

Journée Technique du CEDRE
20 Mars 2012 - Paris

Detection des déversements huileux par radar satellitaire

Satellite radar surveillance of oily waters discharges

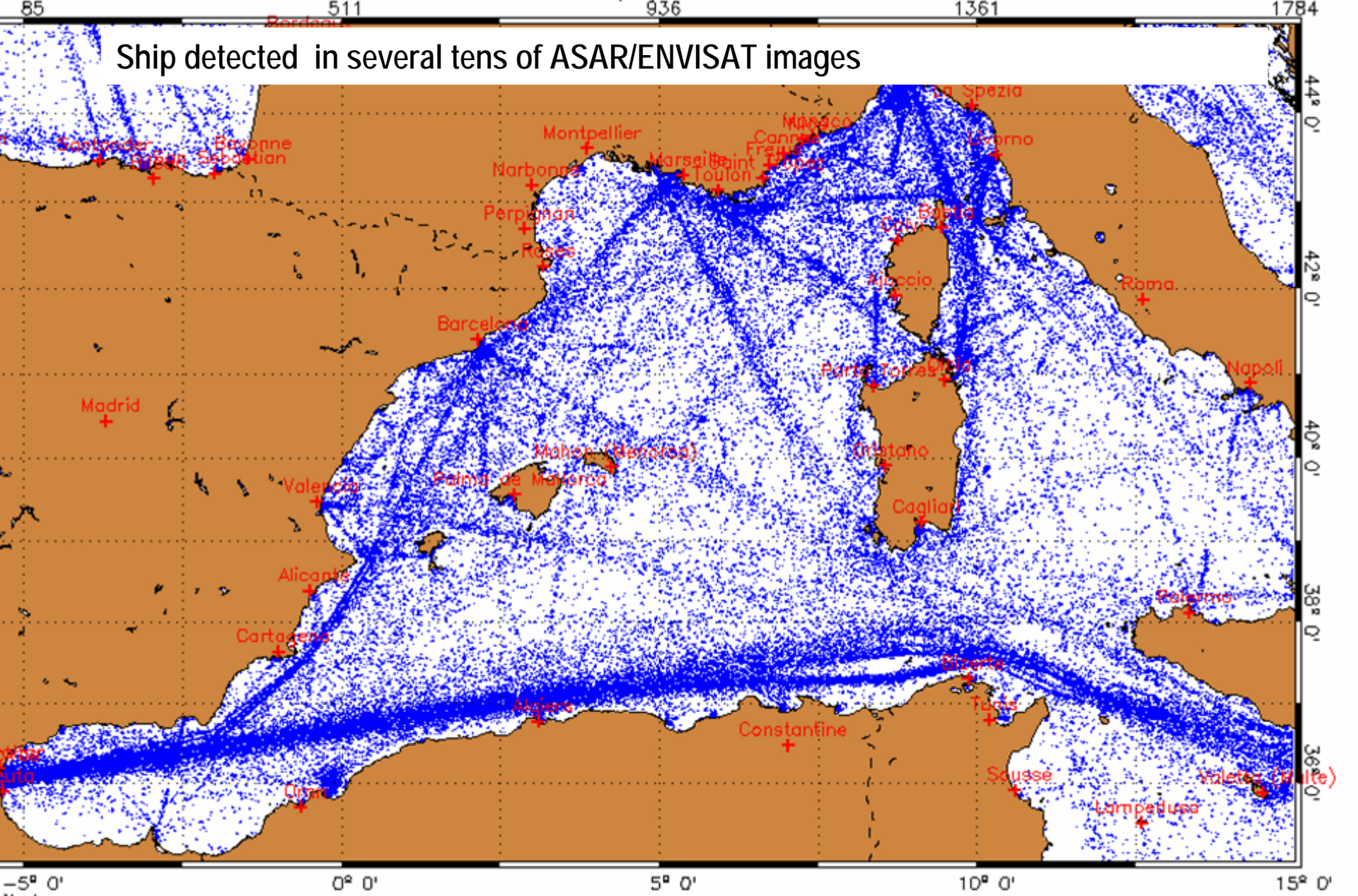


Satellite radar characteristics:

- Wide swath (400 km) and constant resolution (SAR)
 - Large fauchée et résolution constante
- Reliable detection of recent oil pollutions (Prestige,DWH,...)
 - Détection fiable des pollutions huileuses récentes
- Local wind field retrieved from the SAR signal
 - Extraction du champ de vent du signal radar
- Detection of vessels (+ estimation of their speed in some cases)
 - Détection des navires sur zone (et de leur vitesse dans certains cas)
- Complemented by AIS for vessel identification
 - Identification des navires par AIS
- Satellites coming into operation / satellites utilisés et à venir

CleanSeaNet (EMSA) at the European level provides a service and alert at the request of each country within 30' delay.



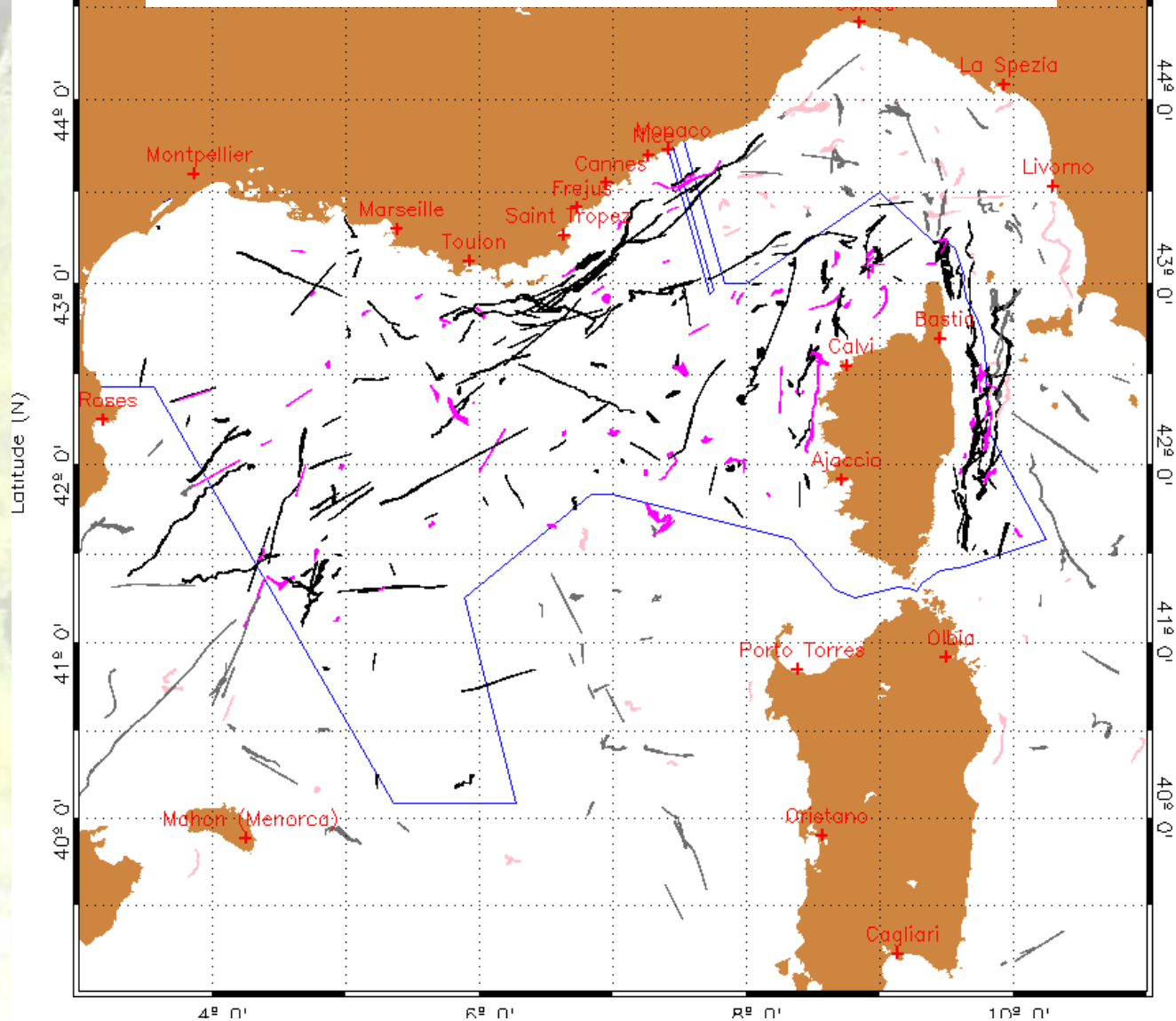


Ship detected in several tens of ASAR/ENVISAT images

Navires détectés sur plusieurs dizaines d'images SAR/Envisat

Courtesy of

Nappes d'huile détectées par satellite (2002-2007)



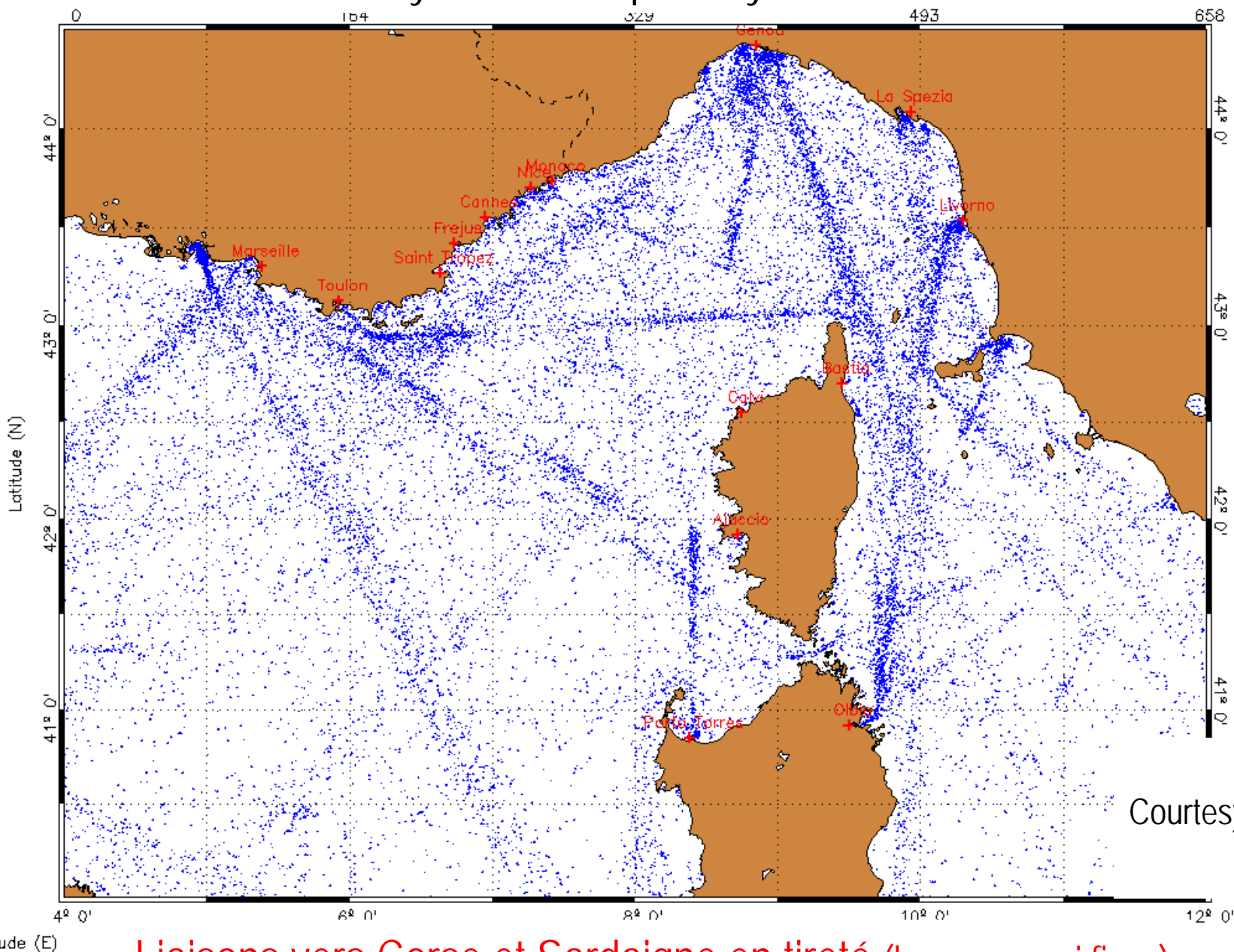
Oil slicks detected by satellite – 2002-2007

