2021 EU Conference on modelling for policy support

22 - 26 November – *online event*

Modelling stakeholder-perceived system interactions to explore policy opportunities for coastal environment improvement

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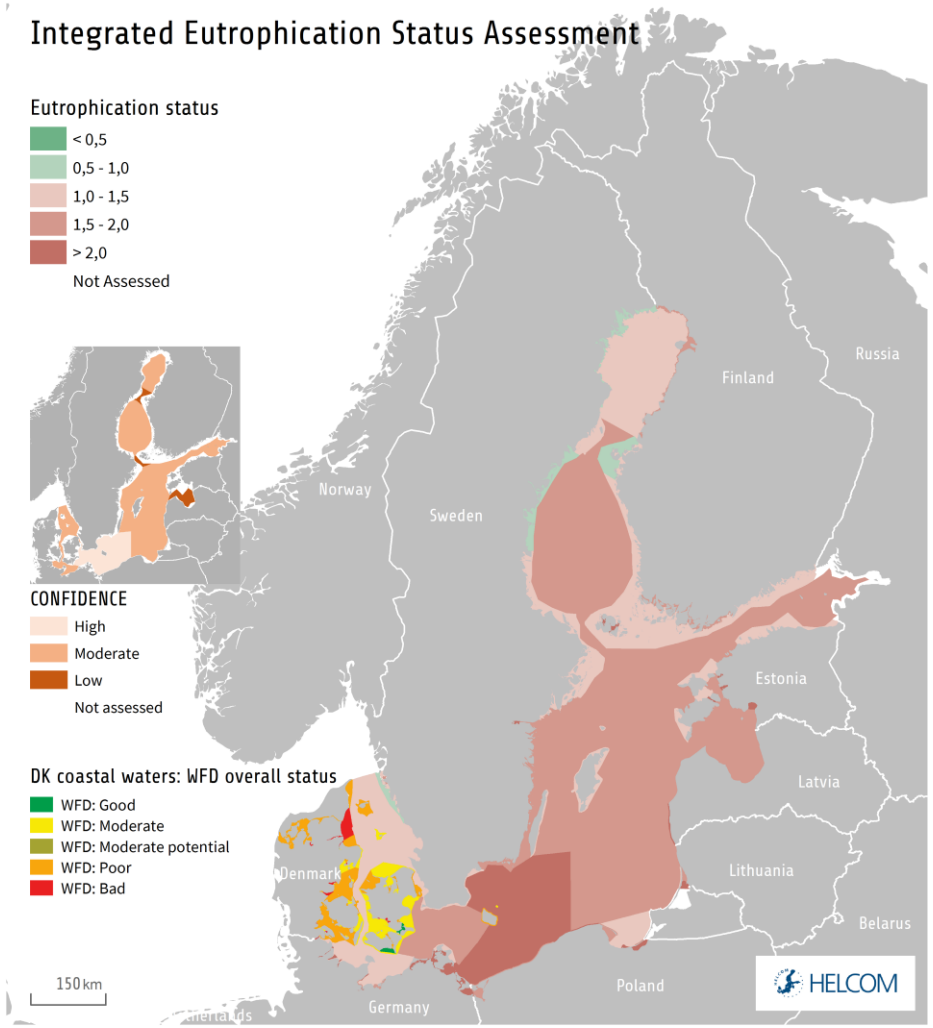
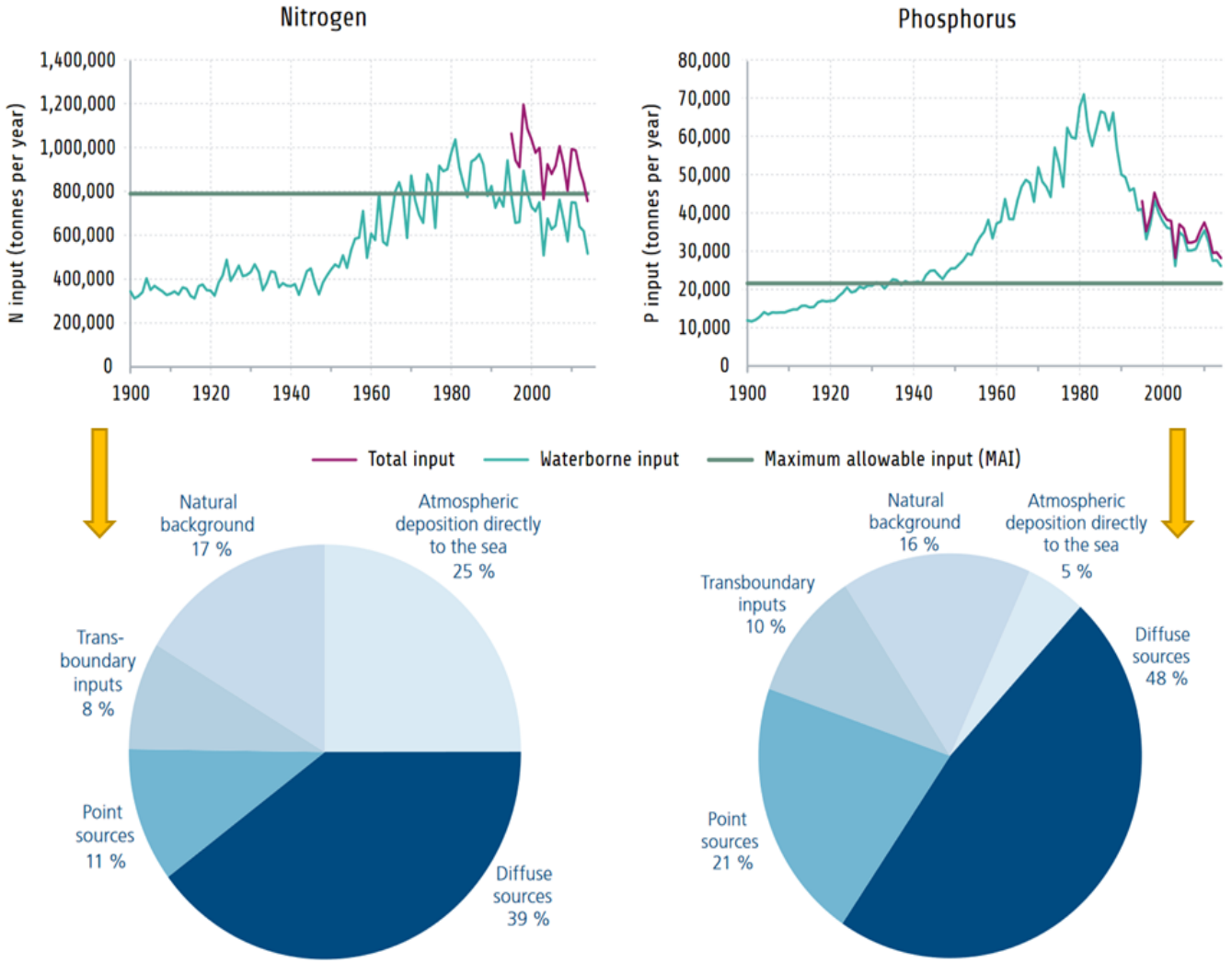
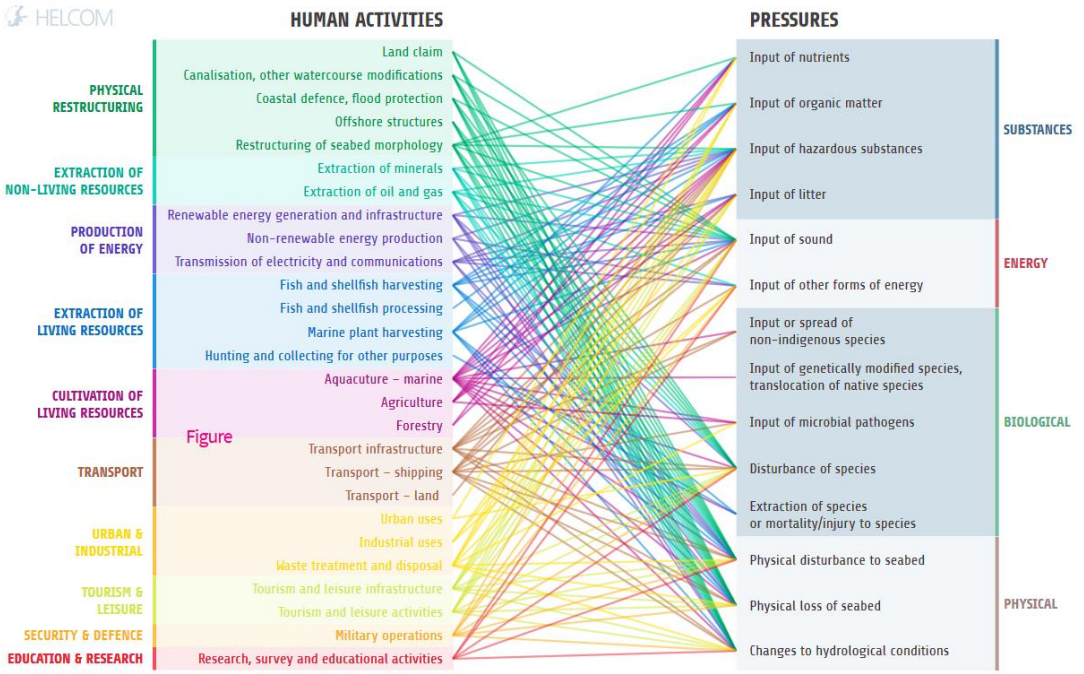
26 November 2021



