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→ SEASAR 2012
The 4th International Workshop on Advances in SAR Oceanography

Oil spill detection and modelling: preliminary results for the Cercal Accident

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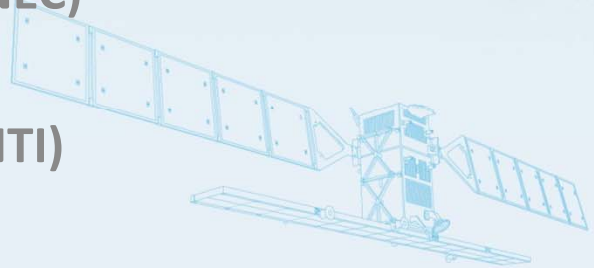

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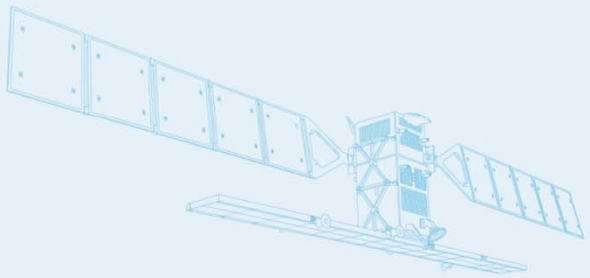
MOTIVATION

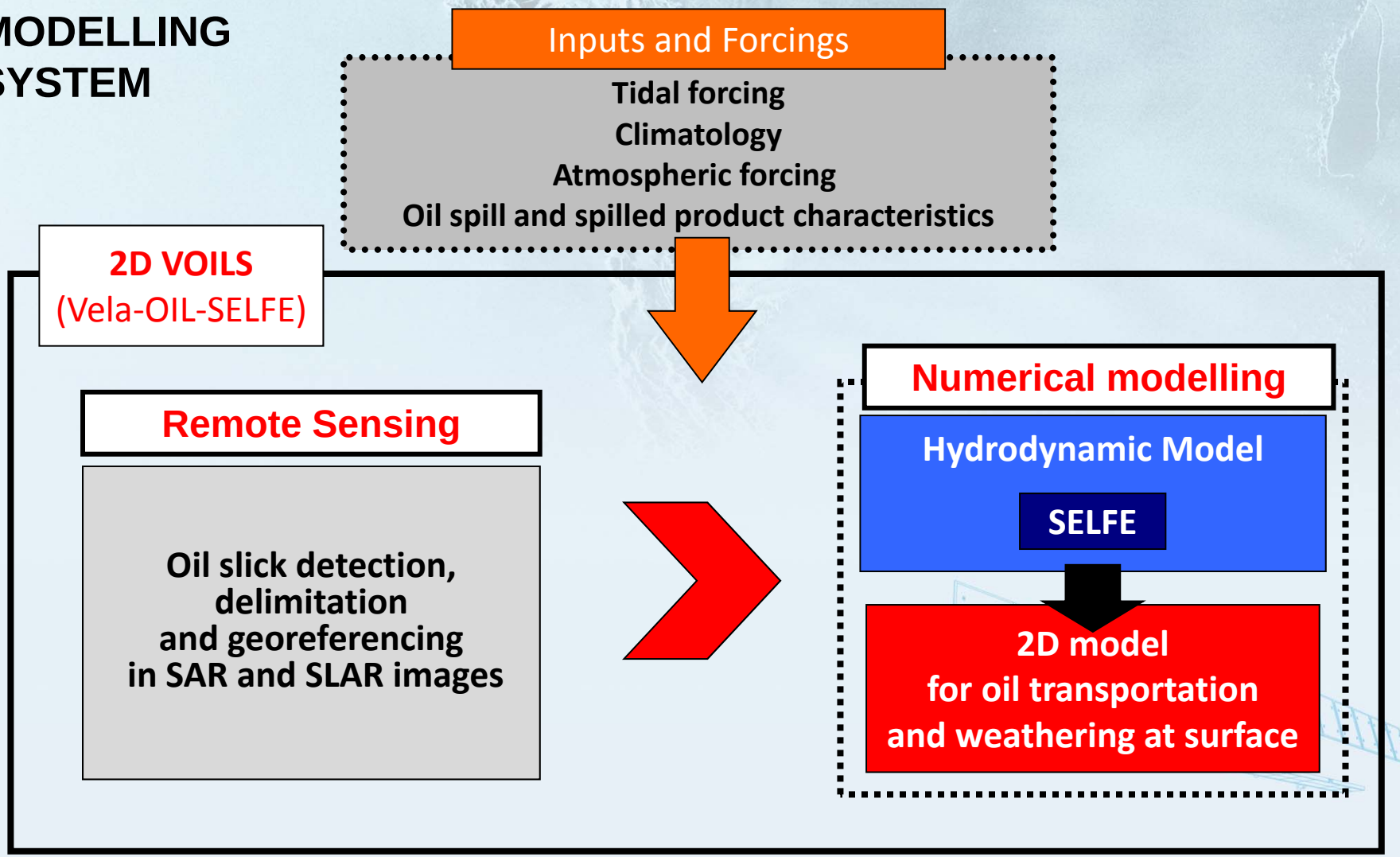
1. Oil spills have high environmental and social-economical impacts;
2. Need for preparedness and capacity building in case of an oil spill;
3. Demand for tools with high level of detail, high performance and results in a useful time period to enhance prevention and mitigation efforts on the ocean, coastal areas and estuaries;
4. Demand for knowledge to conduct better adaptation and to adopt fairer compensations measures
5. Opportunity to advance the knowledge in oceanographic and atmospheric phenomena

OBJECTIVES

1. Development of a multiscale coupled (hydrodynamics + oil transport and weathering) modelling system;
2. Oil slick detection and delimitation based on SAR and SLAR images;
3. Oil spill risk analysis for the Portuguese coast.

