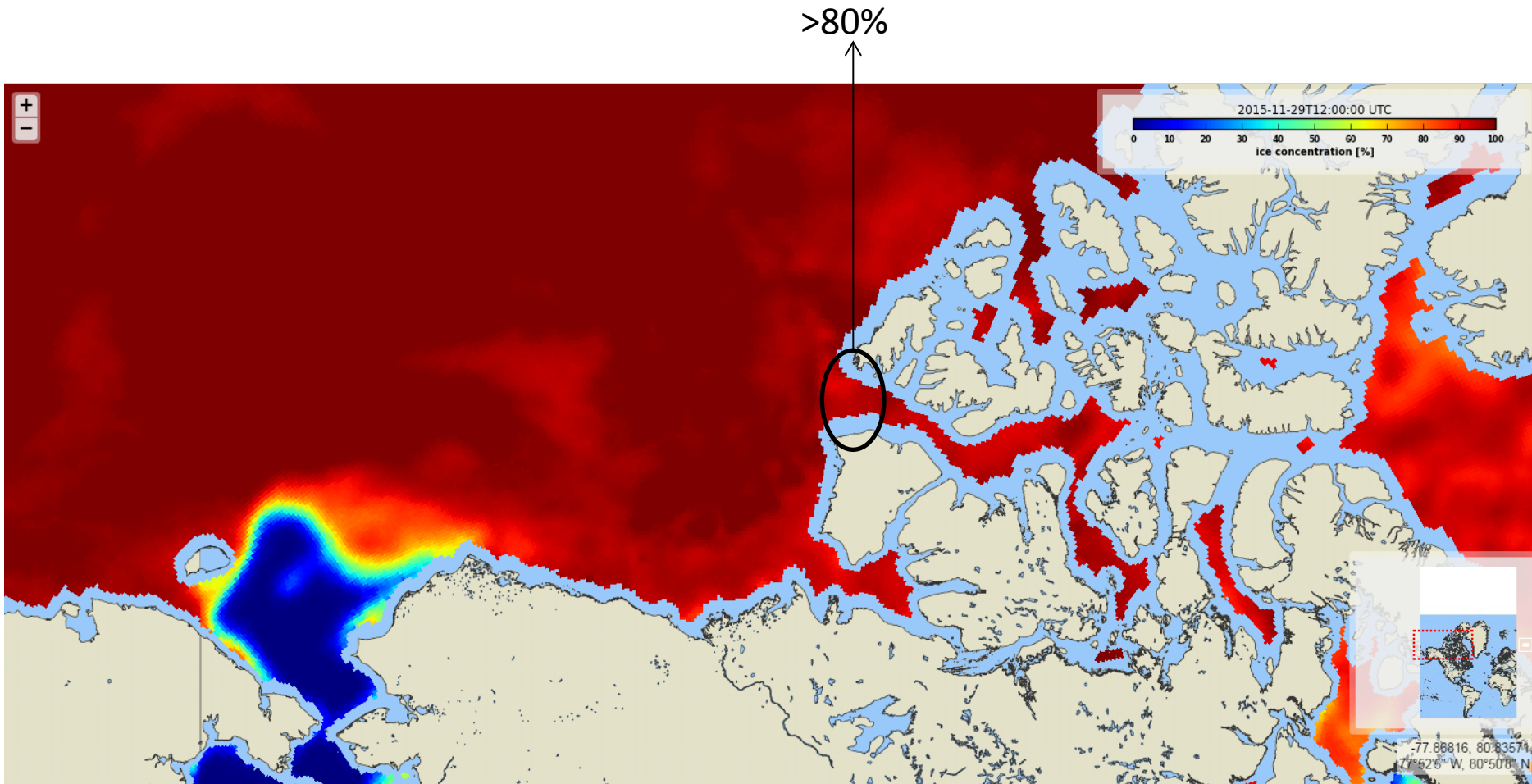


# EXEMPLE: 2015-11-29 MER DE BEAUFORT

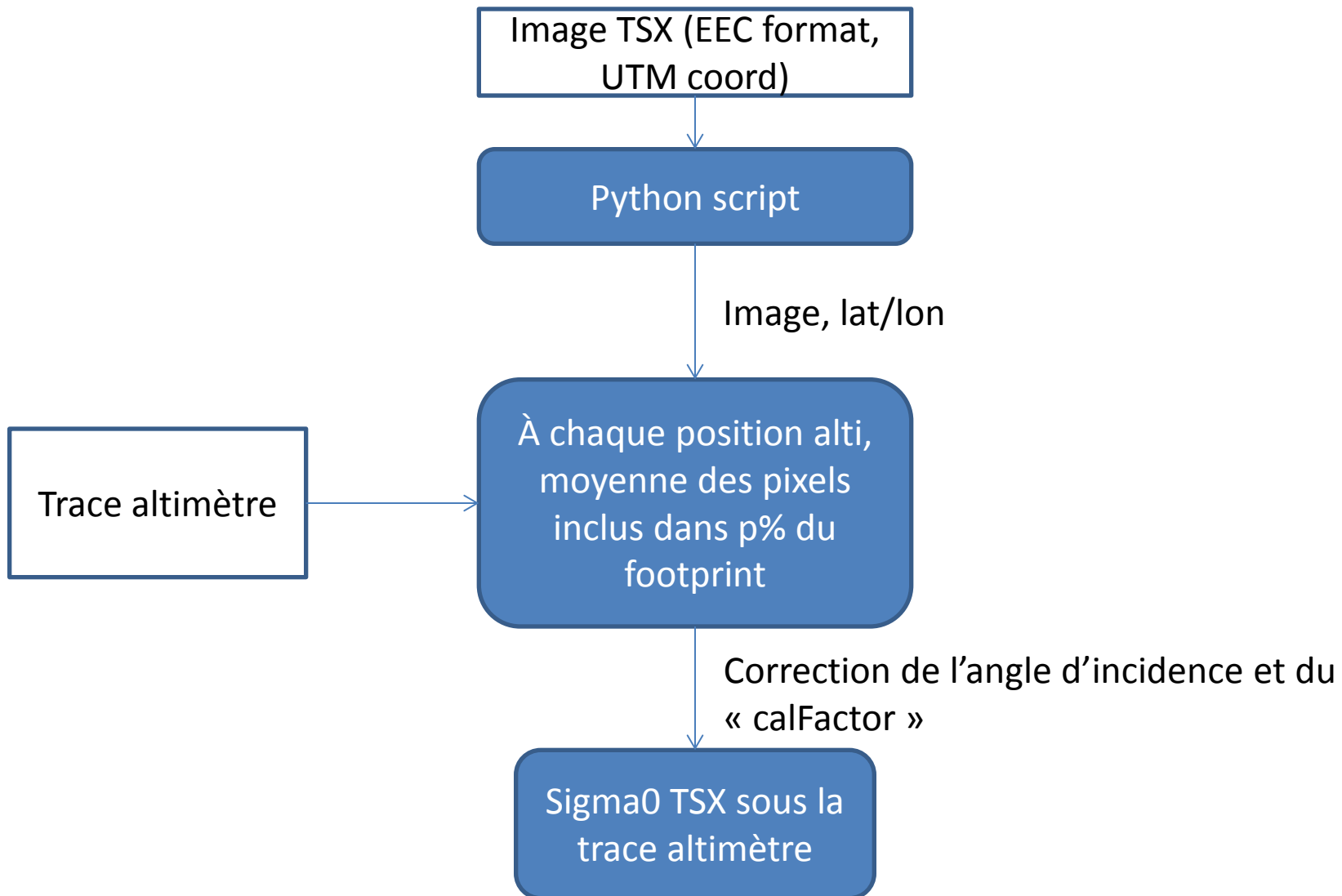


QL 29 nov 2015 asc  
Scansar Wide HH

# 2015-11-29: OSISAF ICE CONCENTRATION



