



Harmonization and Networking for contaminant assessment in the Ionian and Adriatic Seas

Assessment of oil spill risk in selected sites of the Adriatic-Ionian Region using models and data

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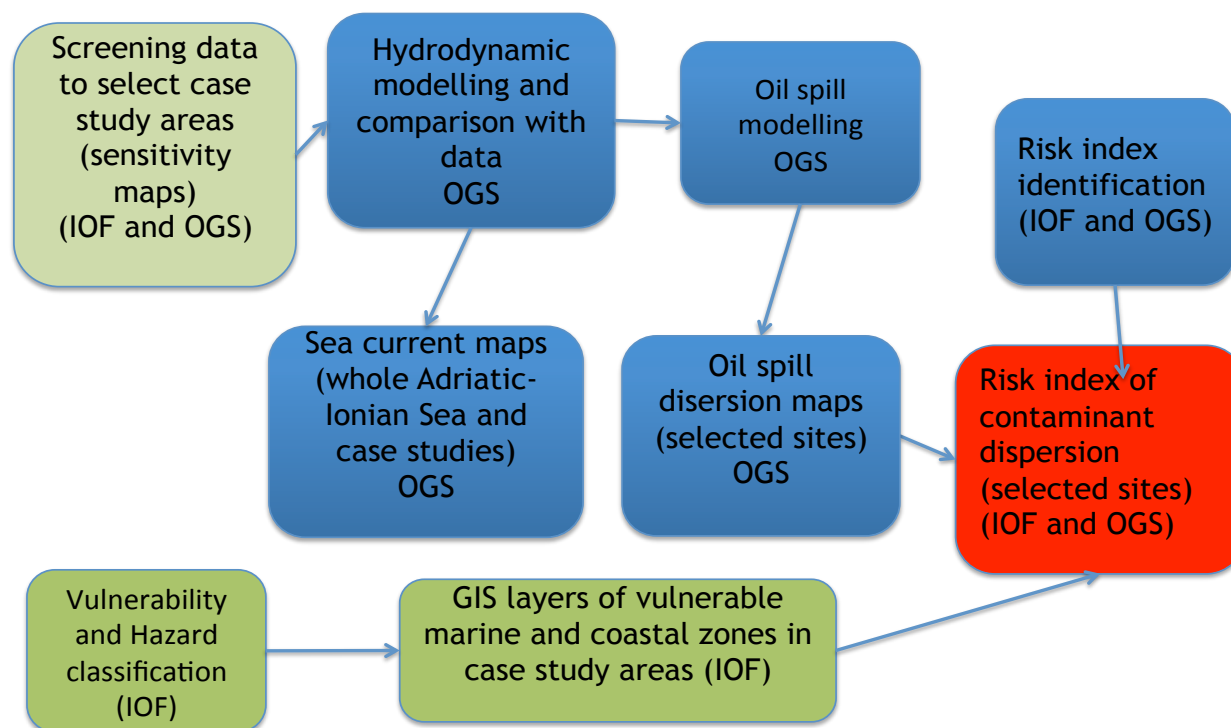
Oil spill Risk: Objectives



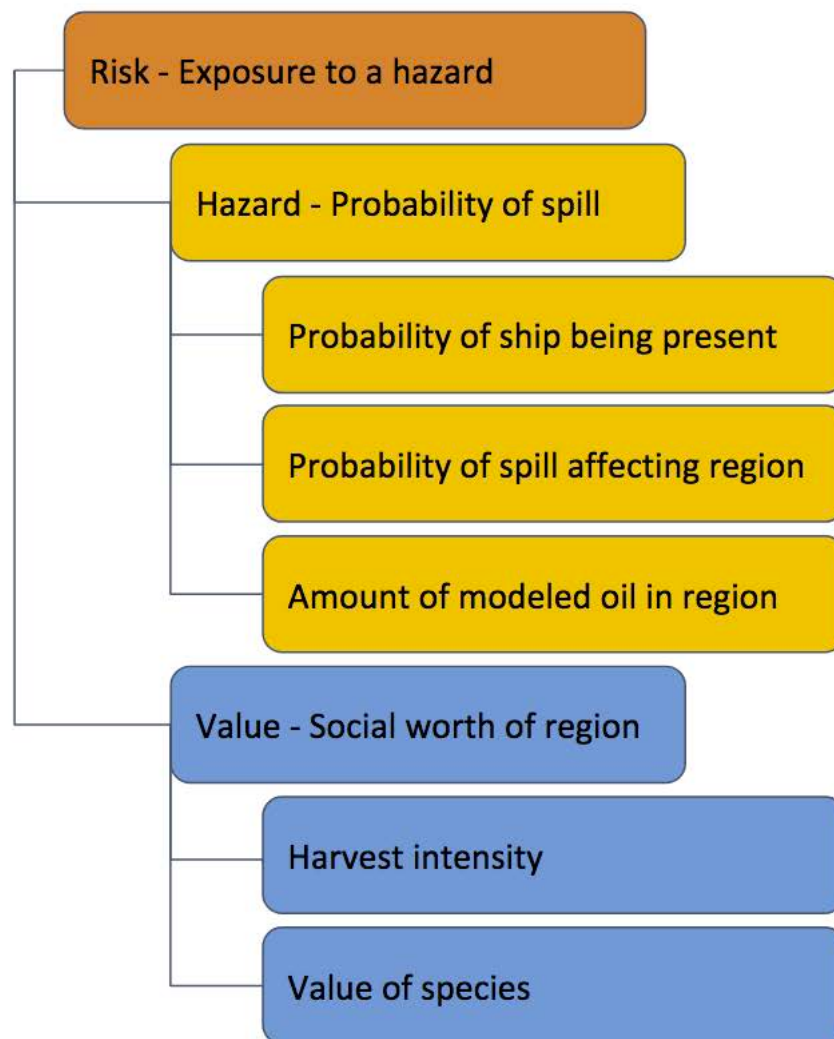
HARMONIA

- Define a **common methodology** to assess oil spill risk at the Adriatic Ionian region to **protect environmental and socio-economic targets from potential sources**
- Using best available knowledge and tools (marine uses, socioeconomic and ecological layers)
- Providing a sharing platform

- Review of applied methods
- Setting up of project case studies
- Geoportal
- Collection of environmental layers
- Simulation of specific spills
- Statistics on oil spill dispersion
- Risk assessment



Oil spill Risk



$$R_s = H_s \cdot I_s$$

$$H_s = (P_t)_r \cdot (P_b)_s \cdot C_s$$

$$P_t$$

$$P_b$$

$$C_s$$

$$I_s = Ha_{s,i} \cdot V_i$$

$$Ha_{s,i}$$

$$V_i$$

RISK ASSESSMENT: HAZARD INDEX

Combining layers of information

How much are the sea and the coast sites exposed to oil spill contamination?

