ENVISAT ASAR:
a Boost for operational near real-time monitoring of the marine environment and maritime situation

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08/03/2012, Brest, France

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ENVISAT ASAR Story

A (very self-centered) summary of its chronology

ENVISAT
Launch

BOOST Technologies
Creation

Wind, waves & currents
ESA contract

SOPRANO
SAR Ocean Products Demo

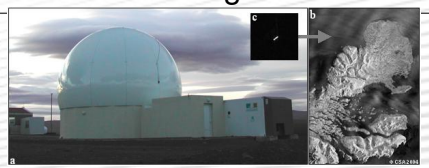
MCGS
New S1 products

2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

CleanSeaNet
Oil detection

CleanSeaNet v2
Oil & ships detection

Kerguelen, Southern Indian Ocean
Detection of illegal fisheries

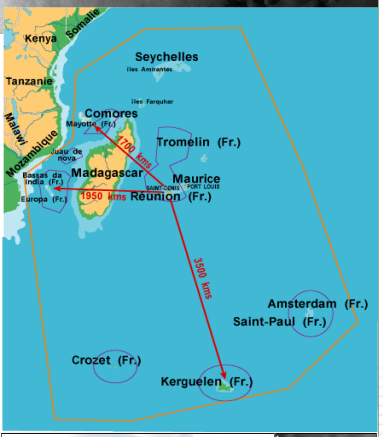


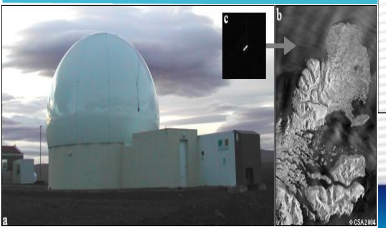
VIGISAT ground station
Opening

A celebration: 10 years of Marine Observations with ENVISAT

2004: Detection of illegal fisheries

Kerguelen Islands - Southern Indian Ocean





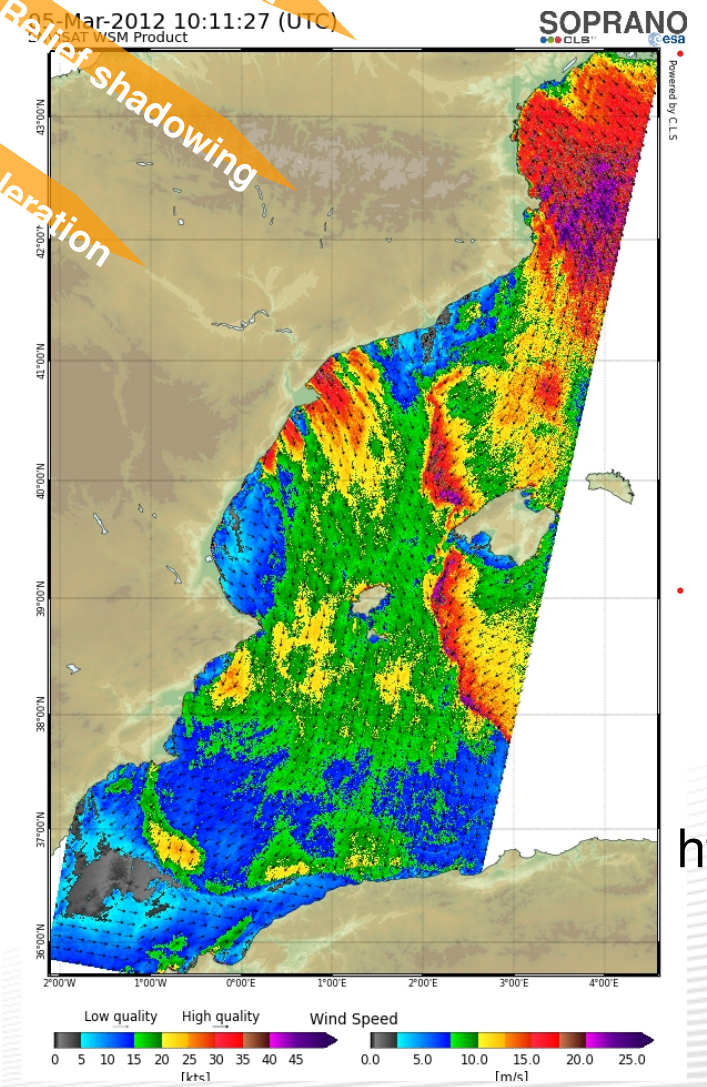
- **Context:**
  - **Protection of the endangered Patagonian toothfish** from illegal fisheries in the French and Australian ZEEs in the Southern Indian Ocean
  - Very remote and large with harsh meteorological conditions

- **Proposed solution**:
  - 2004: Direct reception of SAR images (ENVISAT, Radarsat-1 then 2) was installed on Kerguelen Island
  - Vessel Detection System relying on
    - non-cooperative ship detection using SAR imagery
    - and correlation with position reported by licensed fishing vessels (VMS)

- The stock has now been observed to regenerate proving the **deterrent effect** of the system

2005: SAR Ocean Wind, waves and Currents

Definition, prototyping and validation (ESA contract)



A new **SAR level-2 Ocean Wind product** was prototyped relying on

- Bayesian inversion scheme
- Neural network-based scattering models
- Assessment of the polarization ratio
- Refinement of wind direction estimation and positioning of atmospheric fronts based on SAR Doppler analysis

- SAR level-2 wind products are produced operationally in NRT at VIGISAT for
  - **CleanSeaNet** oil spill monitoring service (EMSA)
  - **SOPRANO** NRT demonstration

http://soprano.cls.fr

2005: SAR Ocean Wind, waves and Currents

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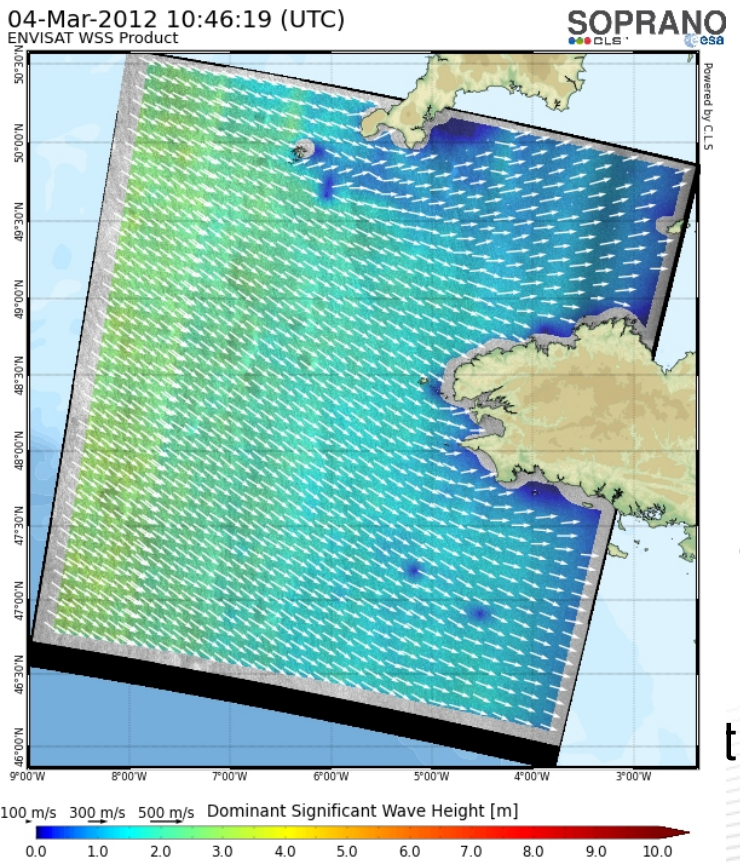