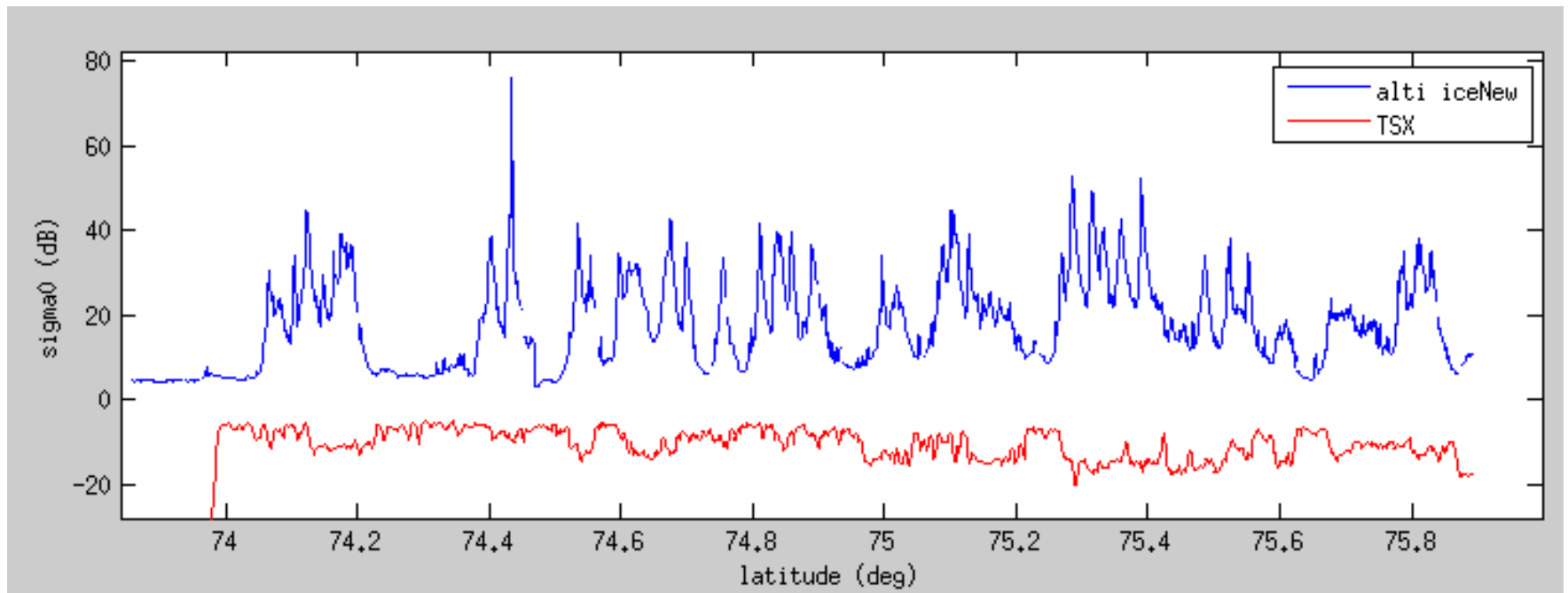
# COMPARAISON SIGMA0 : MÉTHODE



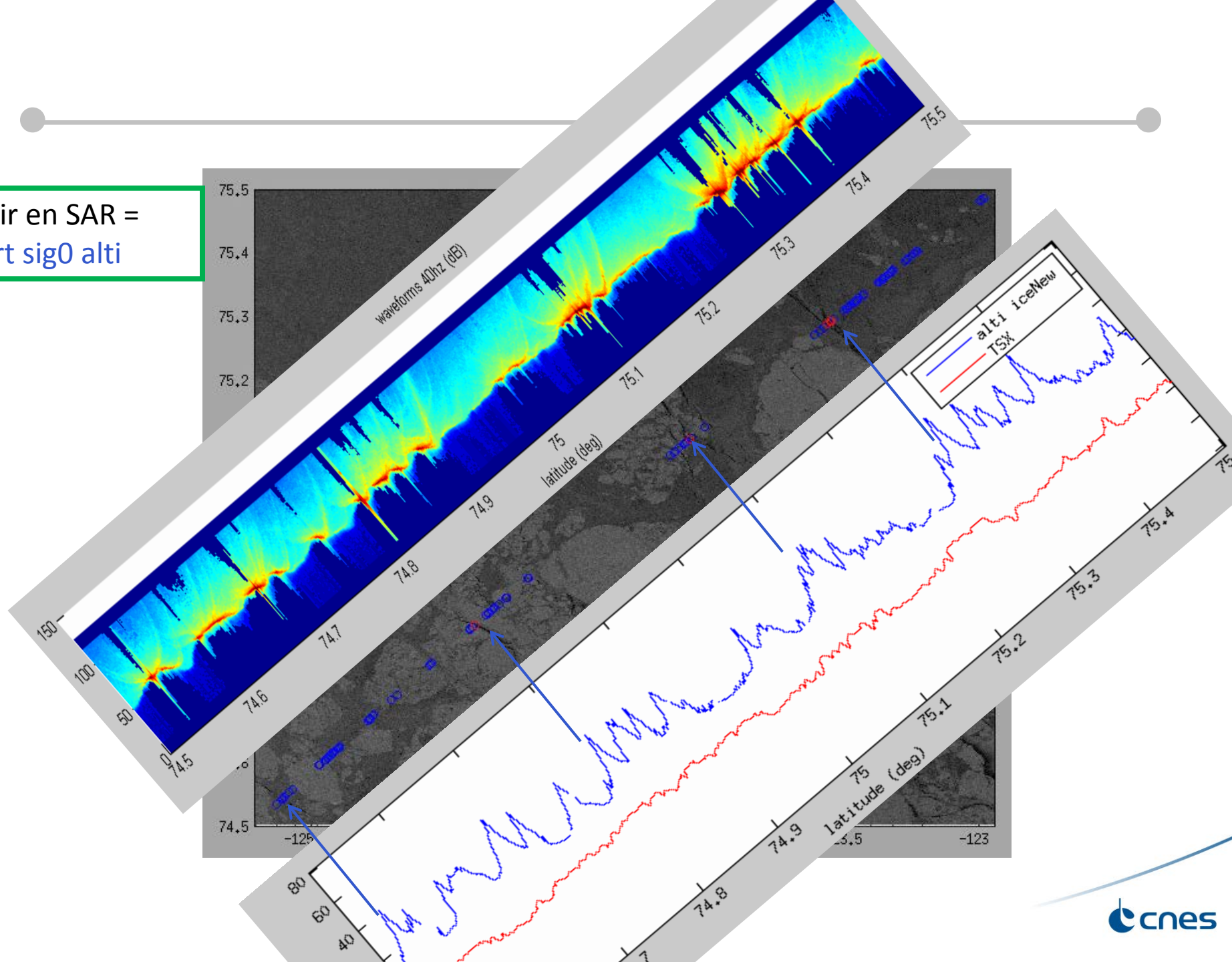


# COMPARAISON SIGMA0

Comme attendu, variations opposées du sigma0 du fait des incidences différentes.

