

WARNING SYSTEM FOR MARINE MINE AND LAND-BASED POLLUTION IN THE ROMANIAN COASTAL AREA

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Introduction



Context

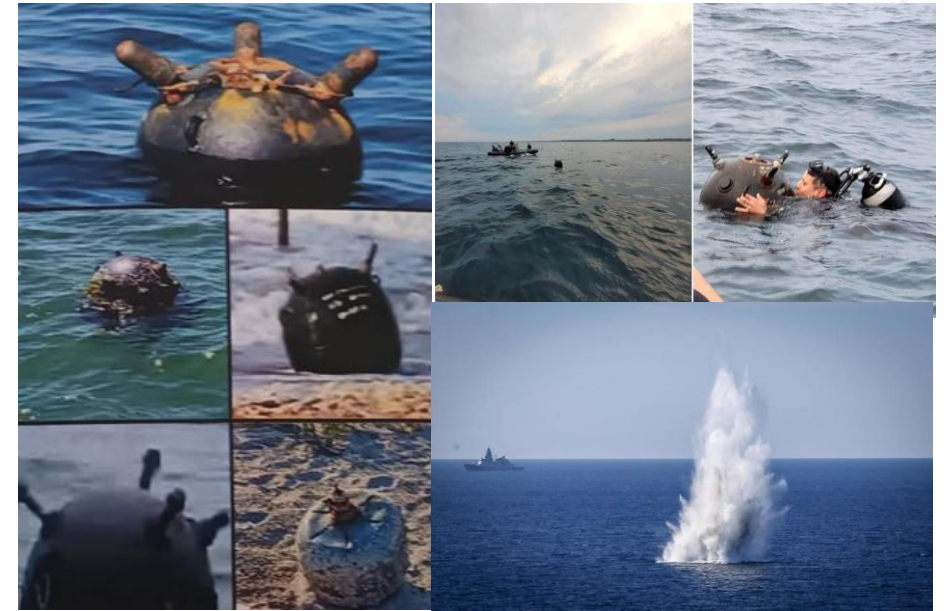
A regional conflict close to Midia and Constanta are the end points of the European transport corridor VI / Rhine - Danube.

Approximately 19 thousand sea and river vessels pass through both ports annually.

Major treats: marine pollution

Interest conflicts with: the regional fishing/and /BS fisheries

Recent threats: **marine mines from the conflict zone**



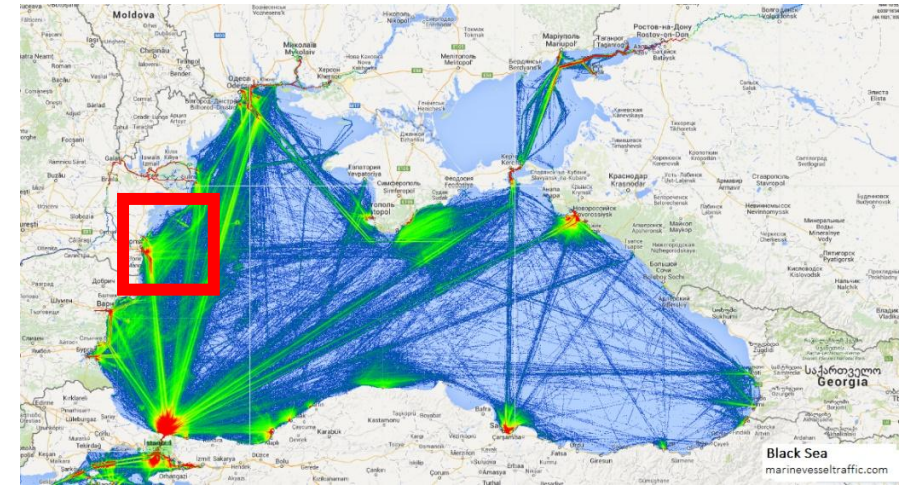
Syroco-2025 project

Necessity:

