Session HS2.3.1: Water quality at the catchment scale: measuring and modelling of nutrients, sediment and eutrophication impacts.

Use of Co-created Causal Loop Diagrams and Fuzzy-Cognitive Scenario Analysis for Water Quality Management

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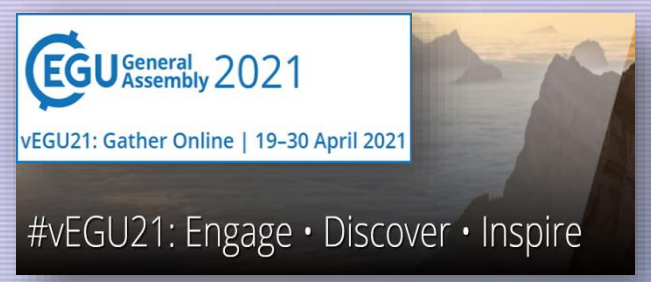

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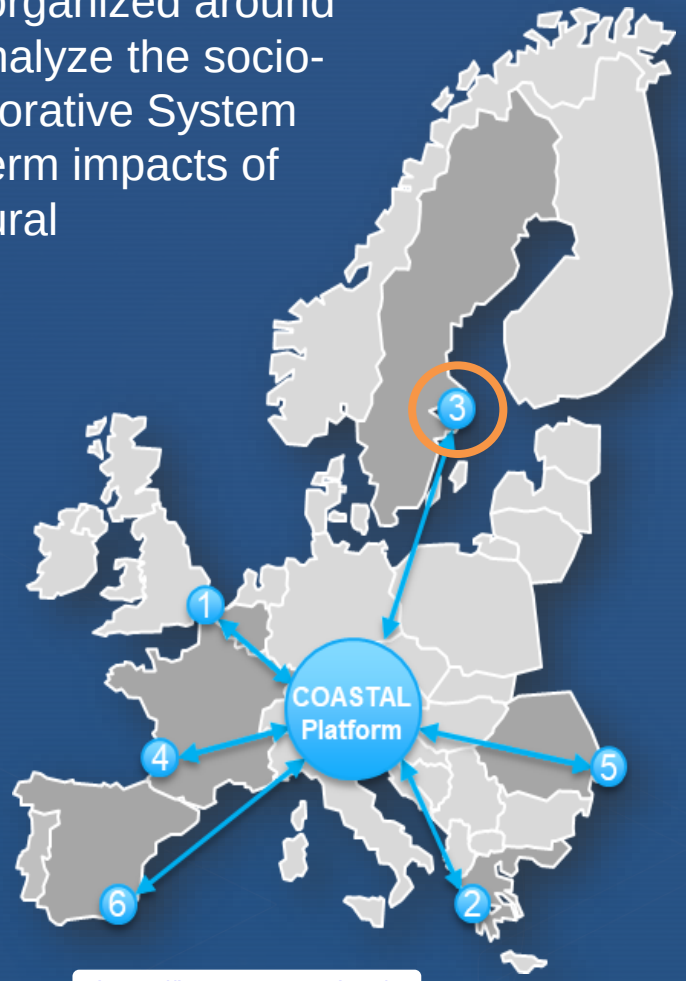
COASTAL Project

COASTAL (COllaborative lAnd-Sea inTegrAtion pLatform) is organized around six interacting case studies around the European Union, to analyze the socio-environmental and economic land-sea interactions in a collaborative System Dynamics framework, considering the short-, mid- and long-term impacts of decision making and feedback mechanisms on coastal and rural development.