Good correlation with the routes

Courtesy of CLS



Ferry routes are partially visible

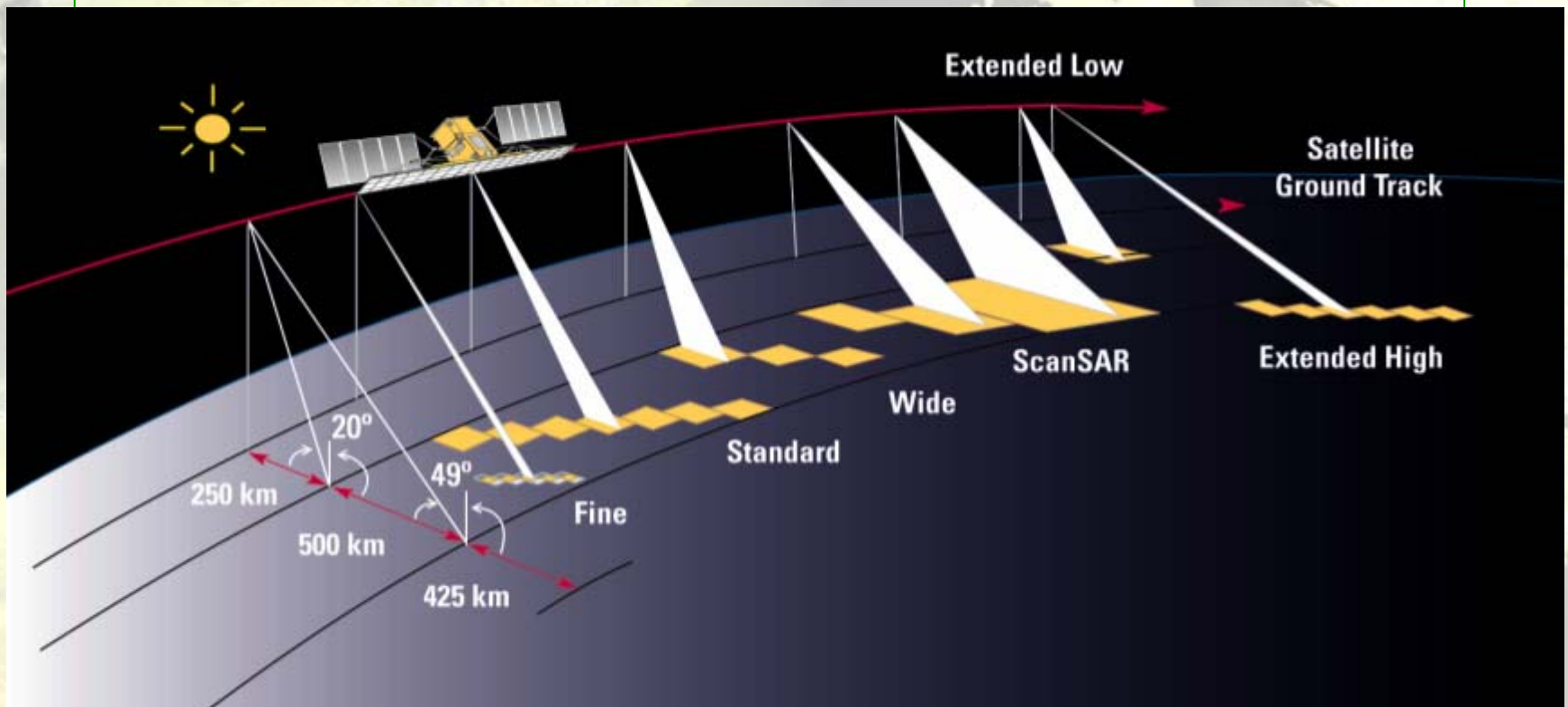


Courtesy of CLS

Liaisons vers Corse et Sardaigne en tireté (heures quasi fixes)

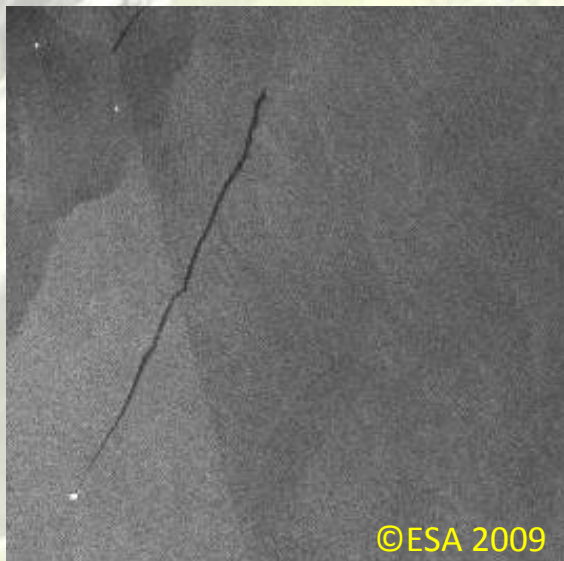
Radarsat modes

ScanSar Narrow: 300x300km
Resolution: 50m



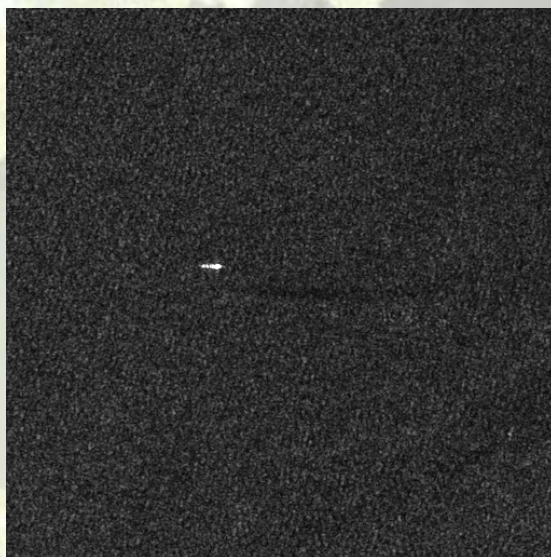
Radar images characteristics according to the modes

Wide swath: routine surveillance



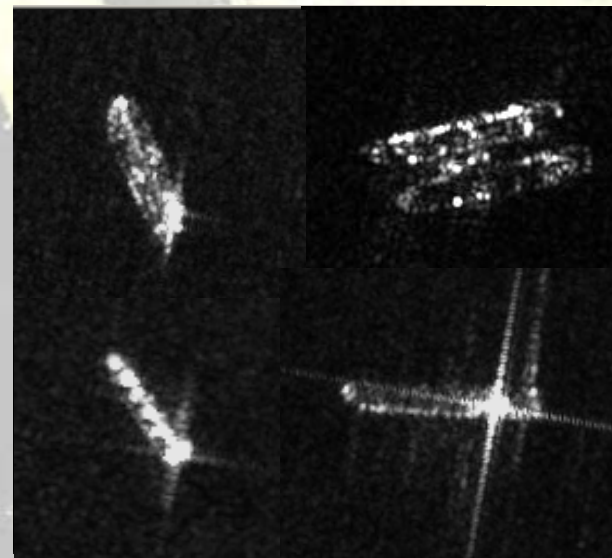
Resolution 100-150 m
Coverage 400 to 500 km
wide
(RADARSAT-1/2 ScanSAR; ENVISAT)

Medium swath: ship detection



Resolution 25 m
Coverage 150 x 150 km
(ENVISAT, RADARSAT-1/2 Image)

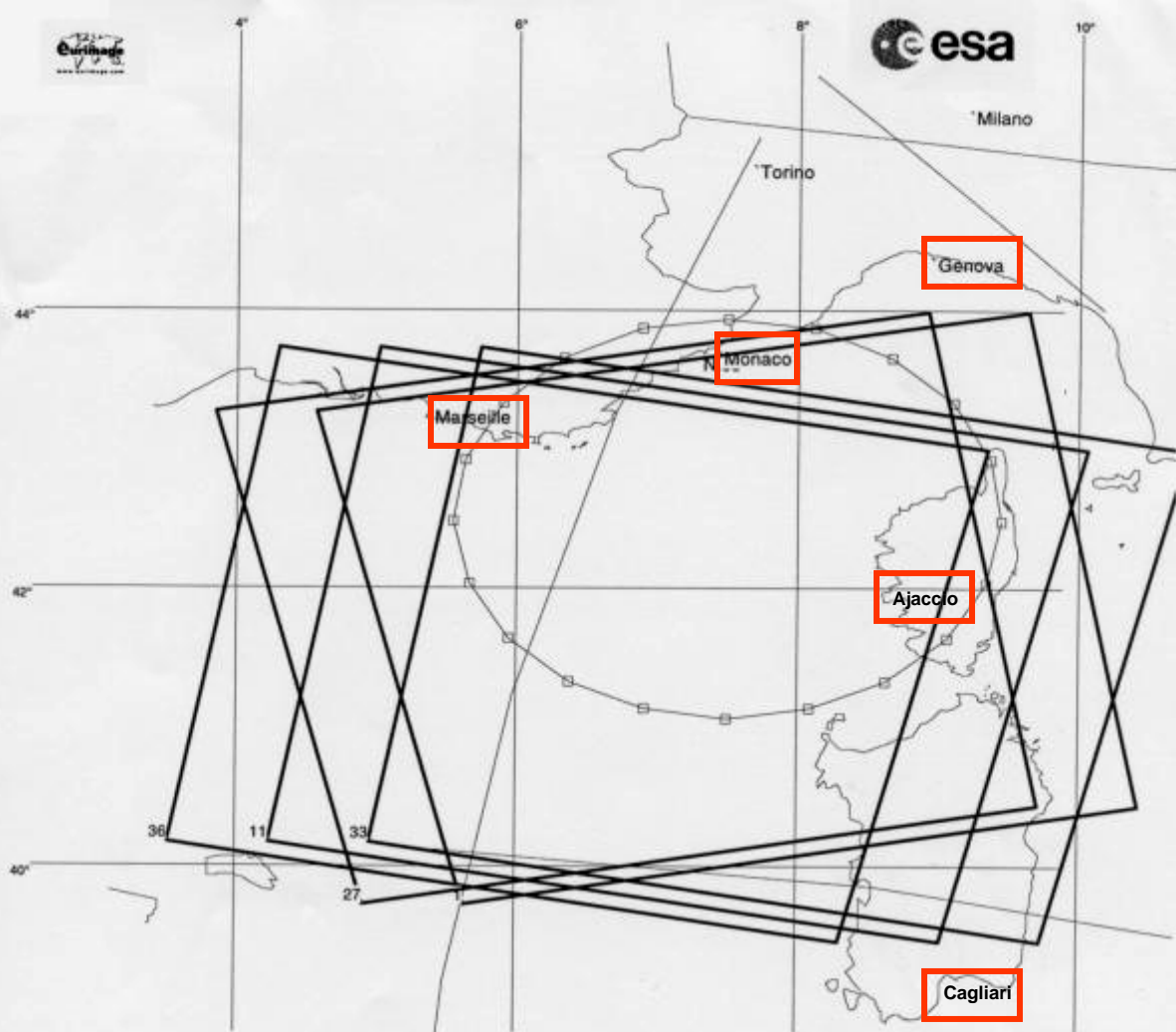
Small swath: detailed image



Resolution 3 m
Couverture 20 x 20 km
(RADARSAT-2 Ultra-fine)