Ensure safe navigation for the main maritime routes/ports within the **Western Black Sea**

Main objectives:

- use CMEMS Black Sea products and locally acquired data , to provide tracking of freely drifting military mines based on **high-resolution oceanographic forecast**
- Provide an IT platform for **decision support** of specific maritime stakeholders' activities
- Two USECASES



Main Outcome - Copernicus Marine Products and Coastal models:

1. Service focused on MARINE MINES MONITORING
2. Service focused on improving the safety of BATHING AREAS within Romanian/Western Black Sea touristic resorts

Syroco – 2025 Project

Consortium



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Elena Vlasceanu



Luc Vandenblucke

NIMRD - Romanian National Institute for Marine Research and Development

- National operator of the integrated physical, chemical and biological monitoring system of the marine environment;
- National scientific responsibility for the implementation of the Marine Strategy Framework Directive (MSFD);
- Regional Activity Center for Environmental Issues in Fisheries and Management of Other Living Marine Resources;
(<https://www.rmri.ro/Home/Home.html>)

SEAMOD Romania (<https://seamod.ro/>)

- Develops and provides practical solutions based on numerical modeling and information technologies – coastal dynamics, environment, harbours & ports, oil&gas, aquaculture, etc
- Background of consultancy projects, offering a combination of engineering experience, scientific knowledge and technological implementation capacity.

Use-cases

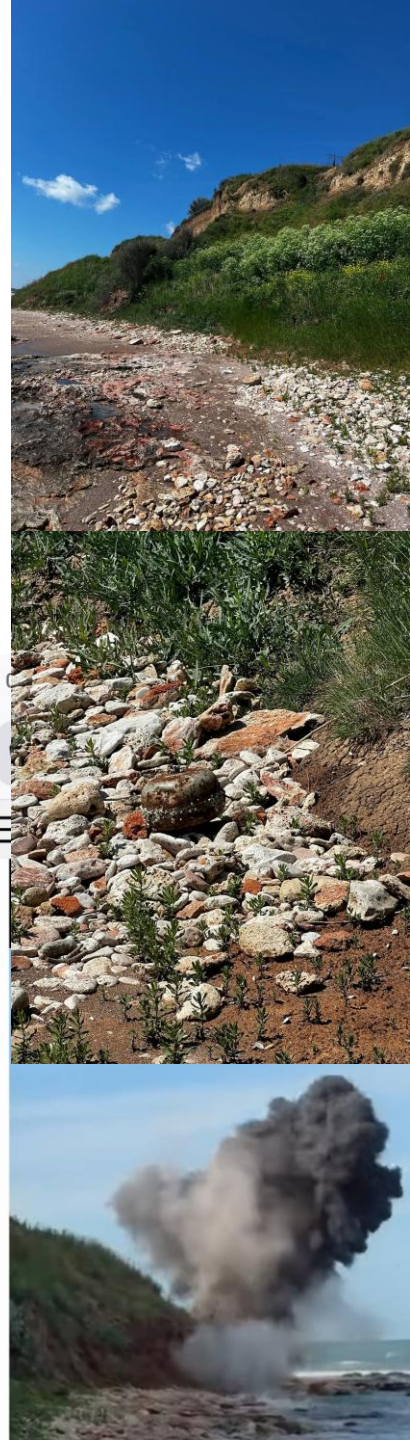
Use Case 1: tracking of freely drifting military mines

Floating mines are signaled by sea-goers (fisherman)
Authorities will access a web-platform to compute the mine drift

Obtain a forecast of the most probable location and of envelope

Ultimately, the aim is for the recovery effort to be more efficient and increase recovery rate

End user: Maritime Hydrographyc Division/[Directia](#)
[Hydrografică Maritimă](#)



