Journée Technique du CEDRE
20 Mars 2012 - Paris

Detection des déversements huileux par radar satellitaire

Satellite radar surveillance of oily waters discharges

F. Parthiot /Cedre – Délégation Méditerranée

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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.

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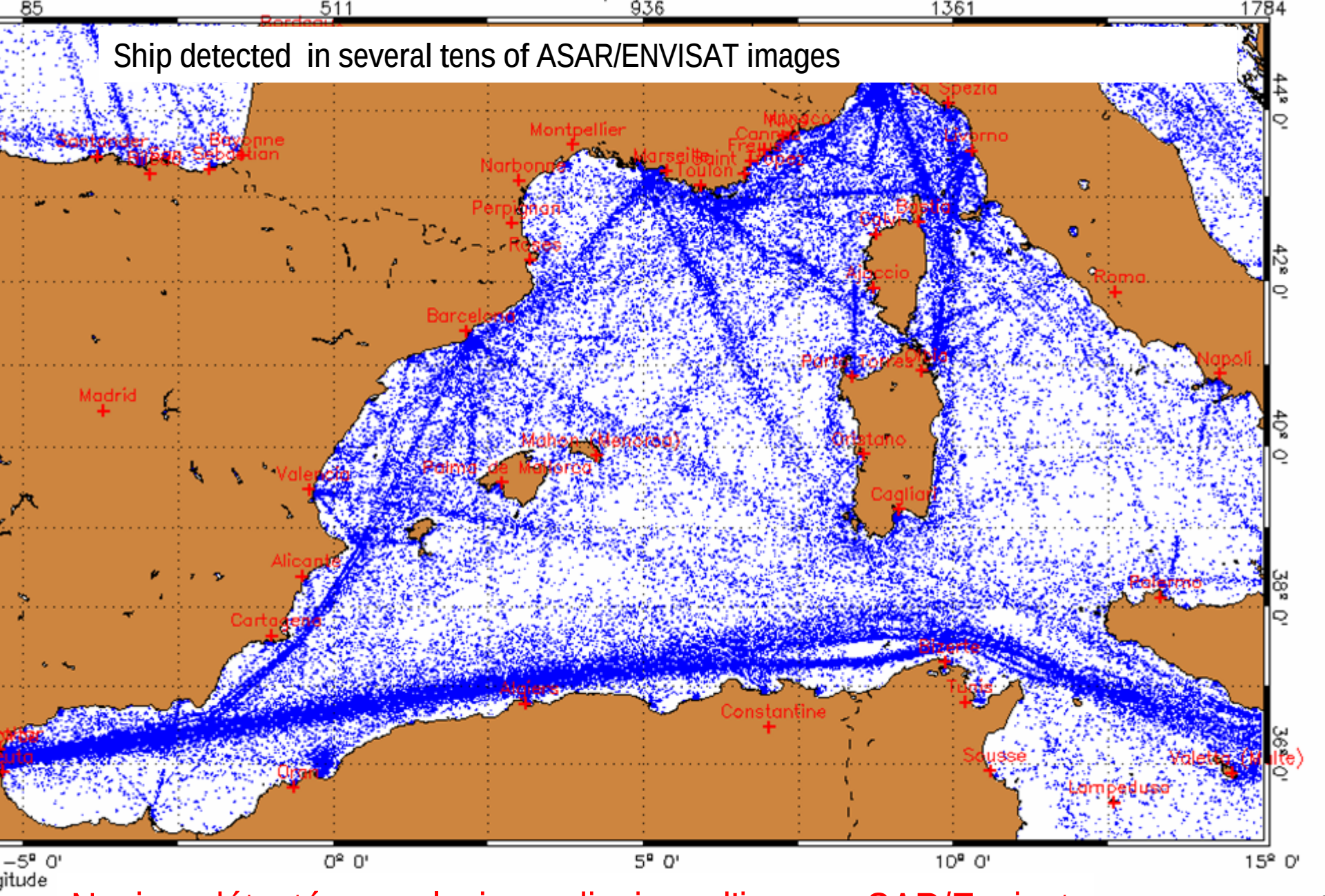
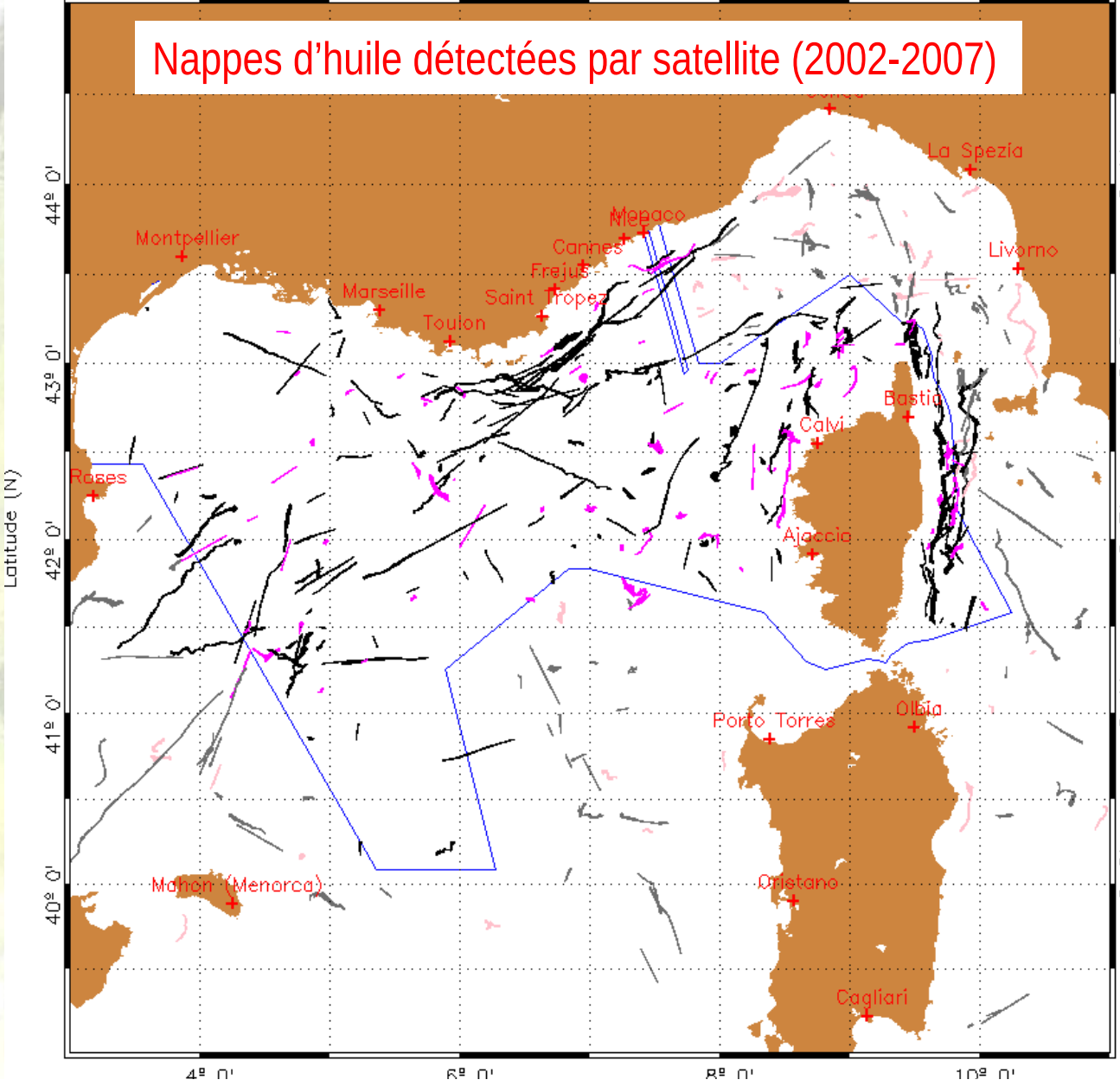


Navires détectés sur plusieurs dizaines d'images SAR/Envisat

Courtesy of



Oil slicks detected by satellite – 2002-2007

Good correlation with the routes

Courtesy of CLS

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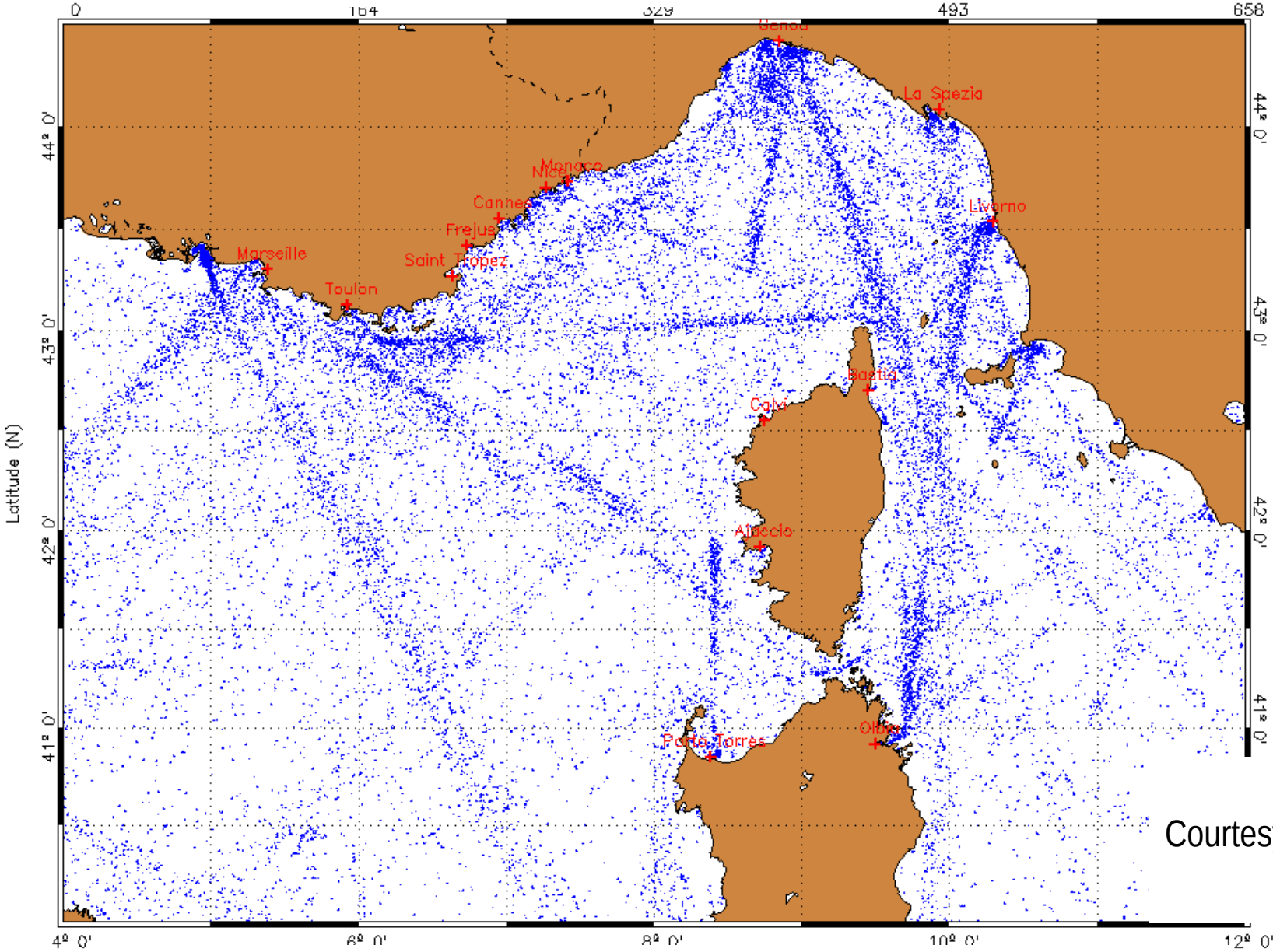
Ferry routes are partially visible