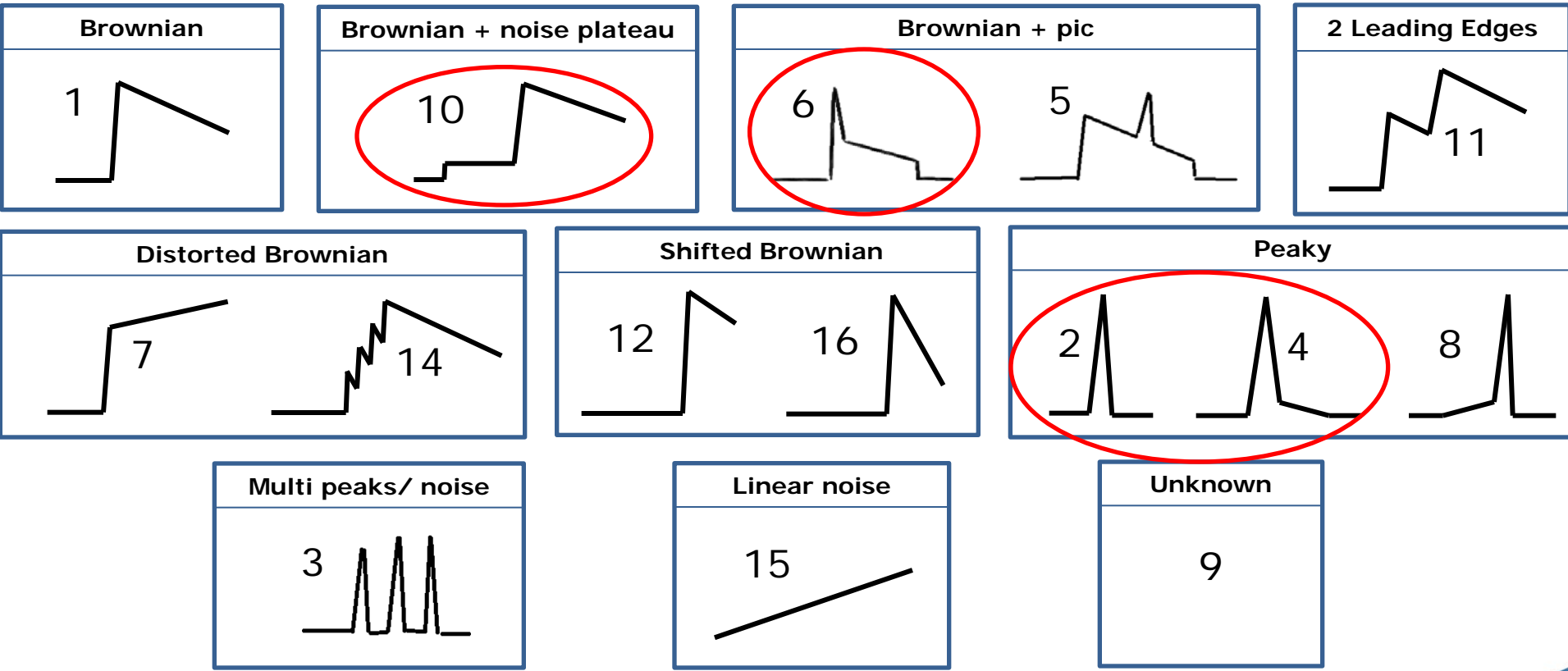


Noir en SAR =  
Fort sig0 alti

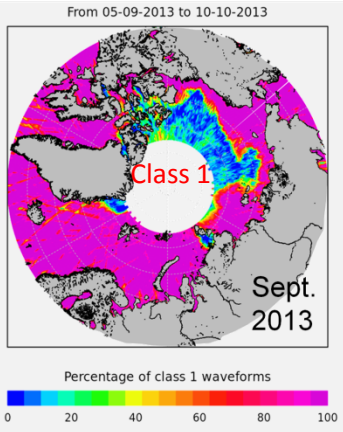


# CLASSIFICATION DES FO ALTI

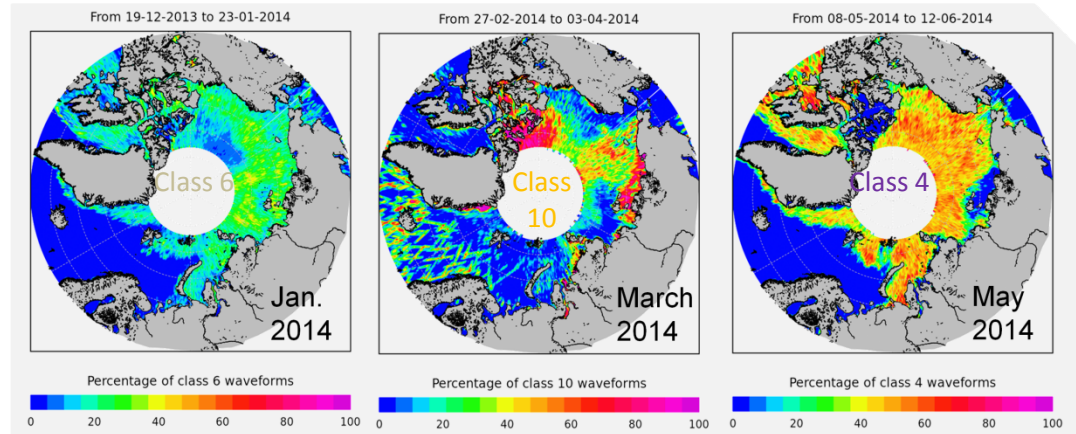
Utilisation d'un réseau de neurones (cf présentation de JC Poisson)



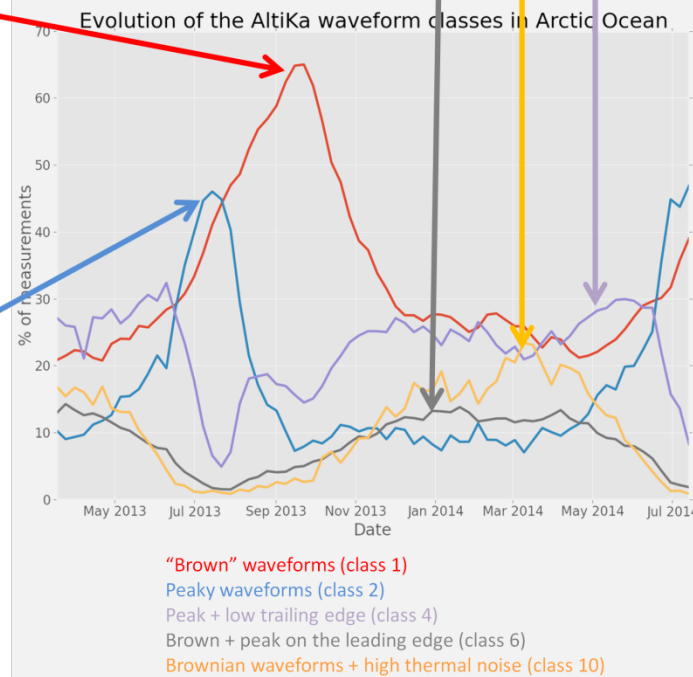
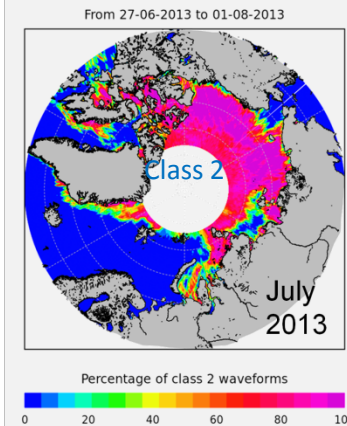
# CLASSIFICATION DES FO : RÉSULTAT SUR L'ARCTIQUE



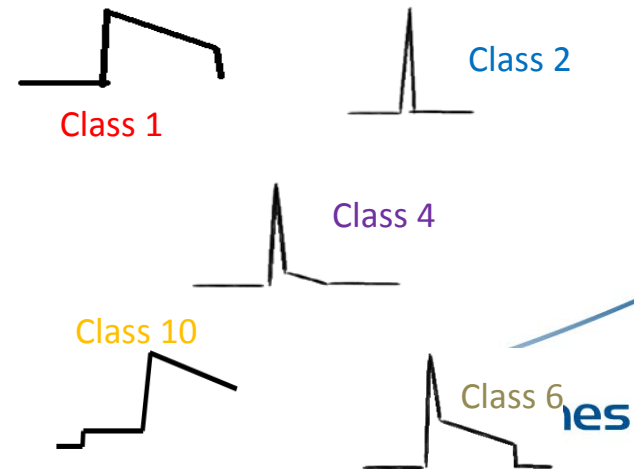
The class 1 (ocean waveforms) maximum population matches the minimum of sea ice expansion.



A class 2 (peaky shape) population peak is clearly visible during ice melting. It can be linked to the emergence of highly reflective surfaces (leads, thin water layer over sea ice, ...)

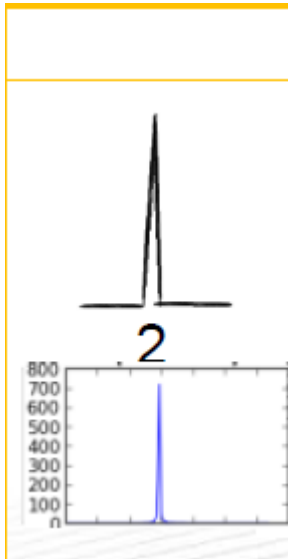


Classes 4 & 6 are only found over sea ice. Their maximum population corresponds to the maximum ice cover.  
 Class 10 describes very low signal to noise ratio conditions. It happens when ocean measurements are impacted by rain cells and may be due to the presence of snow over sea ice.



# FLAG LEAD ALTIMÈTRE

FO classe 2 + sig0 > seuil (20dB pour AltiKa) -> lead



Dans cet exemple, pas d'editing des hooking



# FOREWORD ON SEA ICE BACKSCATTERING FROM SINGLE-POL SAR IMAGES (L-C-X BANDS)

## Sea ice varies according to many parameters:

EM parameters such as the dielectric properties of brine inclusion and of ice depending on salinity

Geo-physical parameters such as the sea ice thickness, its top surface roughness, its porosity, the size/shape of scatterers (brine inclusions, air particles...).

