

20 years of oil routes

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➤ Introduction

- ☐ 20 years of Radar monitoring from ERS-1
- ☐ Importance of oil pollutions

➤ The “20 years of oil routes” project

- ☐ Phases of the project
- ☐ Preprocessing of scenes
- ☐ Connex components determination
- ☐ Connex components feature measurements
- ☐ Classification
- ☐ Thematic maps production

➤ Conclusions



20 years of Radar monitoring from ERS-1

ERS-1

17 July 1991

March 2000



ERS-2

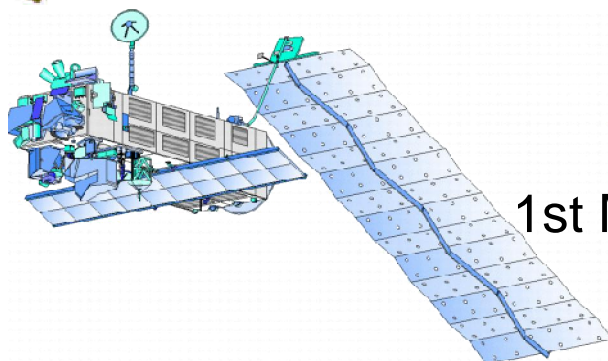
21 April 1995

July 2011



Envisat

1st March 2002



Sentinel-1

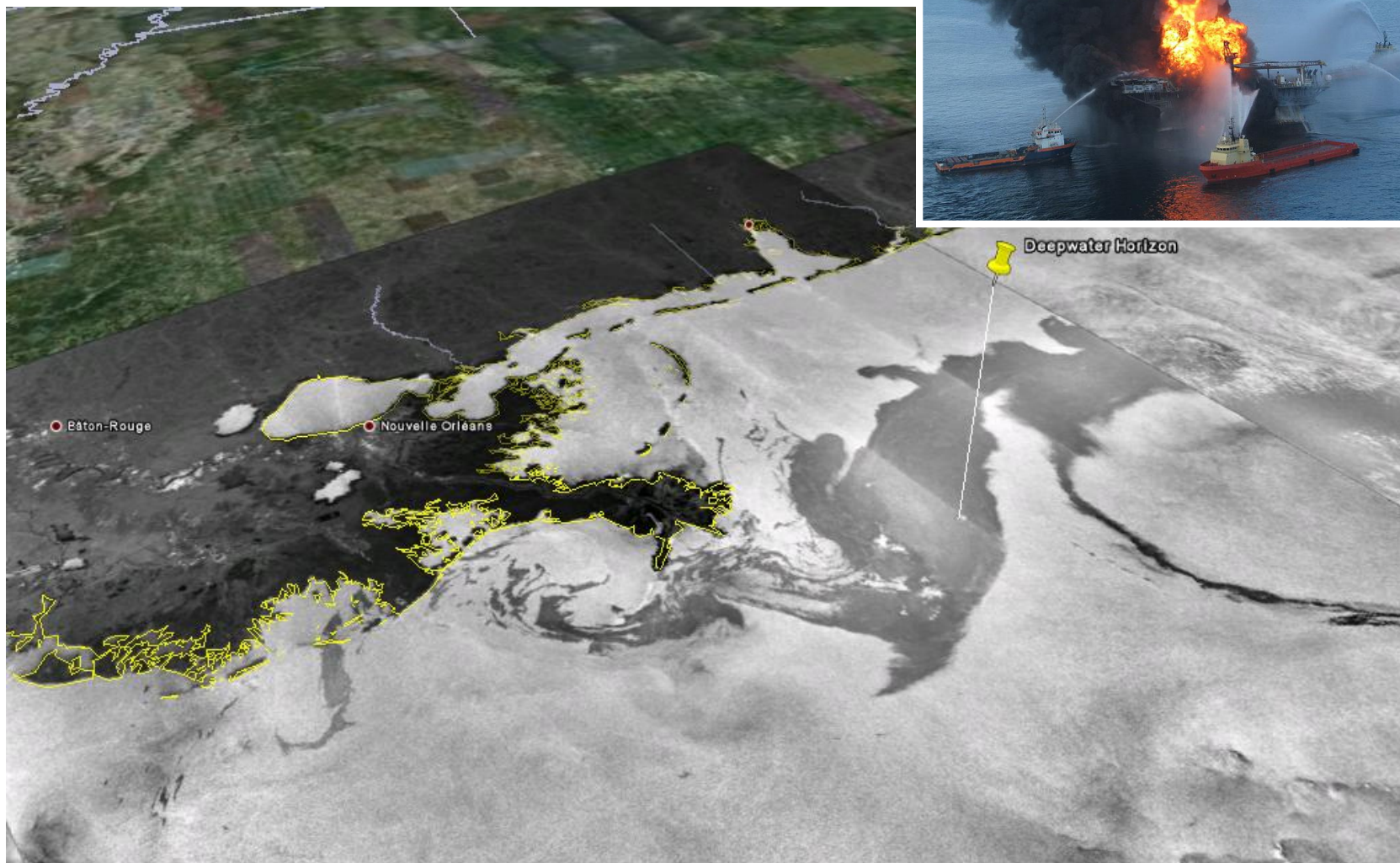
end 2012 ?





Importance of oil pollutions

➤ Mexico Gulf - 20th April 2010





Importance of oil pollutions

➤ Nigeria UNEP report - August 2011

□ <http://www.unep.org/dnc/CountryOperations/Nigeria/EnvironmentalAssessmentofOgonilandreport/tabid/54419/Default.aspx>

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United Nations Environment Programme
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Nigeria

Environmental Assessment of Ogoniland report

UNEP mission in Nigeria

About Ogoniland

Field updates

Green frontiers

Multimedia

Transition Phase

More information

News

Links

ogoniland@unep.org

Photo Gallery

Environmental Assessment of Ogoniland report

[Nigeria → Environmental Assessment of Ogoniland report]

At the request of the Federal Republic of Nigeria, UNEP has conducted an independent assessment of the environment and public health impacts of oil contamination in Ogoniland, in the Niger Delta, and options for remediation.

Ogoni community input was vital and over 23,000 attended project meetings

Media Resources

Press release (En)

Press release (Fr)

UNEP Statement, State House, Abuja

Executive Summary

Video News Release (VNR)