RISK= **HAZARD** × VULNERABILITY

Hazard Index

$$HI_{t,i} = \frac{\sum_0^{ttot} \sum_1^{iitot} x_{i,t}}{\max \sum_0^t \sum_1^{itot} x_{i,t}}$$

HI is the hazard index for the site **i**, for a spill that lasted for a period **t**, and is calculated as the sum of particles reaching the site **i** in the time **t**, divided by the maximum that reached one of the sites in the area.

(with site we consider the smaller unit in which our domain was divided into)

Table 2: First step simplified hazard classes

Class	Index
High	3
Moderate	2
Low	1
Unknown/Non-Applicable	0



Oil spill Risk

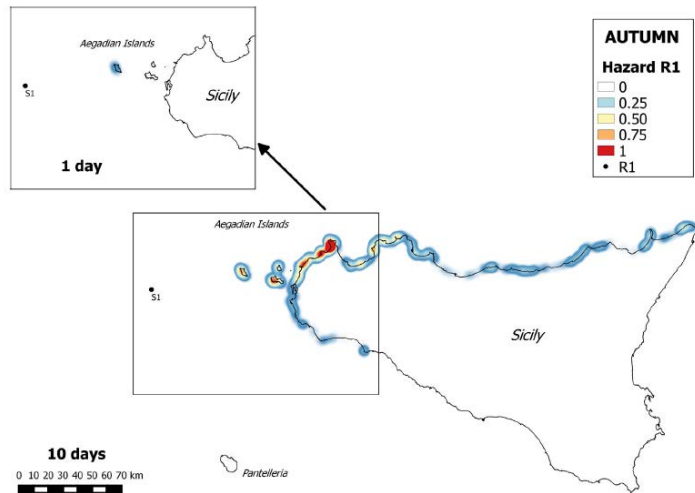
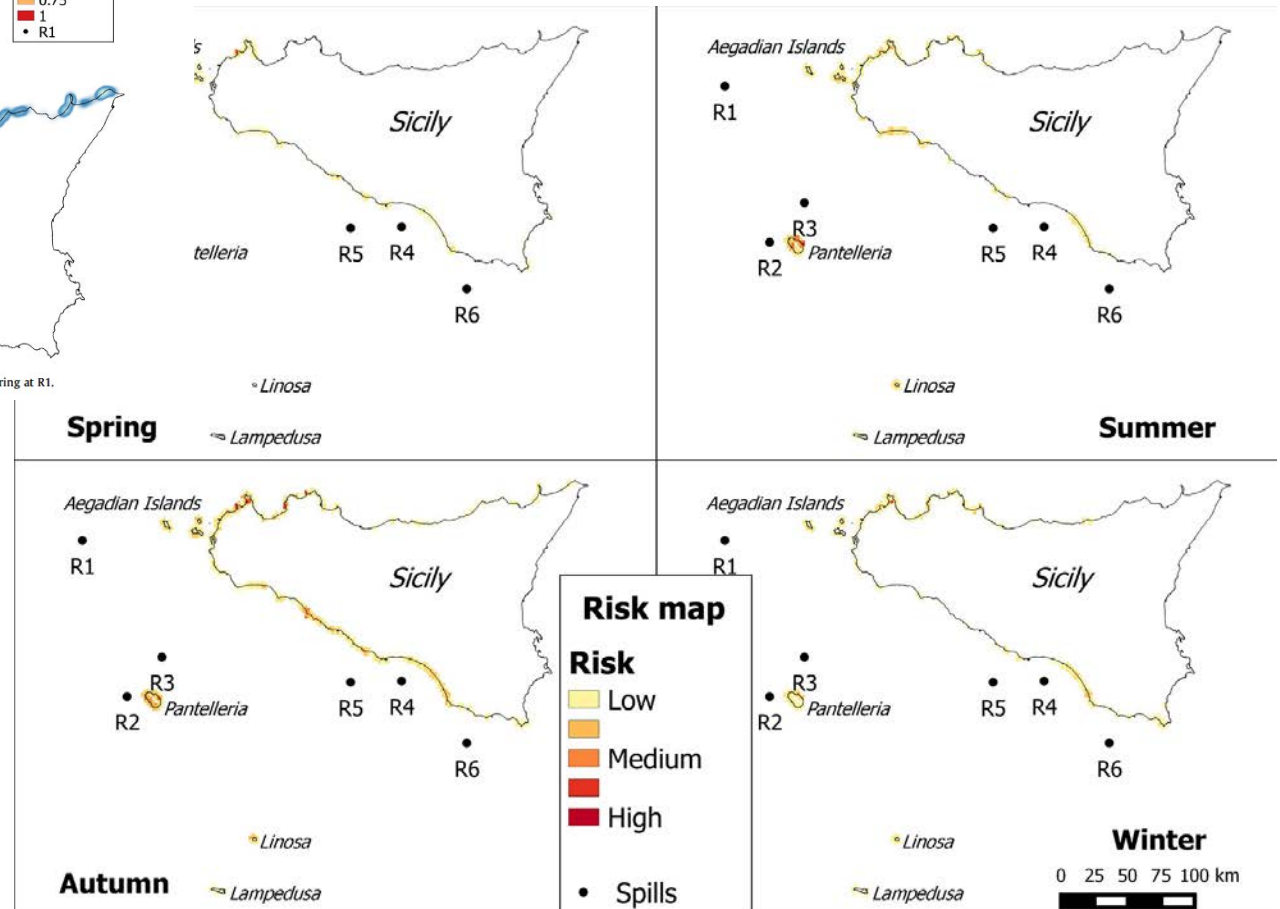


Fig. 5. $HI_{1,1,1}$ index and $HI_{10,1,1}$ for autumn, 1-day and 10-day spill events, from a spill occurring at R1.