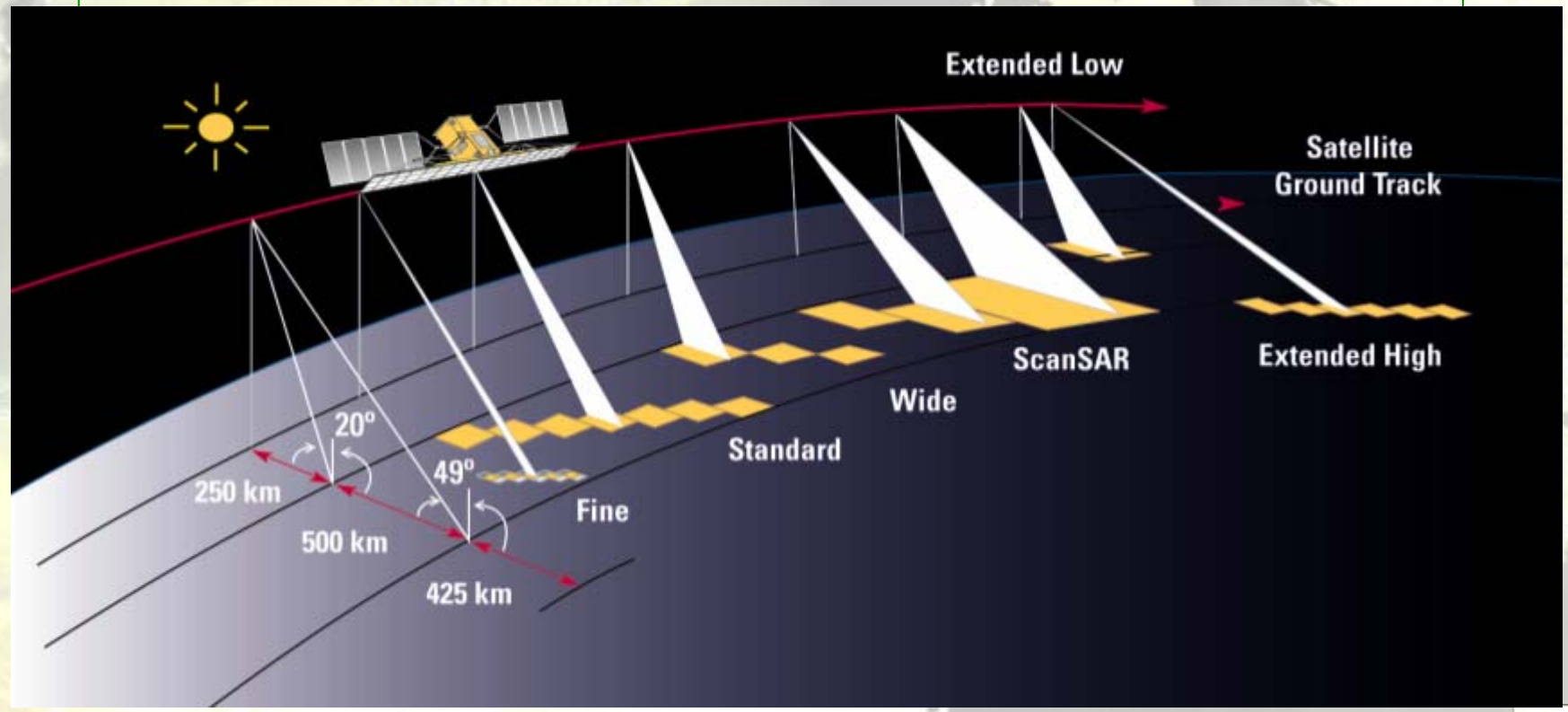
Courtesy of CLS

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

Radarsat modes

ScanSar Narrow: 300x300km

Resolution: 50m



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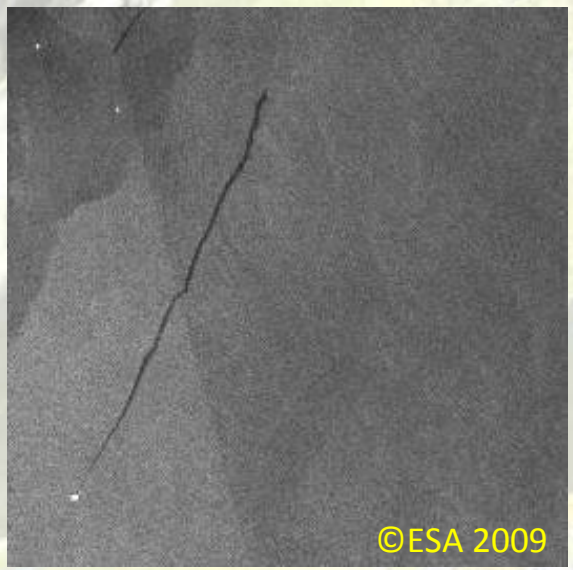
Radar images characteristics according to the modes

Wide swath: routine surveillance

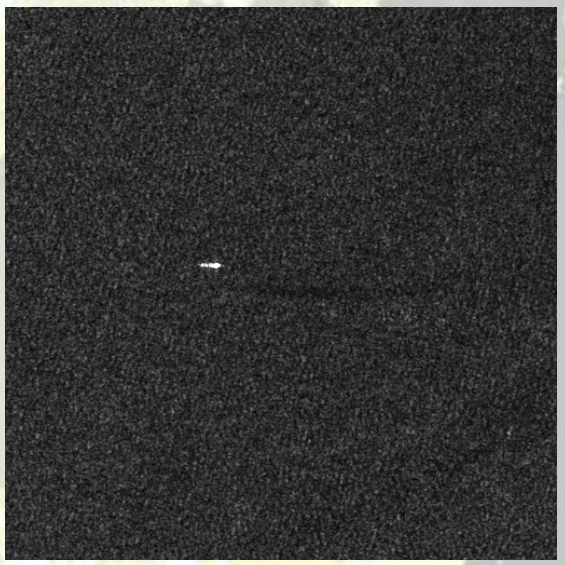


Resolution 100-150 m

Coverage 400 to 500 km wide

(RADARSAT-1/2 ScanSAR; ENVISAT)

Medium swath: ship detection

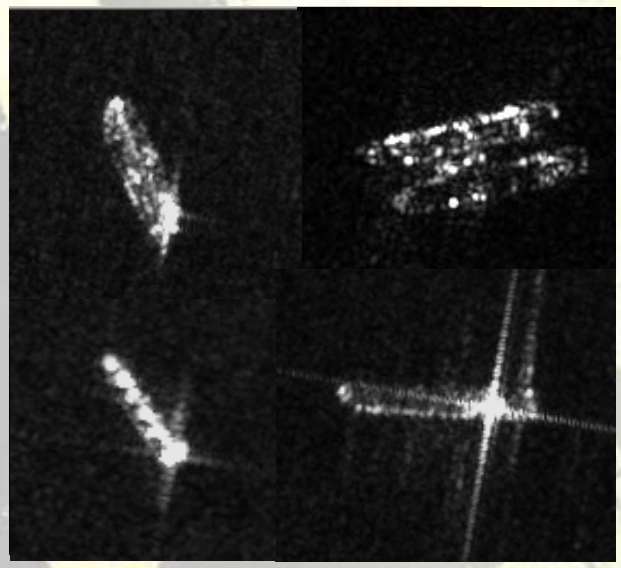


Resolution 25 m

Coverage 150 x 150 km

(ENVISAT, RADARSAT-1/2 Image)