Courtesy of CLS

9 ENVISAT ASAR-Wide Swath
scenes (405 x 405 km)
35 days cycle
1 scene every 3 or 4 days



DESCW Version: 4.37

Mission(s) :

ENVISAT ASAR Wide Swath 20020301 20051227 00001 20000 000 000 0036 7165 all Both All stations

Date : 2003 03 31

Frames Retrieved : 1250

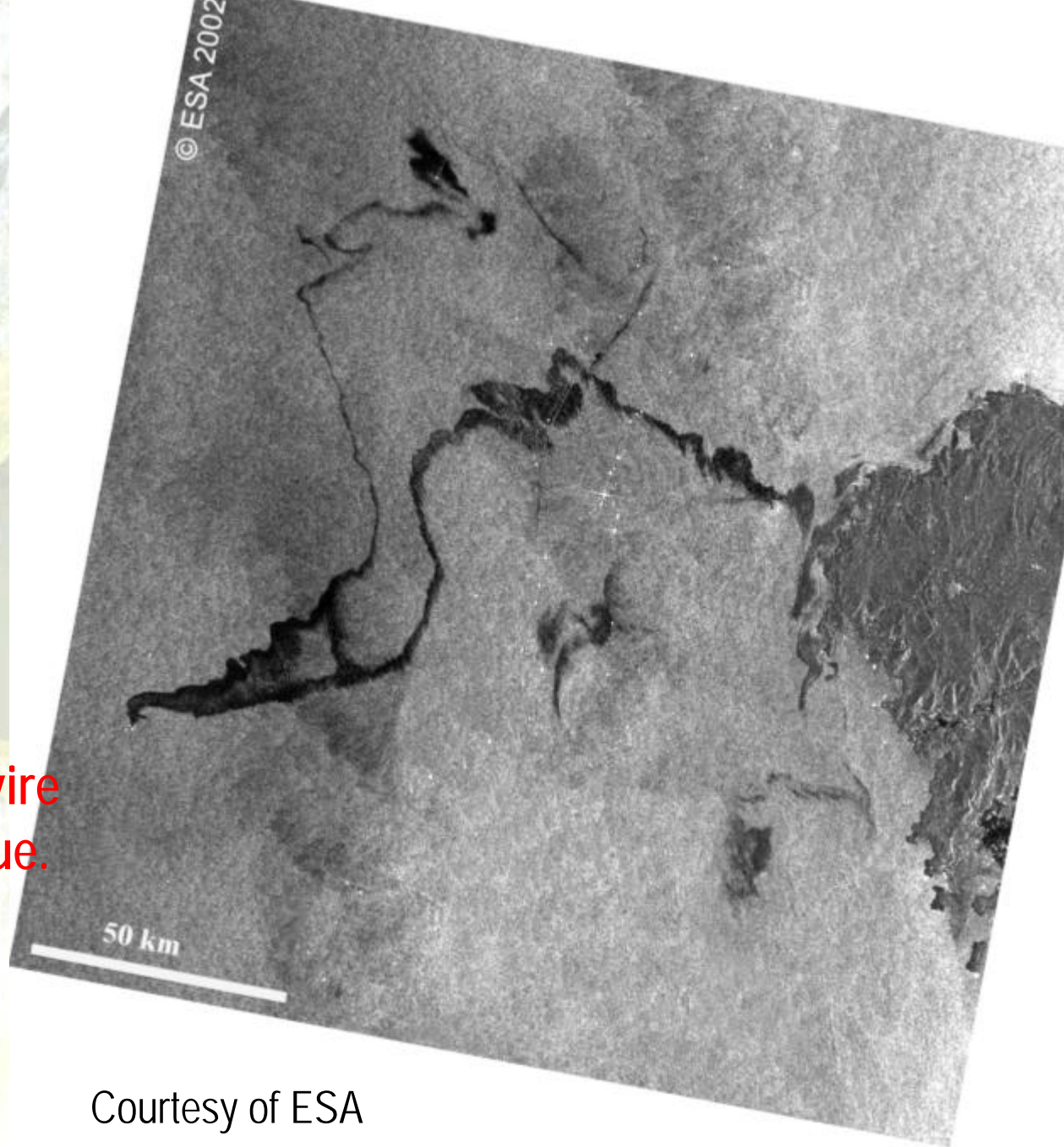


ENVISAT-ASAR
17/11/02 - 10:44 UTC

Prestige :

Visualisation of the slicks
during the towing away
of the crippled vessel

Nappes s'écoulant du navire
alors qu'il est en remorque.

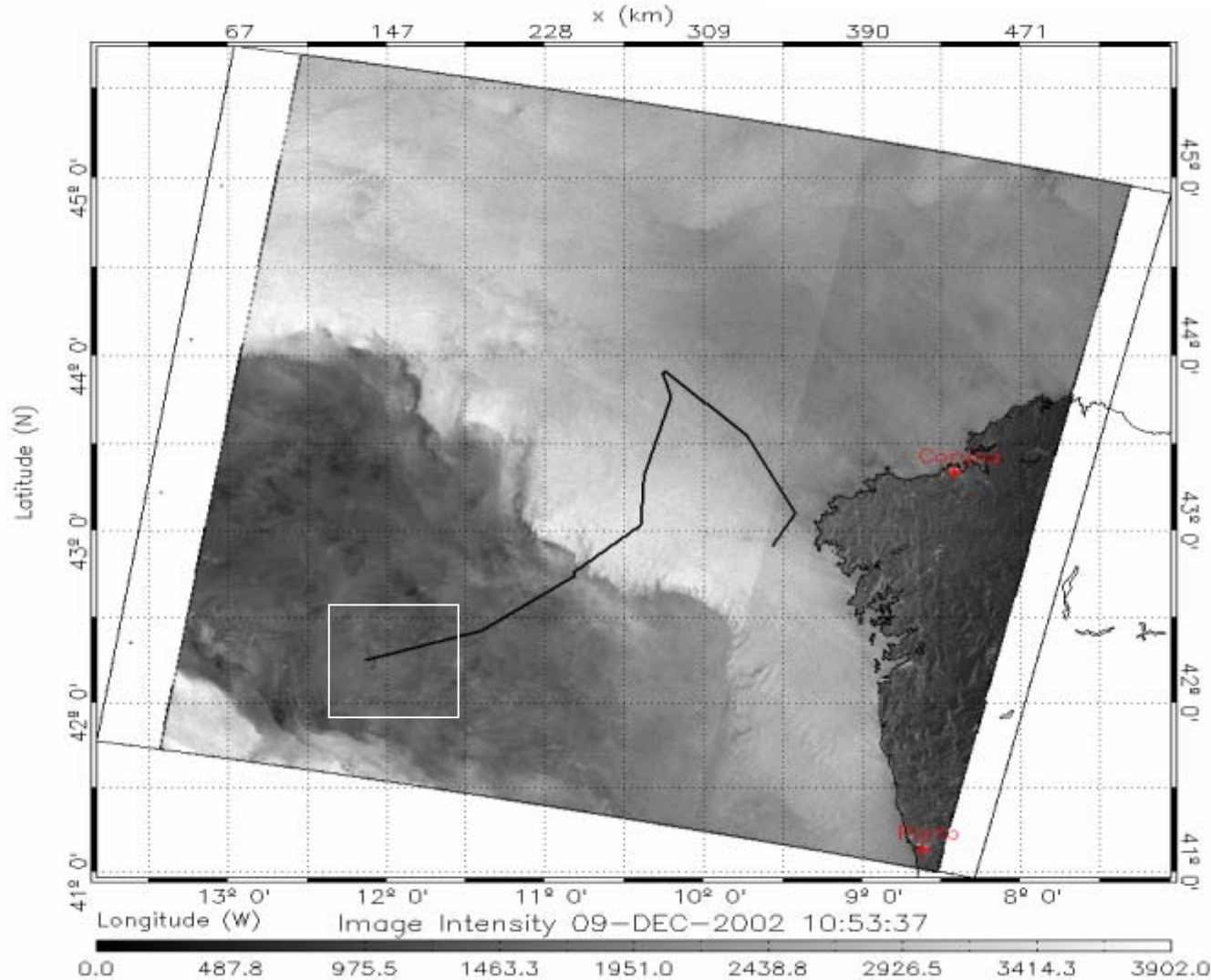


Courtesy of ESA

Wide swath allows surveillance of large areas (405 x 405 km)



image ENVISAT ASAR (9 /12/2002)