Use-cases

Use Case 1: tracking of freely drifting military mines



Ocean**Parcels**

SYROCO observatory – current status – ongoing from the SYROCO project (2024)
NEMO-AGRIF 4.2 nested in CMEMS BLK-MFC

parcels.jl -- a julia clone of Ocean Parcels

- Multiple input (Nemo + WAM + wind) advection
- Seamless flow in between nested grids
- Diffusion
- Beaching (freeze or push-back)
- dikes and barriers
- natively fast, MPI parallelization

6

→ complete platform linking SYROCO forecasts, parcels.jl and user interface:

<https://marine.copernicus.eu/services/use-cases/black-sea-maritime-mines-tracker-support-maritime-safety>

Use Cases

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National Collaboration Programme >

Use Cases >

Use Cases by Topic >

The Copernicus Marine Service **provides ocean products and services for many marine applications** worldwide. We publish here Use Cases sorted by region, country, market sectors, highlighting examples on how marine data we provide for free is used and what are the benefits for users.

Region

Country

Markets

Funding Programme

Black Sea

Romania

All

All

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Black Sea maritime mines tracker to support maritime safety



Protecting Romanian Beaches from Plastic Pollution with Romanian Coastal



Operational Service for Safe Navigation in the Western Black Sea SAFEBLESS

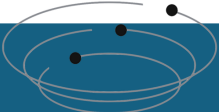


Metocean analysis to support Maritime Spatial Planning in the western Black Sea

What is parcels.jl ?

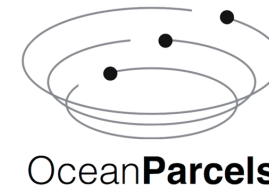
A Lagrangian tracker loosely cloned from ocean parcels

<https://parcels-code.org/>

Differences	OceanParcels  OceanParcels	parcels.jl 
language	Python with “kernels” written in a Python subset, converted to C and compiled just-in-time	Julia (natively fast)
parallelization	parallel computation possible using MPI	natively parallel using MPI: threads are either <i>readers</i> , <i>writers</i> , or <i>computers</i> . <i>Computer</i> threads compute full-time (no i/o).
input currents	possible to use nested grids Grids follow Arakawa conventions	natively allowing arbitrary grids (nested, ...) with arbitrary conventions
input wave, wind	possible to use multiple inputs, code needs to be adapted to <i>also</i> use nesting	natively allowing arbitrary combinations of grids
startup time in operational settings	• at startup, data files are browsed to check for date/time information • actual data is “lazy loaded” during the simulation	• a data catalogue is updated when new input files become available • at startup, parcels.jl reads the catalogue, not the data files • actual data is “lazy loaded” during the sim.

What is parcels.jl ?

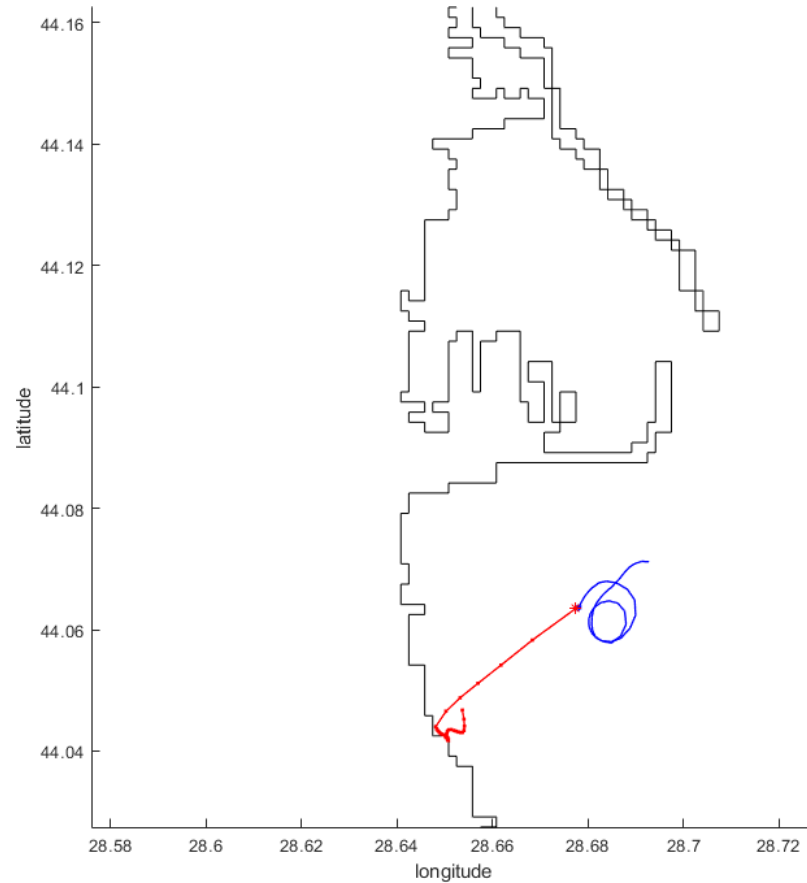
A Lagrangian tracker loosely cloned from ocean parcels
<https://parcels-code.org/>



