Altimeter sigma0bloom and surface slick

Jean Tournadre, Bertrand Chapron, LOS IFREMER

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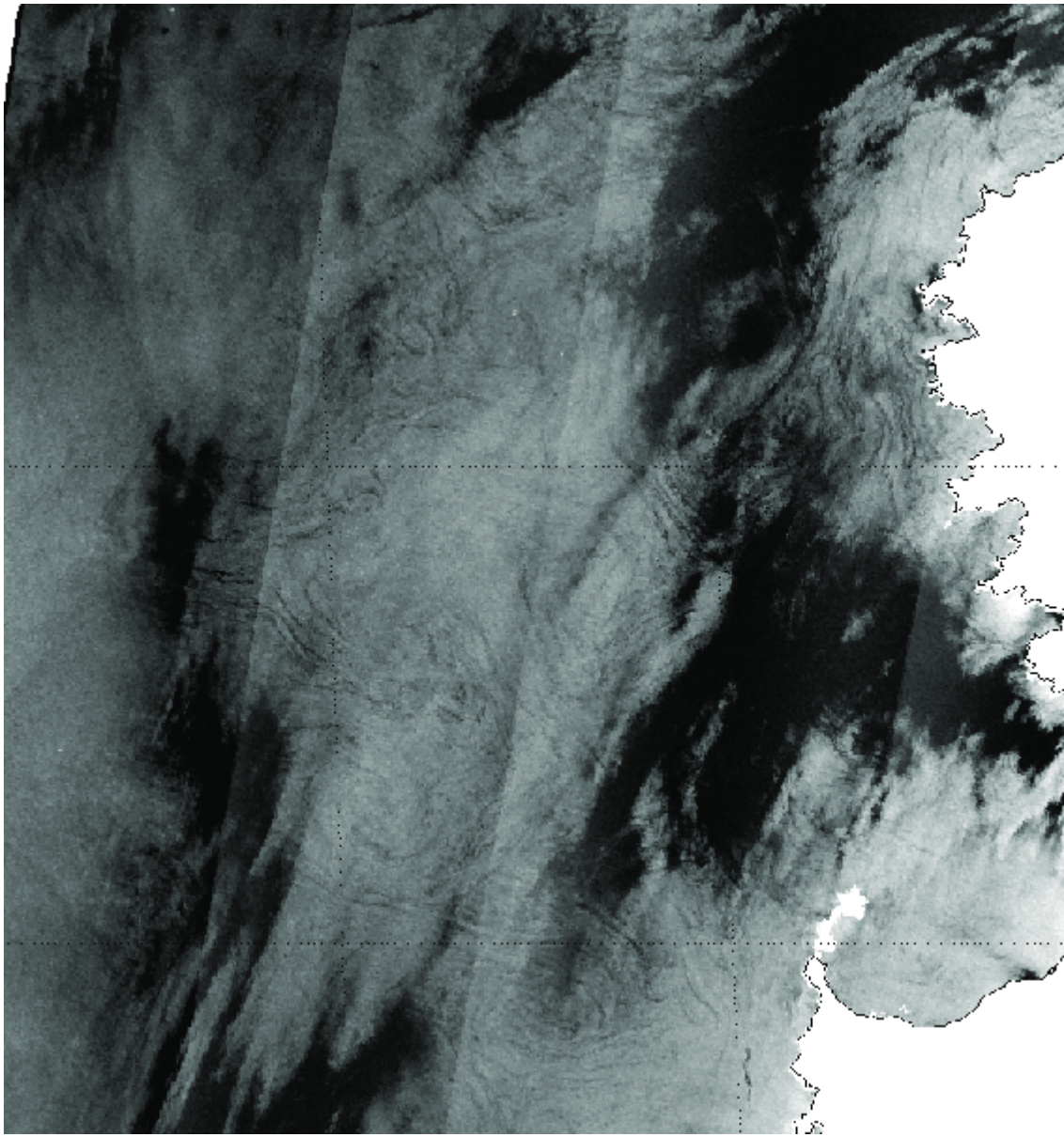
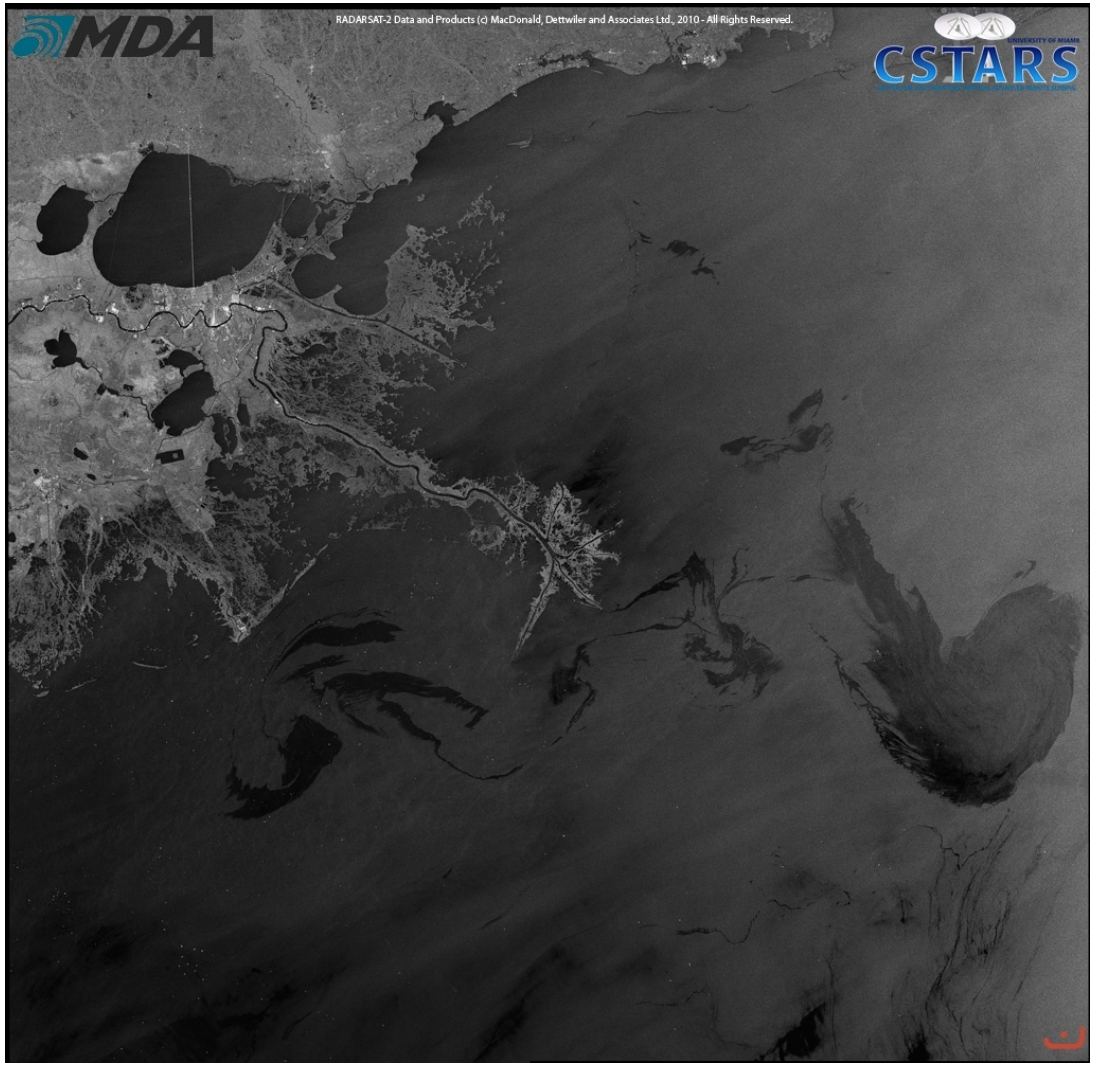
Altimeter Sigma0bloom

