

→ SEASAR 2012

The 4th International Workshop on Advances in SAR Oceanography

Direct ocean surface velocity mapping with Wide Swath SAR:

A user's guide to the range Doppler method

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The 4th International Workshop on Advances in SAR Oceanography

High resolution surface velocity mapping with Wide Swath SAR:

A user's guide to the range Doppler method

The idea for this manual is essentially coming from Beal, Young, Monaldo, Thompson, Winstead and Scott book on High Resolution Wind Monitoring with Wide Swath SAR: A Users' Guide (published by NOAA in June 2005)

MOTIVATION

Operated as a “speed-gun” in space the ASAR Doppler shift anomalies manifest the range component of the sea surface current. Building on more than 5000 synoptic wide coverage acquisitions since 2007, new high-resolution gridded maps ($\sim 10 \text{ km} \times 10 \text{ km}$) of intense surface current regimes have been established.

The ASAR based surface velocity estimates that can be related to surface current are not error free, and they rely on careful processing and correction for near surface wind speed effects and wave motions. This will be demonstrated.

A broad range of examples will be given with coincident ASAR roughness, wind field and range Doppler velocity together with auxiliary data and information such as surface drifter data, satellite altimetry and gravimetry, sea surface temperature measurements which all together can resolve circulation patterns that have important implications for oceanographic and air-sea interaction research.

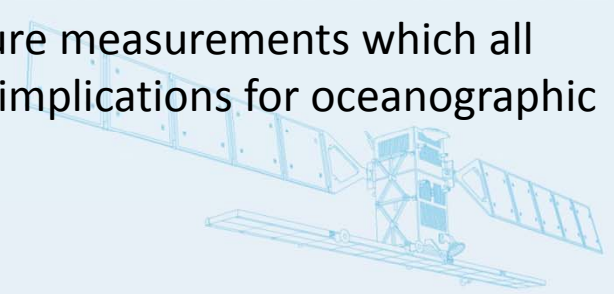
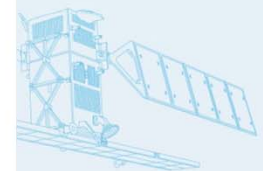
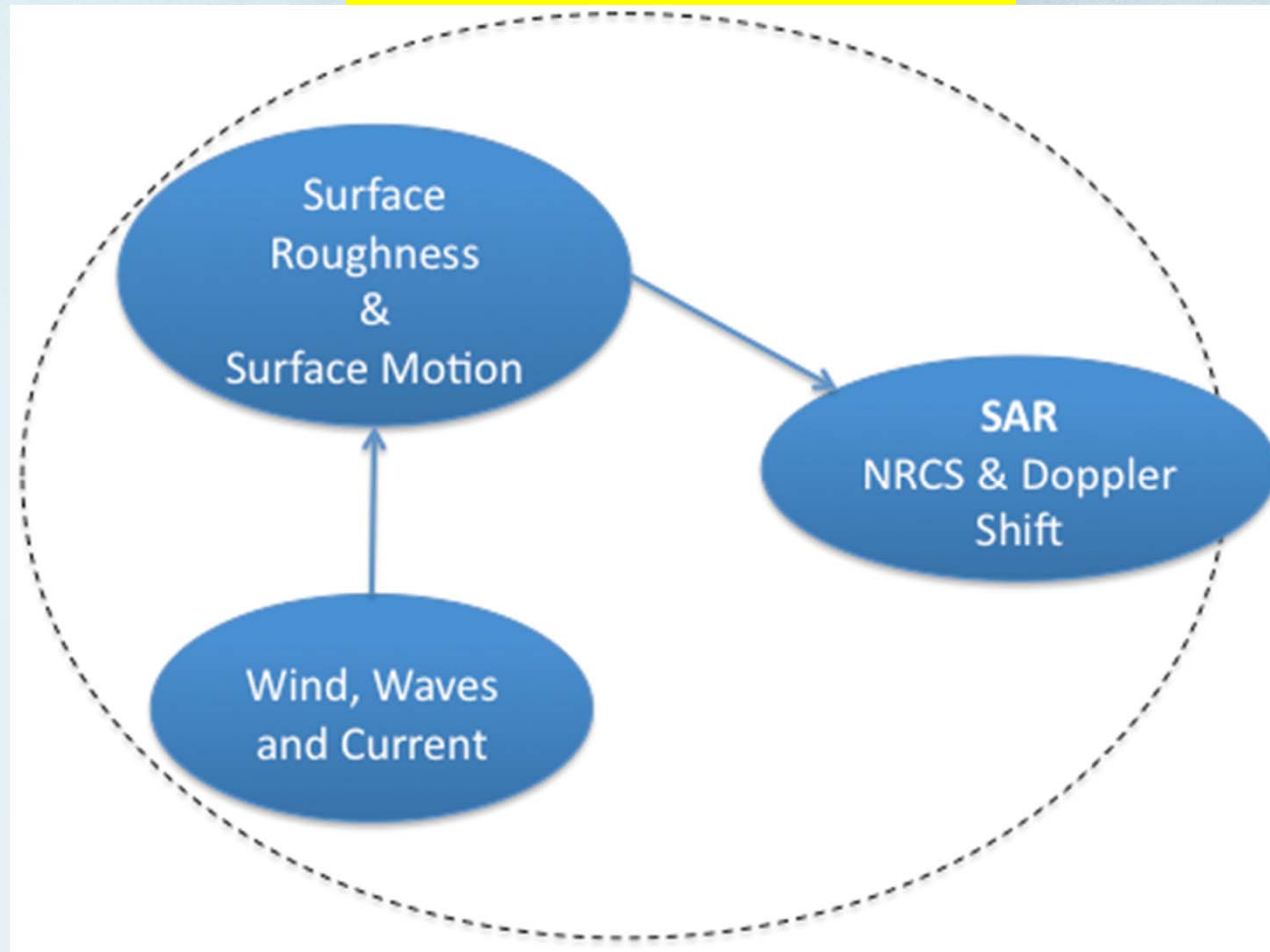