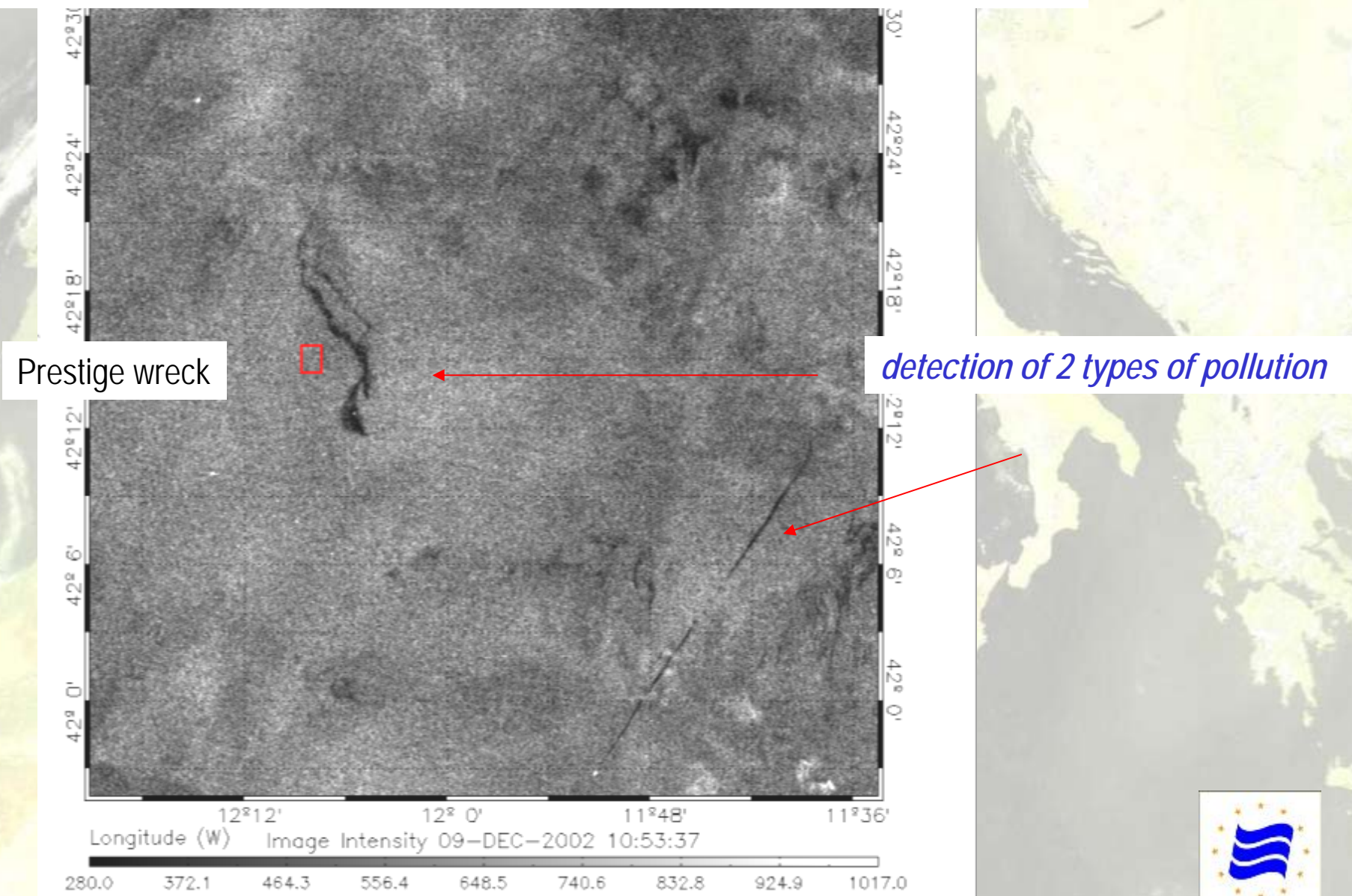


Courtesy of ESA

Surveillance d'une large bande de 405 km



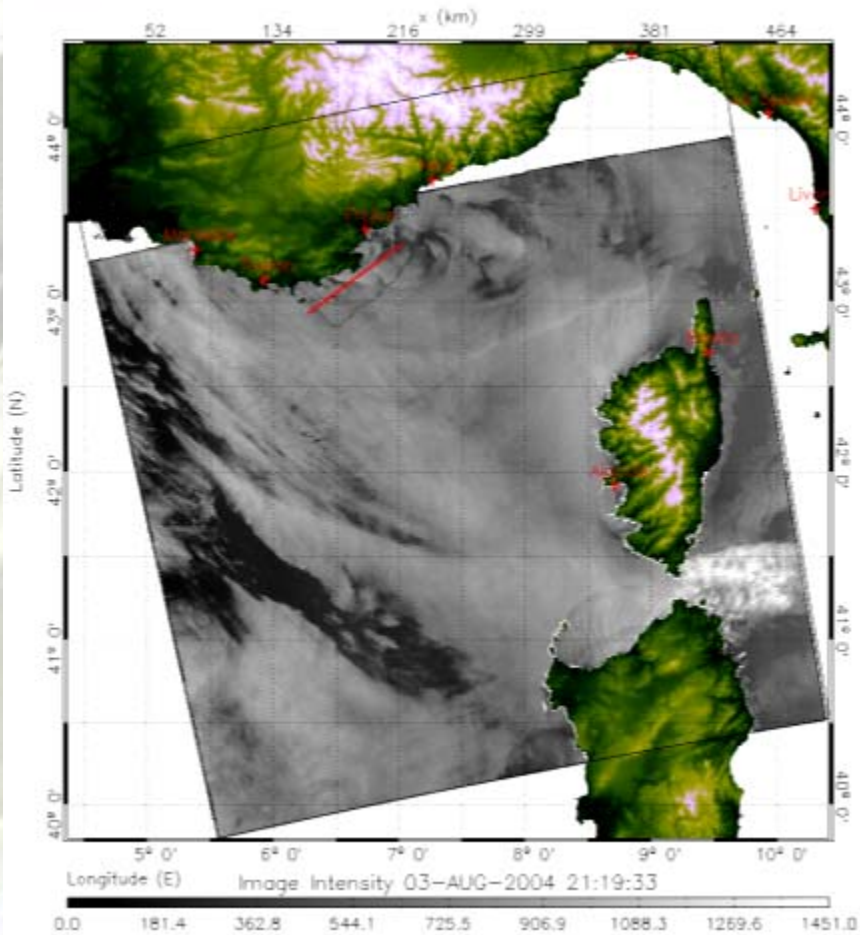
Detailed analysis: leakage of the Prestige wreck confirmed by Nautilie sub



Courtesy of ESA

Détail de l'image: fuites de l'épave visibles et confirmées

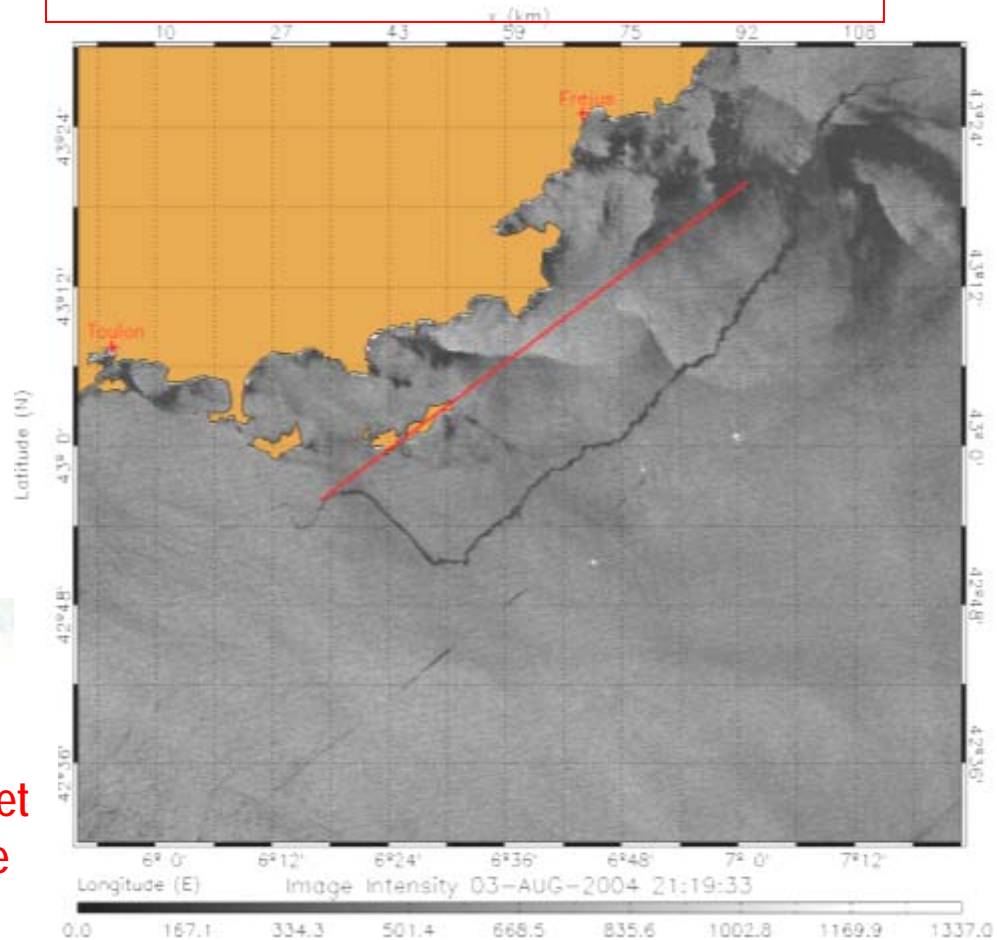




Courtesy of CLS - August 3 - 2004

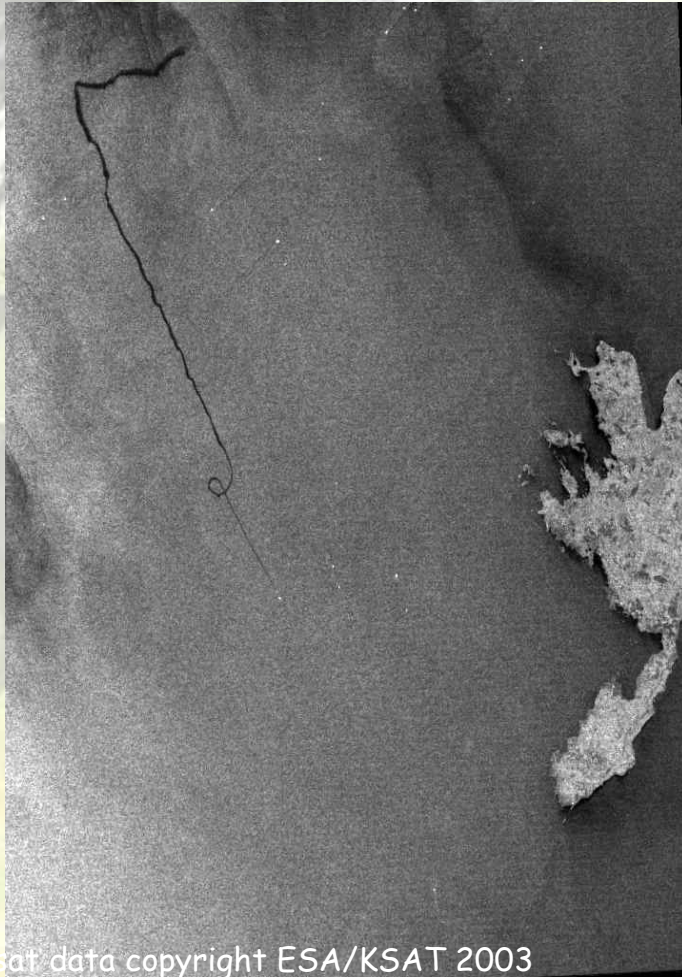
Pollution proche de la côte, confirmée lors d'une reconnaissance aérienne et a fait l'objet d'une dispersion par des navires de la Marine

Pollution threatening the shoreline : confirmation by aircraft (red line), several vessels were sent to disperse the oil pollution