Small swath: detailed image



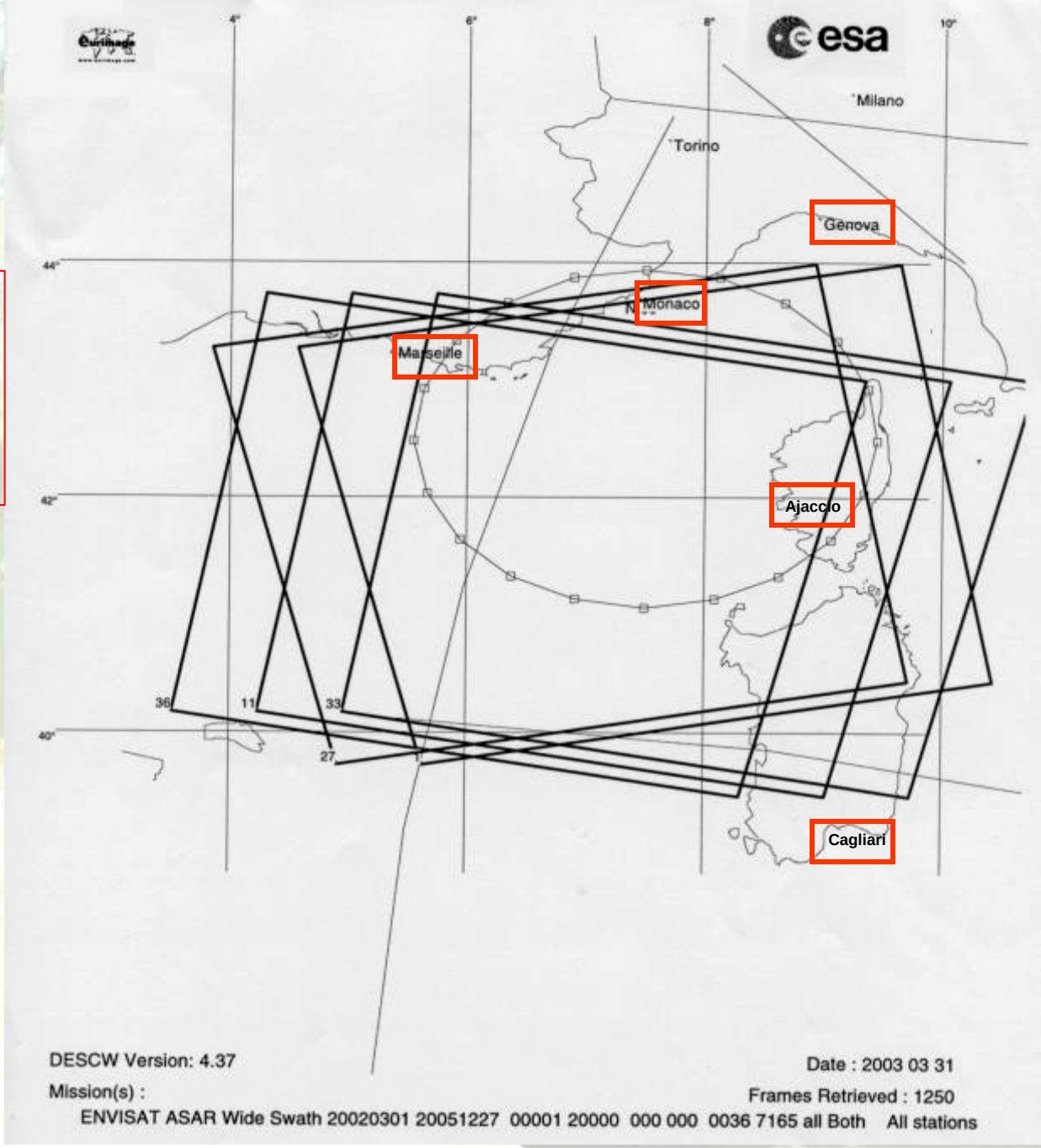
Resolution 3 m

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



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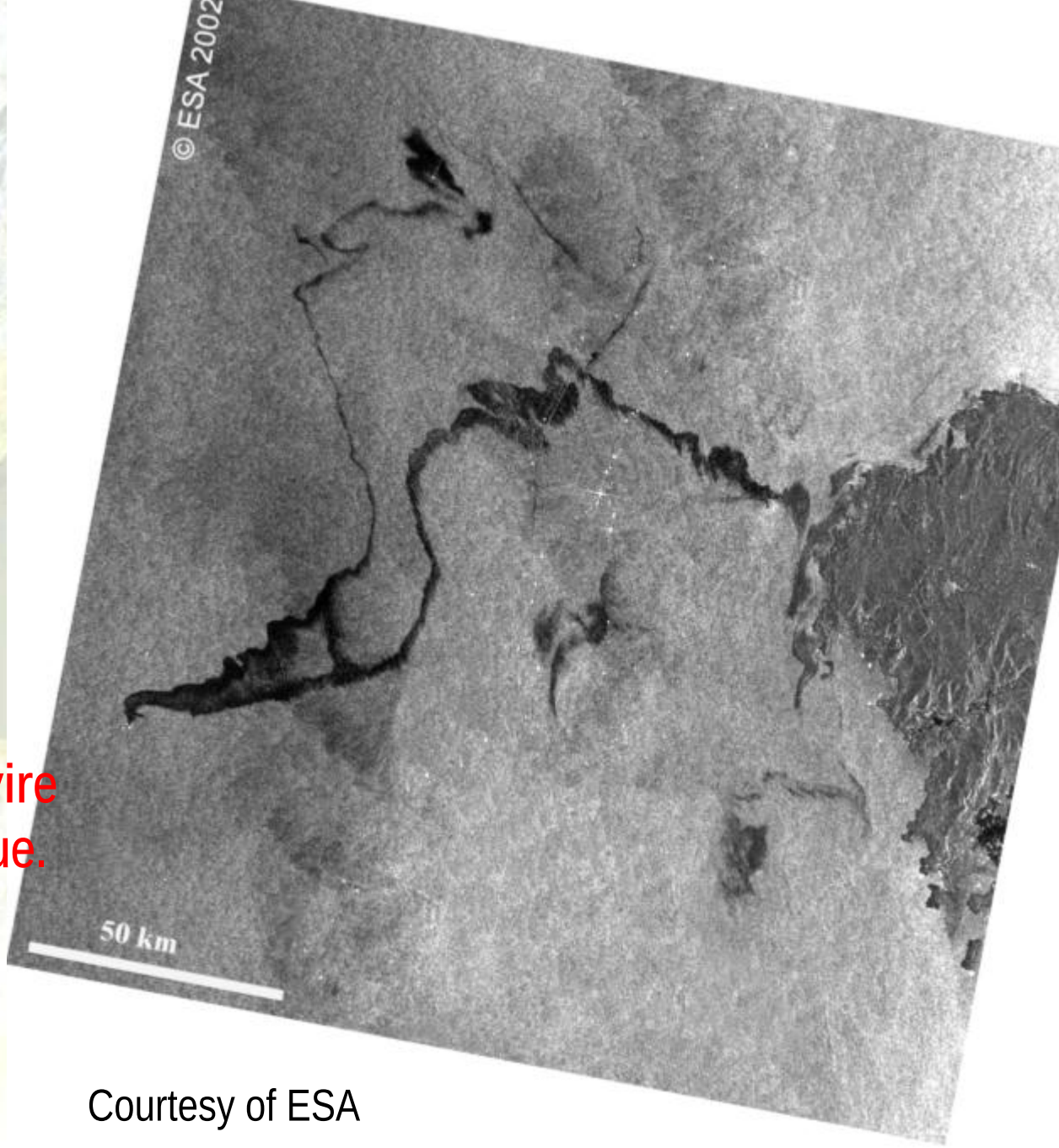
ENVISAT-ASAR
17/11/02 - 10:44 UTC

Prestige :