97% of the Baltic Sea region is assessed as eutrophied in 2011–2016, according to the integrated status assessment by HELCOM.

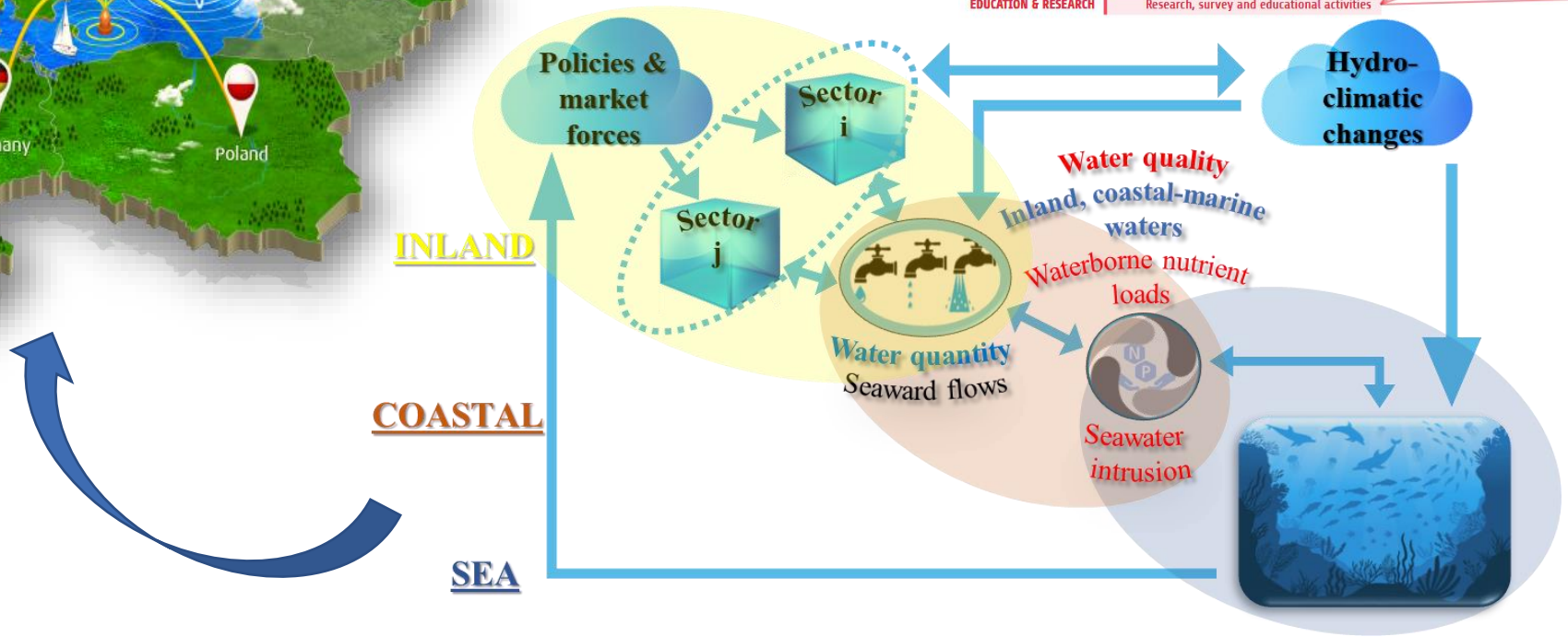


Evolution and source attribution of annual waterborne and total loads of nitrogen and phosphorus from land to the Baltic Sea during 1900-2014. *Sources: HELCOM, 2010 and 2018*

