WP5
LandSeaLot Integration Labs (LIL)

Debora Bellafiore, CNR-ISMAR, Romaric Verney, IFREMER

26-28/03/2024

Funded by
the European Union

LandSeaLot has received funding from the European Union's Horizon Europe Framework Programme for Research and Innovation under grant agreement No 101134575. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

WP5 Objectives

To demonstrate how increased observation capabilities and innovative integrative methodologies provide essential knowledge to address main societal challenges at the LandSeaLot Integration Labs (LILs).

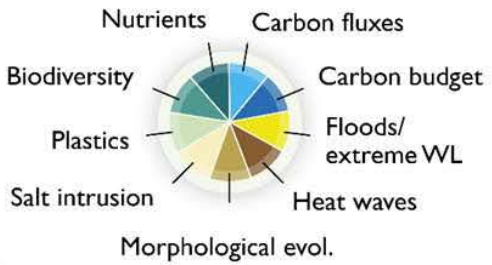
INTEGRATION LABS

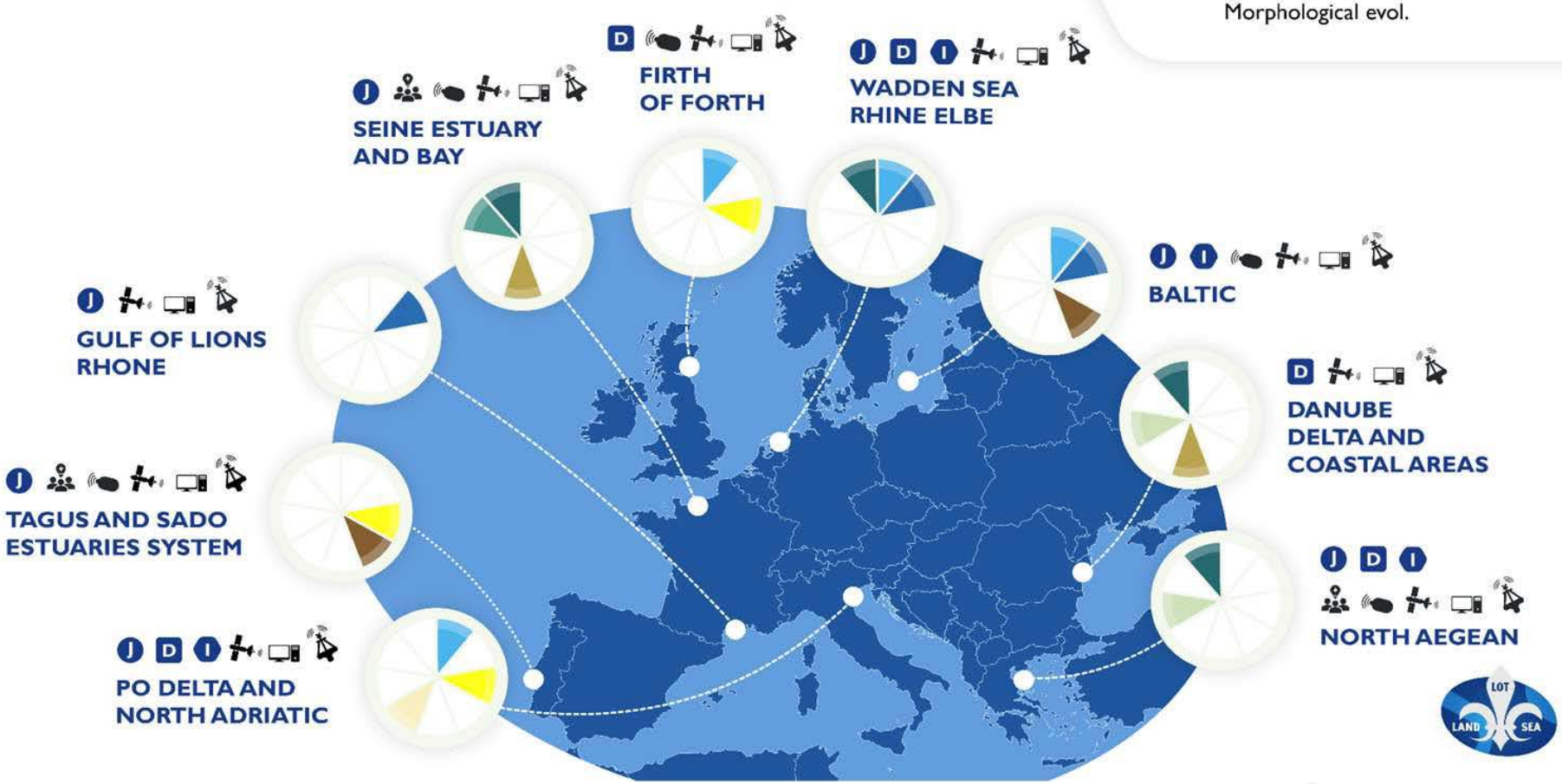
LEGEND

J JERICO-RI D DANUBIUS-RI I ICOS-ERIC

Citizen science Low-cost sensors Earth observation

Numerical modelling In situ observation





WP5 Tasks

M6 M24 M46 M48

Task 5.1 : Co-designing target needs on societal challenges from regional stakeholders in LILs Lead: IFR, Participants: CNR, HEREON, USTIR, DLT, MARIS, BC, GEM, CNRS, HCMR, SMHI, +ATL, TEM, NOR, SYKE, COV.

WP5 Tasks

M6 M24 M46 M48

Task 5.2 Effective implementation of LandSeaLot strategies in LILs Lead: IFR Participants: CNR (task coleads), HEREON, USTIR, DLT, MARIS, BC, PML, GEM, CNRS, HCMR, SMHI, +ATL, TEM, NOR, SYKE.