On SAR images, zone of very calm, flat seas are often observed. They are associated with low winds or surface slicks



Oil slick


MDA
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CSTARS

Altimeter

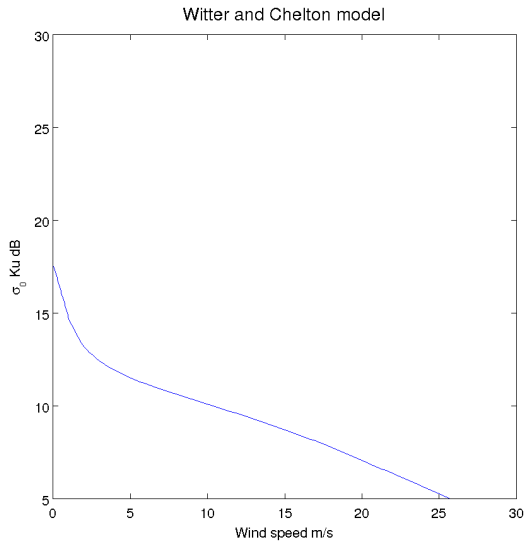
Altimeter : nadir looking radar

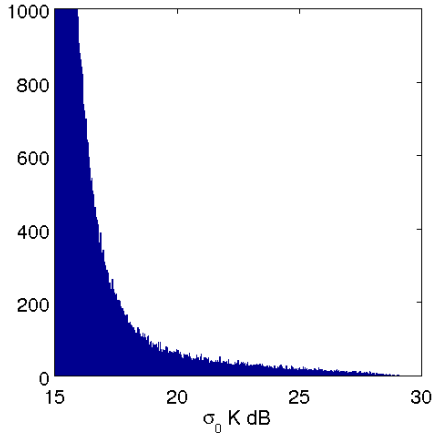
Thus very sensitive to specular reflection

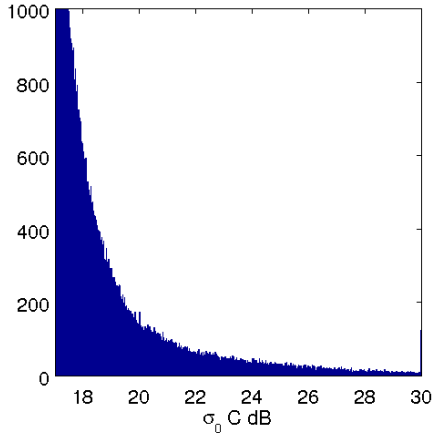
When the surface is very smooth very large variability of the backscatter.

For wind between 0 and 1m/s sigma0 can vary from 15 to 30 dB.

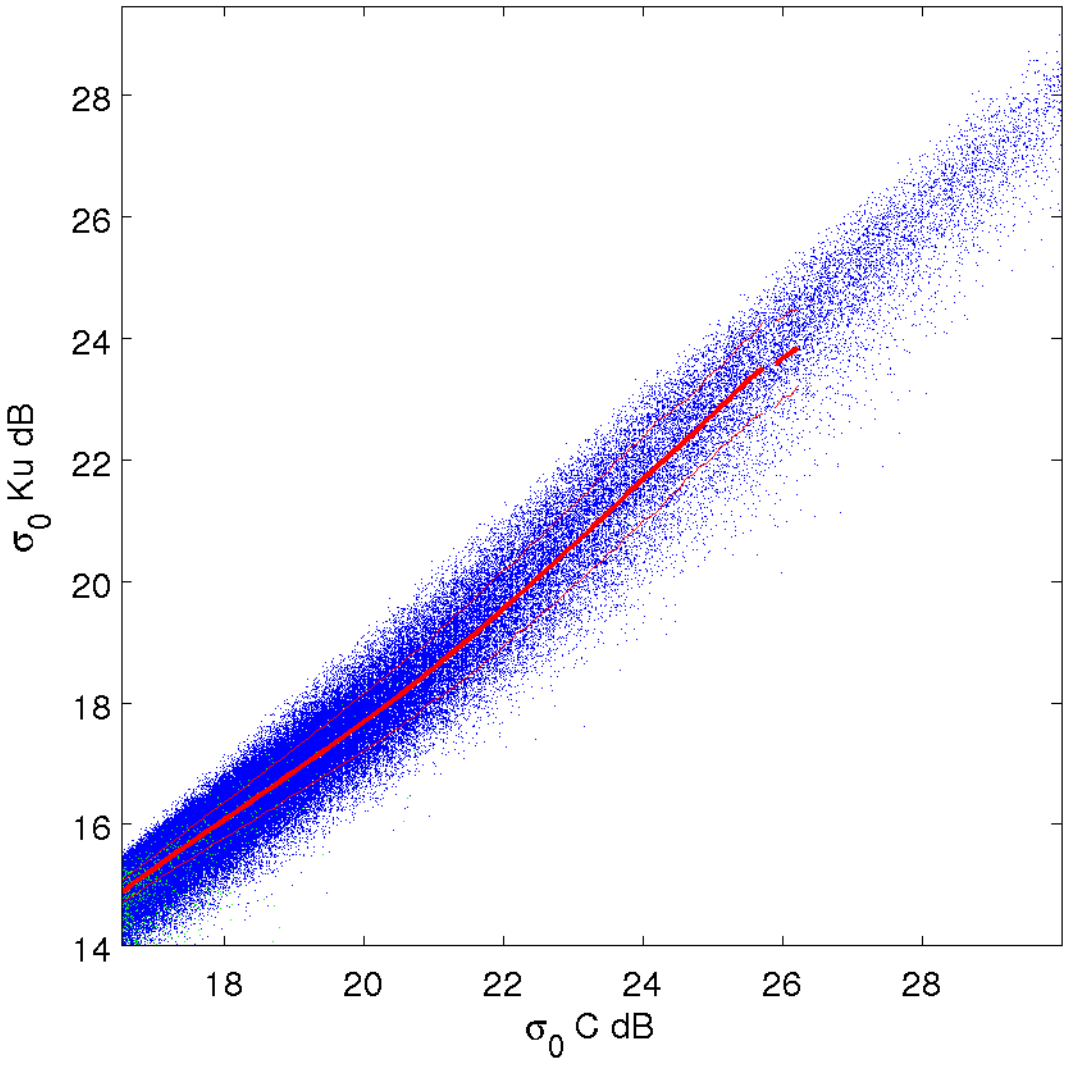
For no wind conditions there exists *seas flater than flat*







