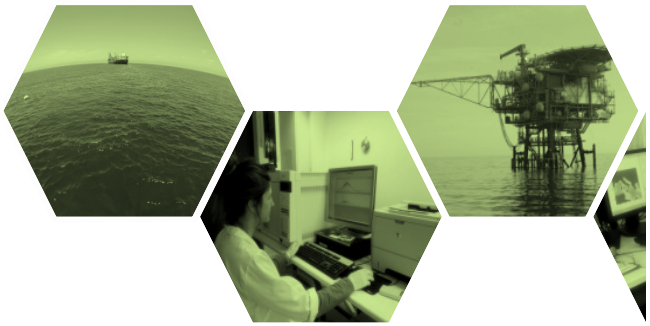


Interreg
EUROPEAN UNION
ADRION
ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession II Fund

HarmoNIA

# 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

Donata Melaku Canu, Célia Laurent, Stefano Querin,
Cosimo Solidoro, Vinko Bandelj

OGS - Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

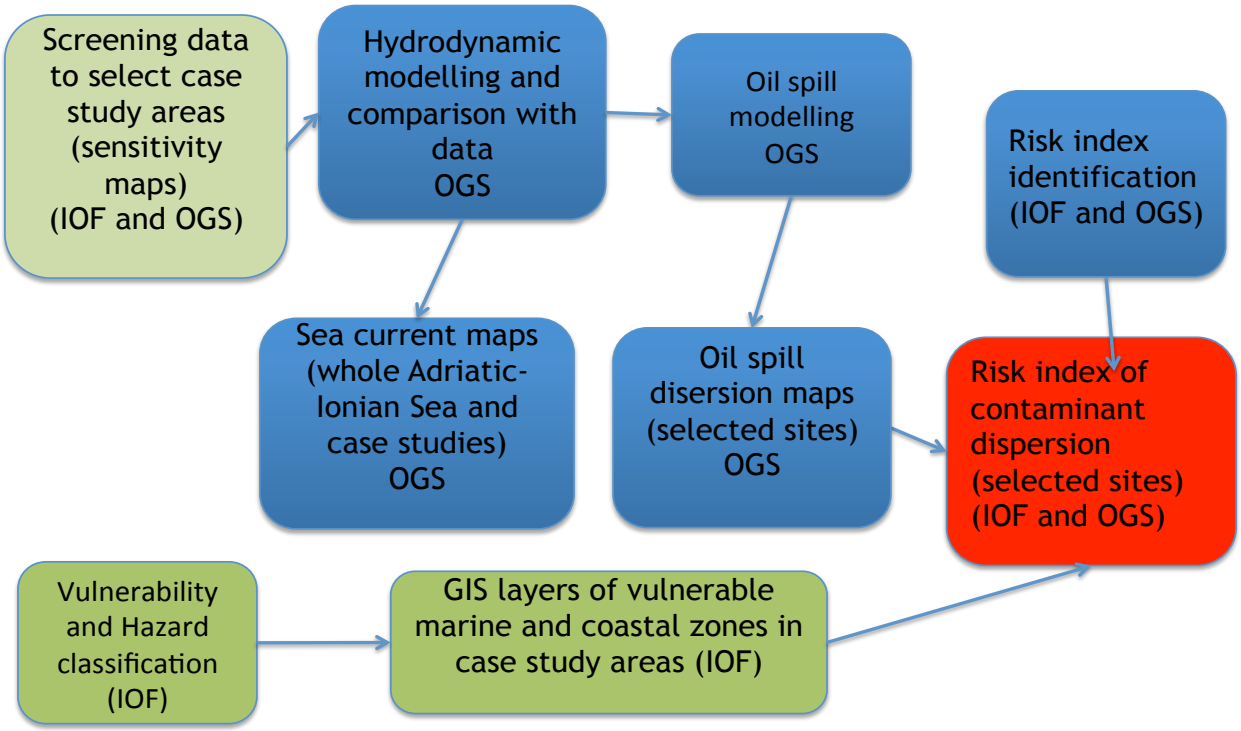
Online – April 28, 2020

# Oil spill Risk: Objectives

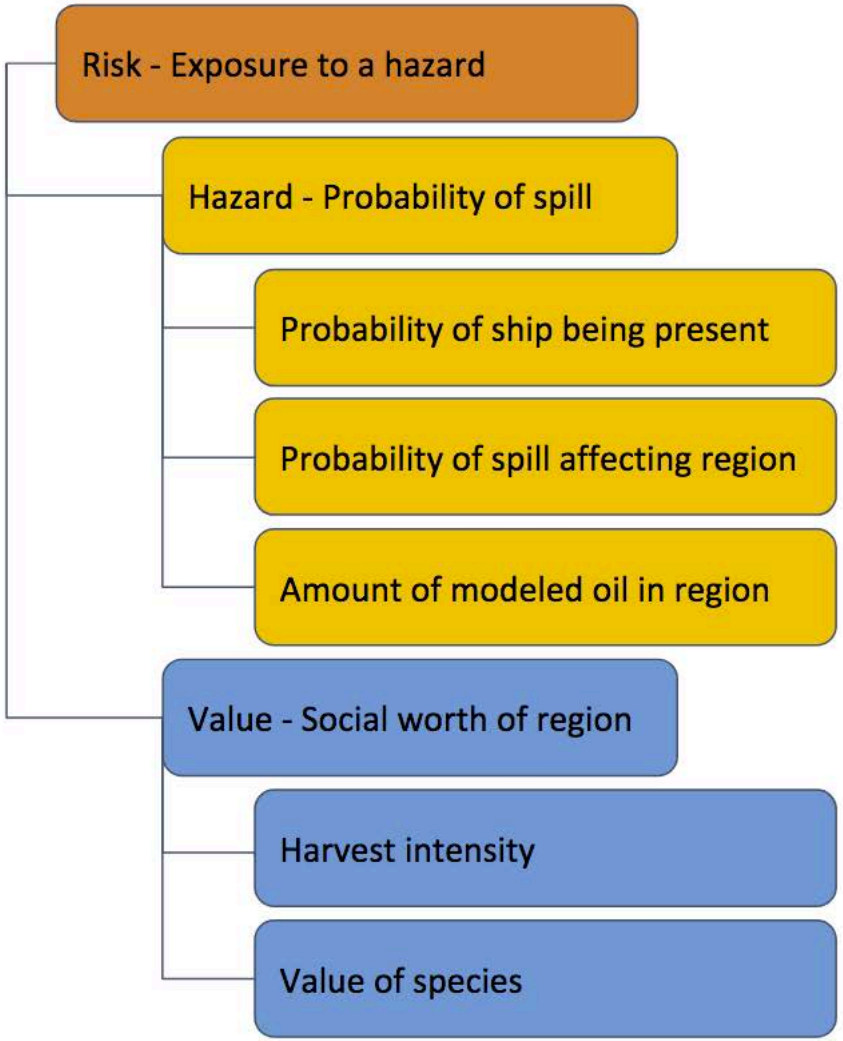
# HARMONIA

- 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, socioeconimic 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




$$R_s = H_s \cdot I_s$$

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

$P_t$

$P_b$

$C_s$

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