- A new **SAR level-2 Ocean Swell product** was prototyped relying on
  - Extension of Modulation Transfer Functions at all incidence angles and polarisation
  - Correction for the non-linear mapping
  - Combined use of cross-spectra and partitioning
  - Use of the full range resolution of Wide Swath Complex (WSS) products

SAR level-2 Swell products are produced operationally in NRT at VIGISAT for

- **CleanSeaNet** oil spill monitoring service (EMSA)
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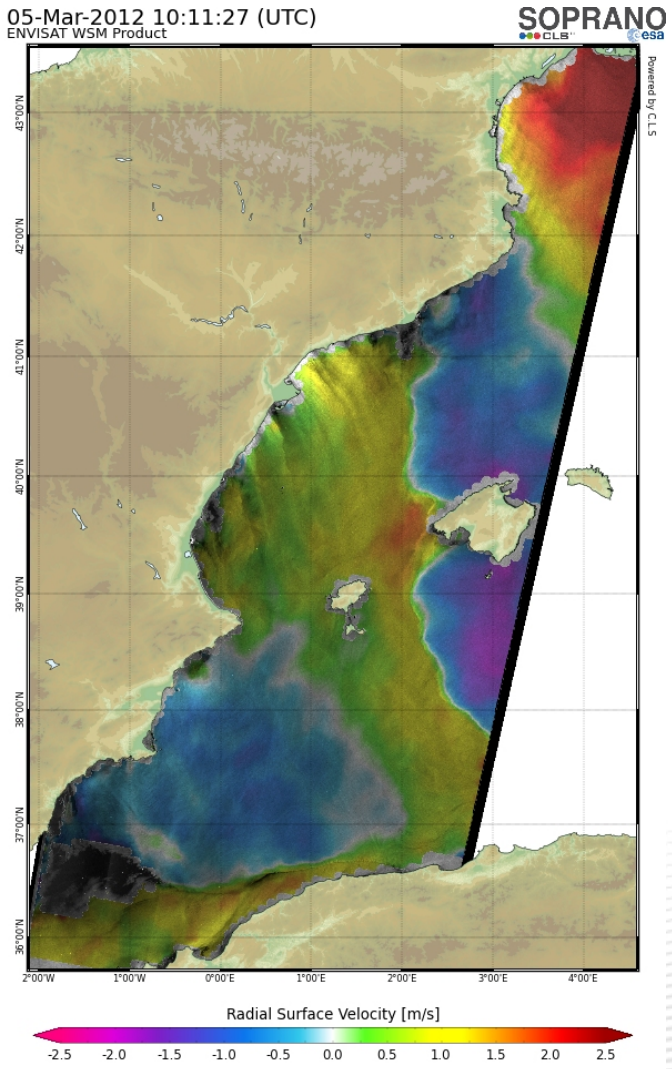

- A new **SAR level-2 Ocean Radial Surface Velocities product** was prototyped relying on
  - Precise Doppler anomaly estimation
  - Description of the 1st order wind contribution (development of the CDOP model)
- SAR level-2 Radial Surface Velocities products are produced operationally in NRT at VIGISAT for
  - **SOPRANO** NRT demonstration

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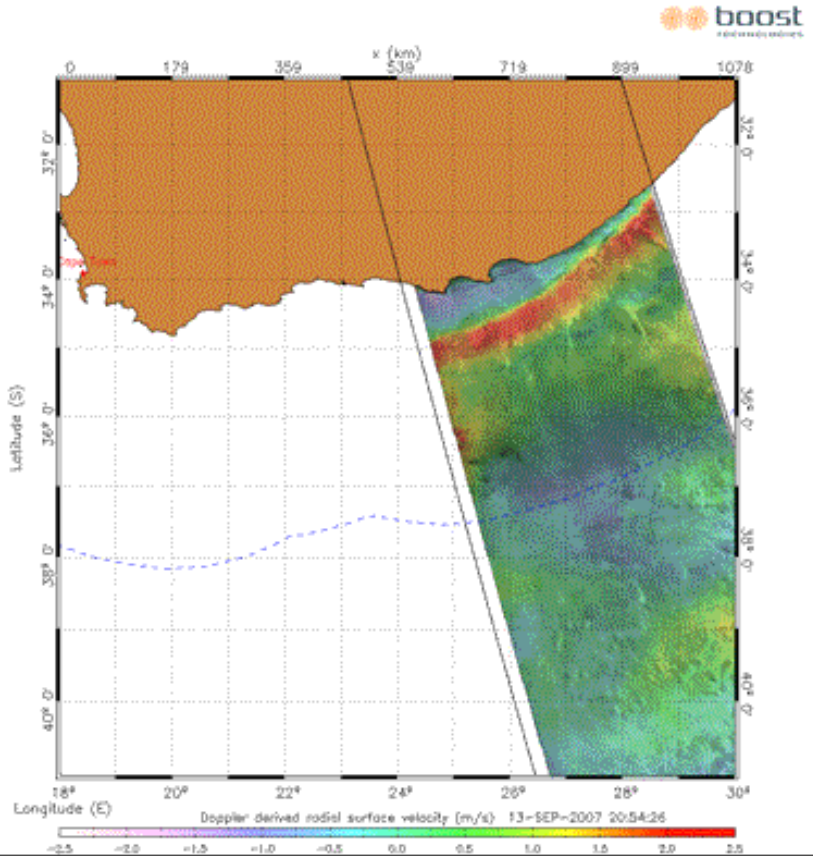
- Further Studies have demonstrated the capabilities of SAR Doppler anomaly **to map the residual sea surface current**

2008-2010: SAR Doppler Anomaly information

Examples of mapping of the surface current

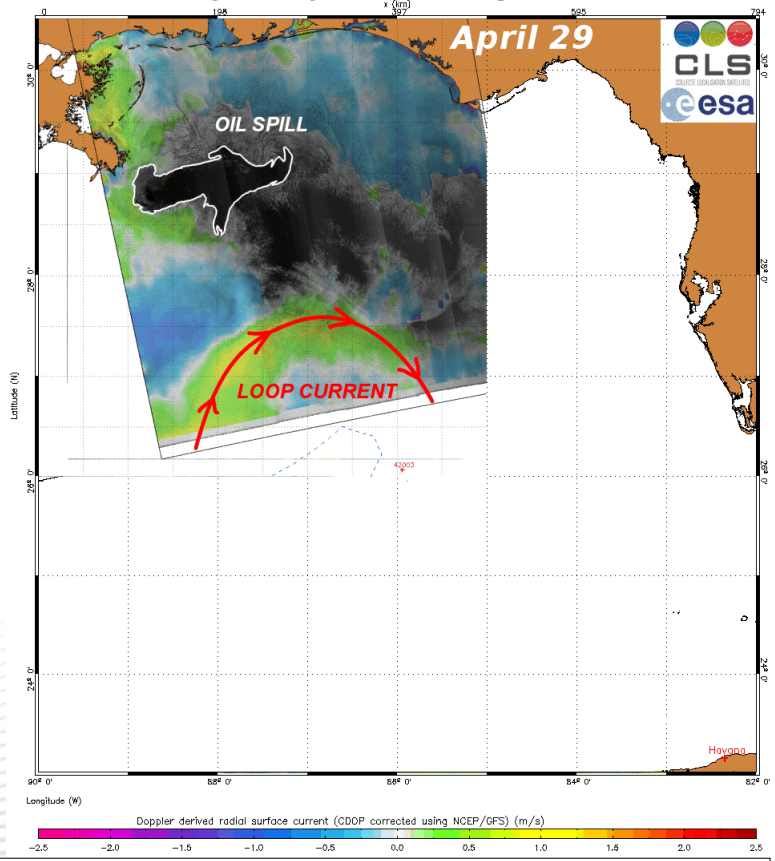
Map of surface velocity of the Agulhas Current using SAR Doppler information