Download images

Site Fact Sheets

67 fact sheets providing data from detailed land and groundwater investigations

View the Fact Sheets

Interactive Google map

Download Full Report

Download Chapters and Appendices

Contents, Executive Summary and Chapter 1: Introduction

Chapter 2: Background to Environmental Degradation in Ogoniland

Contacts

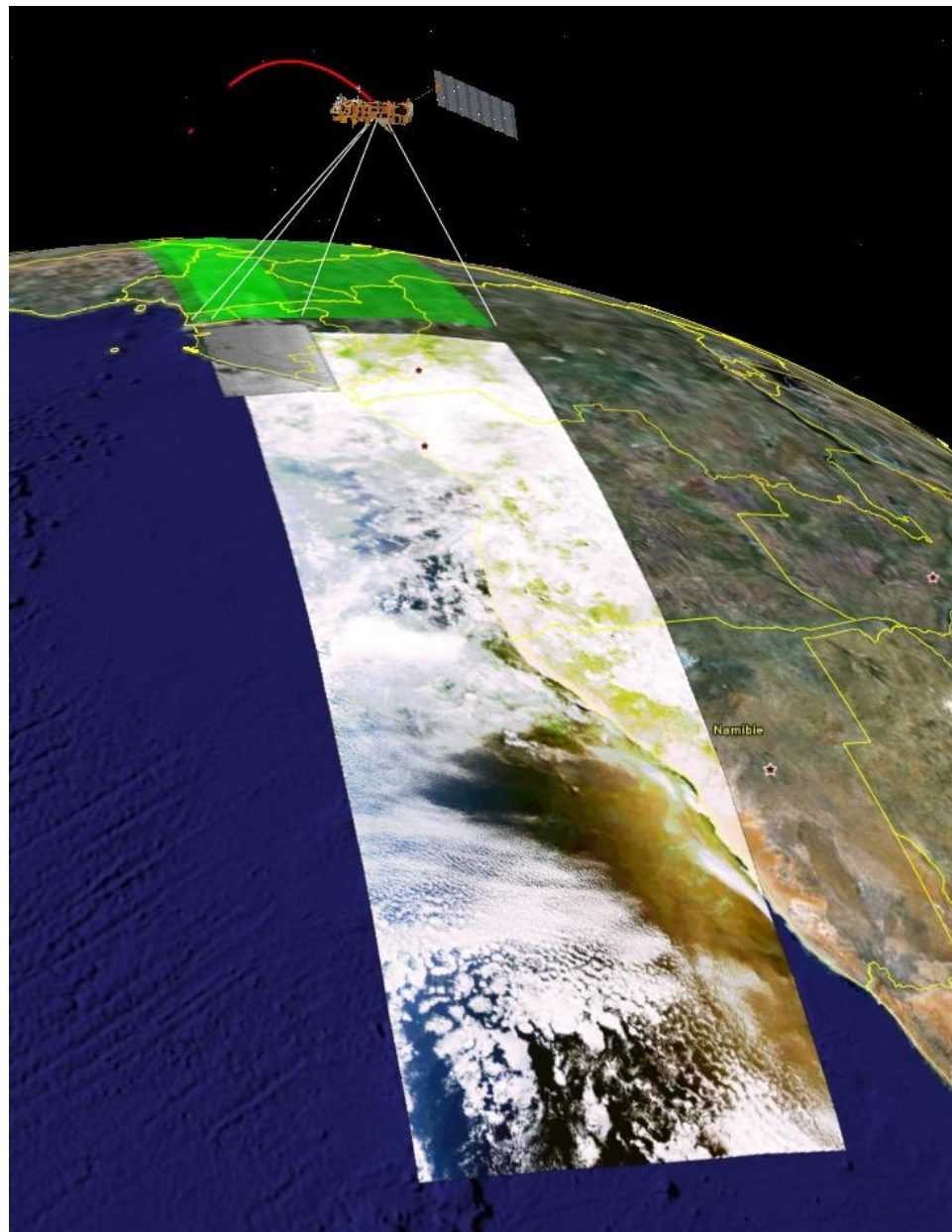
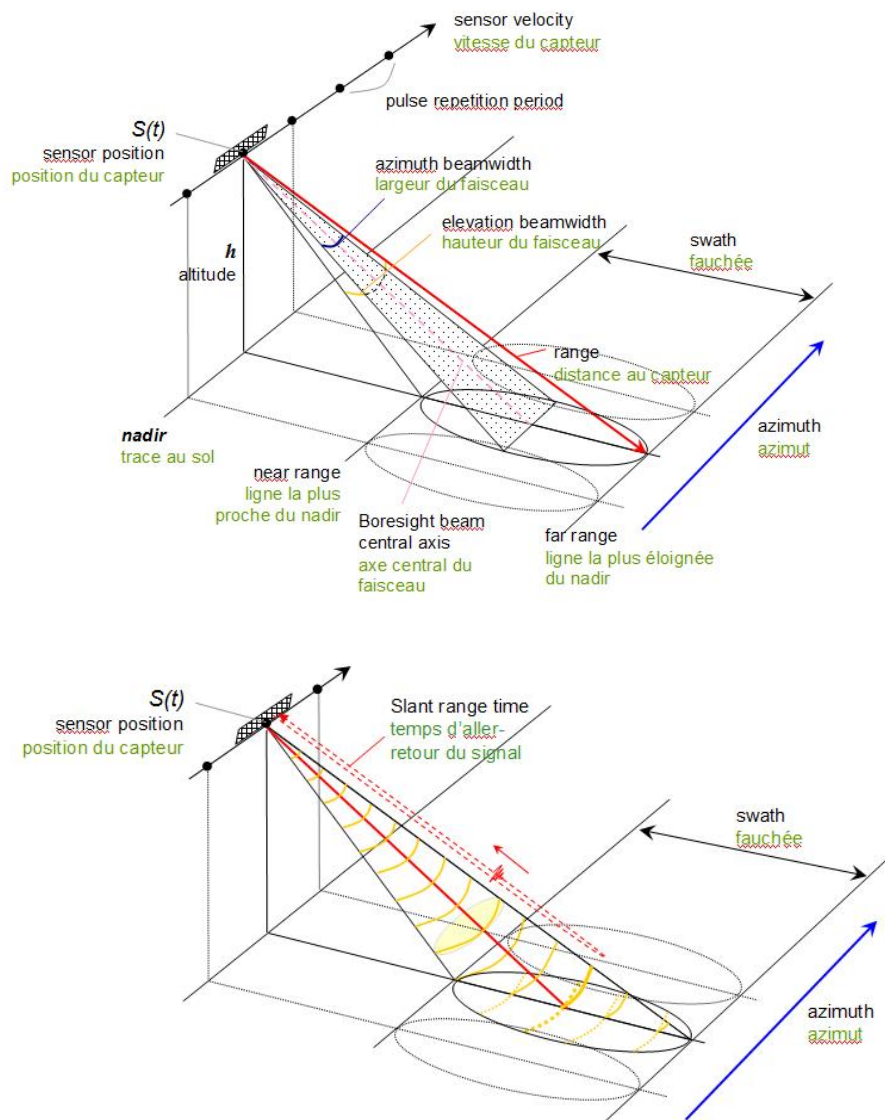
UNEP Project Team

ogoniland@unep.org



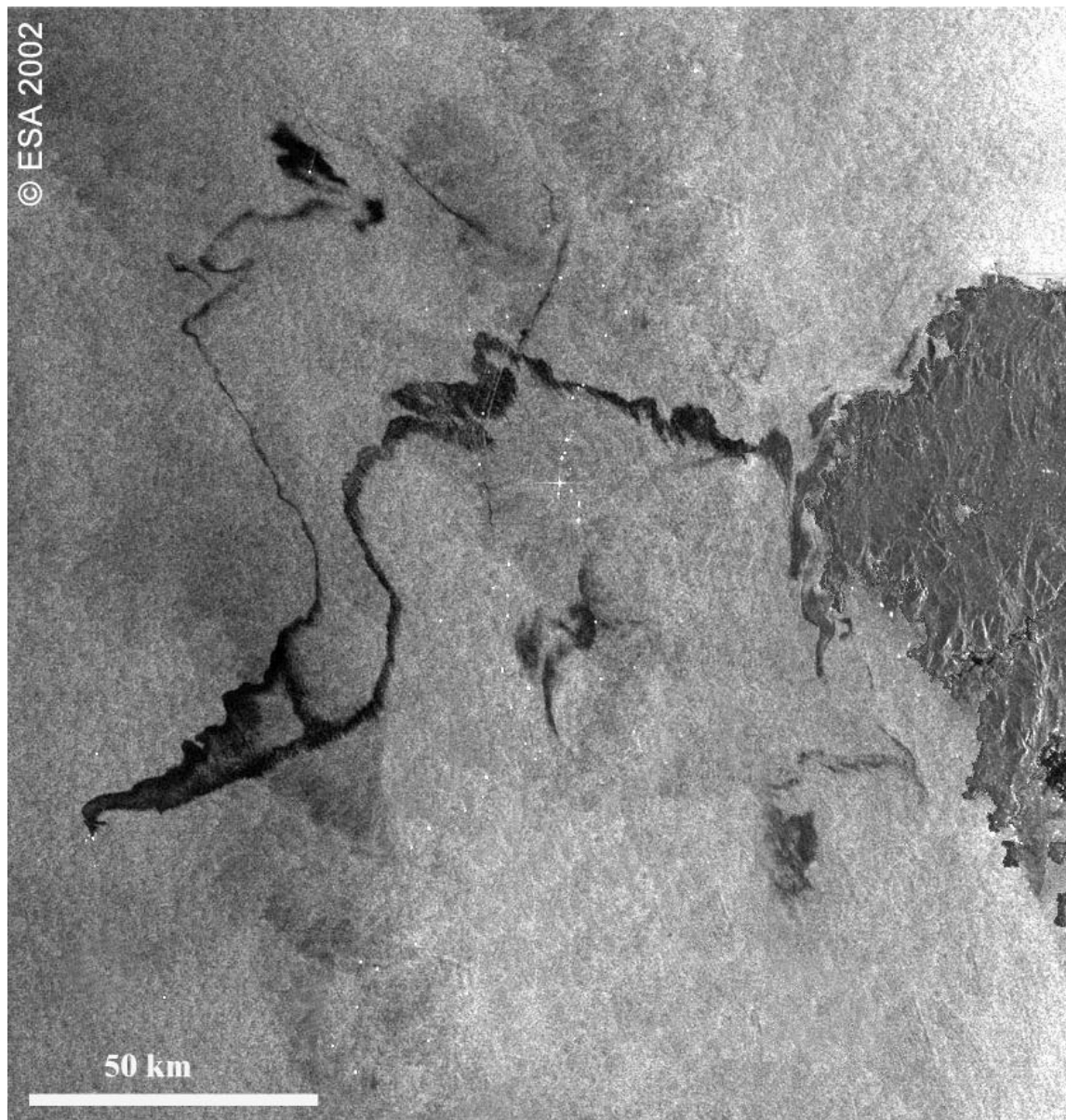
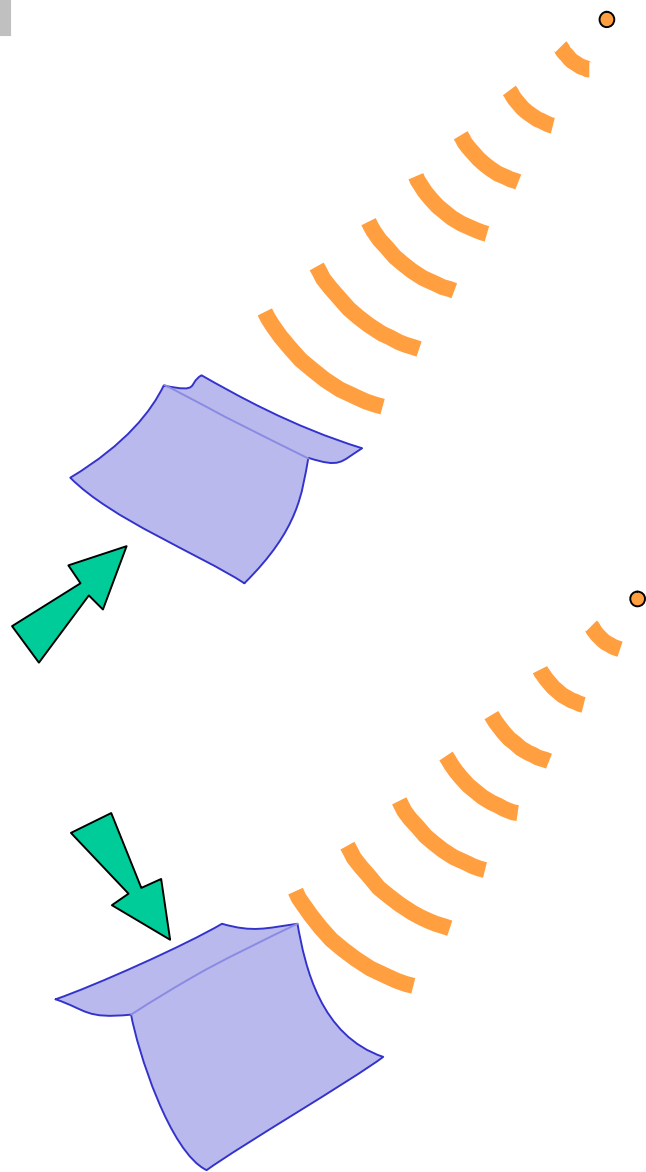