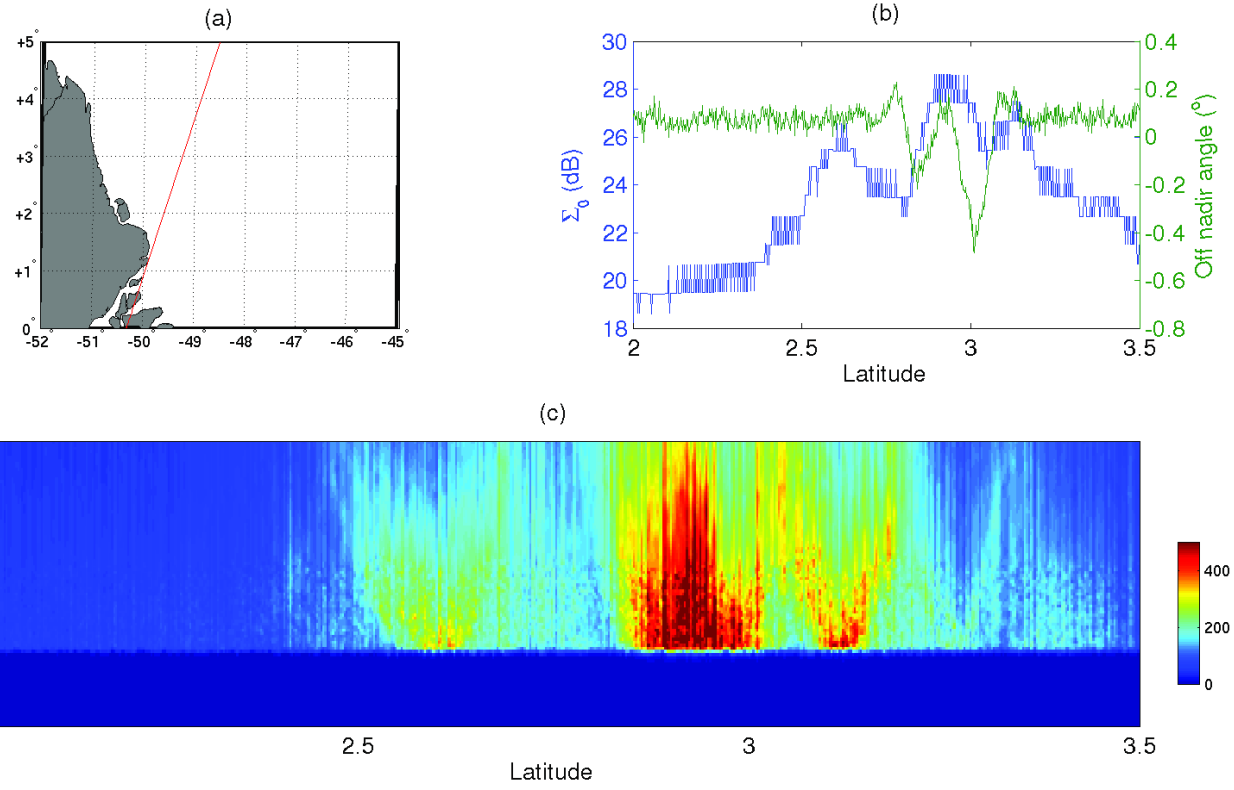
Very large dynamic of backscatter for low/no wind
Large variability of Ku and C band sigma0 as well as large rms around the mean relationship between Ku ad C band backscatter



What's happening during a bloom ?

Within zone of bloom the backscatter of the surface is highly variable at short wavelength (implies distorsion of altimeter waveforms)

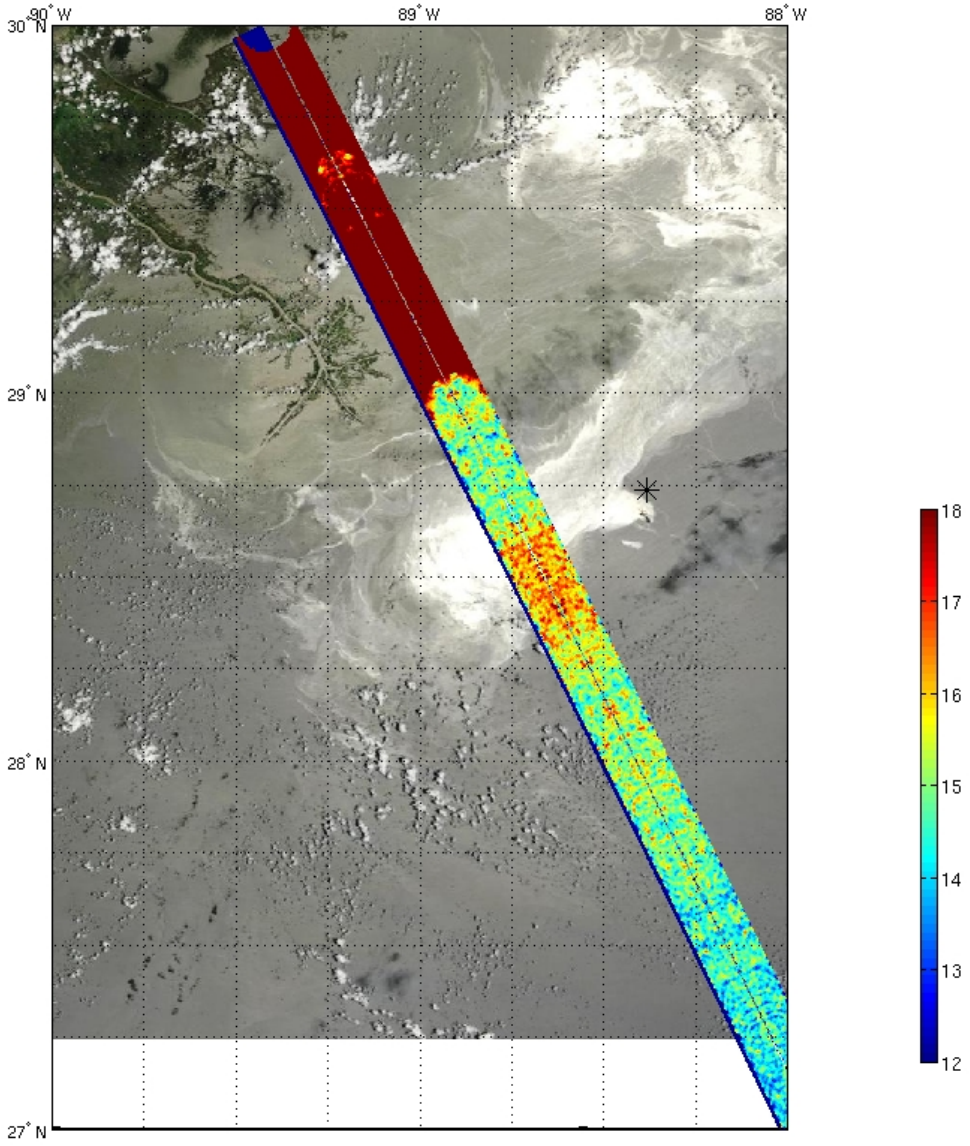
Tournadre et al 2006 developped an analytical model to analyze the waveform during bloom. Presence of patches or bands of high reflectivity Use of off-nadir angle to detect strong distortion of waveforms (Oceanflux)



Jason1 waveforms during a sigma0 bloom event

What's happening during a surface slick ?

Here the altimeter waveforms have been inverted in terms of high resolution surface backscatter (300m resolution)
Strong enhancement of backscatter by the slick