Sub-Task 5.2.1: Assessing lateral carbon fluxes and marine carbon stocks; Upscaling towards CO2 budgets in the LSI

Sub-Task 5.2.2: Prediction/ adaptation to threats to the LSI under climate change:

- Floods/ sea water levels
- Heat waves
- Coastal erosion and estuarine morphodynamics
- Saltwater intrusion

Sub-Task 5.2.3: Support to preserve biodiversity and decrease pollution:

- Analysing biodiversity of the LSI
- Plastics
- Nutrients

WP5 Tasks

M6 M24 M46 M48

Task	WP 5 - LandSeaLot Integration Labs	Firth of Forth (FF)	Baltic (B)	Wadden Sea, Rhine delta and Elbe Estuary (WSRE)	Po Delta and North Adriatic (PNA)	Gulf of Lions (GL)	Seine estuary and bay (SEB)	Tagus and Sado estuaries System (TSS)	Danube Delta and coastal area (DD)	North Aegean (NA)
5.2.1	Assessing lateral carbon fluxes and marine carbon stocks	X	X	X	X	X				
5.2.1	Upscaling towards CO2 budgets in the LSI		X	X		X				
5.2.2	Prediction/ adaptation to threats to the LSI under climate change: Floods/ sea water levels	X			X			X		
5.2.2	Prediction/ adaptation to threats to the LSI under climate change: Heat waves		X					X		
5.2.2	Prediction/ adaptation to threats to the LSI under climate change: Coastal erosion and estuarine morphodynamics						X		X	
5.2.2	Prediction/ adaptation to threats to the LSI under climate change: Saltwater intrusion				X					
5.2.3	Support to preserve biodiversity and decrease pollution: Analysing biodiversity of the LSI						X			
5.2.3	Support to preserve biodiversity and decrease pollution: Plastics								X	X
5.2.3	Support to preserve biodiversity and decrease pollution: Nutrients			X			X		X	X

WP5 Tasks

M6 M24 M46 M48

Task 5.3 Lesson learned from the LIL experiences Lead: CNR, Participants: IFR, HEREON, COV, USTIR, DLT, MARIS, GEM, CNRS, HCMR, SMHI, +ATL, TEM, NOR, SYKE, BC, SSBE).

Danube Delta and coastal area (DD)

Partners: GeoEcoMar, Hereon, CNR, DELTARES

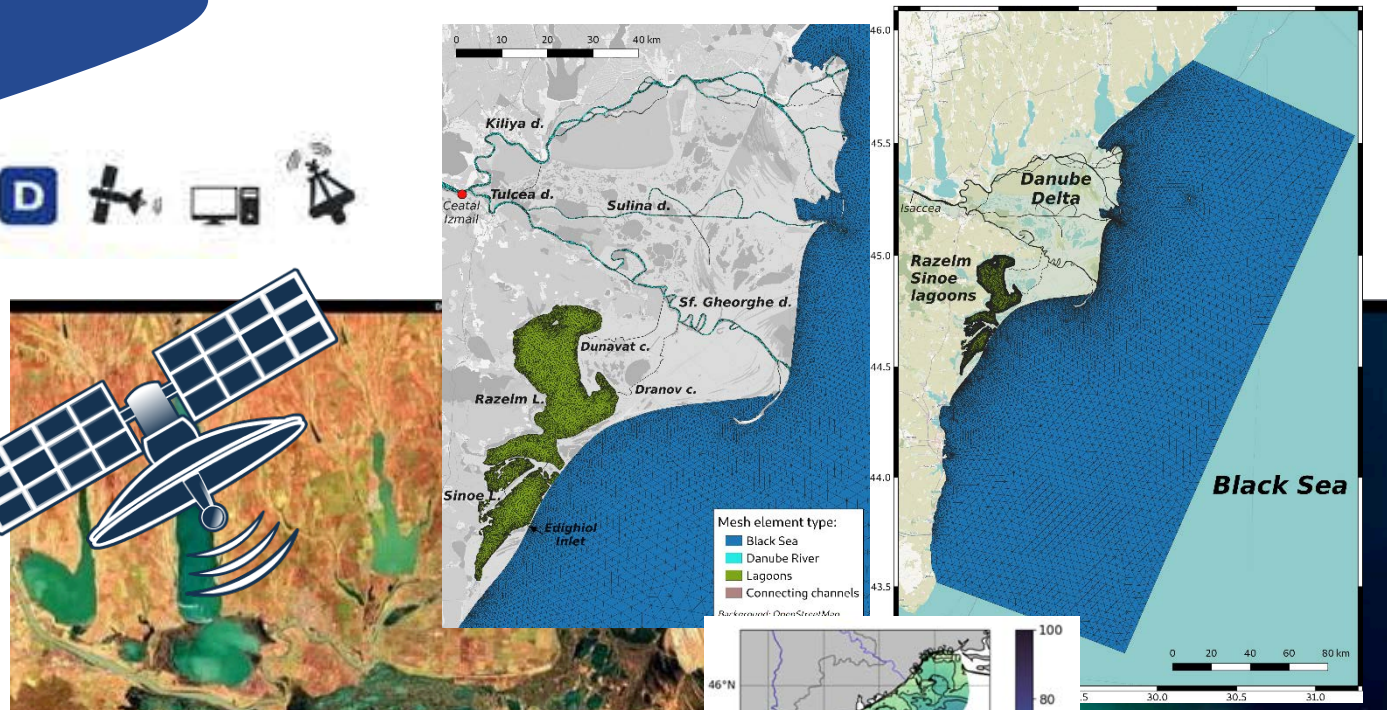
Coastal sediment budget development under combined human / climate pressures : Coastal erosion and morphodynamics:

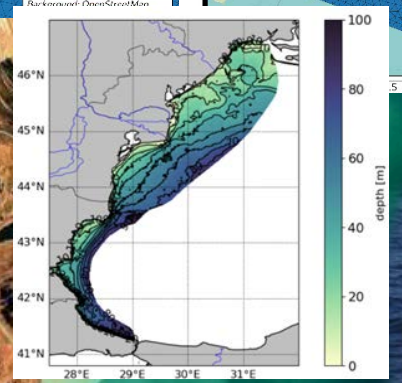
● *In situ* observations (bathymetry, geomorphology and sedimentology surveys) ● remote sensing ● hydrodynamics and sediment transport numerical models