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

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

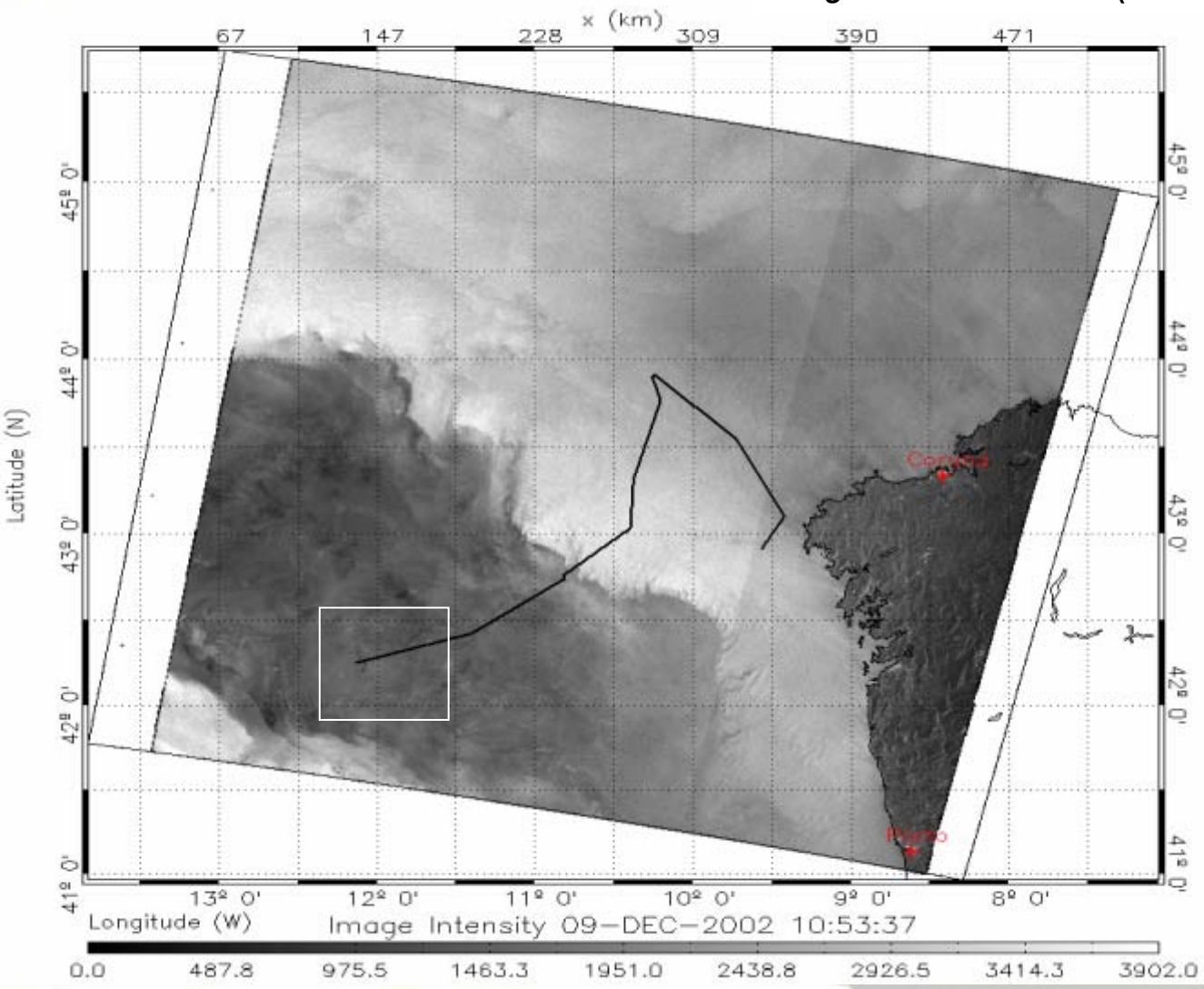


Courtesy of ESA

Cedre

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

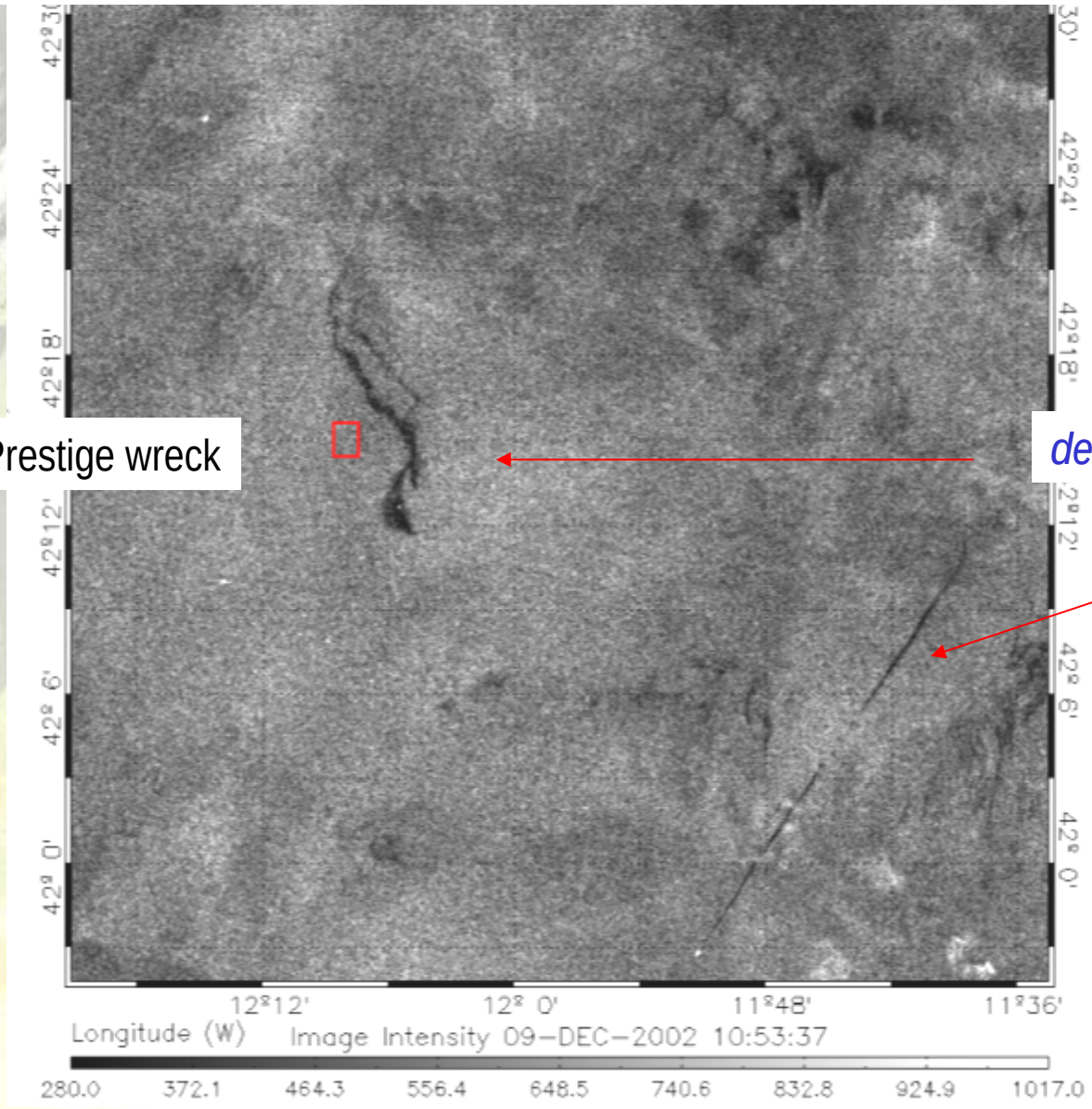
image ENVISAT ASAR (9 /12/2002)



Courtesy of ESA

Surveillance d'une large bande de 405 km

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



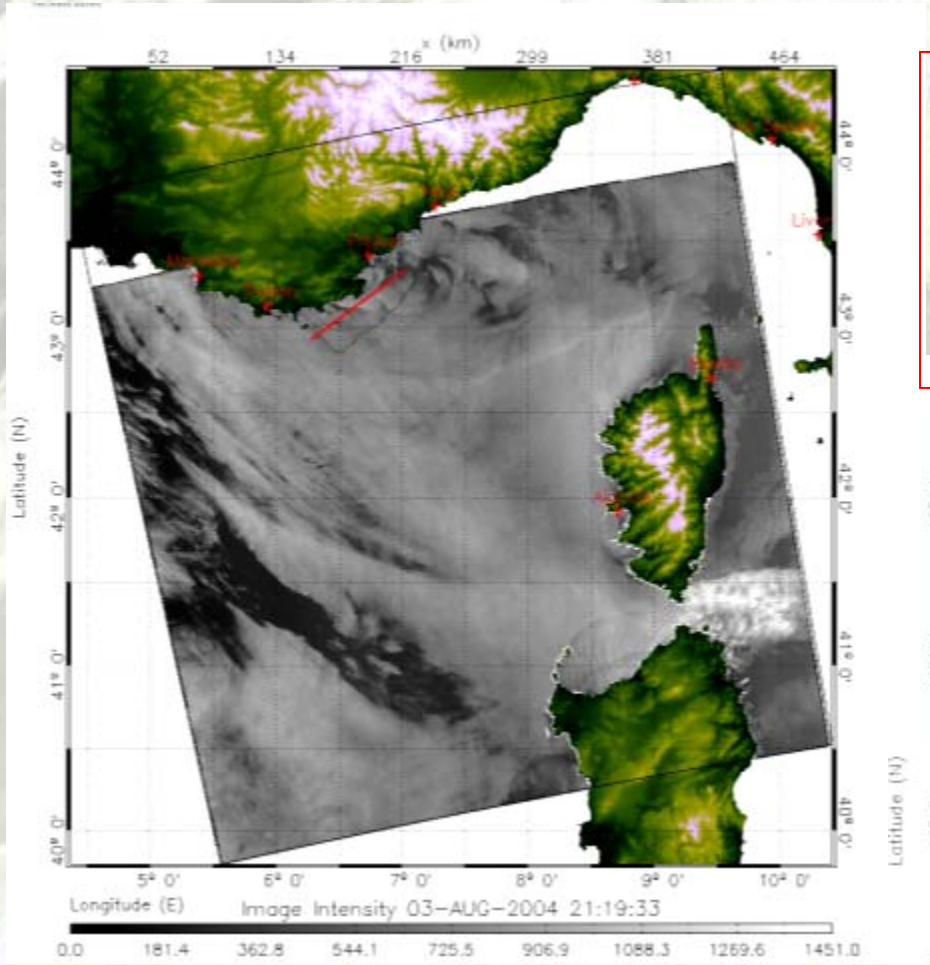
Prestige wreck

detection of 2 types of pollution

Courtesy of ESA

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

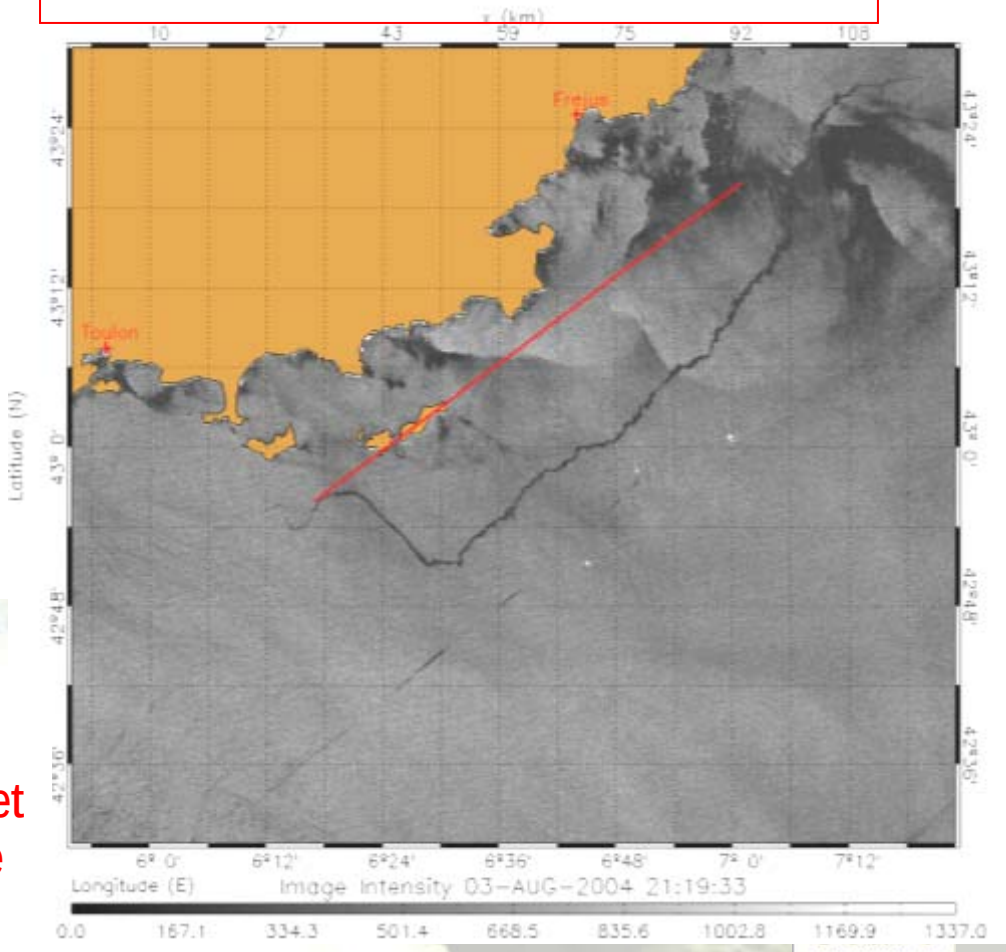
Cedre



Courtesy of CLS - *August 3 - 2004*

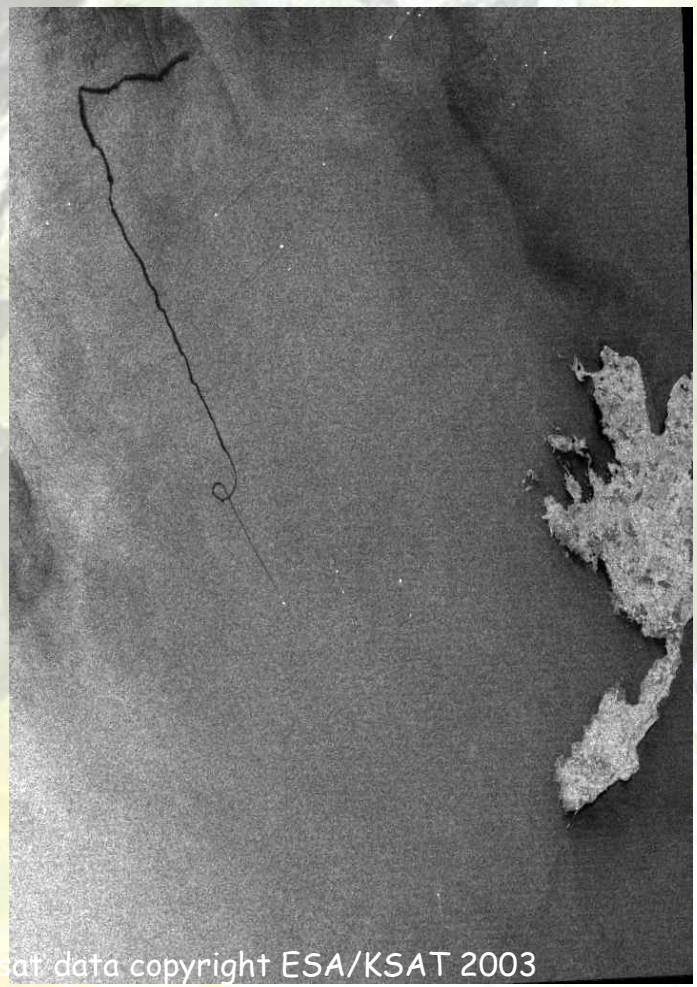
Pollution proche de la côte, confirmée lors d 'une reconnaissance aérienne et a fait l'objet d 'une dispersion par des navires de la Marine