Potential snow cover (dielectric constant of 1.5 for dry snow – varying also with density, frequency and wetness)

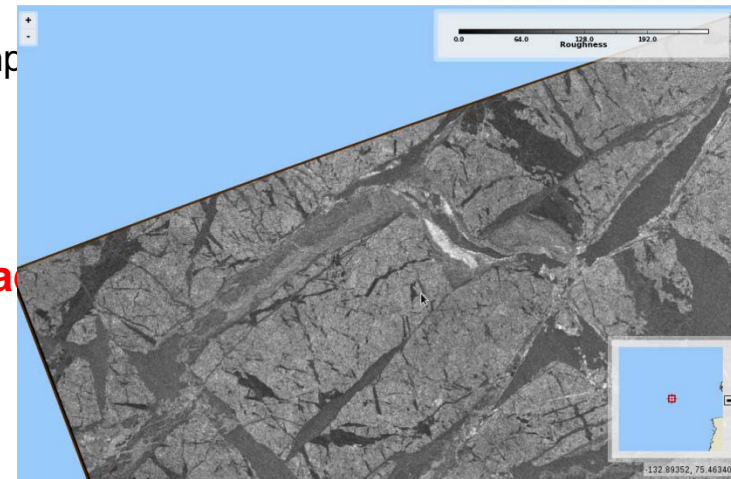
**Large number of parameters impacting sea ice backscattering, potential ambiguities between open water and thin ice in leads with single-pol SAR imagery**

## Lead with thin ice or open

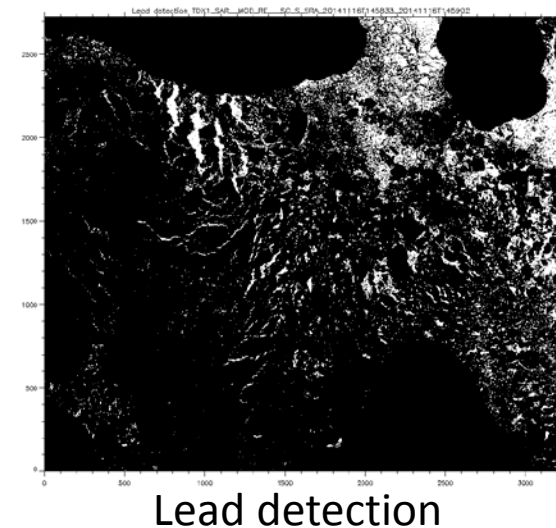
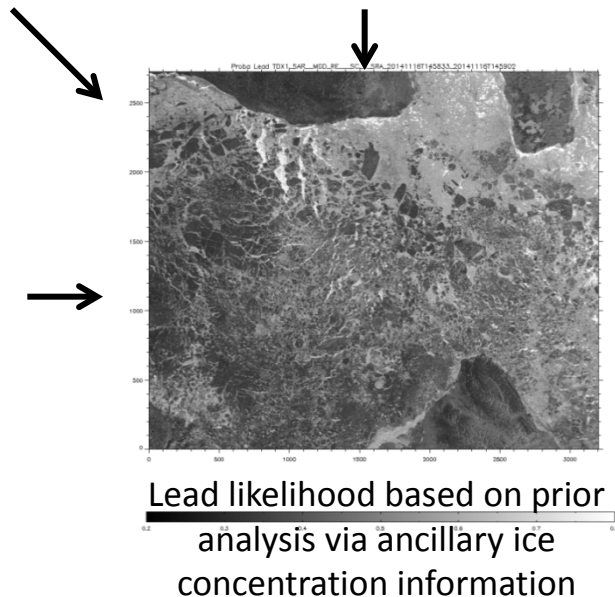
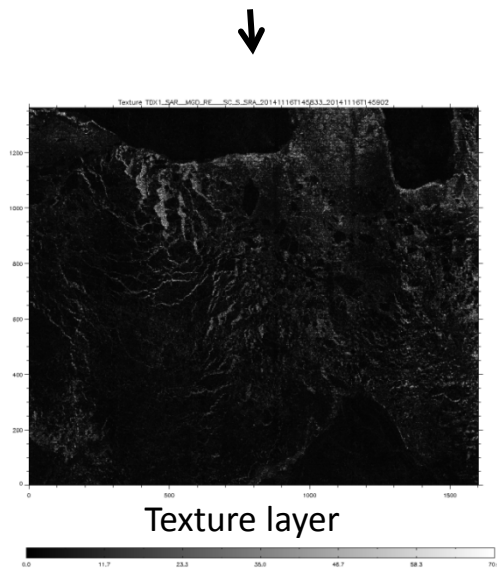
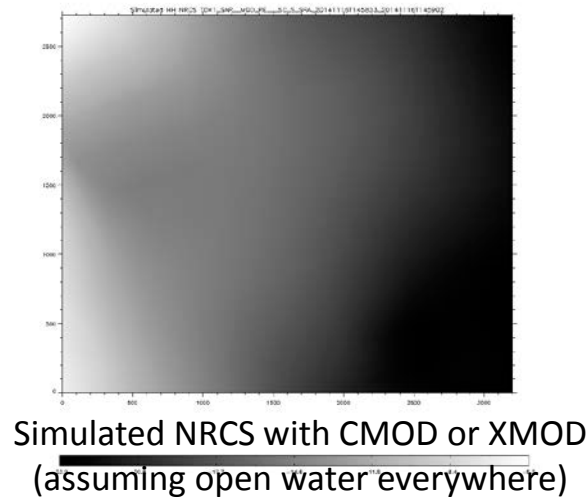
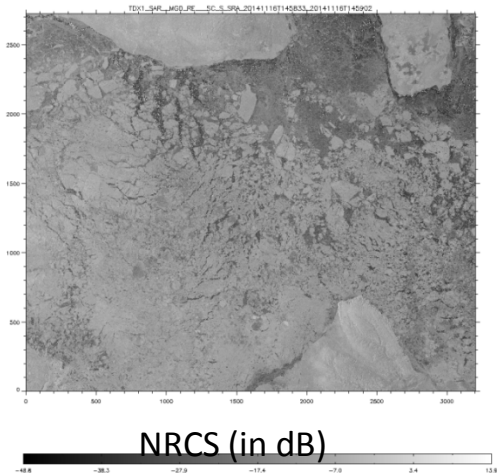
Open water rapidly freezes (directly exposed to the cold air temperature) formed followed by black ice