Observing the Earth with visible and radar





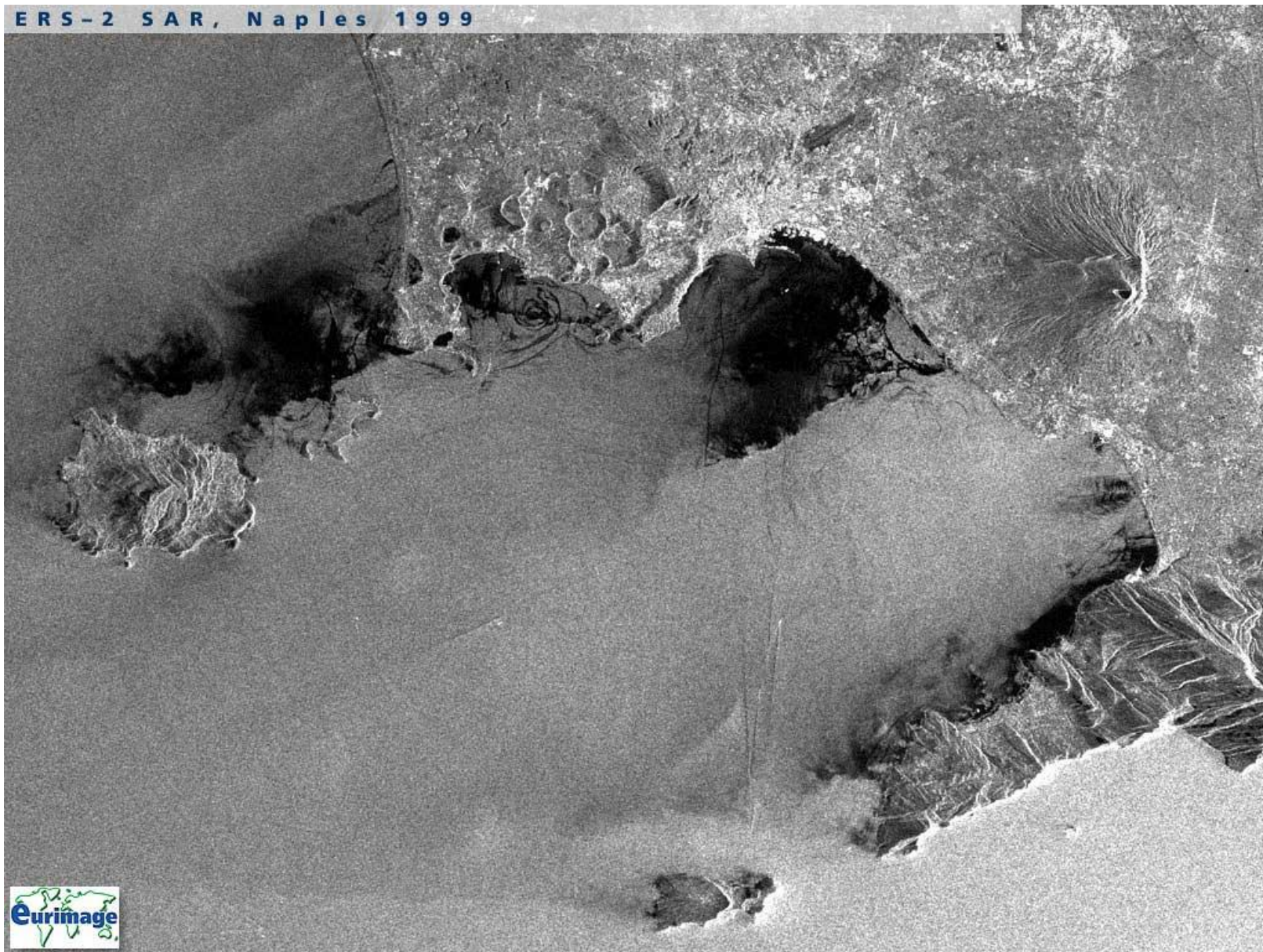
Why oil is appearing black ?