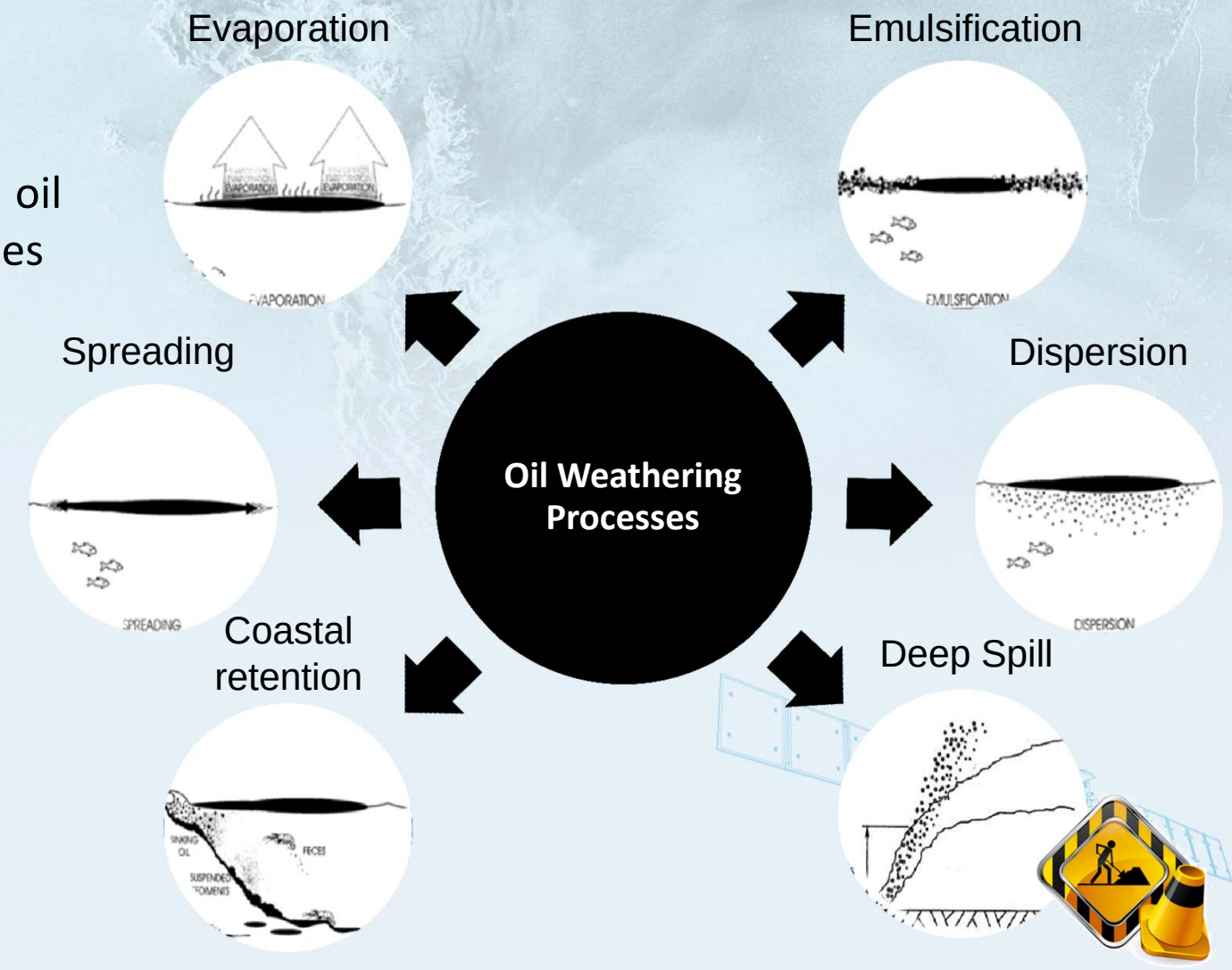


MODELLING SYSTEM



MODELLING SYSTEM (cont.)