New radar satellite technique sheds light on ocean current dynamics

ESA web story – 28/01/2008

Successive maps of the oil spill in the GoM **caught by the Loop current**



Gulf of Mexico oil spill in the Loop Current

ESA web story - 19/05/2010

2008: SOPRANO

NRT demonstration of SAR Ocean Wind, waves and currents

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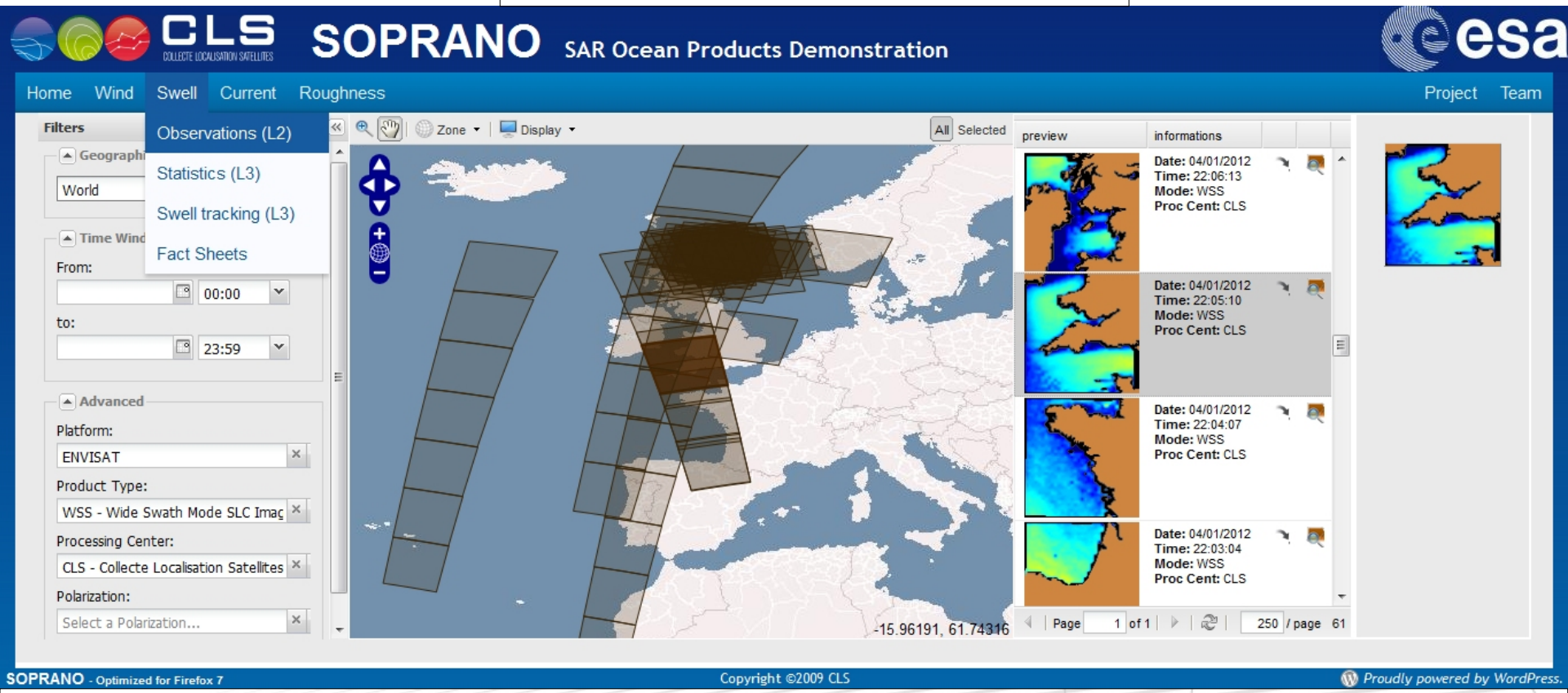
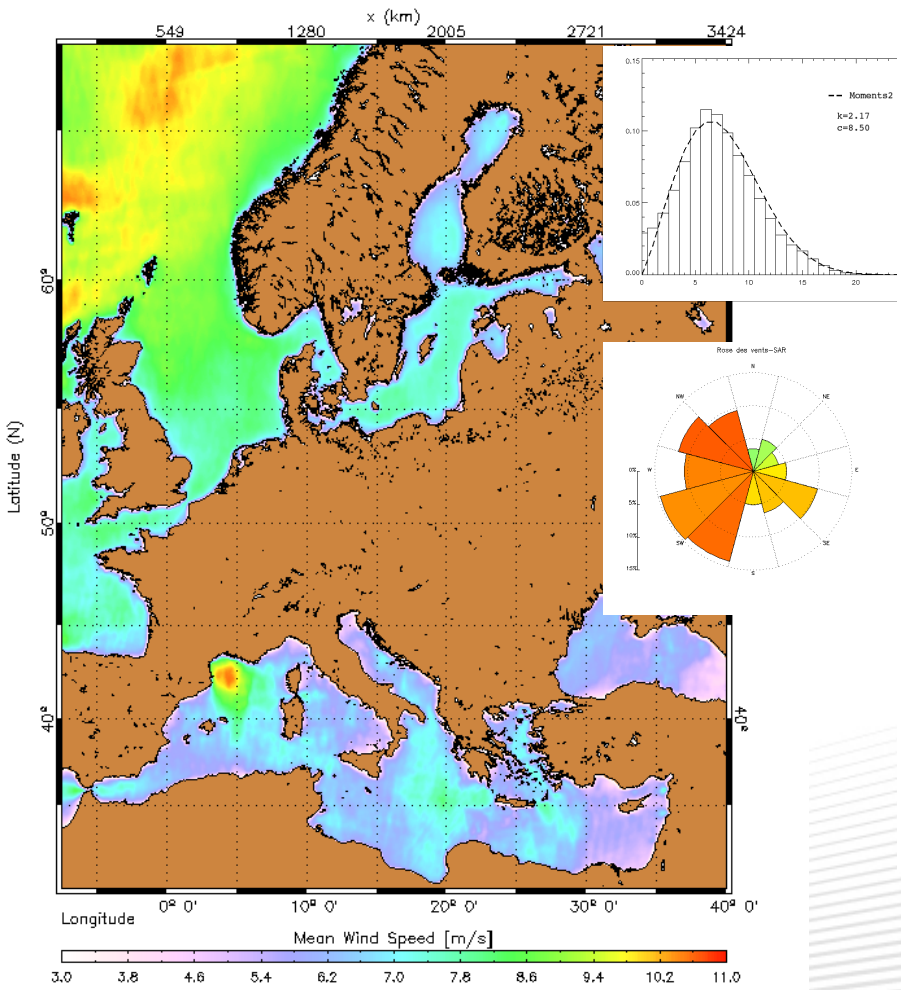
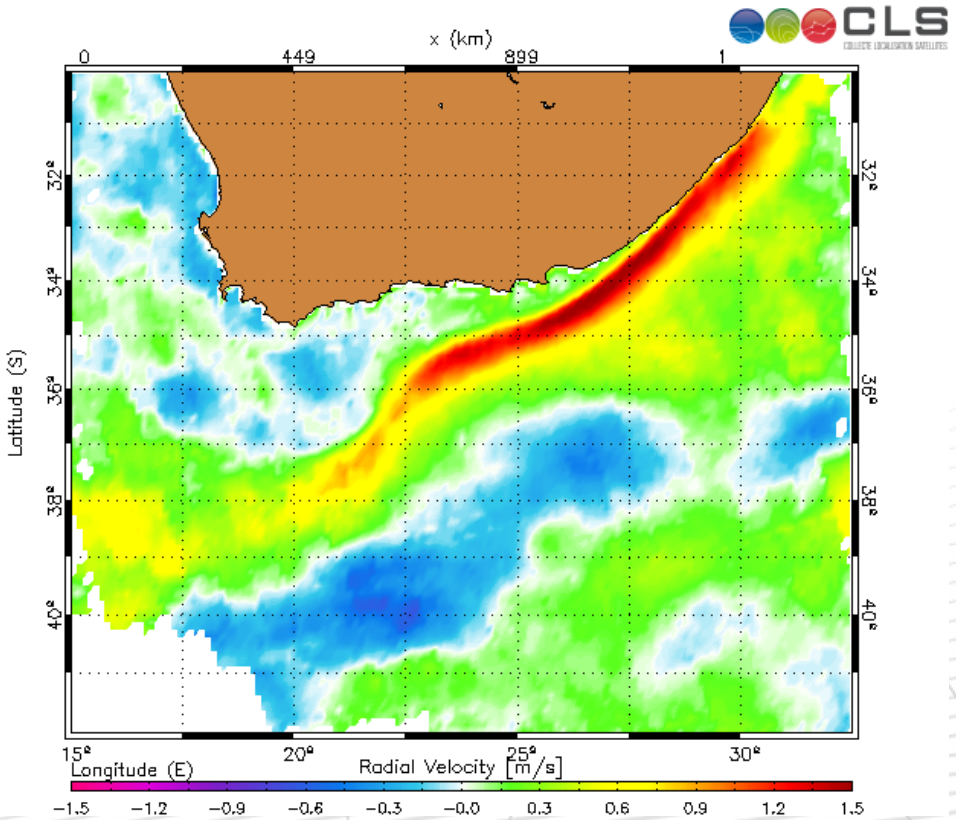