1. Belgian Coastal Zone (Belgium)
2. South-West Messinia (Greece)
3. Norrström/Baltic Sea (Sweden)
4. Charente River Basin (France)
5. Danube Mouth and River Basin (Romania)
6. Mar Menor Coastal Lagoon (Spain)



https://h2020-coastal.eu/

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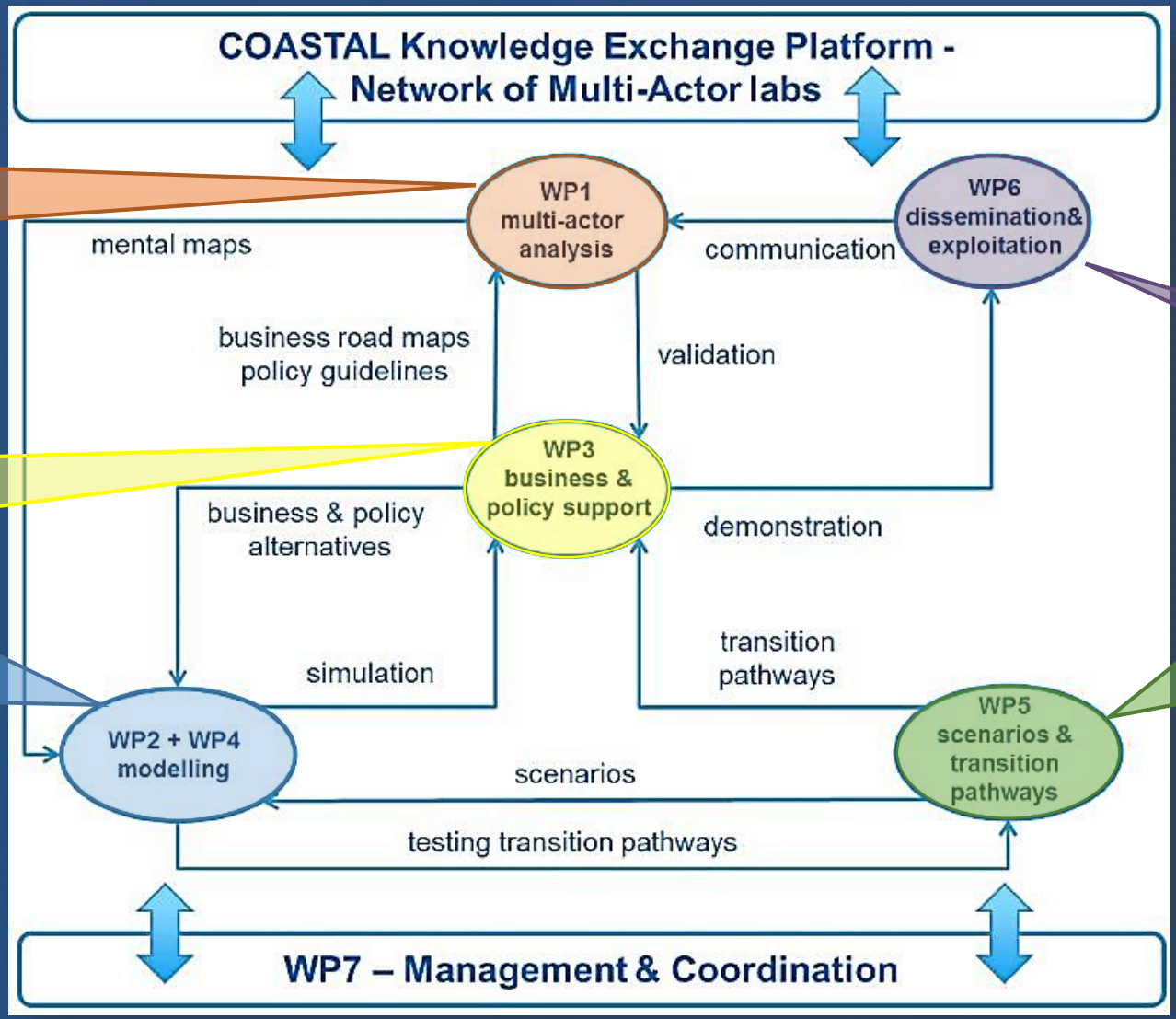
COASTAL Project