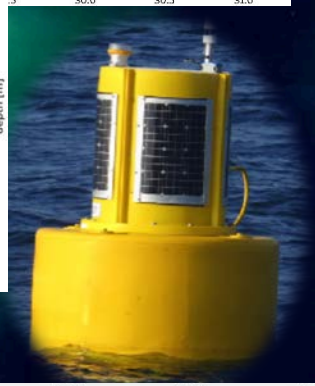
Inputs of pollutants from the Danube River to the North-West Black Sea through the delta

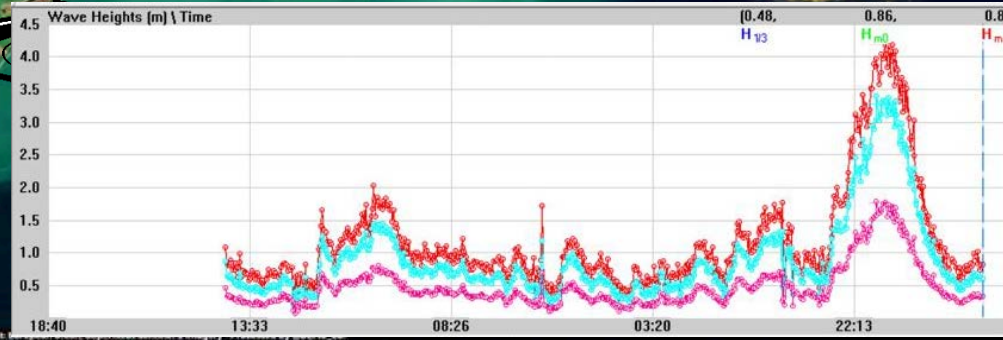
Plastics: ● *In situ* observations ● Refined quantification of plastic sources (river flow) from running monitoring programs or via new citizen science action and stakeholders.

Nutrients: ● *In situ* observations (from RIs or ongoing research) and multi-sensor coastal stations (T, P, C, O_2, Chla, turbidity).









Seine Estuary and Bay (SEB)

Partners: IFREMER, CNRS and affiliated universities

Sediment fluxes and morphological changes under climate (global) change scenarios

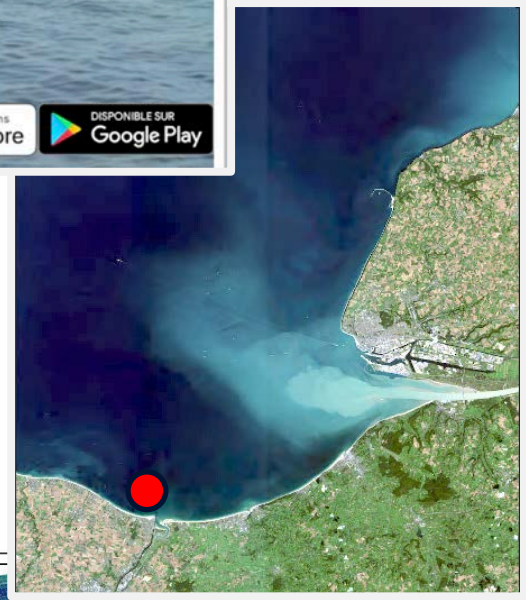
● Upgrade EO T° and SPM products merging with in situ observation in the estuary/bay ● Upgrade CROCO-MUSTANG numerical model and enhance its validation level, evaluate scenarios co-designed with local SH for morphological changes ● Evaluate low cost sensor (T, S, Turb) + Citizen Science program ● Data fusion using scattering transforms

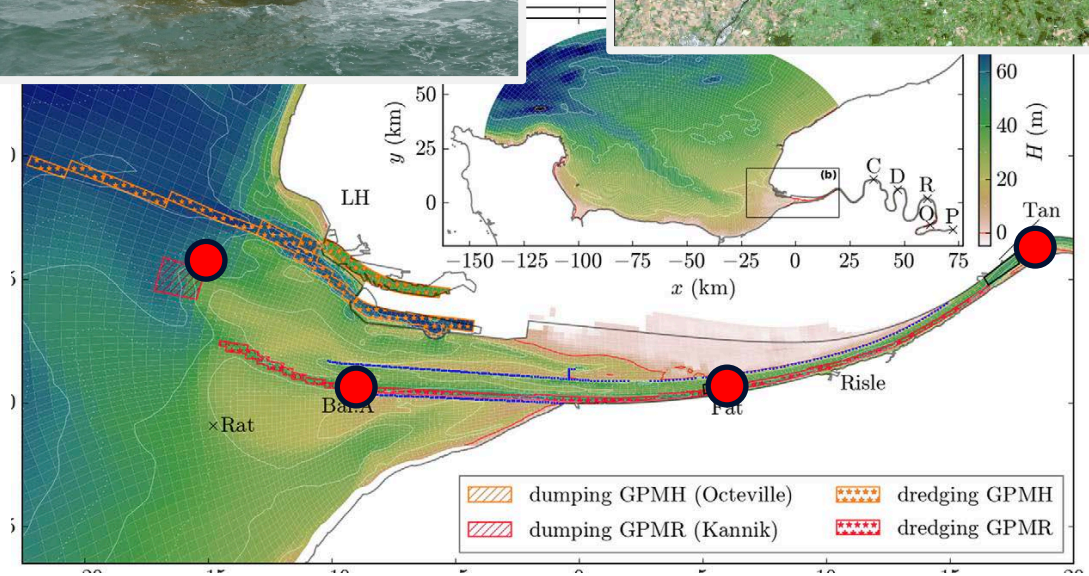
Preserving physical habitats supporting biodiversity

● From hydrodynamics and morpho-sediment dynamics model results, evaluate (physical) habitat modifications in the LSI.