Hazard



Risk

R1-R6 sources have been identified inside the exploration/production areas

Melaku Canu et al., 2015

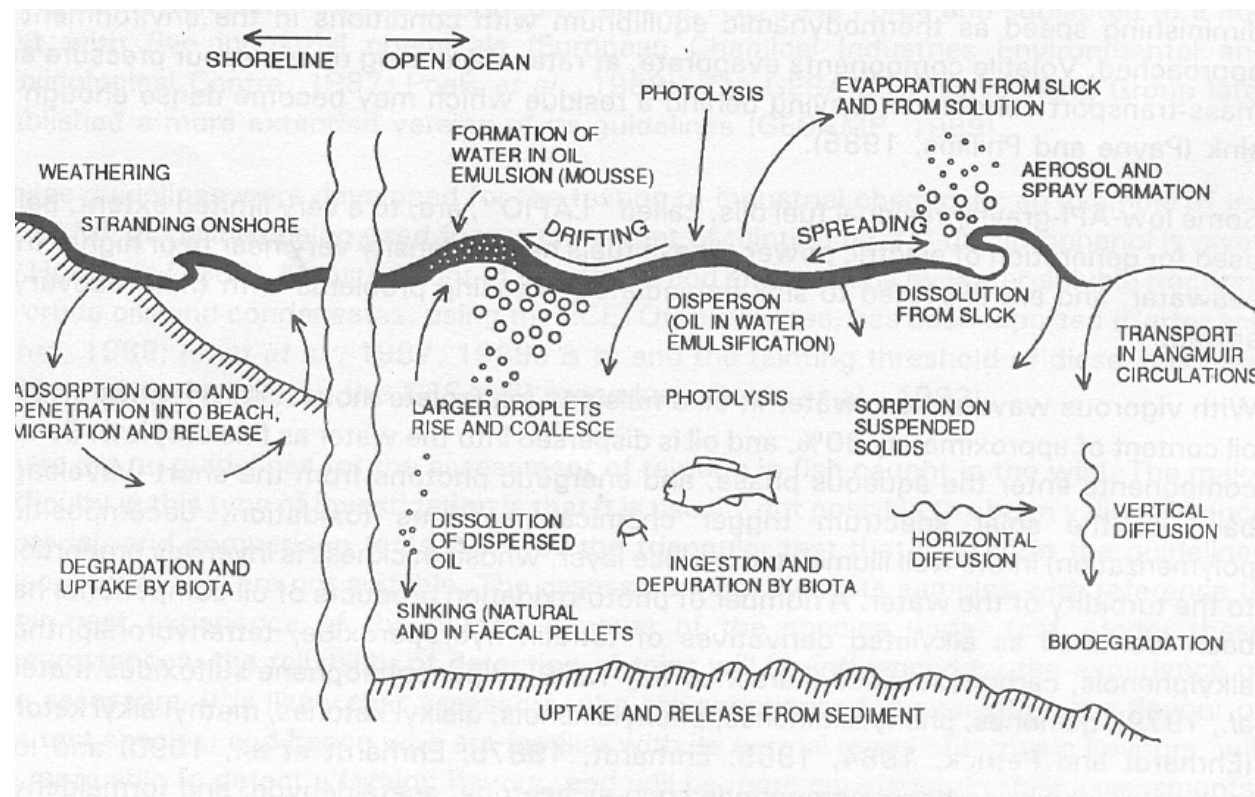
Method

- **Identification of potential oil sources**
- **Sea current information based on hydrodynamic fields**
- **Oil behaviour in the sea, based on oil spill modelling**
- **Identification of ecological-socio-economic vulnerability**

Production of oil spill density maps of oil spill dispersion from surface spills scenario simulations:

1. From the **main shipping routes** in the Adriatic basin
2. From a tanker accident occurring in the Gulf of Trieste (I)
3. From a tanker accident occurring in the Bay of Split (HR)
4. At an oil platform during discharge operations with FSO (GR)

	OILTRANS mod
Advection	+
Diffusion	+
Wind drift	+
Stokes drift	+
Floating objects	-
Backtracking	+
Stranding	+
Spreading	+
Evaporation	+
Emulsification	+
Natural Dispersion	+
Vertical Movement	-
Dissolution	-
Sedimentation	-
	OILTRANS mod