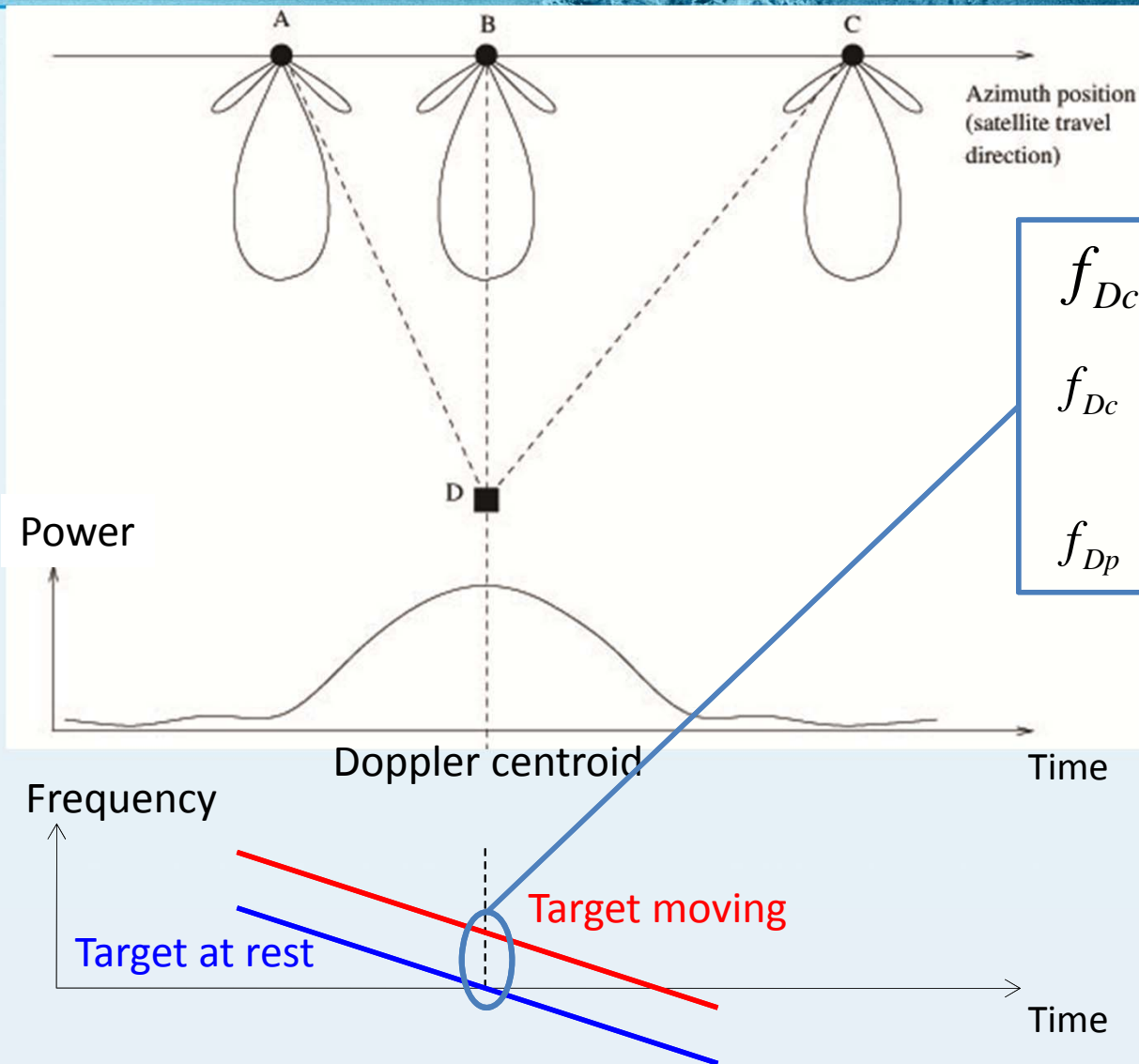
TABLE OF CONTENT

1. Frontispiece
2. Introduction
3. The Speed-gun in space
4. Estimation of wind and waves effects
5. Monitoring intense current regimes
6. Mean Doppler range velocities and Mean Dynamic Topography
7. Examples of additional Monitoring Capabilities
8. Challenge –emerging Applications – outlook
9. References

The book will be colorful and about 100 pages long in landscape format

The Speed-gun in space



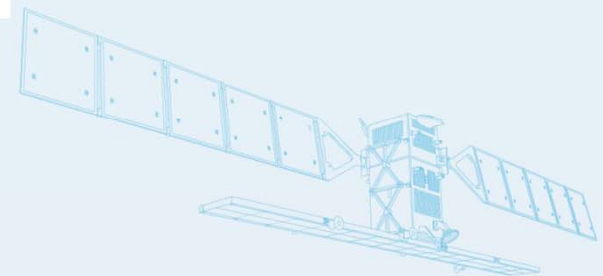


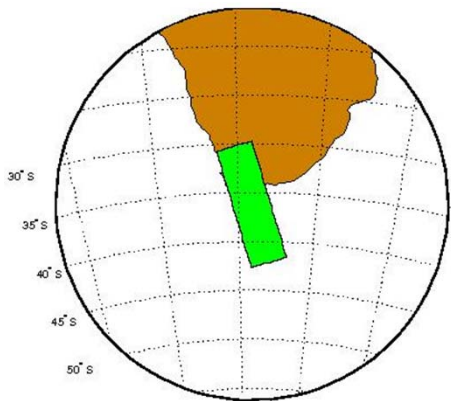
$$f_{Dca} = f_{Dc} - f_{Dp}$$

f_{Dc} : estimated Doppler centroid frequency shift

f_{Dp} : predicted Doppler shift

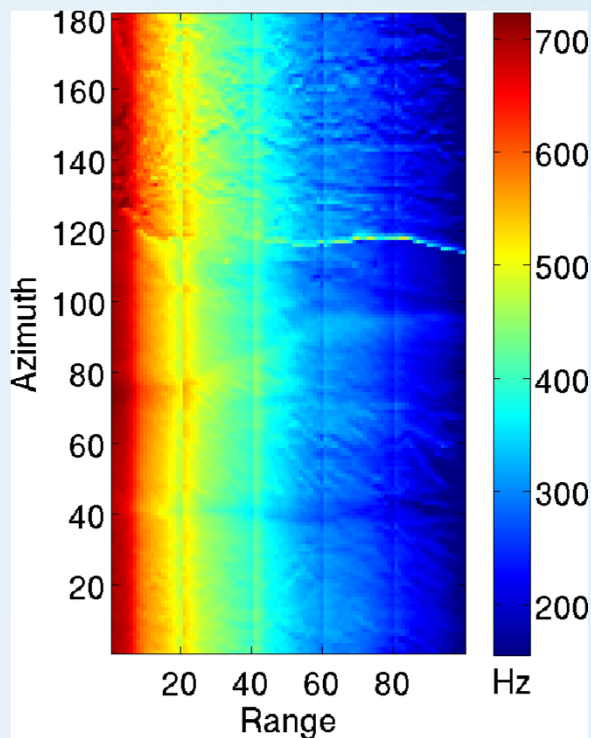
Chapron et al. (2003, 2005)



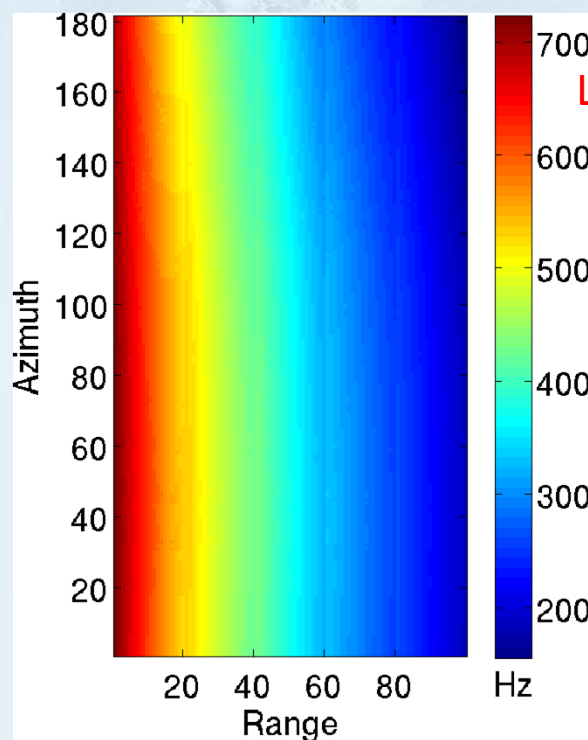


Envisat ASAR scene off the South African coast
 14 September 2010, 21:15 UTC
 Hansen et al., 2011 (IEEE TGRS)