Implemented oil weathering processes

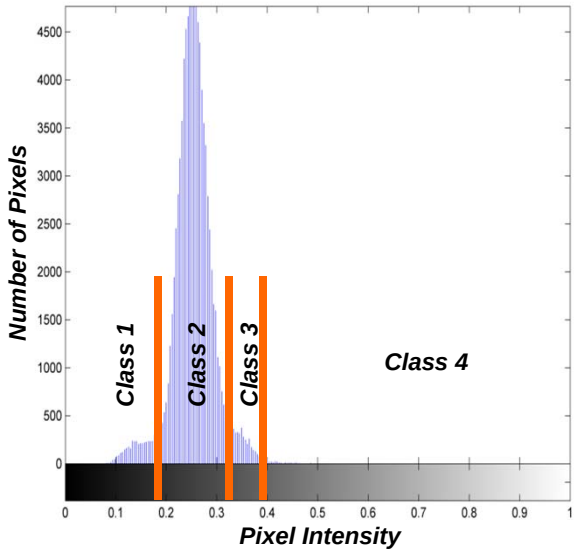


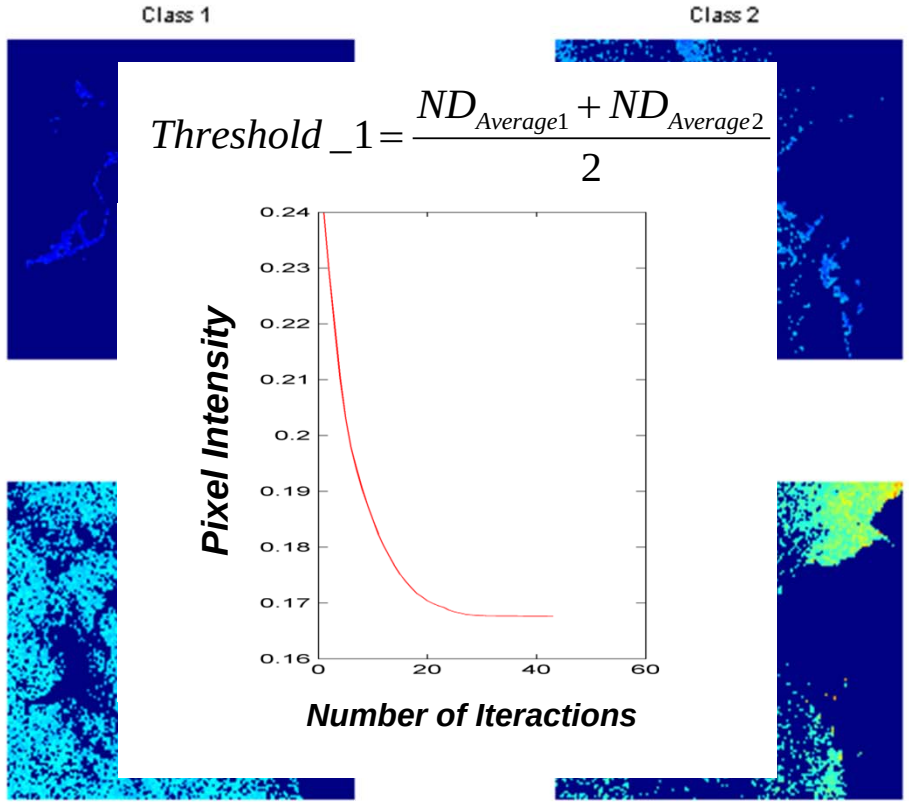
REMOTE SENSING EXAMPLE

K-means clustering algorithm for slick detection and delimitation

$$ND_{Average1} = \frac{1}{nPixels_{C1}} \sum_{i=1}^{nPixels_{C1}} ND_i$$

$$ND_{Average2} = \frac{1}{nPixels_{C2}} \sum_{i=1}^{nPixels_{C2}} ND_i$$

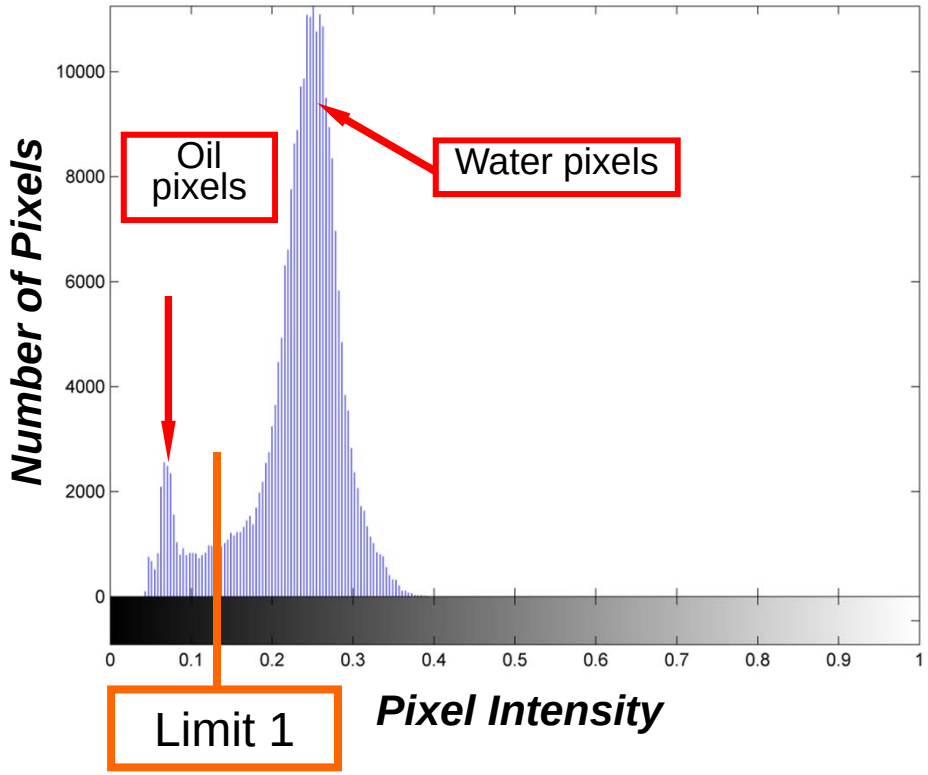


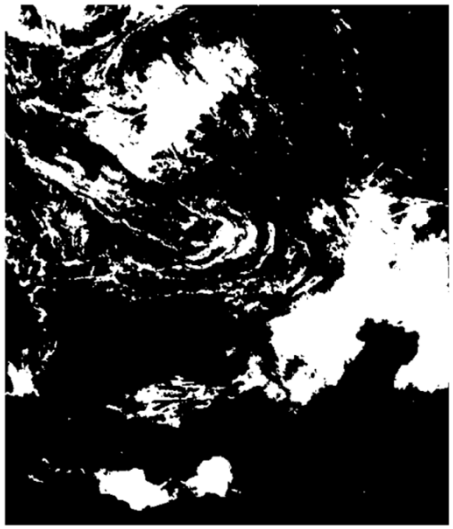


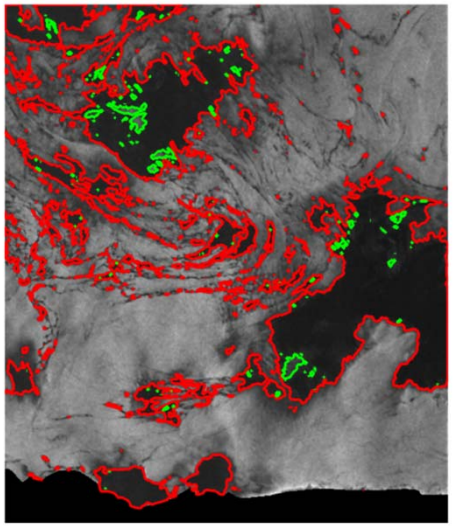
$$Threshold_1 = \frac{ND_{Average1} + ND_{Average2}}{2}$$

REMOTE SENSING EXAMPLE (cont.)

Histogram analysis, binarization and slick delimitation in SAR images

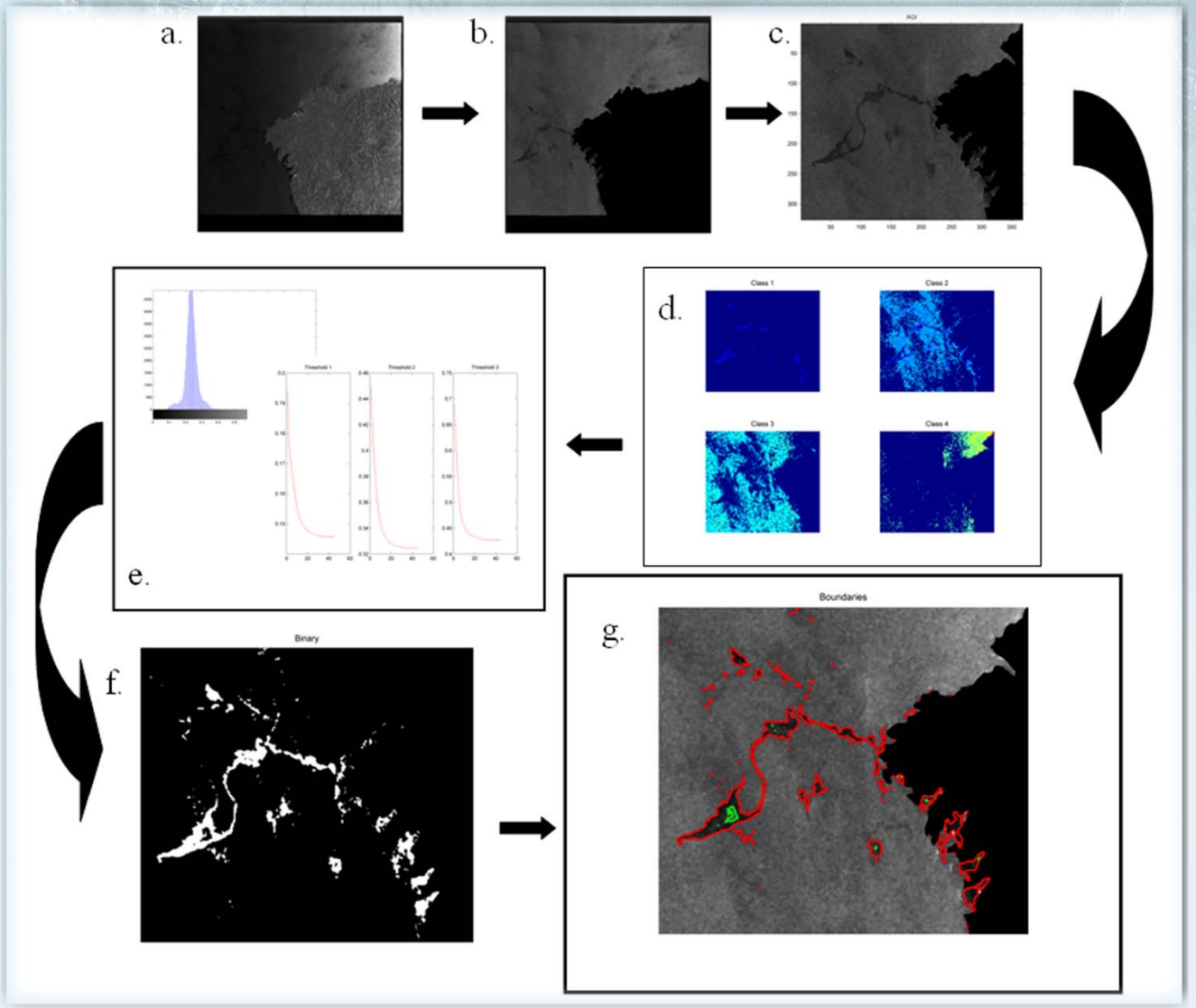






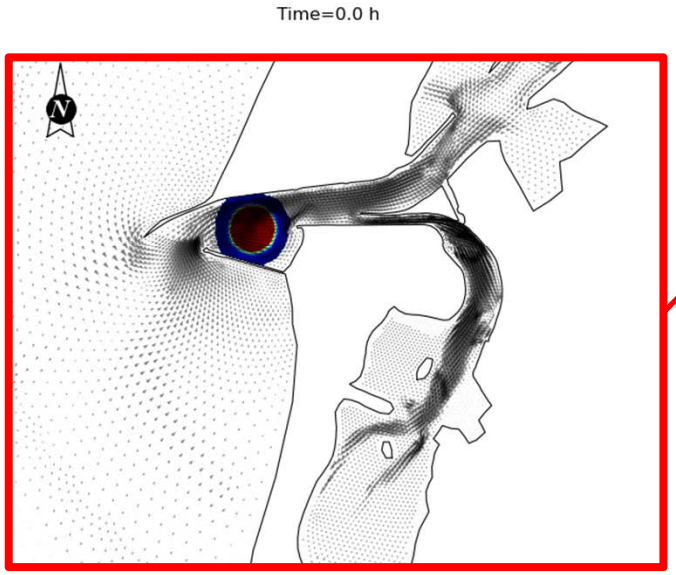
REMOTE SENSING EXAMPLE (cont.)