Phytoplankton bloom dynamics

● Upgrade EO Ocean Color Chla data (upgrade algo – phyto. Sp.) using In situ observation ● low cost sensor + Citizen Science program ● data fusion using AI and Machine learning techniques



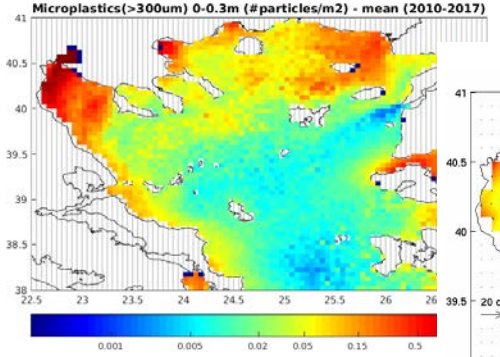


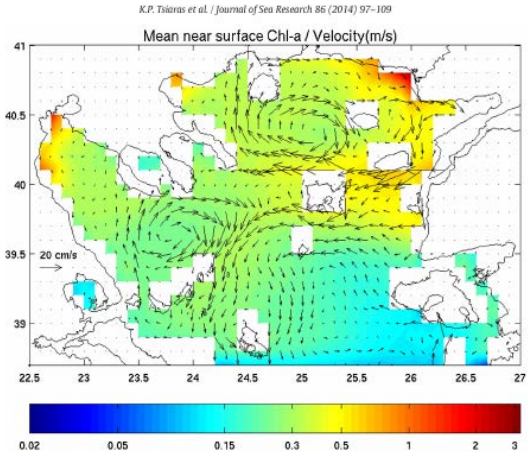
LiL North Aegean Sea (NA) / Eastern Mediterranean Sea

Parners: HCMR, SYKE

JERICO-RI, ICOS-ERIC, DANUBIUS- RI, HIMIOFOTS (national RI)

Integrated approaches to inform on specific challenges regarding:
a) plastic pathways from rivers to the sea
b) the effect of nutrients inputs on the trophic status of the ecosystem.





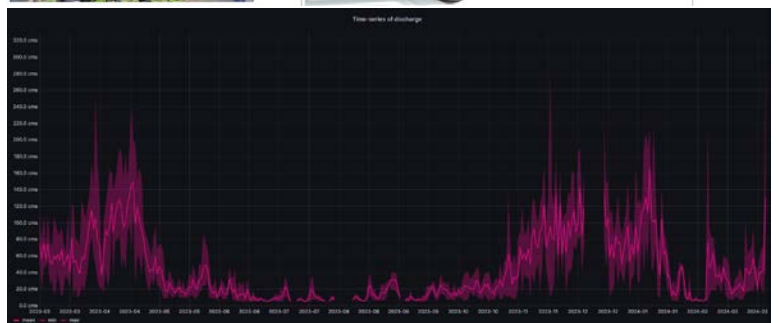
Method: link low-cost observation systems and citizen actions with numerical biochemical and Lagrangian simulations improved by EO products assimilation.

Modelling :

a) POM-ERSEM (hydrodynamic/biogeochemical) with satellite data assimilation
b) PPTM (Lagrangian plastic dispersion)
c) SWAT

Observing: EO (in lakes and coasts) and in situ in inland waters (sensors for water level, T, S, DO, etc). To improve model forcing/validation hoping to acquire:

- Cameras under bridges to count macroplastics and estimate their flow
- Nets for microplastics placed in rivers and coasts (CS: e.g. NGOs, fishermen, sailing boats)
- Low-cost buoys equipped with Chla, T, S, DO with data transmission (CS: e.g. NGOs, marinas)



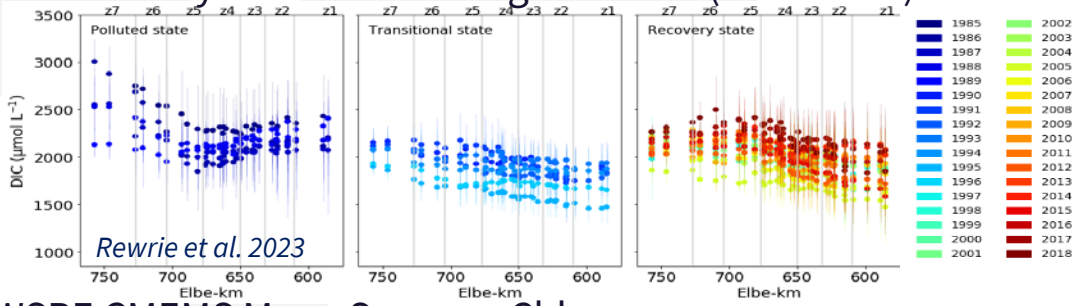
Wadden Sea, Rhine delta and Elbe Estuary (WSRE)

Parners: Deltares, Hereon

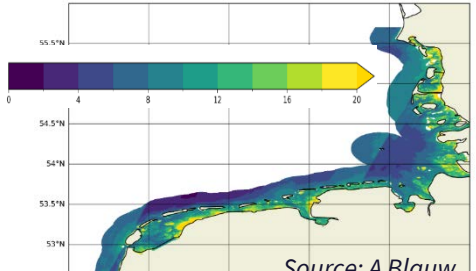
Source J. Meyer

The **Wadden Sea -** largest intertidal sand and mud flats system, with **Dutch, German** & Danish **Wadden Sea** national parks and conservation areas (UNESCO). **Elbe** and **Rhine Rivers** are major Rivers to the **WSRE LIL**

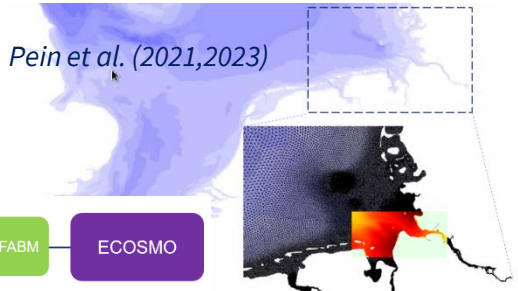
Elbe: Ecosystem State Change and DIC (1985-2020)



WSRE CMEMS Mean Summer Chl a



Source: A Blauw



Assessment of lateral C fluxes, marine C stocks

- Integrating ICOS-ERIC, DANUBIUS-RI and JERICO-RI data: WS potential for C sequestration
- Improving ecomodel parametrisations to predict lateral C fluxes accross LS interface (e.g. SCHISM-ECOSMO–SED unstructured coupled framework)

