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Use of SAR data for Maritime Application

Gianni Riccobono

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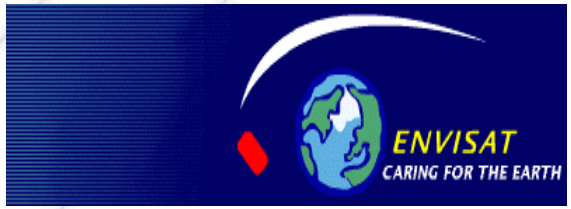
Telespazio relevant experience

ERS-1/ERS-2 (1991/1995)
Processing and Archiving Facility - Development & Operations

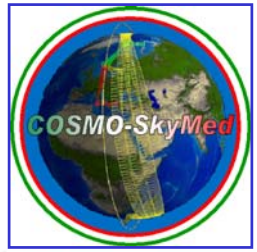
SIRC/XSAR (1994)
Processing and Archiving Facility - Development & Operations

SRTM (1997)
Processing and Archiving Facility - Development & Operations

ENVISAT (2002)
Processing and Archiving Centre - Operations



COSMO (today)
Ground Segment - Development & Operations



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Matera Ground Station

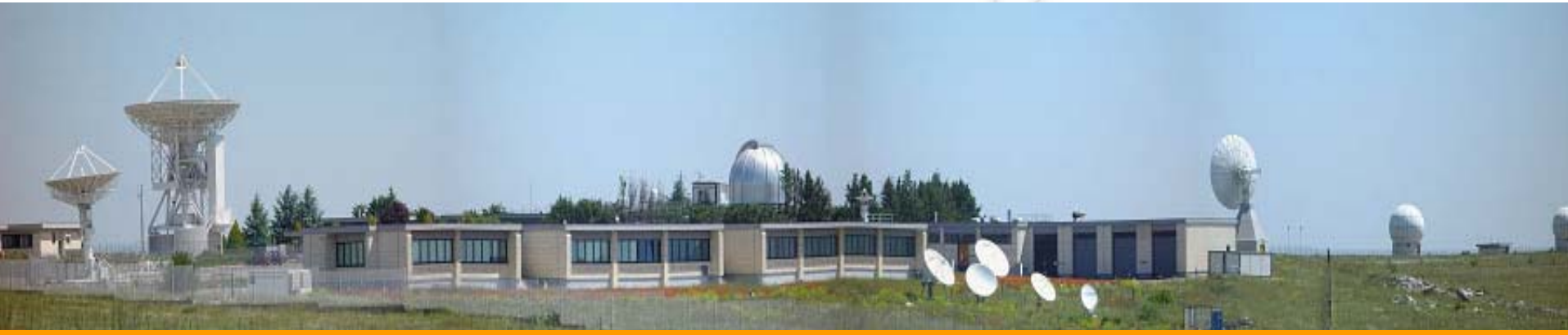
Remote Sensing Data Acquisition & Processing

Landsat	(USGS/ESA)
ERS, Envisat	(ESA/ASI)
Terra, Aqua	(NASA/ESA)
Meteosat	(Eumetsat)
Tiros/AVHRR	(NOAA)

Geodesy: Data Acquisition & Analysis

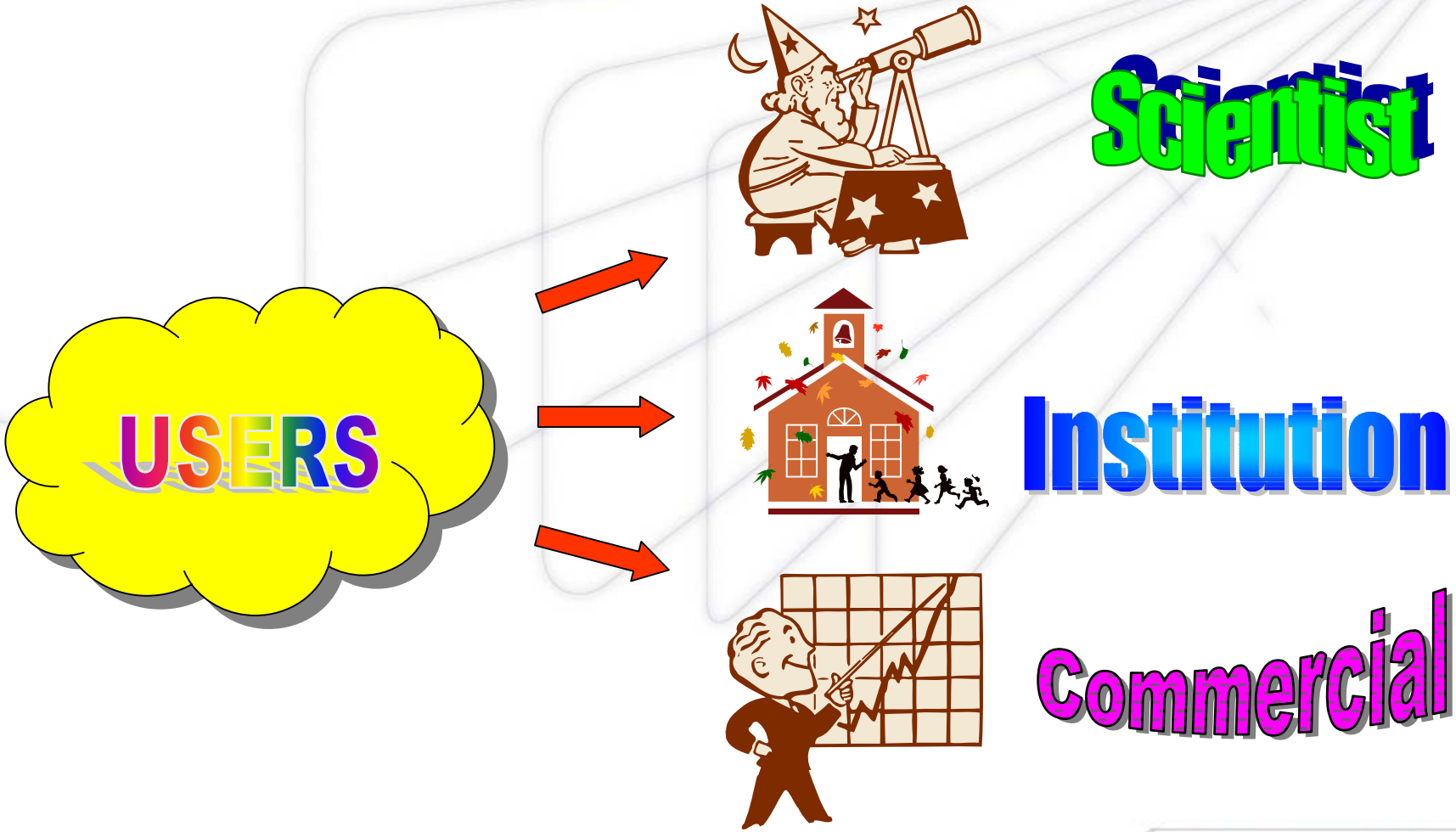
GPS	(ASI)
VLBI	(ASI)
MLRO	(ASI)

25 year satellite data archive



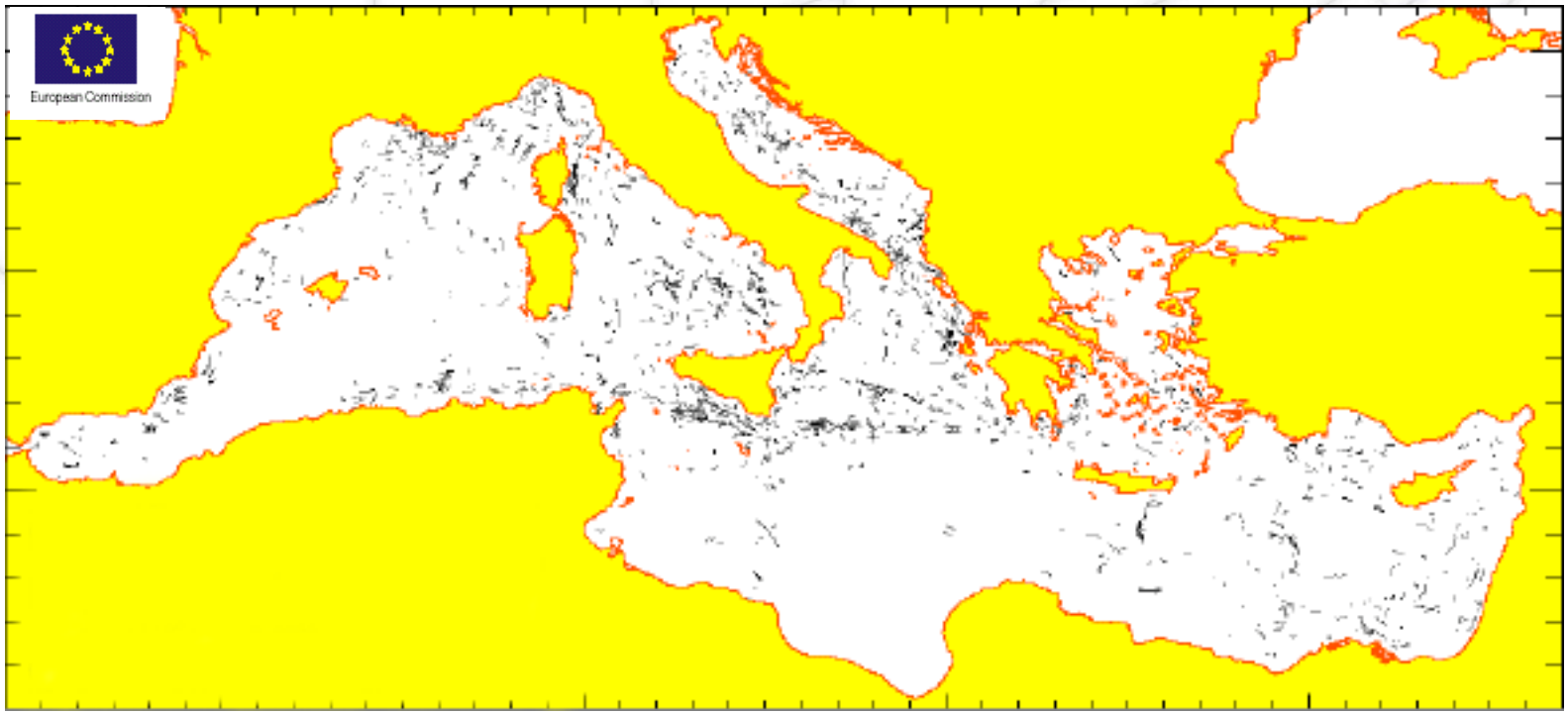
Buildings: 9.000 m^2 **Antennas:** 11 **People:** 70