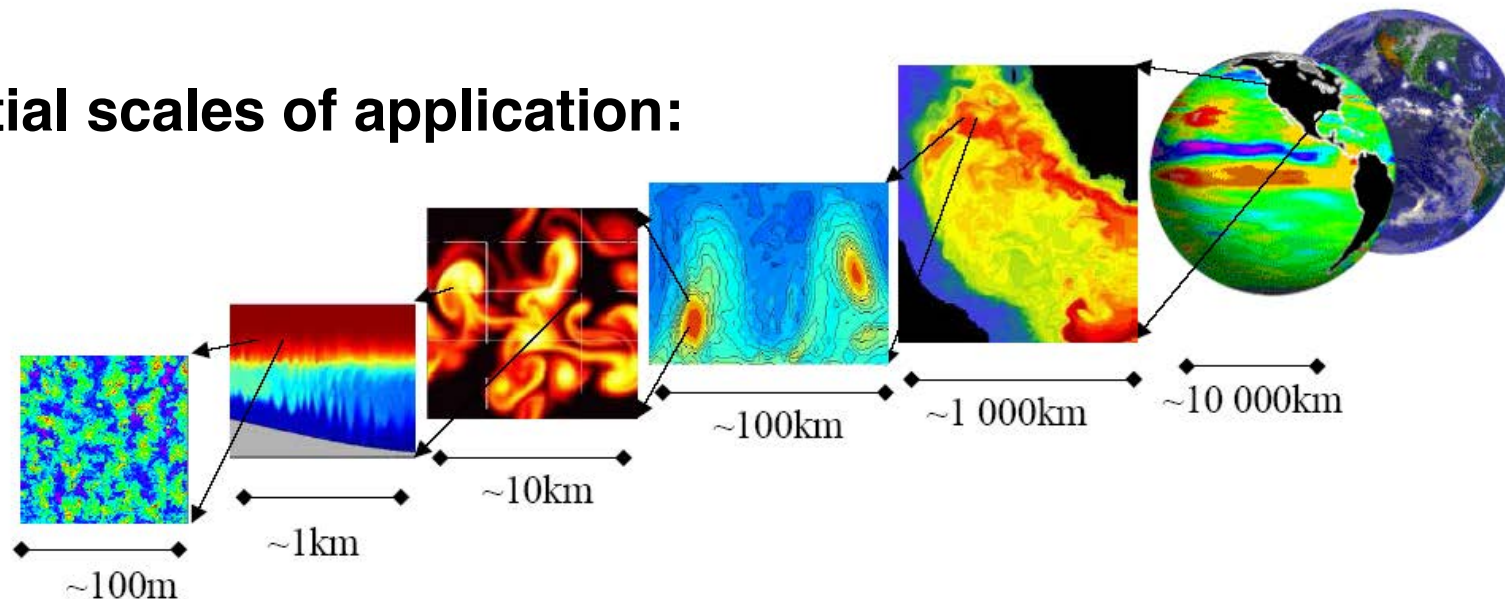
Laurent et al., 2020

Oil in sea water, processes, OILTRANS lagrangian model

MITgcm Ocean General Circulation Model [*Marshall et al.*, 1997]

- non hydrostatic
- finite volumes
- open source

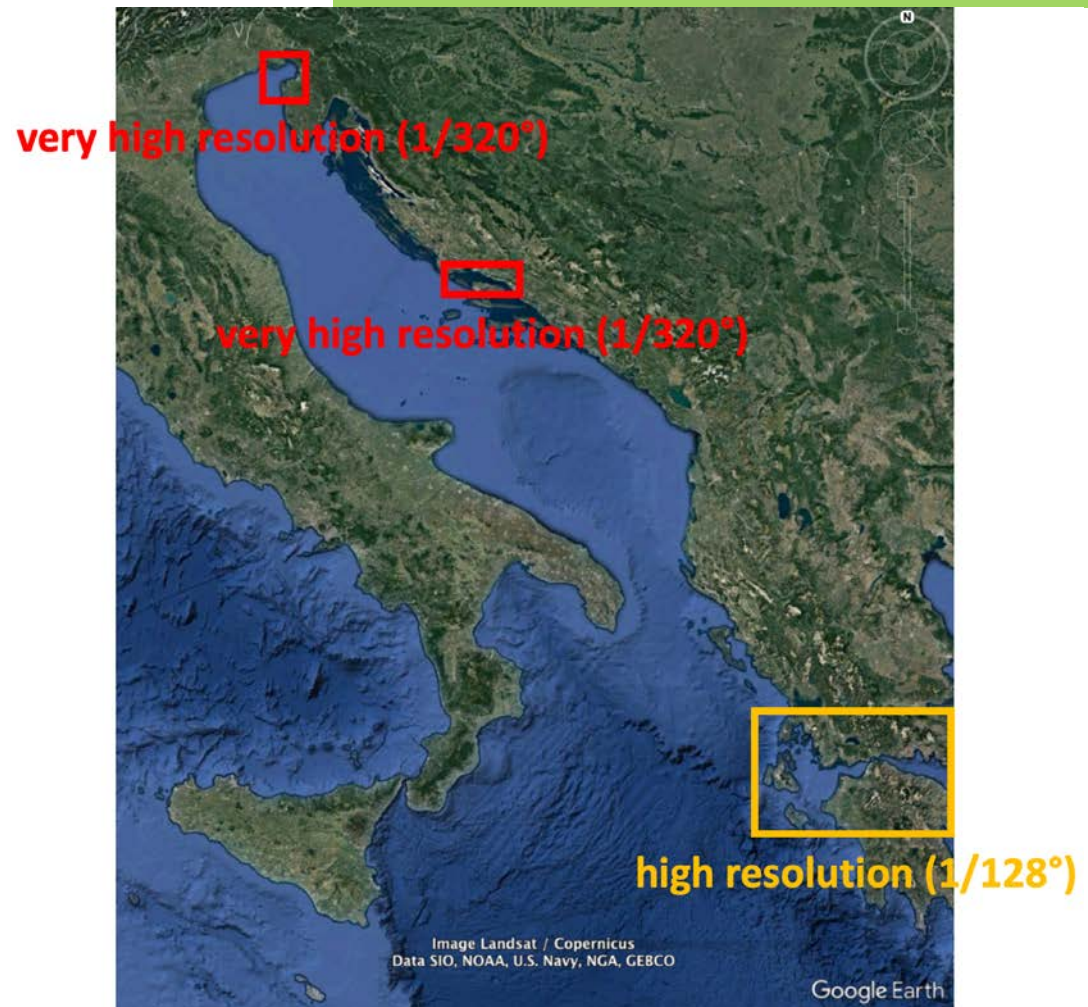
Spatial scales of application:



MITgcm

Ocean General Circulation Model

- Adriatic-Ionian
- Spatial resolution $1/32^\circ$ (~ 2 nm)
- *Study sites Nesting at higher resolution ($1/320^\circ$, $1/128^\circ$)*
- Long term simulation 2006-2012
- Time step 200 s
- *spin-up* (45 days)