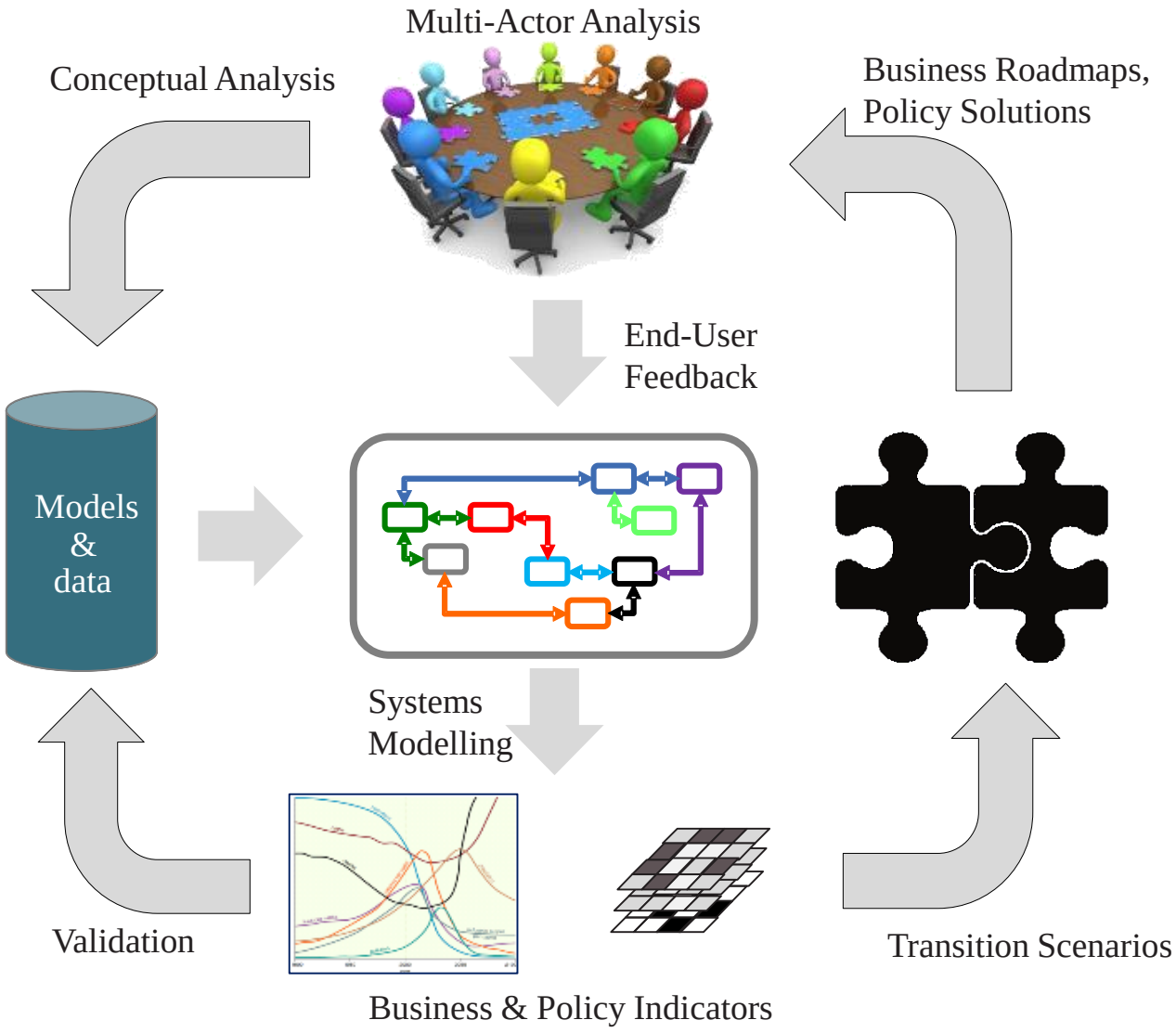


Figure

HELCOM, 2018

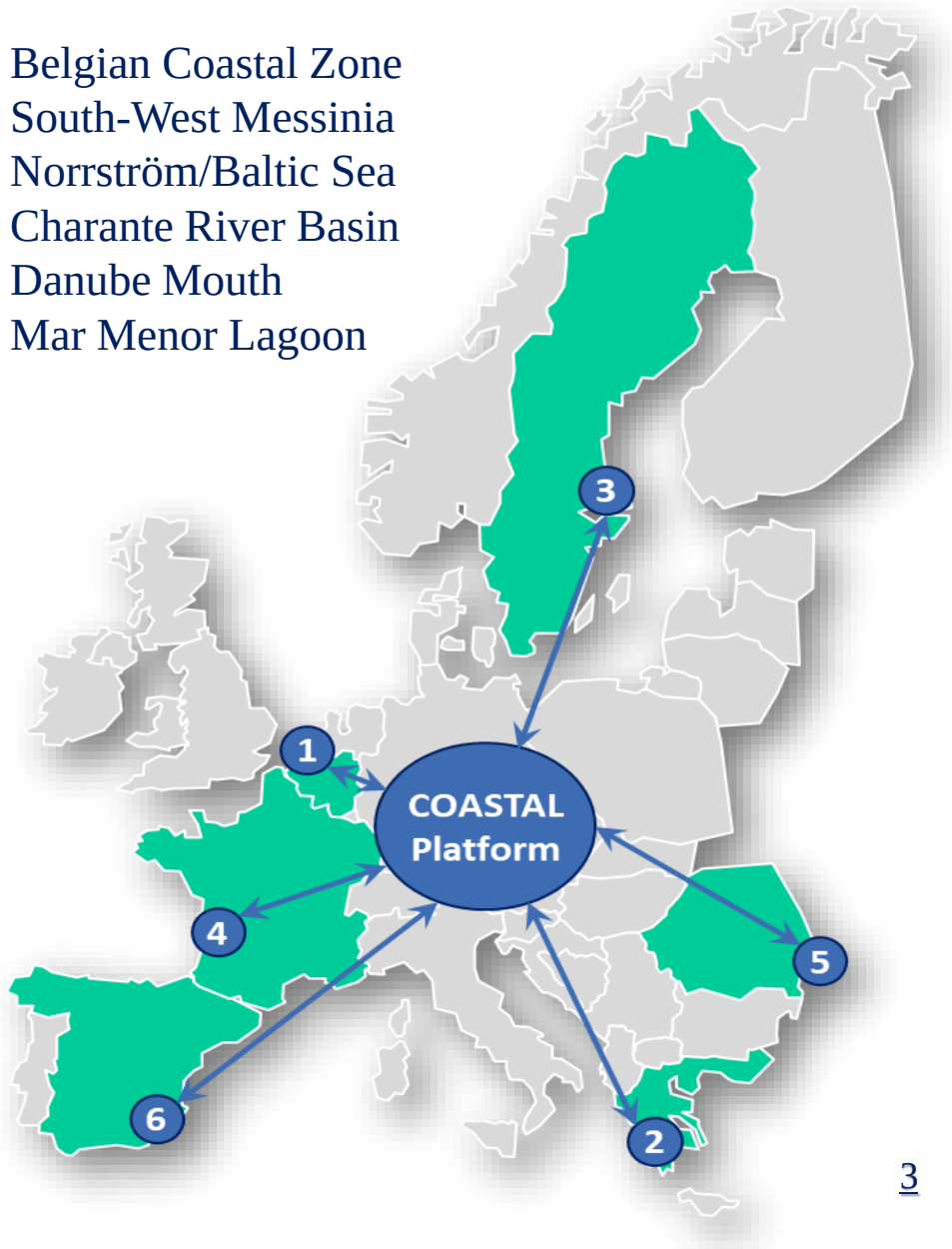


COASTAL
Collaborative Land-Sea Integration Platform
