

Oil spill modeling and related topics: summary of recent activities

FIRESPILL | ARPA FVG (PP 11) | Massimo Bagnarol

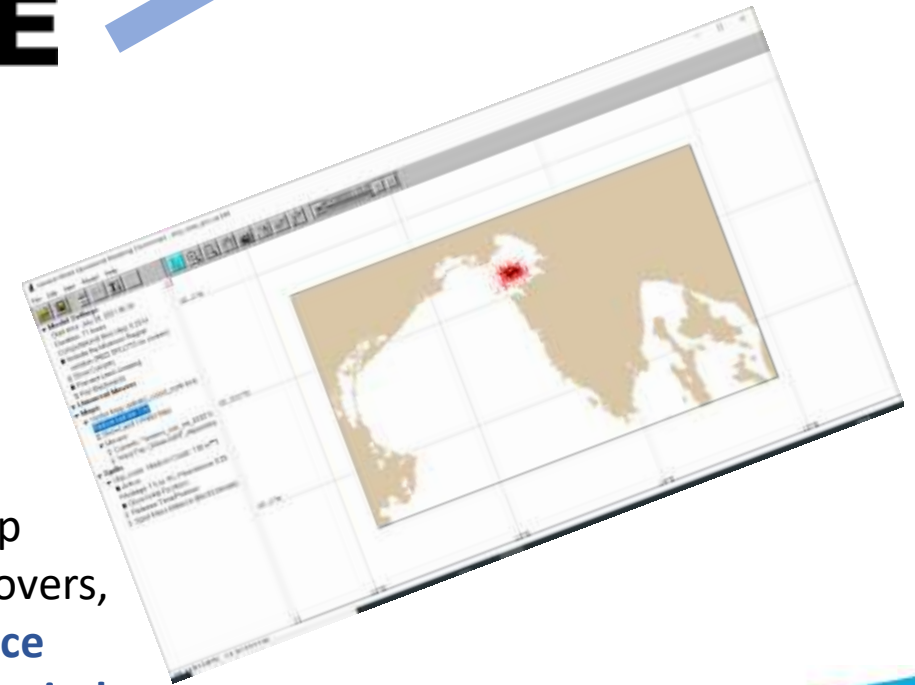
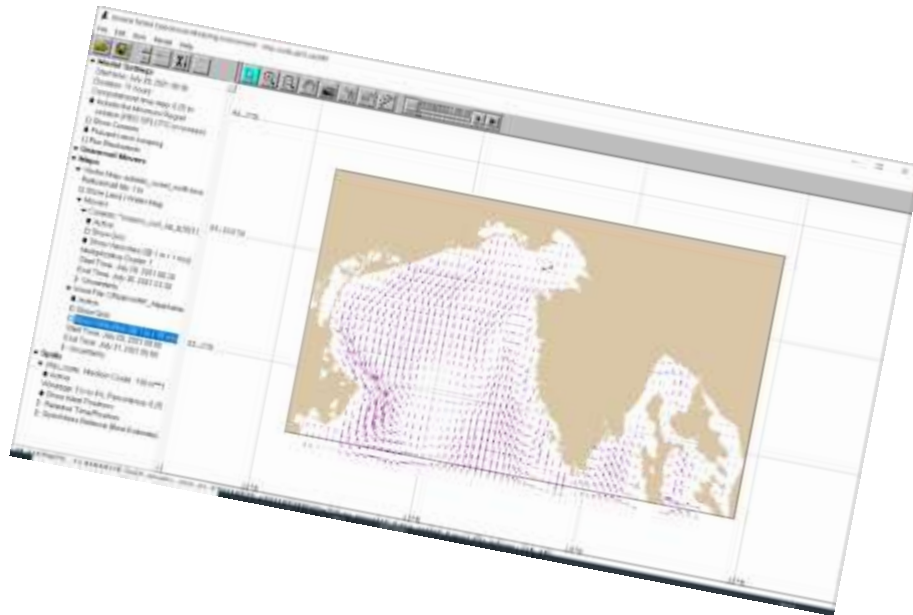
Internal meeting | Palmanova | 05.08.2021