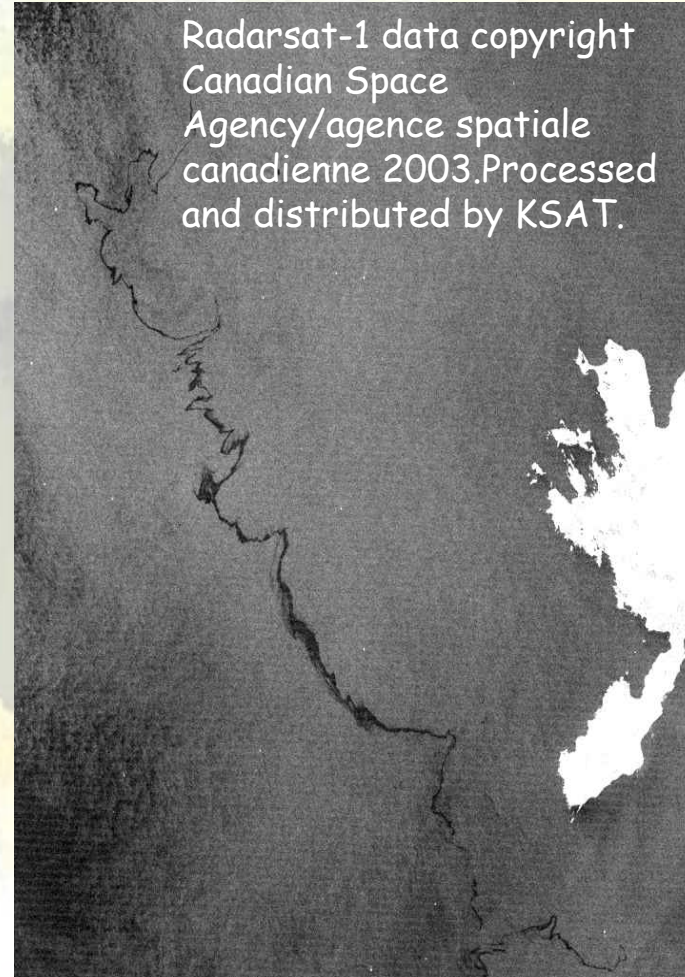
Oil slick evolution within 20h

Courtesy Oceanides Project – Baltic Sea



Envisat data copyright ESA/KSAT 2003

Envisat Wide Swath VV
16 September 2003 - 20:03:35 Z

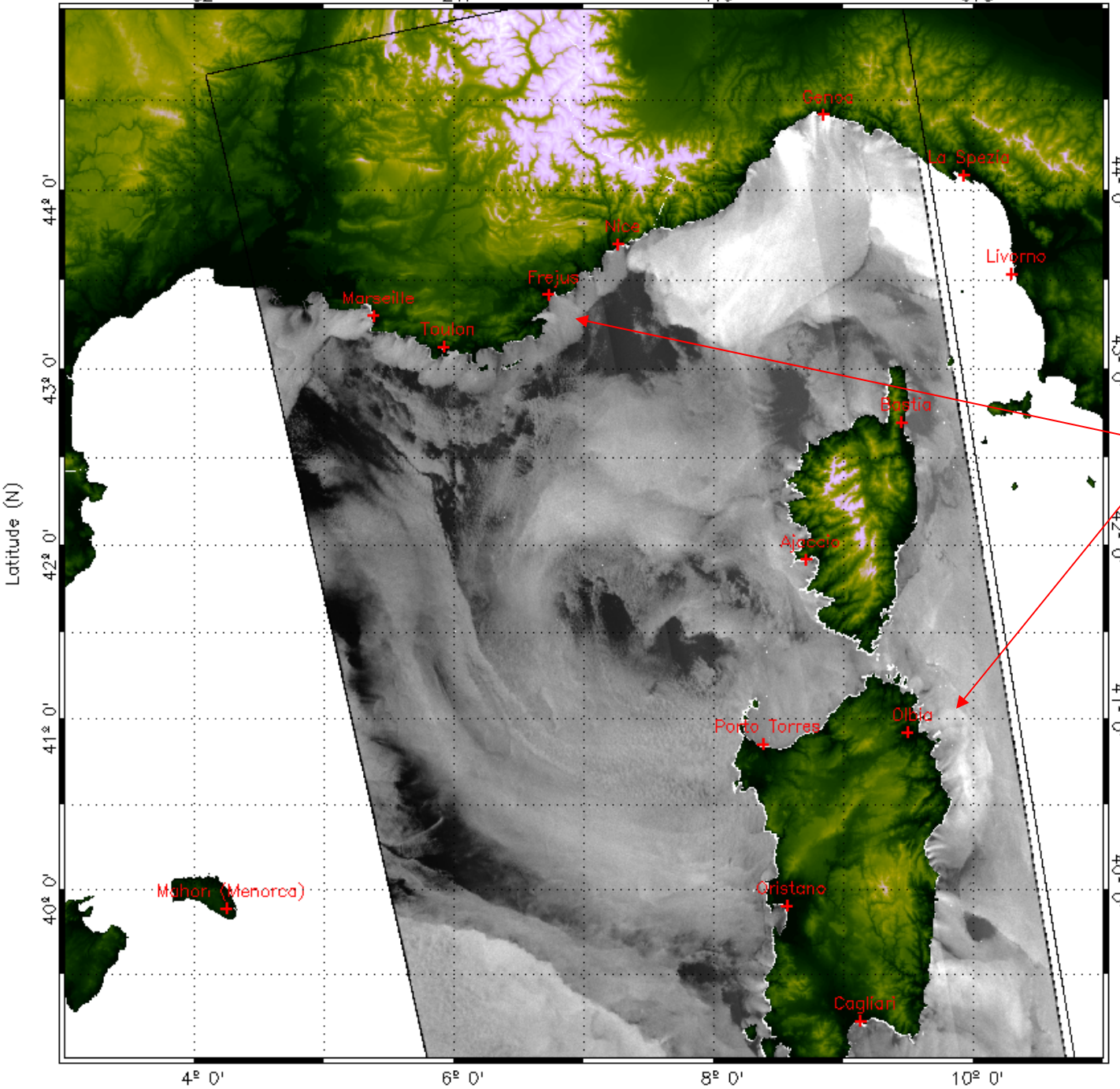


Radarsat-1 data copyright
Canadian Space
Agency/agence spatiale
canadienne 2003. Processed
and distributed by KSAT.

Radarsat-1 ScanSAR
17 September 2003 - 16:13:22 Z



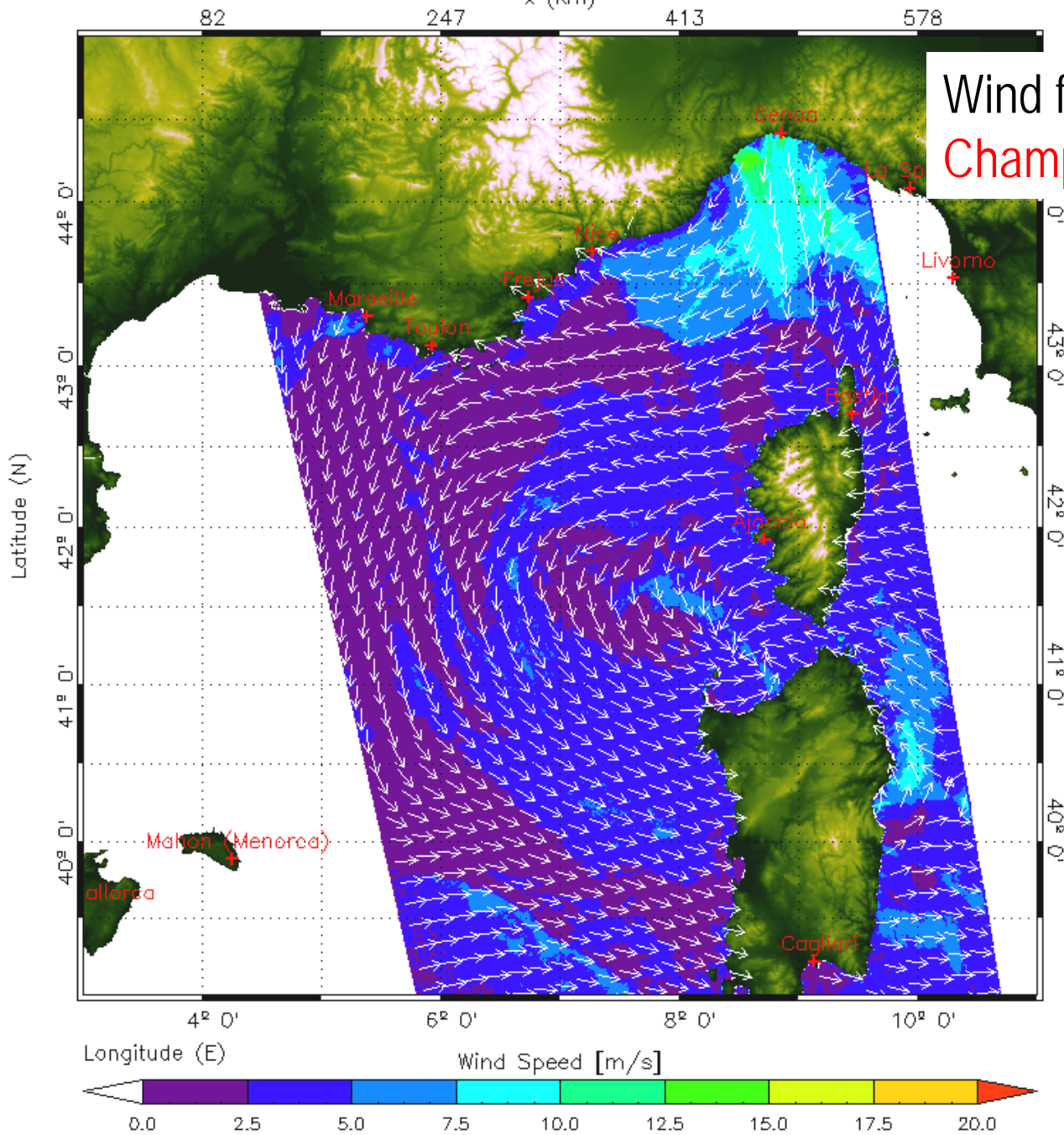
82 247 413 578 x (km)