Conservation of biodiversity and pollution decrease

- Chl-a, turbidity & temperature maps based on multi-sensor satellite products, validated with in-situ obs, ‘low-cost’ sensors
- Nutrient fluxes (integrating missing data, ex. Cuxhaven Station, land/Lake Ijssel), application of SCHISM-ECOSMO model & benthic-pelagic coupling

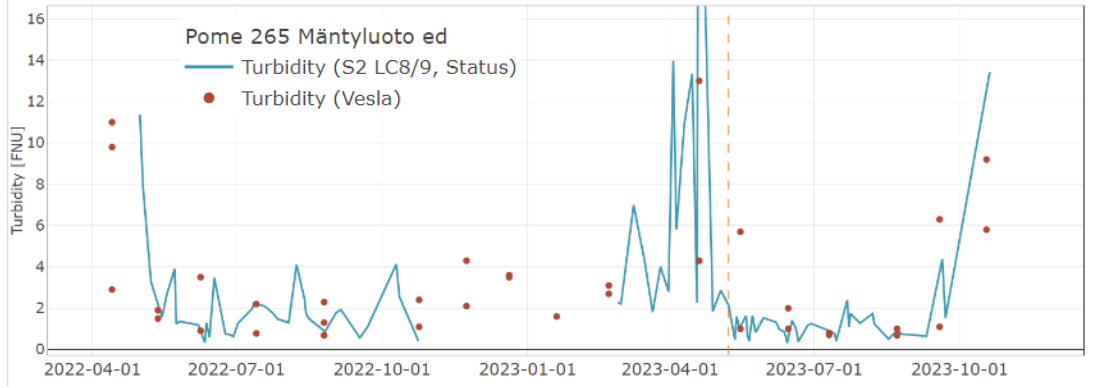
Lessons learned from the LIL experiences, stakeholder exchange

Baltic Sea (B)

Partners: Syke, SMHI, BC, NORCE

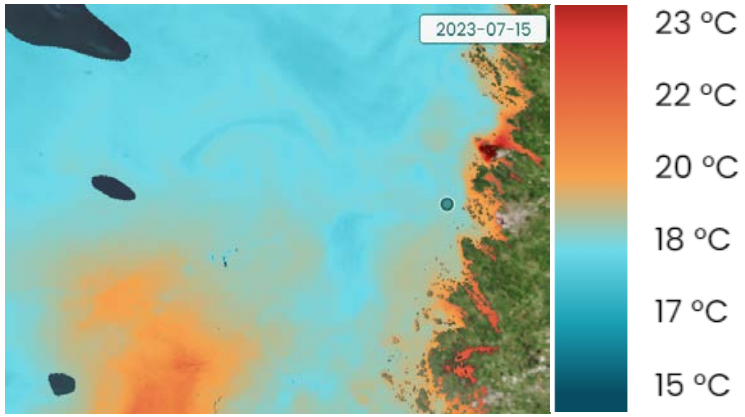
Evaluation of carbon budgets in the Baltic area is hampered by high uncertainties in the influx of carbon from land

- Improved EO algorithms coupled with numerical models, automated and manual in situ observations and isotope analysis will help qualify and quantify carbon fluxes at river mouths.



Phytoplankton bloom dynamics

- The impact of heatwaves on cyanobacteria blooms and dissolved carbon degradation will be evaluated by coupling merged EO SST products and in situ low-cost temperature observations with biogeochemical observations.



Gulf of Lion & Rhone (GDL)

Partner CNRS (Univ.): L.Coppola, C.Rabouille (CEA), C.Ulses (Univ. Toulouse)

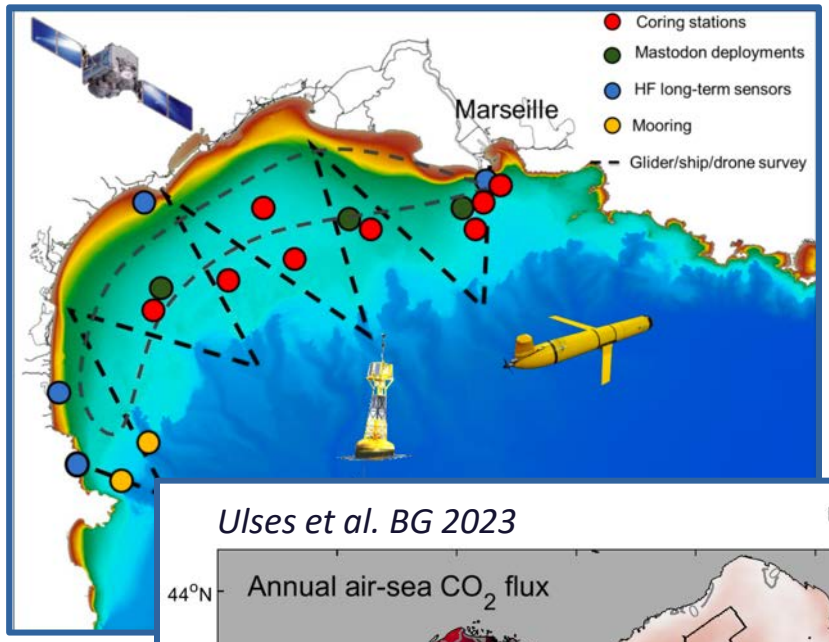
Mediterranean coastal region : microtidal site with **sustained observation activity** and strong expertise in transport processes and carbon fluxes. Physical and BGC models (e.g. SYMPHONIE/ECO3MS) + observing systems (**ILICO-RI** & **JERICO**) + OC satellite observations.