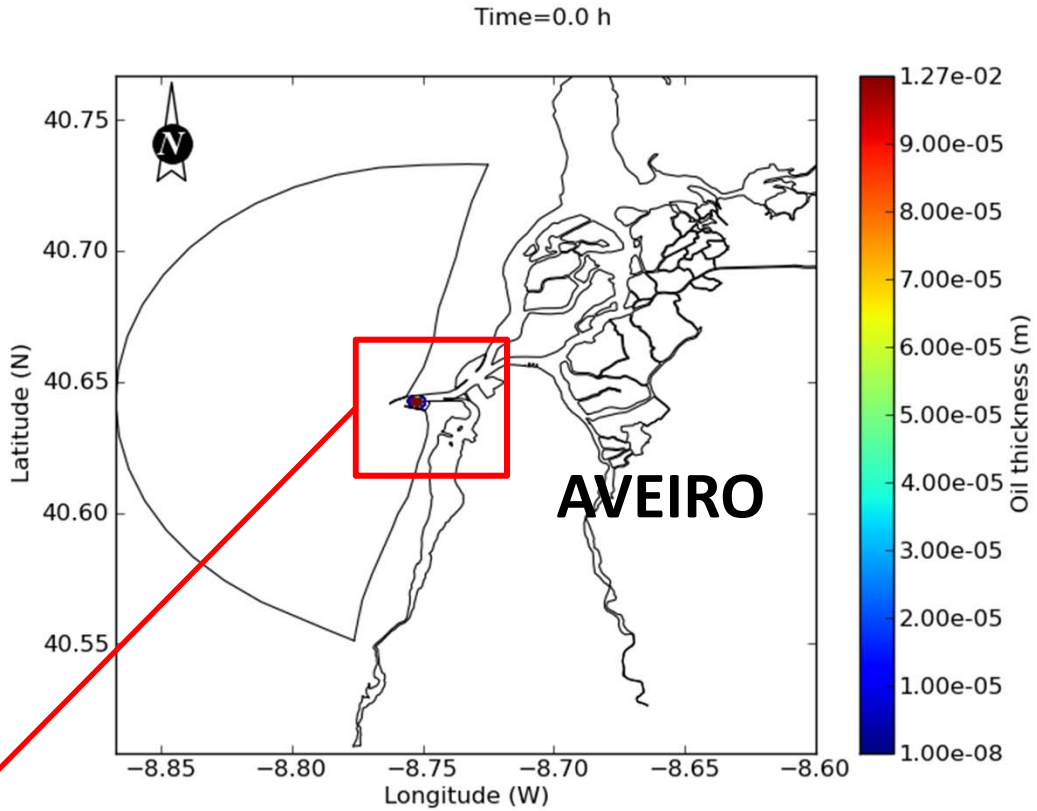
User defined number of classes



NUMERICAL MODELLING EXAMPLE

2D coupled (hydrodynamics + oil transport and weathering) numerical model of the Ria de Aveiro, Portugal

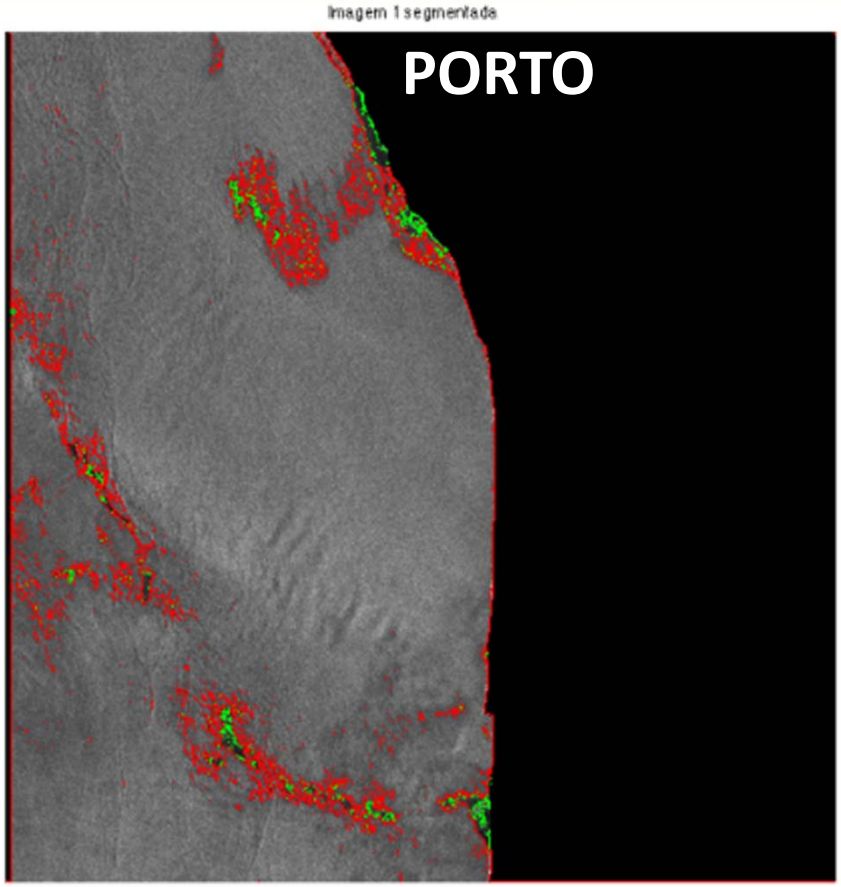




Zoom plot
Aveiro harbour

CASE STUDY CERCAL

On the 2nd of October 1994, the Motor Tanker Cercal grounded and suffered major hull damage at the entrance of Leixões harbour spilling 1258 – 2500 t (82 000 t carried) of Arabian Light crude oil, 20 000 t were recovered. After the grounding, the damaged ship carried on its journey and polluted 45 km of coastline, particularly Lavadores beach



3, 4 or 5 classes?

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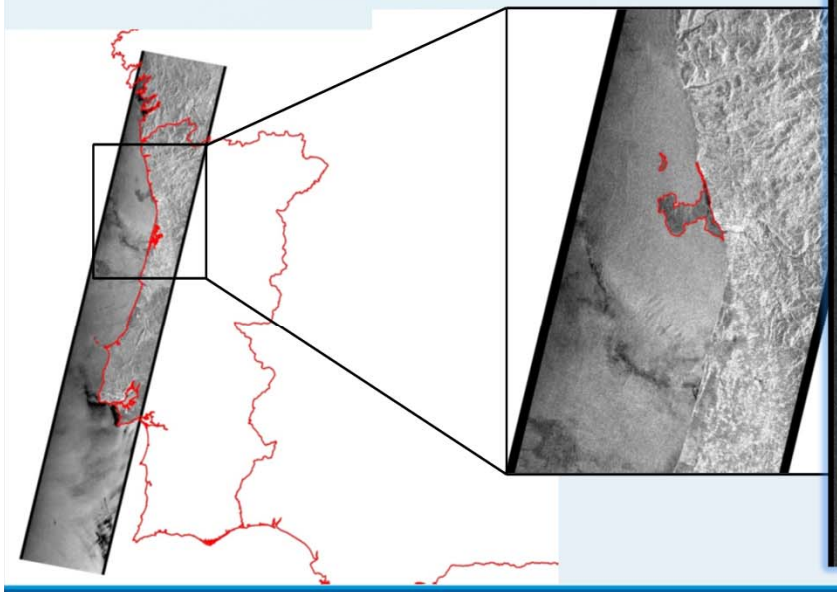
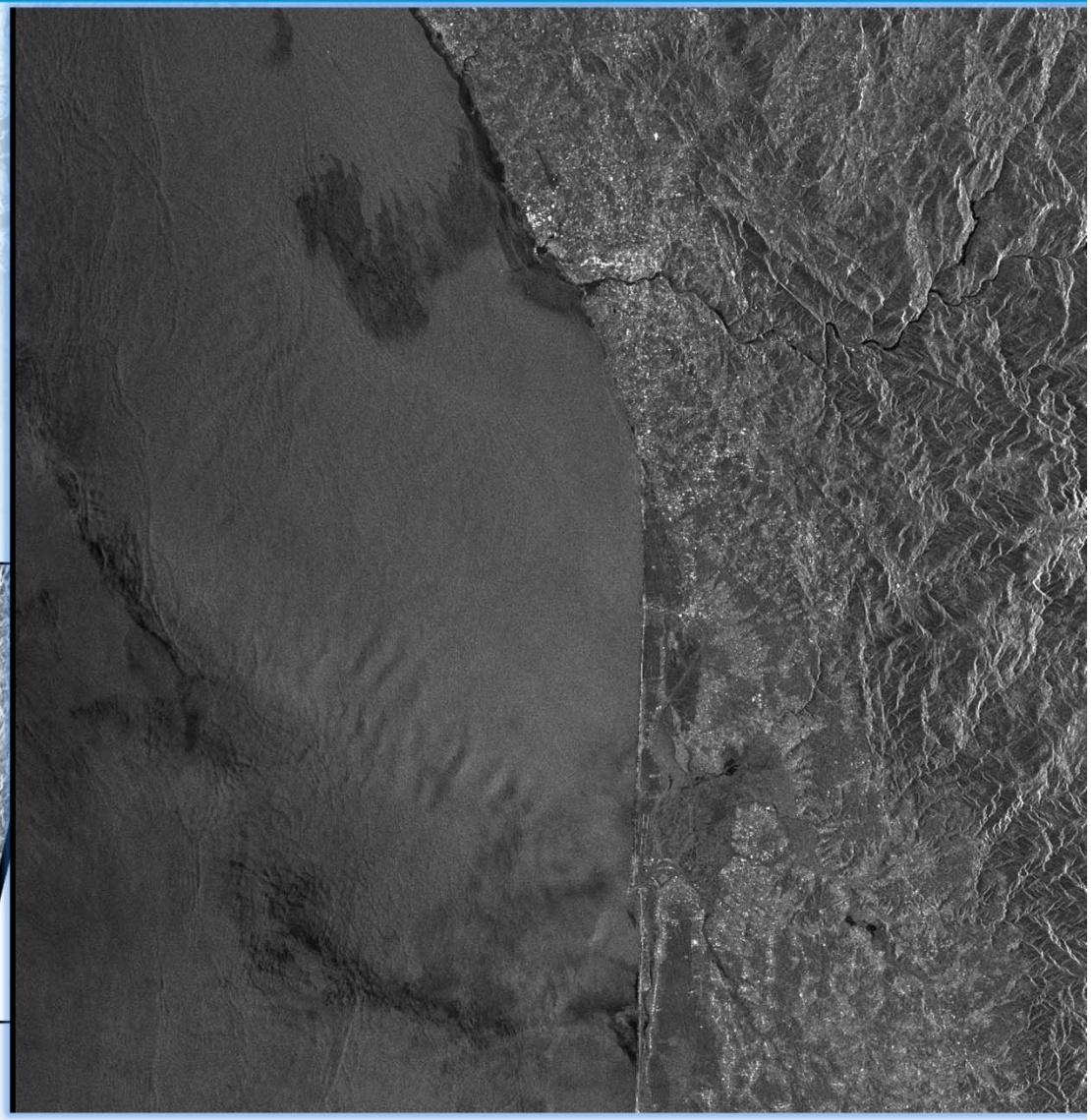
CASE STUDY CERCAL