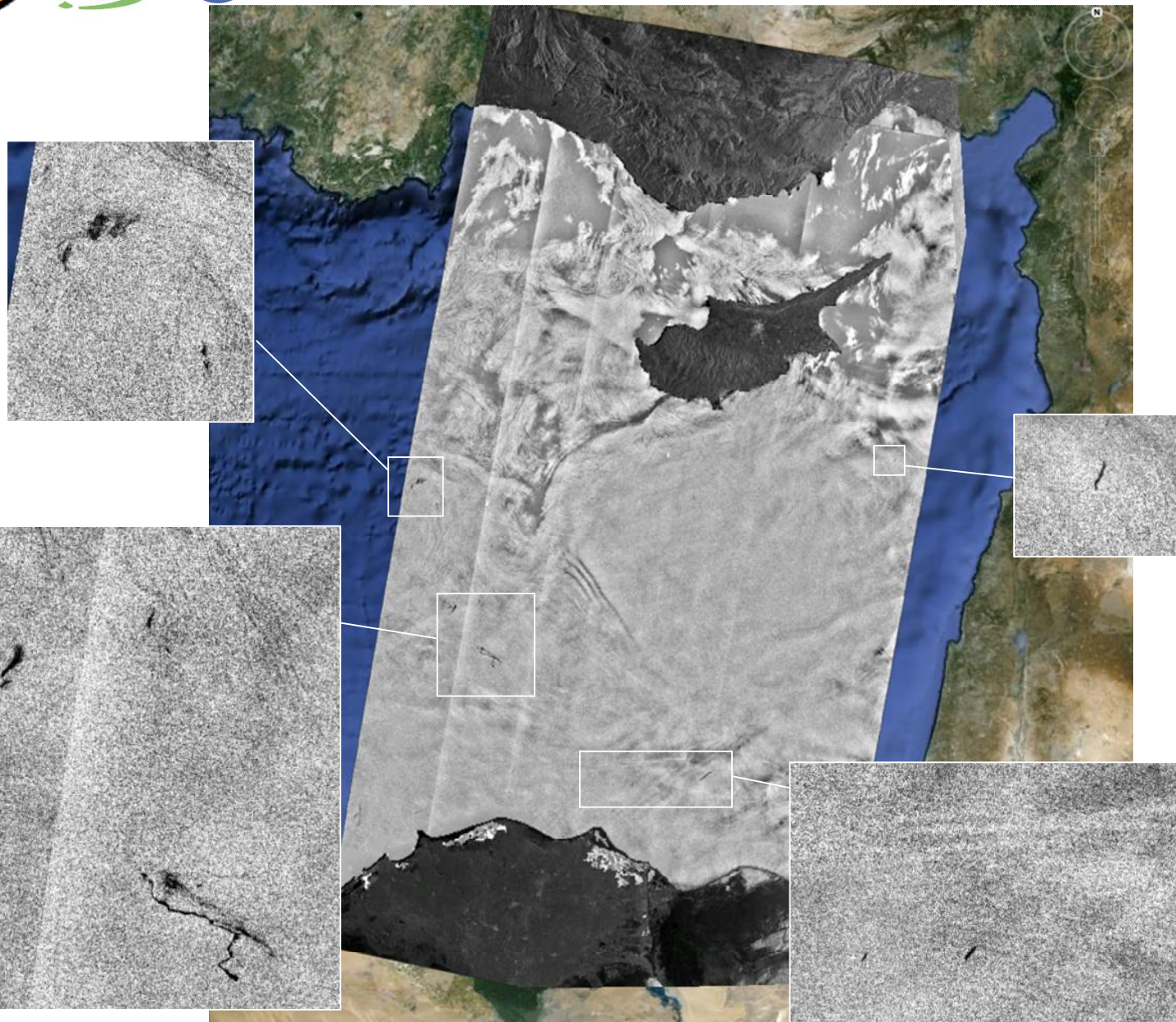


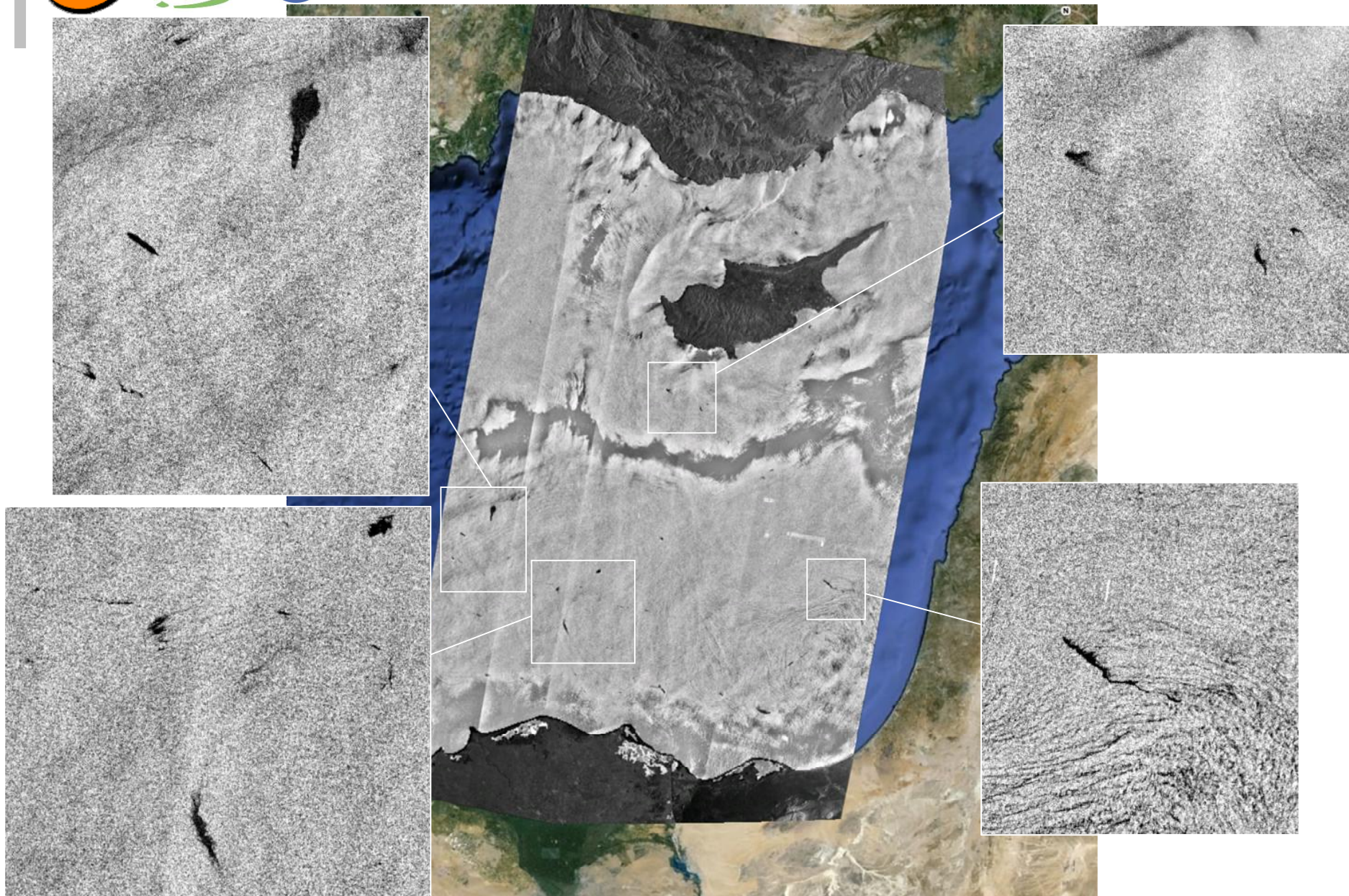


All black objects are not always oil !

ERS-2 SAR, Naples 1999









➤ Algorithms development and qualification

- ☐ Huge bibliography
- ☐ Scene selection
- ☐ Human photo-interpretation
- ☐ Software development
- ☐ Qualification

➤ Massive production

- ☐ Agreement with ESA
- ☐ Planned in 2012

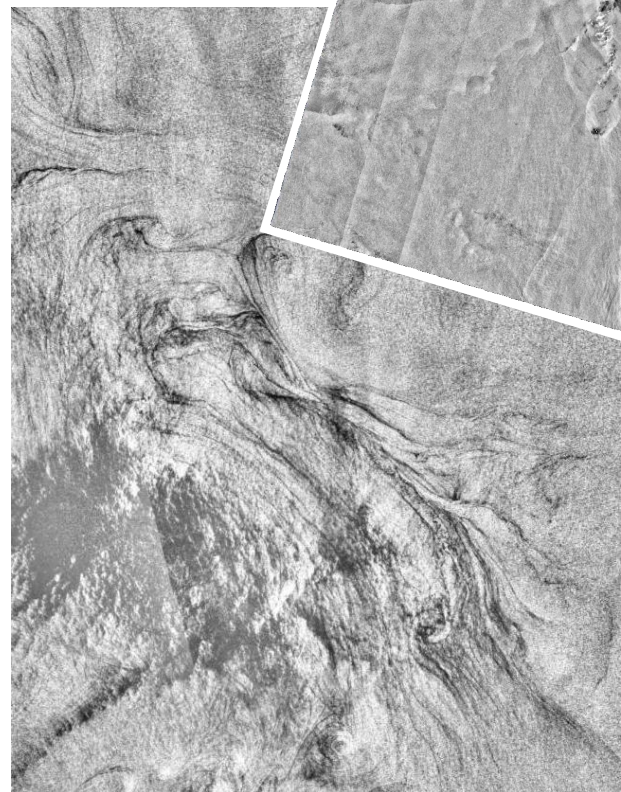
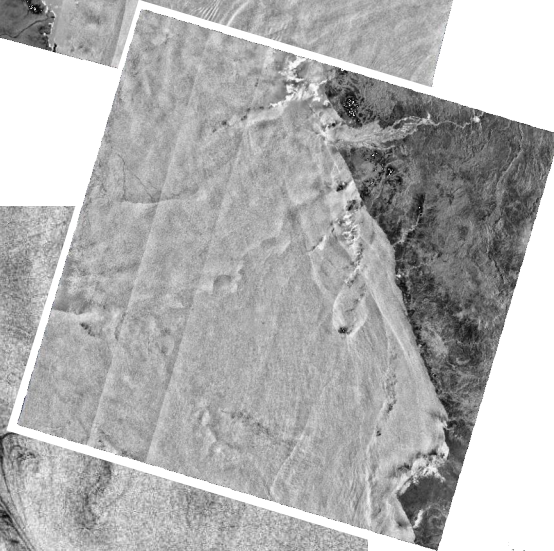
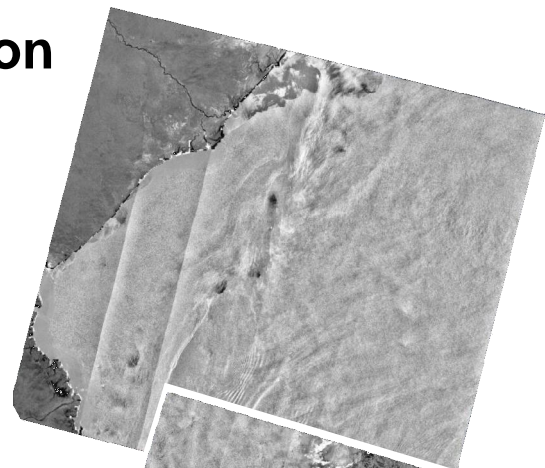
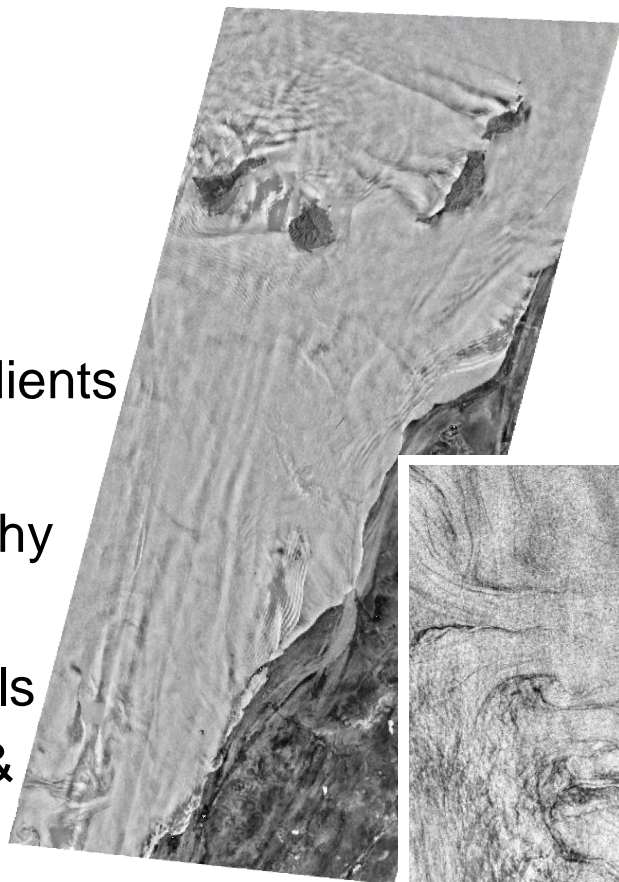
➤ Cartography