Users evolution



Illegal oil spill since 1999 on Mediterranean Sea

SAR images processed =1600
Oil spill detected= 1638



Source: JRC/Institute for the Protection and Security of the Citizen

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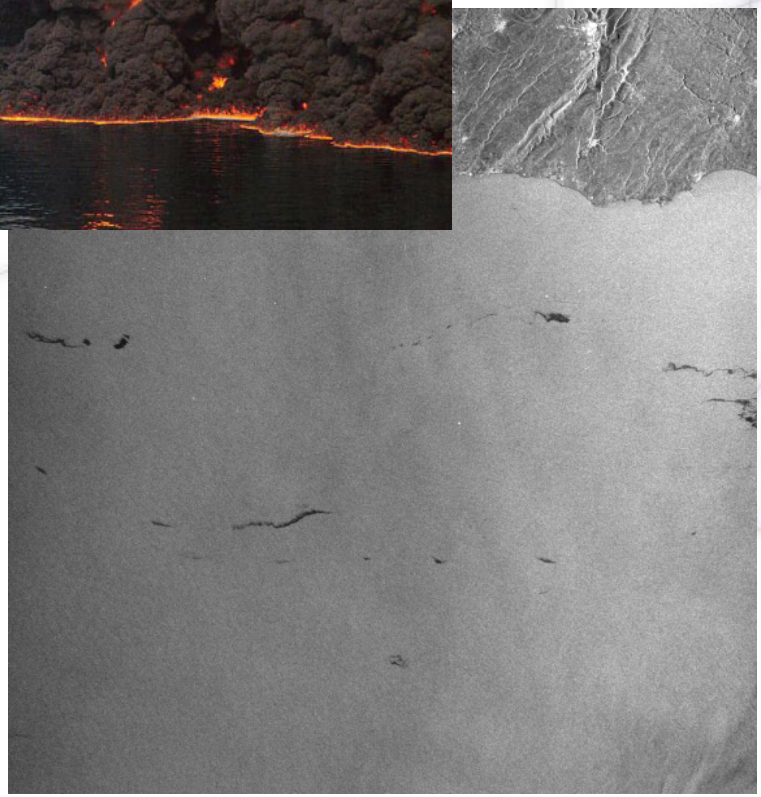
SAR data for Oil Spill



- The monitoring of oil spots in sea is one of the problems more felt for the environmental protection considering the intense traffic of oil-tankers in all the navigable seas.
- The oil film smoothes the sea surface roughness producing a radar return reduced enough in comparison to the background limiting the backscattering.
- The SAR allows to quickly cover very great areas using low resolution and wide swath images.
- SAR allows day/night and all weather acquisition

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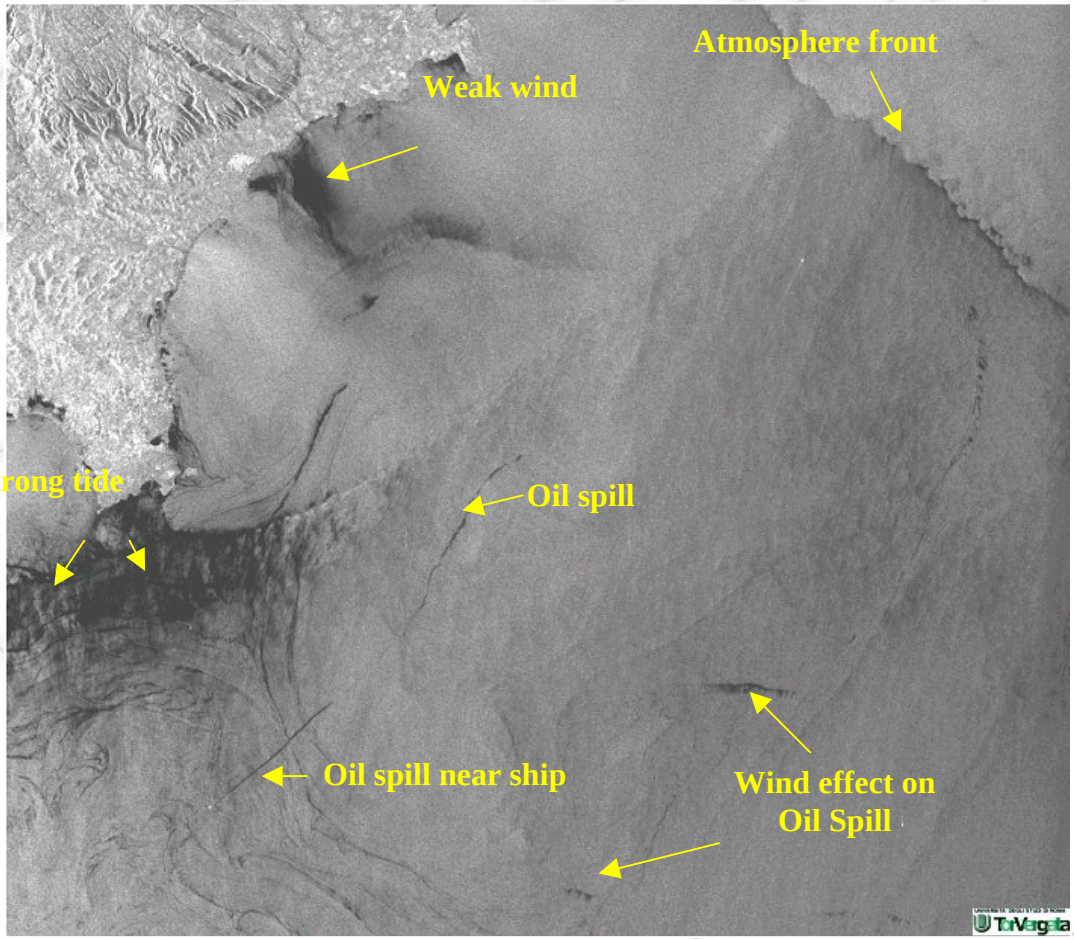
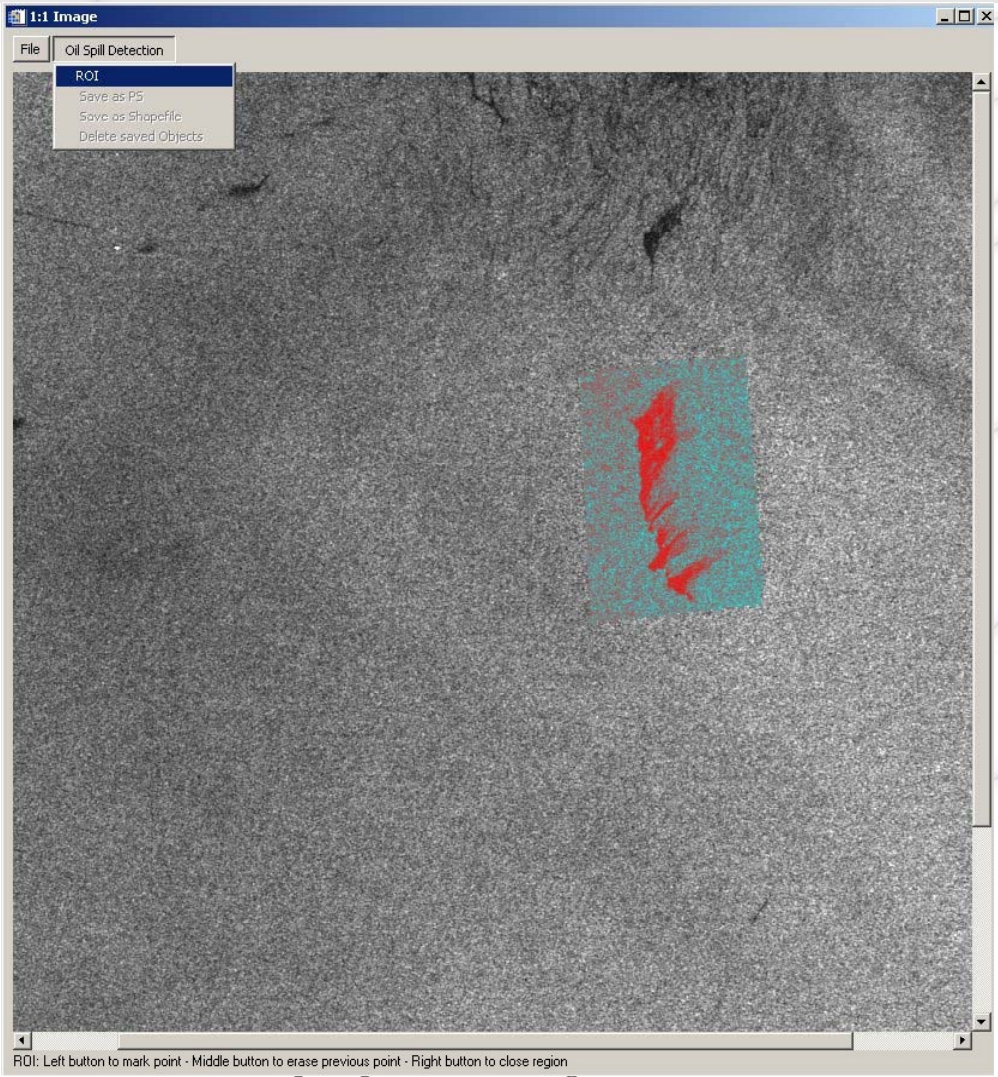
Look-alike phenomena (false alarms)