$Ha_{s,i}$

$V_i$

Sepp-Neves 2015, 2016

# RISK ASSESSMENT: **HAZARD INDEX**

Interreg ADRION ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession II Fund
HarmoNIA

# Combining layers of information

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

RISK= **HAZARD** × VULNERABILITY

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

Table 2: First step simplified hazard classes

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

***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)

OGS

# Oil spill Risk

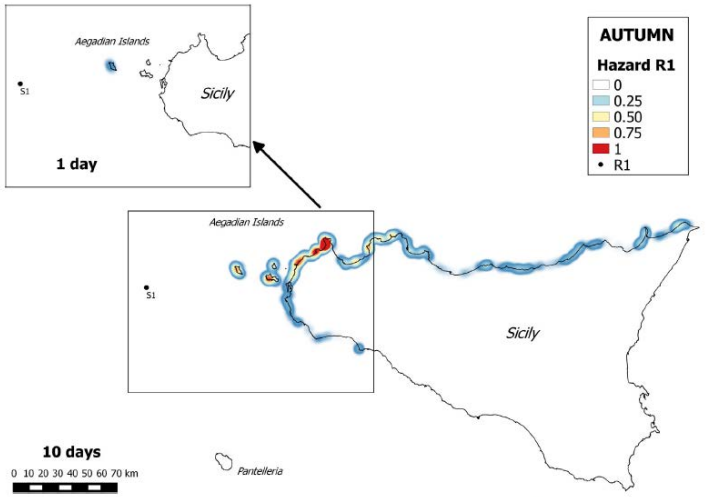
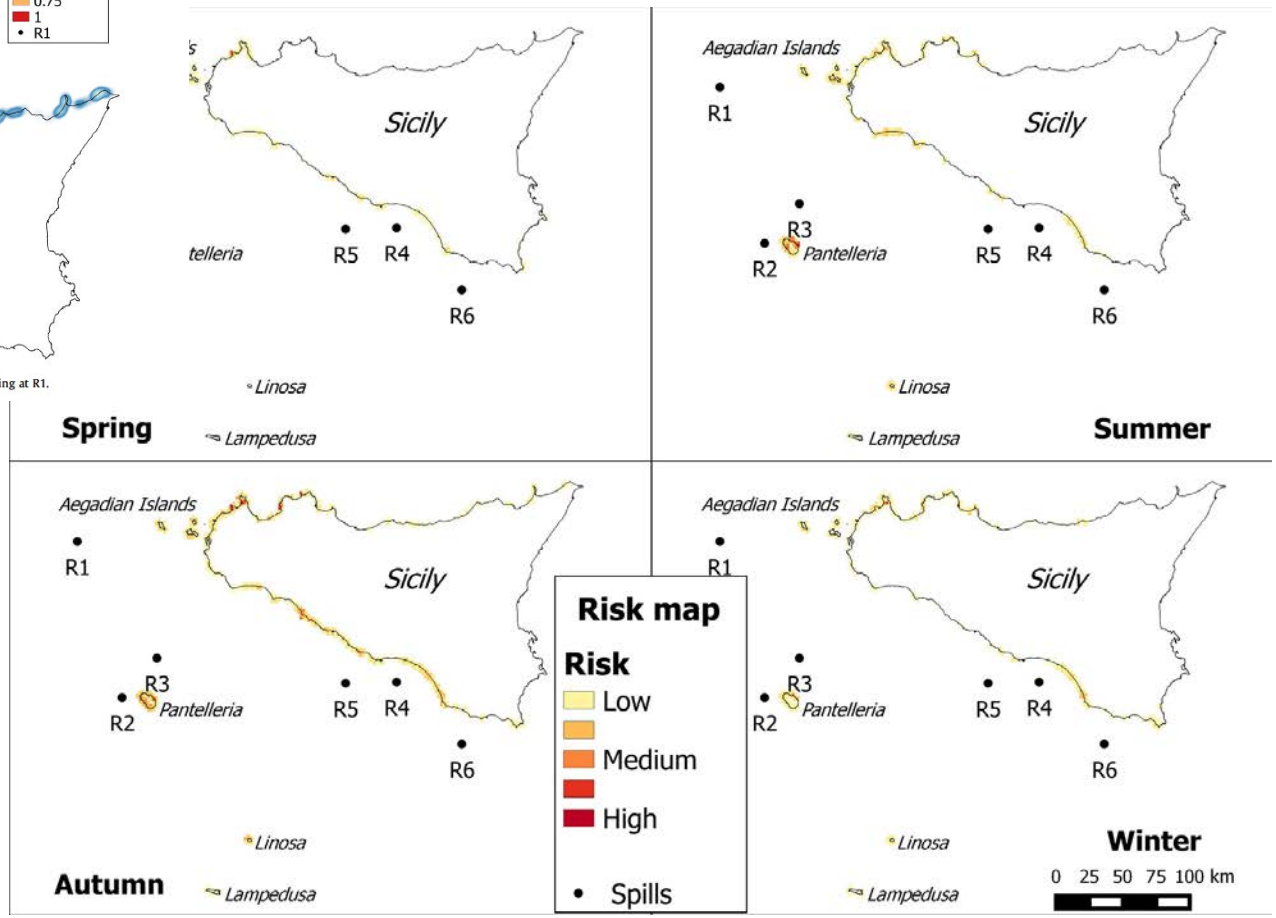



Fig. 5. $HI_{1,1,j}$ index and $HI_{10,1,j}$ for autumn, 1-day and 10-day spill events, from a spill occurring at R1.