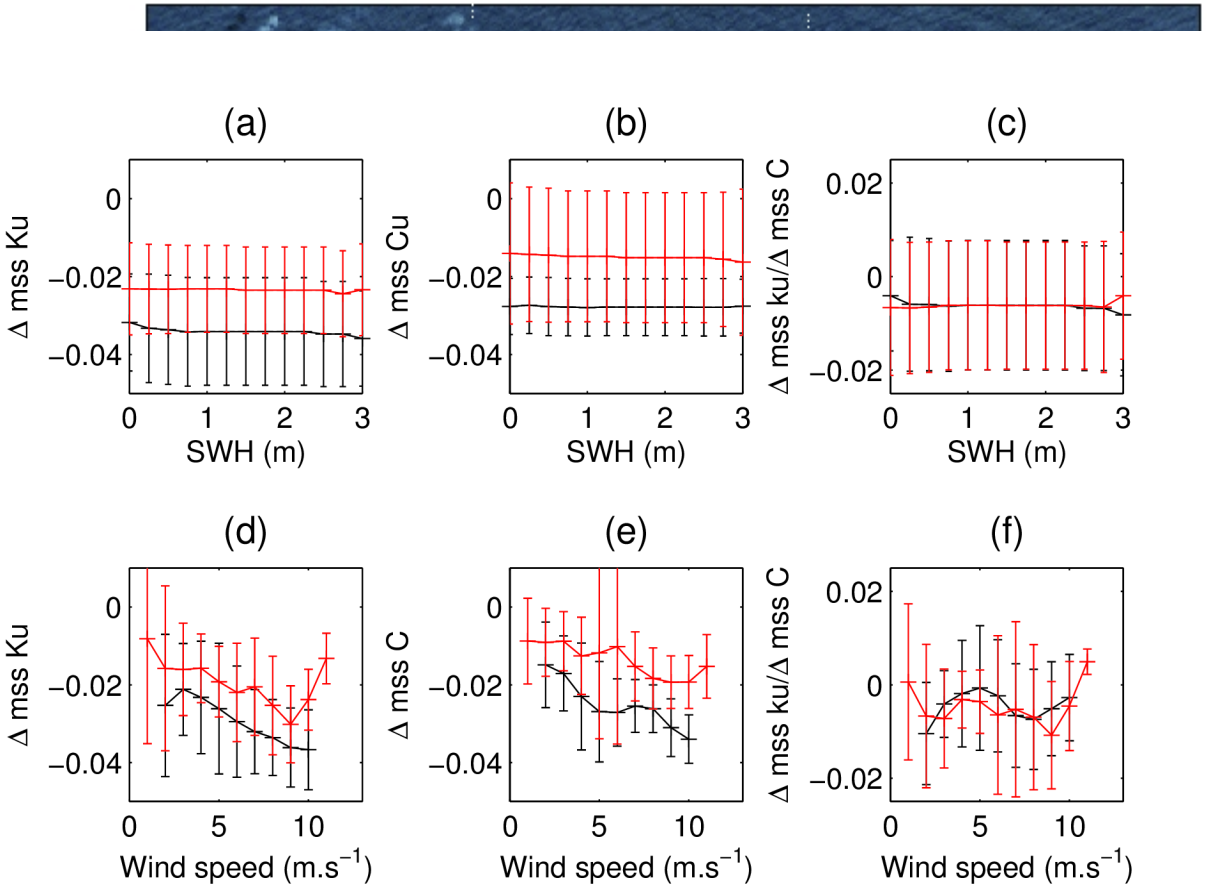
Questions

What can we learn about the very calm zones from altimeter data ?. The variability of surface backscatter for low/no winds shows that the surface roughness is highly variable at these regimes.

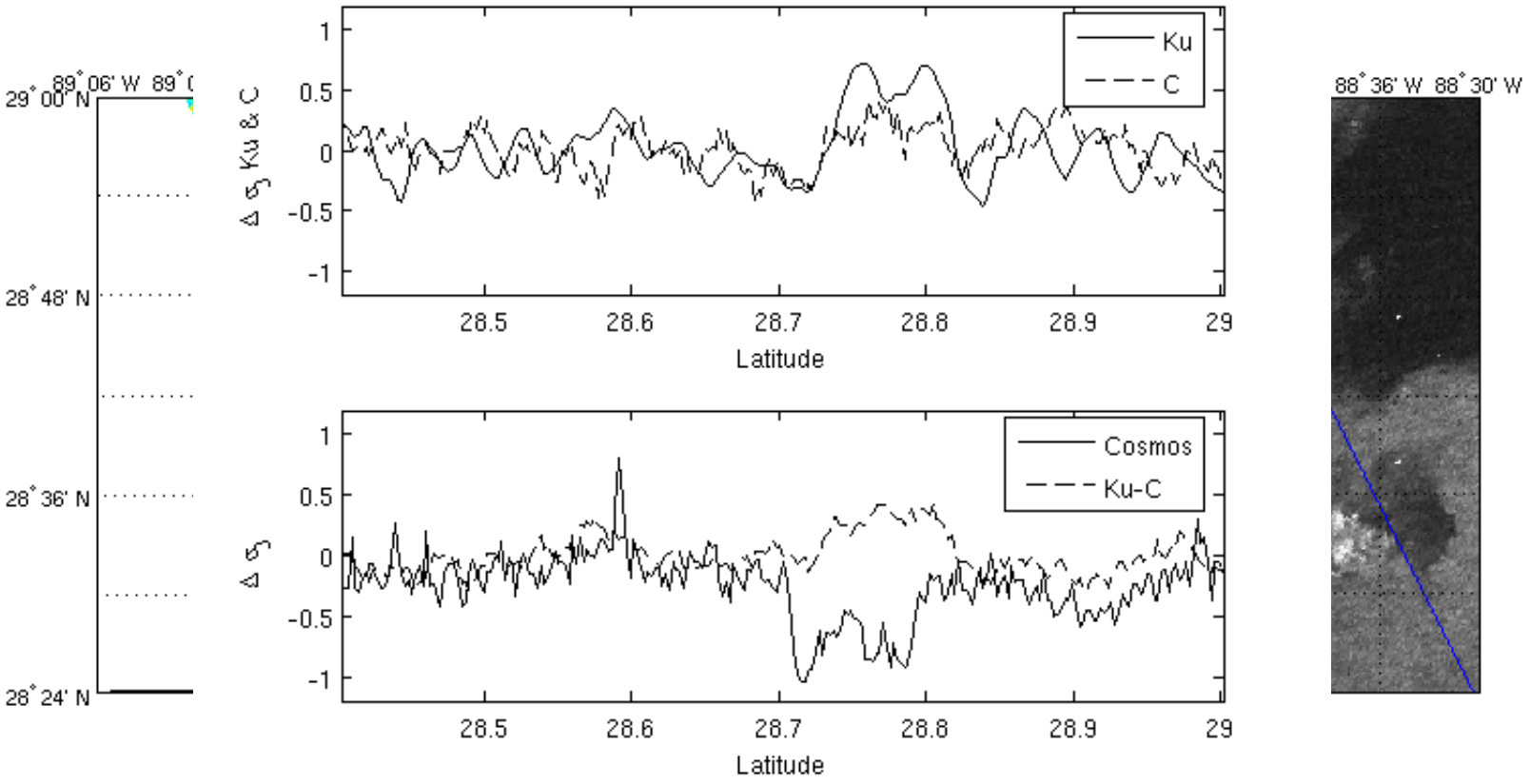
Can we use the altimeter to detect/discriminate between no wind and surface slicks ? In particular the dual frequency capabilities of most altimeters.

Impact of submerged reef on backscatter

Inversion of altimeter waveforms
Altimeter precise enough to detect the variation of roughness caused by a small reef and can be use to analyze it impact on Ku and C band roughness



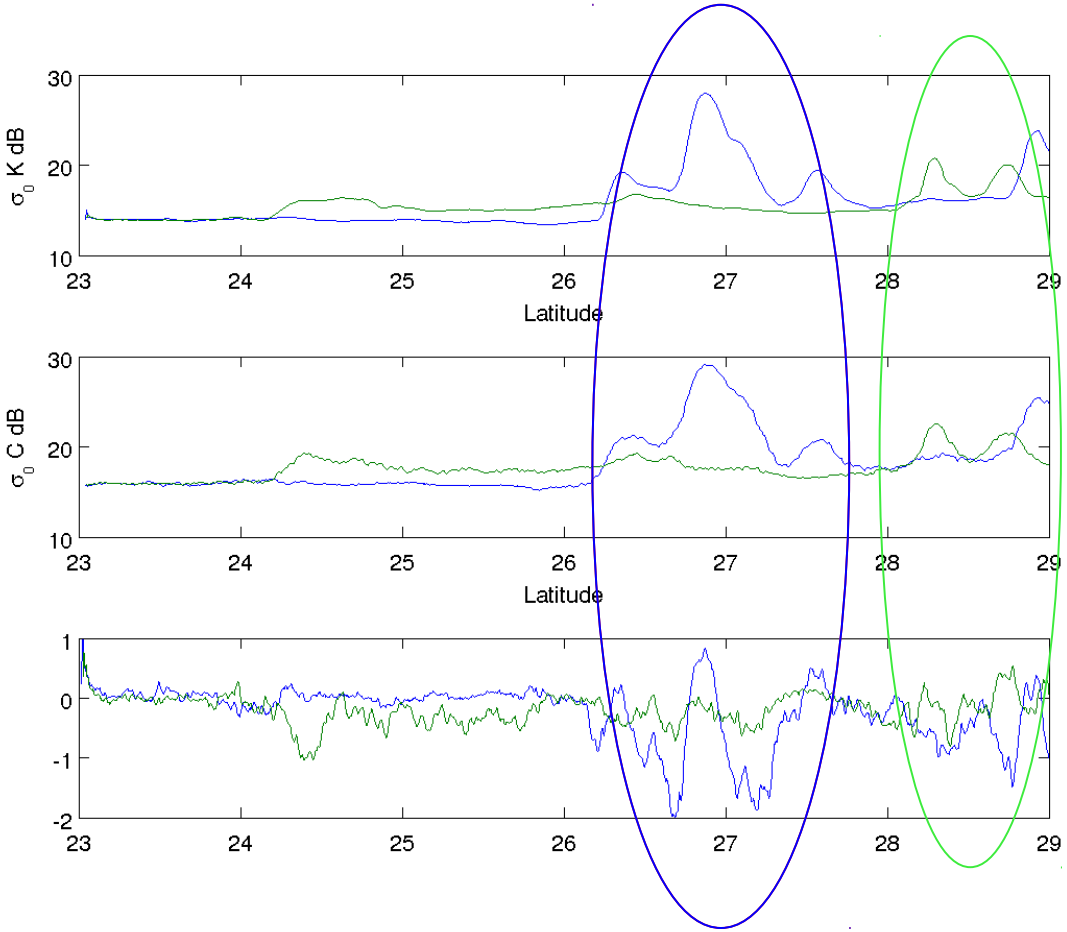
What's happening during a slick ?