Stakeholder feedback on modelling and analyses

Business roadmap and policy solution at case study level

System Dynamics modeling and quantification



Dissemination of the project results

Scenarios and transition pathways at case study level

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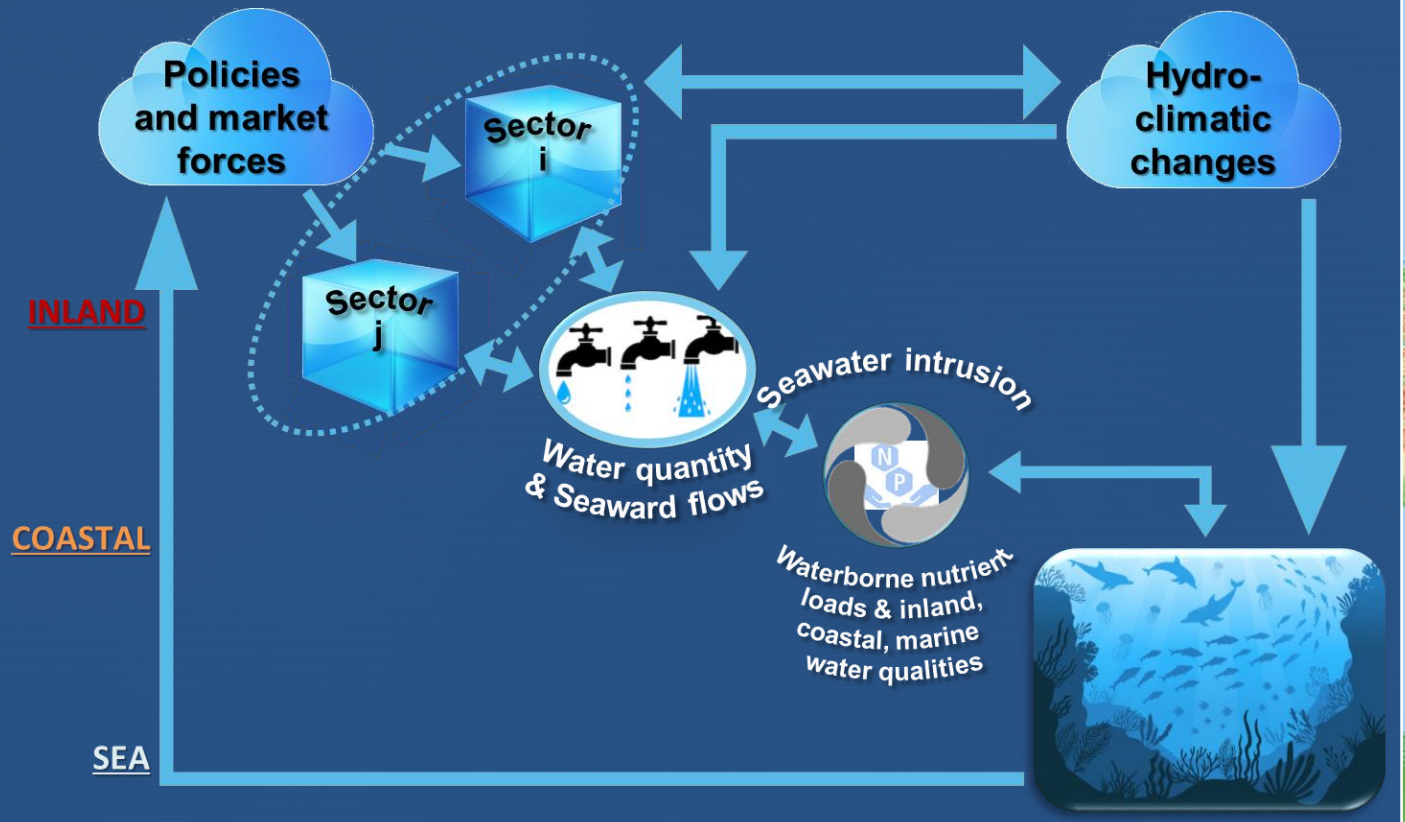
Norrström Drainage Basin/Baltic Sea Region



Source: State of the Baltic Sea – First version – HELCOM, 2017.

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This Study

Aim:

To bridge the gap between environmental research and policy in the study region by modelling the stakeholder-identified key land-sea system interactions of high relevance for inland and coastal-marine water quality and its possible improvement.

Approach:

Assessing the integrated modelled land-coast-sea system implications for water quality state development under scenarios of changed human pressures and hydro-climatic conditions.