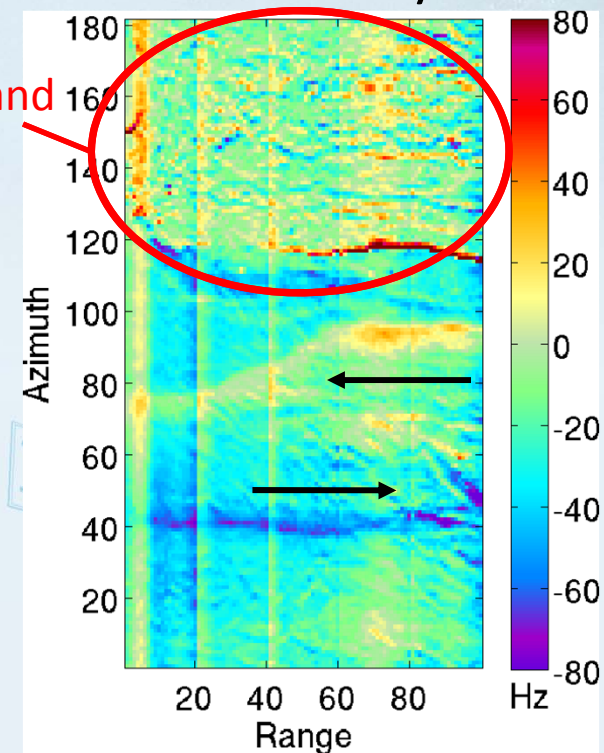
Observed



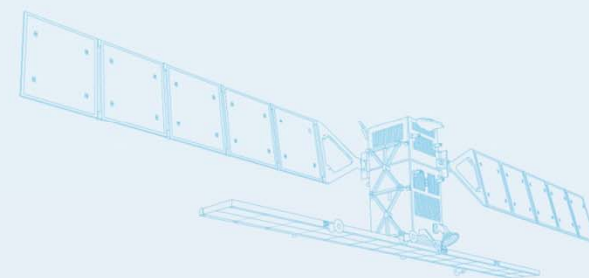
Predicted



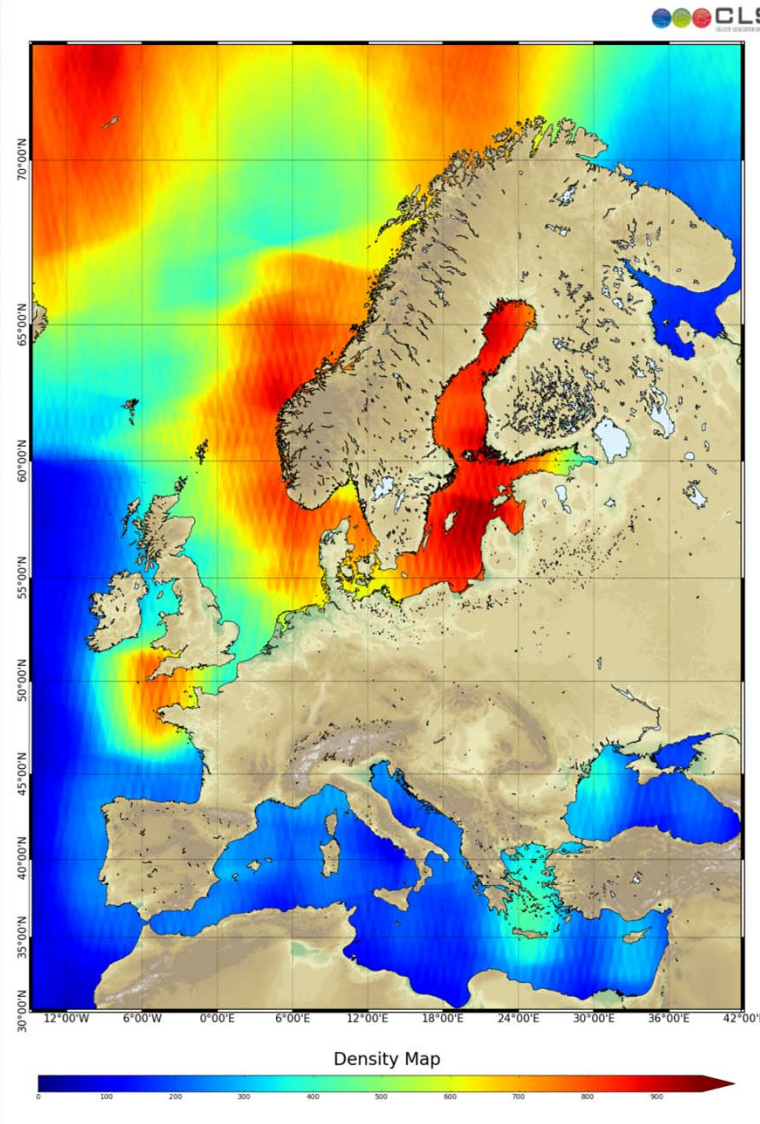
Doppler centroid anomaly

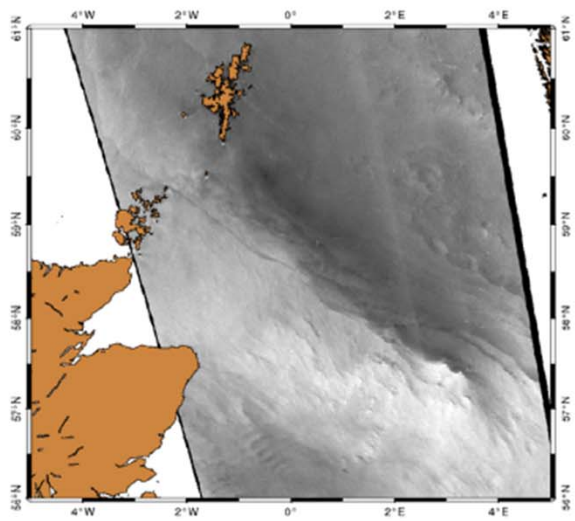


Estimation of wind and waves effects

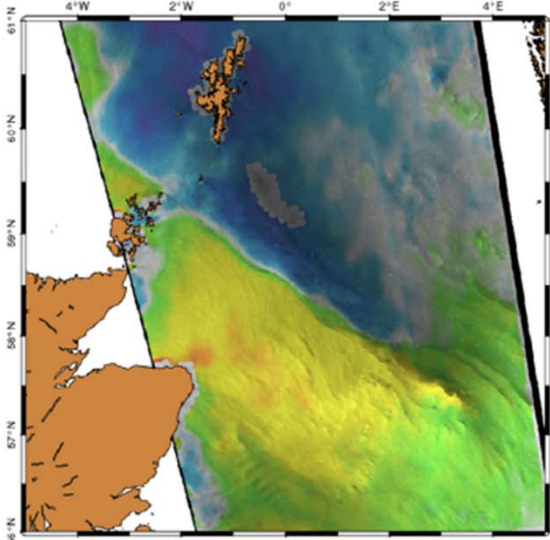


Data Coverage

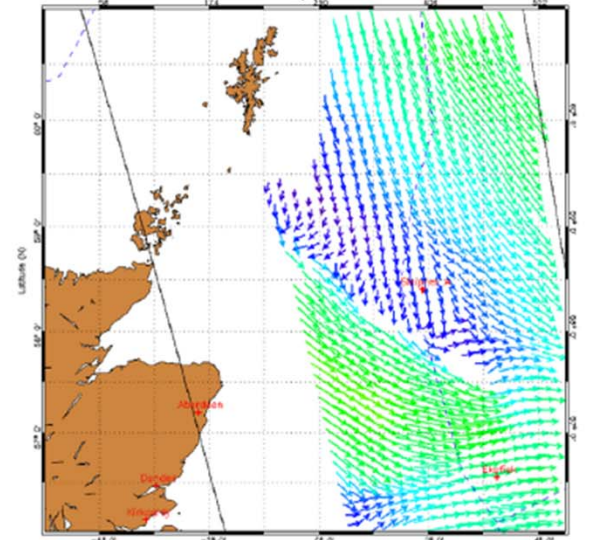




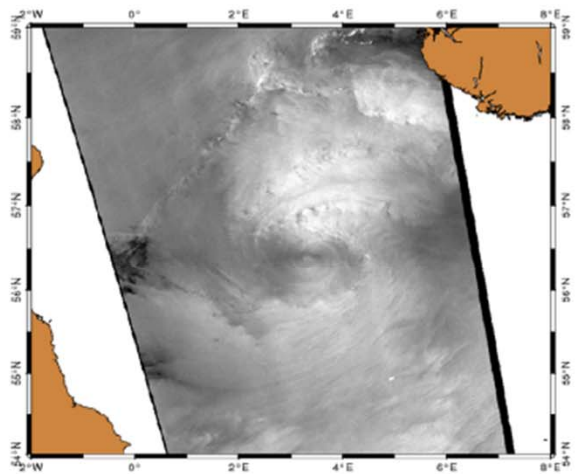
(a)