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

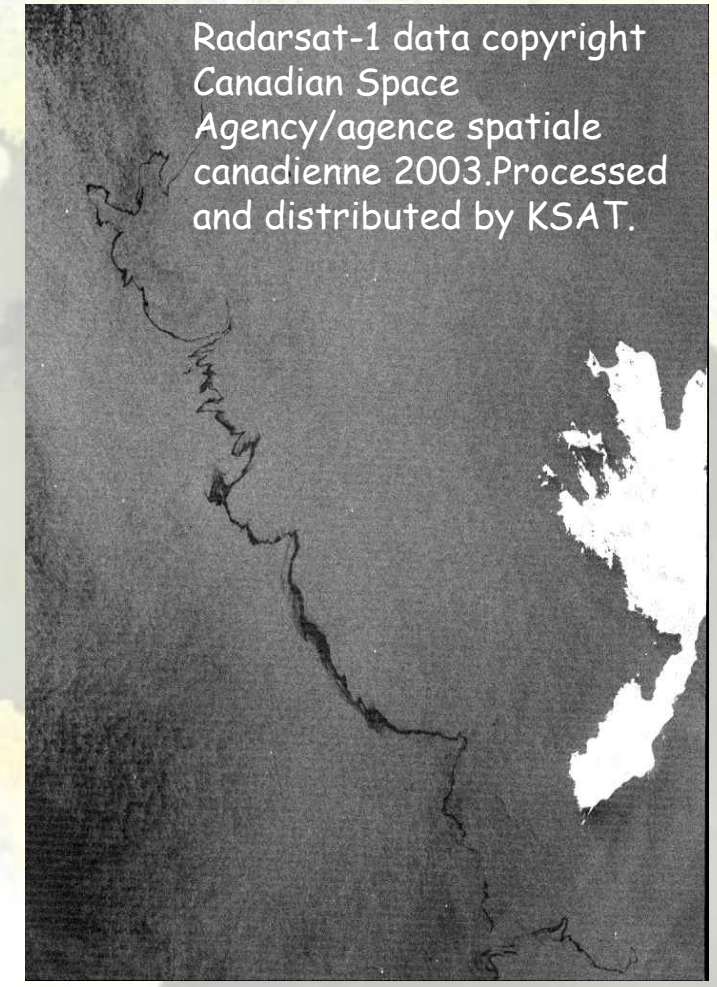


Oil slick evolution within 20h

Courtesy Oceanides Project – Baltic Sea

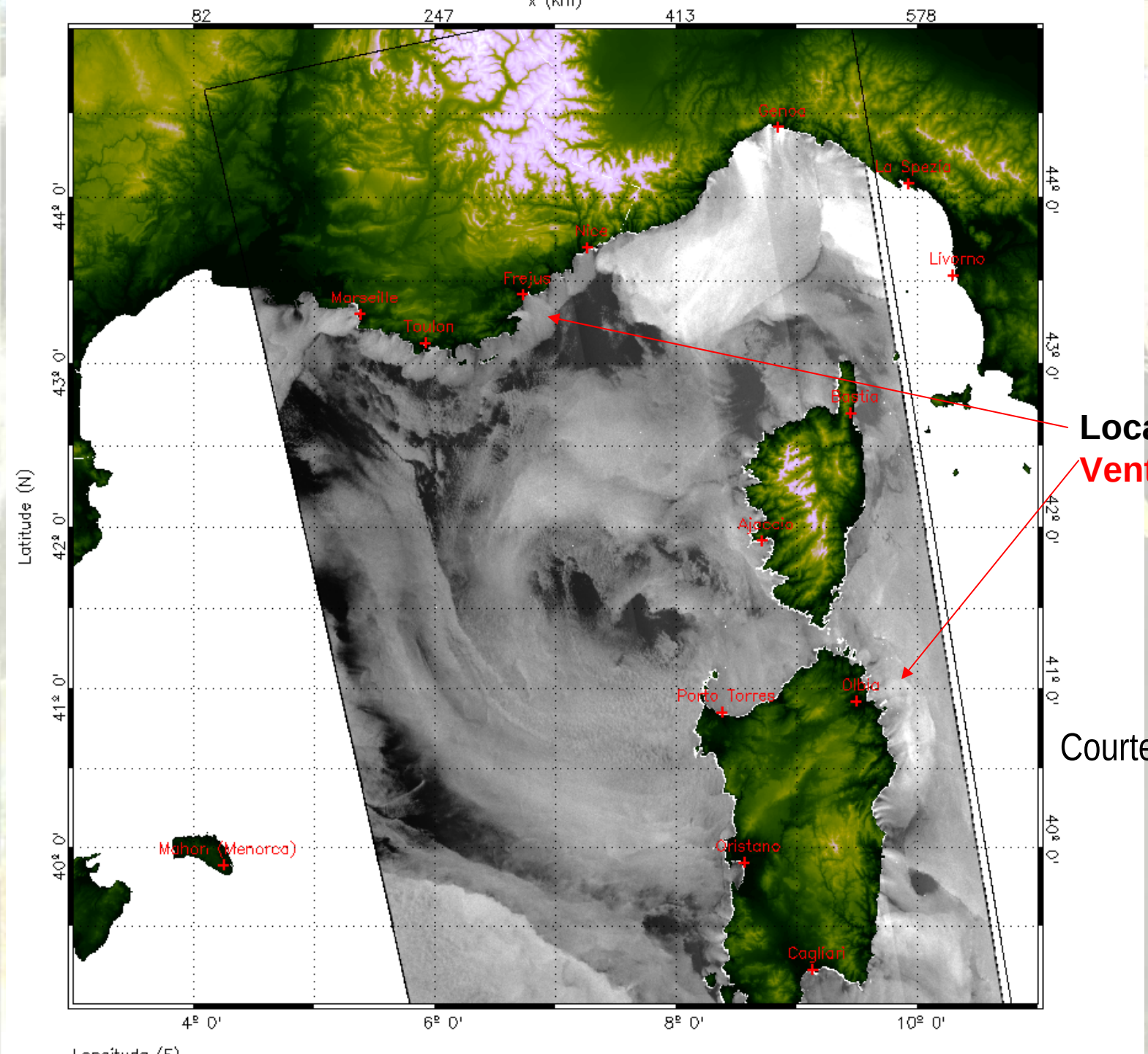


Envisat Wide Swath VV
16 September 2003 - 20:03:35 Z



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

Cedre

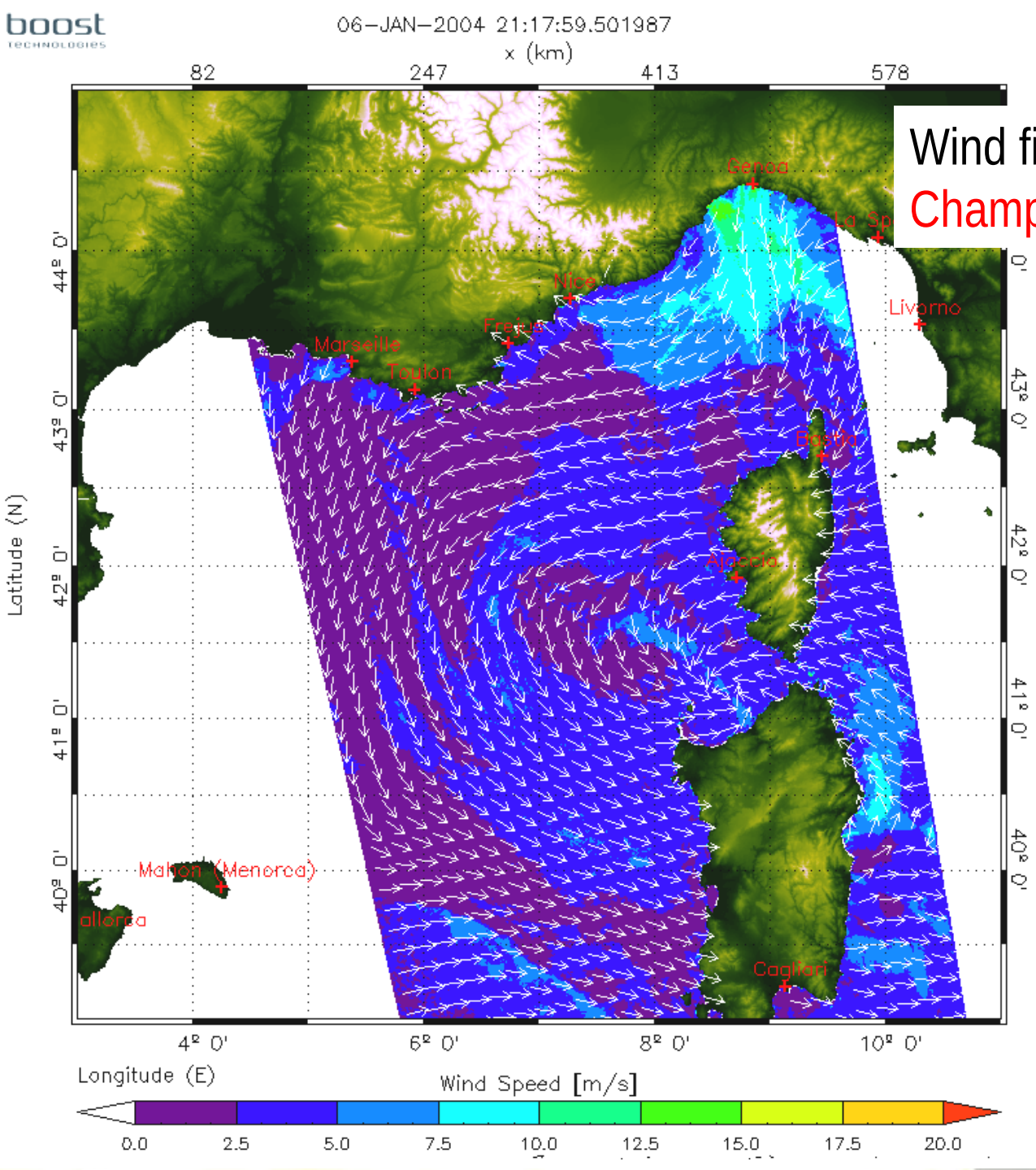


Local winds

Vents locaux

Courtesy of CLS-Boost