On SAR images look-alike phenomena are generated by:

- natural slick due to biologic film
- some atmosphere phenomena
- Very low wind speed



Oil Spill software tool (1)



- The oil spill detection is mainly performed by means of photo interpretation. The required functions are:
  - Automatic or manual identification of the Area of Interest.
  - Automatic evaluation of the probability of the oil spot respect to false alarm
  - Automatic determination of the extension and geographical position of the oil spot

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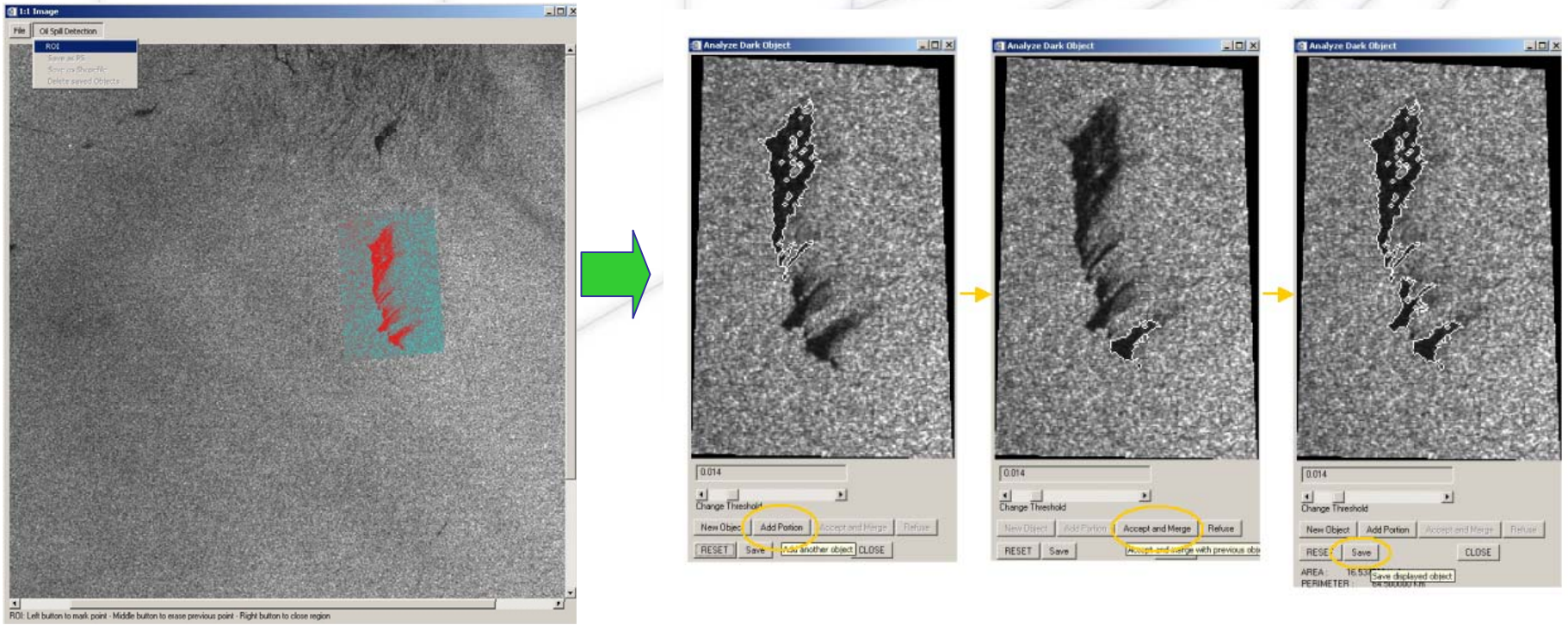
Oil Spill software tool (2)

- Area selection
- Area classification
- Sub-area merging.



- The oil spill classification is performed by means of use of neural network properly trained.

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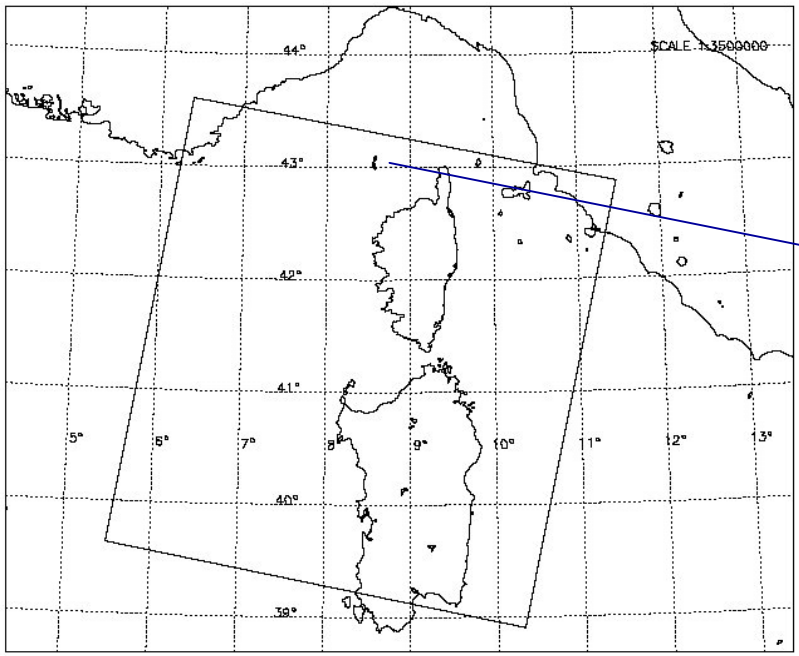
Oil Spill software tool (3)

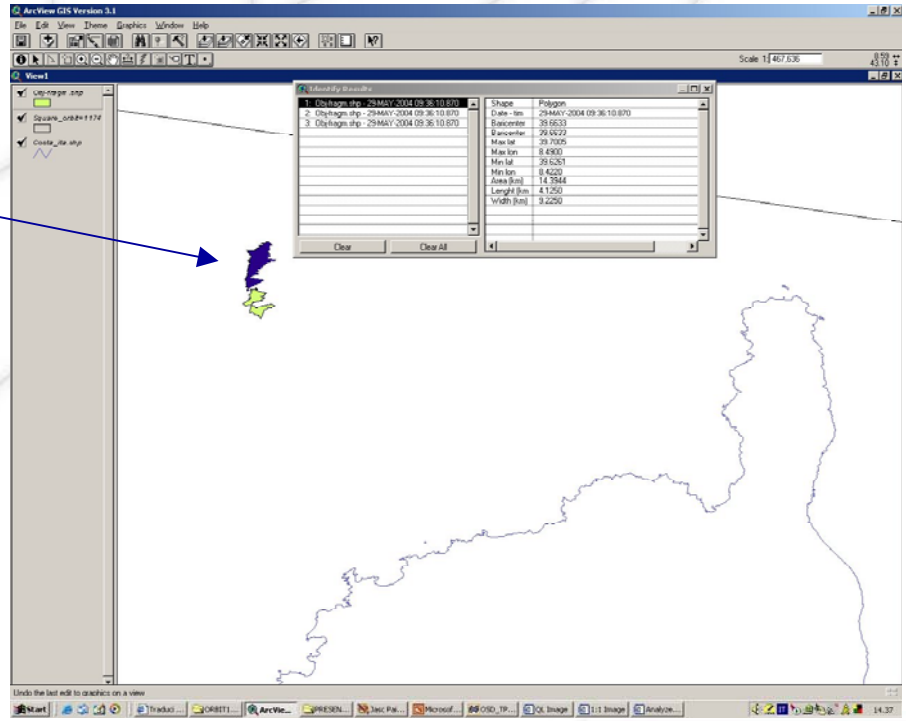
- Final Report includes oil spill position (centre and corners) and extension.
- Final report can be exported as shape file for GIS application