2018 - 2022

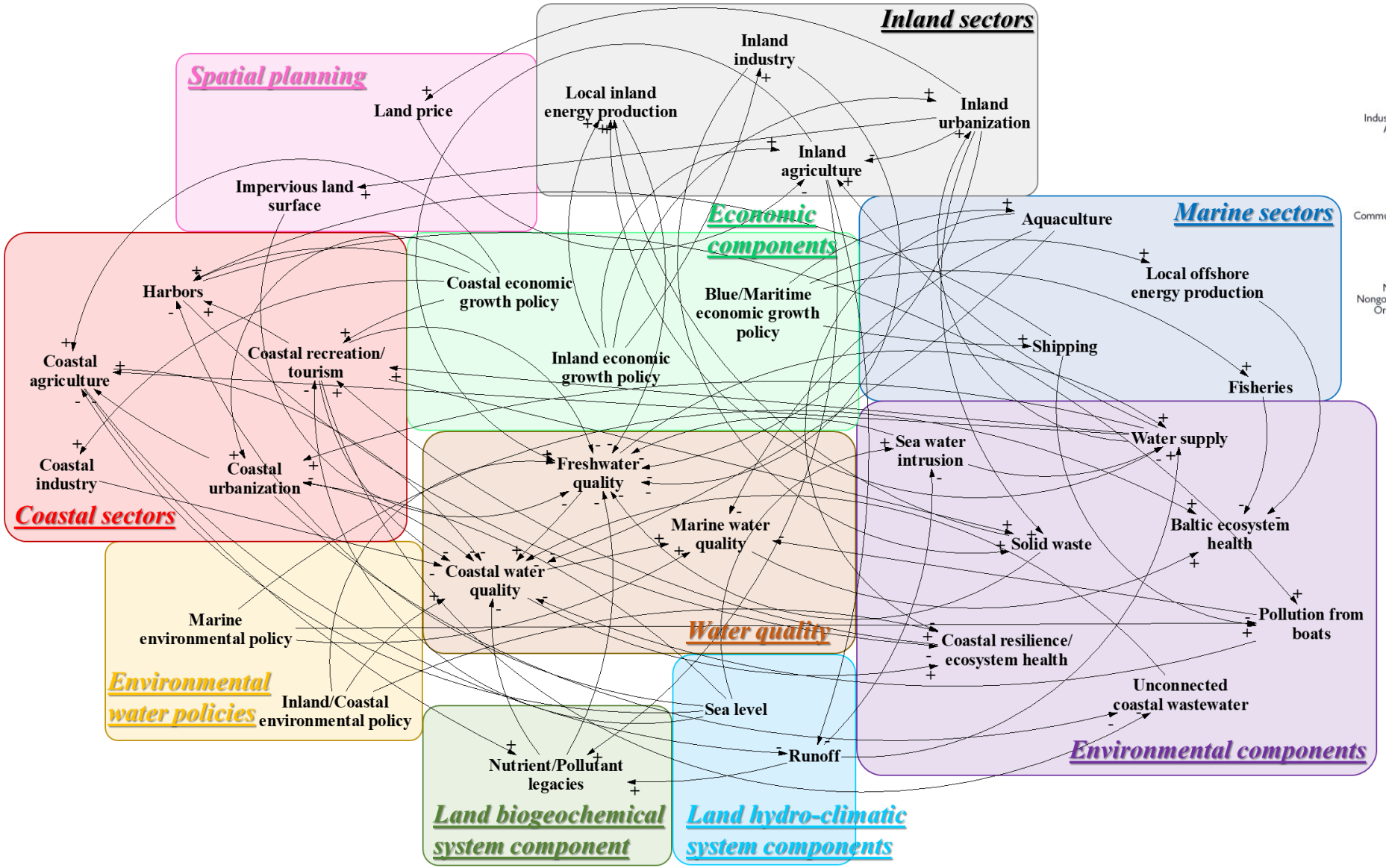


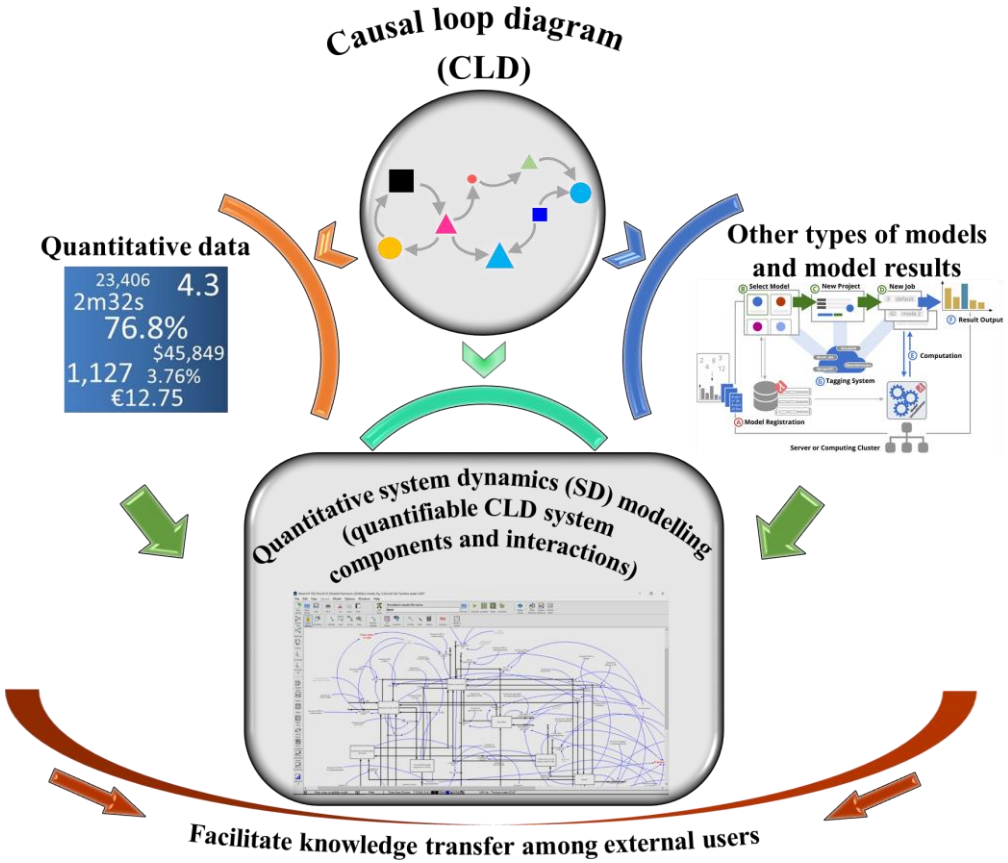
Multi-Actor Labs

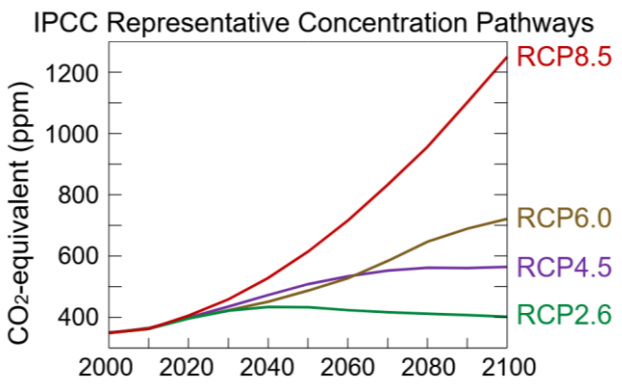
1. Belgian Coastal Zone
2. South-West Messinia
3. Norrström/Baltic Sea
4. Charante River Basin
5. Danube Mouth
6. Mar Menor Lagoon