Gulf Oil spill collocated Jason2 and Cosmosskymed data
Change of relationship between Ku and C band
Comparison with no wind conditions

Use of Gulf Oil spill data base

Large data base of SAR, sunglint images that allows to better understand the behavior of Ku and C band in presence of slick or low winds
Work in progress
Inversion of waveforms, comparaison with SAR
Impact of slick thickness on Ku/C band relation



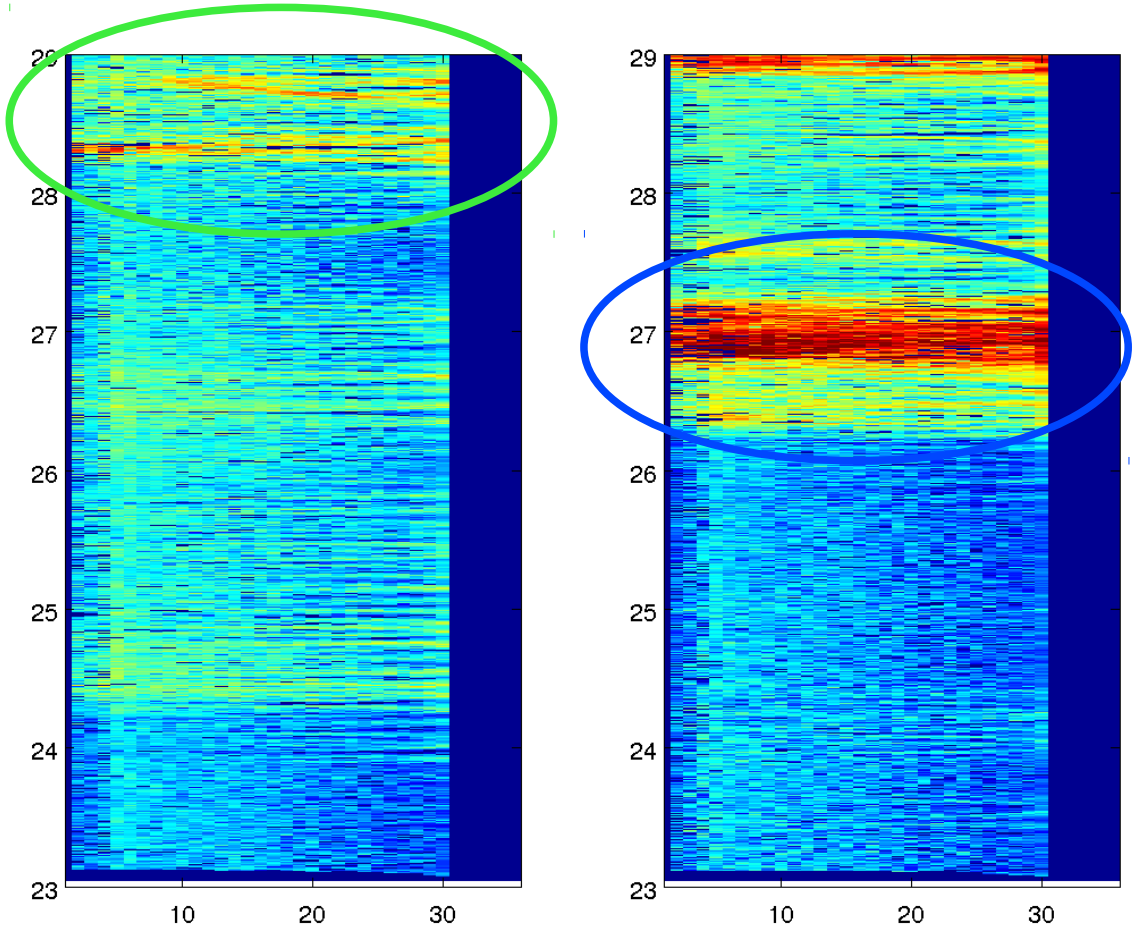
No wind

oil slick

Use of Gulf Oil spill data base

Inverted waveforms showing the signature of slicks and no wind

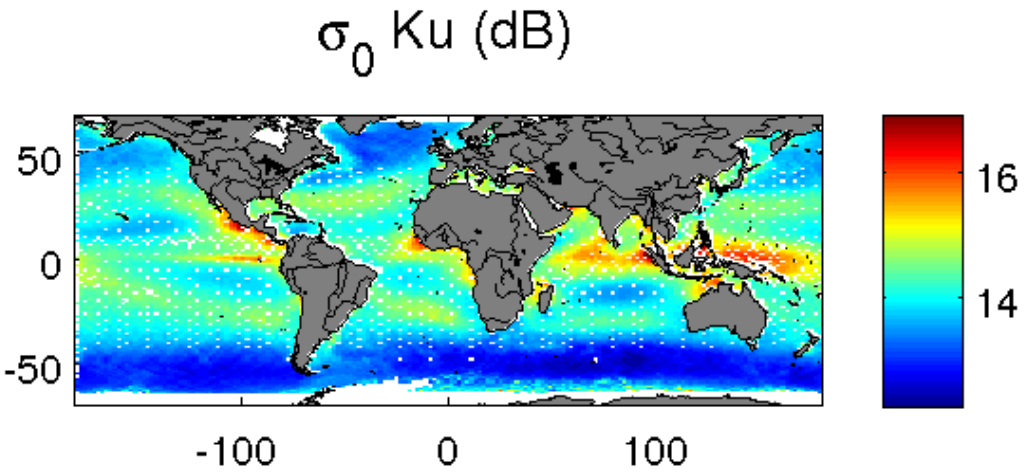
slick

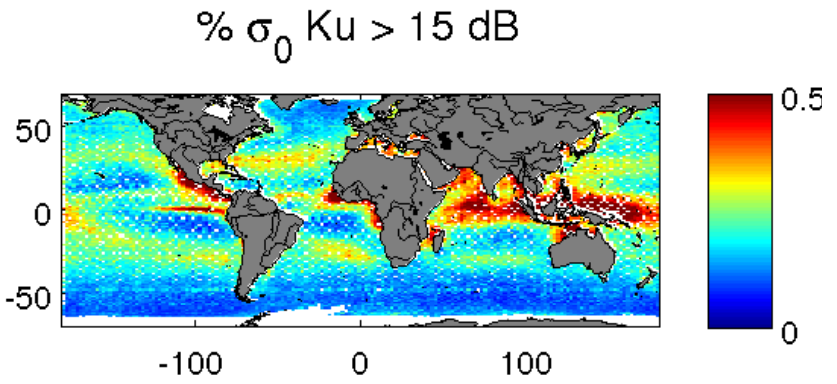