Oil Spill Report – DEMO

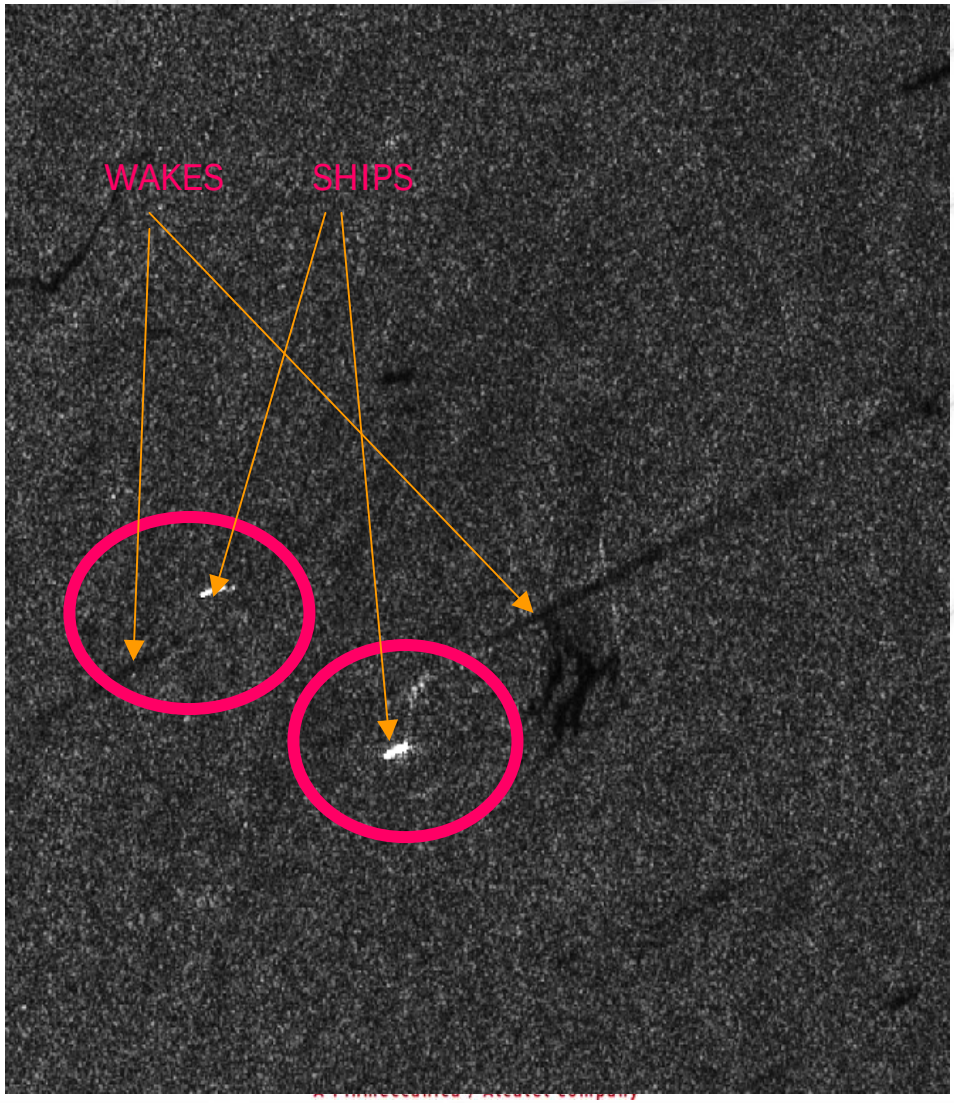


29–MAY–2004 09:36:10.870 ORBIT=11742

OIL SPILL	1
Baricenter Lat/Lon	39.60/ 8.75
Extreme coordinates Max Lat/Lon Min Lat/Lon	 39.85/ 8.79 39.55/ 8.71
Surface (Km²)	16.10
Lenght (Km)	4.88
Width (Km)	12.98