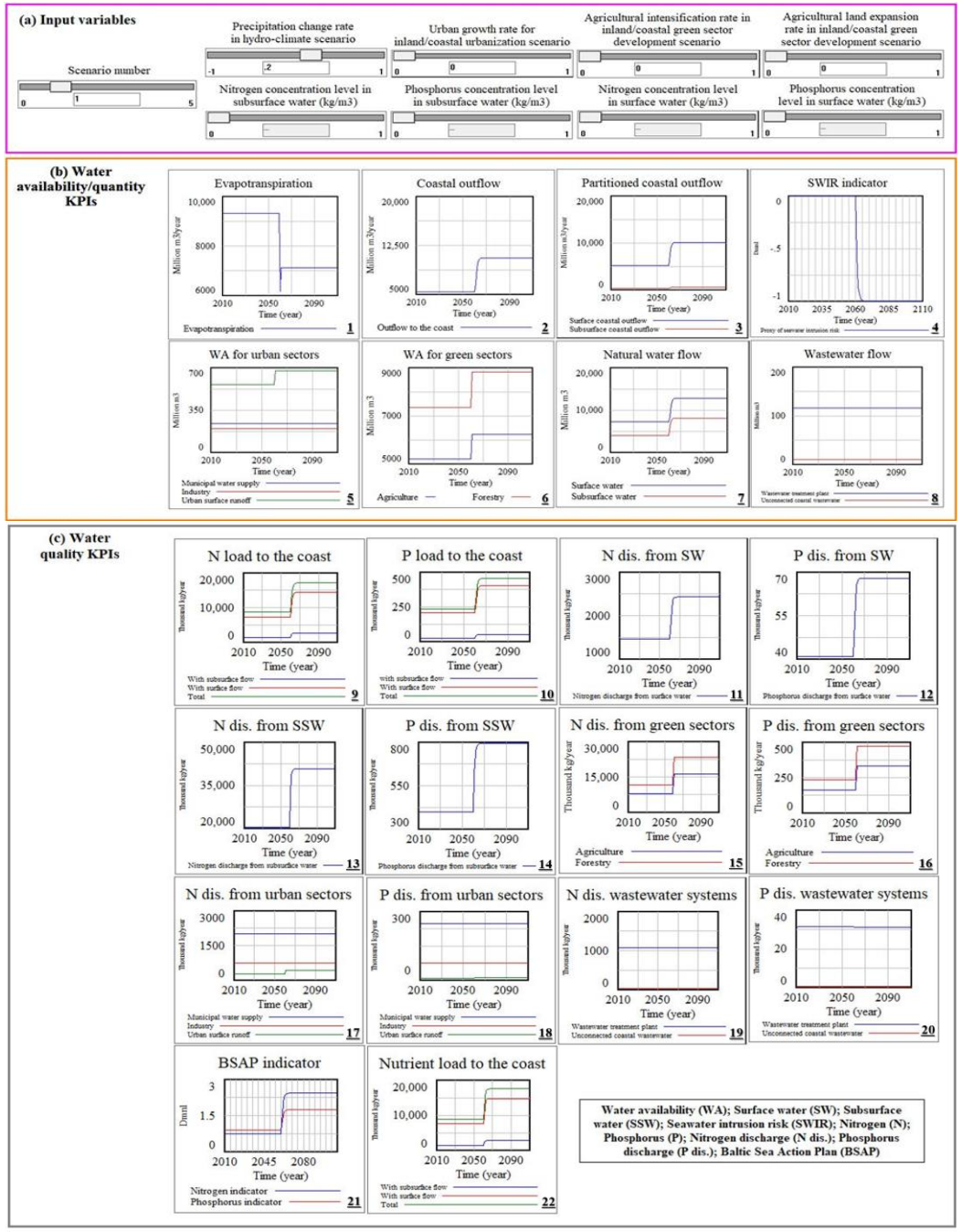
Regional causal loop Diagram (CLD) and Fuzzy cognitive mapping (FCM)