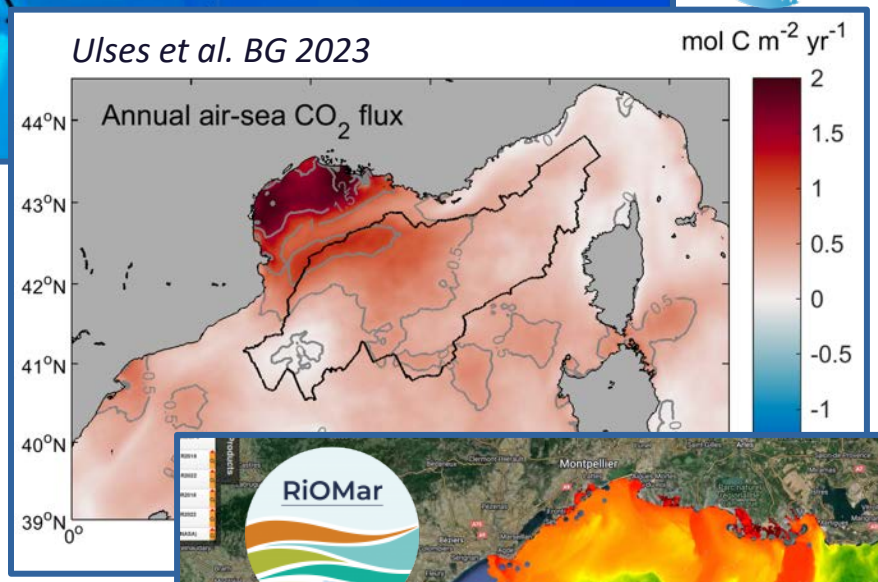
On-going national project **RIOMAR** (2023-2028) to improve the process study during special observation periods (gliders, ship visits, moorings) and model future ecosystems in this area

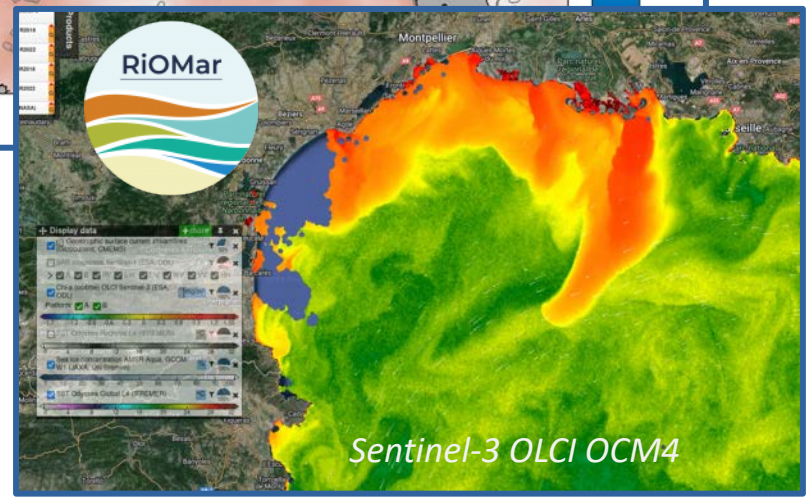
Assessing lateral carbon fluxes and marine carbon stocks

- Evaluate **carbon budget (DIC) and pCO2 fluxes** in shelf area impacted by river plumes and Northern Current. Sensitve to climate change, anthropogenic pressures and extreme events.

- **ANN methods** with **models simulations** (PHY+BGC), **satellite** SST and Chl-a products and **in situ observations** (fixed stations, gliders) to provide CO2 budgets and fluxes ranging from the river mouth to the coastal sea (shelf area)







Po Delta and North Adriatic (PNA)

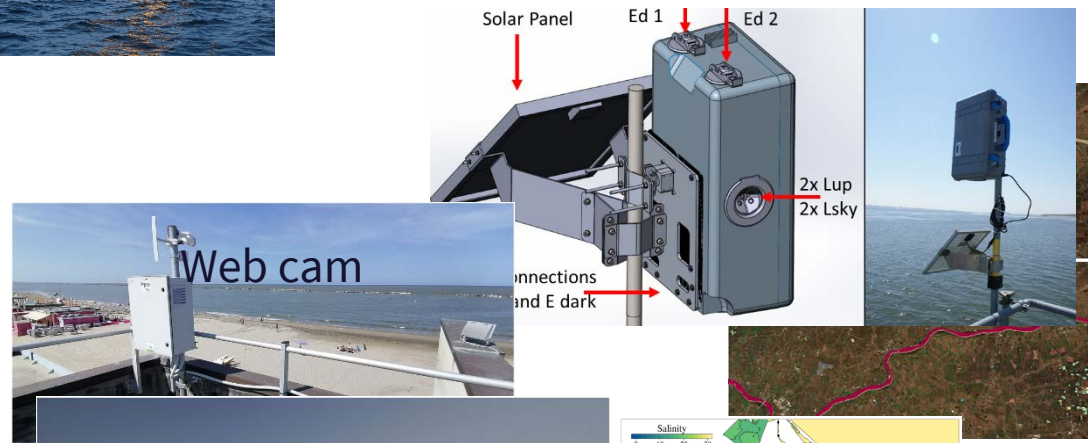
Partner: CNR

Assessment of lateral carbon fluxes from its distributed river drainage basin

- Investigate at sea the effect of river loads on dissolved (organic and inorganic) carbon and CO2 fluxes through the RIs' observation facilities and integrating the fixed stations information with remote sensing products.

Saltwater intrusion of the Po river delta

- EO algorithm development for a surface salinity proxy based on field data and high resolution EO.
- Integration of data sources (circulation model SHYFEM on the Po Delta system, water level and river flow in-situ measurements from monitoring network, salinity, SST and hyperspectral radiometry continuously at fixed stations.