- ☐ Map production
- ☐ Press releases



➤ Many artifacts

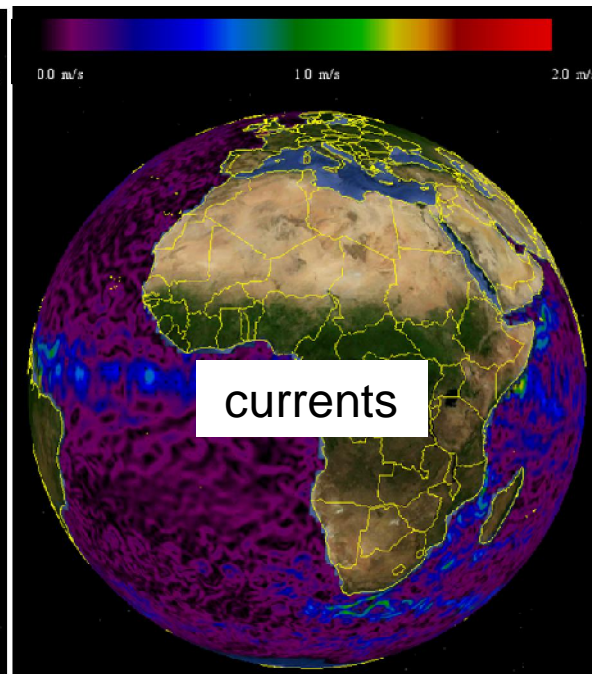
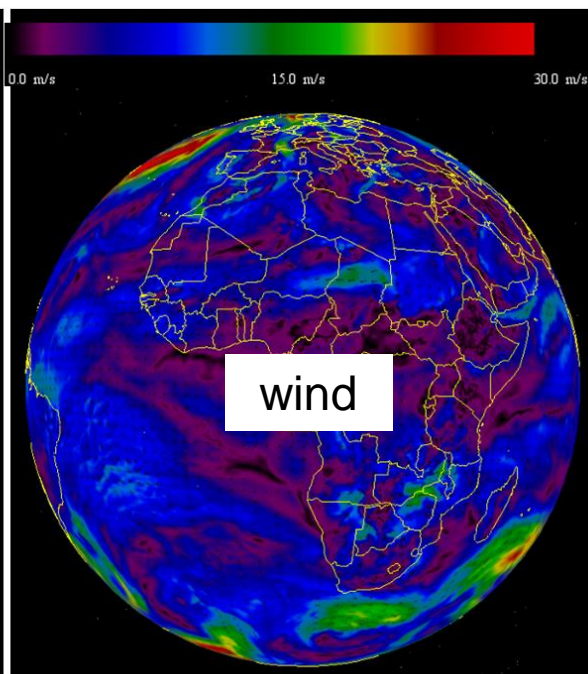
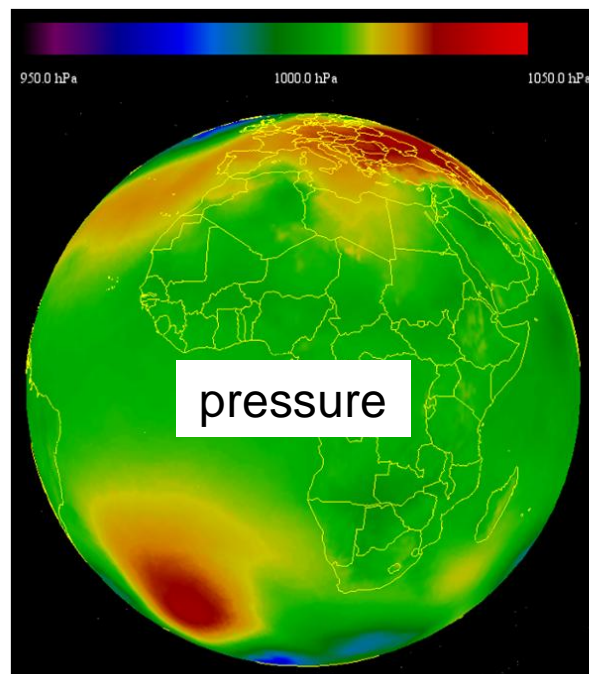
- ☐ Near shore
- ☐ Internal waves
- ☐ Ocean current & gradients
- ☐ Upwelling
- ☐ Underwater topography
- ☐ Oil & surfactants
- ☐ Biogenic & mineral oils
- ☐ Marine atmospheric & cellular convection
- ☐ Mesoscale storms
- ☐ Atmospheric vortex
- ☐ Rainfall





➤ Meteorological data and currents

- ☐ Pressure (ECMWF)
- ☐ Wind fields (ECMWF, KNMI, IFREMER)
- ☐ Ocean currents (NOAA)



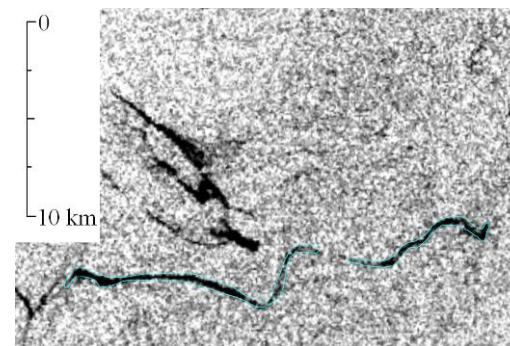
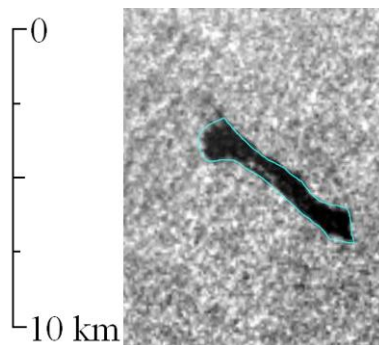
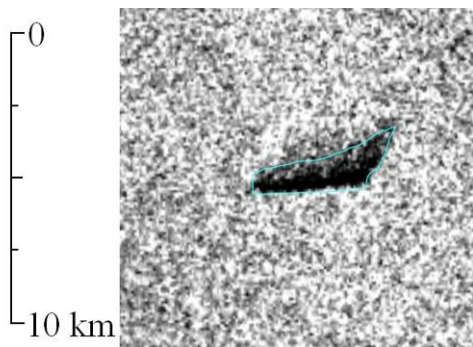
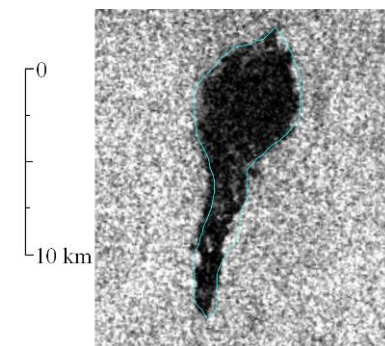
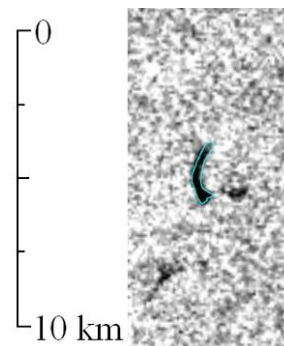
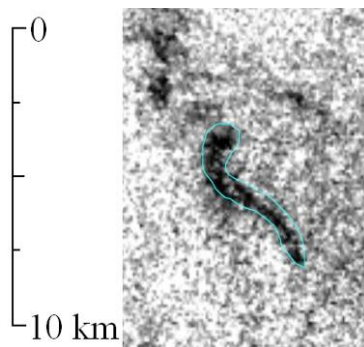
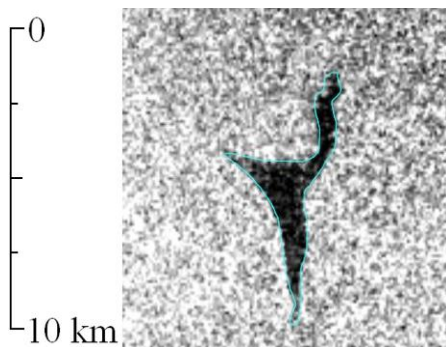
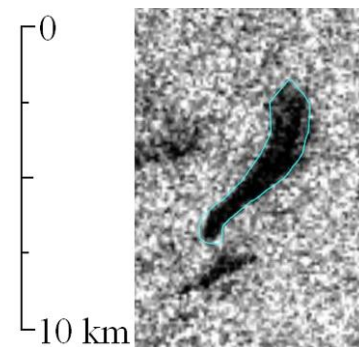
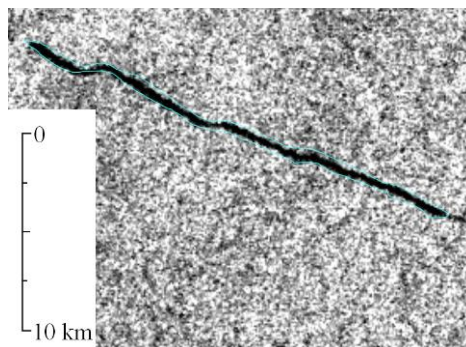
produced by VTEscape™ (VisioTerra)