Hazard




Risk

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

*Melaku Canu et al., 2015*

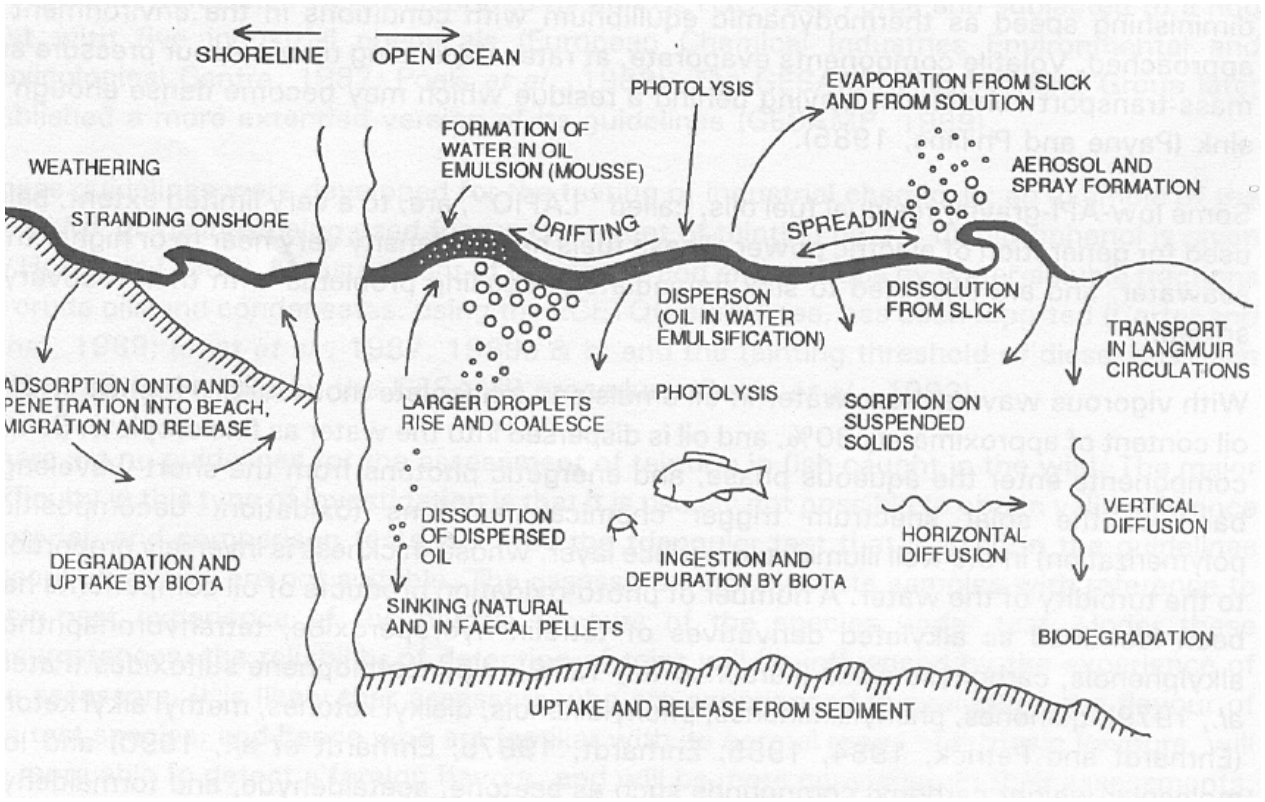
# Method

- **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-econimic the 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 |