NRT demonstration of ENVISAT SAR level-2 Wind, Swell and Radial Surface Velocities products

2008: SOPRANO

NRT demonstration of SAR Ocean Wind, waves and currents





Demonstration of ENVISAT SAR level-3 products

2009: VIGISAT - CLS ground receiving station

Operational since September 2009

Satellite missions received:

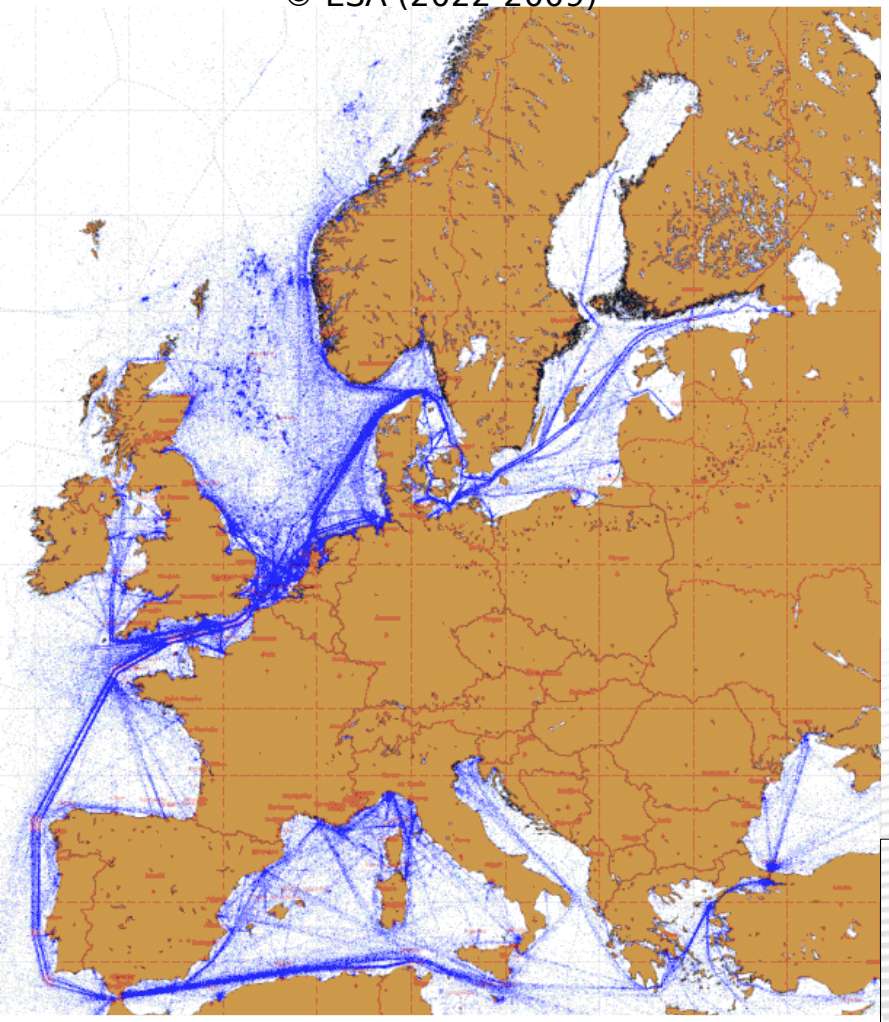
ENVISAT, ERS-2, RADARSAT-1 & 2

2009: VIGISAT ground receiving station

- A major breakthrough paving the way to:
  - Move towards operational services:
    - CleanSeaNet v2 (oil spill & ships detection, wind & swell products delivery)
    - Maritime surveillance for French Navy
  - Stimulate R&D studies and education
    - Creation of the GIS BreTel (group of research and educational institutes)
  - Boost the demonstration of new products
    - NRT generation of Wide Swath swell products (SOPRANO)
    - Operational infrastructure of the French Marine Collaborative Ground Segment for Sentinel-1