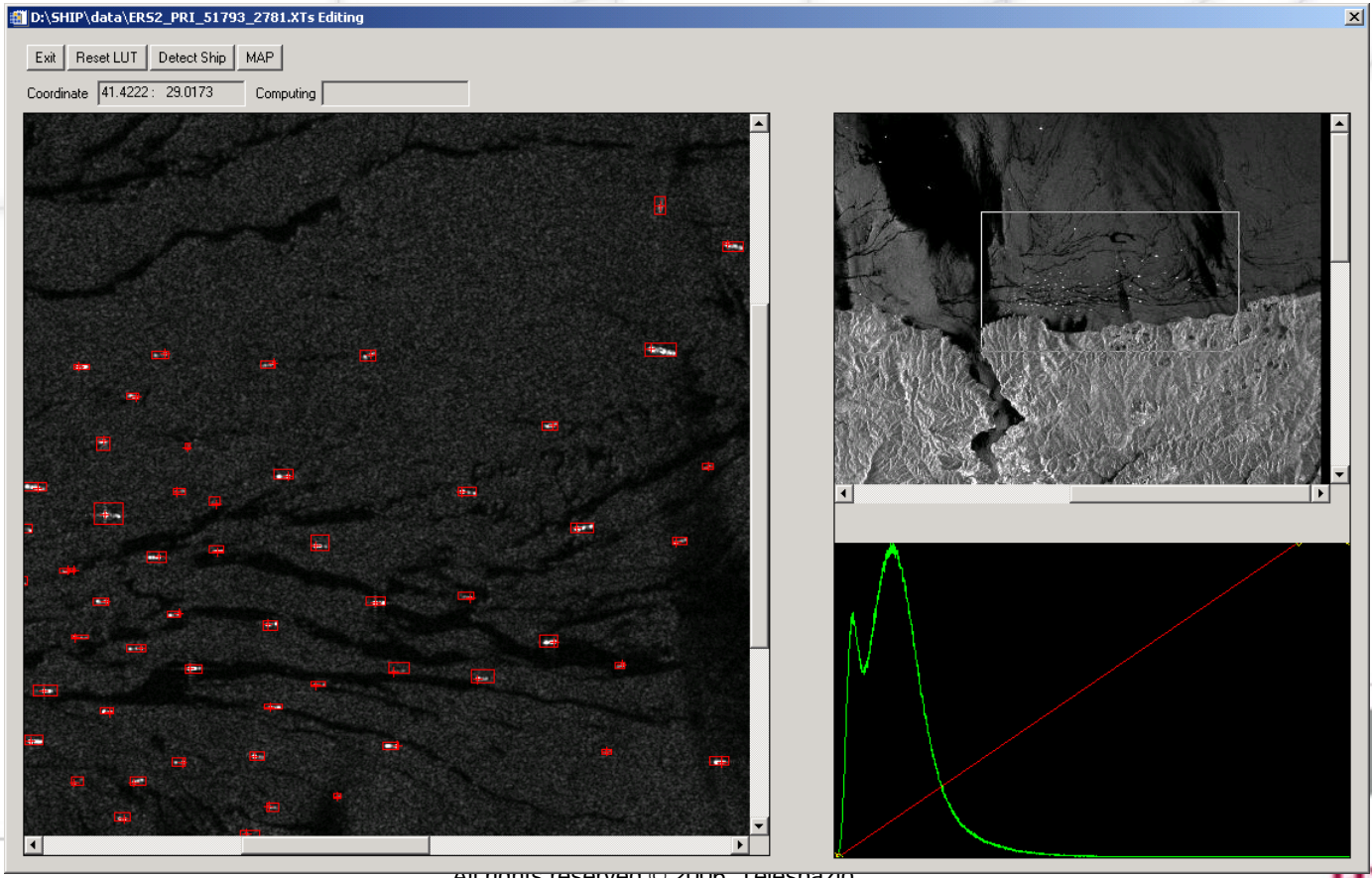
SAR usage for Ship Detection



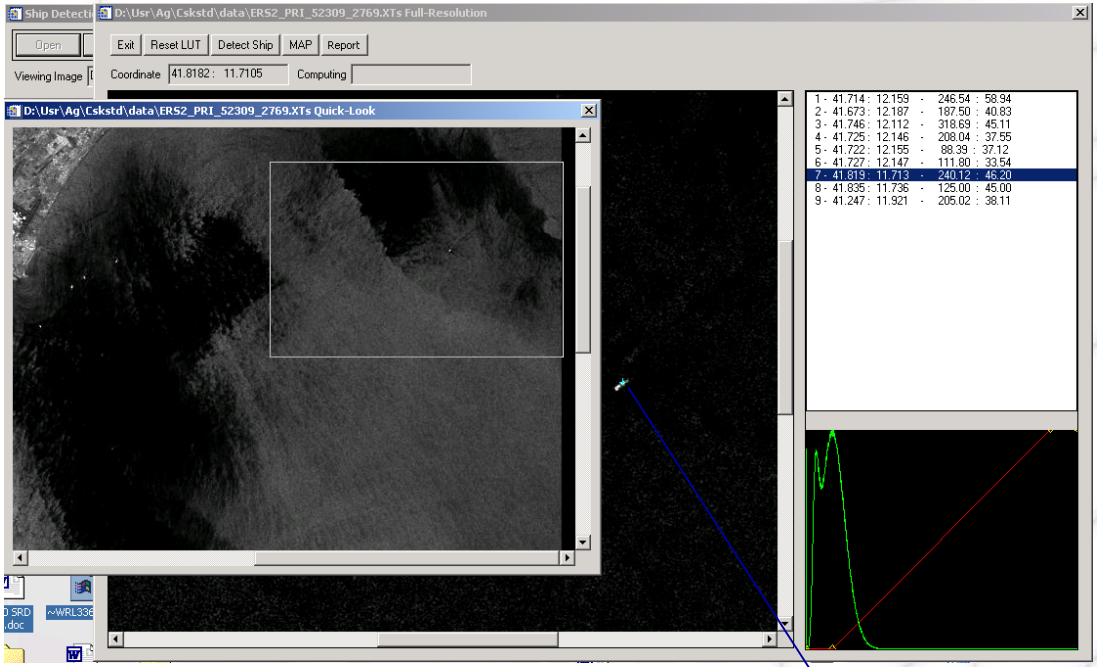
- The automatic ships detection in open sea represents an important application of the SAR both for civil purposes and military.
- The ships normally produce an elevated radar return in comparison to the background of the sea surface due to the high reflectivity of the metallic parts.
- The higher is the resolution the better is the capability to eliminate false alarms caused by the bad sea conditions.
- The wakes displacement from the ship for the doppler effect allows to estimate the speed of the ship

Ship Detection software tool (1)

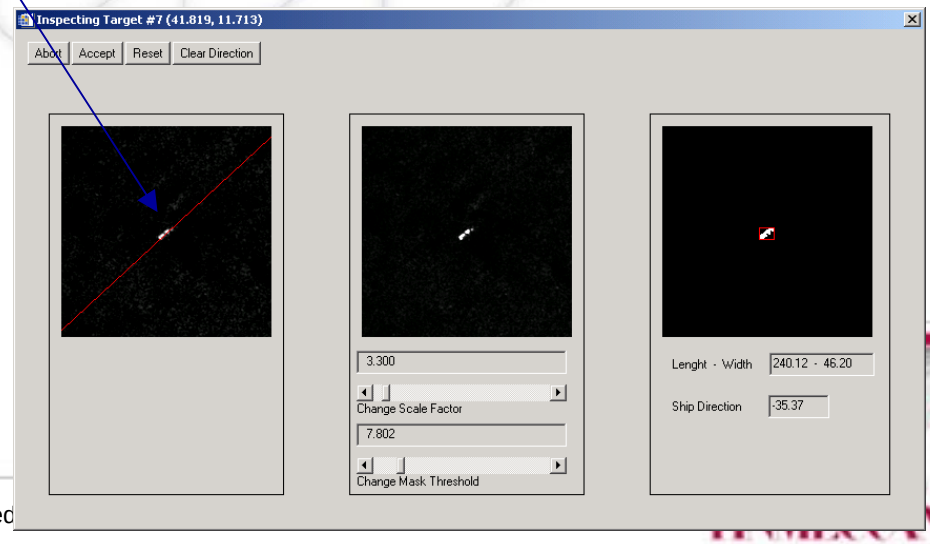
- The required functionalities are:
  - Automatic ship detection
  - Automatic evaluation of ship dimension and geographic position
  - Automatic ship direction and speed estimation



Ship Detection software tool (2)



- Ship detection
- Dimension calculation
- Geographic position determination
- Ship route.



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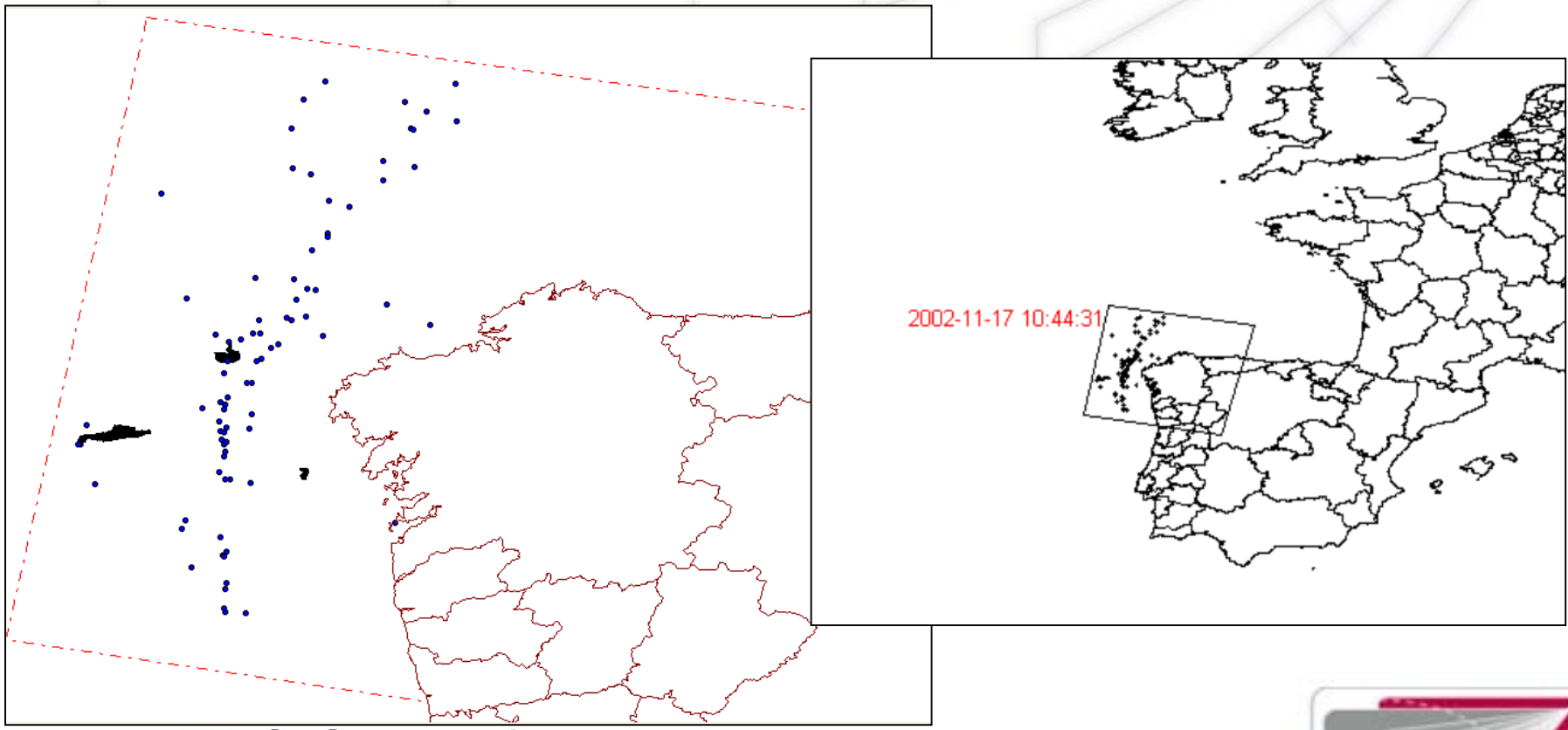
Ship Detection software tool (3)

- The final report includes the position, the dimension and the direction of the ships.
- Map of the ships is produced in the geographical area
- Oil Spill detected in the same area are displayed too