Model for oil-spill emergency response: GNOME

2D Eulerian/Lagrangian model



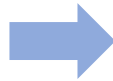
GUI desktop version



Needed inputs:

- **coastline** map
- data of oil movers, such as **surface currents and winds**
- **spill** details

Support to oil-spill emergencies



Spill Information

Spill Name:

Pollutant: # Spills: Windage:

Amount Released: m³ Age at Release: hours

Release start

July 12 2021 Lat: 45.621333 North

Start Time (24-hour): 6:30 Long: 13.552666 East

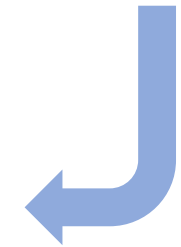
Different end release time: Different end release position:

July 12 2021 Lat: 45.607 North

End Time (24-hour): 7:30 Long: 13.511833 East

decimal degrees
 degrees/minutes
 degrees/minutes/seconds

OK Cancel Help...



Data processing for GNOME: CMEMS currents



INPUT DATA

Content: **current velocity fields**

Format: **NetCDF**

Type: both **forecast (3D)** and **reanalysis (2D)**

Model: **MFS** by CMCC

Horizontal resolution: **1/24°** (ca. 4 km)

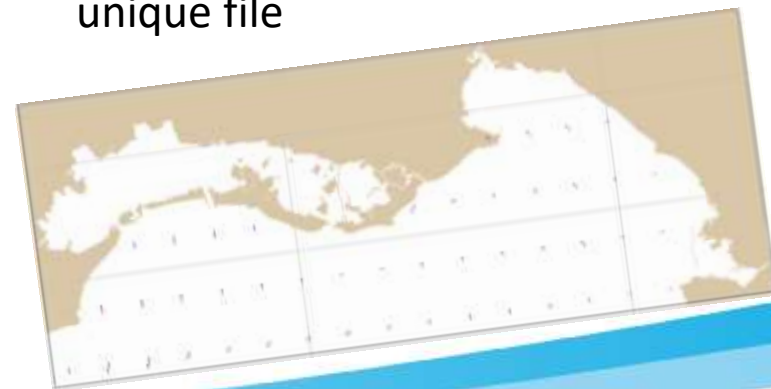
Vertical resolution: **141 levels for forecast**

Temporal resolution: **1 h**

GNOME FOR GNOME

Operations to do:

- **data cut** to retain only those relevant to the sea surface and to the area of interest
- **time axis shift**
- **variable renaming** and **attribute change** to be compliant with GNOME standard
- **merging** of single-day datafiles into a unique file



Data processing for GNOME: WRF winds



INPUT DATA

Content: **wind velocity fields at 10 m**

Format: **NetCDF**

Type: **analysis**

Model: **WRF** at ARPA FVG - CRMA

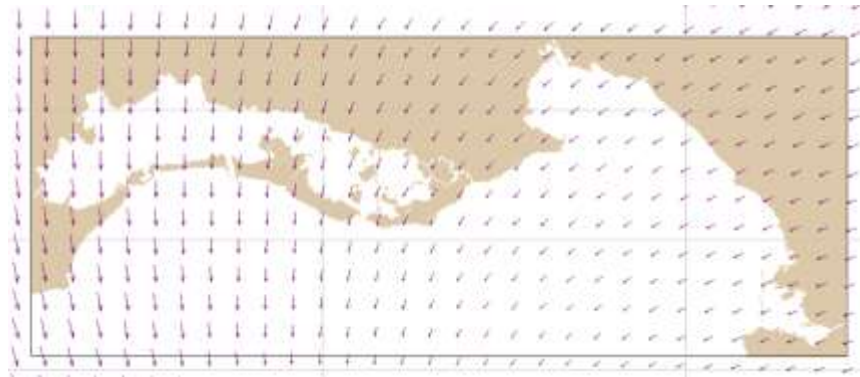
Horizontal resolution: **2 km for AlpeAdria
10 km for Italy**

Temporal resolution: **1 h for AlpeAdria
3 h for Italy**

GNOME FOR GNOME

Operations to do:

- **merging** of files containing data of a single component
- **variable renaming** and **attribute change** to be compliant with GNOME standard



Data processing for GNOME: SHYFEM currents



INPUT DATA

Content: **current velocity fields**

Format: **SHY**

Type: both **hindcast** and **forecast**

Model: **SHYFEM** at ARPA FVG - CRMA

Horizontal resolution: **variable**, up to **tens of meters** in the lagoon

Vertical resolution: **variable**

Temporal resolution: **1 h**

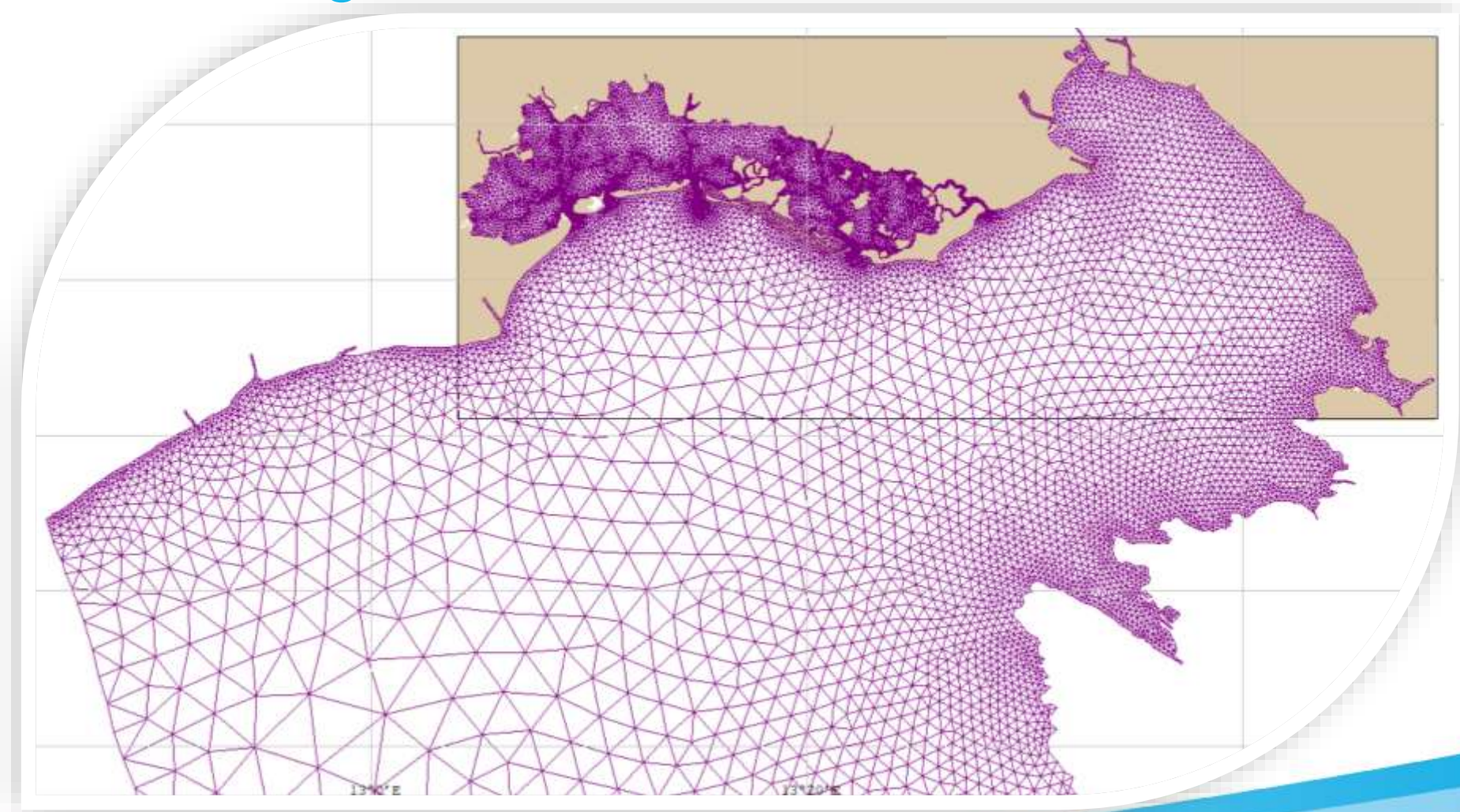
GNOME FOR GNOME

Operations to do:

- **conversion from SHY to NetCDF** to be loadable by GNOME
- **extraction of grid boundary nodes and lines**, and **classification** of boundary lines
- **insertion of a new variable** in the NetCDF file, with information about boundary lines
- **variable renaming** and **attribute change** to be compliant with GNOME standard
- **data cut** to retain only those relevant to the sea surface

NB: joint work with A. Minigher

SHYFEM grid as viewed via GNOME



Daily processing of forecast data

Work flow is managed by *Gnome_movers* ecFlow suite

```
GNOME_movers ▲
  YMD=... 20210730 ...
  t_color ▲🕒
  fvg_coast ▲🕒
    /GNOME_movers:TIME >= 2345
    time 04:00 23:30 00:30 # nextTimeSlot=10:30 🕒
    t_cmems_curr ▲
      info: 20210730 data not found, 20210729 data already ok
      curr_ok
      already_done
    t_wrf_wind
      info: output already OK
      wind_ok
      already_done
    t_roms_curr
      info: output already OK
    t_zip ▲
      north_adriatic ▲🕒
      full_adriatic ▲🕒
      t_clean 🕒
```



Availability of daily GNOME inputs to external users



Zip archive



Public access webpage

interreg Italy - Croatia FIRESPELL | GNOME model driving forces | arpa FVG | CRMA

interreg154R-FIRESPELL@ARPA-FVG-CRMA

Driving forces for oil spill simulations via GNOME model

Scenario	Before controls	Works at 10 m	Link to zip archive	Last update
FVG coast	Source: CRMS Model: MFS (Mod Control) - ERM Product: FRESPELL_ANALYSISPROCKOT_FVG_COA_FVG Horizontal resolution: 124' (ca. 4 km) Temporal resolution: 1 h	Source: ARPA FVG - CRMA Model: MFS v. 3.3.1.7 Horizontal resolution: 2 km Temporal resolution: 1 h	WRF-MFS access for FVG coast	FR 22 06:30:04 UTC 2021
FVG coast	Source: Arpa - SMC Model: ANALYSIS Horizontal resolution: 2 km Temporal resolution: 2 h	Source: ARPA FVG - CRMA Model: MFS v. 3.3.1.7 Horizontal resolution: 2 km Temporal resolution: 1 h	WRF-CRMS access for FVG coast	FR 22 06:30:04 UTC 2021