2009: A synoptic view of European shipping routes

Cumulated ship detection reports using ENVISAT ASAR WSM products,



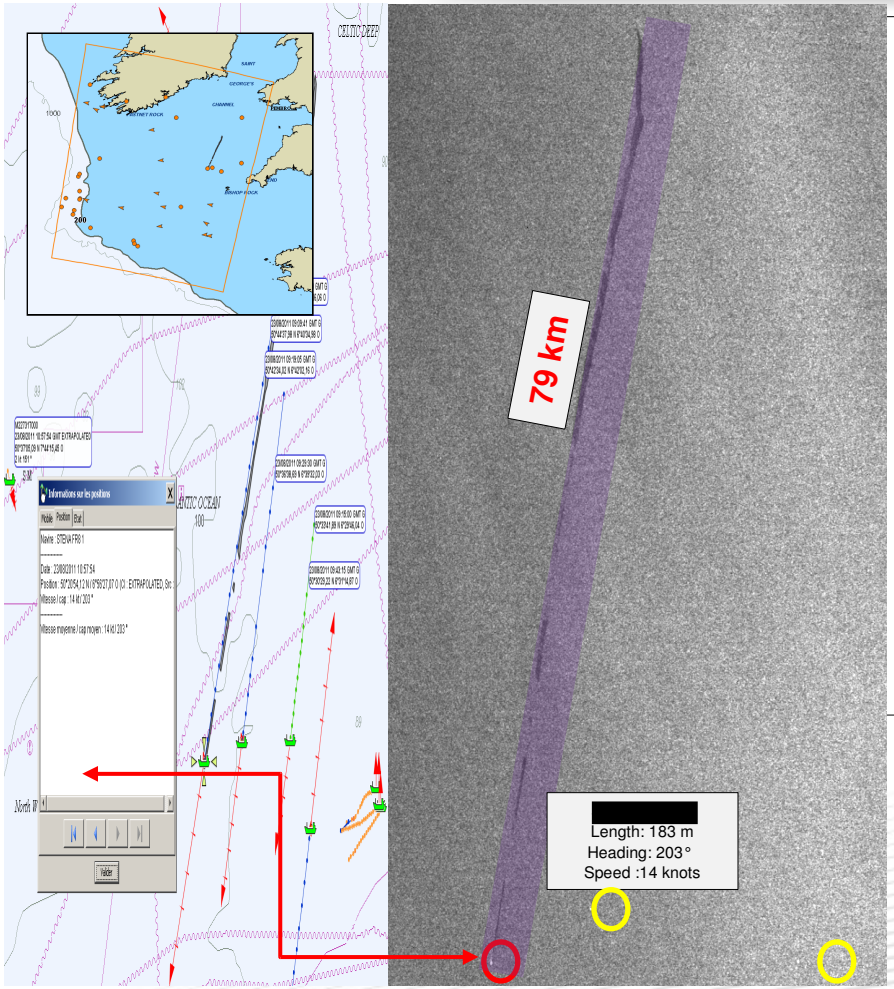
Powered by SARTool®

- Operational ships detection services provided for several years
- Accumulation of ships detected on ENVISAT ASAR Wide Swath imagery over several years produce **an overview of ship traffic patterns**
- NO2 emissions from ships can be measured from space along major shipping routes

ESA map reveals European shipping routes like never before
ESA web story - 22/05/2009

2011: The paneuropean CleanSeaNet service v2

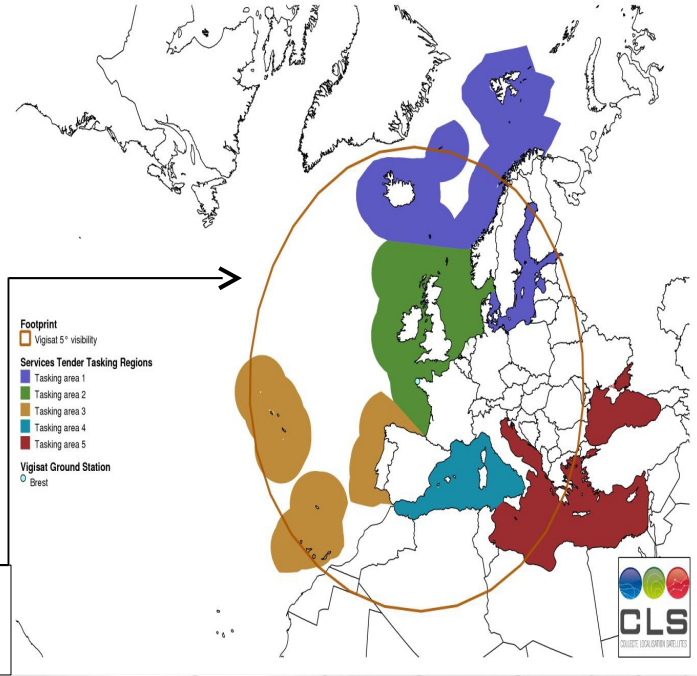
/CleanSeaNet /European Maritime Safety Agency/



A near real-time detection service of oil spills and ships at sea using SAR imagery

- Delivered by EMSA since 17 April 2007
- To apply the European directive 2005/35/EC :
  - Detect from space oil spills at sea
  - To identify the source of pollution

23/08/2011 10:57UTC – ENVISAT
79 km long discontinuous discharge



Service area covered by VIGISAT

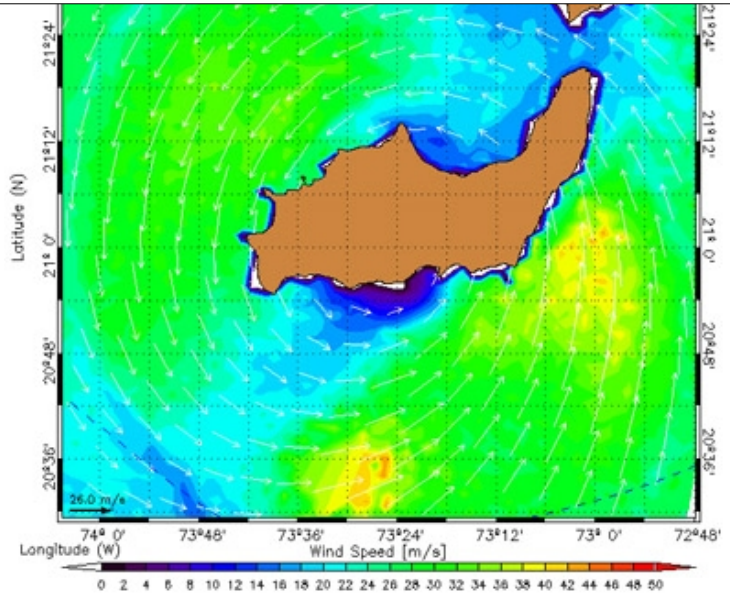
2011: The French Marine Collaborative Ground Segment (MCGS)

- Objectives:
  - Develop satellite-based ocean products and services through dedicated processing centres, complementary to the Sentinel “core products”
  - Build a competitive business for marine/coastal markets driven by industry
- Examples of MCGS products
  - Sentinel-1 L2 Wind products including Doppler anomaly (EMSA)
  - Sentinel-1 L2 Swell products derived from IW and EW (EMSA)
  - Sentinel-1 SAR L3 global swell tracking product derived from Wave Mode
  - Sentinel-1 SAR L2 radial current component product

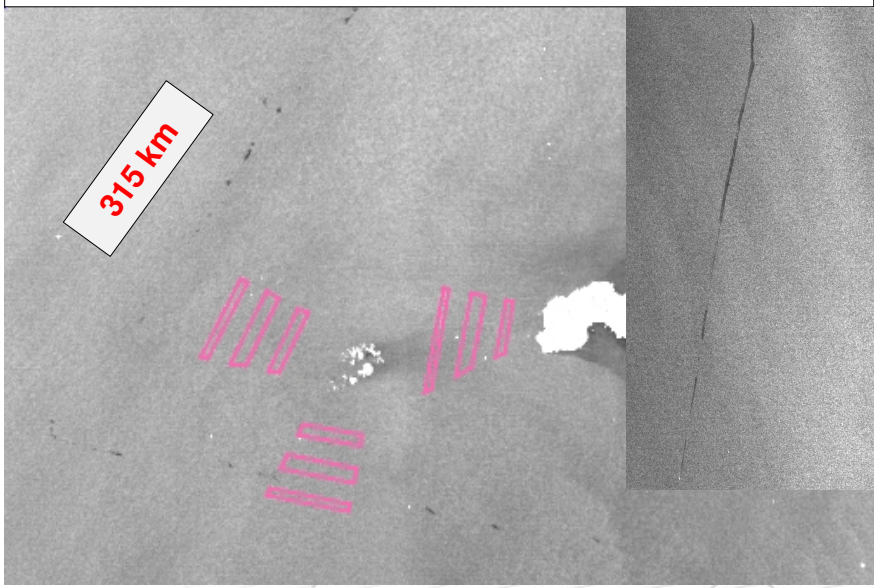
Consortium

Our ENVISAT SAR Guinness book

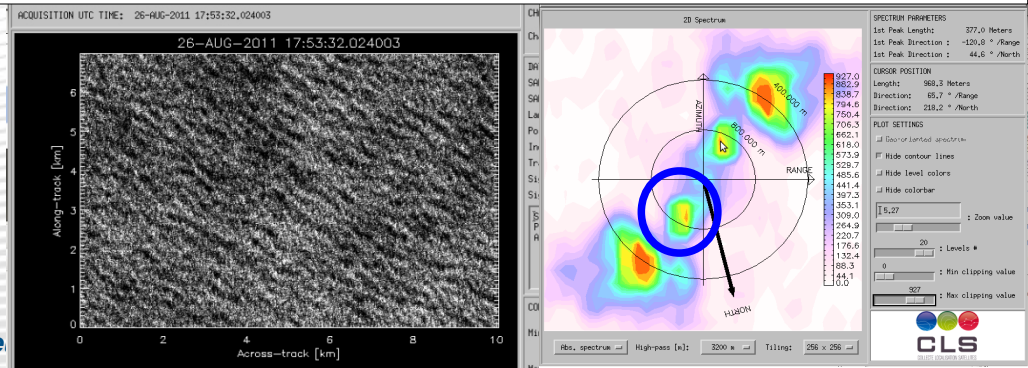
The highest wind measured: 40 m/s
Hurricane Ike on 7 September 2008