04.10.1994

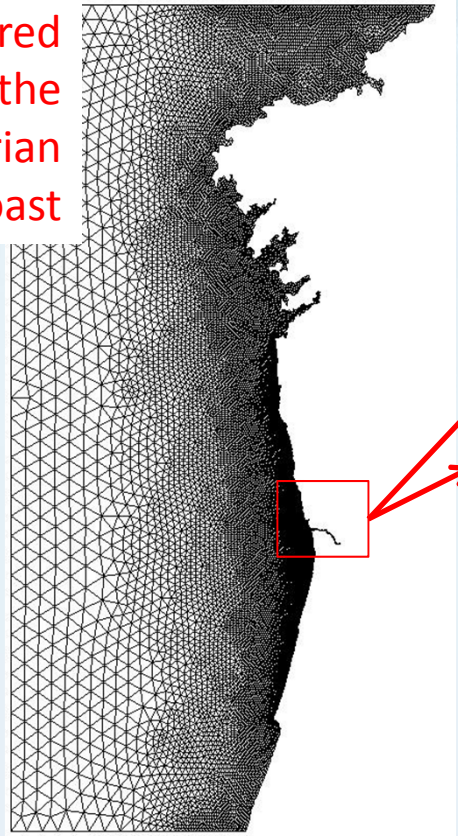




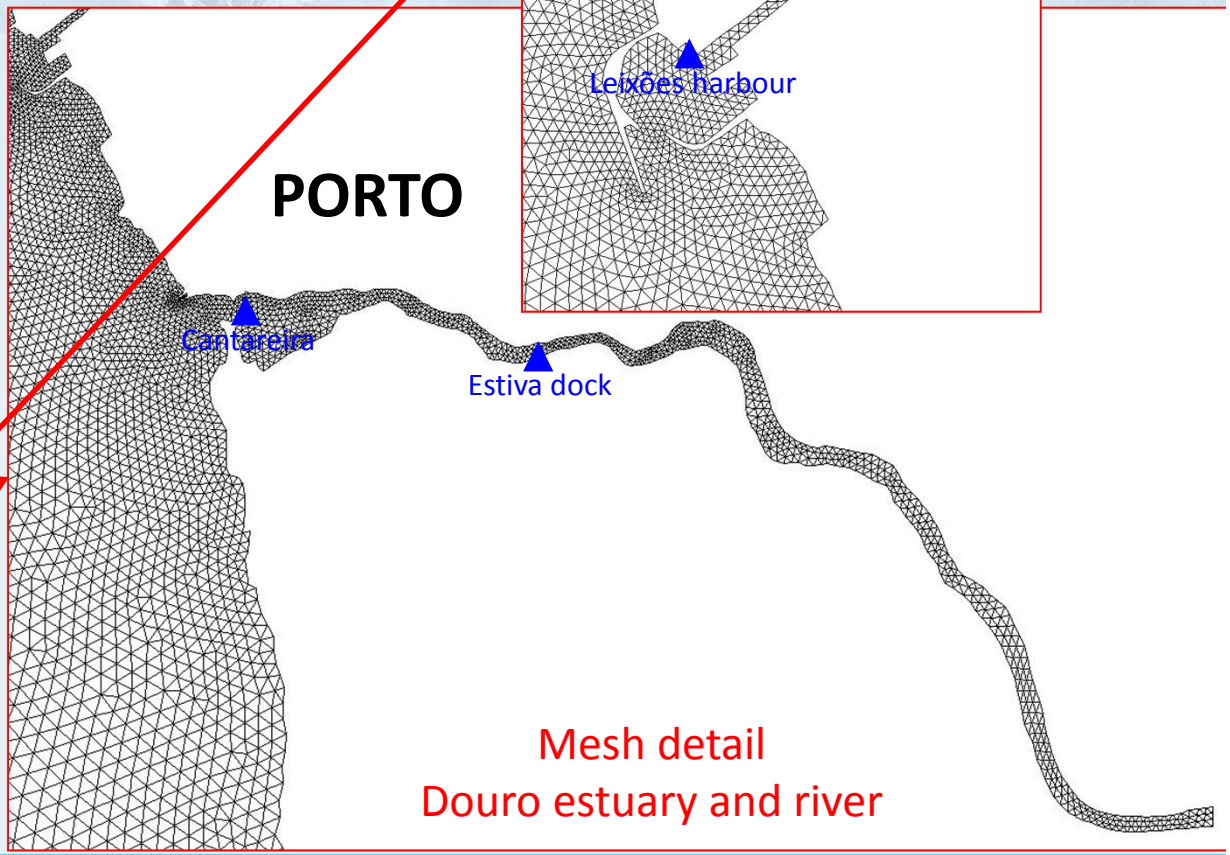
CASE STUDY CERCAL (cont.)