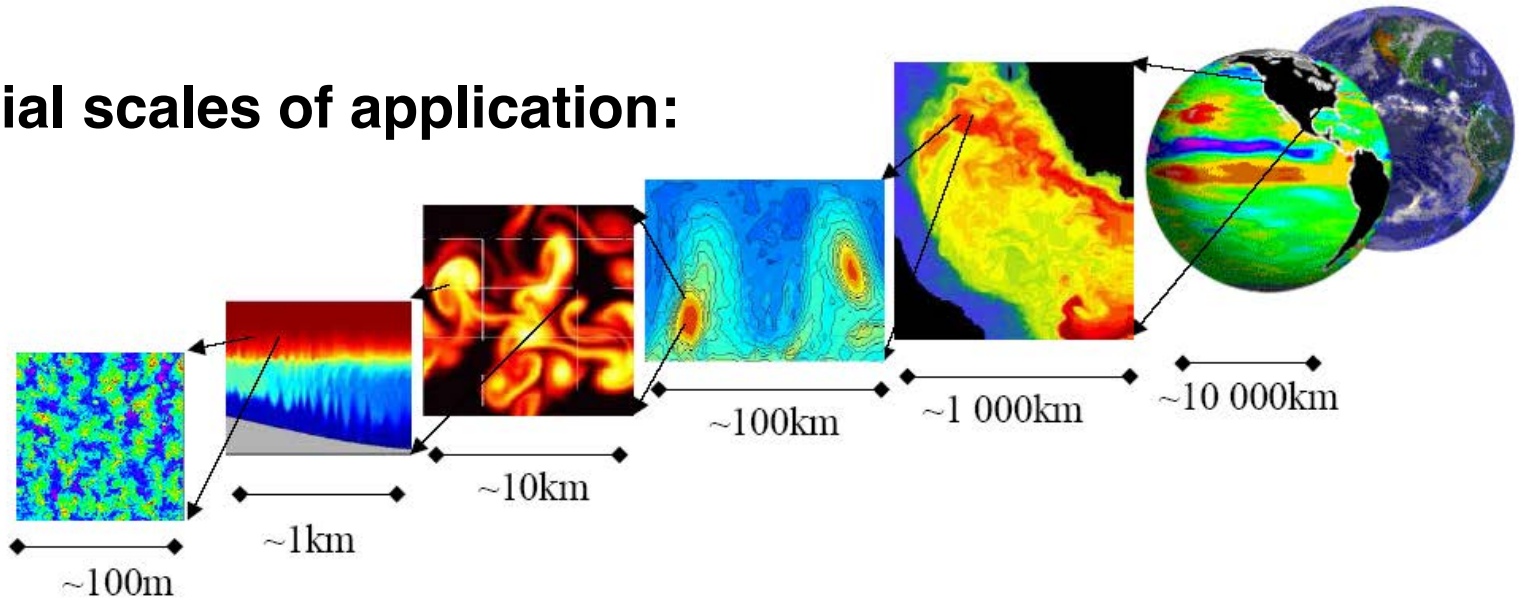

Laurent et al., 2020

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 hydrodynamic model

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

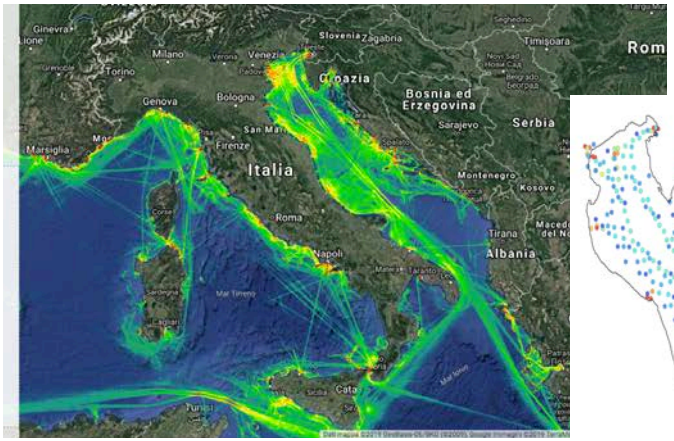

MITgcm model (1/32°) Adriatic-Ionian system (*Querin et al.*, 2013; *Querin et al.*, 2016)

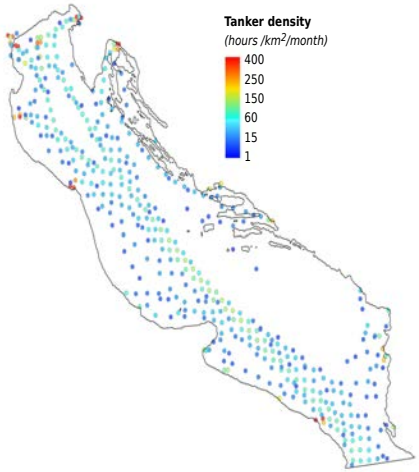
MITgcm hydrodynamic model

# ADRIATIC IONIAN

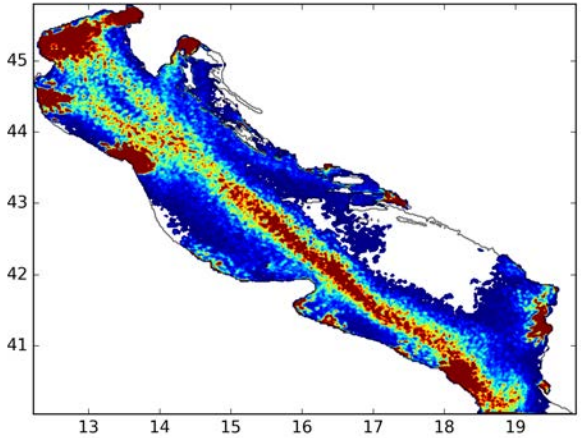
Interreg ADRION ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession II Fund
HarmoNIA