Local winds
Vents locaux

Courtesy of CLS-Boost



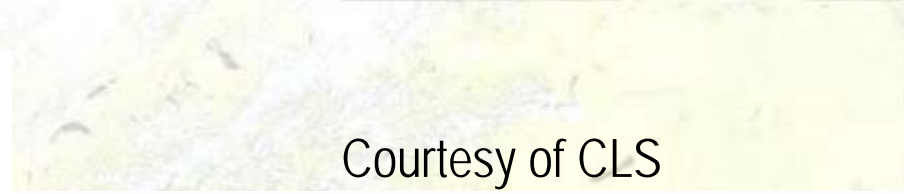


Wind field from SAR signal
Champ de vent SAR

Courtesy of CLS-Boost

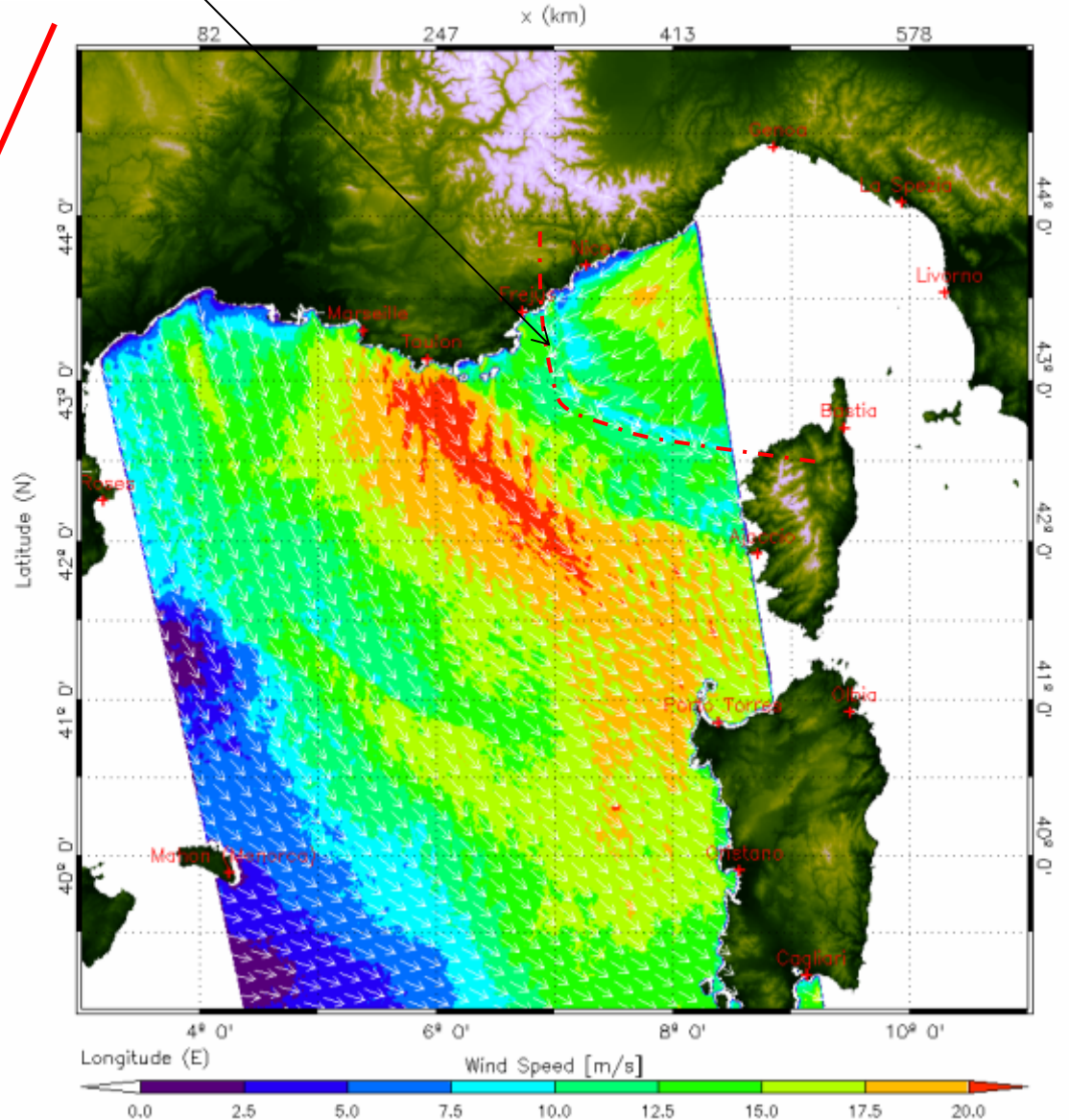
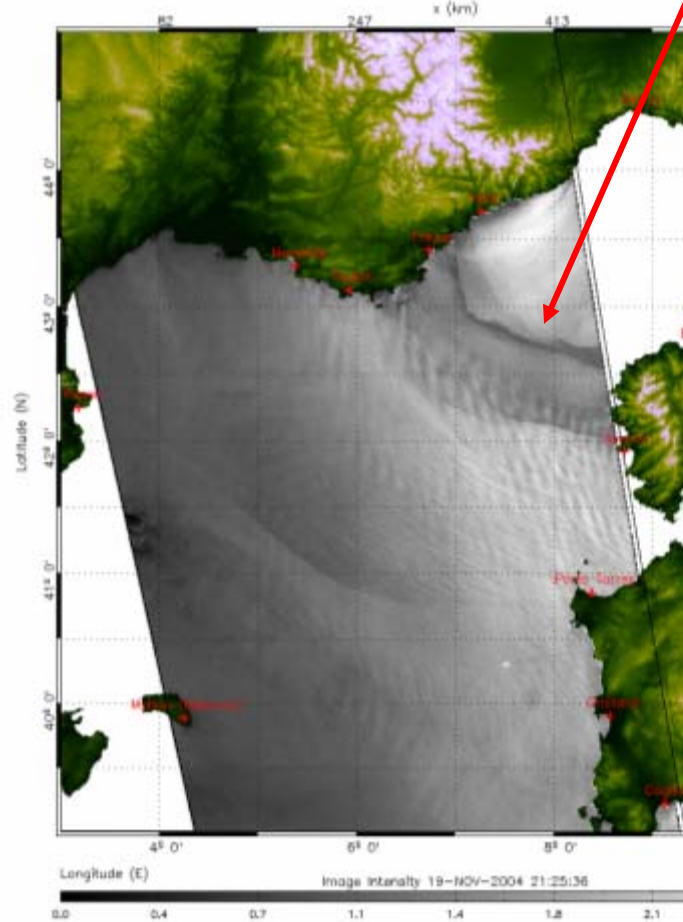
Wind front

Front de vent



Courtesy of CLS

19-NOV-2004 21:25:36.499487



Vessel speed determination if its propeller wake is visible

Détermination de la vitesse si le sillage d'hélice est visible

The screenshot displays the 'Ships Detection' software interface. The main window shows a satellite image of a ship's wake. Three speed measurements are overlaid on the image:

- Speed: 15.4 knts (red box)
- Speed: 23.8 knts (green box)
- Speed: 20.6 knts (red box)

A red circle highlights a specific point in the wake, with a red arrow pointing to it. A white box zooms in on this point, showing a detailed view of the wake's structure.

The software interface includes a control panel on the right with the following sections:

- TARGET INFORMATION**

Number	:	3
Latitude	:	43°N 0' 46,377"
Longitude	:	6°E 59' 41,482"
Size [m]	:	529,4
Route [deg]	:	70,5
Speed [knots]	:	****
Reliability	:	1
- DETECTION SETTINGS**
 - Detect wake
 - 1000 : Offshore dist. [m]
 - [7,5] : PFA [10[^](-x)]
- GEOGRAPHIC INFORMATION**
 - Land mask: Medium Grid
- CONTRAST TUNING**
 - Min.: 144
 - Max.: 1647

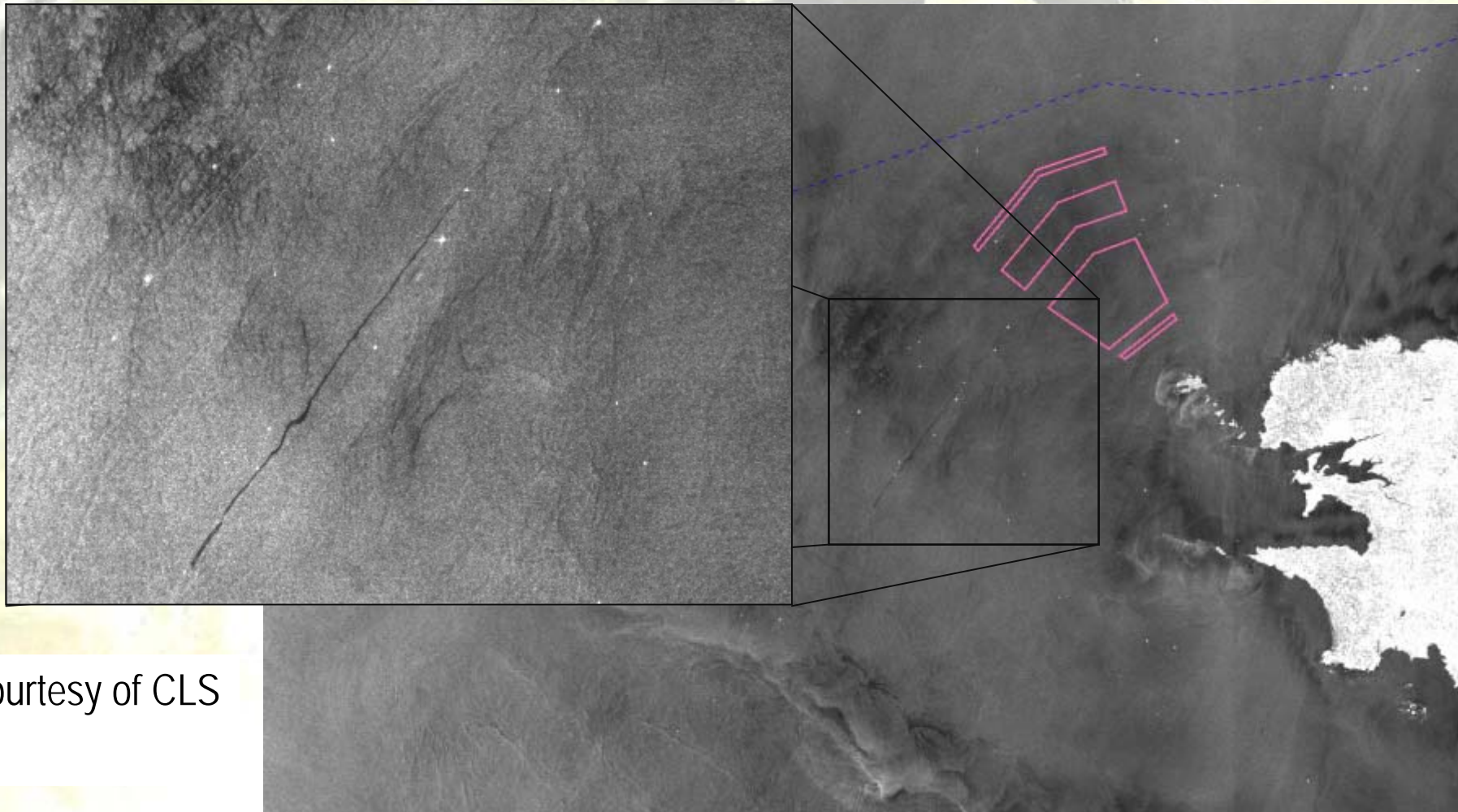
At the bottom center, there is a button labeled "== RUN DETECTION ==". The Boost Technologies logo is visible in the bottom right corner.