Backscattering close to NESZ of current available sensors

**Potential ambiguity in leads between thin ice and open water (limited fetch -> very calm sea surface)**

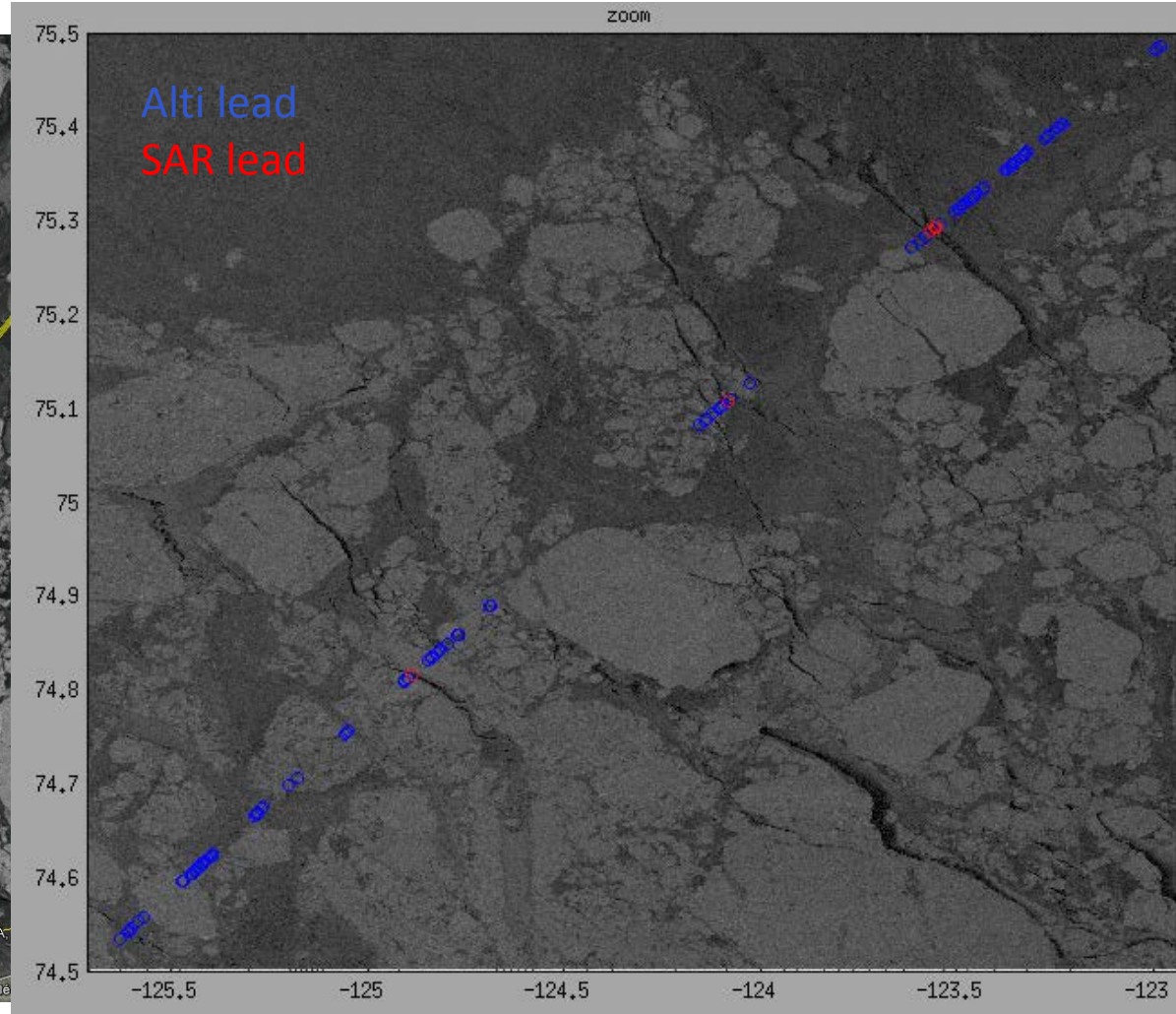


# AUTOMATIC LEAD DETECTION WITH SINGLE-POL X-BAND DATA



Iterative threshold with morphological filter

# COMPARAISON DES FLAGS LEAD



# À VENIR

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Calcul automatique des coloc (spatiales et temporelles) entre Sentinel-1 et SARAL / Cryosat-2 / Sentinel-3

Calcul d'un flag lead Sentinel-1 sur les coloc (intégrant l'apport de la double polarisation)

Comparaison au flag lead altimètre



# EN COURS

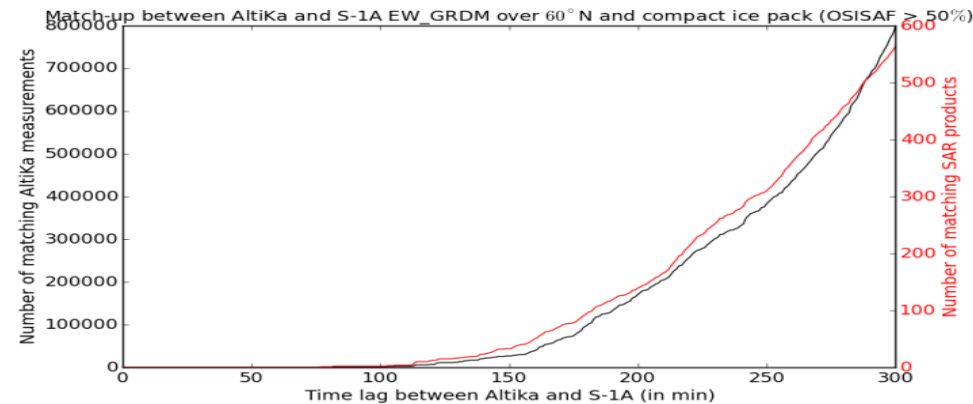
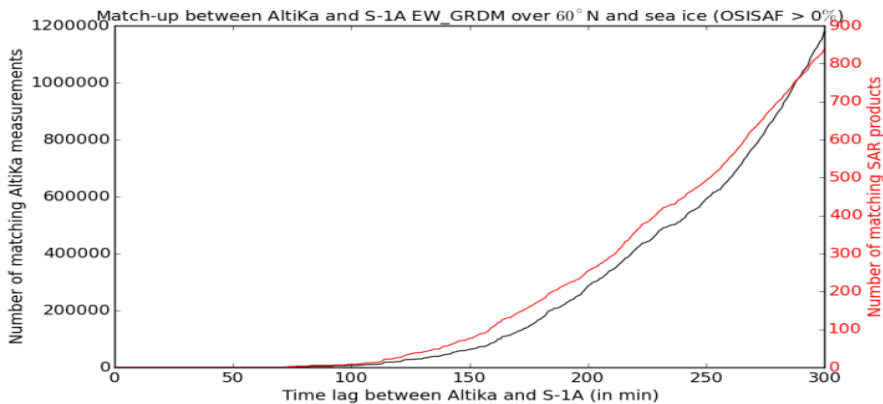
## Calcul des colocs SARAL / S-1A (hiver 2015 en Arctique)

Utilisation de l'archive IW et EW S-1A en entrée

- utilisation **Annotation files** pour identifier la zone d'acquisition et la date
- Filtre : au moins un coin de l'image > 60°N

Recherche des traces SARAL traversant une image S1A à +/-5h

On ne conserve que les colocs remplissant le critère ice concentration > 0 (OSISAF)