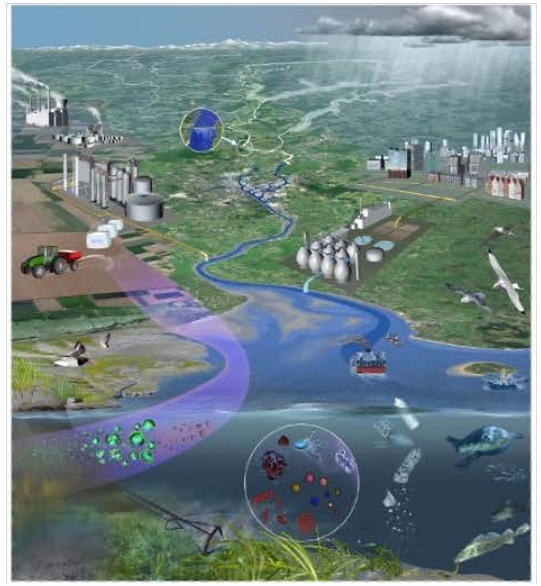


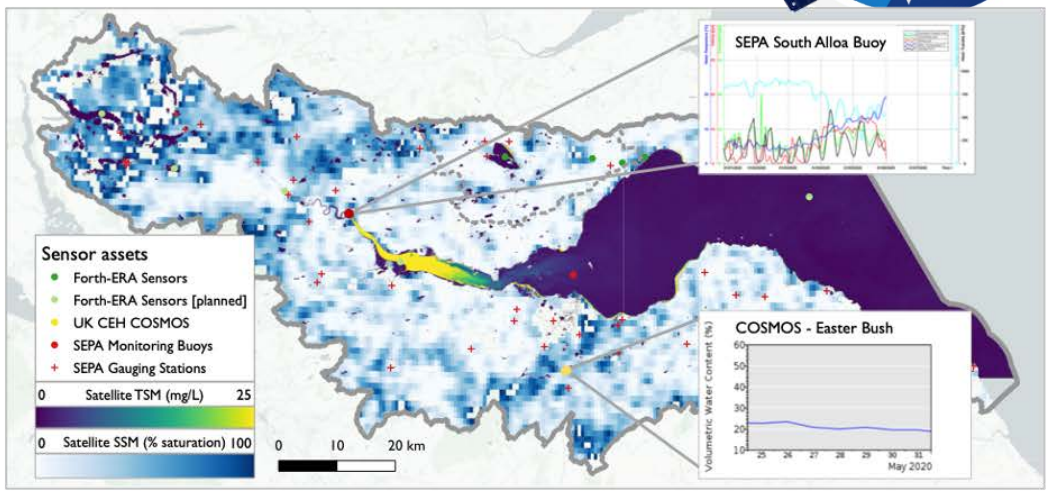
Flood risk from sea due to storm surges

- Improvement of the storm surge and wave modelling in the sea through data assimilation of in-situ (tide gauges and wave buoys) and EO (altimetry).
- Integration of coastal observations (detection of coastline from webcams, provided by regional EPA, tide gauges, wave buoys) and ocean model results (hindcast and forecast) results to implement coastal flood models and develop flood algorithm based on AI.

Firth of Forth (FF)

Partner: Univ. of Stirling





Assessing lateral carbon fluxes and marine carbon stocks

Combine information/data from ● eddy covariance tower in Flanders Moss National Nature Reserve peatland with ● in situ water measurements and ● water colour methods to assess lateral carbon fluxes

Prediction/ adaptation to threats to the LSI under climate change: Floods

focus on floods from land, to evaluate a ● data driven flood algorithm integrating existing in situ data, SAR flood mapping, in situ and model data

River

Inner estuary

Outer estuary

Tagus and Sado Estuaries Systems (TSS)

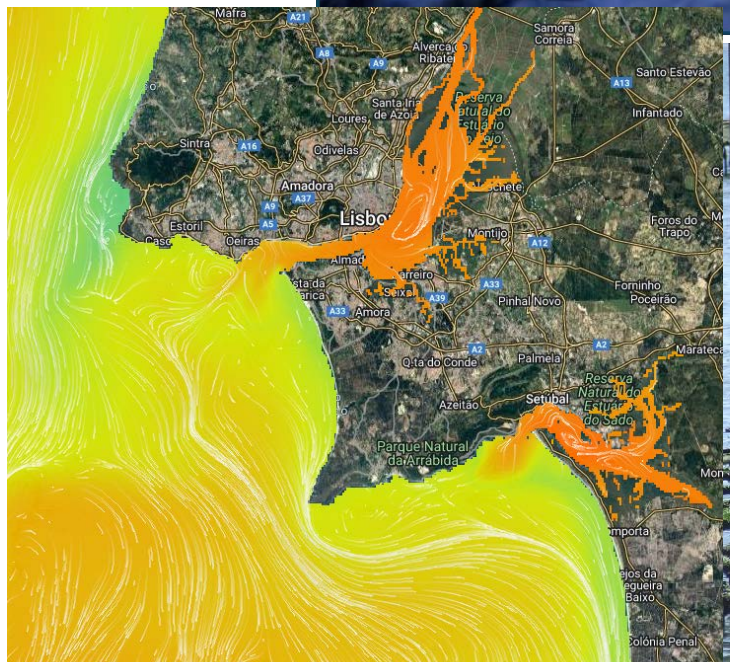
Partner: +ATLANTIC CoLAB

Heat waves

● High resolution EO products supplemented with ● numerical model results and ● low-cost temperature sensors will be used to estimate SST ● Increased resolution and accuracy temperature (and salinity) observations along rivers will support the quantification of effects on the local ecosystems, inferring on heat waves impacts on aquaculture and tourism sectors in TSS LIL.

Flood risk from sea due to storm surges

The risk of flooding and land inundation is driven by high river discharges and extreme sea levels generated by storm surges. Tagus and Sado estuaries System (TSS) LIL will provide ● compound and river flooding (hindcast and forecast) by improving intertidal and shallow areas ● EO satellite derived bathymetry and ● increasing the monitoring network, assuring data flow with low-cost sensors placed along the water continuum with support of citizen (marinas and aquaculture).