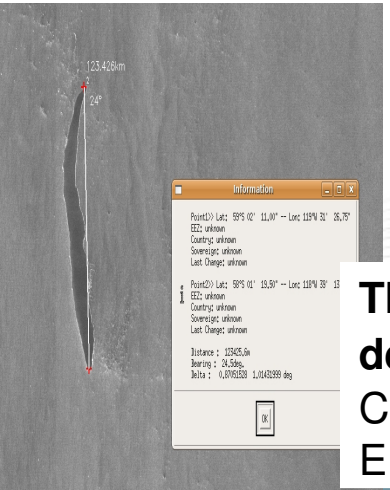


The longest oil spill detected : 315 km
23/08/2011 22:17UTC – ENVISAT



The longest wave system measured: 950m (24.7 s)
26/08/2011 – SE of New Zealand



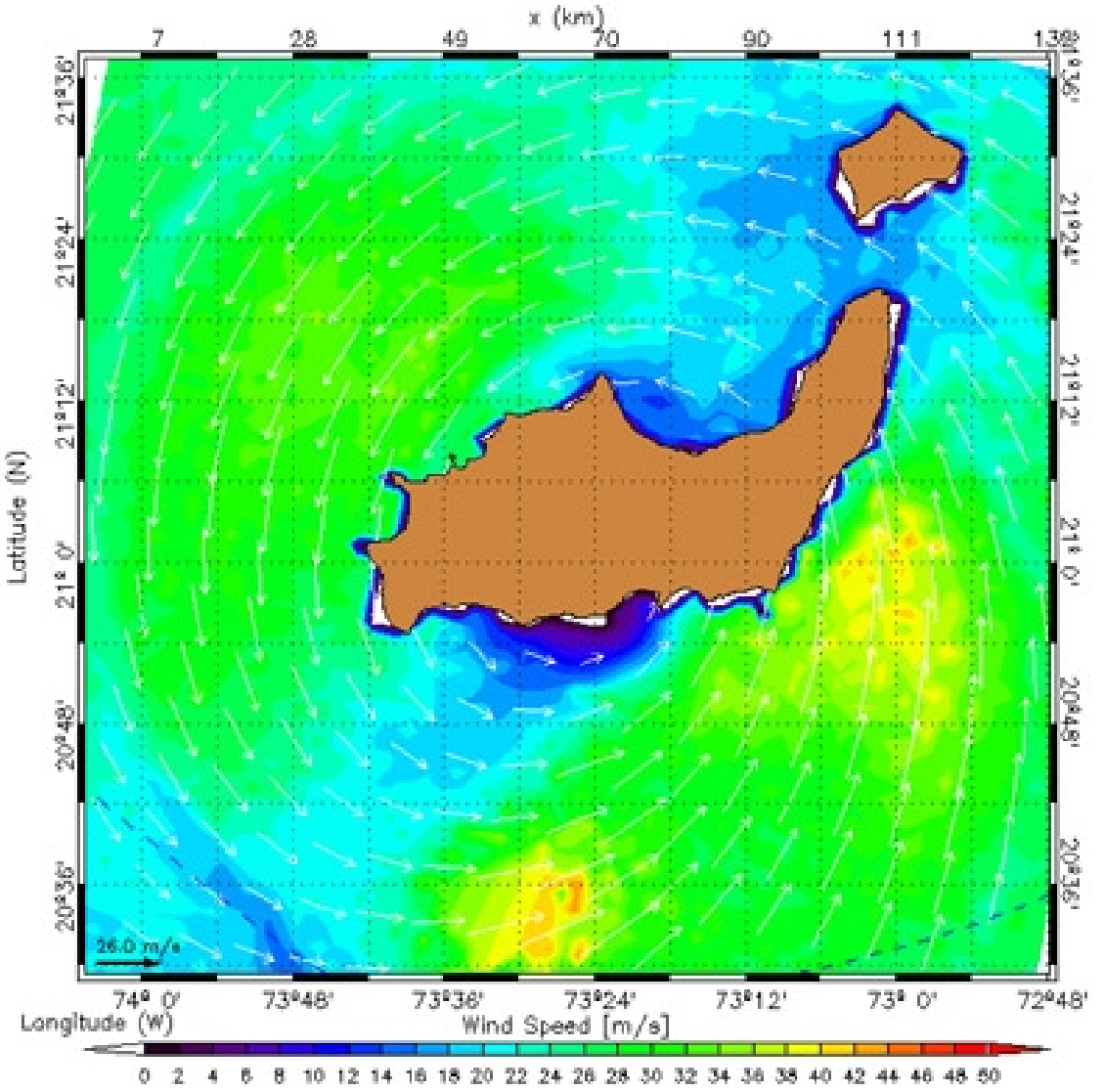


The longest iceberg detected: 123 km
C-19A observed by ENVISAT on

Our ENVISAT SAR Guinness book

The highest wind measured: 40 m/s
Hurricane Ike on 7 September 2008

Hurricane Ike tracked by ESA's ENVISAT
ESA web story - 11/09/2008



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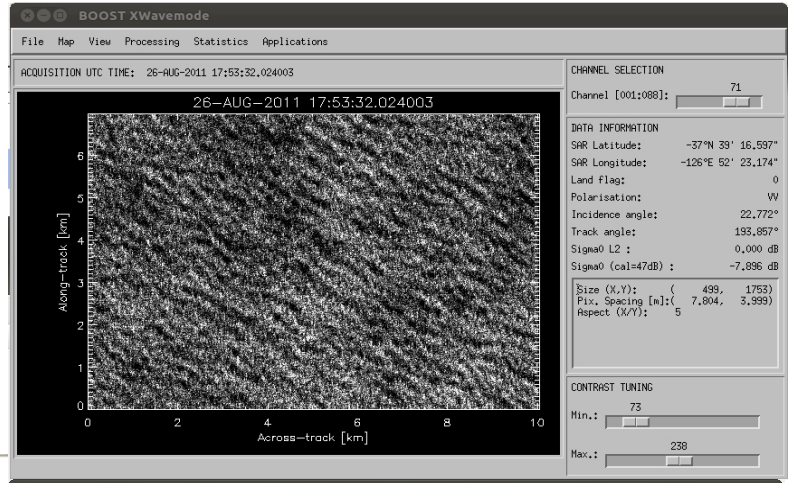
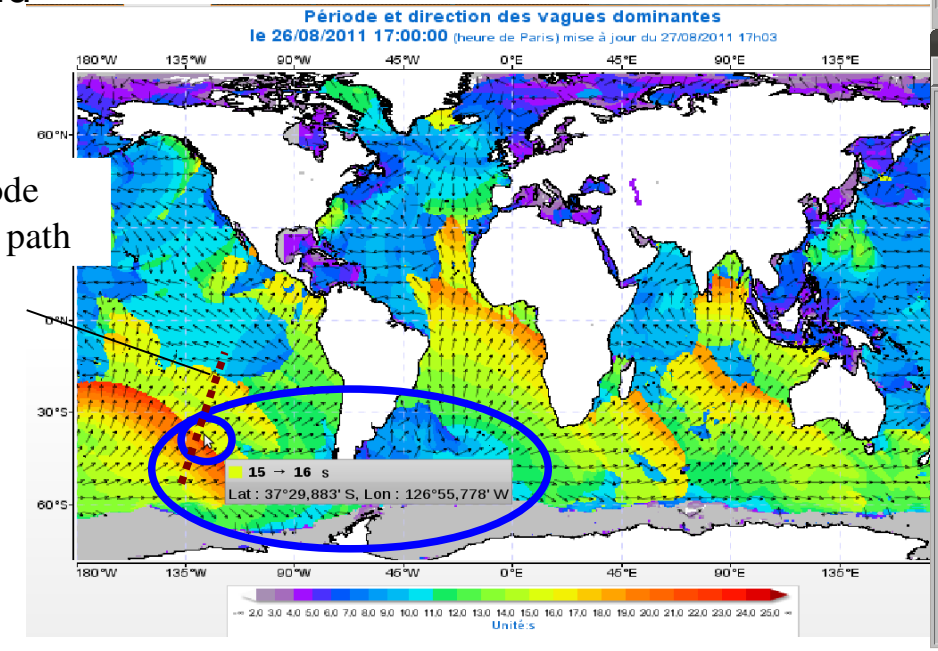
The longest wave system measured: 950m (24.7 sec.)