Cedre



Wind field from SAR signal

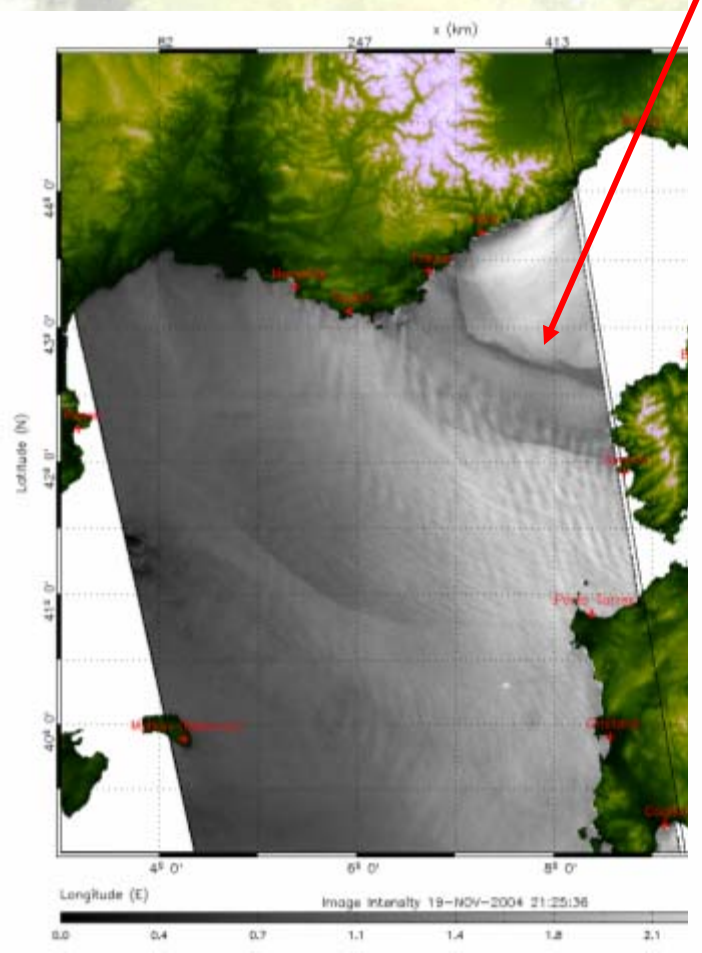
Champ de vent SAR

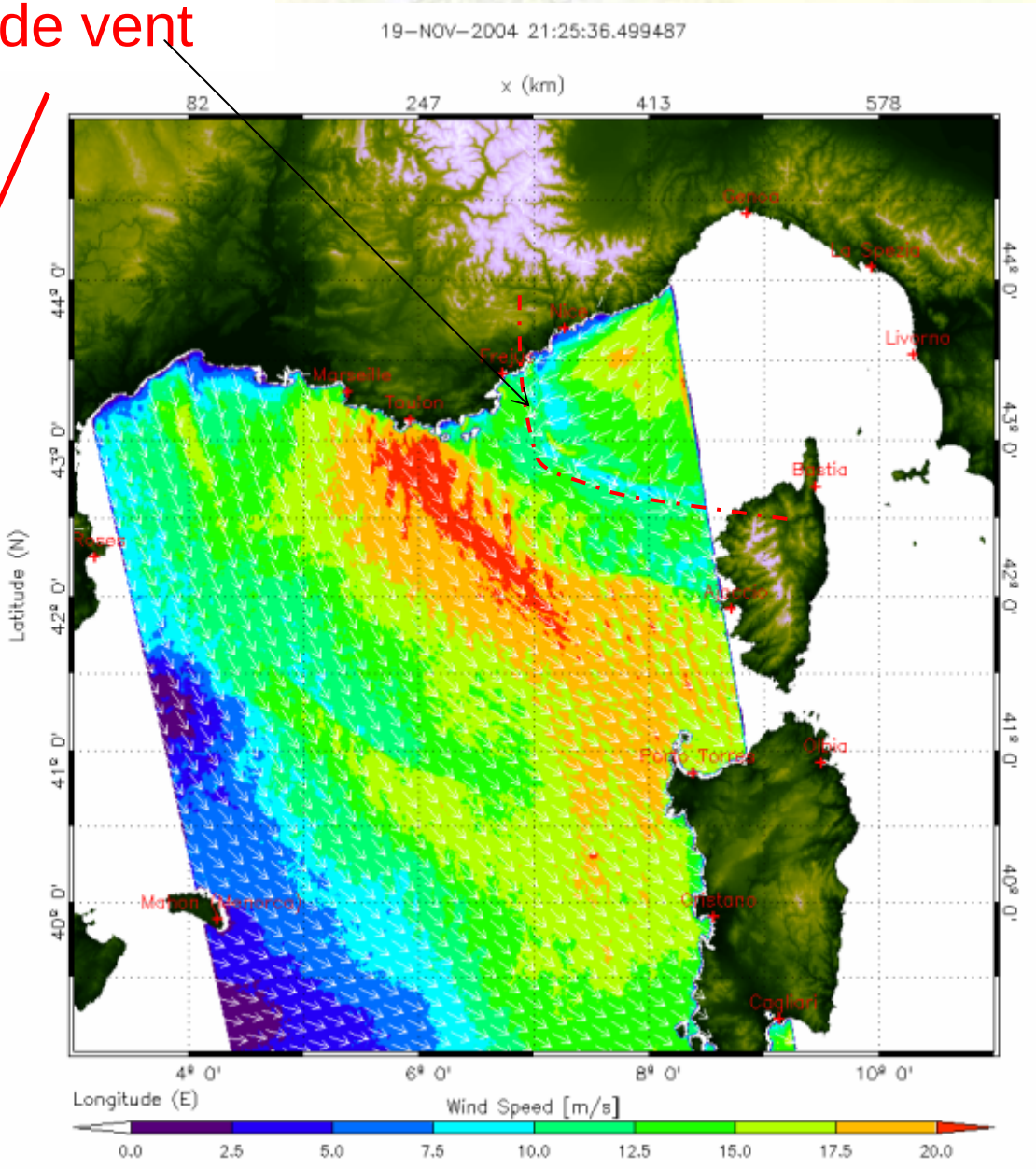
Courtesy of CLS-Boost

Wind front

Front de vent

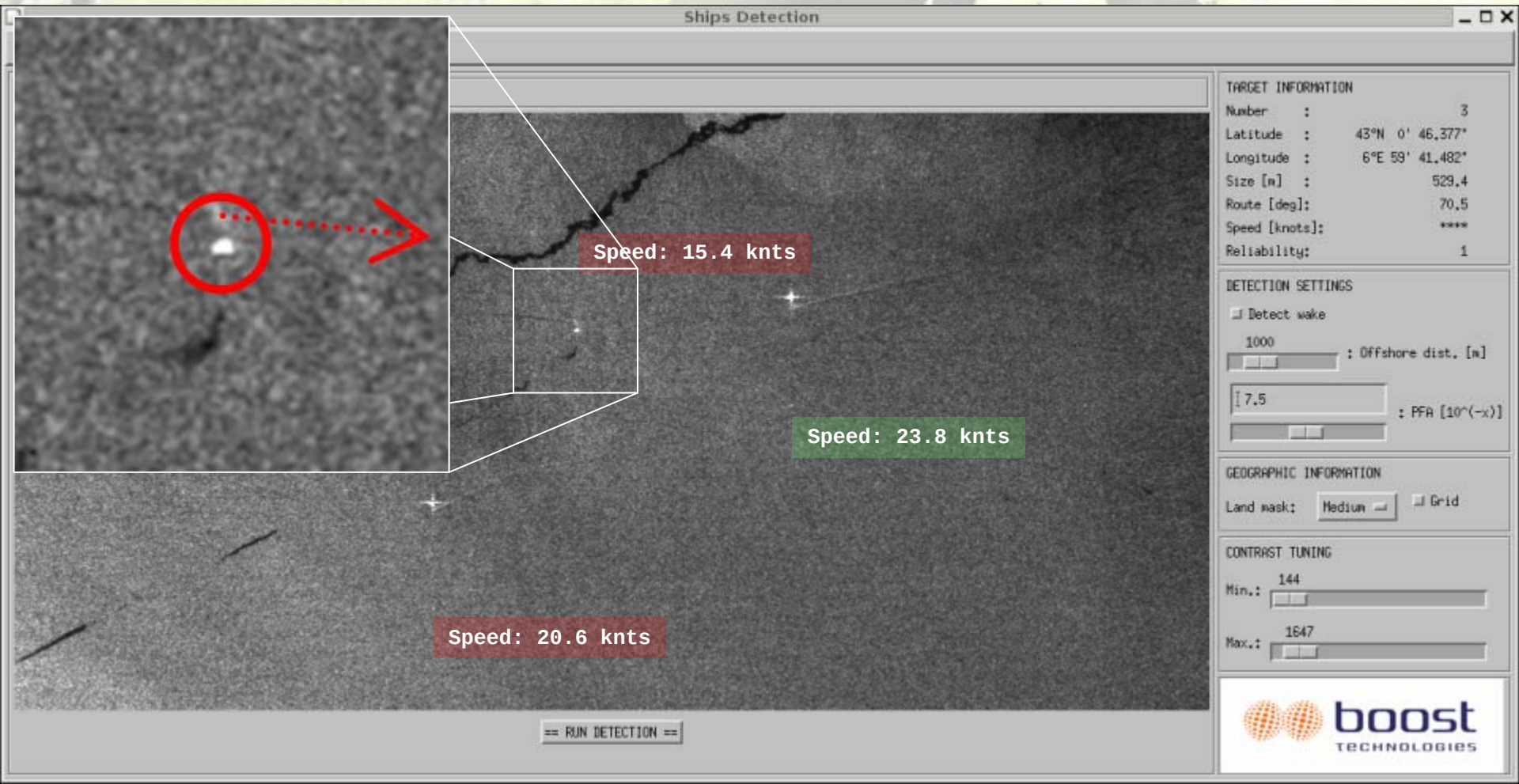
Courtesy of CLS





Vessel speed determination if its propeller wake is visible

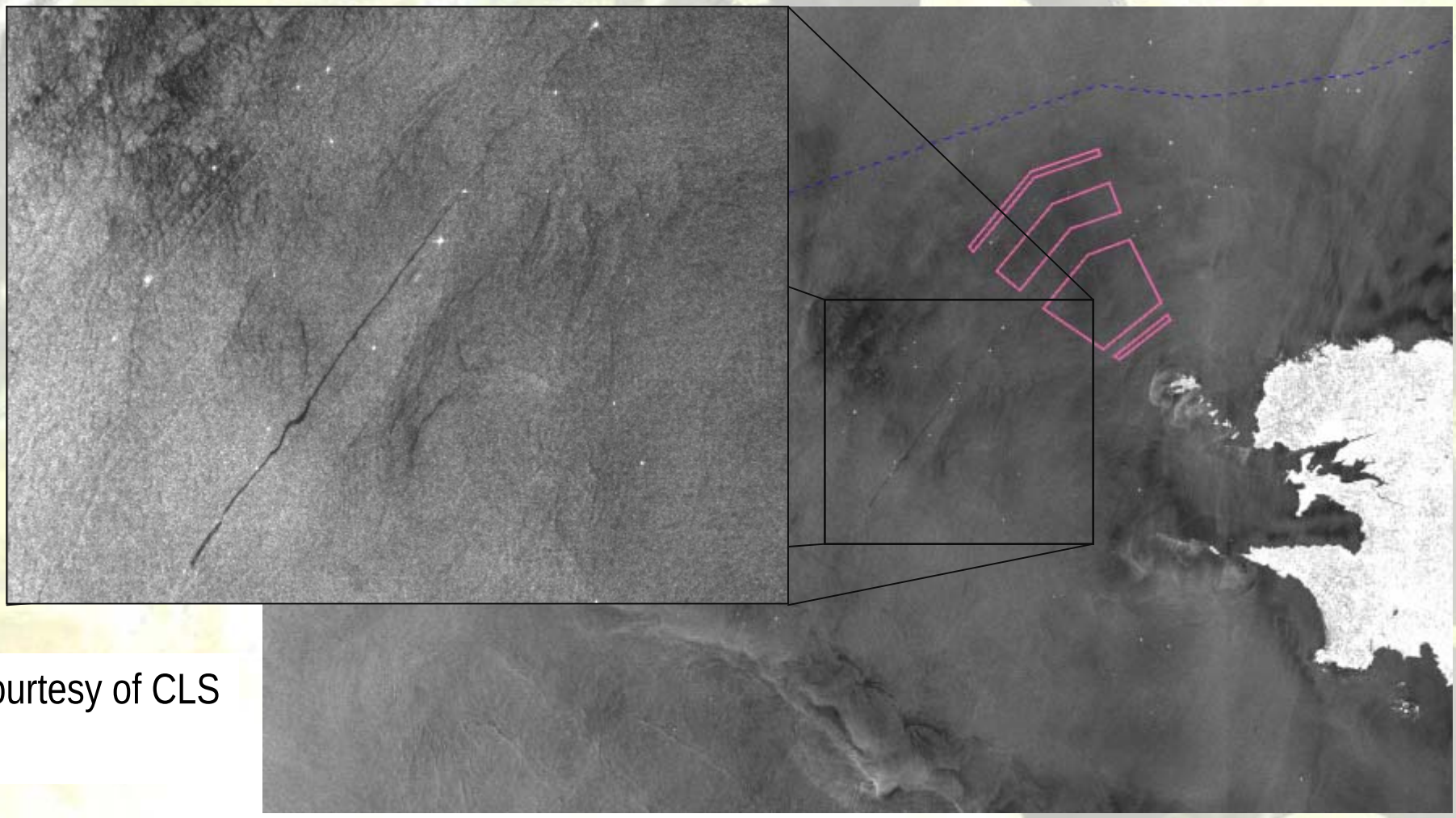
Détermination de la vitesse si le sillage d'hélice est visible