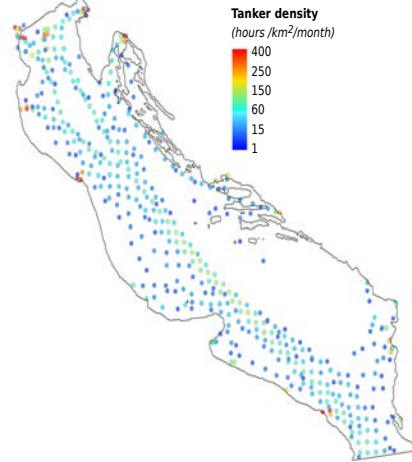
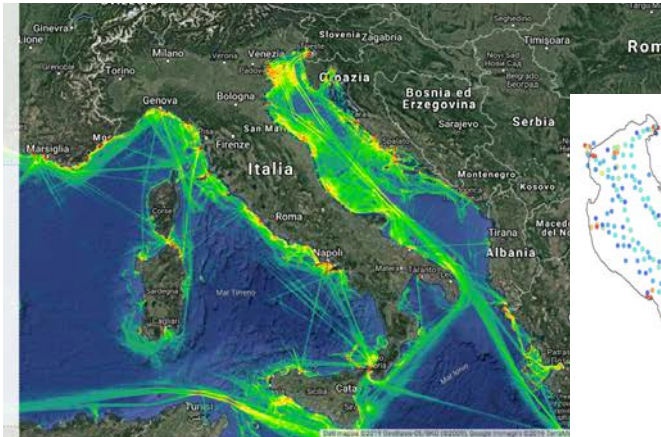


MITgcm model ($1/32^\circ$) Adriatic-Ionian system (Querín et al., 2013; Querín et al., 2016)

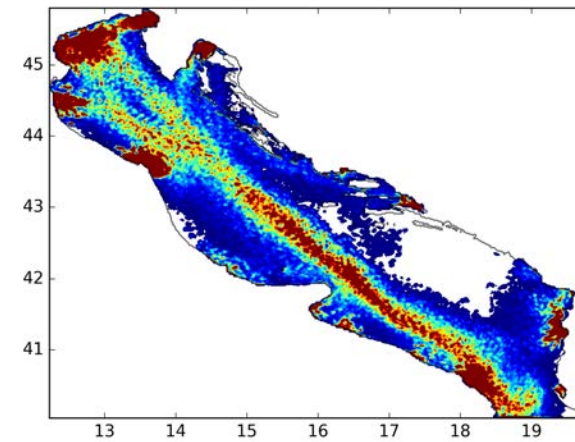
ADRIATIC IONIAN



MAIN SHIPPING ROUTE

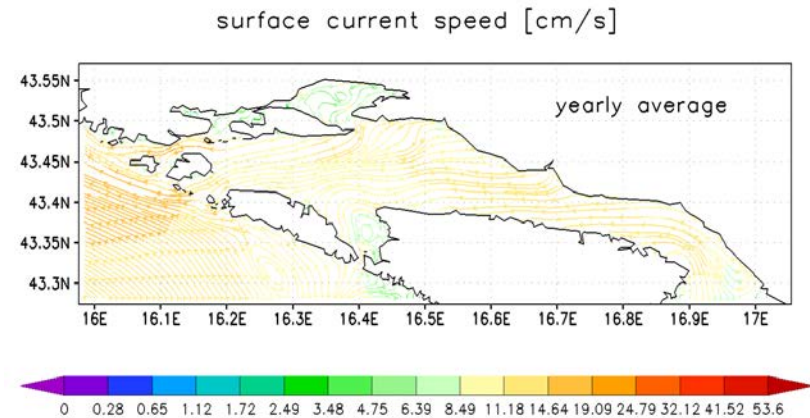
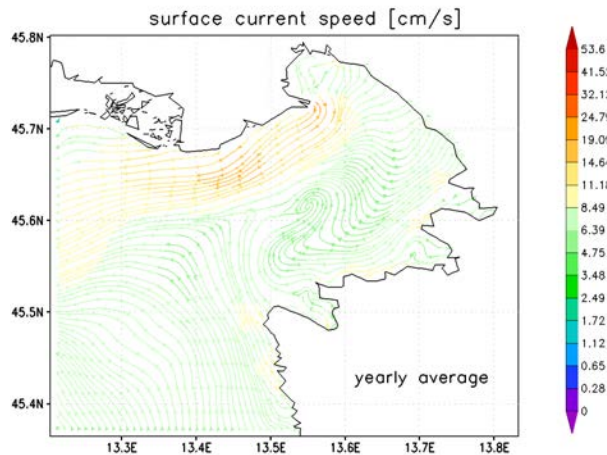


MAIN 24 H AFTER SPILL



High resolution

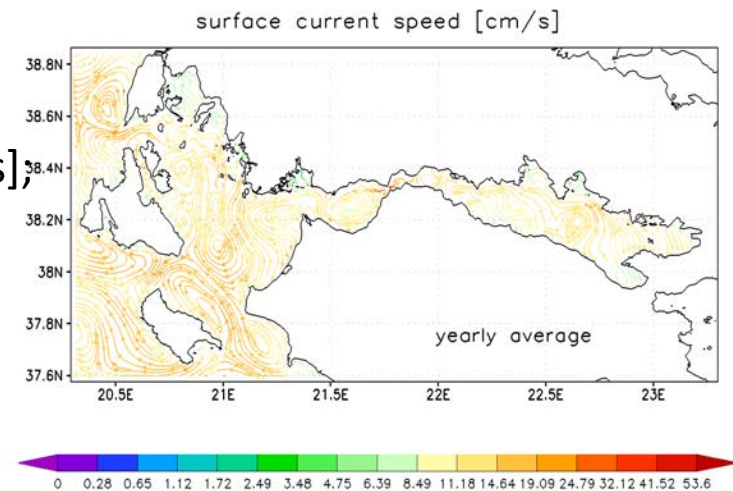
Average currents



DATA FILES for the WEBportal:

- grid coordinates [degrees lon, degrees lat];
- bathymetry [m];
- monthly averages of surface velocity (12 files) [m/s];
- yearly average of surface velocity [m/s].