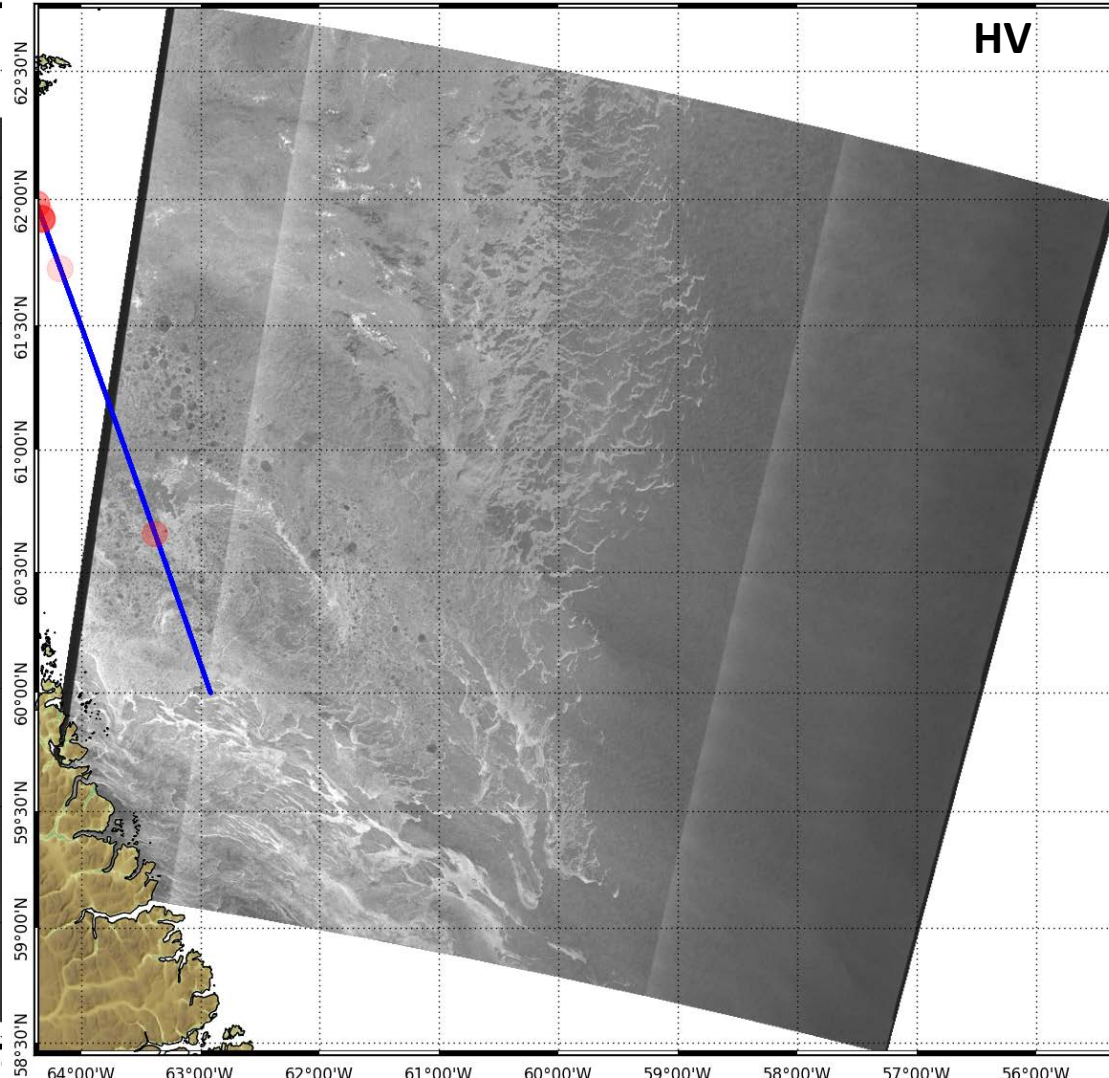
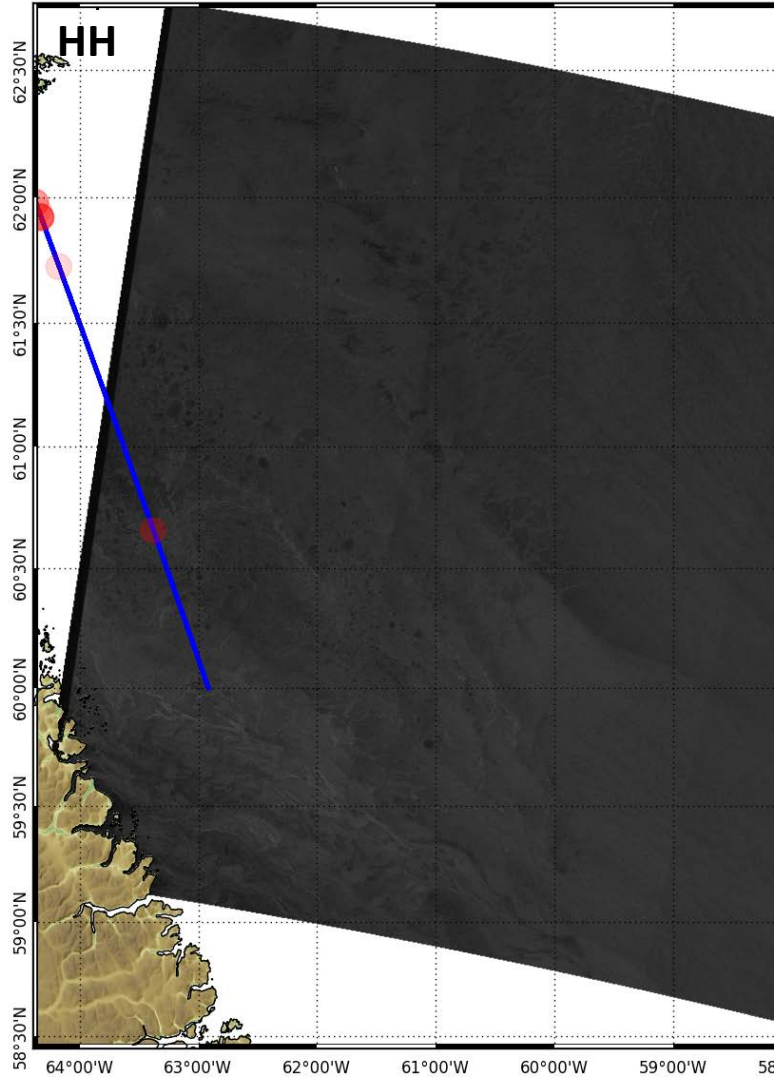
=> Téléchargement des images sélectionnées à partir du serveur ESA



# INTÉRÊT DE LA DOUBLE POLARISATION

S-1A EW HH @ 2015-12-28 10:26 UTC  
SARAL/Altika 40.00Hz @ 2015-12-28 09:20 UTC ( $\Delta_t = 66$  min)

S-1A EW HV @ 2015-12-28 10:26 UTC  
SARAL/Altika 40.00Hz @ 2015-12-28 09:20 UTC ( $\Delta_t = 66$  min)



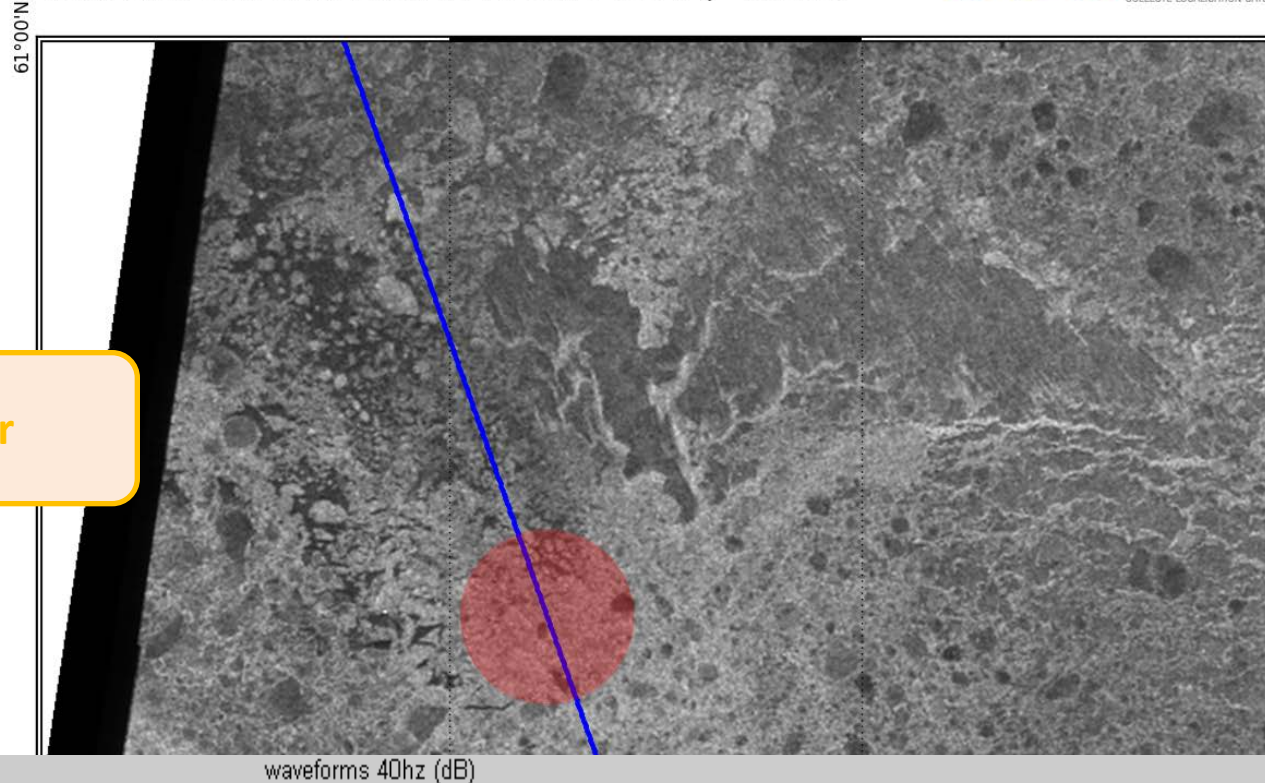
# PREMIERS EXEMPLES

S-1A EW HH @ 2015-12-28 10:26 UTC  
SARAL/Altika 40.00Hz @ 2015-12-28 09:20 UTC ( $\Delta_t=66$  min)