Methodology:

Semi-quantitative fuzzy-cognitive system modelling based on a co-developed causal loop diagram by various stakeholders following the systems thinking technique.

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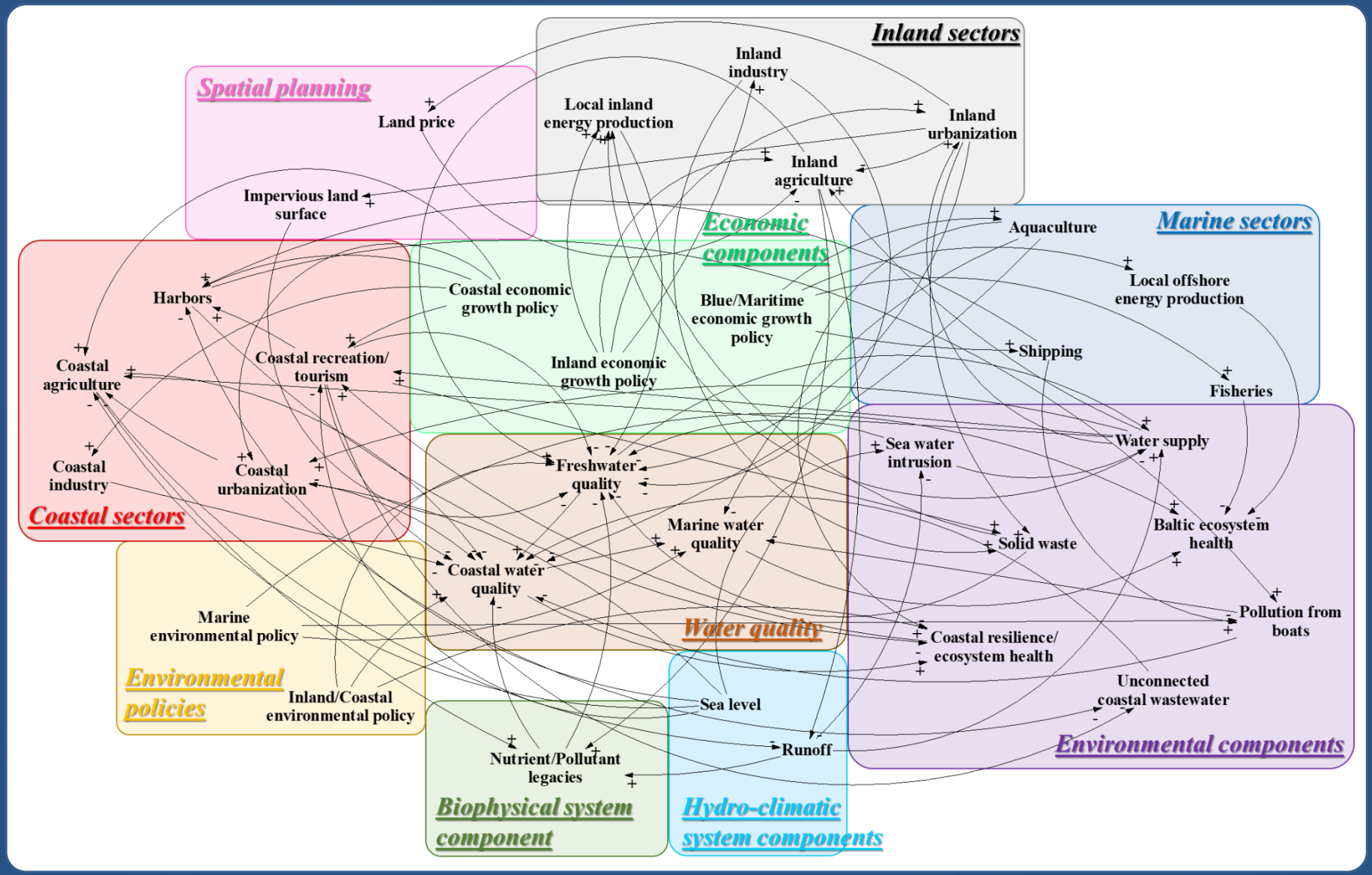
Causal Loop Diagram