Current developments on the hydrodynamic modelling

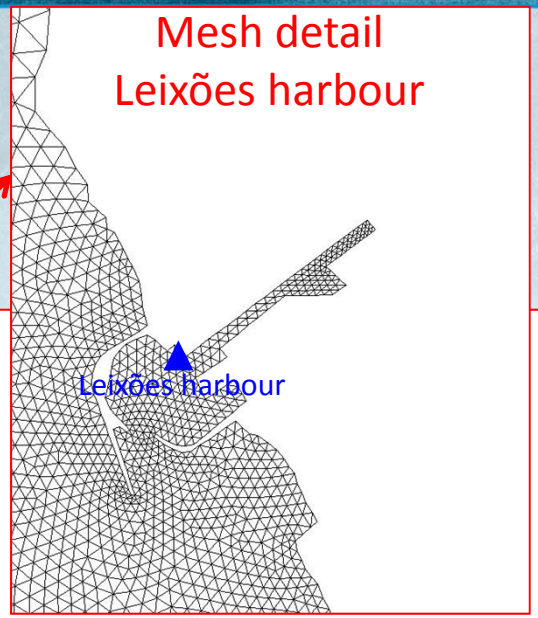
Unstructured mesh for the NW Iberian coast



▲ Tidal stations used for model calibration



Mesh detail
Douro estuary and river



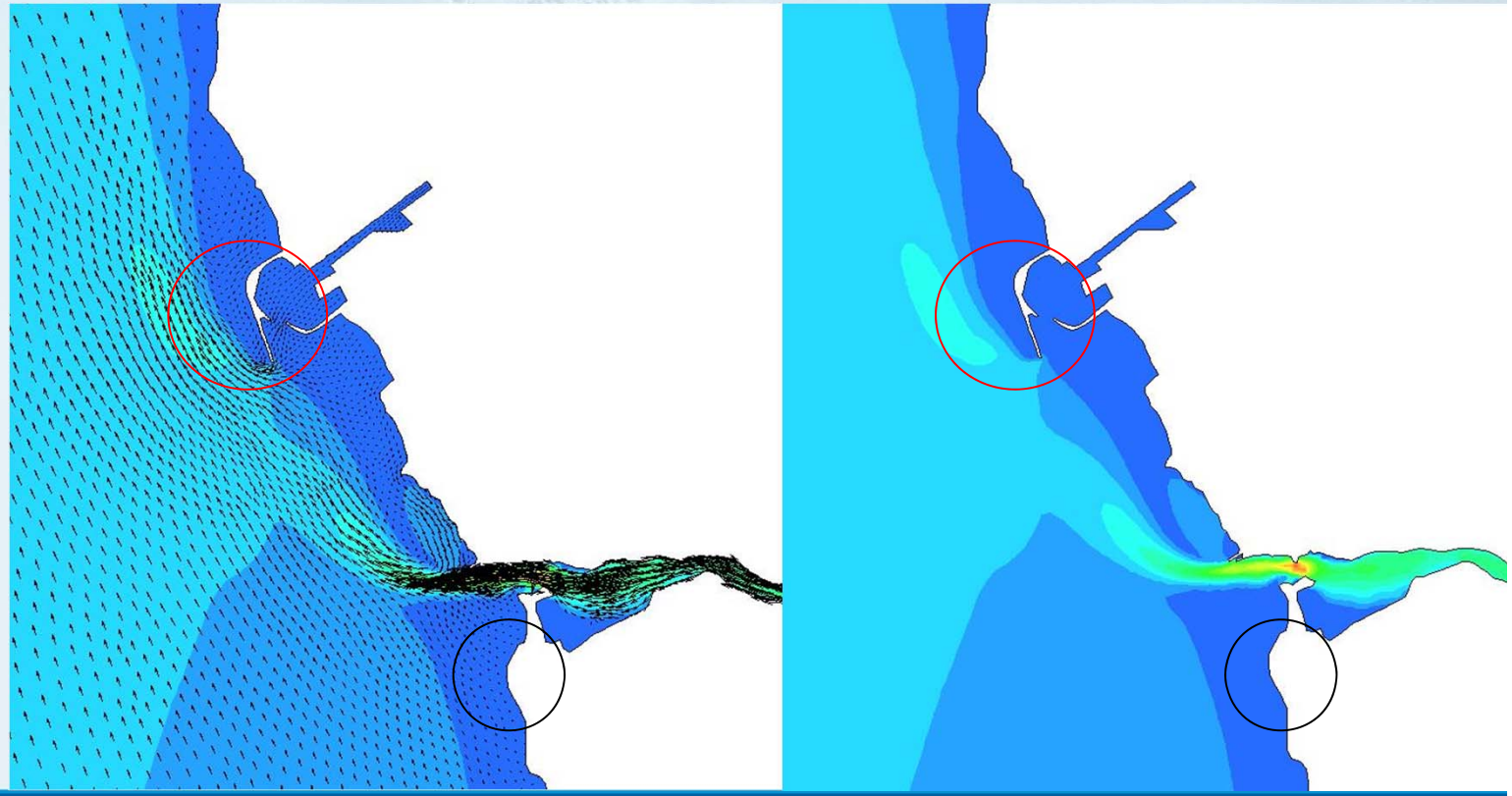
Mesh detail
Leixões harbour

CASE STUDY CERCAL (cont.)

Preliminary velocity fields and velocity magnitudes during the accident

Red circles representing the accident location

Black circles representing the most impacted area, Lavadores beach



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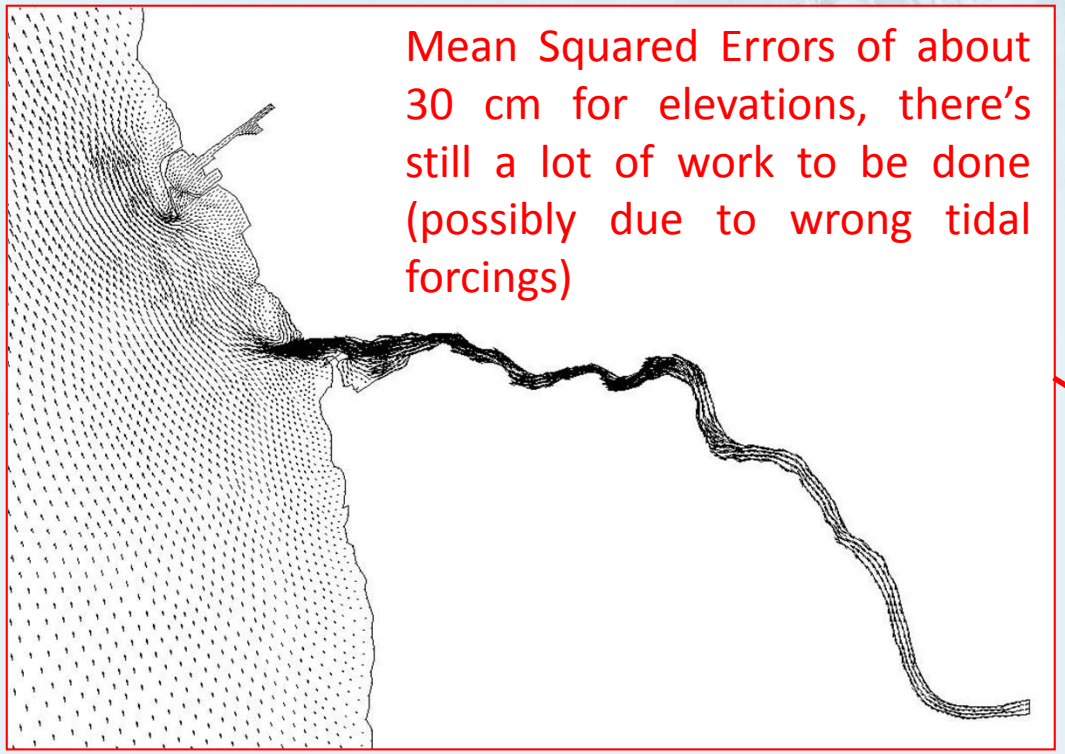
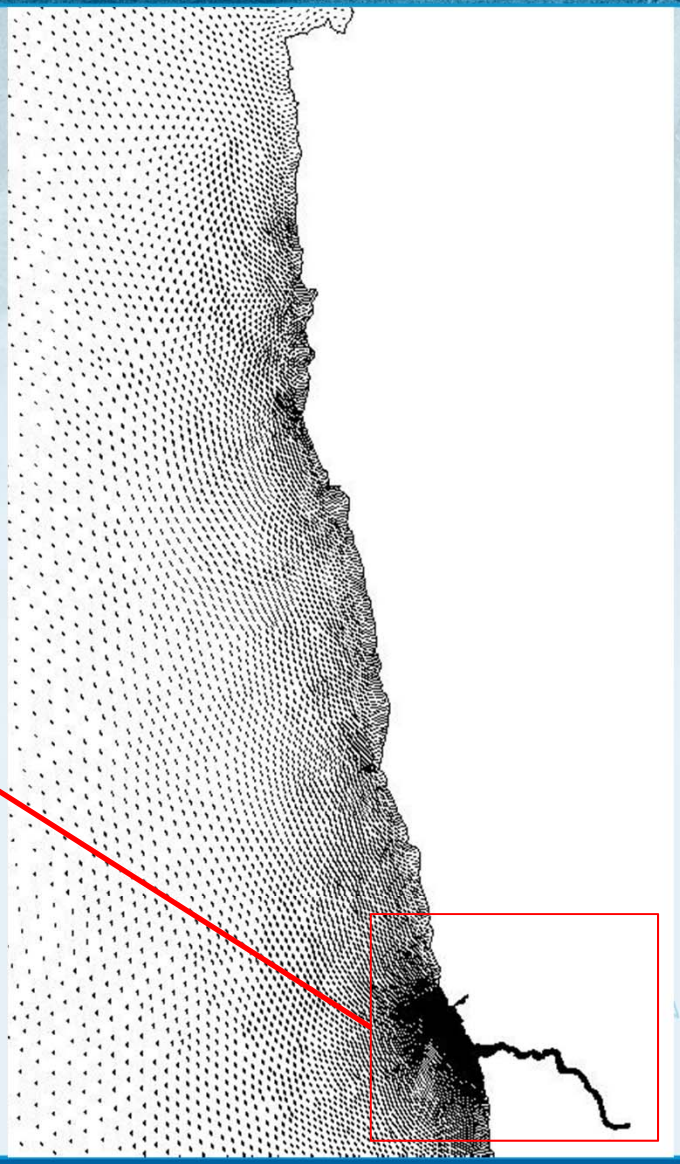
CASE STUDY CERCAL (cont.)