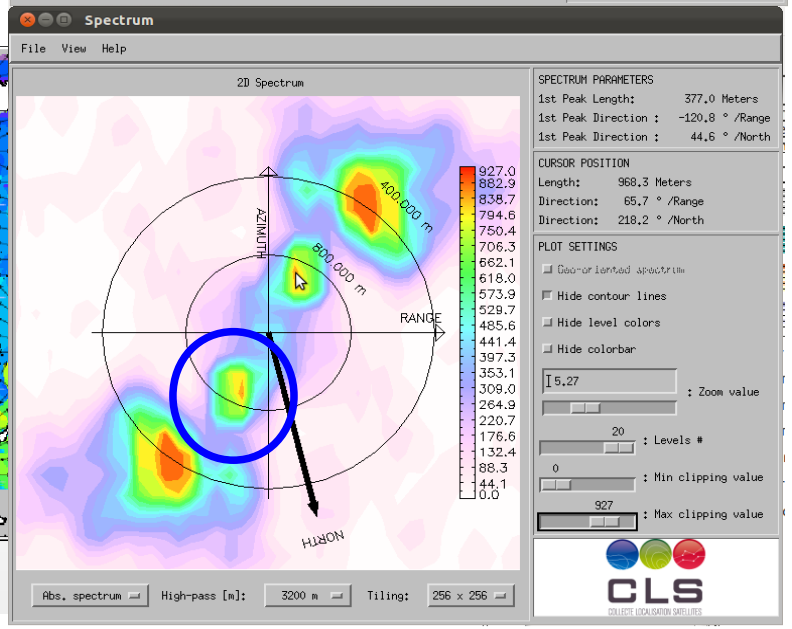
Storm in South Pacific Ocean generated a very energetic swell field

Maximum Total Hs above **15m as seen by WW3** - on 24th August 2011, SE of New Zealand





Wave mode sampling path



Dominant wave period measured by WW3

Peak wavelength > 950m (24.7 sec.)

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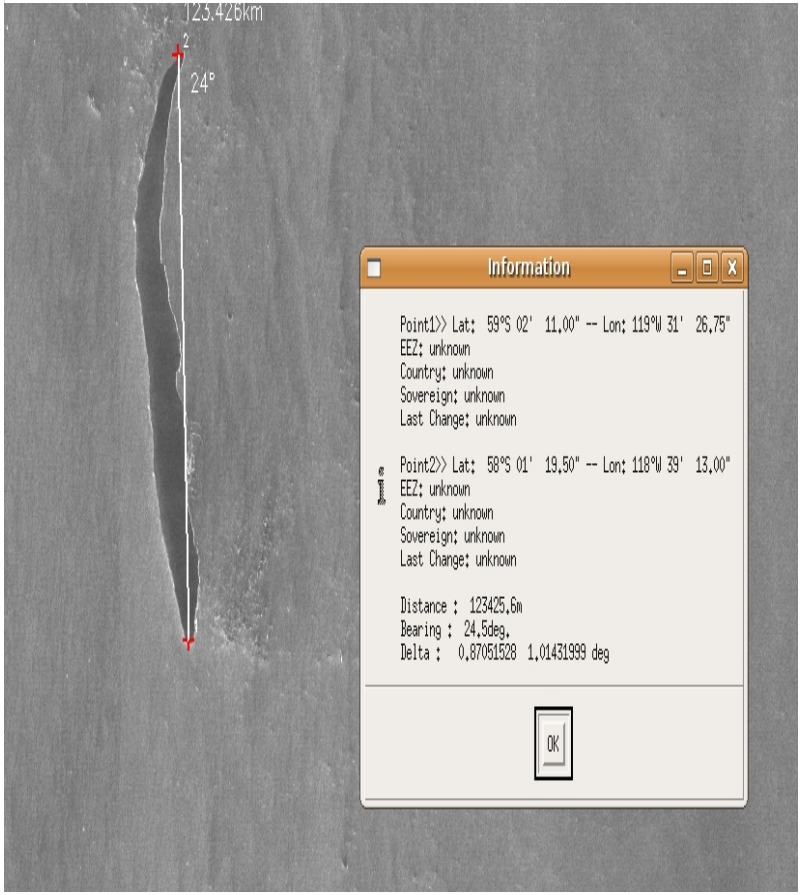
The longest iceberg detected: 123 km