Contribution to deliverable 4.3.1 of FIRESPELL project



Act 4.3 OIL SPILLS AND OTHER MARINE HAZARDOUS POLLUTANTS DEPLOYMENT

Start date: 01/02/2021
End date: 30/06/2022

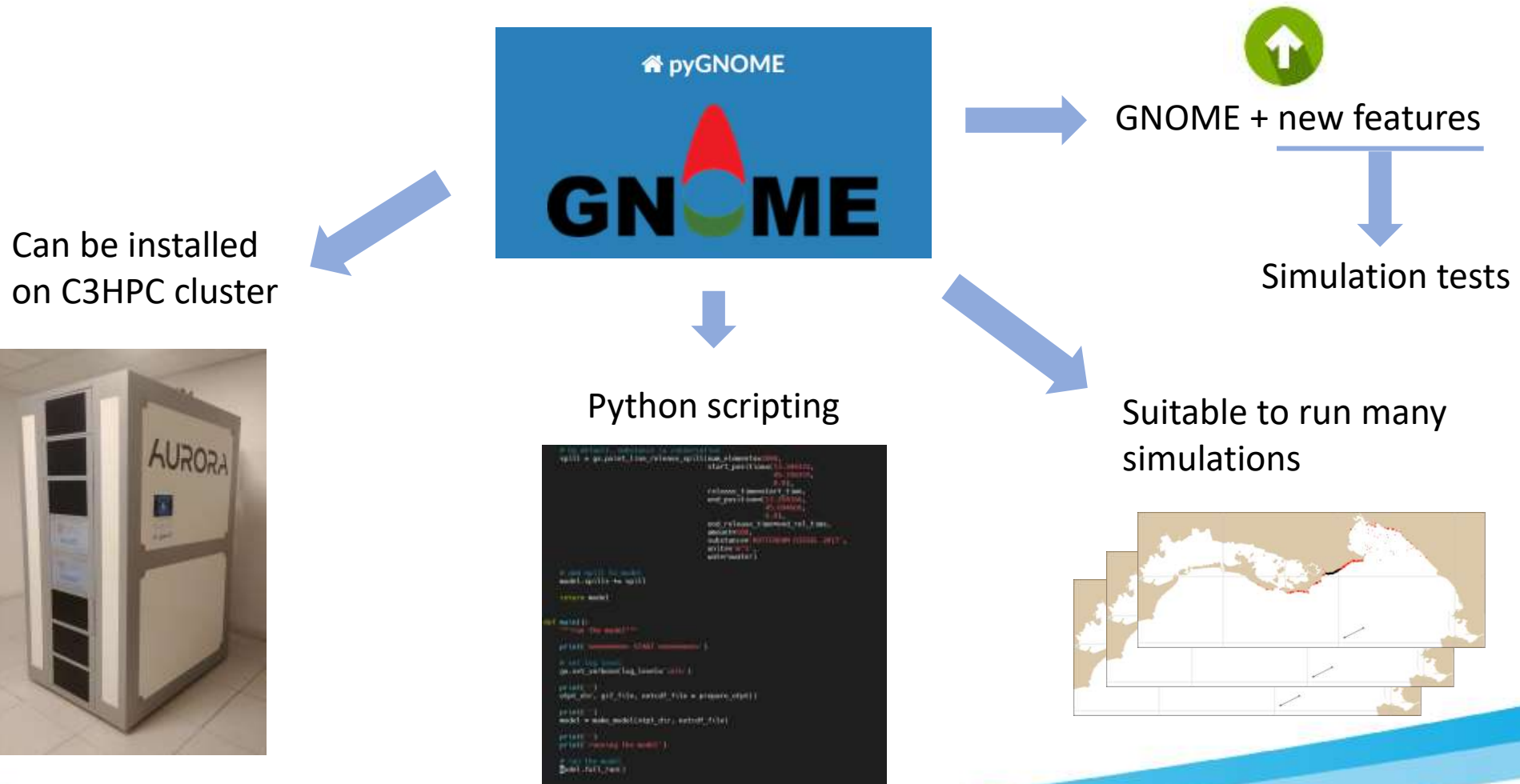
Activities refer to the development of methodology for risk assessment for oil spills in the Adriatic Sea providing data collection on maritime traffic, possible sources of pollution, exposure, environmental sensitivity, impacts on human life, environment and economy etc. Simulations of oil spill scenarios using oil spill trajectory models for tracking the movement of the oil slick, and oil spill dispersion model for predicting possible impacts to the environment are foreseen. Capitalization of existing simulation models for oil spills and its upgrade with new functionalities will be available to all partners through web interface and interoperable services and development of oil spill operational prototype and hazard mapping capabilities relevant for all partners. Equipment to act in case of oil spills and other marine hazards will be improved, as well as specialized exercises and simulations for coast guards and civil protection units thus increasing their level of preparedness.