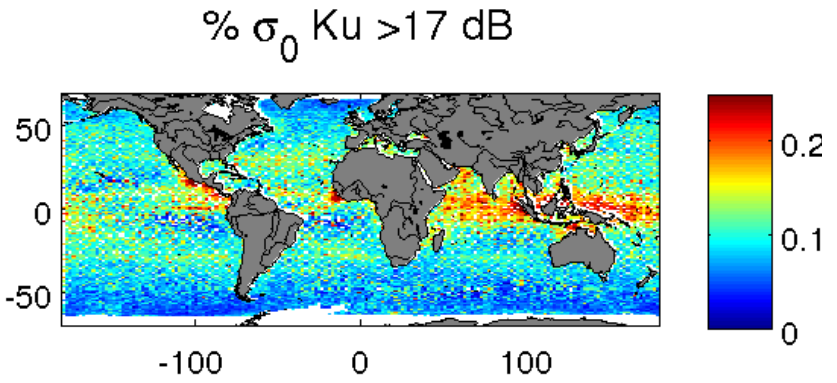
No wind

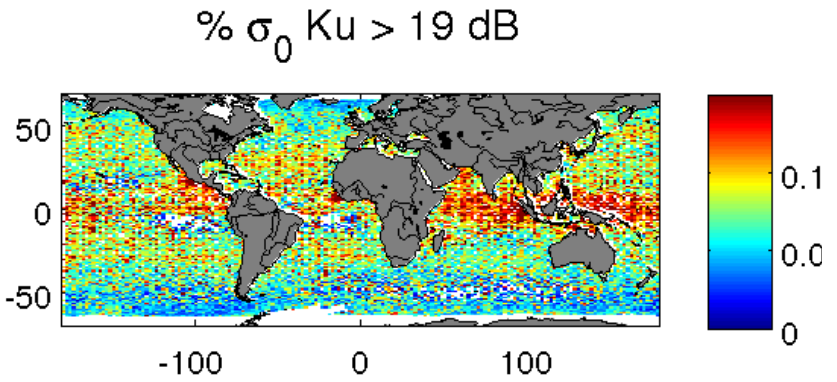
Probability of sigmabloom

Inverted waveform (large quantity of data) First approach use of 1Hz data
Distribution of backscatter, 10 years of Jason1 altimeter data
15dB wind < 1m/s
Blooms sigma0>17dB 0 m/s
Slight differences vs wind distribution



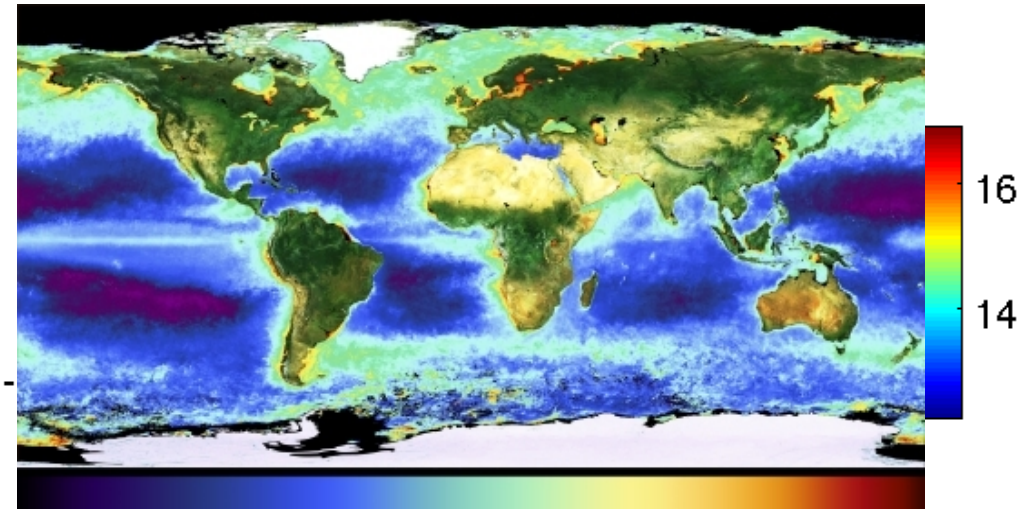


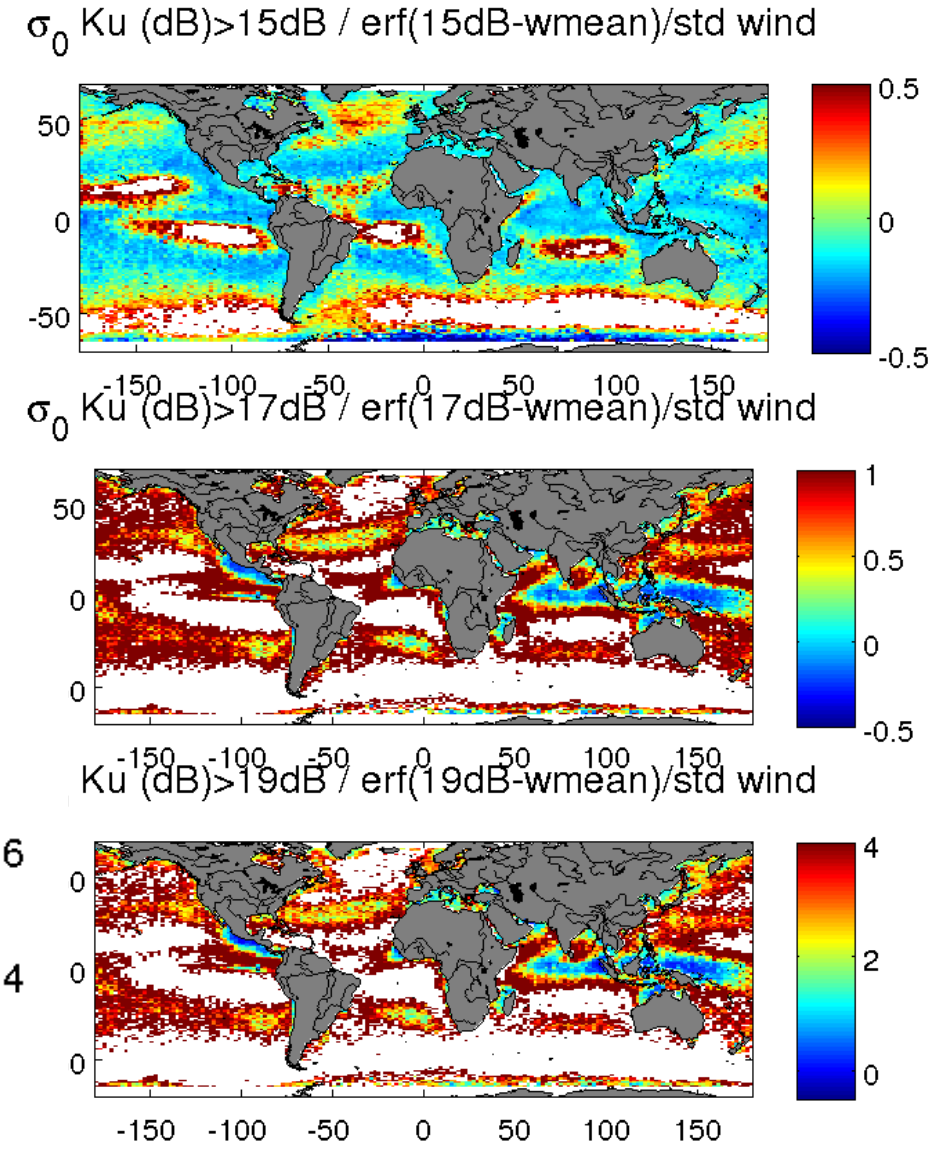




Comparaison with distribution of wind

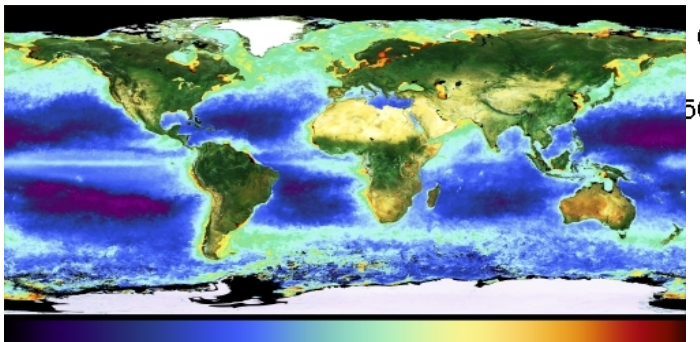
Measured probability of presence of sigma0bloom
And expected probability from gaussian distribution N(mean sigma0, std sigma0)
Different regimes
Relation with wind and Chl