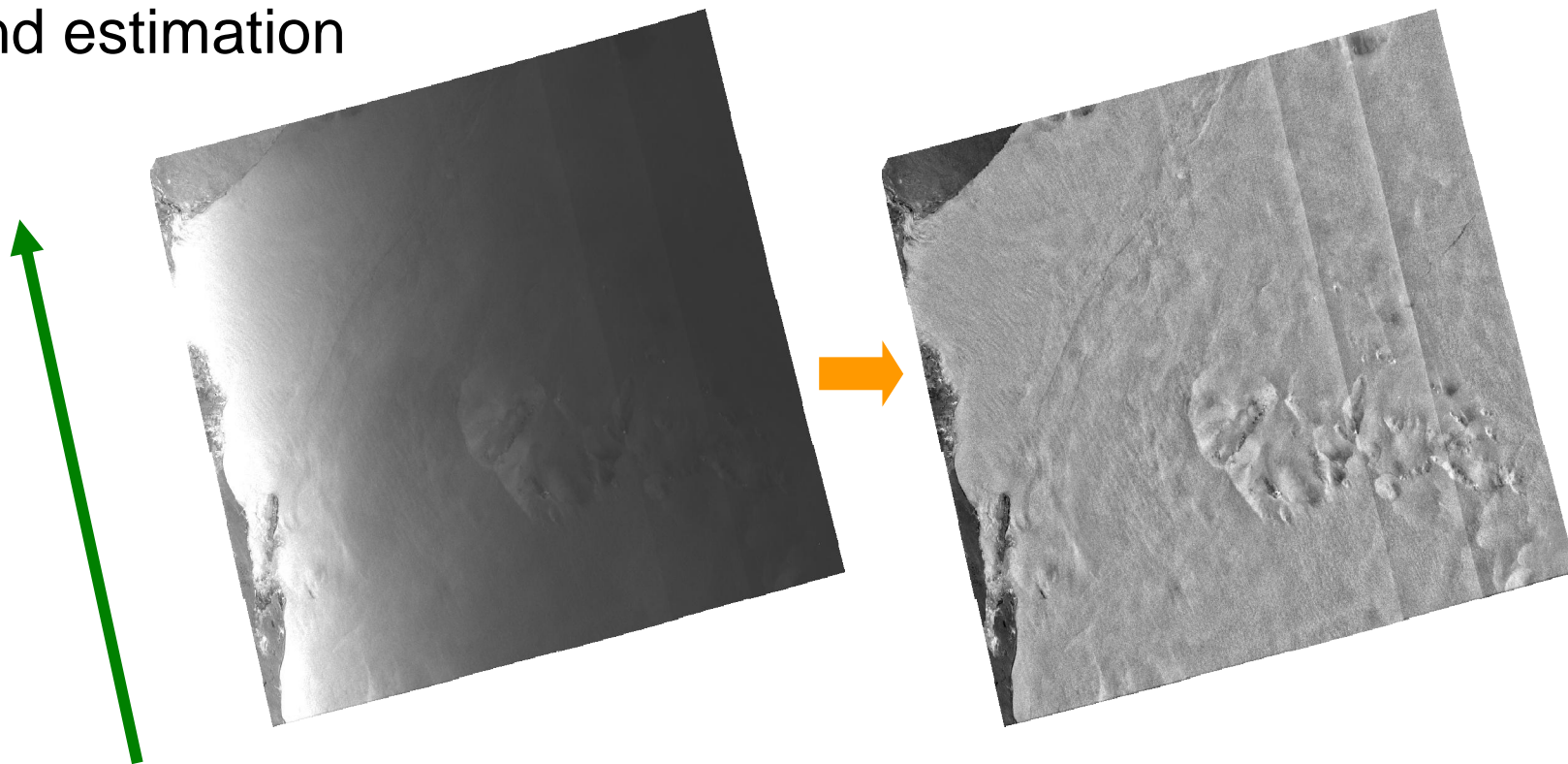
➤ Three classes

- ❑ oil spill from ships
- ❑ oil spills from platforms
- ❑ oil seepages (seeps)





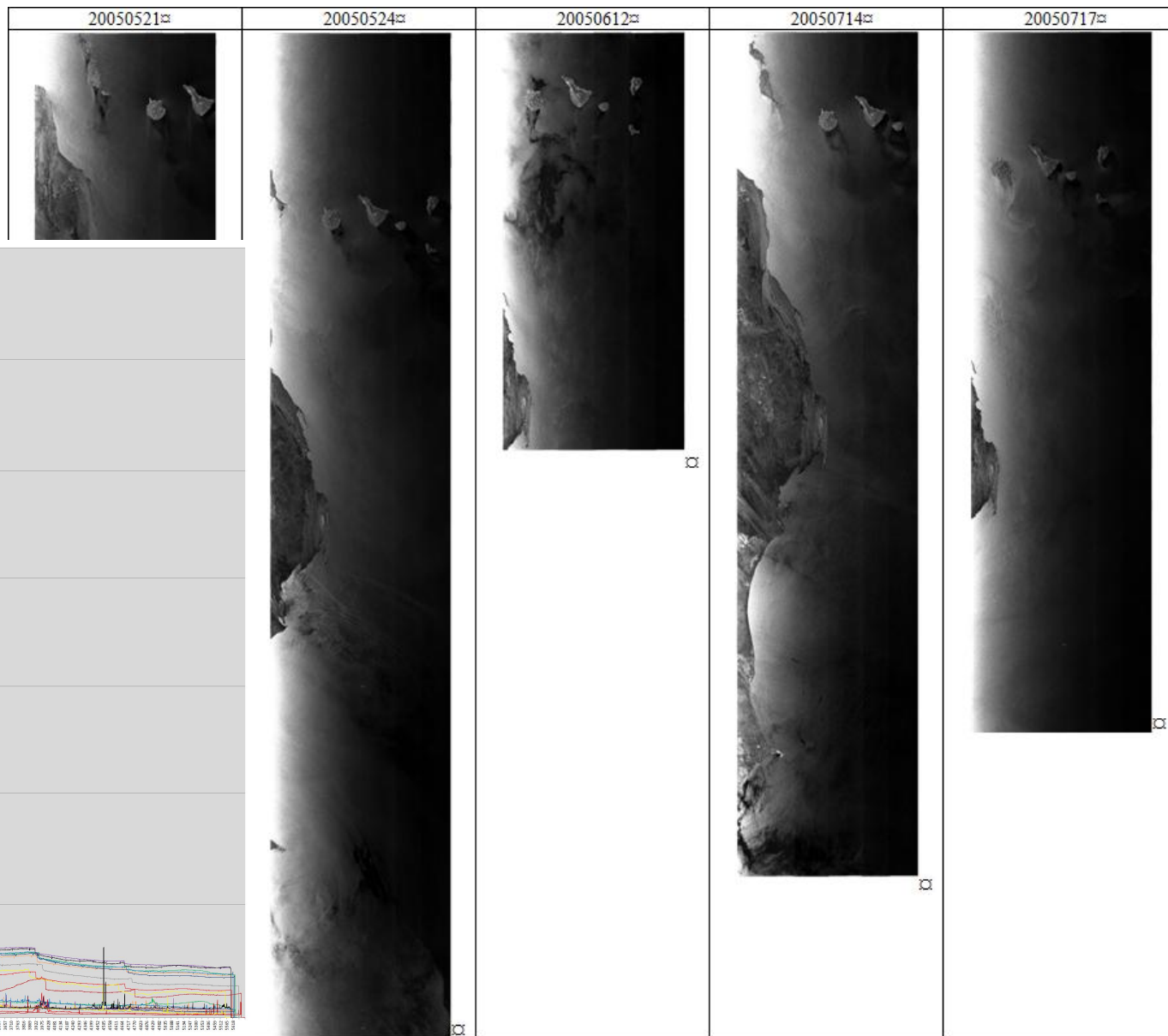
- Local stretching using local statistics
- Radar cross sections modeling
- RMS equalization
- Wind estimation





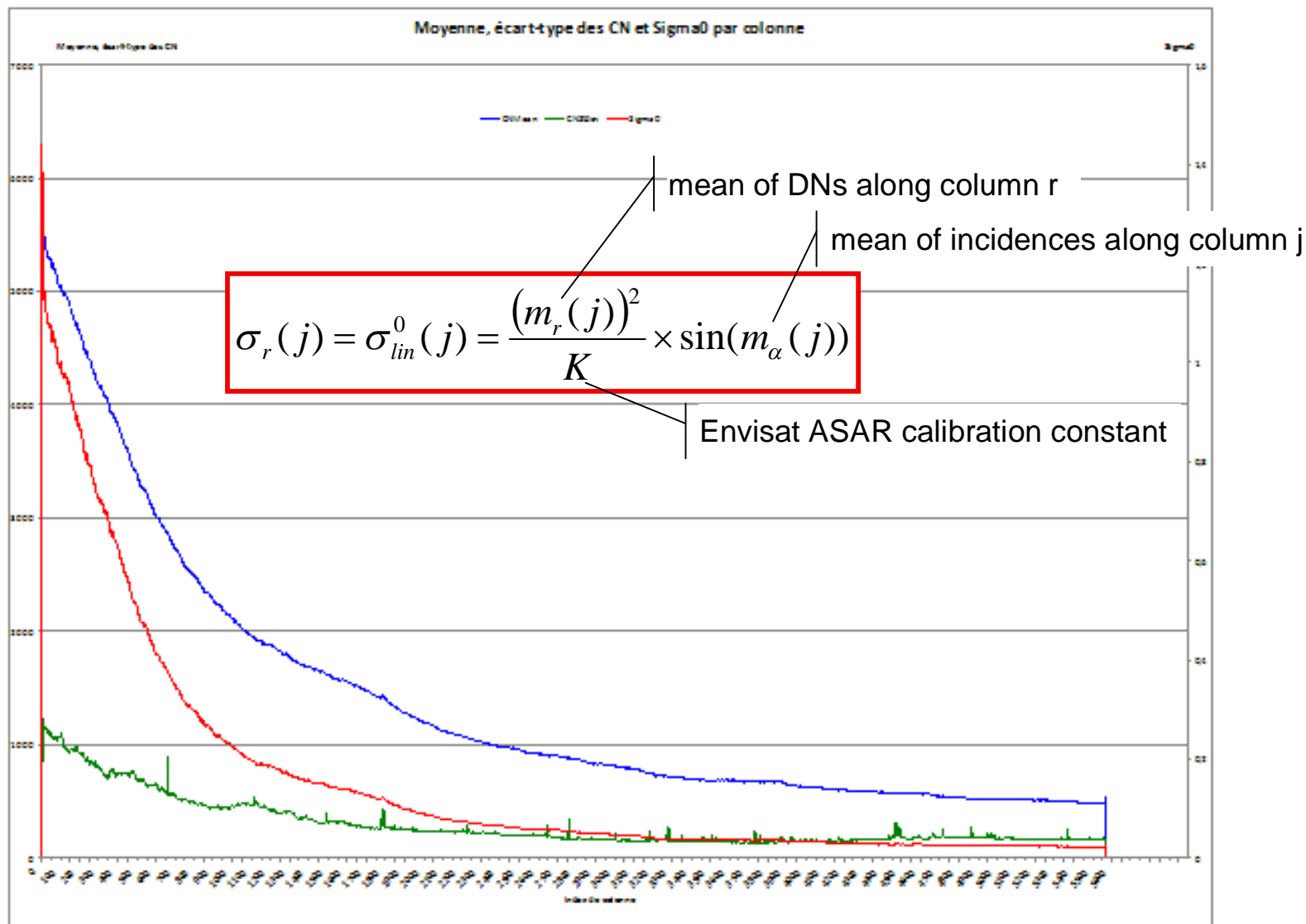
NRCS (Normalized Radar Cross Section) modeling