Deliverable

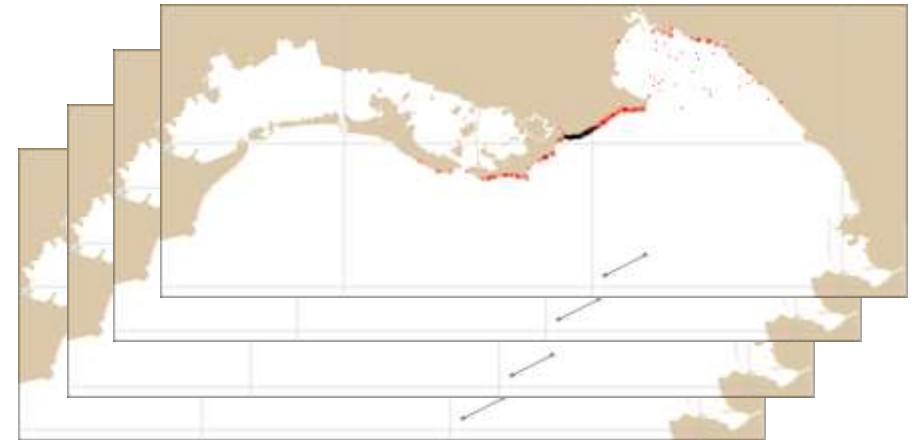
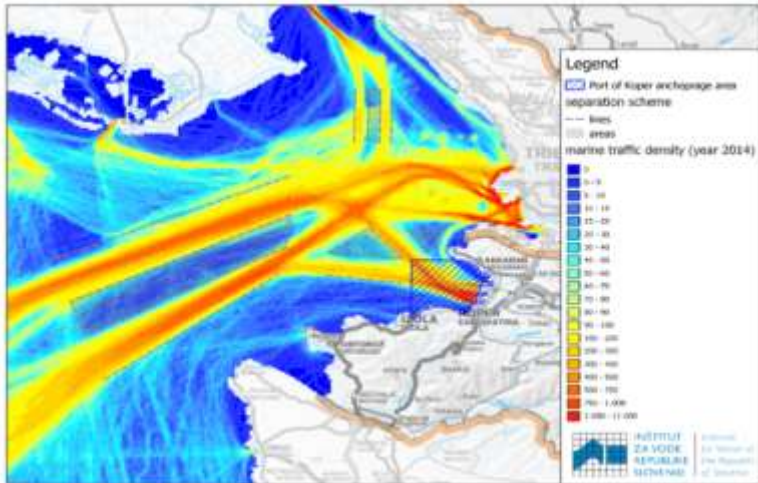
D4.3.1 - N° 1 Pilot deployment of "Oil spills and other marine hazards" Pilot deployment of "Oil spills and other marine hazards" will consist of:

- N° 1 Methodology/guidelines for risk assessment for oil spills in the Adriatic Sea developed (PP4)
- N° 1 Oil spill operational prototype and hazard mapping algorithm developed (PP9)
- N° 2 Enhanced simulation models for oil spills and other marine hazards (PP9, PP11)
- N° 5 Specialized exercises implemented (with usage of personal protective equipment and specialized equipment/life jackets, boats, etc...) (1 exercise per PP)

Model for oil-spill risk assessment: pyGNOME



Planned activities for risk assessment (1)