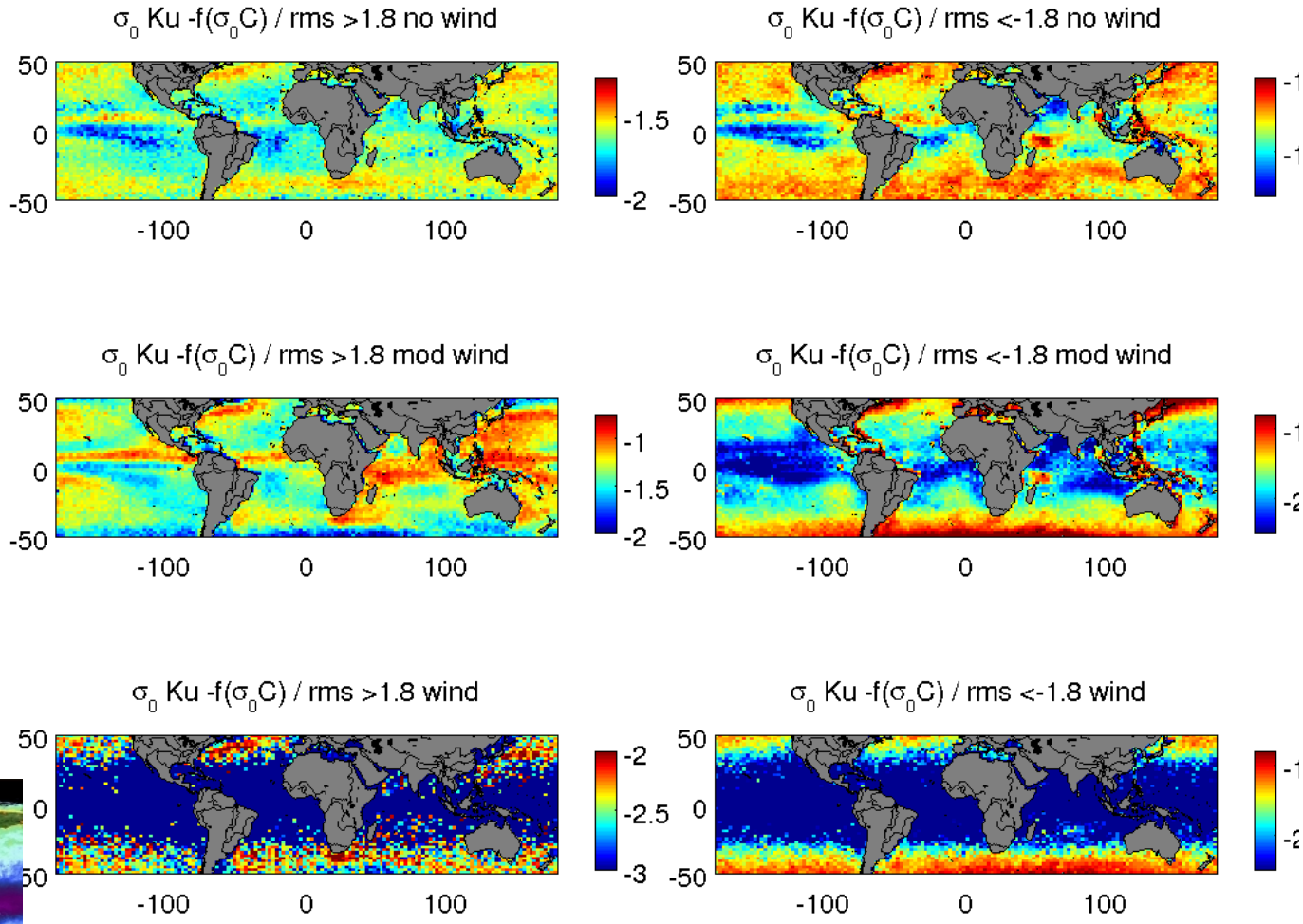




Use of Ku/C band relationship

Second approach use of the relationship between Ku and C band Impact of surface current