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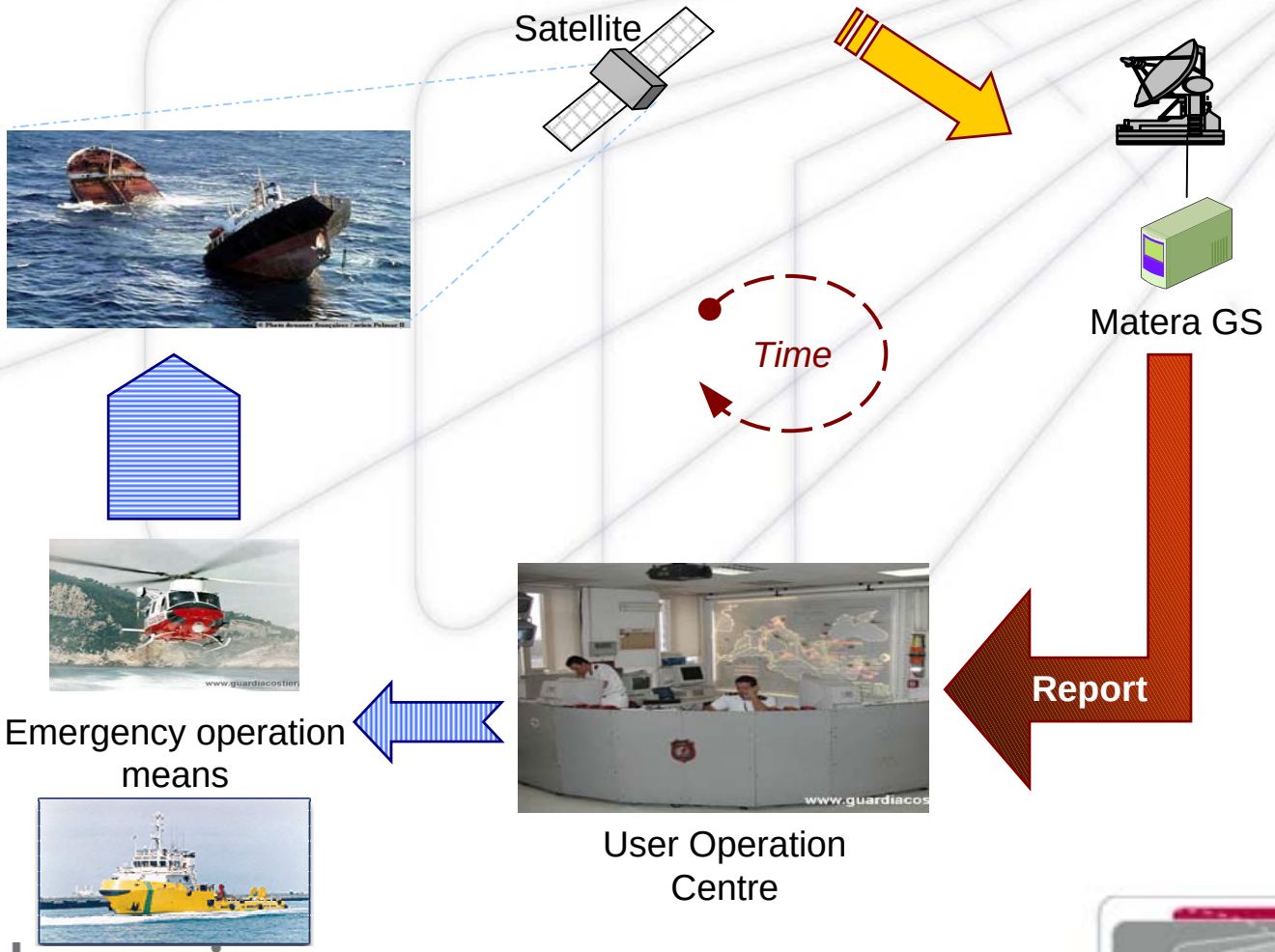
Satellite Oil Spill monitoring Service on Mediterranean Sea



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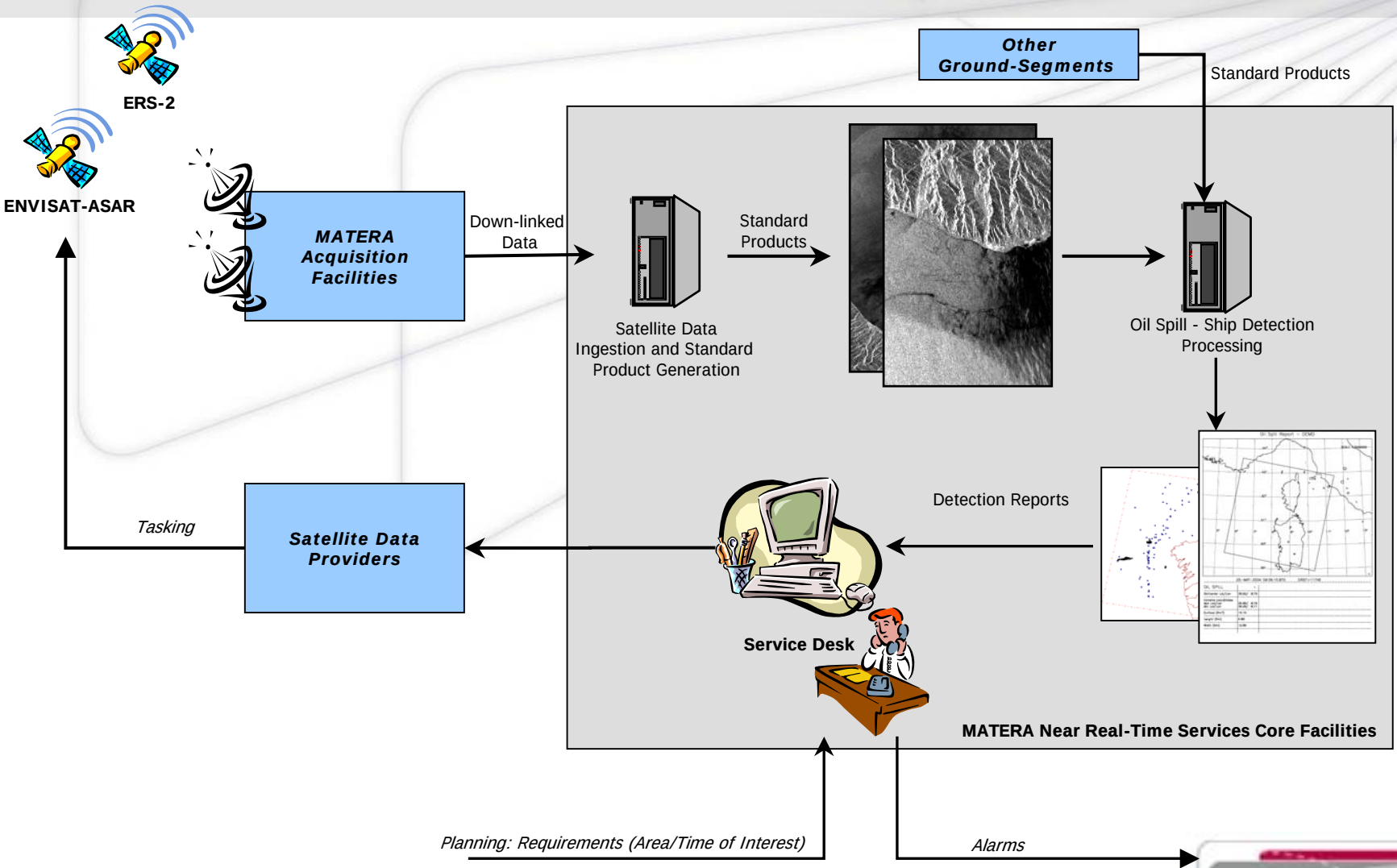
NEAR REAL-TIME SERVICES PROCESSING CHAINS



The service

The monitoring is based on the repetitive observation performed by Remote Sensing satellites.

- Data gathered by the satellites are processed as soon as available (ERS-2, RADARSAT, ENVISAT).
- Image products are generated.
- Meteo-ocean data and forecast over the interested area are provided.
- The Value Adder analyses the image and apply specific algorithms on it, to detect and localise the oil spill.