Surface velocities refer to the **u** (zonal) and **v** (meridional) components of water current in the top layer of the model.



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GULF OF TRIESTE



Oil spill, from oil spill
Simulation, Capitaneria
di Porto Trieste, 7th May
2019

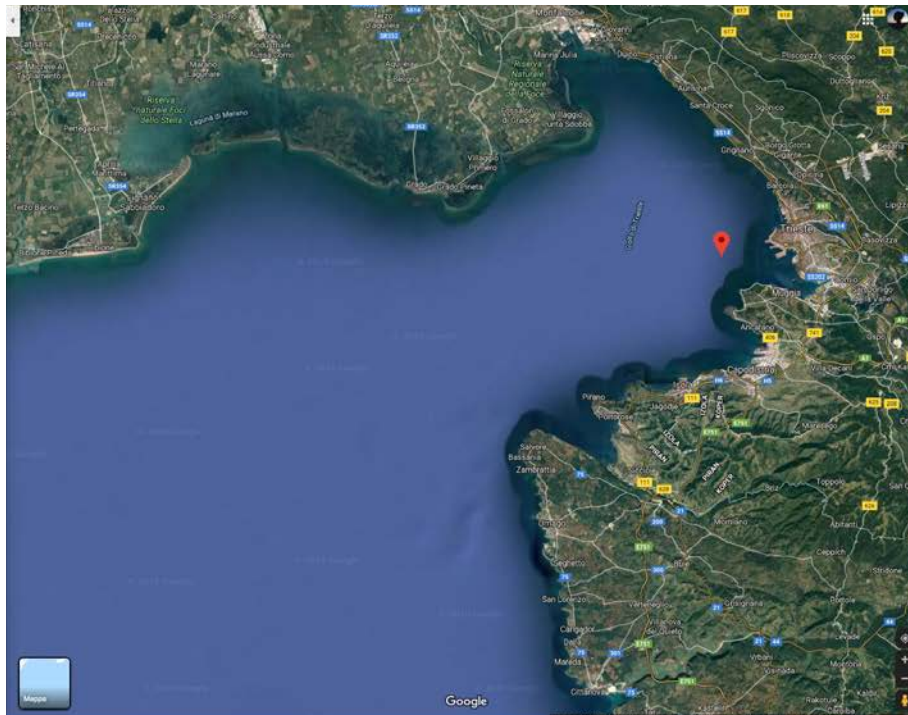


6 days

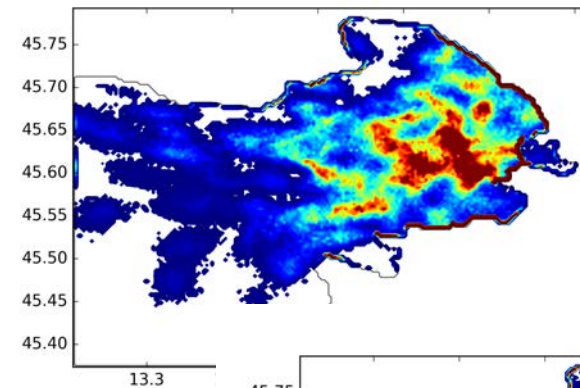
Spill of 50 mc il Arabian
light

GULF OF TRIESTE

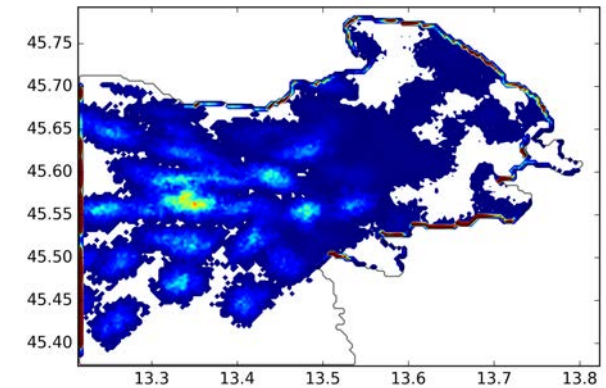
24 H AFTER SPILL



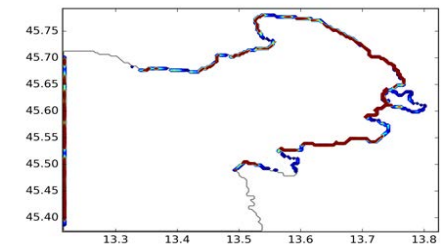
surface



dispersed



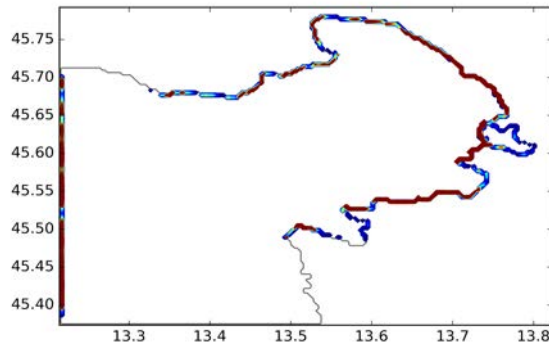
slicked



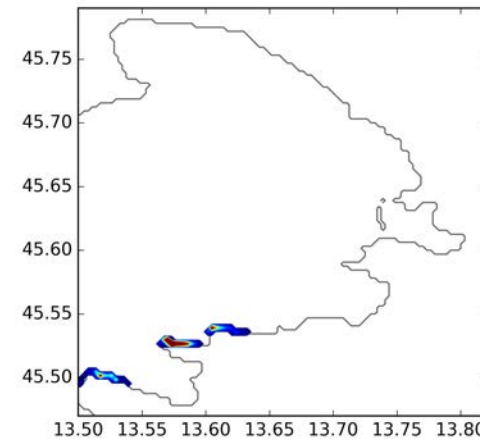
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GULF OF TRIESTE