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*

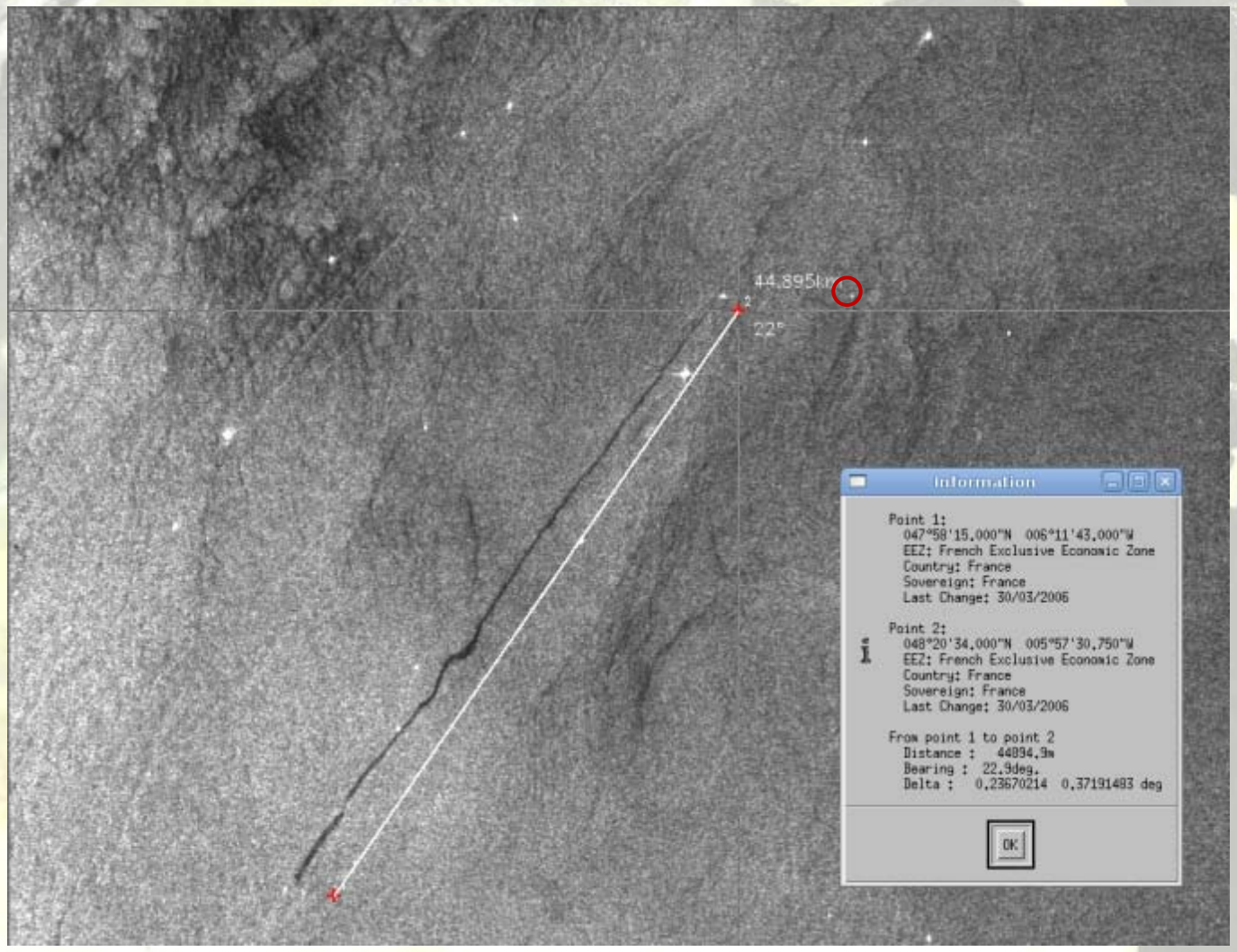


Courtesy of CLS

Navire directement relié à la nappe

Vessel directly connected to the slick

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

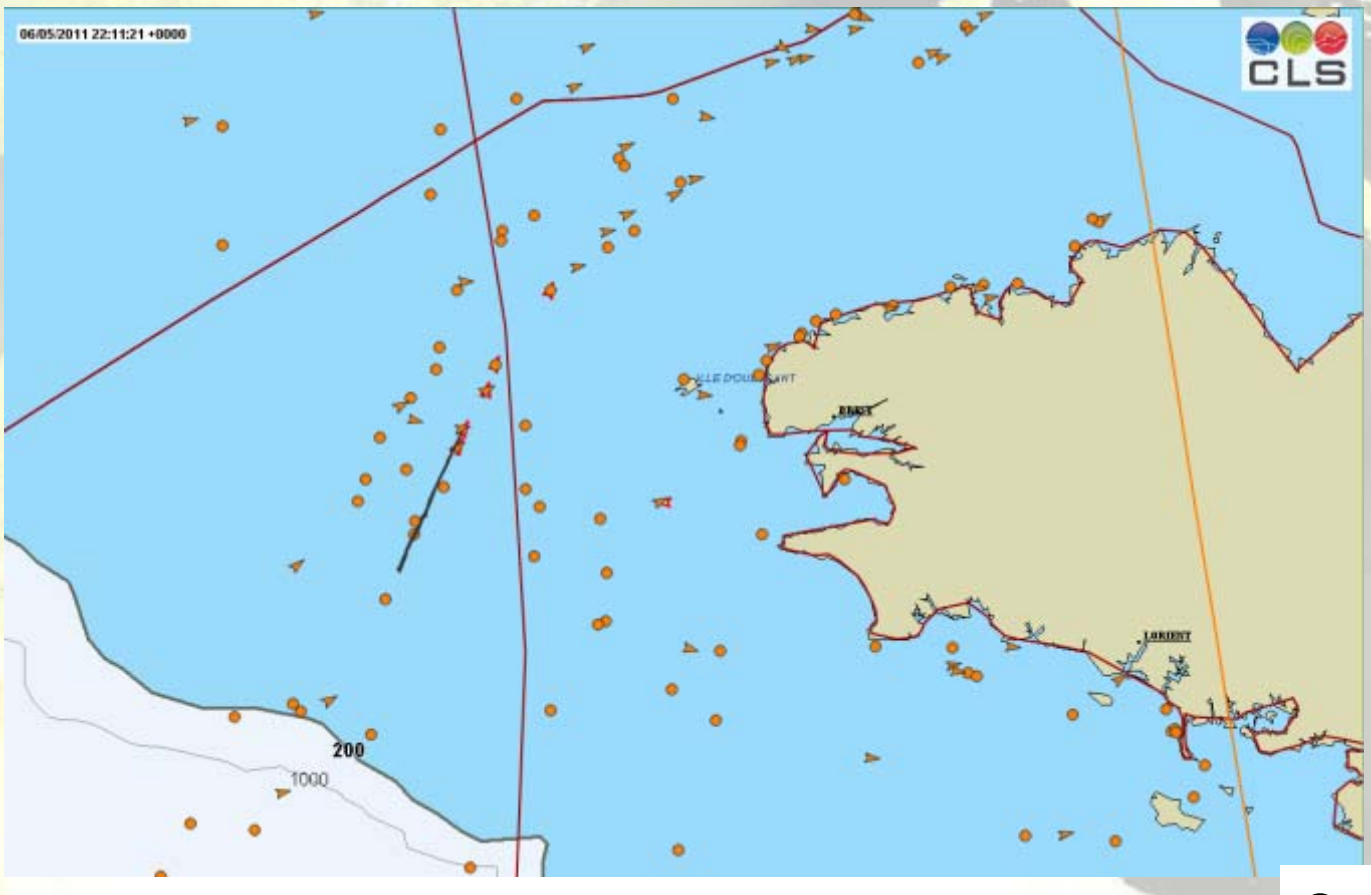


Slick 45 km long

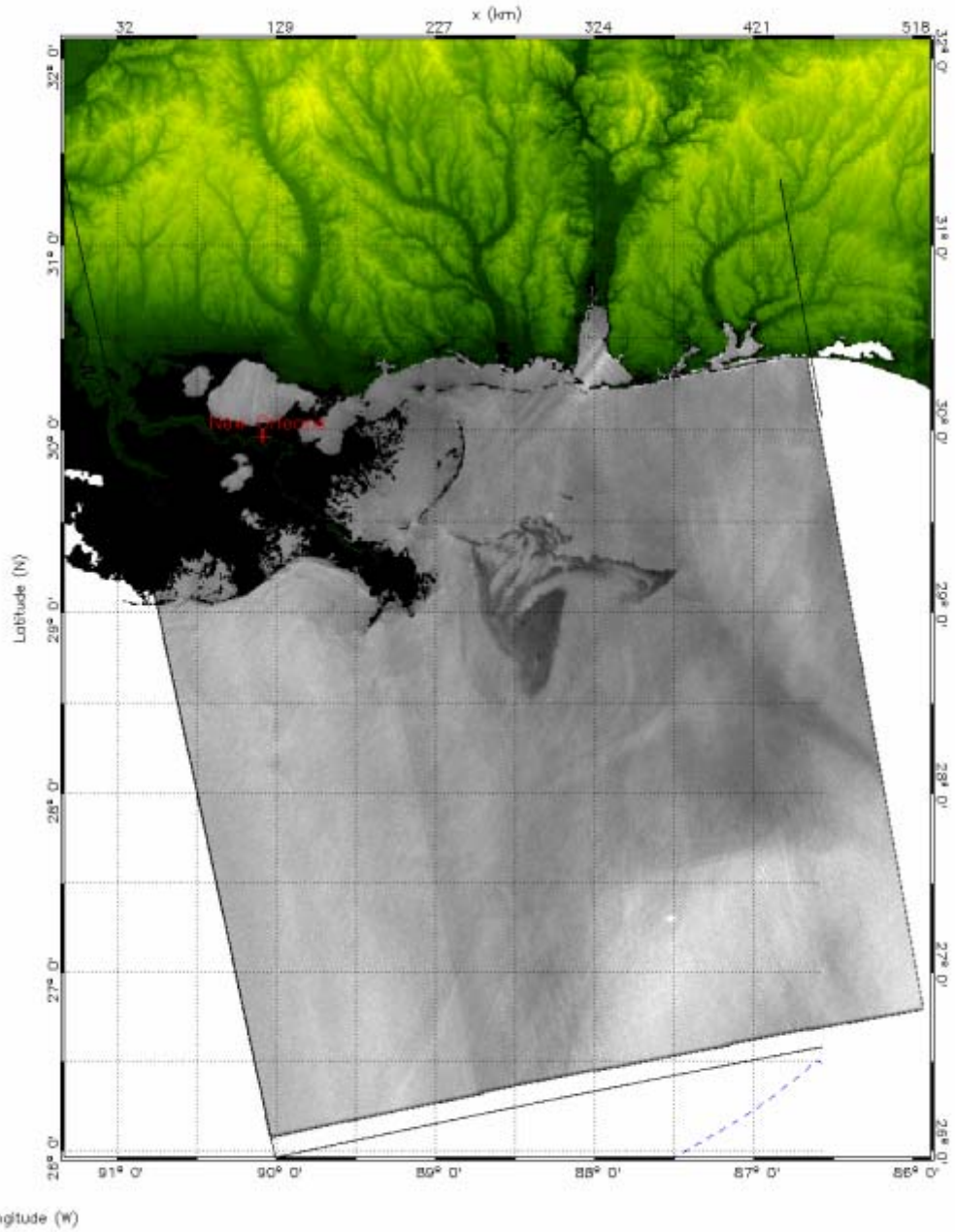
Courtesy of CLS

Identification of the discharging vessel
Identification du navire en cause

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

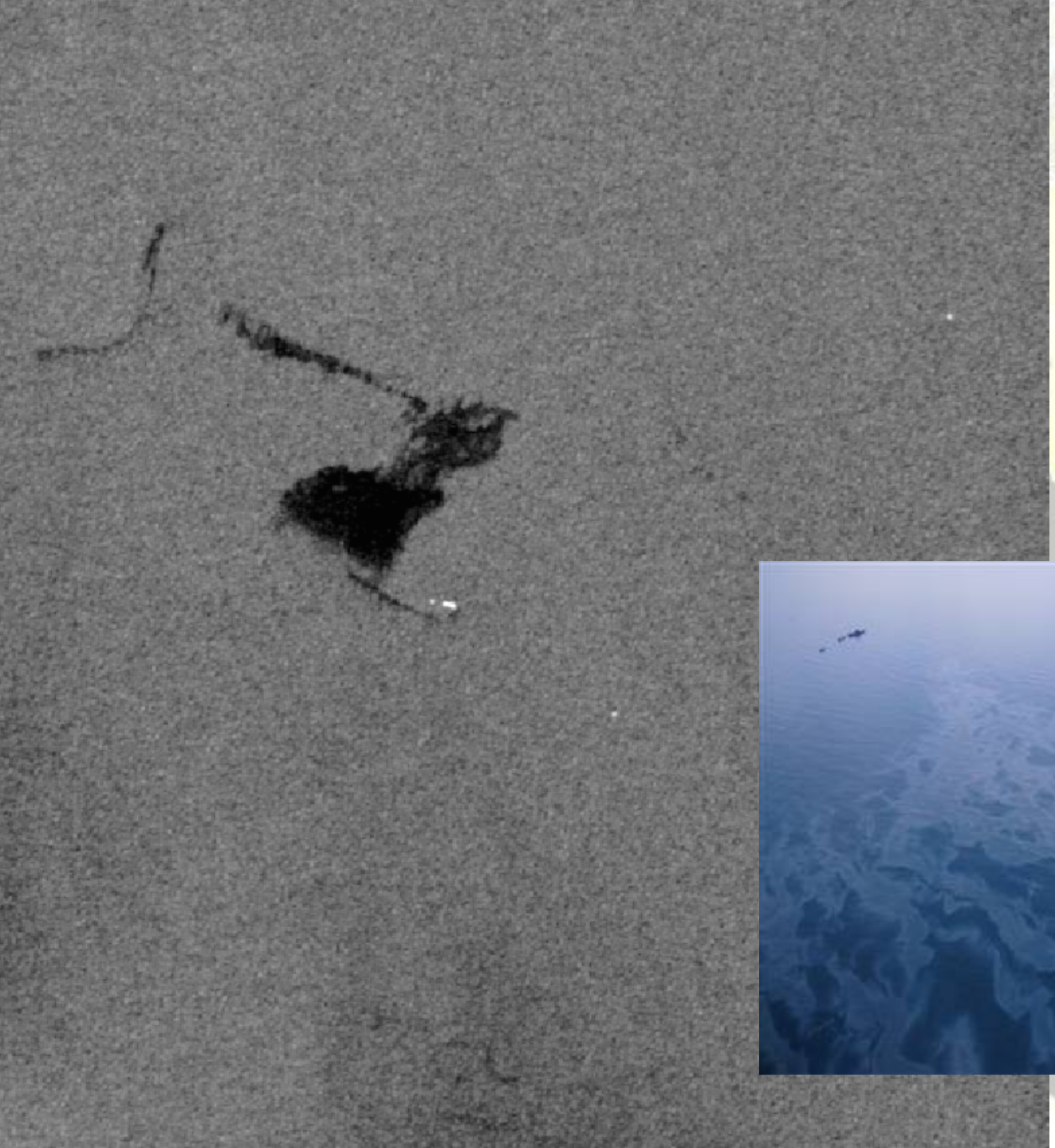