  - VA is an expert in detection of oil-slicks on SAR images

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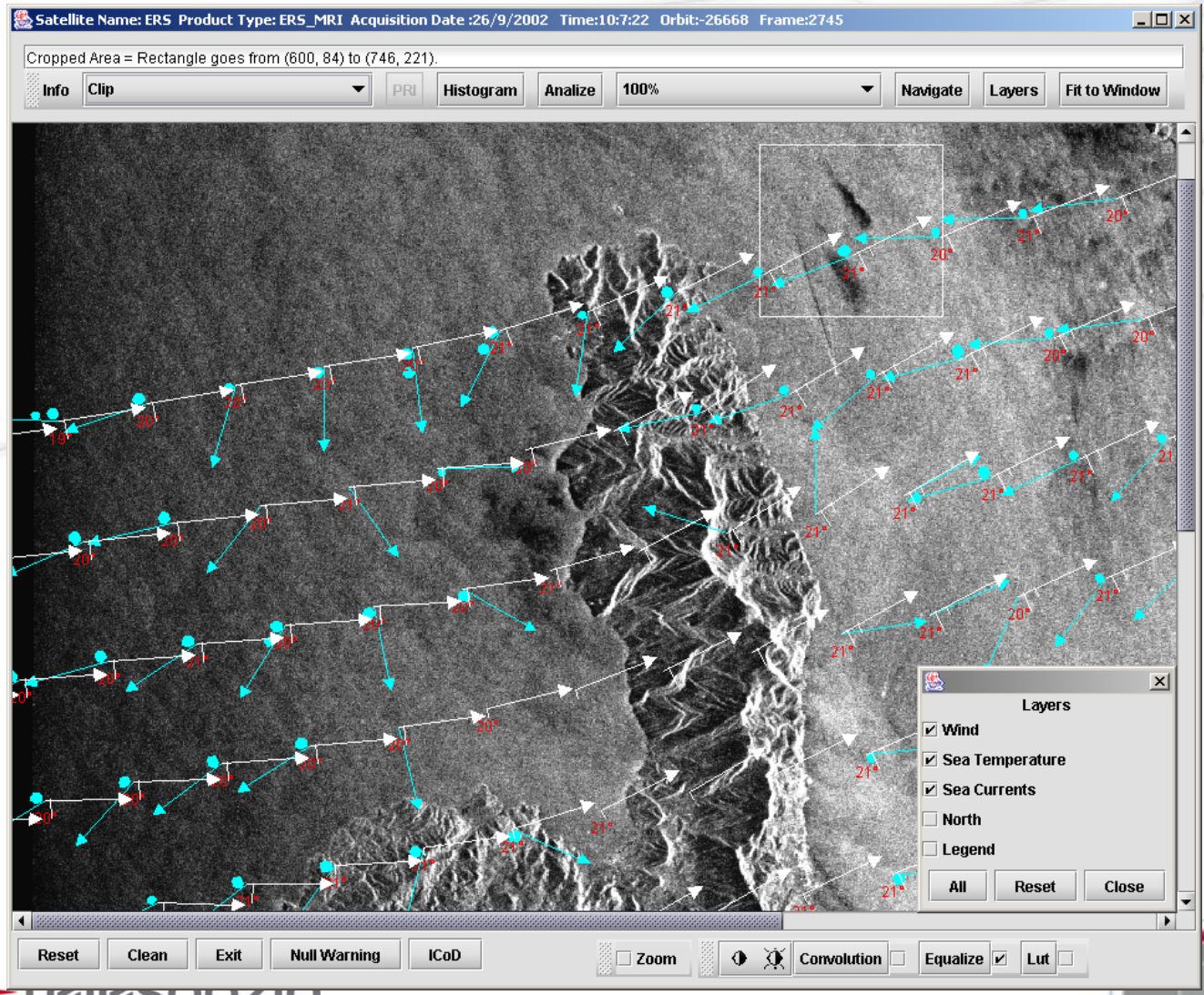
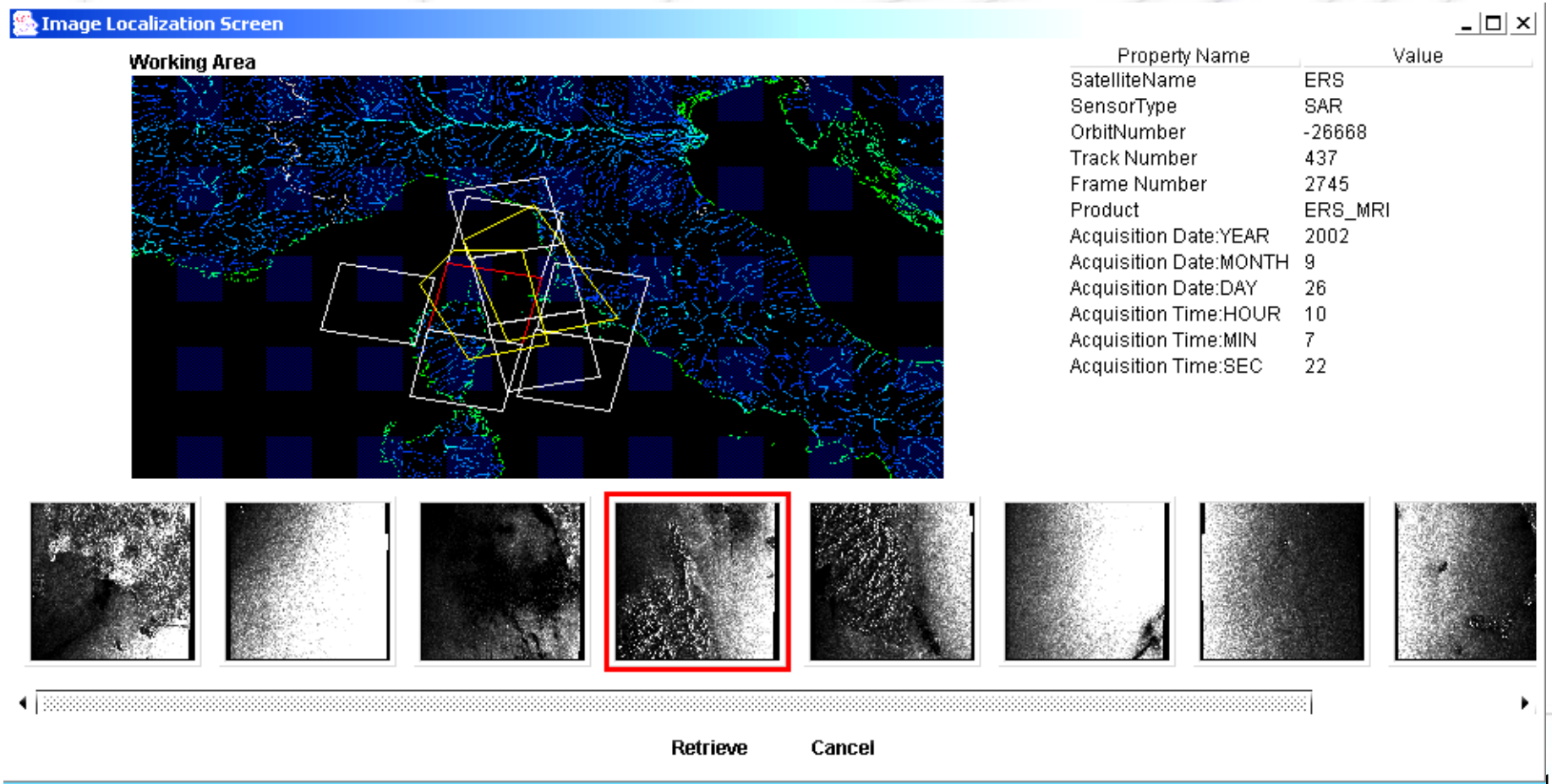
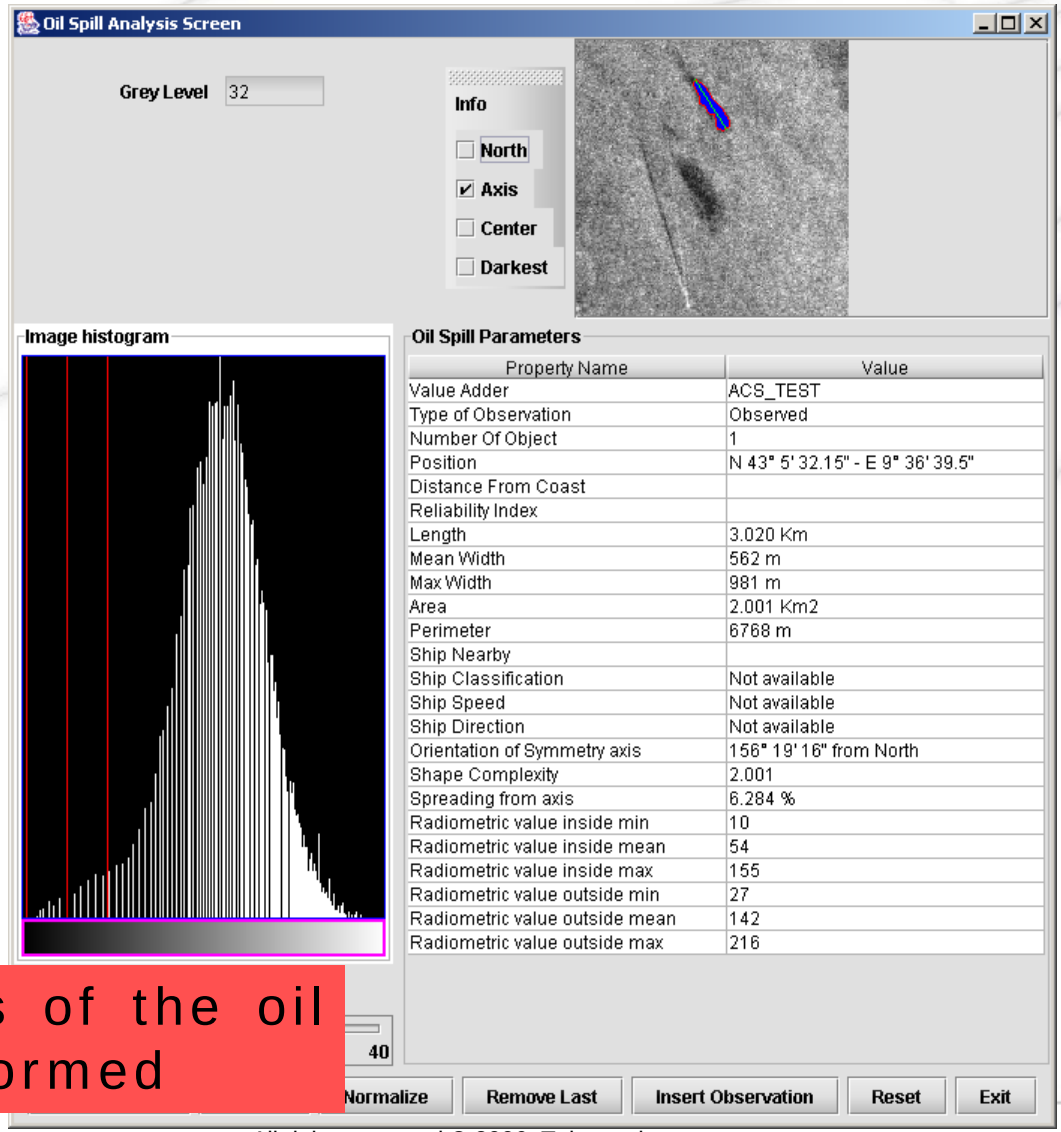
The VASCO Service OS Detection