Preliminary velocity fields one month after the accident

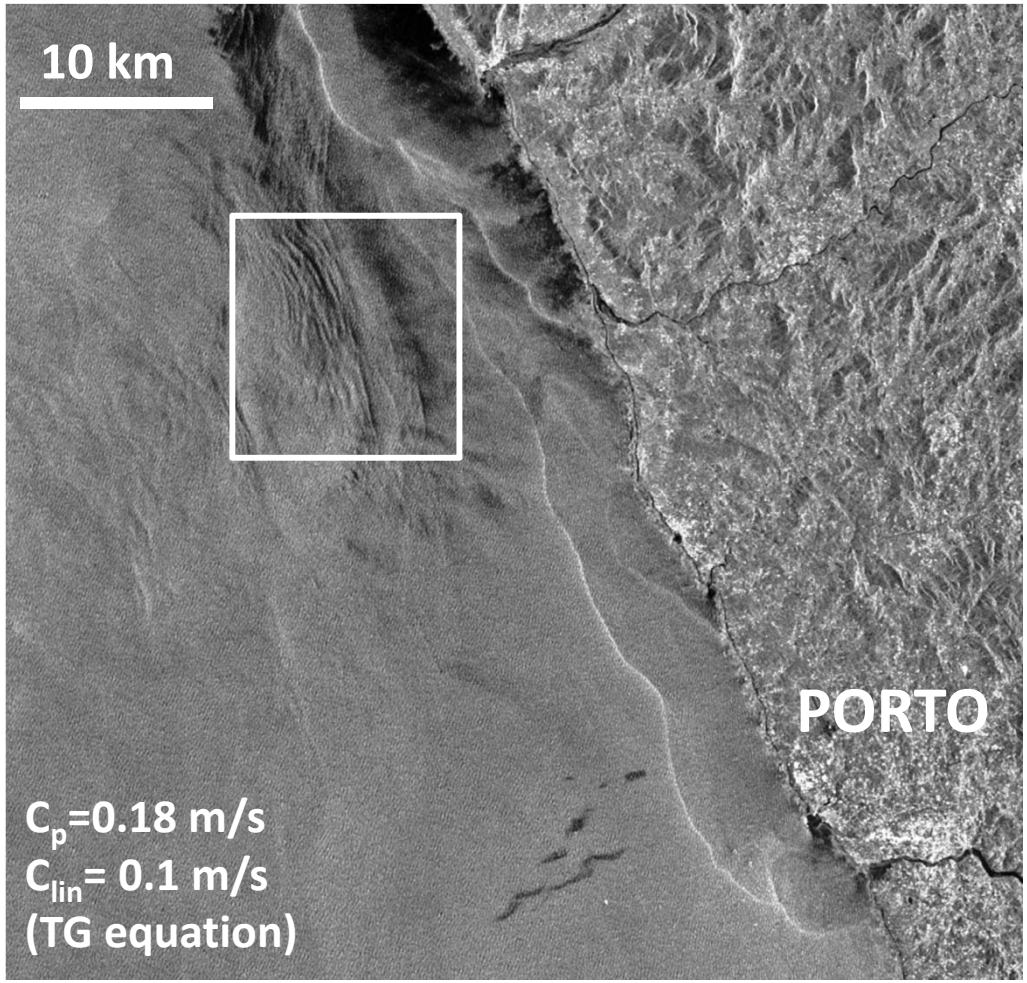


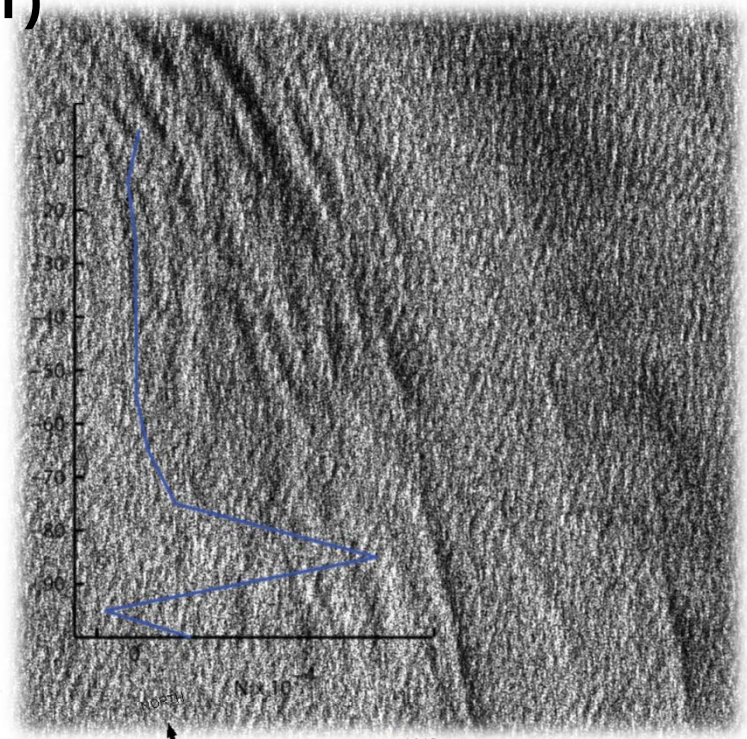
Mean Squared Errors of about 30 cm for elevations, there's still a lot of work to be done (possibly due to wrong tidal forcings)