# MAIN SHIPPING ROUTE



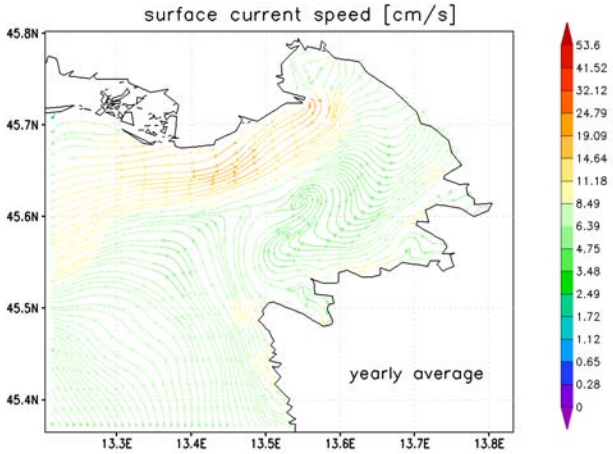

## MAIN 24 H AFTER SPILL

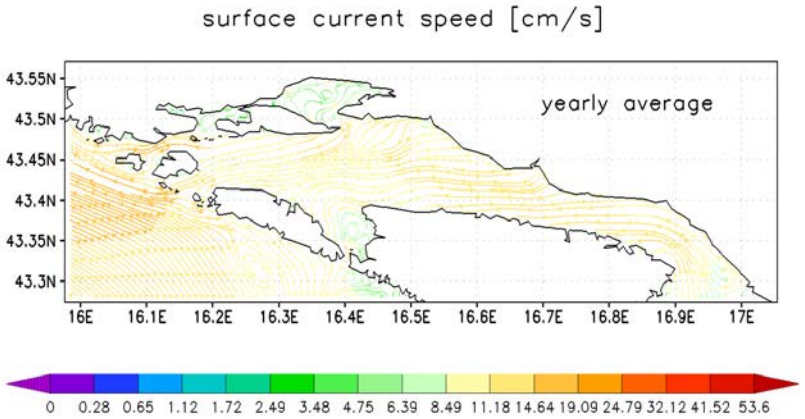



OGS

# High resolution

# Average currents

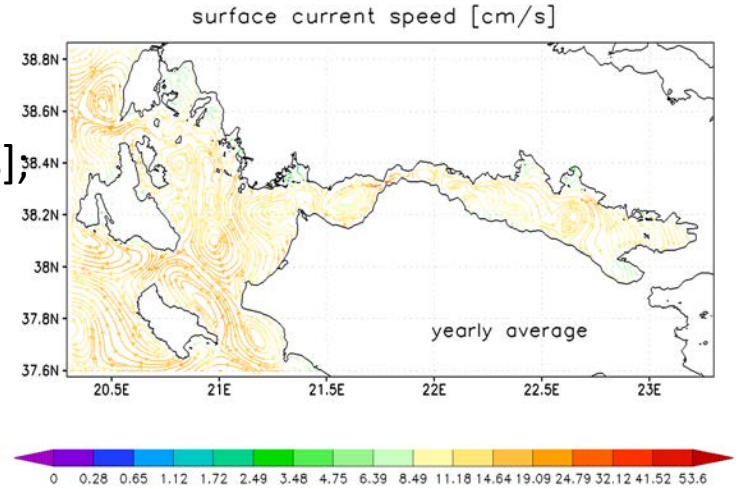



**DATA FILES** for the **WEBportal**:

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

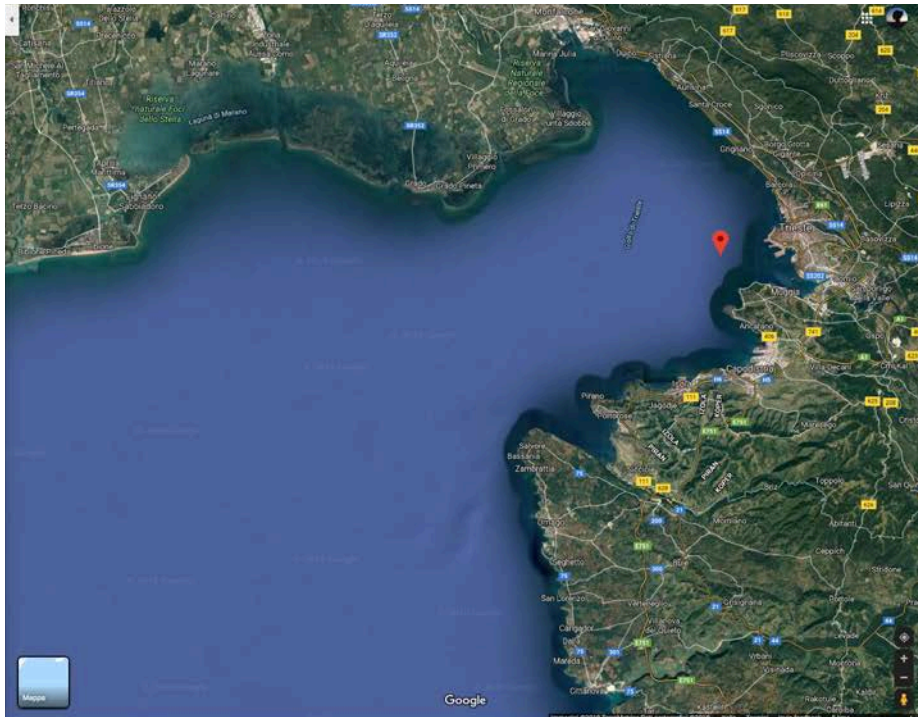
Surface velocities refer to the **u** (zonal) and **v** (meridional) components of water current in the top layer of the model.



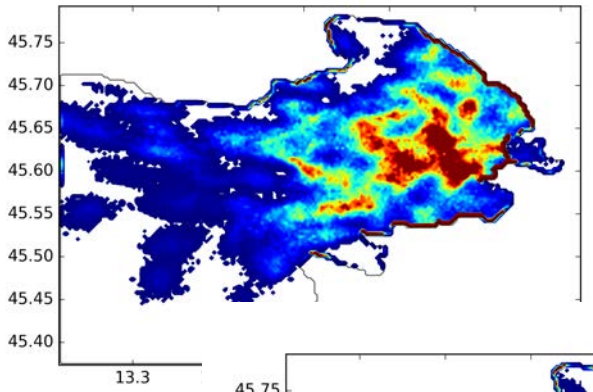
# GULF OF TRIESTE

Interreg ADRION ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession II Fund
HarmoNIA