On-going discharge detected on SAR image

Détection d'un rejet en cours sur image SAR

ENVISAT *Wide Swath* image dated 6 May 2011 – 22h09 Z

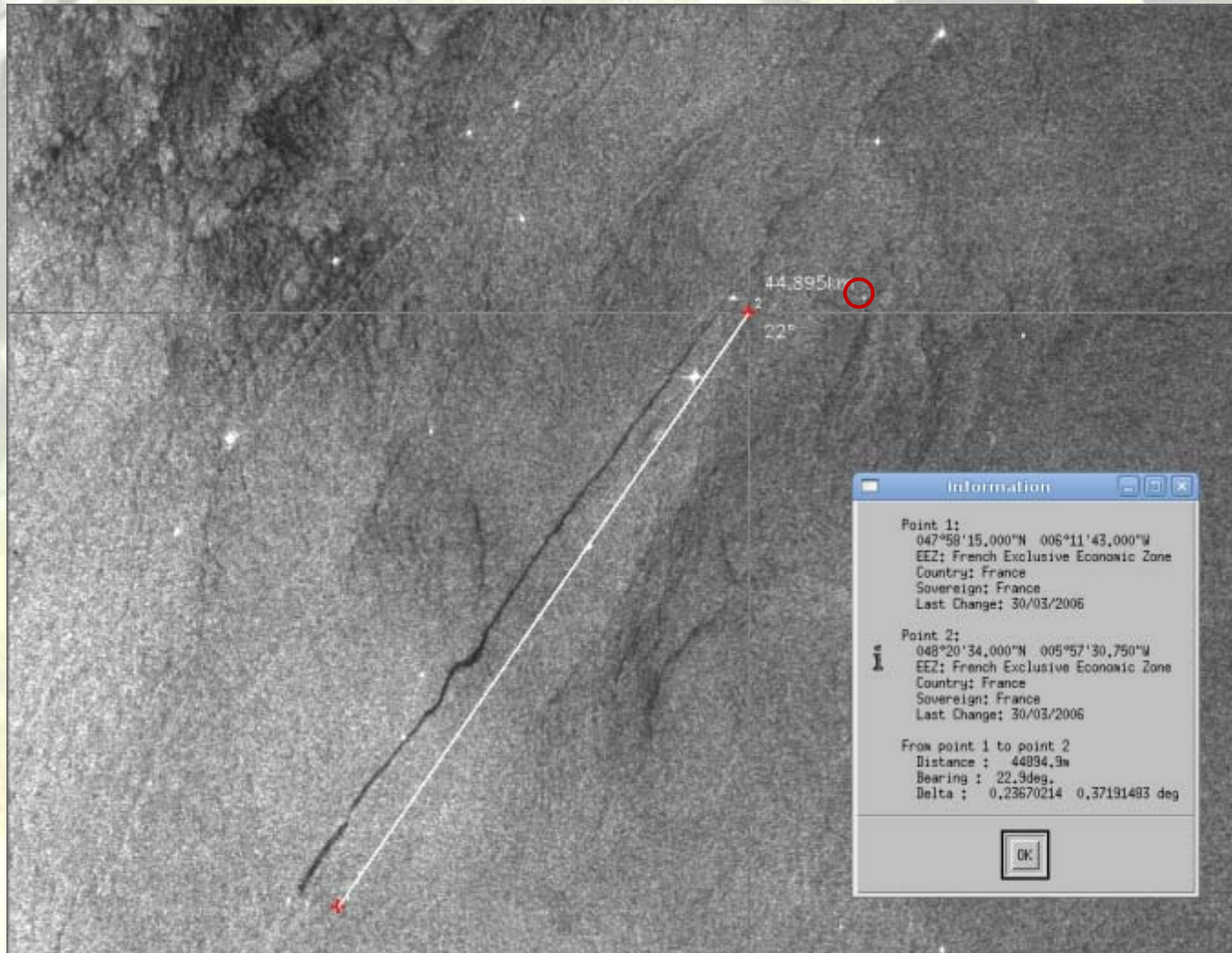
18



Courtesy of CLS

Navire directement relié à la nappe
Vessel directly connected to the slick

ENVISAT Wide Swath image dated 6 May 2011 – 22h09 Z



Slick 45 km long

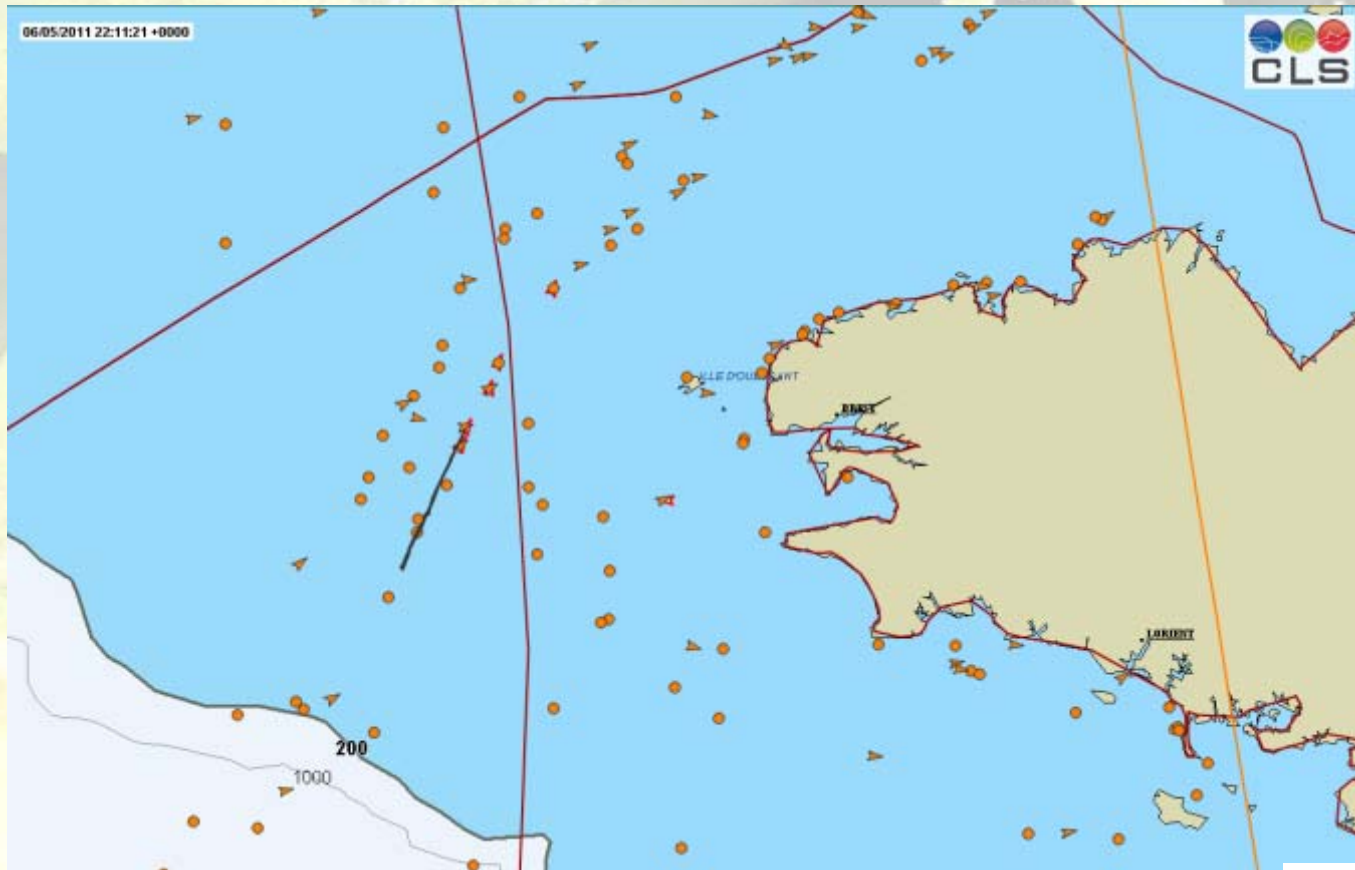
Courtesy of CLS

Identification of the discharging vessel

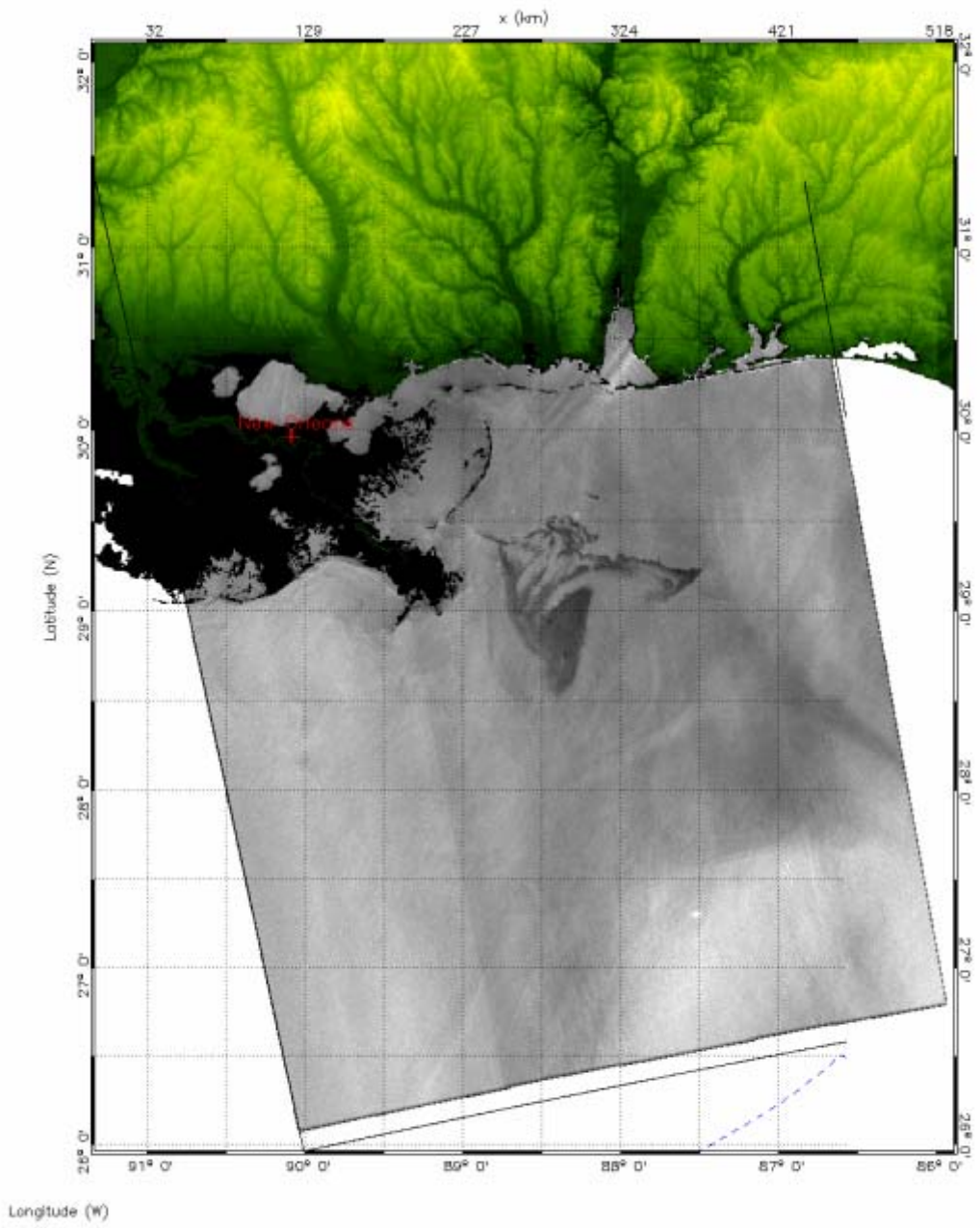
Identification du navire en cause

20

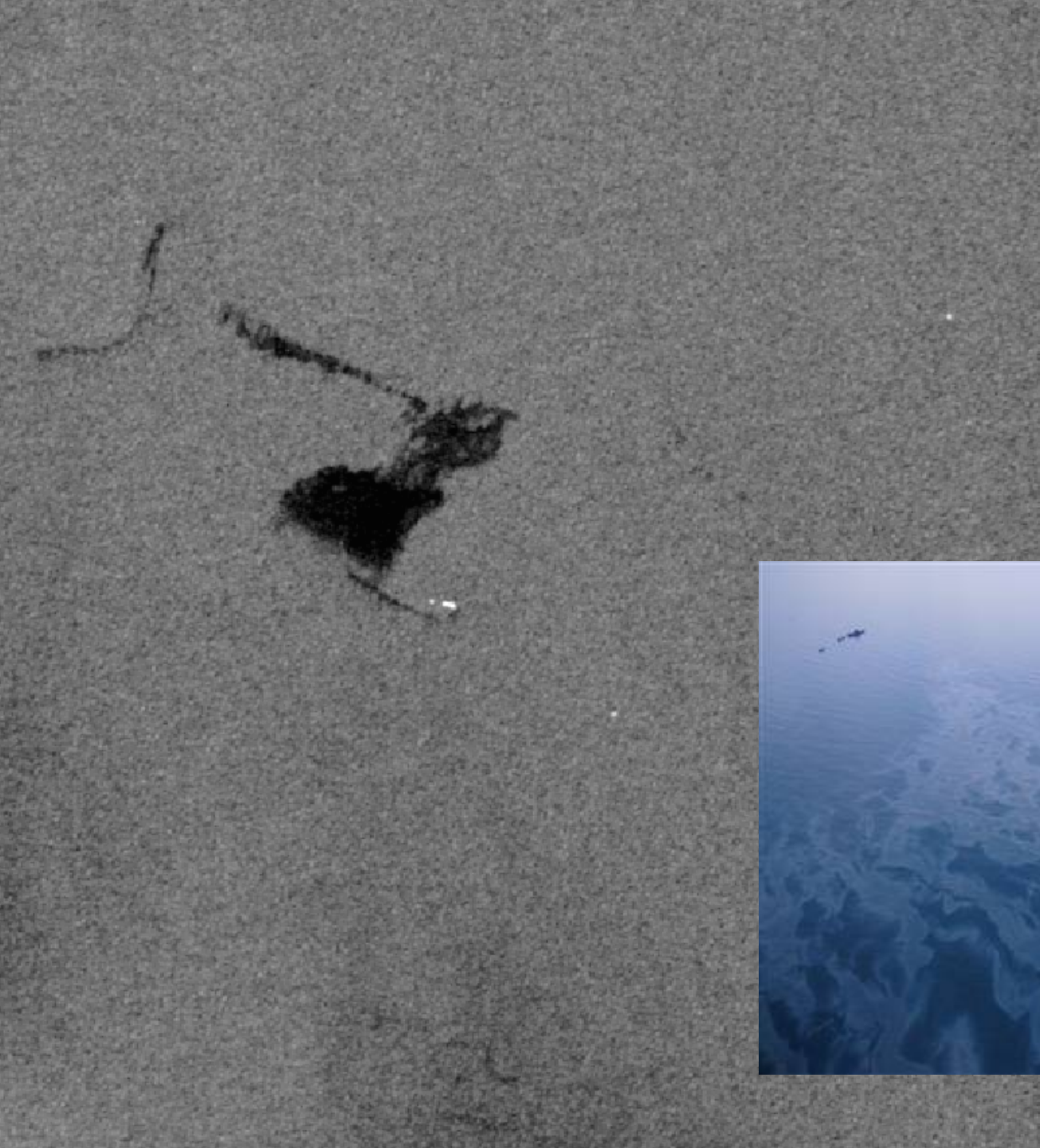
Use of **THEMIS** platform to correlate the target with AIS data
(CLS receiving station situated on Ouessant island)



Courtesy of CLS



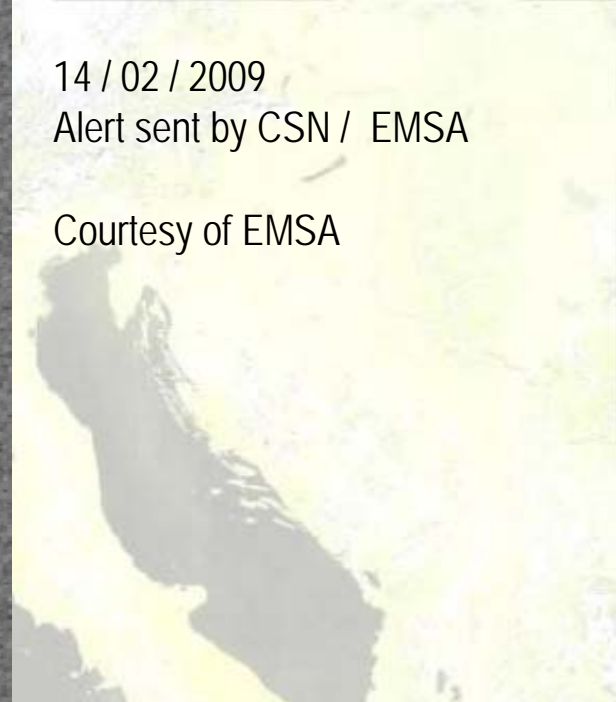
Gulf of Mexico
Deepwater Horizon
May 2011

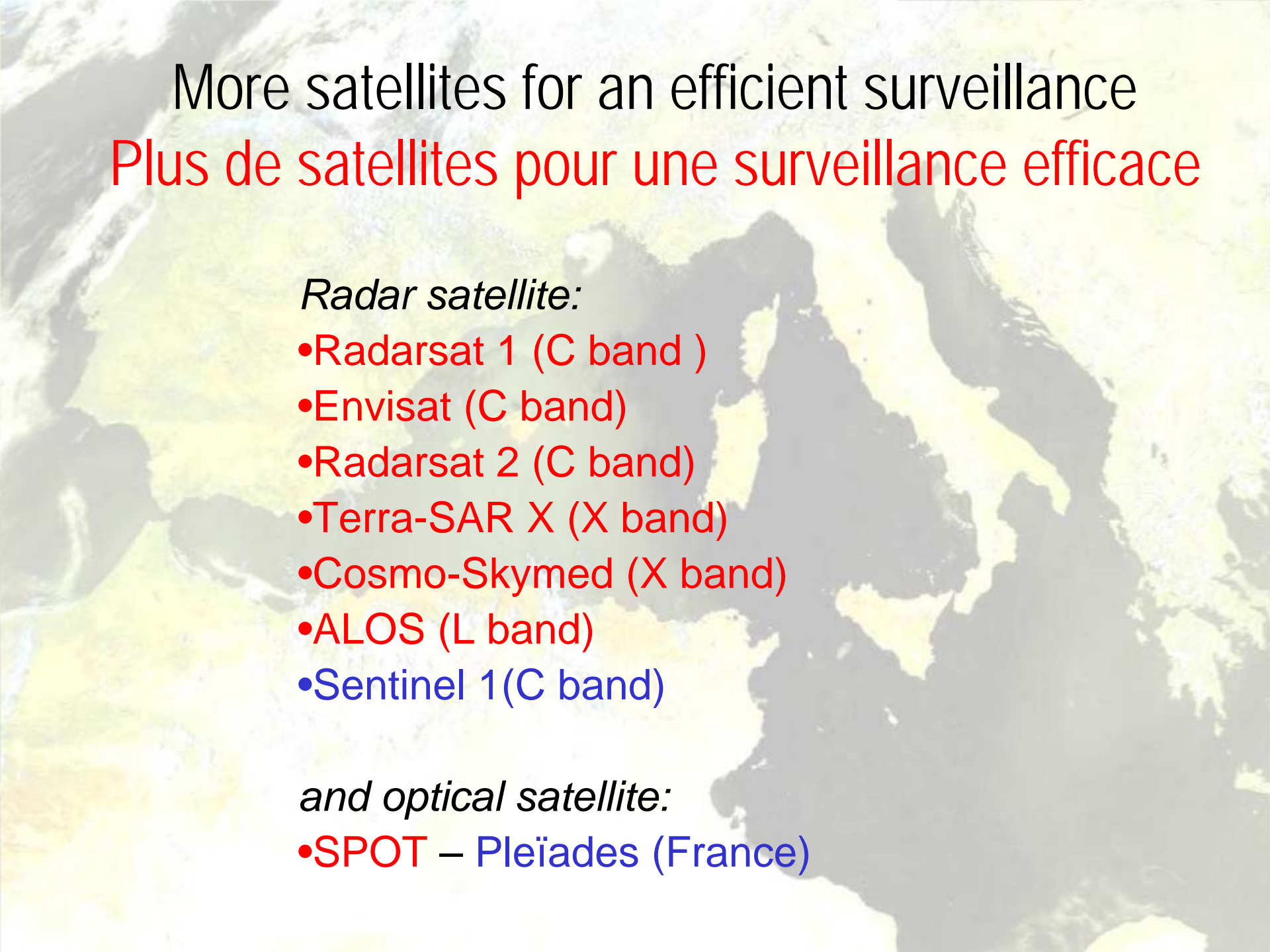


14 / 02 / 2009

Alert sent by CSN / EMSA

Courtesy of EMSA





More satellites for an efficient surveillance

Plus de satellites pour une surveillance efficace

Radar satellite:

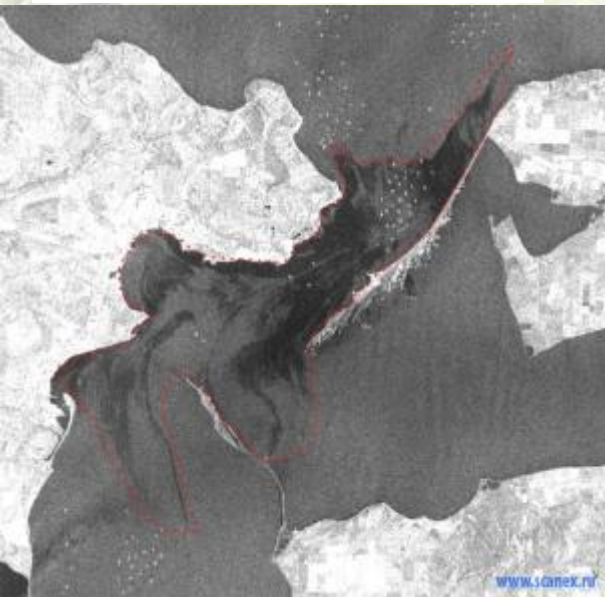
- Radarsat 1 (C band)
- Envisat (C band)
- Radarsat 2 (C band)
- Terra-SAR X (X band)