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Fuzzy-Cognitive Analysis

	Category (To)	Inland sectors				Coastal sectors					Marine sectors				Biophysical component Environmental policies Hydro-climatic components					Environmental components								Economic components			Spatial planning		Water quality components		
Category (From)	System elements	Inland agriculture	Inland industry	Inland urbanization	Local inland energy production	Coastal agriculture	Coastal industry	Coastal recreation/ tourism	Coastal urbanization	Harbors	Aquaculture	Fisheries	Local offshore energy production	Shipping	Nutrient/ Pollutant legacies	Inland/coastal environmental policy	Marine environmental policy	Sea level	Runoff	Baltic ecosystem health	Coastal resilience/ ecosystem health	Pollution from boats	Sea water intrusion	Solid waste	Unconnected coastal wastewater	Water supply	Blue/Maritime economic growth policy	Coastal economic growth policy	Inland economic growth policy	Impervious land surface	Land price	Freshwater quality	Coastal water quality	Marine water quality
Inland sectors	Inland agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	-0.80	0	0	0	0	0	0	0	0	0	0	0	0	-0.95	0	0
	Inland industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.60	0	0	0	0	0	0	0	-0.60	0	0
	Inland urbanization	-0.70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.35	0	0	0	0	0	1.00	1.00	-0.30	0	0
	Local inland energy production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.20	0	0
Coastal sectors	Coastal agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	-0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.95	0
	Coastal industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.60	0
	Coastal recreation/tourism	0	0	0	0	0	0	0	0	0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0.30	-0.50	0	0	0	0	0	0	-0.50	-0.50	0
	Coastal urbanization	0	0	0	0	-0.70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.50	0	0	0	0	0	0	0	-0.50	0
	Harbors	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.10	0.70	0	0	0	0	0	0	0	0	0	0	0	0
Marine sectors	Aquaculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.70	0	0	0	0	0	0	0	0	0	0	0	-0.50	-0.30
	Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local offshore energy production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Shipping	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0
Biophysical component	Nutrient/Pollutant legacies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1.00	-1.00	0
Environmental policies	Inland/coastal environmental policy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.60	0	0	0	0	0	0	0	0	0	0	0.60	0.60	0
	Marine environmental policy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.60	0	-0.70	0	0	0	0	0	0	0	0	0	0	0	0.60
Hydro-climatic components	Sea level	0	0	0	0	-0.30	0	-0.10	-0.50	-0.70	0	0	0	0	0	0	0	0	0	0	0	0	0.70	0	0	0	0	0	0	0	0	0	0	0
	Runoff	0	0	0	0	0	0	0	0	0	0	0	0	0	0.85	0	0	0	0	0	0	0	-0.85	0	0	0.20	0	0	0	0	0	0	0	0
Environmental components	Baltic ecosystem health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coastal resilience/ecosystem health	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pollution from boats	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.90	-0.80
	Sea water intrusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.20	0	0	0	0	0	-0.20	0	0
	Solid waste	0	0	0	0.55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.60	0	0
	Unconnected coastal wastewater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.90	0
	Water supply	0.20	0	0.10	0.55	0.30	0	0.30	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic components	Blue/Maritime economic growth policy	0	0	0	0	0	0	0	0	0	0.50	0.50	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coastal economic growth policy	0	0	0	0	0.50	0.50	0.50	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Inland economic growth policy	0.50	0.50	0.50	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spatial planning	Impervious land surface	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.20	0	0
	Land price	-0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water quality components	Freshwater quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.70	0	0	0	0	0	0	1.00	0
	Coastal water quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0
	Marine water quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sharing is encouraged