- OceanParcels has many available kernels: diffusion, larvae growth, particle-particle interaction...
- parcels.jl cloned the kernels useful for object types currently available: dissolved particles, macro-plastics, micro-plastics, floating military mines, person-in-the-water (P-I-W)
- objects have their own characteristics, e.g. plastics: size and density, P-I-W: age, floating device or not, clothed or not, alive or not, etc.
- kernels include: 2D and 3D advection incl. Stokes drift (vertical extension cloned from OpenDrift), diffusion, decay, sinking, beaching/freezing/unbeaching, barriers (dikes etc), biofouling, rotting, etc

SYROCO is a forecasting system including a (very user-friendly) web platform
Users can run on-demand Lagrangian simulations

Validation – Lagrangian model in the coastal grids



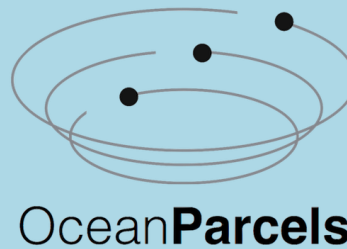
- Loose spotter buoy
- Extremely poor ECMWF wind field
- Poor surface current, poor Stokes drift, poor windage effect
- By luck, still small separation after 5 days (~3.5 km)
- Need more Lagrangian data

4. Associated Use case - Syroco 2024

Use Case : macro-plastics pollution

Ocean Parcels 3.0 configuration :

- Nested grids
- Multiple sources
- Custom kernels
 - Runge-Kutta 4 advection
(inputs: NEMO, WAM, ECMWF)
 - Diffusion (stochastic run)
 - Beaching (freeze)
 - « dikes »



Ocean Parcels Julia :