➤ Column statistics





From DN to σ_0





The CMOD models (used for scatterrometers)

CMOD4

$$\sigma_{CMOD4}^0(V, \phi, \theta) = b_0 (1 + b_1 \cos \phi + b_3 \tanh b_2 \cos 2\phi)^{1.6}$$

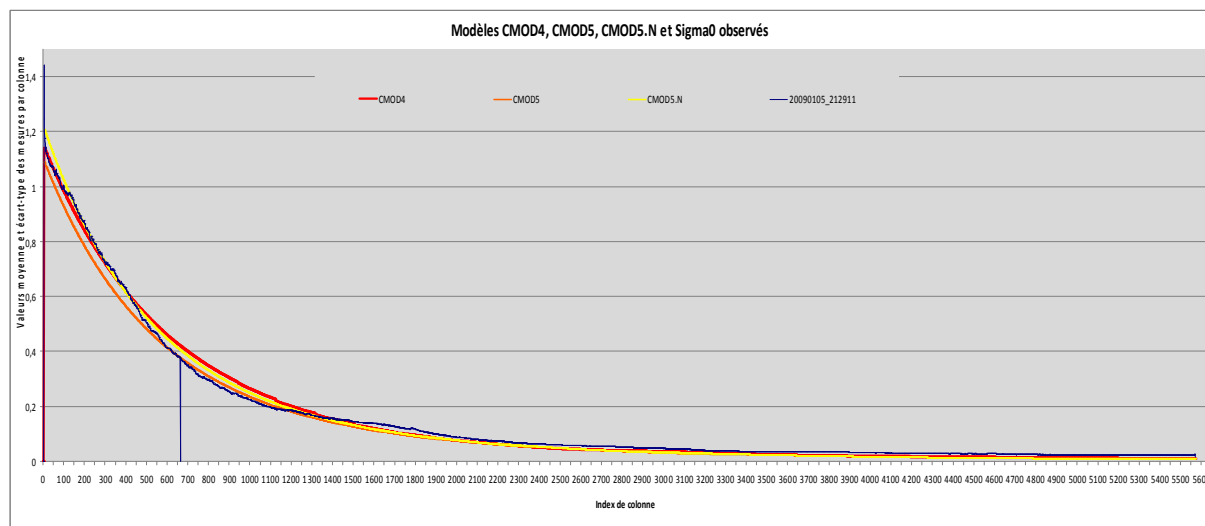
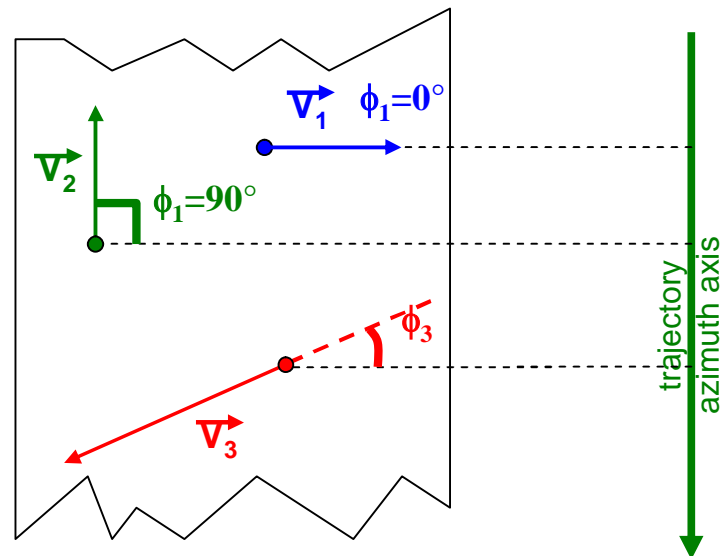
incidence of radar pulse over target

angle between wind and radar pulse

wind modulus

CMOD5 and CMOD5.N

$$\sigma_{CMOD5}^0(V, \phi, \theta) = b_0 (1 + b_1 \cos \phi + b_2 \cos 2\phi)^{1.6}$$





Modeling the NRCS

$$\sigma_r(j) \approx A \times \sigma_M(V, \phi, m_\theta(j))$$

σ_0 of the model (CMOD4 or CMOD5 or CMOD5.N)

gain estimated by linear regression

σ_0 observed

$$E(S_k, M, A, V, \phi) = \sqrt{\frac{1}{\sum_{j=0}^{N-1} \delta(j)} \times \sum_{j=0}^{N-1} \delta(j) \times [\sigma_r(j) - A \times \sigma_M(V, \phi, m_\theta(j))]^2}$$

$$\Rightarrow A = \frac{\sum_{j=0}^{N-1} \delta(j) \times \sigma_r(j) \times \sigma_M(V, \phi, m_\theta(j))}{\sum_{j=0}^{N-1} \delta(j) \times \sigma_M(V, \phi, m_\theta(j))^2}$$

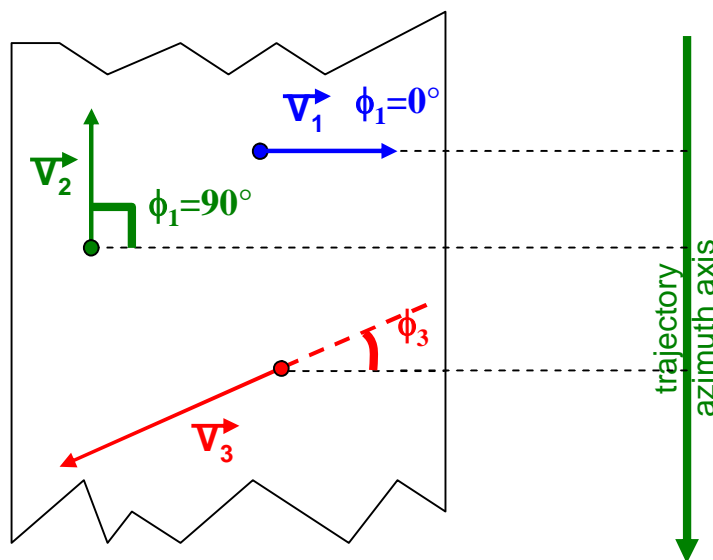


Retrieving A assuming a mean value V , ϕ

Solution with mean wind – proposed by Bertrand CHAPRON (IFREMER)