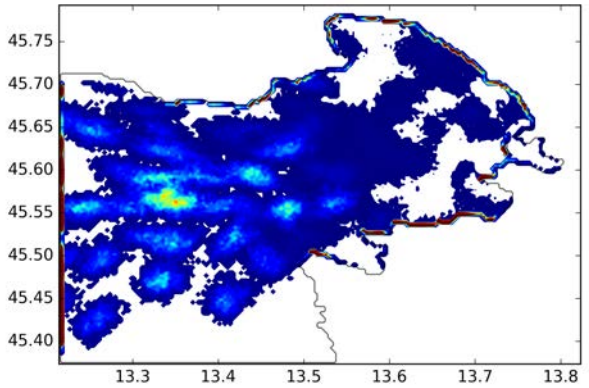
# 24 H AFTER SPILL



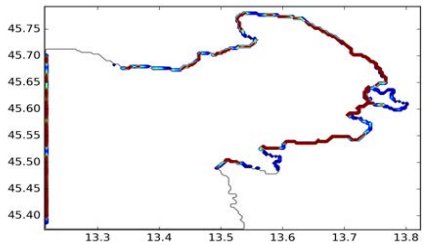

surface




dispersed




slicked



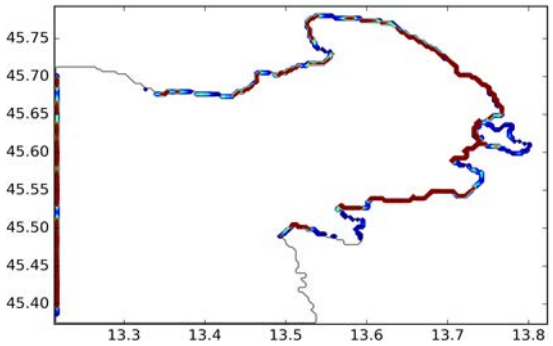

OGS

Trieste online, 17-18/3/2020

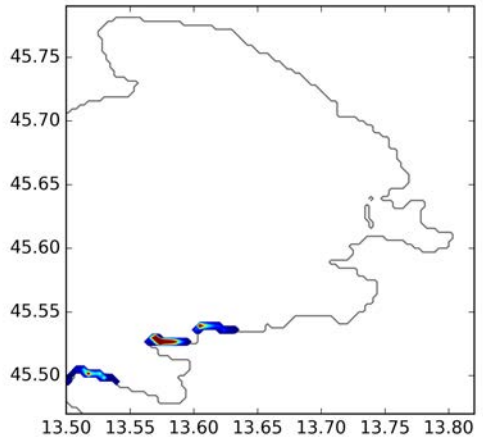
# GULF OF TRIESTE

Interreg ADRION ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession II Fund
HarmoNIA

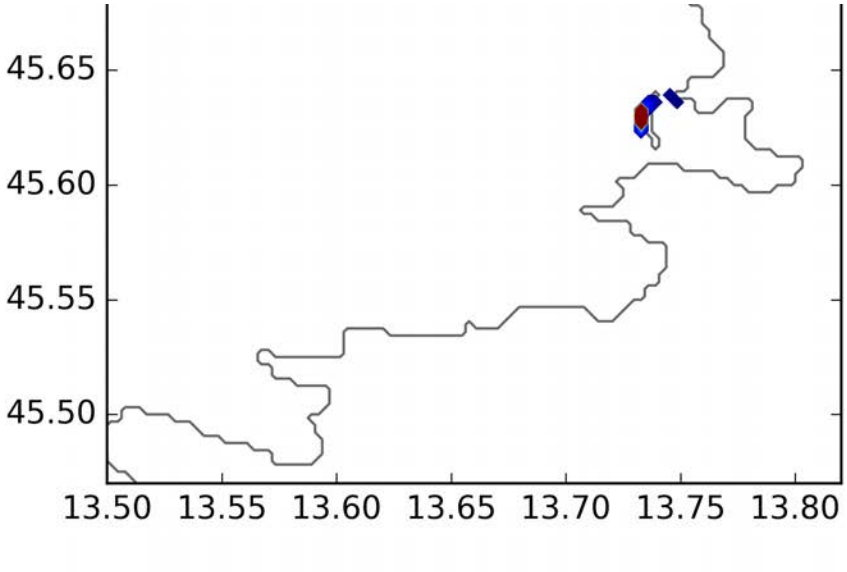
## Average/Worst cases After 24 hours




Average simulation surface




Average simulation Surface, simulation 15 th of April

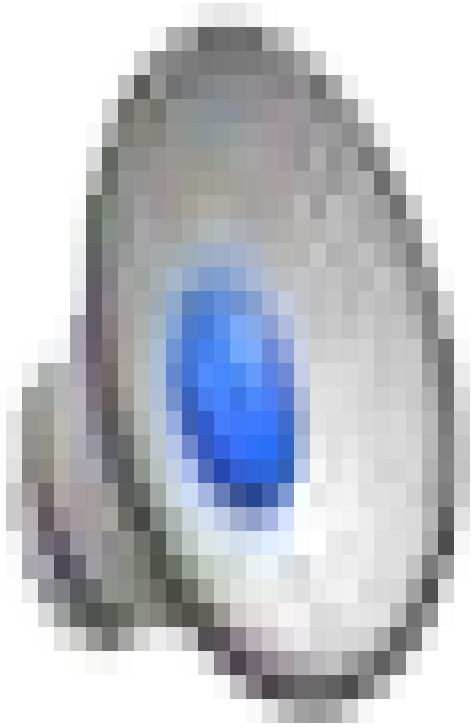



Average simulation Surface, simulation 7 th of November

# GULF OF TRIESTE

Interreg ADRION ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession II Fund
HarmoNIA