- Cosmo-Skymed (X band)
- ALOS (L band)
- Sentinel 1 (C band)

and optical satellite:

- SPOT – Pleiades (France)

Accident in the straight of Kerch (11 November 2007) (1500 T of heavy fuel oil)

C-band: RADARSAT



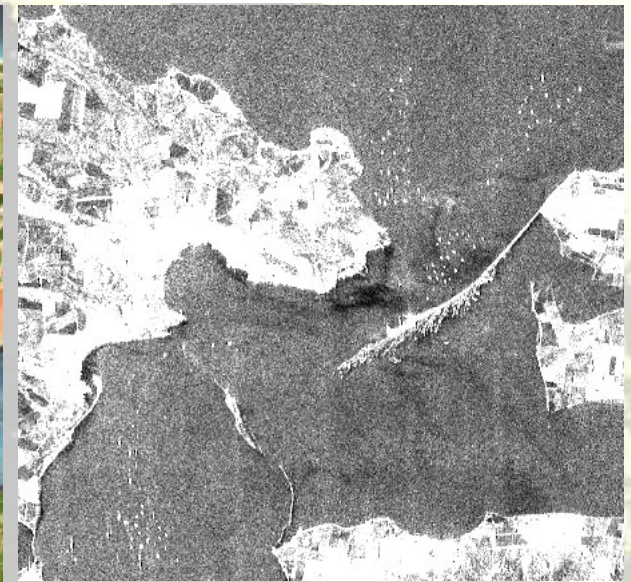
Courtesy: Scanex

X-band: TerraSAR



Courtesy: DLR

L-band: ALOS



Satellite radar images on 16 Novembre from 3 satellites

Conclusions :

- Satellite SAR images are useful and frequently available but are rather costly and require mutualisation at European level (CSN/EMSA)
 - Images SAR utiles et fréquents mais mutualisation nécessaire car coûteuses
- Good means to survey very large zones (EEZ) but no flexibility as for the time of visit (time schedule known in advance)
 - Moyen de surveillance de grandes zones mais heures de passage imposées
- Alert can be provided within 20' at best (not much time left for the aircraft to be on the spot while the ship is still discharging!)
 - Alerte envoyée au mieux 20' après passage du satellite
- Concerning illegal discharges the offender may be identified using : « SAR images + AIS data »
 - Identification du pollueur présumé en utilisant images SAR+AIS