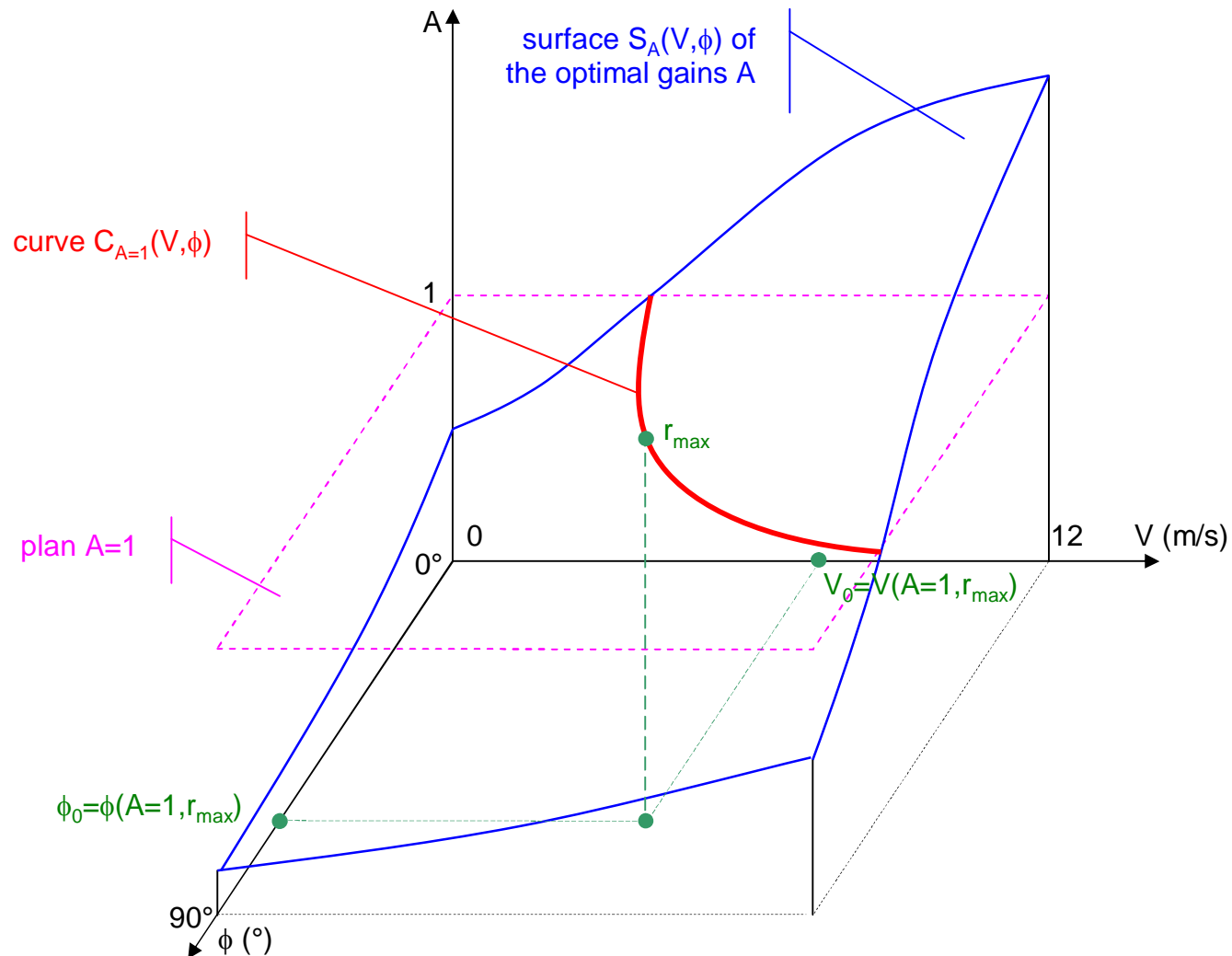
$$\begin{aligned} V &= 7 \text{ m/s} \\ \phi &= 45^\circ \end{aligned}$$

\Rightarrow We retrieve $V \times \cos(\phi)$



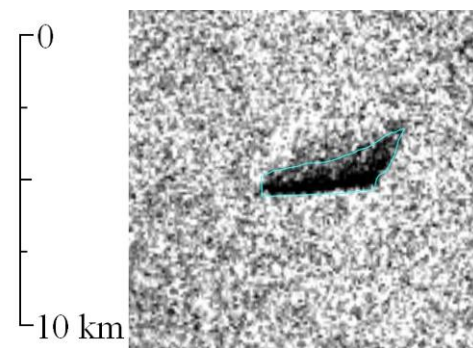
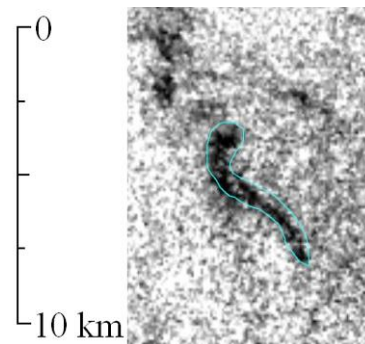
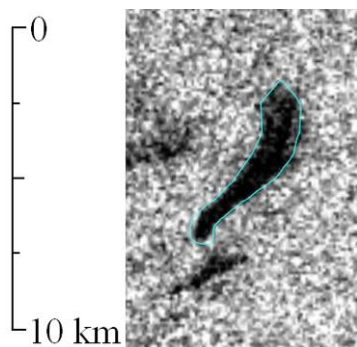
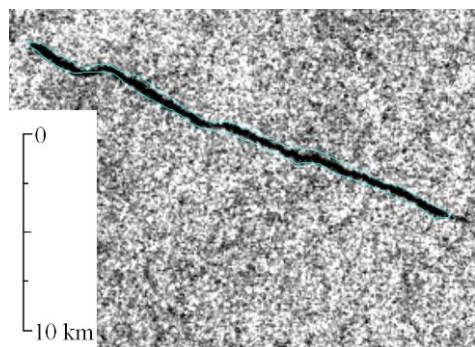


Exhaustive solution – proposed by VisioTerra





- Connex components determination
 - ☐ Hysteresis thresholding
 - ☐ Components aggregation
- Connex components measurements
 - ☐ Geometry features - area, compacity, linearity, holes frequency...
 - ☐ Radiometry features - mean, standard deviation, relative contrast...
 - ☐ Spatial frequency - Occurrence image

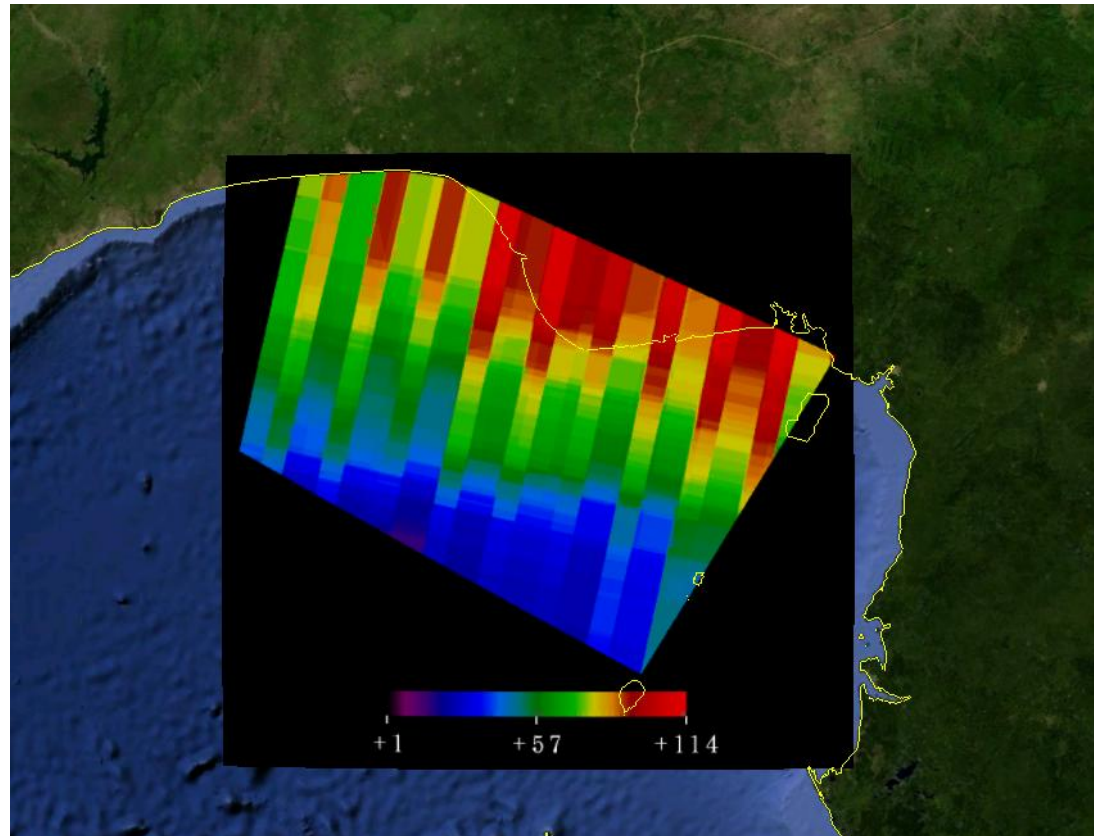




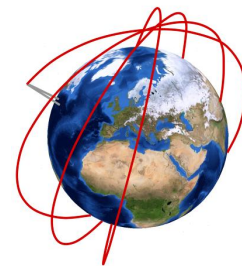
➤ Classification

- ❑ Three classes: -oil spill from boats, -oil spills from platforms
- ❑ Training sets and confusion matrix
- ❑ Cartographic production

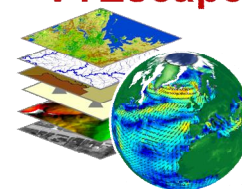
➤ Occurrences and frequencies



- Collaboration VisioTerra - University - ESA
- Development of new algorithms and softwares
 - ❑ wind direction and modulus
 - ❑ morphological (object oriented) classification
 - ❑ Occurrence and frequencies
- Dedicated to the environment
- Production of maps
 - ❑ oil routes (yearly since 1991)
 - ❑ oil spill pollutions from platforms (archive and real-time monitoring)
 - ❑ oil seeps frequencies (seeps DB)



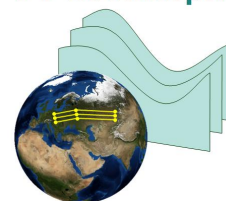
VTEscape



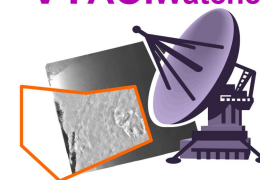
VT Tile Grabber



VT Geomorpho



VT AOI Watcher



Thank you