C-19A calved from the Ross Ice Shelf on May 2002

Observed by ENVISAT ASAR
on 17november 2008



Observed by MODIS
on 23 november 2008

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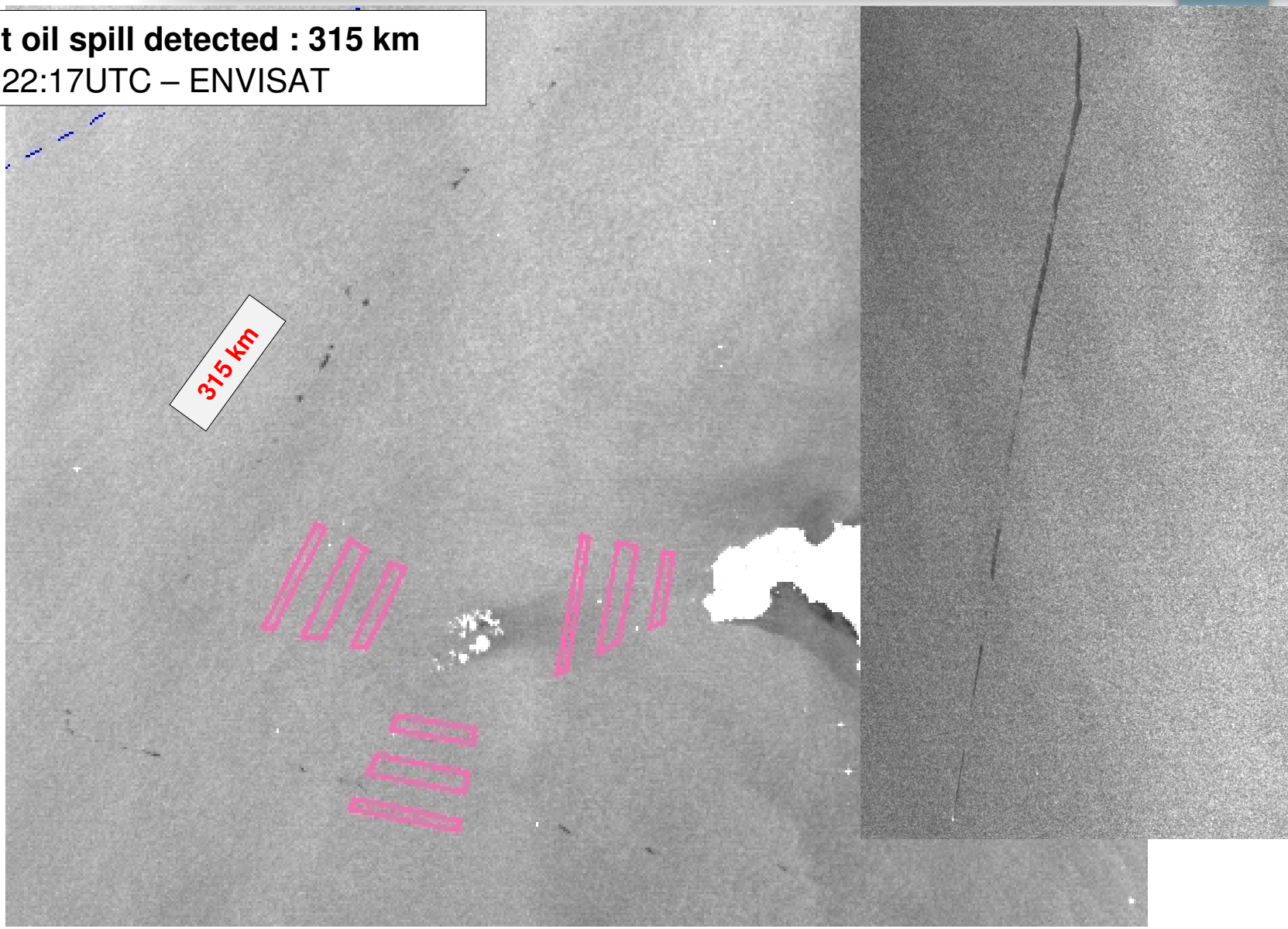
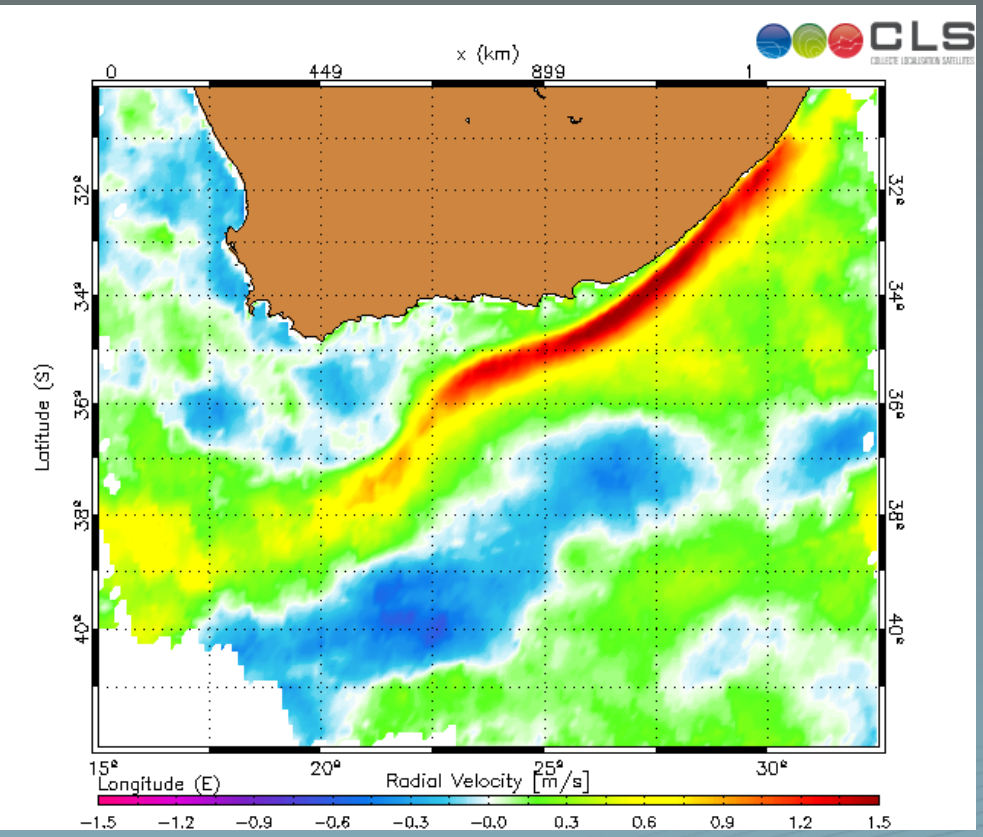
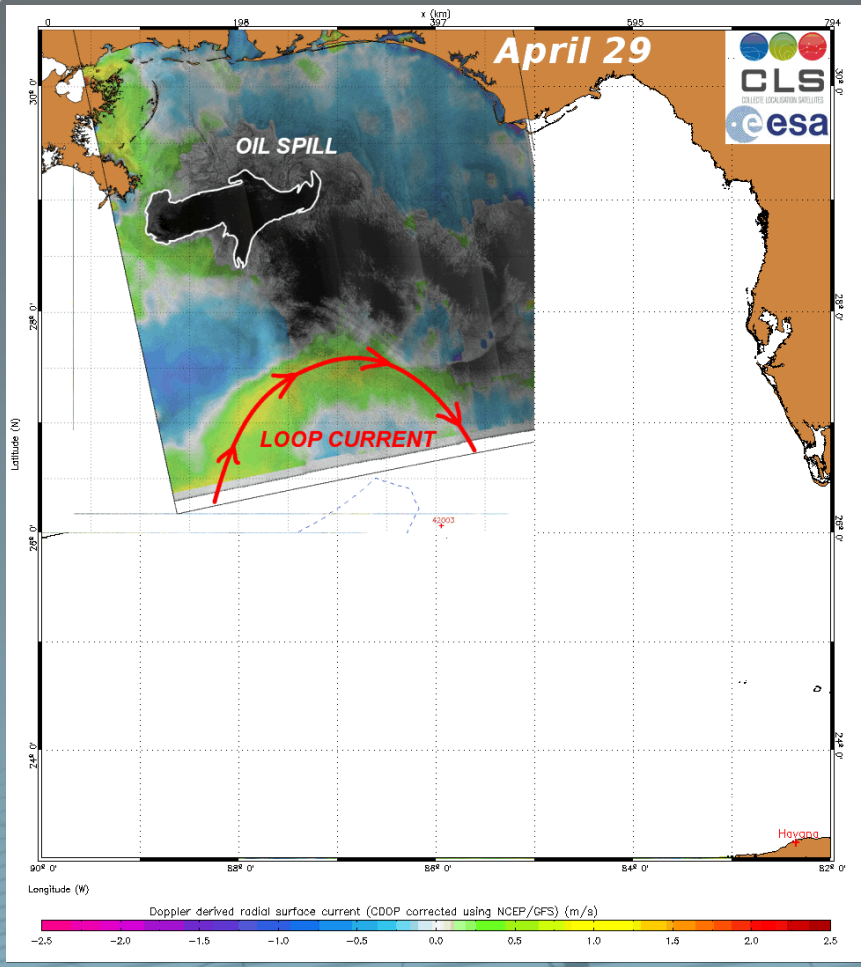
23/08/2011 22:17UTC – ENVISAT







Thank you for your attention!

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