The VASCO Service: Images preview



The VASCO Service: Product Analysis



Property Name	Value
Value Adder	ACS_TEST
Type of Observation	Observed
Number Of Object	1
Position	N 43° 5' 32.15" - E 9° 36' 39.5"
Distance From Coast	
Reliability Index	
Length	3.020 Km
Mean Width	562 m
Max Width	981 m
Area	2.001 Km2
Perimeter	6768 m
Ship Nearby	
Ship Classification	Not available
Ship Speed	Not available
Ship Direction	Not available
Orientation of Symmetry axis	156° 19' 16" from North
Shape Complexity	2.001
Spreading from axis	6.284 %
Radiometric value inside min	10
Radiometric value inside mean	54
Radiometric value inside max	155
Radiometric value outside min	27
Radiometric value outside mean	142
Radiometric value outside max	216

An analysis of the oil spill is performed

Prestige Disaster

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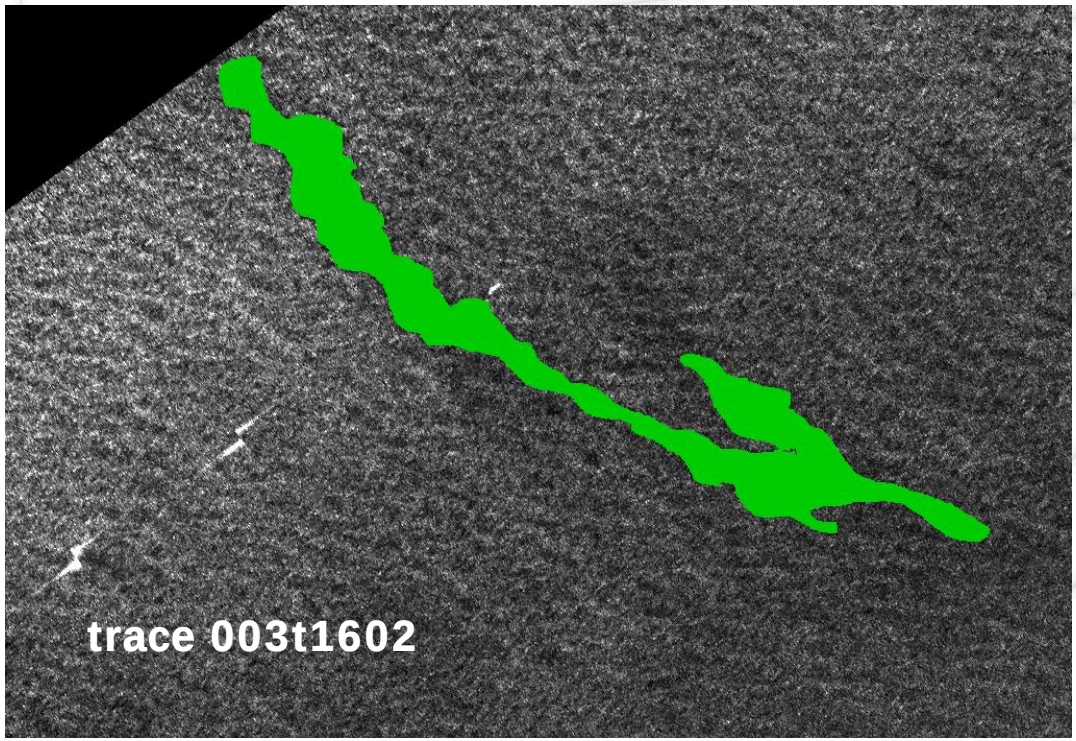
1st of February: Sinking place



Speed vector (0.436,0.405) Km/h

Speed module 0.594 Km/h

trace	Lat	Lon	area [m^2]	perimeter [m]	note
003t1425	42°10'57''N	12°01'57''W	961632	10932	lengthened irregular form
003t1602	42°11'22''N	12°01'57''W	1379052	18096	lengthened irregular form

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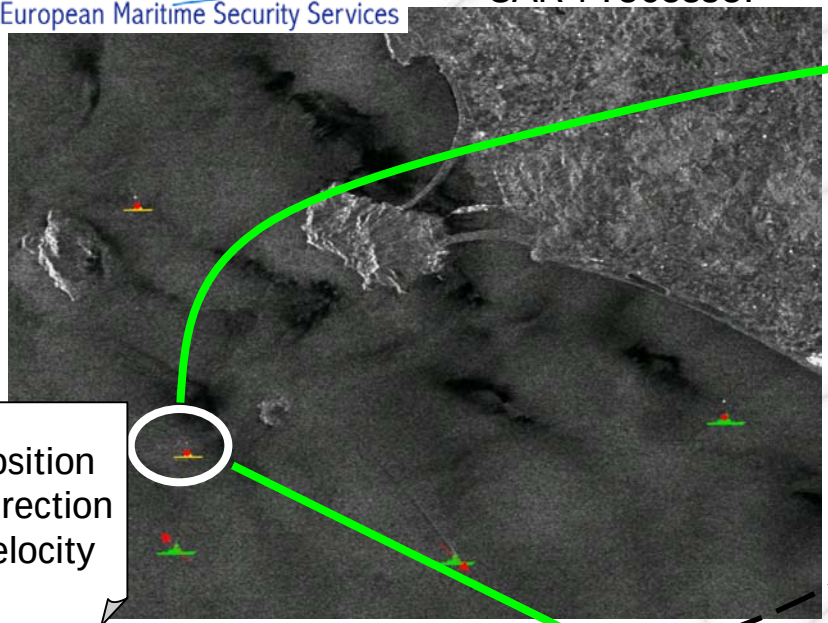
Telespazio in GMES Program

FUNDING PROGRAM	PROJECT	LEADER	THEME	TELESPAZIO ACTIVITY
ESA GSE	Risk Eos	EADS-Astrium	Forest fires, floods	Burn Scar Mapping (BSM) Service in Italy, Spain and France.
ESA-EARTH WATCH (FUEGO)	Fuegosat	INSA	Forest fires	Forest fires detection from geo-stationary satellites.
ESA GSE	Roses, Marcoast	AAS	Oil spill, water quality	Oil spill NRT detection over the Mediterranean Sea.
ESA GSE	Forest Monitoring	GAF	Forest monitoring, mapping of land use changes	Forest inventory and mapping with Italian Min. of Environment
ESA GSE	MARISS	Telespazio	Maritime surveillance services for security.	Demonstration of pre-operational maritime surveillance services
ESA GSTP3	MASS	Telespazio	ASP services	Integration of EO services in the ESA Portal.Oil spill services.
EC FP6 IST	WIN	AAS	Distributed architecture for risk management in GMES.	Analysis and demonstration for different kinds of risk.
EC FP6 A&S	BOSS4GMES	Infoterra Ltd	GMES sustainability.	Business model and governance definition.
EC FP6 A&S	LIMES	Telespazio	Security	Development & demonstration of EO based services (maritime, borders, emerging treaths)
EC FP6 A&S	EURORISK - PREVIEW	EADS-Astrium	Risk management	Leader of the geo-hazard cluster (floods, seismic and volcanic risk)
EC FP6	HUMBOLDT	FHG-IGD	INSPIRE	EO data armonization models and prototype sw implementation.

MARISS
European Maritime Security Services

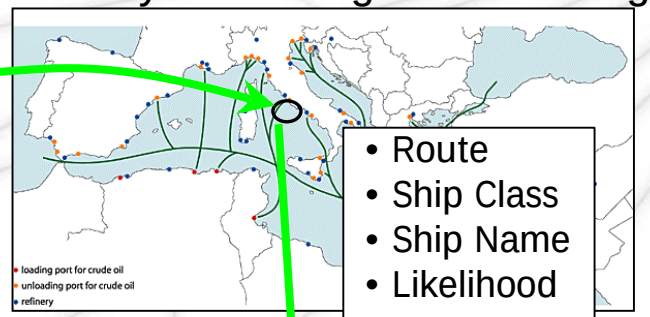
MARISS Services Basic Concepts

Ship Detection
SAR Processor



- Position
- Direction
- Velocity

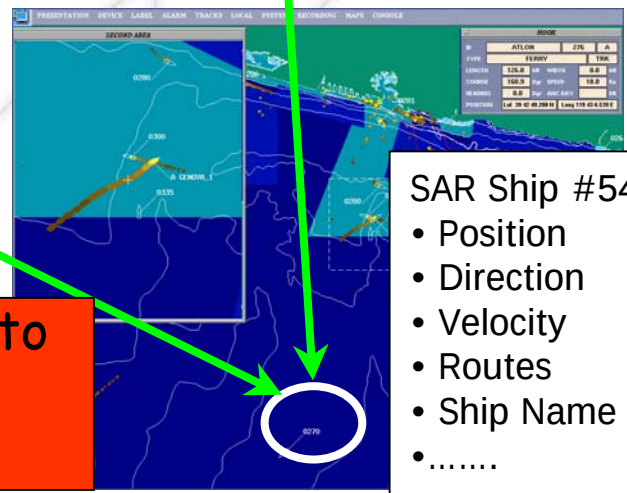
Ancillary Data Integrator/Modeling



- Route
- Ship Class
- Ship Name
- Likelihood
- ....

Unclassified Area

VTS Console



Classified Area

SAR Ship #54
- Position
- Direction
- Velocity
- Routes
- Ship Name
- .....

Fusion of information from all sources to create a more effective *Reference Maritime Picture.*

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