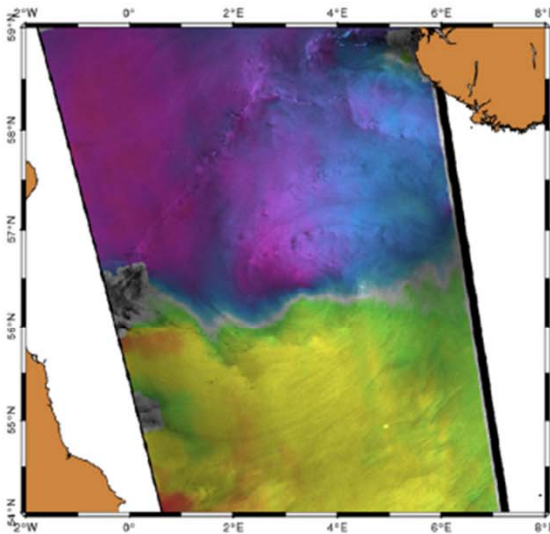
(b)



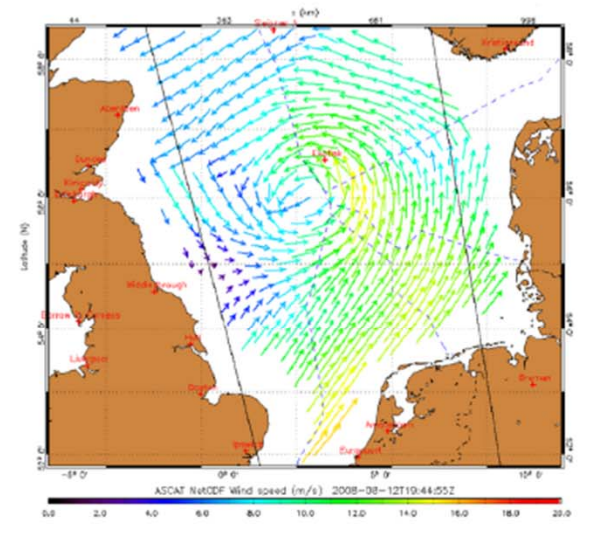
(c)



(d)

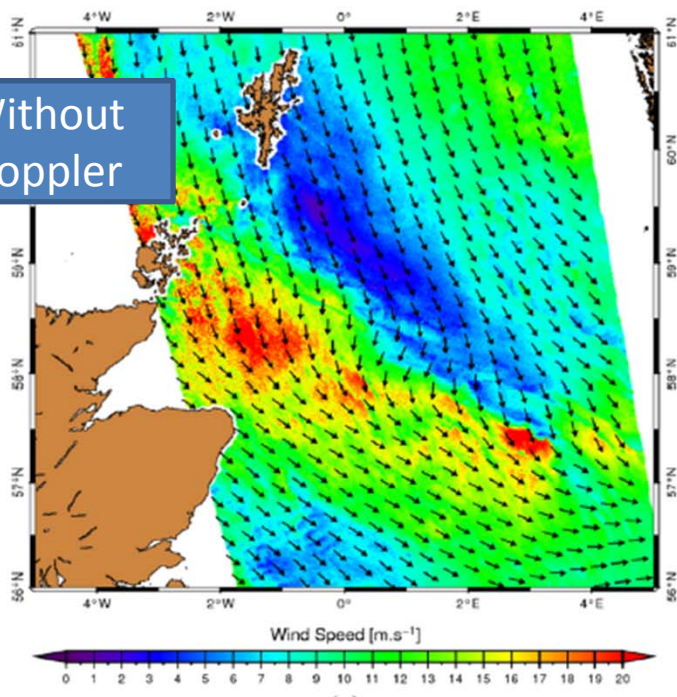


(e)



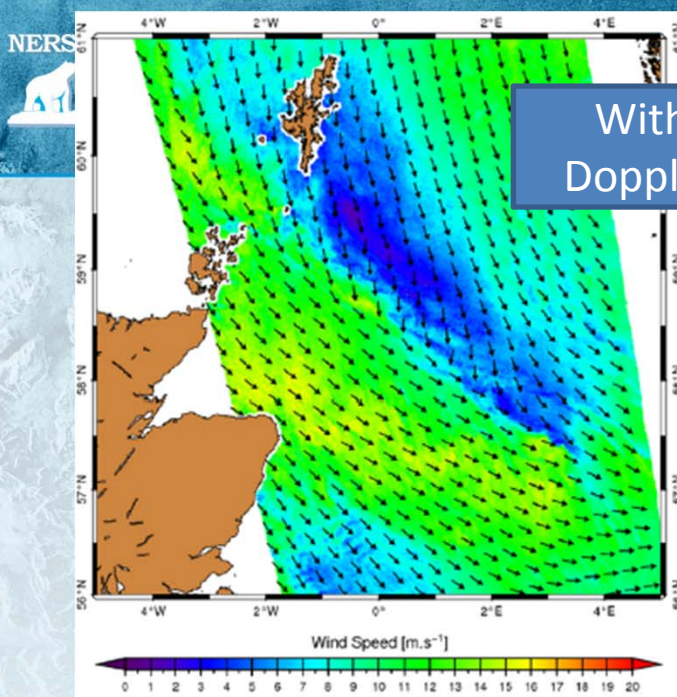
(f)

Without Doppler



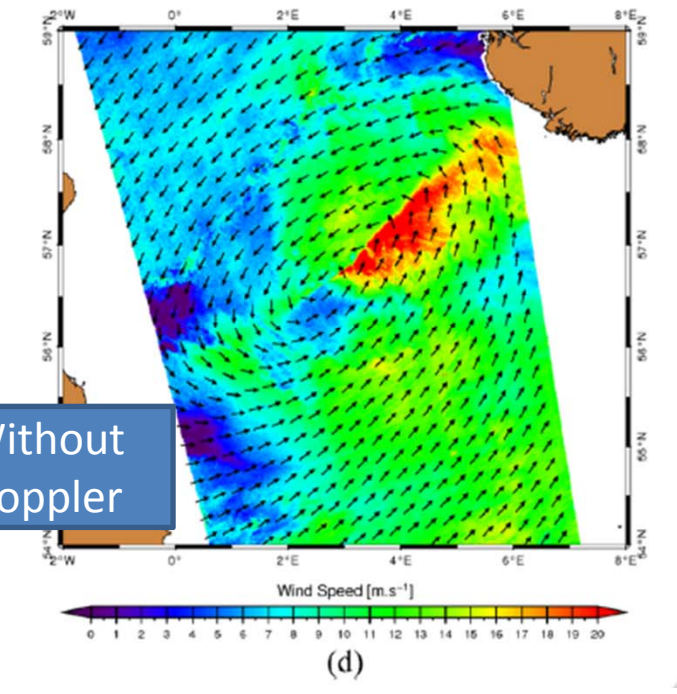
(a)

With Doppler



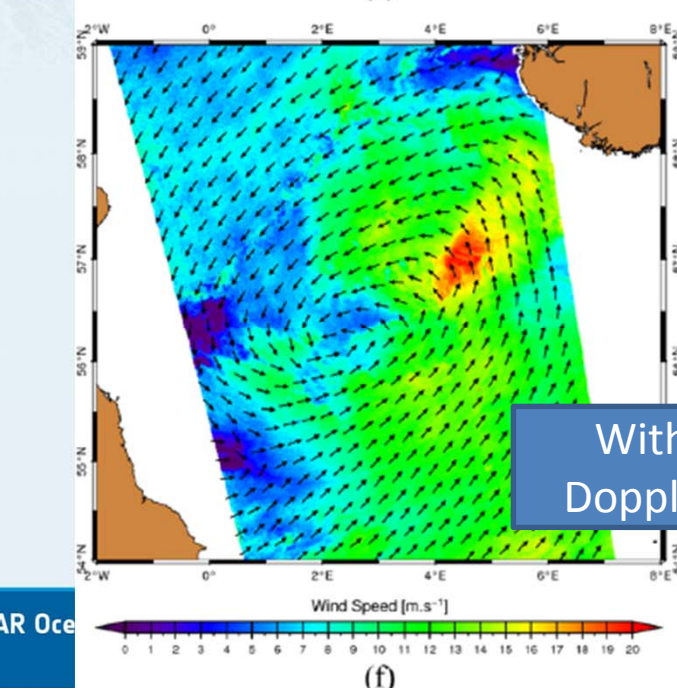
(c)