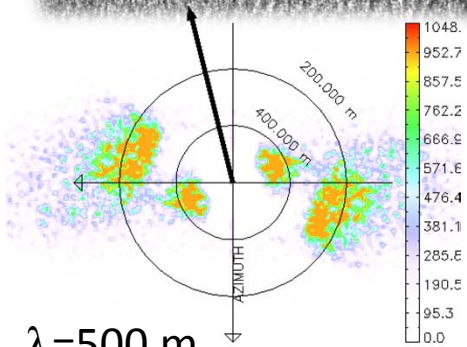


CASE STUDY CERCAL (10.11.1994 11:21 UT)

one month after the accident

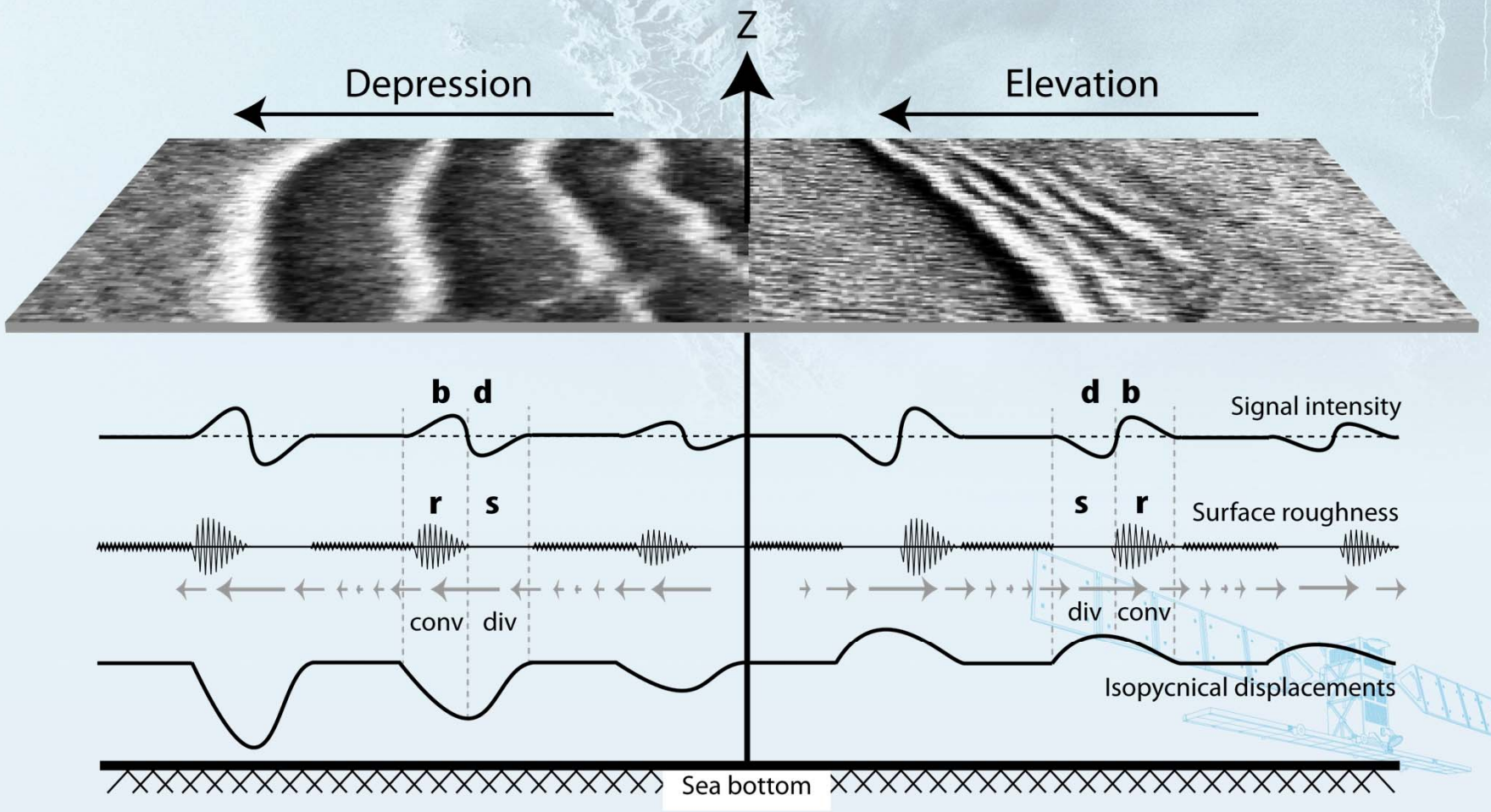






λ=500 m

SOME THEORY


Z
Depression
Elevation
b d
d b
Signal intensity
r s
s r
Surface roughness
conv div
div conv
Isopycnical displacements
Sea bottom

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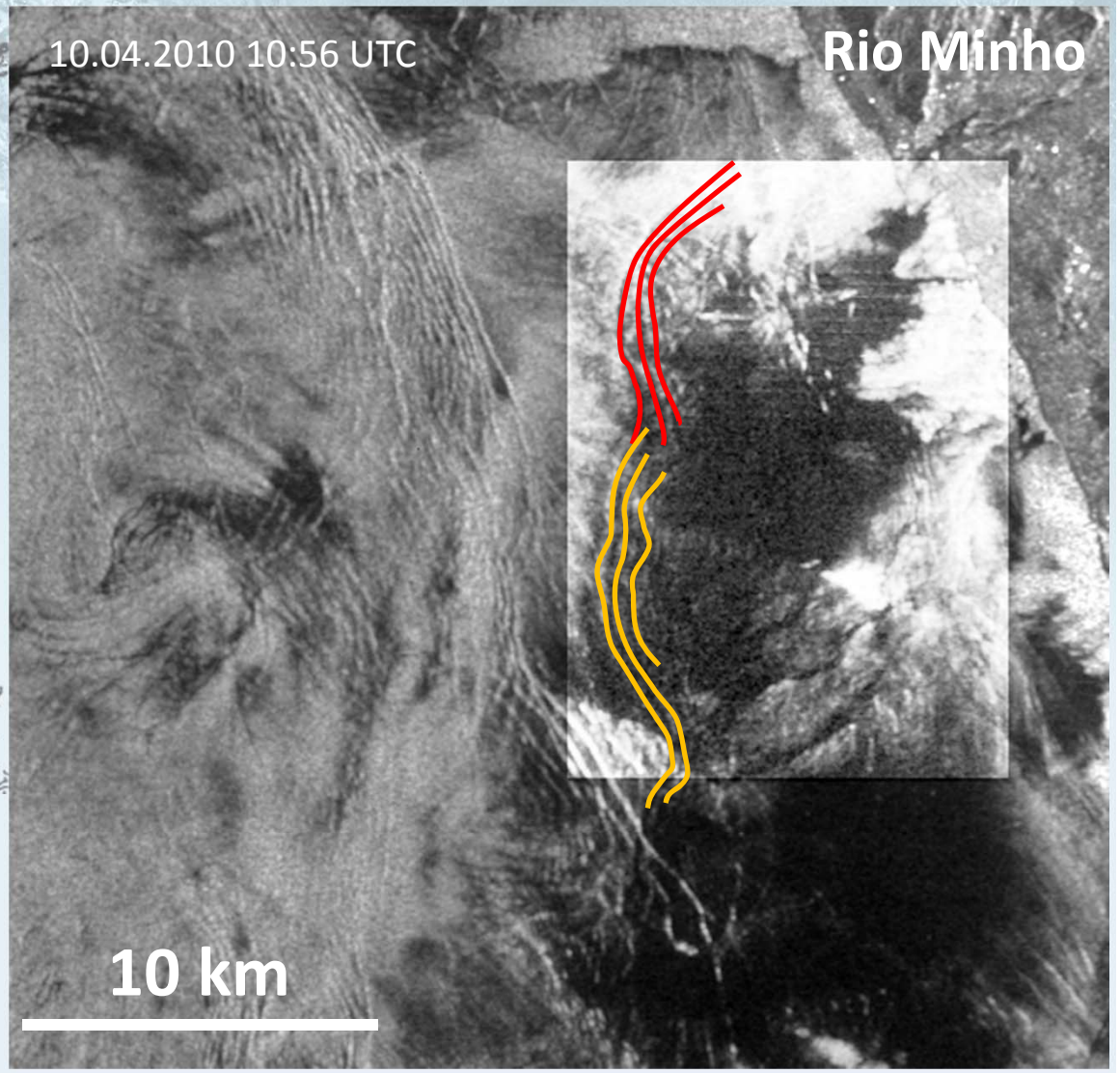
River plumes may generate nonlinear internal waves



Is the river outflow supercritical at some stage?

The present work has been conducted under an FCT/MCTES (PIDDAC) Portuguese funded project entitled PAC:MAN – “Pollution accidents in coastal areas: a Risk management system” (PTDC/AAC-AMB/113469/2008)

Thank You

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