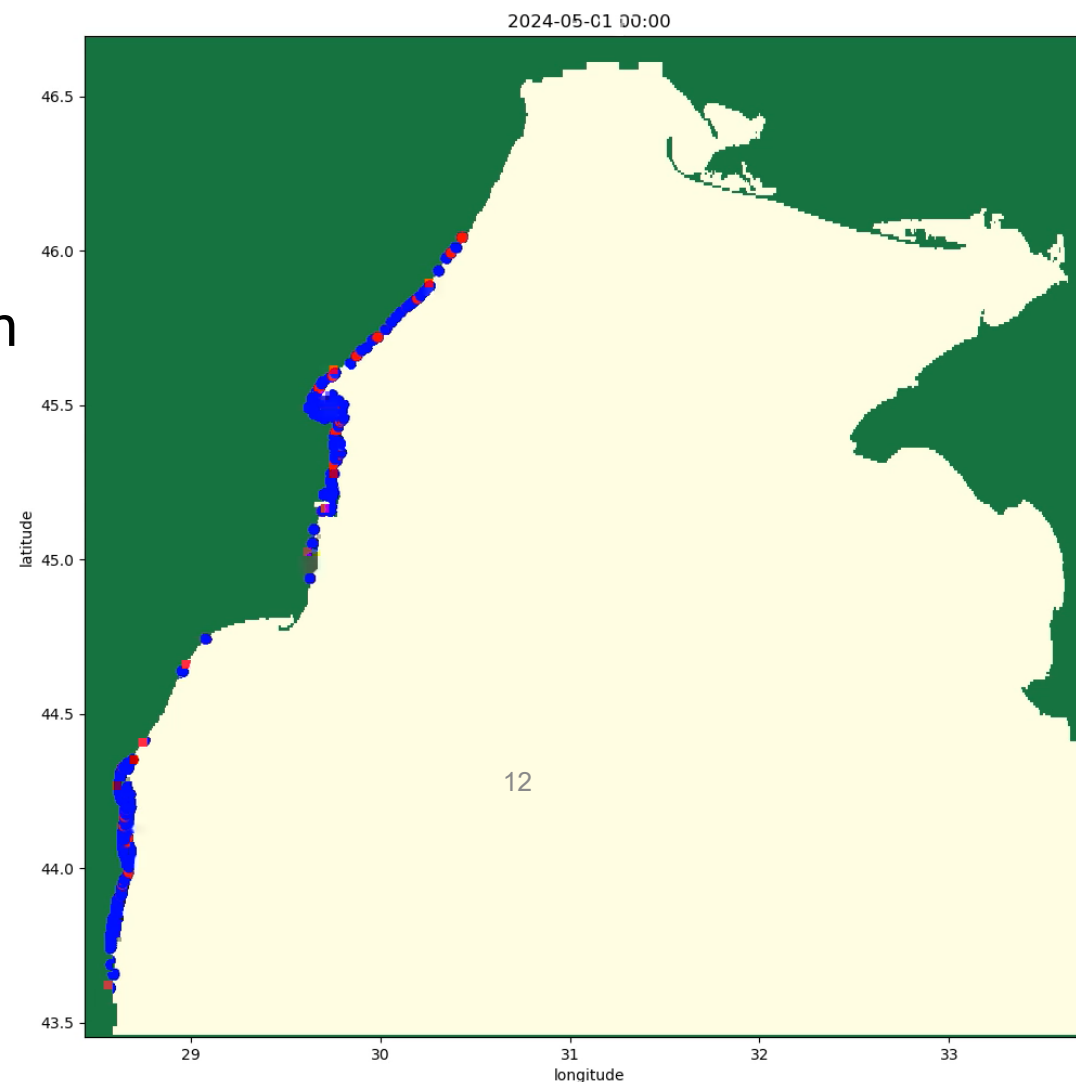
- all the features used before
- but in pure Julia
- parallized from scratch with MPI
(io threads, computing threads)
- input file catalogue