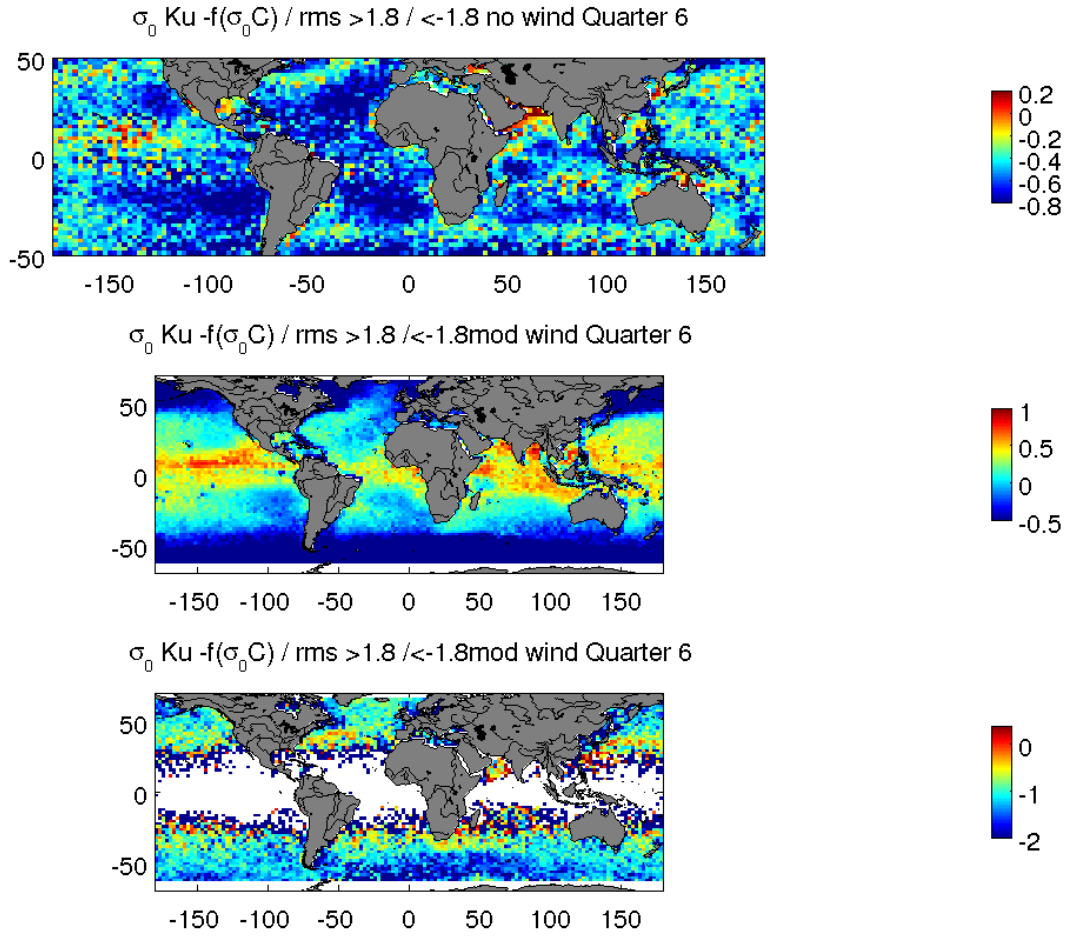


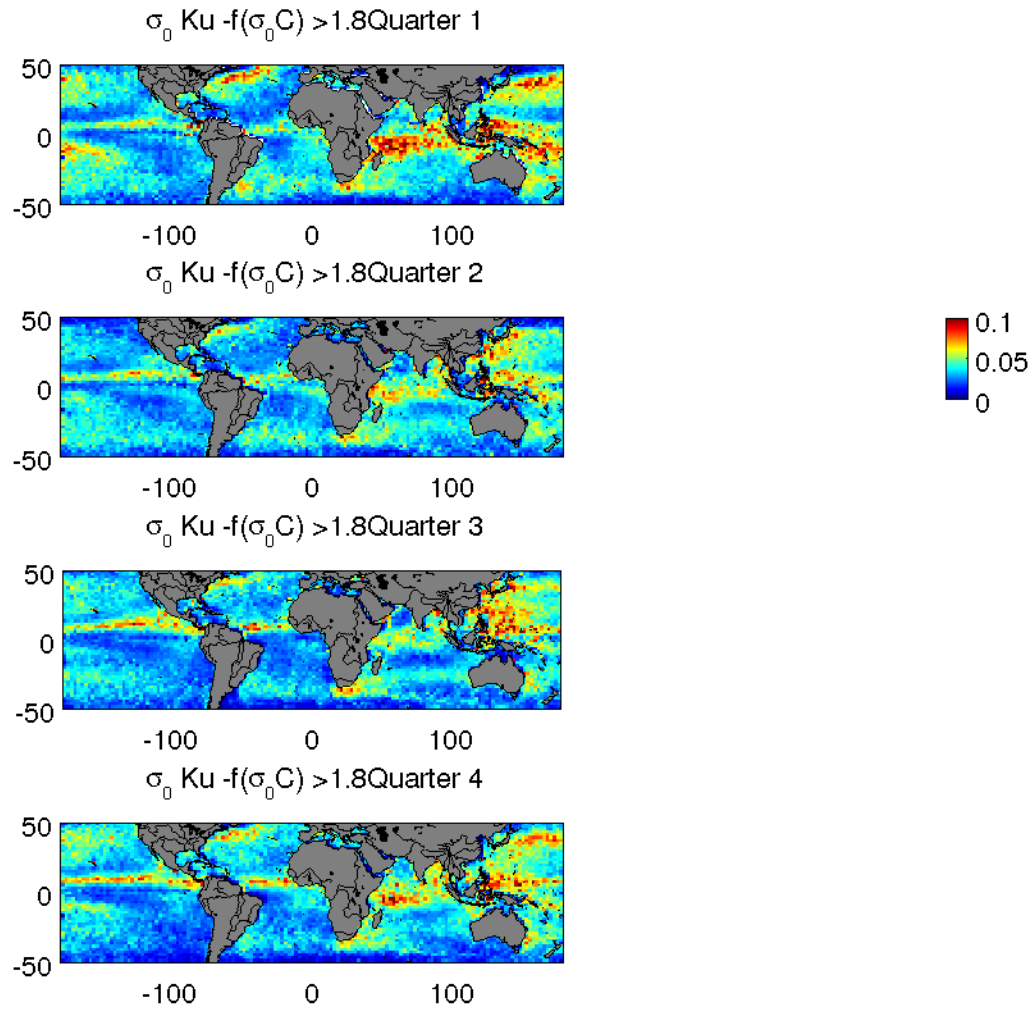


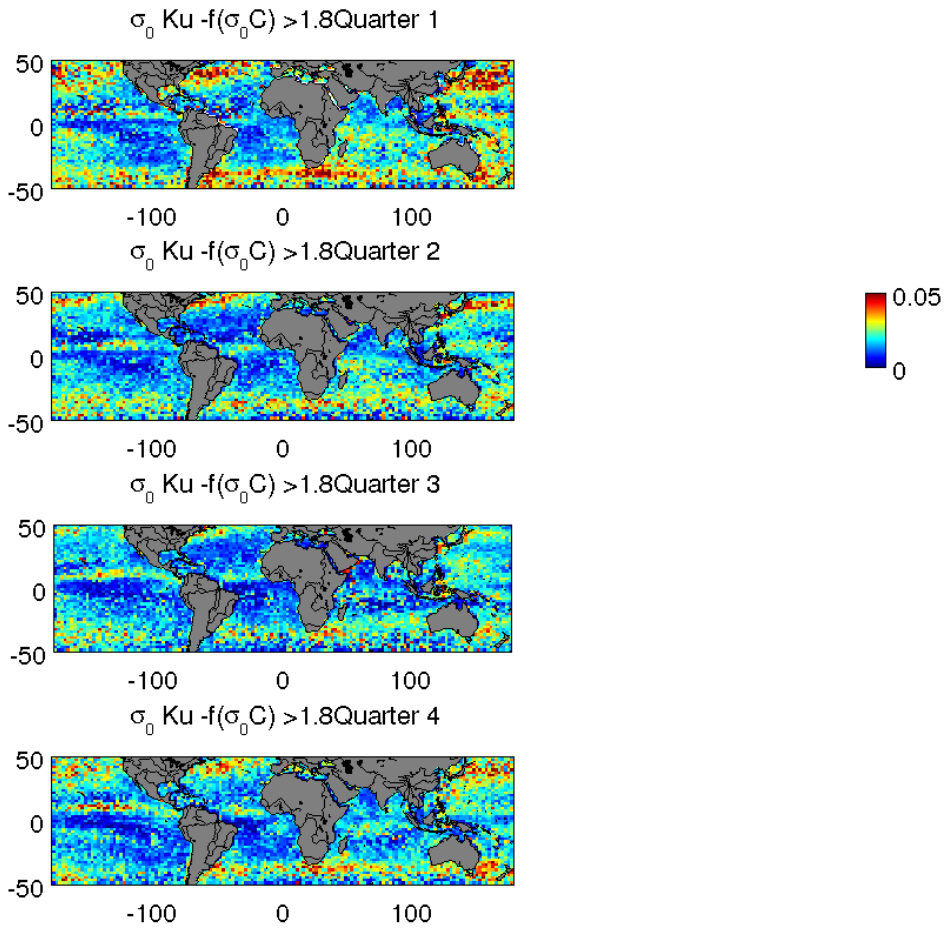
Perspective

The use of Ku and C band open new perspective to better understand the behavior of the surface roughness under no wind and slick conditions

The Gulf oil spill data base constitutes a good opportunity to study/validate the impact of slick on backscatter.


σ0 Ku -f(σ0C) / rms >1.8 / <-1.8 no wind Quarter 6
50
0
-50
-150 -100 -50 0 50 100 150
0.2
0
-0.2
-0.4
-0.6
-0.8
σ0 Ku -f(σ0C) / rms >1.8 /<-1.8mod wind Quarter 6
50
0
-50
-150 -100 -50 0 50 100 150
1
0.5
0
-0.5
σ0 Ku -f(σ0C) / rms >1.8 /<-1.8mod wind Quarter 6
50
0
-50
-150 -100 -50 0 50 100 150
0
-1
-2


σ0 Ku -f(σ0C) >1.8Quarter 1
σ0 Ku -f(σ0C) >1.8Quarter 2
σ0 Ku -f(σ0C) >1.8Quarter 3
σ0 Ku -f(σ0C) >1.8Quarter 4
50
0
-50
-100
0
100
0.1
0.05
0


σ0 Ku -f(σ0C) >1.8Quarter 1
50
0
-50
-100
0
100
σ0 Ku -f(σ0C) >1.8Quarter 2
50
0
-50
-100
0
100
σ0 Ku -f(σ0C) >1.8Quarter 3
50
0
-50
-100
0
100
σ0 Ku -f(σ0C) >1.8Quarter 4
50
0
-50
-100
0
100
0.05
0