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



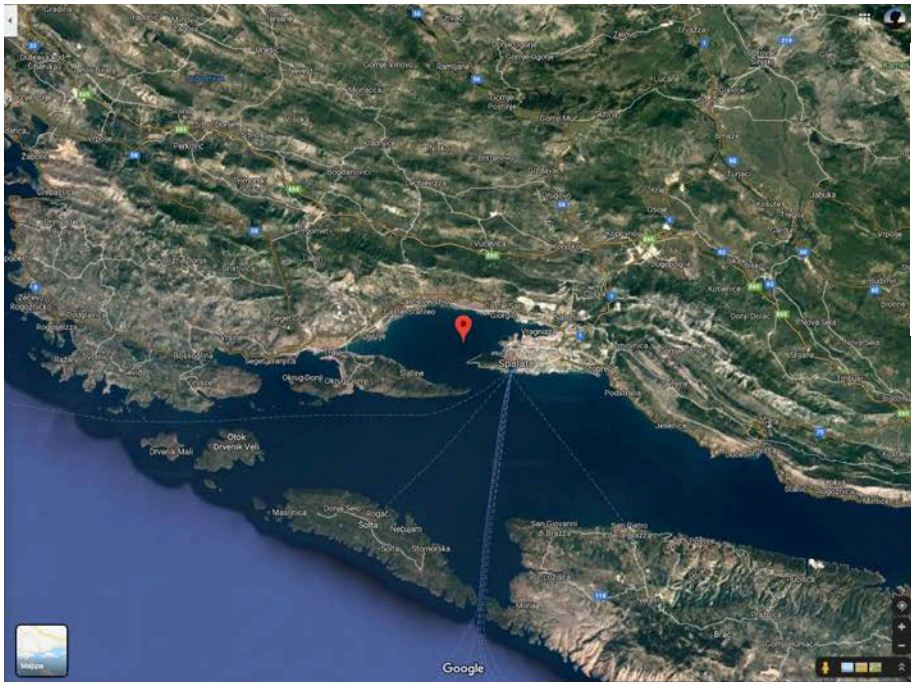
6 days

Spill of 50 mc il Arabian light

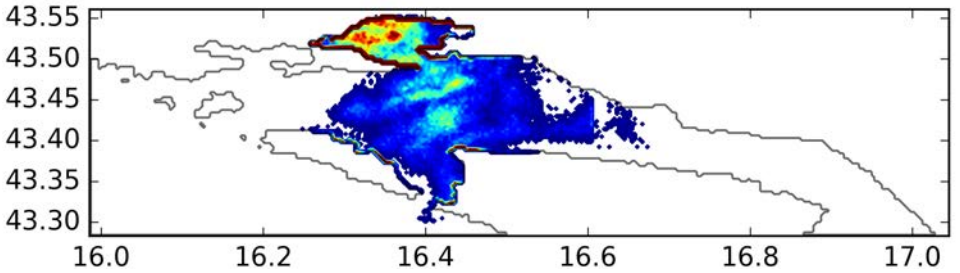
# BAY OF SPLIT

Interreg ADRION ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession II Fund
HarmoNIA