Without Doppler



(d)

With Doppler



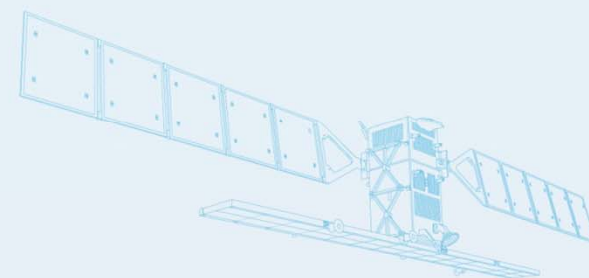
(f)



Monitoring intense current regimes

L2 and L3 products from

- Agulhas Current
- Gulf Stream
- North Brazilian
- Norwegian Sea



Exemple over Agulhas current

Radial current sea surface roughness wind

09-Feb-2012 21:20:12 (UTC)
ENVISAT WSM Product

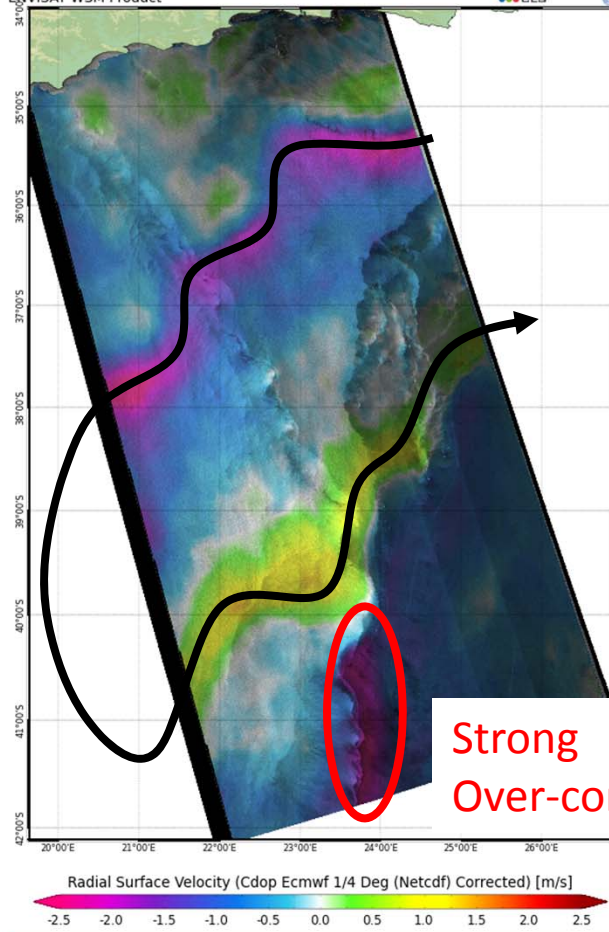
SOPRANO
CLM

09-Feb-2012 21:20:12 (UTC)
ENVISAT WSM Product

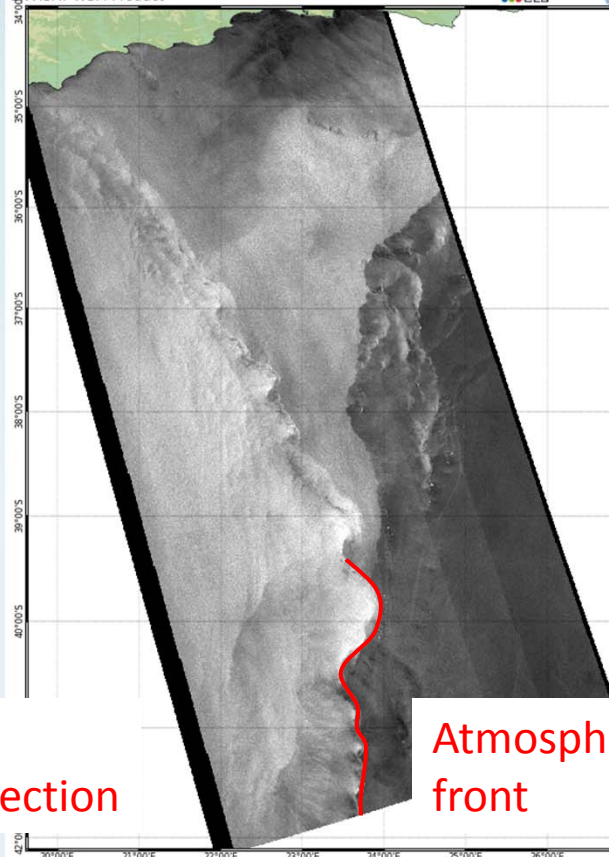
SOPRANO
CLM

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ENVISAT WSM Product

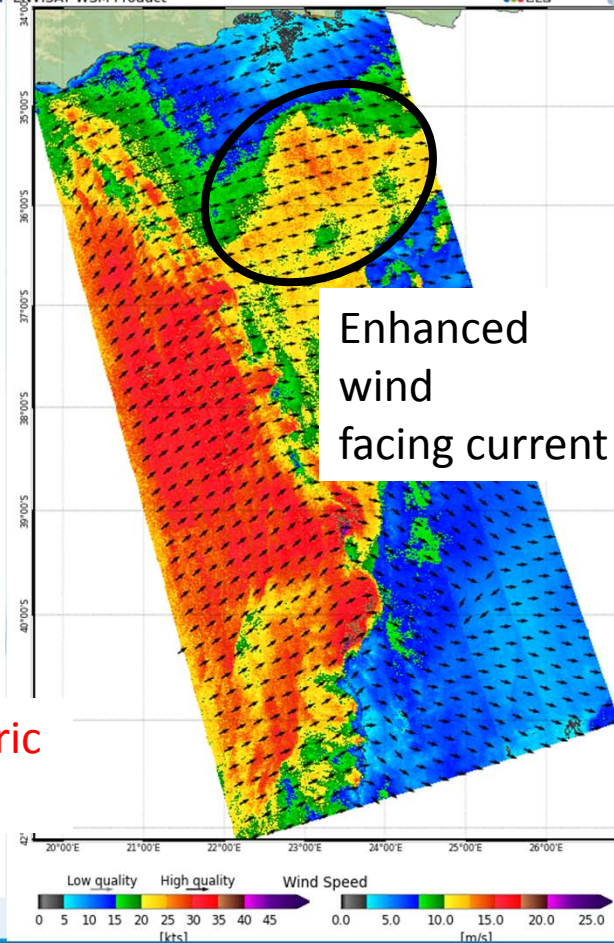
SOPRANO
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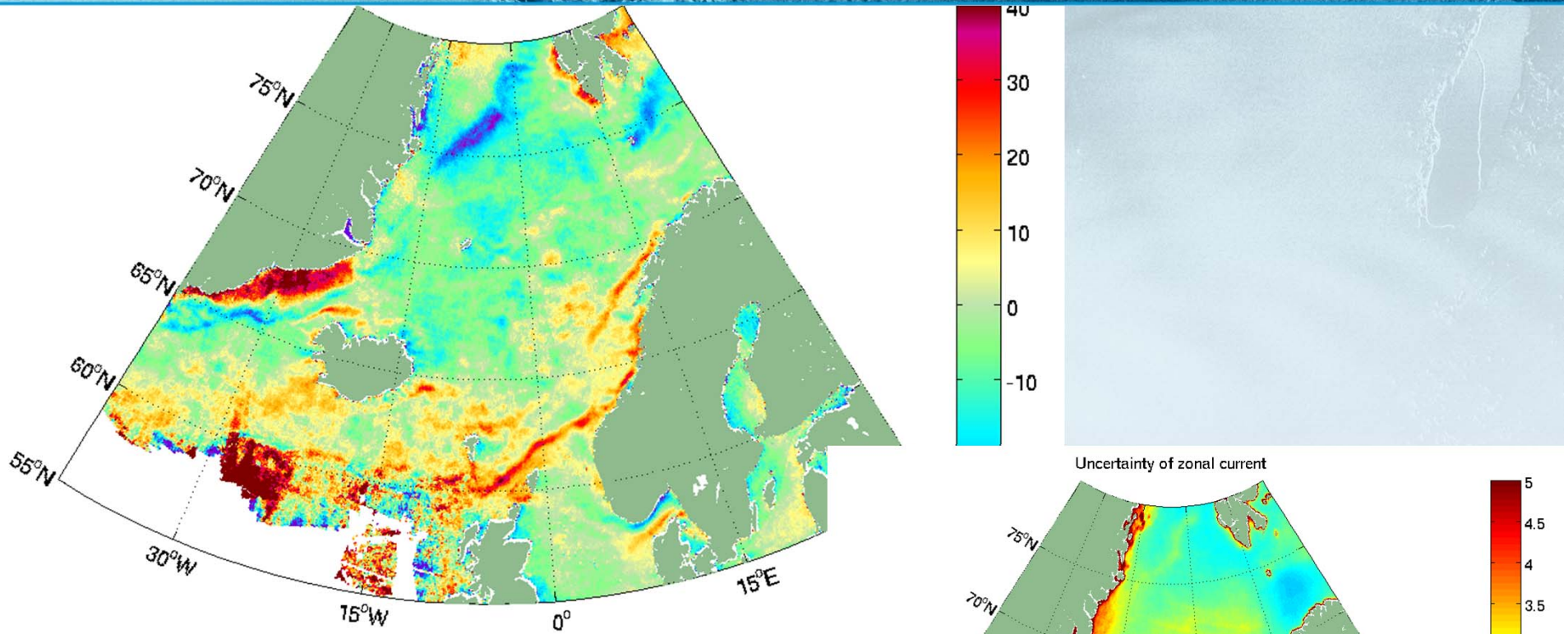