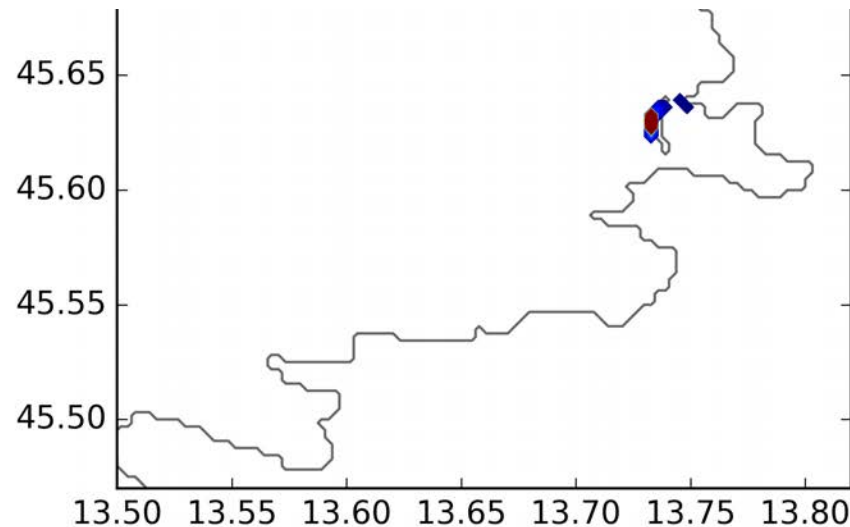
Average/Worst cases After 24 hours



Average simulation
surface



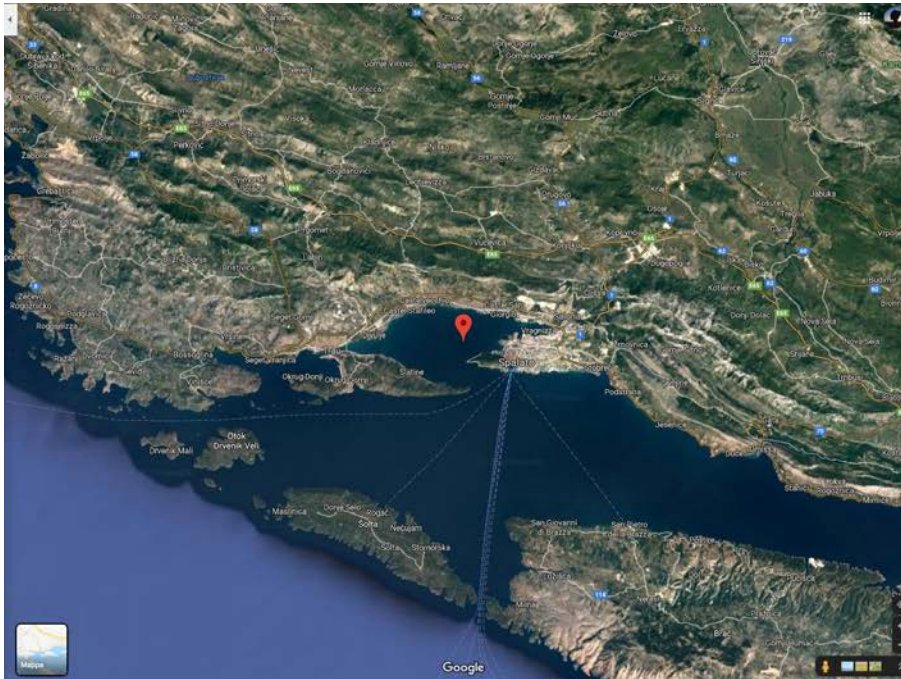
Average simulation
Surface, simulation 15 th of
April



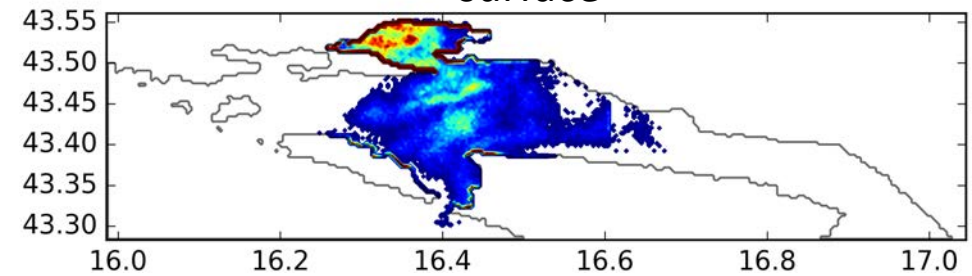
Average simulation
Surface, simulation 7 th of
November