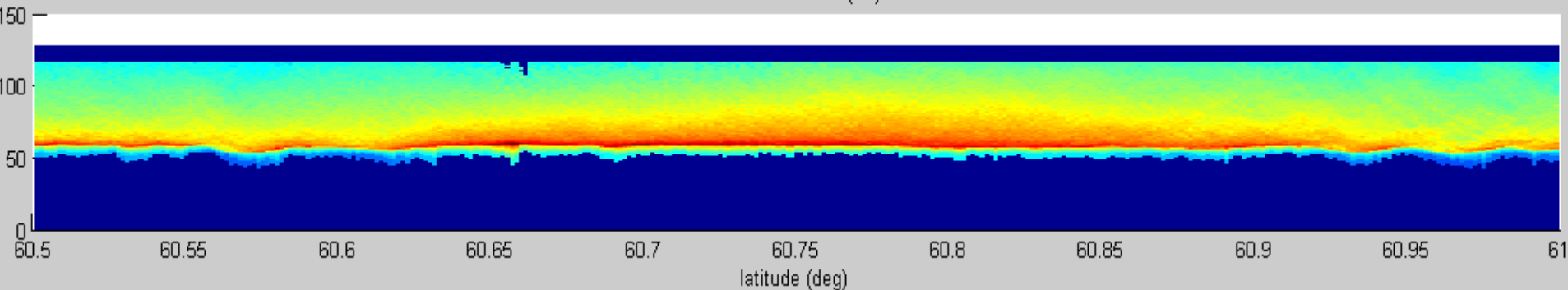


Points rouges =  
lead alti

À investiguer



waveforms 40hz (dB)



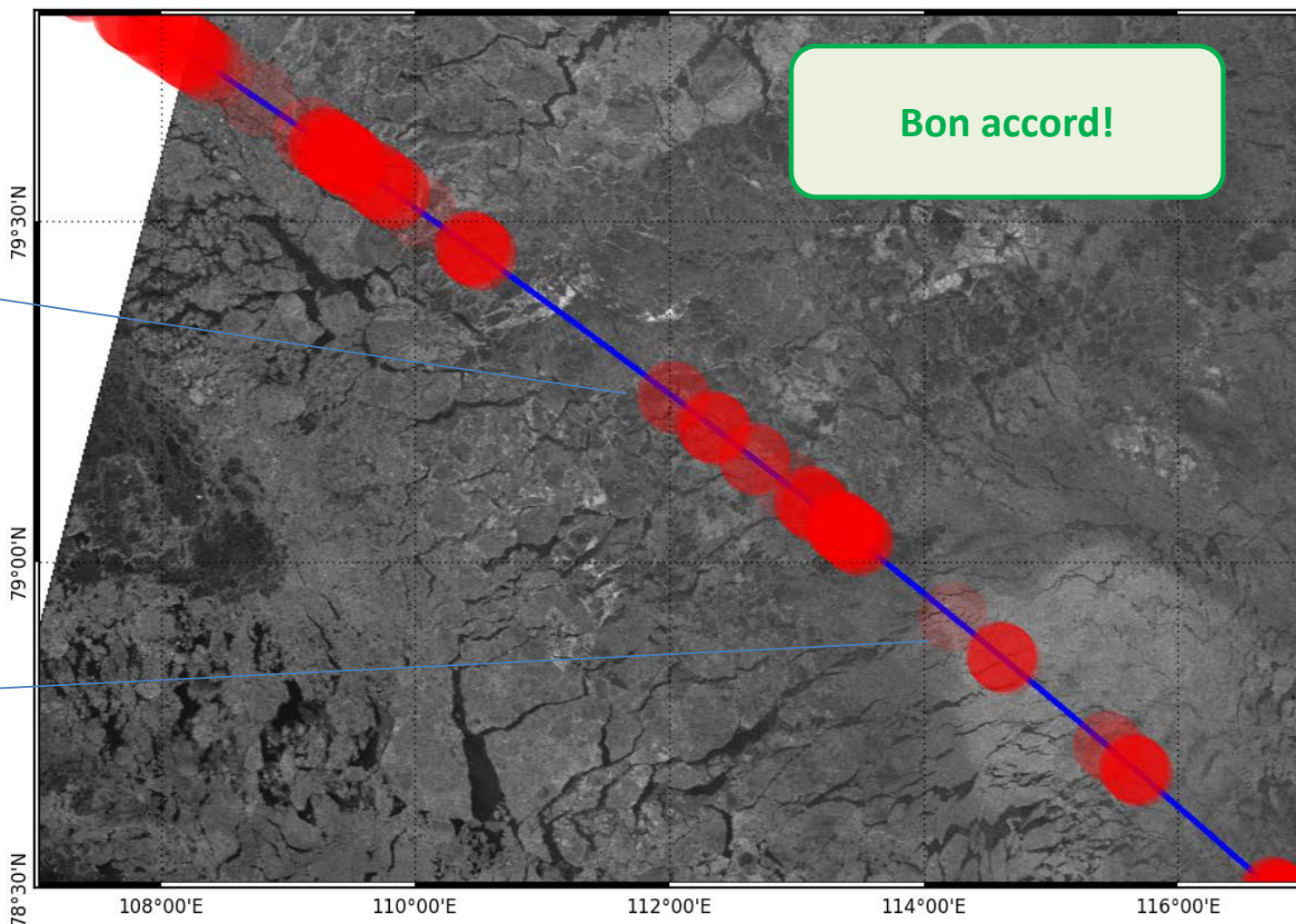
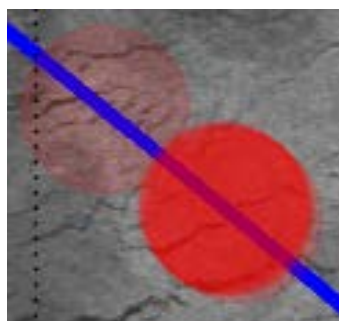
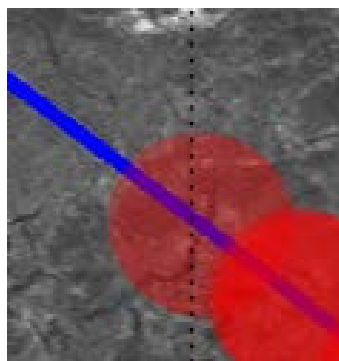


# PREMIERS EXEMPLES

S-1A EW HH @ 2015-10-10 23:39 UTC  
SARAL/Altika 40.00Hz @ 2015-10-10 19:07 UTC ( $\Delta_t = 272$  min)



Points rouges =  
lead alti



## EN RÉSUMÉ...

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### Complémentarité entre l'imagerie SAR et l'altimétrie

### Comparaison systématique SAR/altimétrie à venir

La double polarisation sur S1 sera exploitée

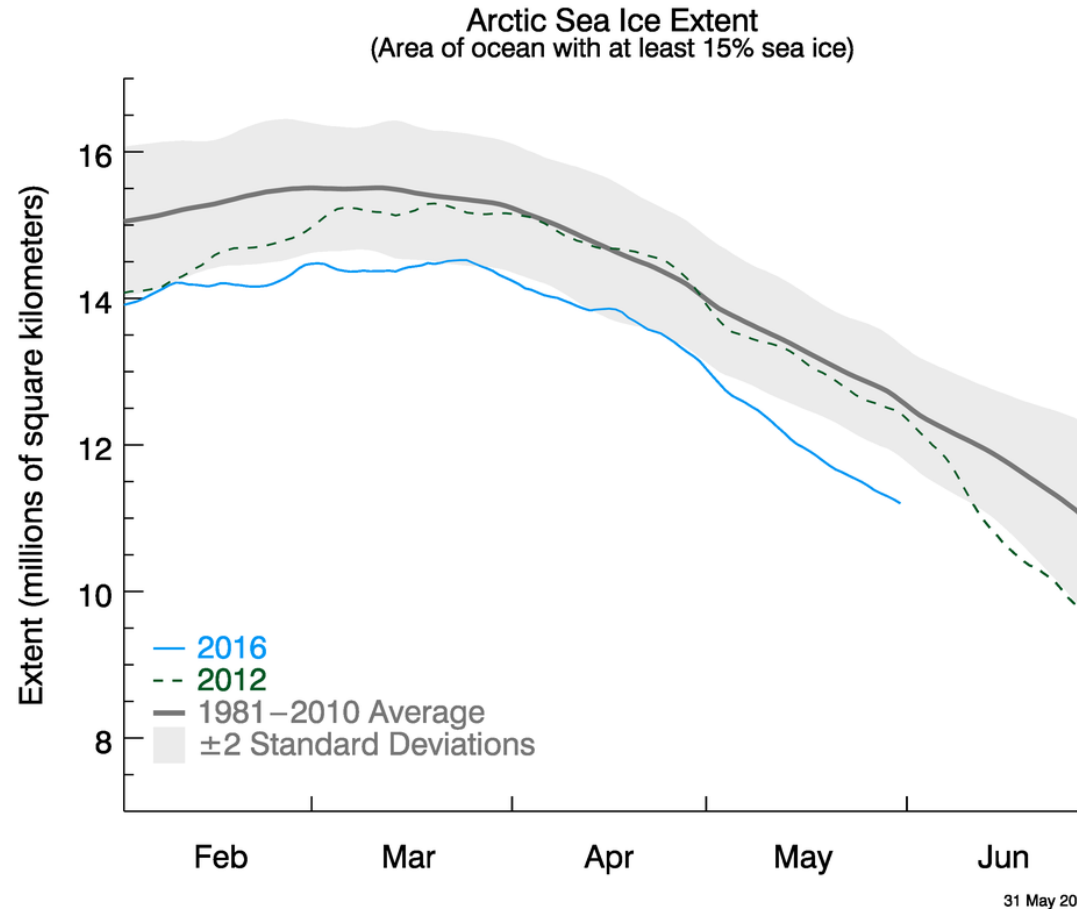
Les données Sentinel-3 (alti) et Sentinel-1B (images) seront également utilisées