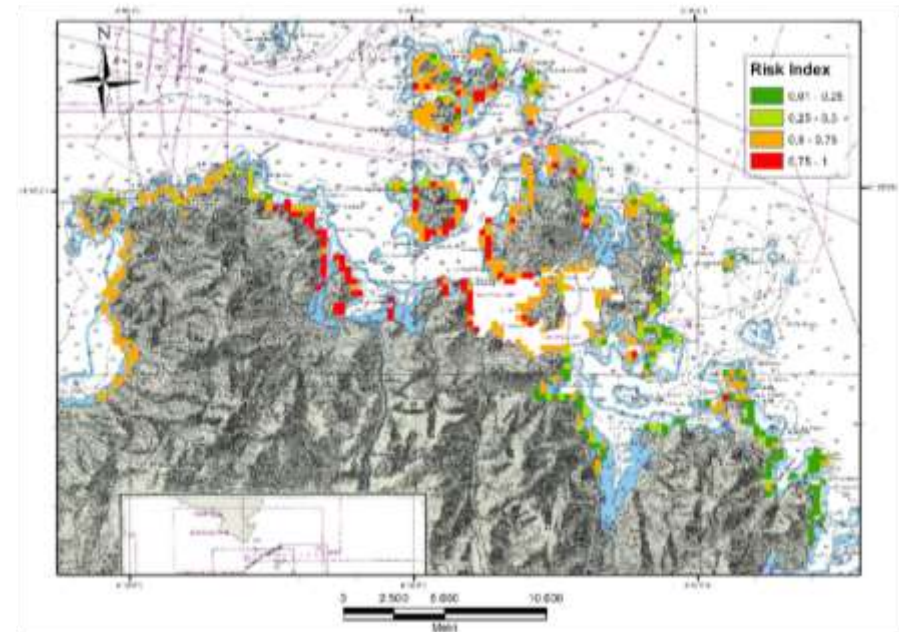


1. Identification of possible sources, for instance by means of the analysis of shipping routes

2. For each source, simulations of hourly occurrence of an oil spill for a whole year

Planned activities for risk assessment (2)

```
setdiff_test {
dimensions:
  Time = UNLIMITED ; // (253 currently)
  data = UNLIMITED ; // (240665 currently)
  two = 2 ;
  three = 3 ;
  weathering = 22 ;
variables:
  double time(time) ;
    time:long_name = "time since the beginning of the simulation" ;
    time:standard_name = "time" ;
    time:calendar = "gregorian" ;
    time:comment = "specified time zone" ;
    time:units = "seconds since 2020-08-01T00:00:00+00:00" ;
  int particle_count(time) ;
    particle_count:units = "1" ;
    particle_count:long_name = "number of particles in a given timestep" ;
    particle_count:ragged_row_count = "particle count at nth timestep" ;
  int age(data) ;
    age:long_name = "age of particle from time of release" ;
    age:units = "seconds" ;
  short status_code(data) ;
    status_code:long_name = "particle status code" ;
    status_code:flag_values = 0L, 1L, 2L, 3L, 4L, 5L, 6L, 7L, 8L, 9L, 10L, 11L, 12L ;
    status_code:flag_meanings = "not_released:0 in_water:1 on_land:2 off_shelf:3 evaporated:4 to_be_removed:5 as_tideflat:6" ;
  double mass(data) ;
    mass:long_name = "mass of particle" ;
    mass:units = "kilograms" ;
  double depth(data) ;
    depth:long_name = "particle depth below sea surface" ;
    depth:standard_name = "depth" ;
    depth:units = "meters" ;
    depth:axis = "z positive down" ;
  double density(data) ;
    density:long_name = "medium density at end of timestep" ;
    density:units = "kg/m^3" ;
  double viscosity(data) ;
    viscosity:long_name = "medium viscosity at end of timestep" ;
    viscosity:units = "m^2/sec" ;
  int id(data) ;
    id:long_name = "particle ID" ;
  double surface_concentration(data) ;
```



3. Output analysis and interpretation

4. Risk maps

Complementary activities

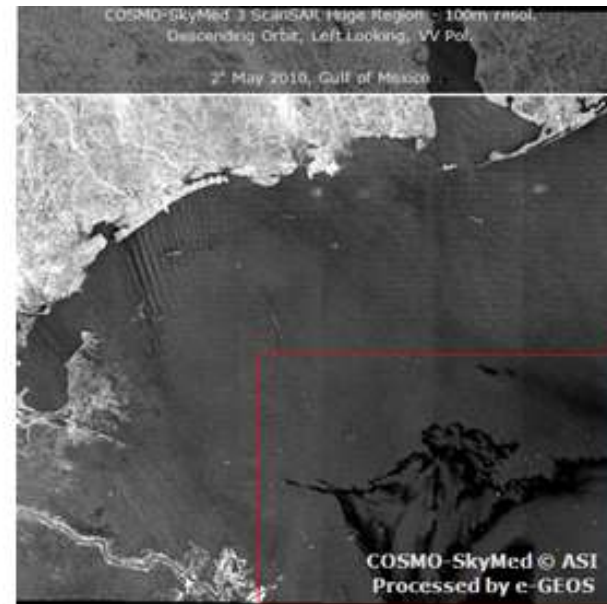
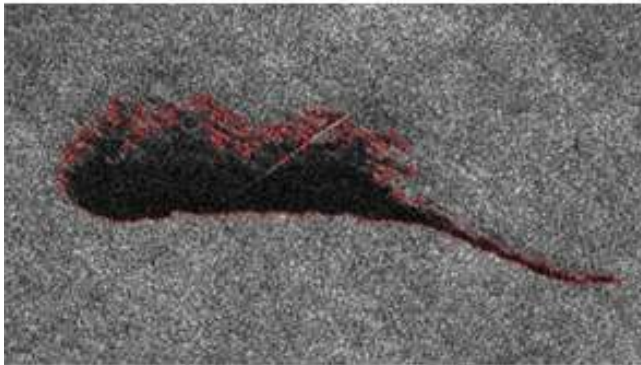
Model validation via **remote sensing** tools