BAY OF SPLIT

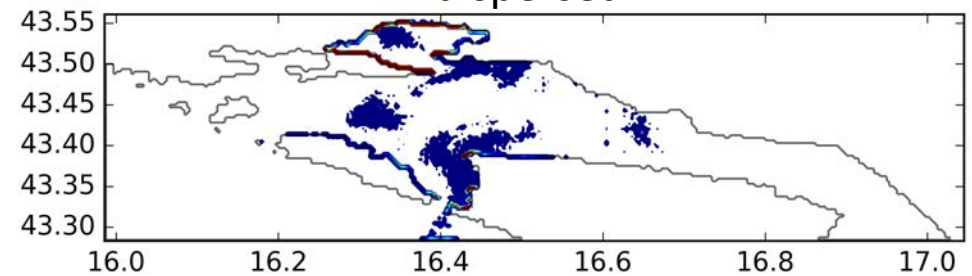
24 H AFTER SPILL



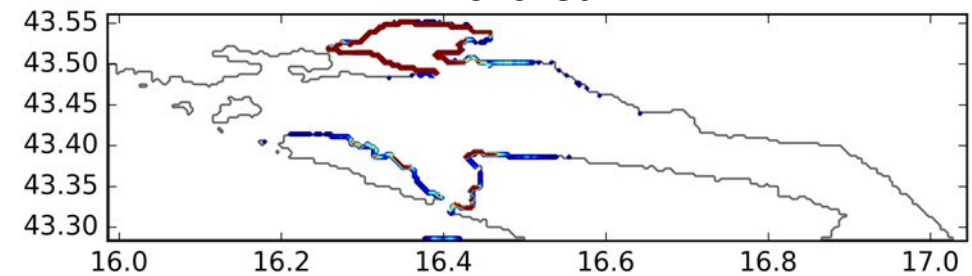
surface



dispersed



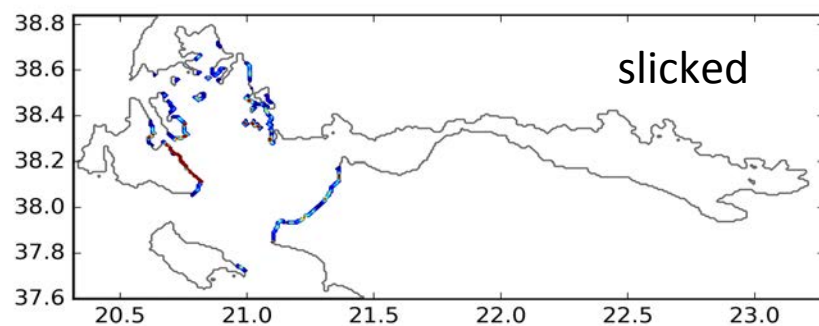
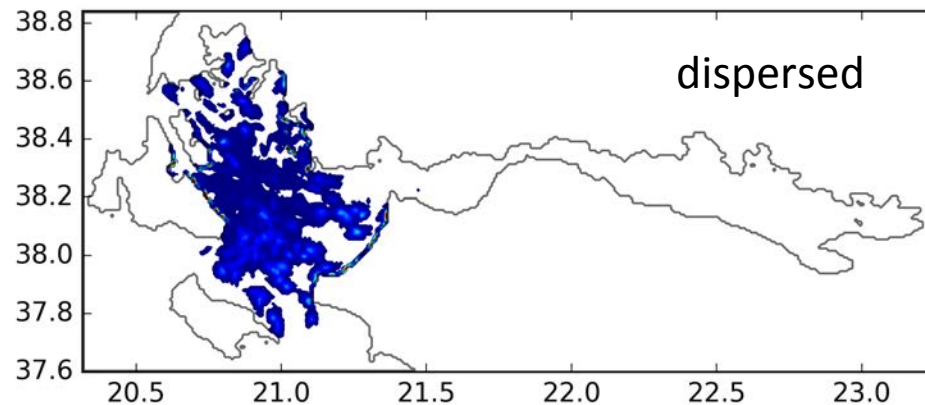
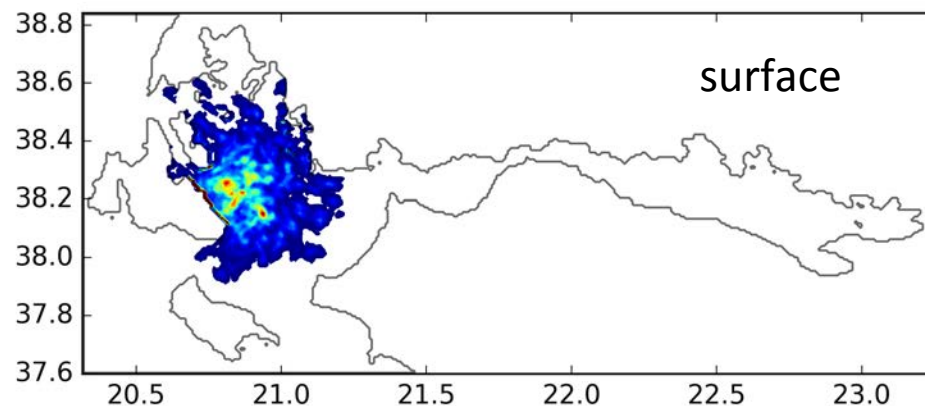
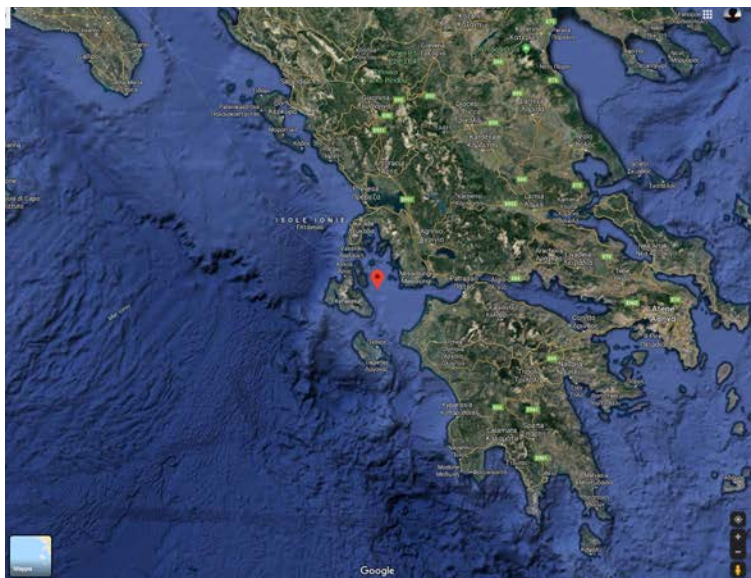
slicked



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GULF OF PATRAS

24 H AFTER SPILL



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Conclusion

RISK

Marine uses (shipping intensity, oil extraction...)
Hydrodynamic model
Oil spill model

GAPS AND NEEDS
AT THE ADRIATIC
IONIAN REGION
SCALE?

Oil spill densities

Hazard Index

Sensitivity layers

Vulnerability
Index

Geoportal

RISK

Ecological components
Social components
Economic components

DPSIR approach