### Pistes :

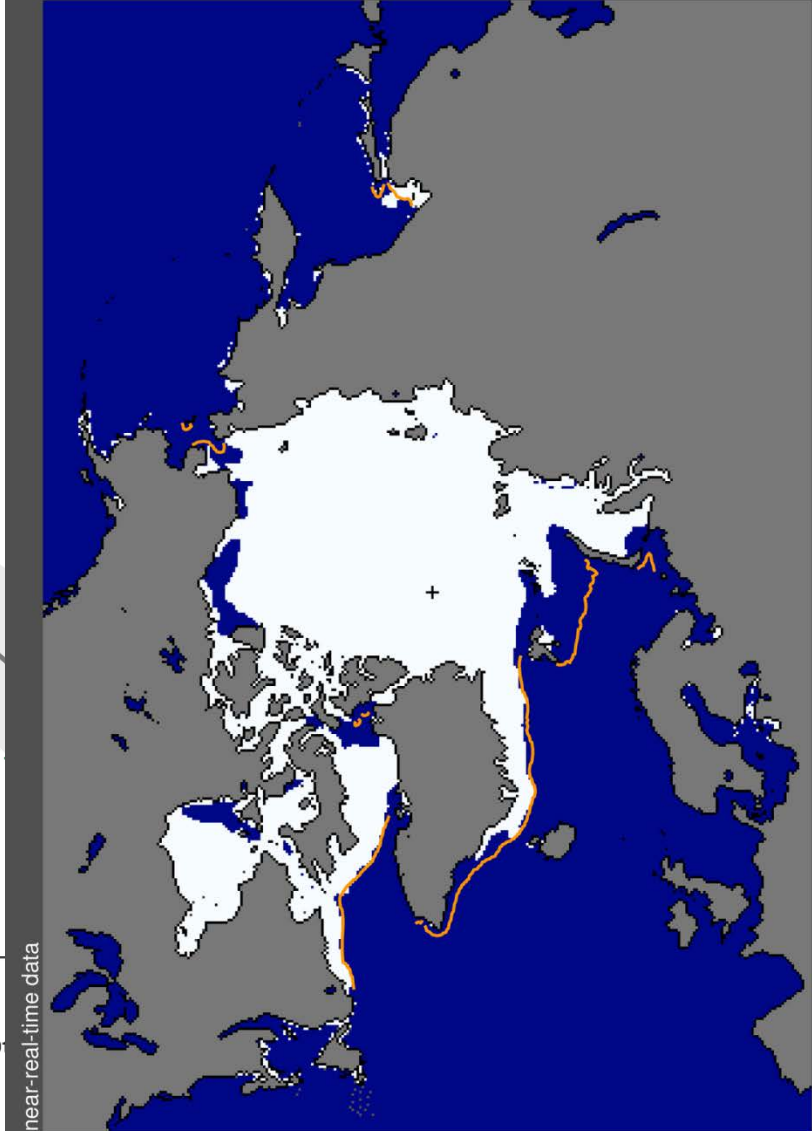
Utilisation d'un produit de dérive de glace pour compenser le délai entre les acquisitions alti et SAR (Ifremer, NSIDC)

Fusion des flags lead et SAR pour aboutir à un flag multi-capteurs?

# COUVERTURE DE GLACE (NSIDC)



Sea Ice Extent  
05/31/2016



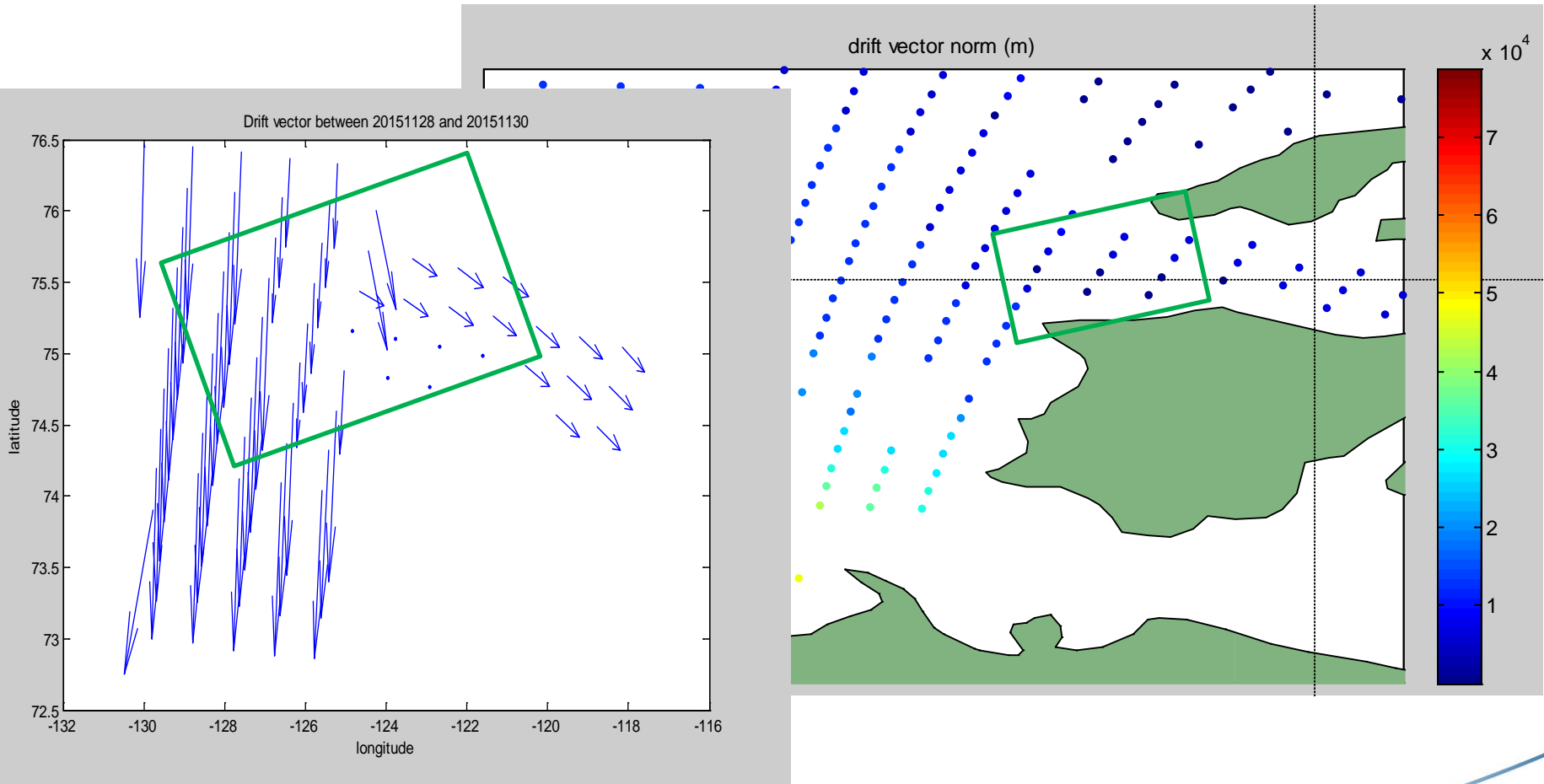


# BACKUP SLIDES



# SEA ICE DRIFT

Produit Ifremer : ~700m de dérive entre les 2 acquisitions



# COMPARISON FLAGS LEAD

+ alti lead

+ TSX lead