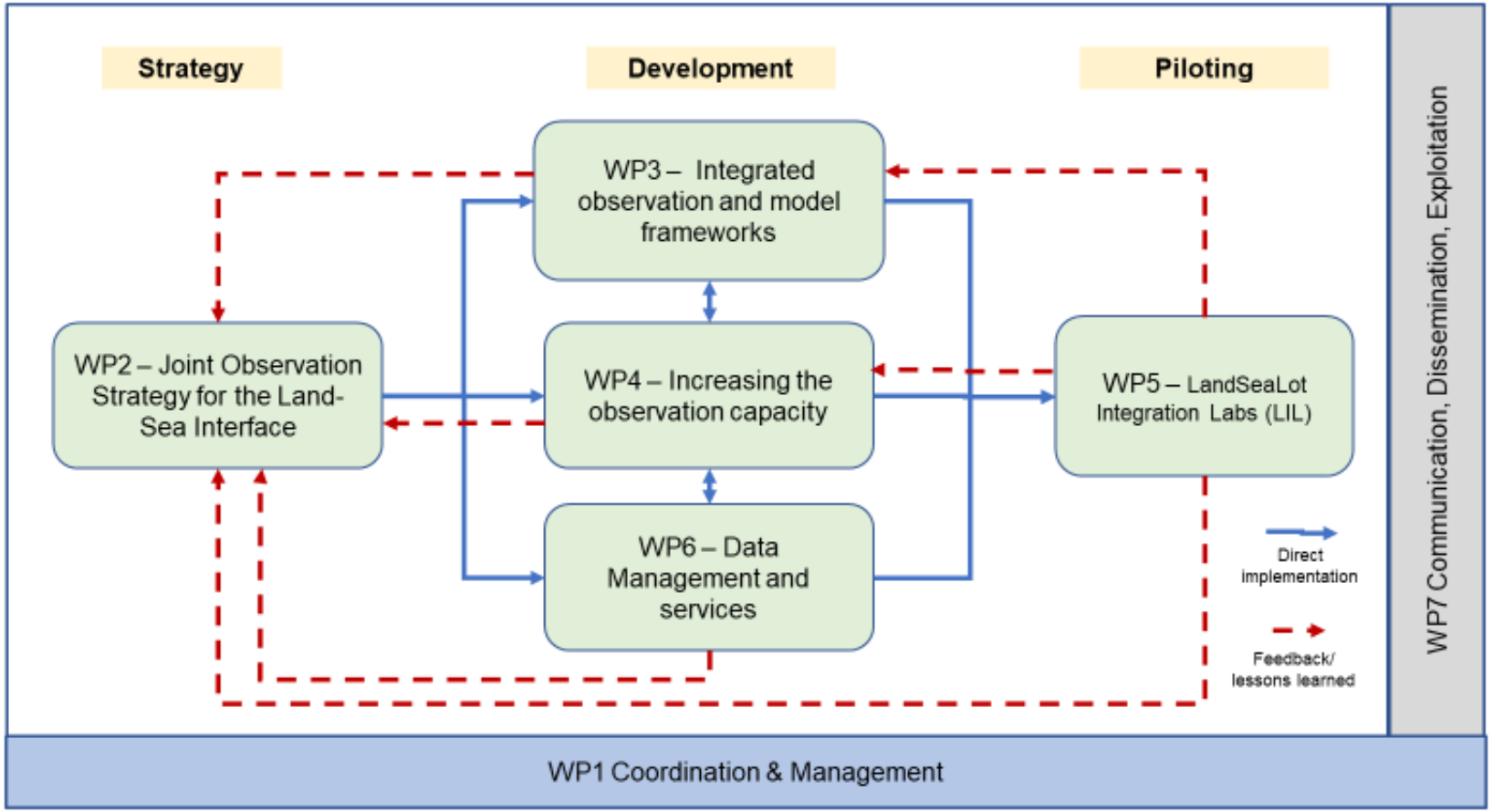
Deliverables

Nr	Deliverable Title	Lead	Type	Dissemination Level	Due Date
5.1	Effective implementation and proof of concept of developments: preliminary outcome	IFREMER	R — Document, report	Sensitive	M18
5.2	Effective implementation and proof of concept of development: intermediate outcome	CNR	R — Document, report	Sensitive	M30
5.3	Effective implementation and proof of concept of development: final report	IFREMER	R — Document, report	Public	M46

Milestones

Nr	Title	WPs	Lead	Means of verification	Due Date
1	LSC, LCD, LCE and LRS established	WP2, WP4, WP5	1-DLT	First forum meetings conducted (MoM)	5
3	Catalogue of low-cost technologies and communities	WP4, WP5	-SMHI	List of low-cost technologies and communities raised	6
5	Inception Plan presentation to regional stakeholders in LILs (in person/virtual)	WP2, WP5	3-IFR	Minutes of meetings in the ILs with local stakeholders	8
6	LandSeaLot common vision between communities achieved	WP2, WP5	1-DLT	Minutes of Meeting	10
8	LandSeaLot-week#1 - 1st Integration Workshop	WP7, WP1, WP2, WP4, WP5, WP6, WP3	1-DLT	Minutes of the LandSeaLot-Week#1	12
12	LandSeaLot-Week#2 -2nd Integration Workshop - Draft LCOS available to all WPs	WP7, WP1, WP2,WP4, WP5, WP6, WP3	1-DLT	Minutes of the LandSeaLot-Week#2	24
15	Draft roadmap for integrating observations and models at the LSI	WP5, WP3	19-USTIR	Minutes of joint WP3, WP5 meeting	34
17	LandSeaLot-Week#3; 3rd Integration Workshop	WP7, WP1, WP2,WP4, WP5, WP6, WP3	1-DLT	Minutes of the LandSeaLot-Week#1	36

Interaction with other WPs



Actions and Interaction with other WPs

INTERNAL WP5

LiL coordination meeting : every 6months?

Thematic subgroups among LiLs

Interaction methodology to be discussed : Through regular meetings (~4-6months), common virtual workplaces)

Organizing LiL meetings with local stakeholders –> MS5 (due M8)

INTERACTION WITH METHODOLOGICAL WPs :

Regular WP5-WP3, WP5-WP4 alignment meetings: every 3 months + dedicated meeting in the yearly LandSeaLot Week, update of methodological developments, LiL activities, dashboard follow-up
→ check through D5.1, D5.2, D5.3

COORDINATION WP5-WP2

Particularly in the first activity year, to align local stakeholder action to the LSC, LCD, LCE and LRS
-> **MS1 and MS5**

Fundamental need for a LandSeaLot sharepoint

Let’s observe together!

Visit landsealot.eu

Be part of the conversation

Funded by
the European Union

LandSeaLot has received funding from the European Union’s Horizon Europe Framework Programme for Research and Innovation under grant agreement No 101134575. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.