costeLAB



Pre-operative platform for monitoring coastal areas through **satellite image** processing



Communication to stakeholders

Presentation of pilot concepts to target groups



Deliverable 4.1.2



L'approccio modellistico alla gestione delle emergenze di oil-spill e alla valutazione del rischio di impatto ambientale

FIRESPELL | ARPA FVG (PP 11) | Massimo Bagnarol

Presentazione progetto FIRESPELL | Zoom | 29 luglio 2021

European Regional Development Fund

PRESENTAZIONE PROGETTO INTERREG IT-HR FIRESPELL

ARPA FVG Agenzia per la Protezione dell'Ambiente del Friuli Venezia Giulia è lieta di invitare alla

PRESENTAZIONE PROGETTO INTERREG IT-HR FIRESPELL
Affrontare l'emergenza ambientale nel caso di perdite di idrocarburi in mare ed altri rischi marini

WHEN
29 LUGLIO 2021 ORE 9.30

WHERE
ZOOM MEETING

PROGRAMMA

Saluti iniziali
Fabio Scoto (marina, Accesso alla Difesa dell'Ambiente, energia, sviluppo sostenibile Regione Autonoma Friuli Venezia Giulia)
Stefano Vatta, Direttore generale Arpa FVG

Presentazione del progetto FIRESPELL – descrizione generale del progetto e obiettivi specifici per ARPA FVG e benefici per la regione FVG
Dario Giaretti, Arpa FVG Centro regionale modellistica ambientale

L'azione pilota in Friuli Venezia Giulia
Dario Giaretti, Arpa FVG Centro regionale modellistica ambientale

L'approccio modellistico alla gestione dell'emergenza di oil-spill e alla valutazione del rischio d'impatto ambientale
Massimo Bagnarol, Arpa FVG Sviluppo sostenibile, innovazione e semplificazione

La strumentazione e dei dispositivi per il monitoraggio durante le emergenze (RADAR, droni, drifter)
Stefania Del Frate, Arpa FVG project manager FIRESPELL

Discussione e risposte alle domande
Moderata: Stefania Del Frate

Per partecipare, compilare il modulo al seguente link: <https://bit.ly/2hwU6e8>

European Regional Development Fund

What's next?



Adding daily **SHYFEM** forecasts for emergency response with GNOME



Proceeding with oil-spill risk assessment



Using **STELLA** software for system dynamics modeling



Introducing **MEDSLIK-II** model

References

Interreg IT-HR FIRESPILL: <https://www.italy-croatia.eu/web/firespill>

ARPA FVG – FIRESPILL: http://www.arpa.fvg.it/cms/istituzionale/servizi/progetti_europei/firespill.html

GNOME driving forces webpage: http://interreg.c3hpc.exact-lab.it/FIRESPILL/gnome_inputs/gnome_inputs.html

GNOME model: <https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/gnome.html>

pyGNOME: <https://gnome.orr.noaa.gov/doc/pygnome/index.html>

MEDSLIK-II model: <http://www.medslik-ii.org/>

CMEMS: <https://marine.copernicus.eu/>

WRF model: <https://www.mmm.ucar.edu/weather-research-and-forecasting-model>


SHYFEM model: <https://sites.google.com/site/shyfem/home>

costeLAB platform: <https://www.costelab.it>


Contacts

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 www.italy-croatia.eu/firespill