Strong
Over-correction

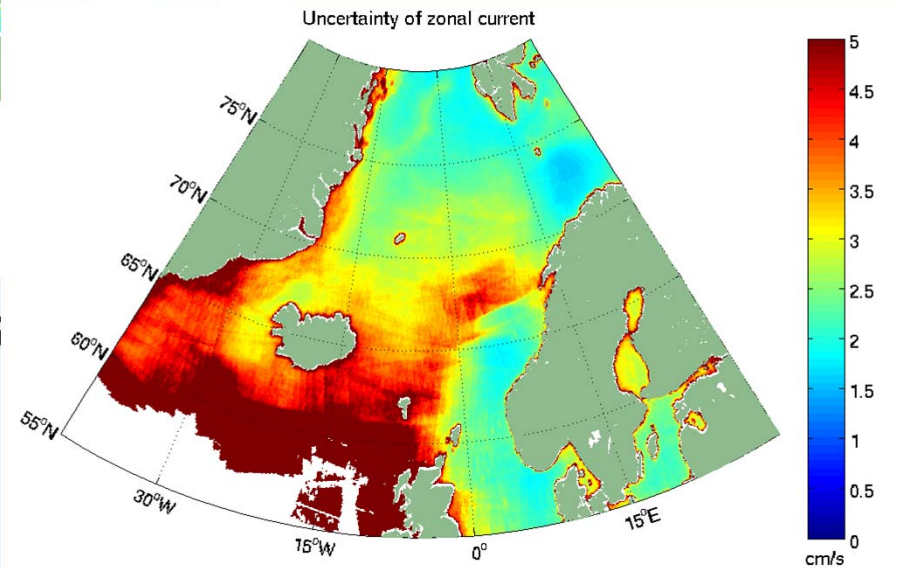


Atmospheric
front

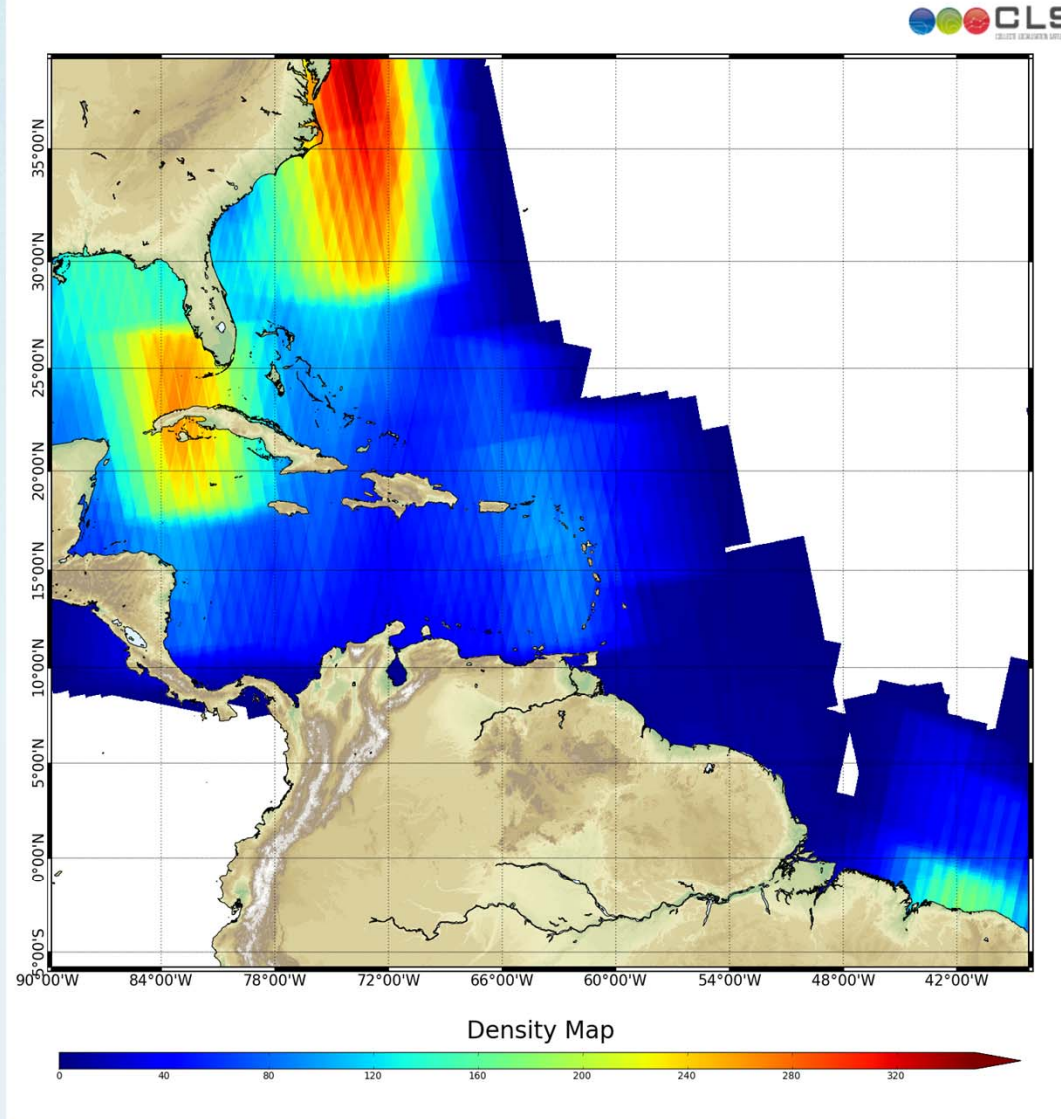


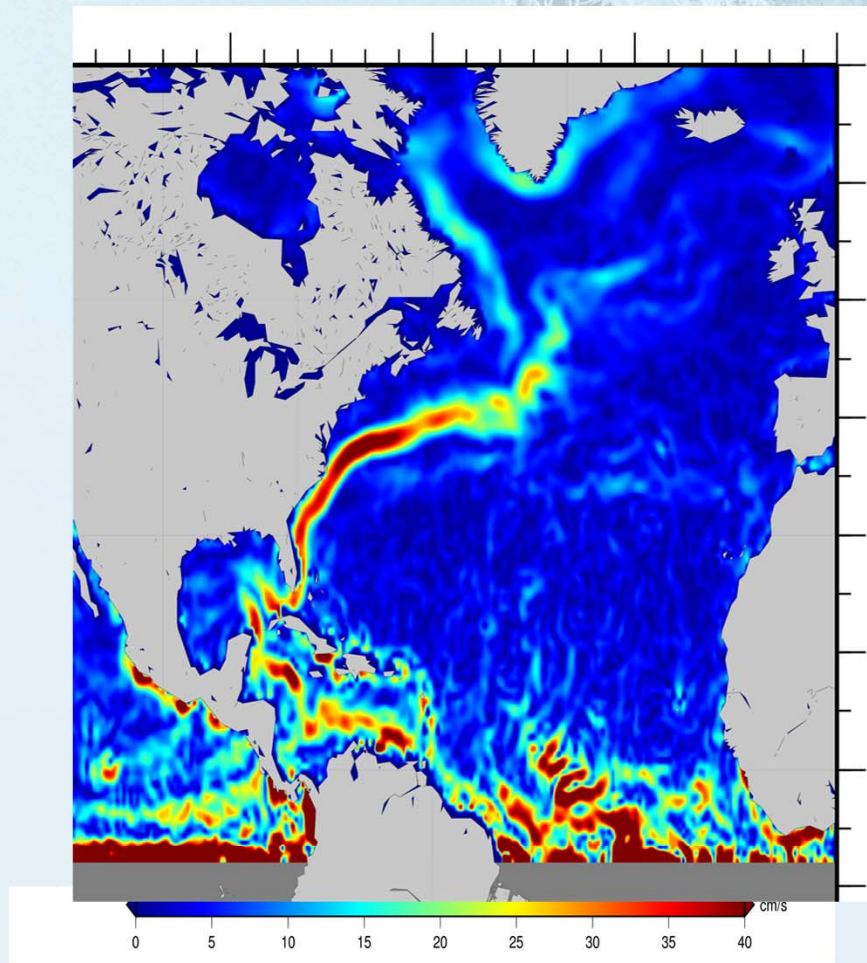


Zonal Current in the Nordic Seas

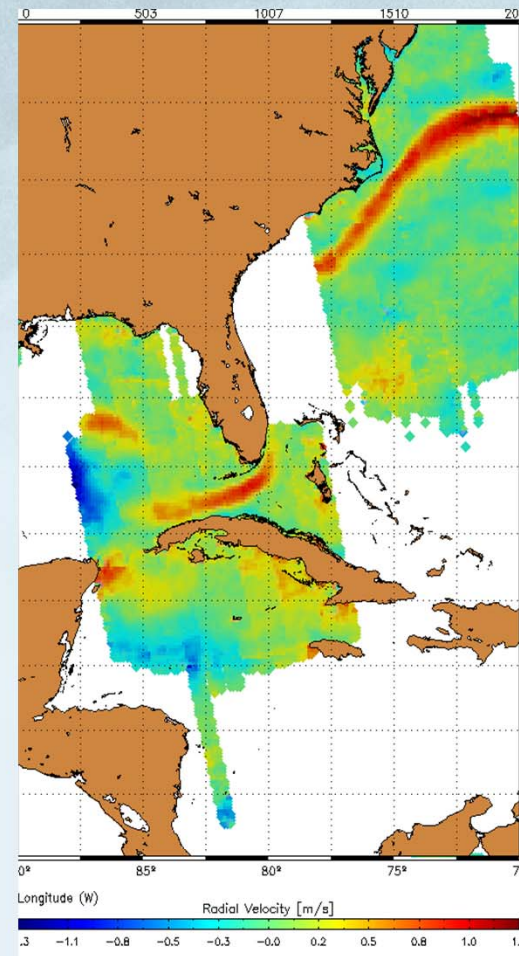


Data Coverage



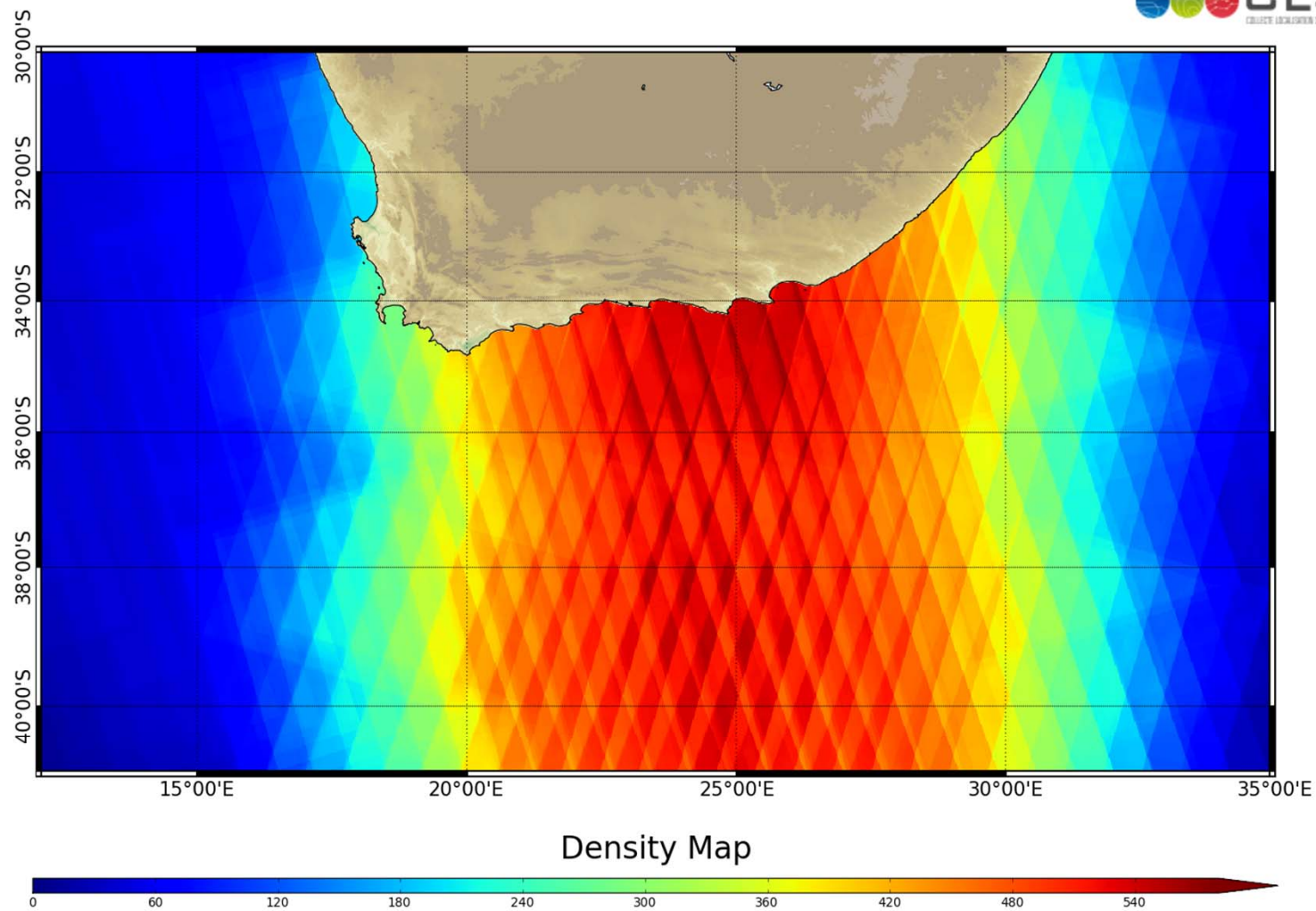


GOCE – 1 year integration

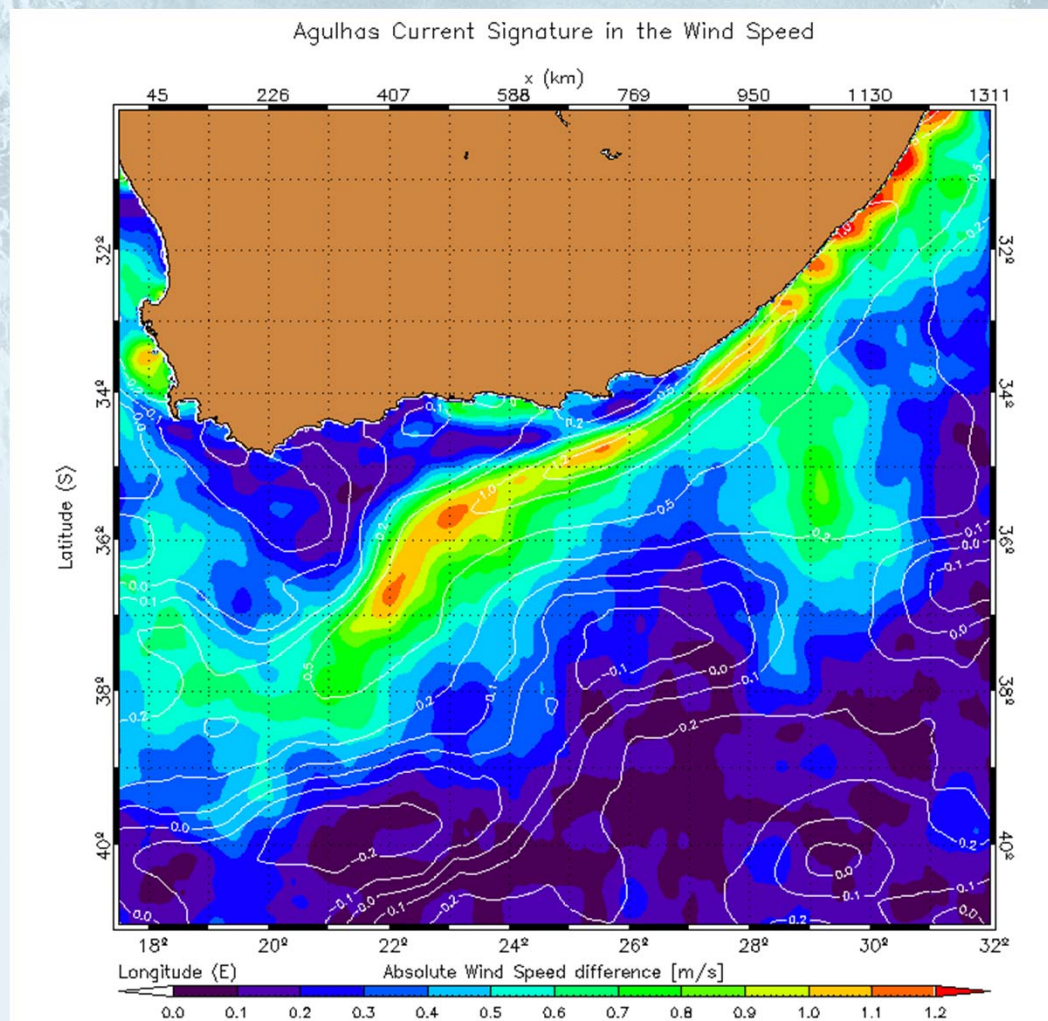