Courtesy of CLS



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:

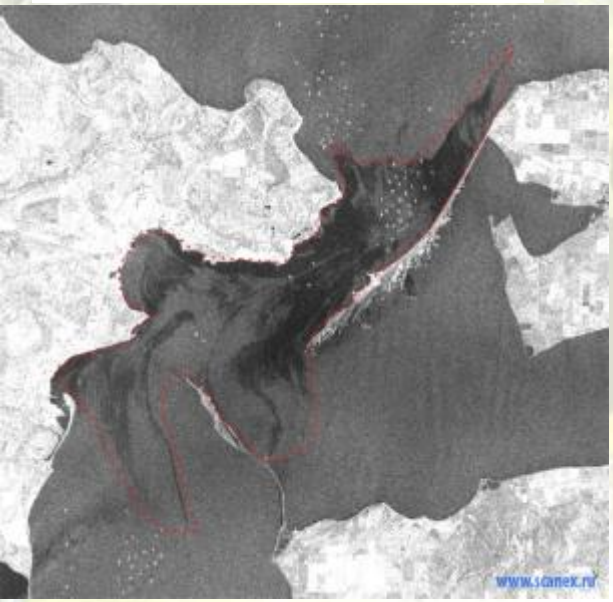
- Radarsat 1 (C band)
- Envisat (C band)
- Radarsat 2 (C band)
- Terra-SAR X (X band)
- Cosmo-Skymed (X band)
- ALOS (L band)
- Sentinel 1(C band)

and optical satellite:

- SPOT – Pleïades (France)

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

C-band: RADARSAT

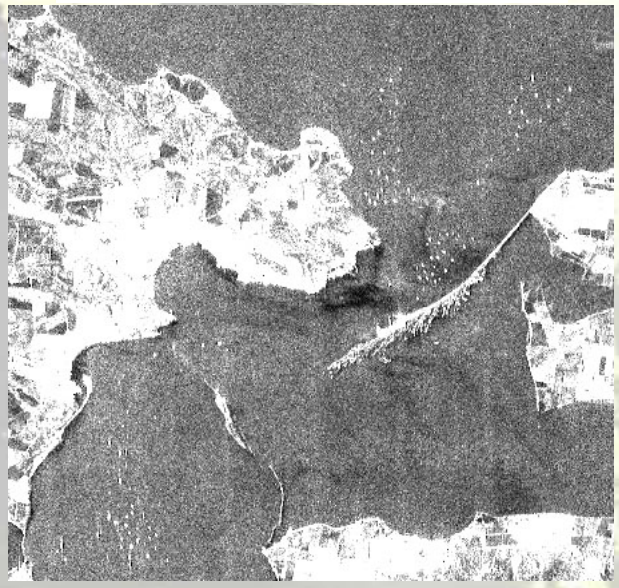


Courtesy: Scanex

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