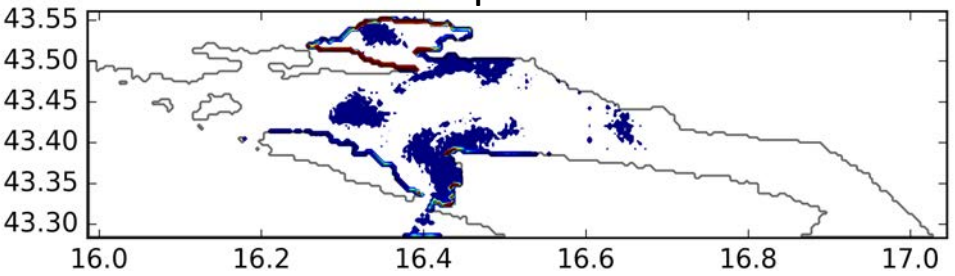
# 24 H AFTER SPILL



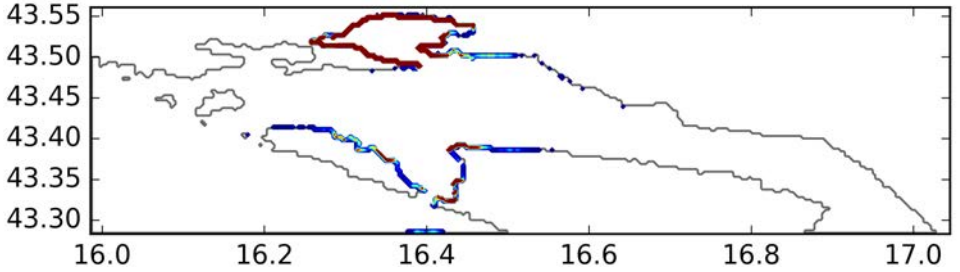

surface




dispersed




slicked

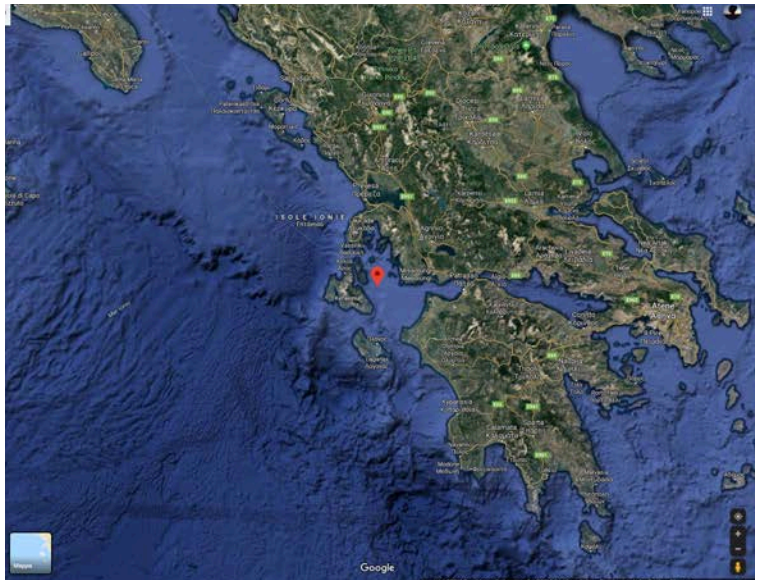


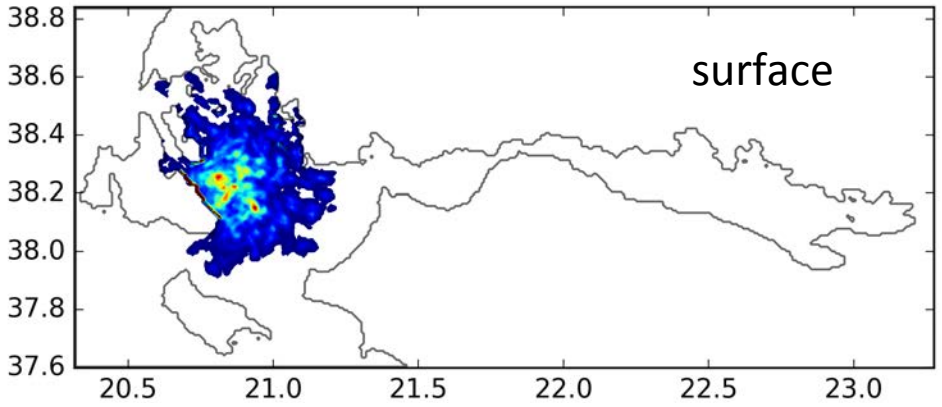

OGS

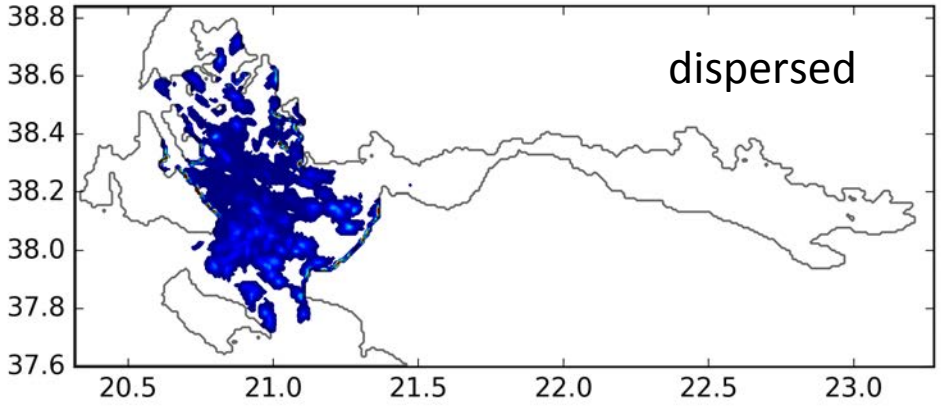
# GULF OF PATRAS

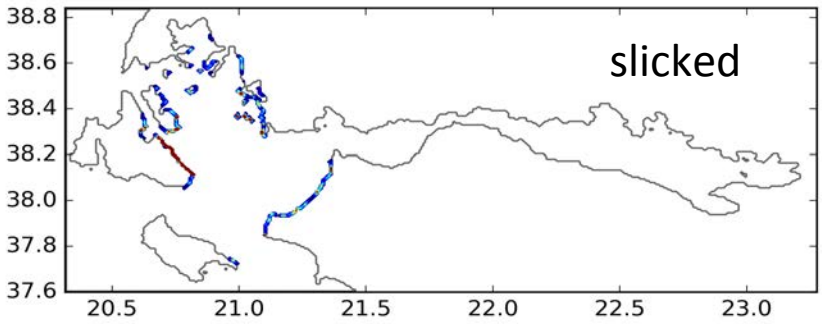
Interreg ADRION ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession II Fund
HarmoNIA

# 24 H AFTER SPILL



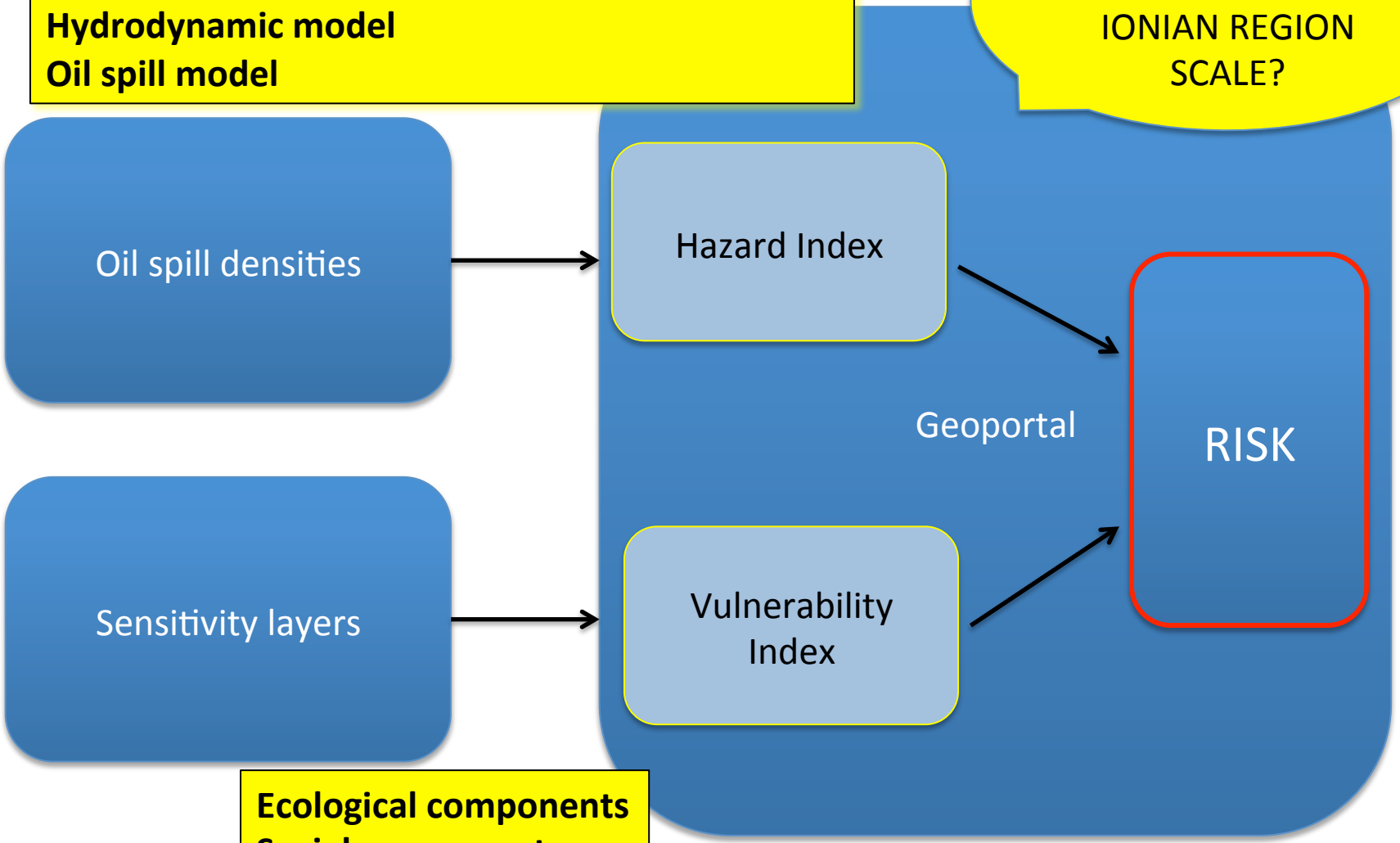

OGS

# Conclusion

# RISK

GAPS AND NEEDS AT THE ADRIATIC IONIAN REGION SCALE?

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




**Ecological components**
**Social components**
**Economic components**