ASAR 2007-2011 Climatology

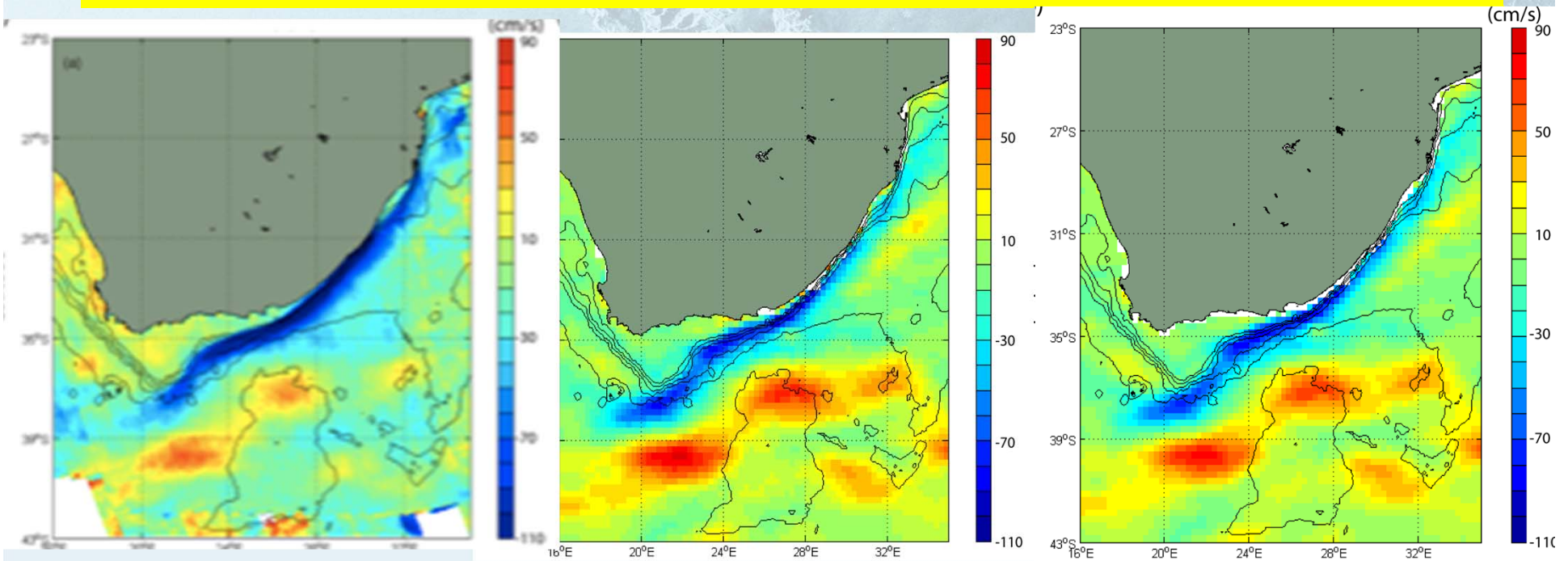
Data Coverage



Wind field anomalies
(SAR wind-ECMWF)
contains surface
current information
(cross section modified
in the presence of
surface current and
SST front (via ABL
adjustment))



Mean Doppler range velocities and Mean Dynamic Topography



ASAR

RIO 09

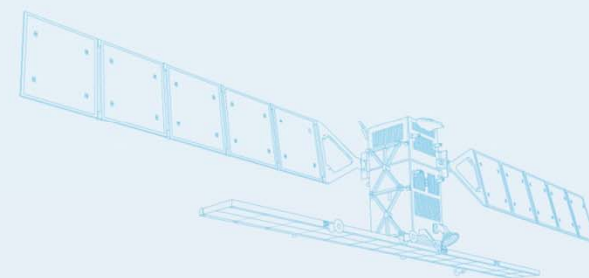
GOCE Derived SGC

Examples of additional Monitoring Capabilities

Strong river outflow

Hurricanes

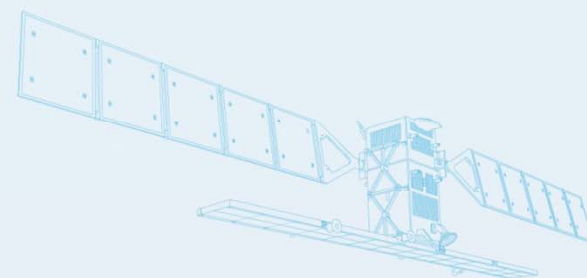
Intense rainfall



Challenge – emerging Applications – outlook

From ENVISAT ASAR to Sentinel 1 A/B

With the launch of the Sentinel-1 missions in 2013 and 2015 a Doppler grid product will be made available.



The manual will be released in 1st quarter of 2013