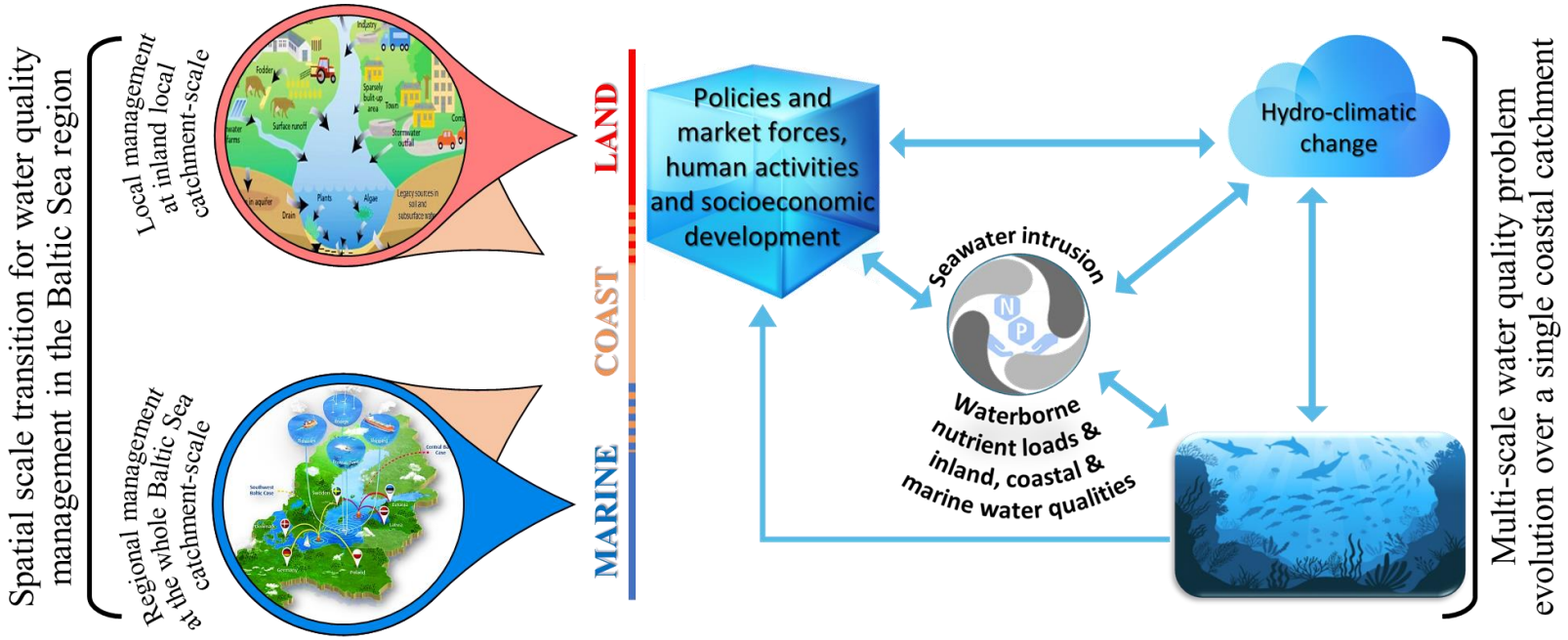


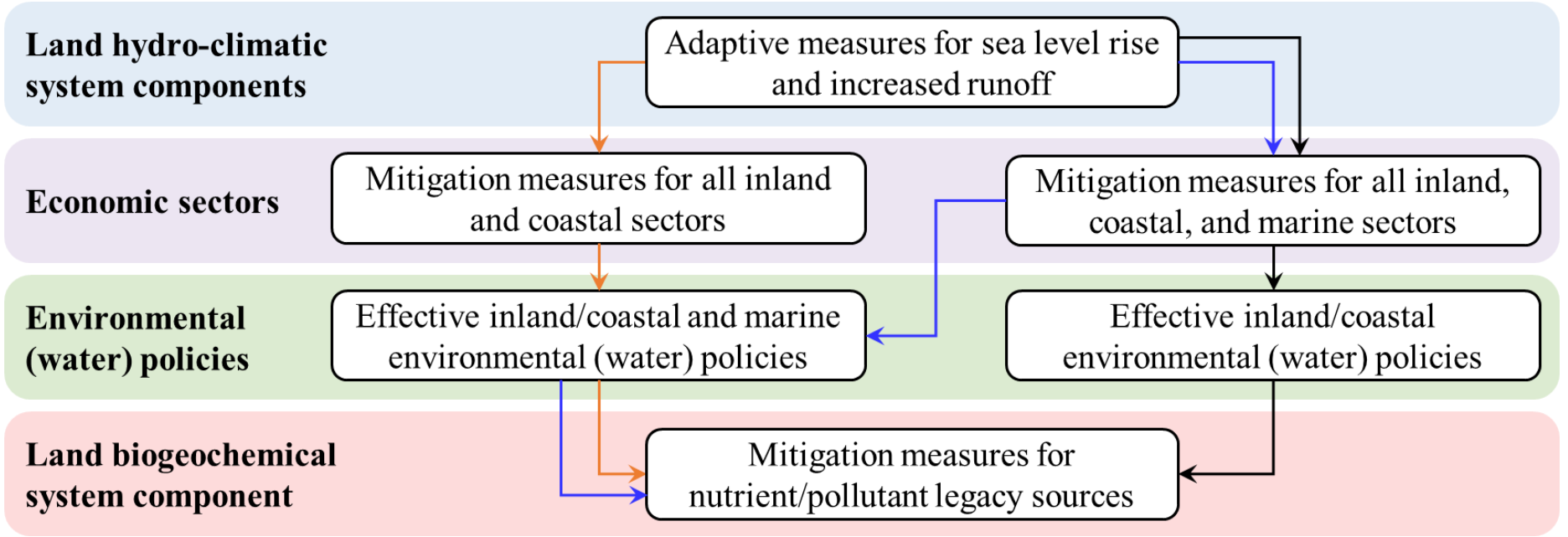

Causal loop diagram (CLD)
Quantitative data
23,406
4.3
2m32s
76.8%
$45,849
1,127
3.76%
€12.75
Other types of models and model results
Quantitative system dynamics (SD) modelling (quantifiable CLD system components and interactions)
Facilitate knowledge transfer among external users


IPCC Representative Concentration Pathways
CO2-equivalent (ppm)
1200
1000
800
600
400
2000
2020
2040
2060
2080
2100
RCP8.5
RCP6.0
RCP4.5
RCP2.6