→ *fast* ←

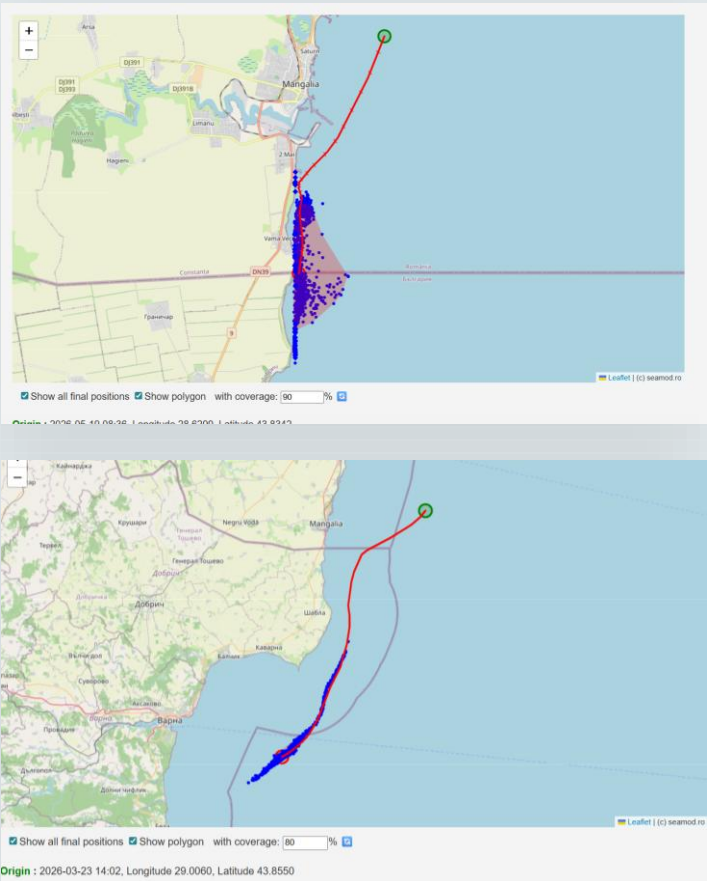
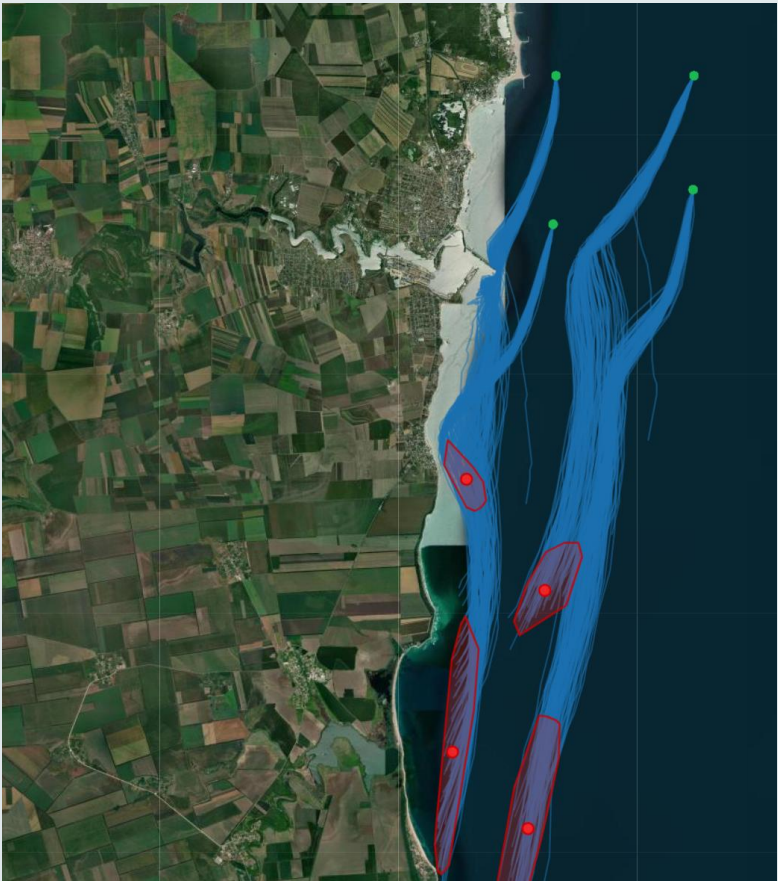
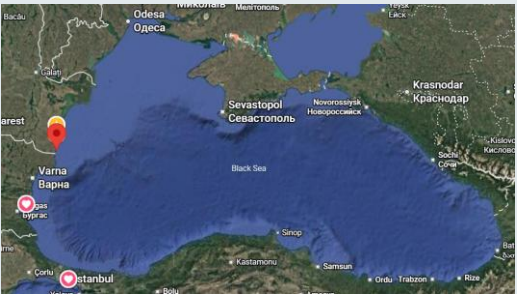
Use case Syroco 2024

From simulation
results

To coastal density maps:
(particles / km)
→ Actionable deliverable



Example of user simulation results :



Recent threats



Usecase 2: Baywatch support



Thanks for your attention!

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