Socio-economic challenges for mitigation
★ SSP 5
(Mitigation challenges dominate)
Fossil-fueled development
Taking the Highway
★ SSP 3
(High challenges)
Regional rivalry
A Rocky Road
★ SSP 2
(Intermediate challenges)
Middle of the road
★ SSP 1
(Low challenges)
Sustainability
Taking the Green Road
★ SSP 4
(Adaptation challenges dominate)
Inequality
A Road Divided
Socio-economic challenges for adaptation


(a) Input variables
Scenario number
Precipitation change rate in hydro-climate scenario
Urban growth rate for inland/coastal urbanization scenario
Agricultural intensification rate in inland/coastal green sector development scenario
Agricultural land expansion rate in inland/coastal green sector development scenario
Nitrogen concentration level in subsurface water (kg/m3)
Phosphorus concentration level in subsurface water (kg/m3)
Nitrogen concentration level in surface water (kg/m3)
Phosphorus concentration level in surface water (kg/m3)
(b) Water availability/quantity KPIs
Evapotranspiration
Coastal outflow
Partitioned coastal outflow
SWIR indicator
WA for urban sectors
WA for green sectors
Natural water flow
Wastewater flow
(c) Water quality KPIs
N load to the coast
P load to the coast
N dis. from SW
P dis. from SW
N dis. from SSW
P dis. from SSW
N dis. from green sectors
P dis. from green sectors
N dis. from urban sectors
P dis. from urban sectors
N dis. wastewater systems
P dis. wastewater systems
BSAP indicator
Nutrient load to the coast
Water availability (WA); Surface water (SW); Subsurface water (SSW); Seawater intrusion risk (SWIR); Nitrogen (N); Phosphorus (P); Nitrogen discharge (N dis.); Phosphorus discharge (P dis.); Baltic Sea Action Plan (BSAP)


Spatial scale transition for water quality management in the Baltic Sea region
Local management at inland local catchment-scale
Regional management of the whole Baltic Sea catchment-scale
LAND
COAST
MARINE
Policies and market forces, human activities and socioeconomic development
Hydro-climatic change
Seawater intrusion
Waterborne nutrient loads & inland, coastal & marine water qualities
Multi-scale water quality problem evolution over a single coastal catchment


Land hydro-climatic system components
Adaptive measures for sea level rise and increased runoff
Economic sectors
Mitigation measures for all inland and coastal sectors
Mitigation measures for all inland, coastal, and marine sectors
Environmental (water) policies
Effective inland/coastal and marine environmental (water) policies
Effective inland/coastal environmental (water) policies
Land biogeochemical system component
Mitigation measures for nutrient/pollutant legacy sources

Key messages

- Cross-scale and multi-sectoral **synergistic management measures** are required for considerable improvement of inland, coastal, and marine water quality in the Baltic Sea region.
- Synergistic management strategies should involve mitigation of the **potential dominant contribution from nutrient legacy sources** to the water bodies in the Baltic Sea region.
- Planned socioeconomic developments with projected hydro-climatic conditions will **reduce the seawater intrusion risk** in the Baltic coastal areas.
- Coastal nutrient (nitrogen and phosphorus) **load targets set in regional policies will not be achieved** with planned socioeconomic developments and projected hydro-climatic conditions.

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European Commission

Bolin Centre for Climate Research

THANK YOU

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H2020 COASTAL

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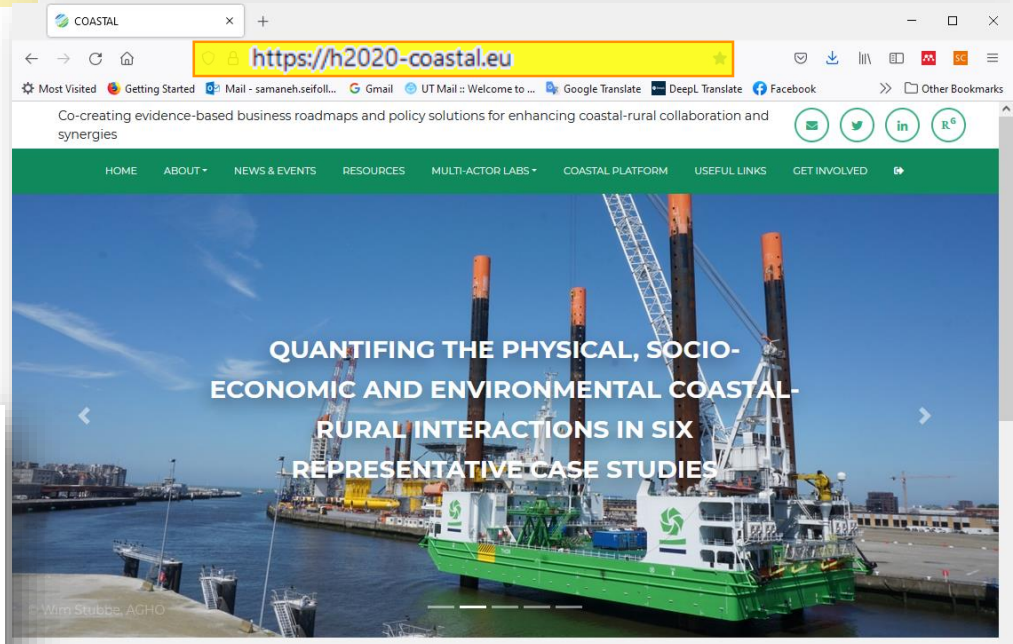

Project partners

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