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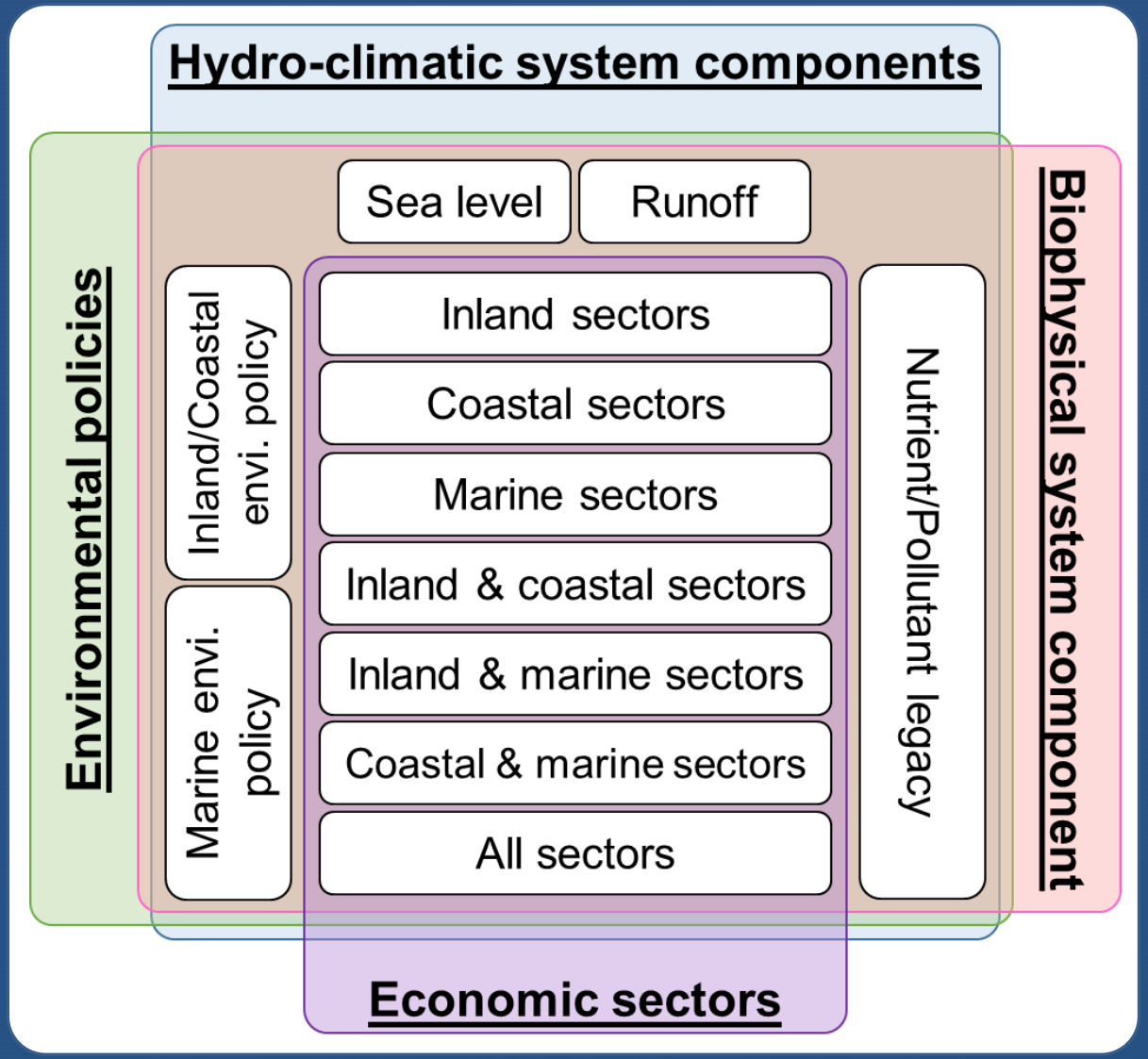
Scenario Set-up



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Kay Findings

- Scenario analysis helps understand the dynamics of system evolution, the role of system feedbacks and complexities, and the sensitivity of quantification assumptions made for system modelling.
- Synergistic multi-scale management strategies are needed to improve inland and coastal water quality.
- Scale implications play a key role in water quality management in semi-enclosed marine environments and their associated coastal regions.
- Handling of long-lived nutrient/pollutant legacy sources is essential for any water quality improvement.
- A complexity trade-off exists between qualitative and quantitative system dynamics modelling.

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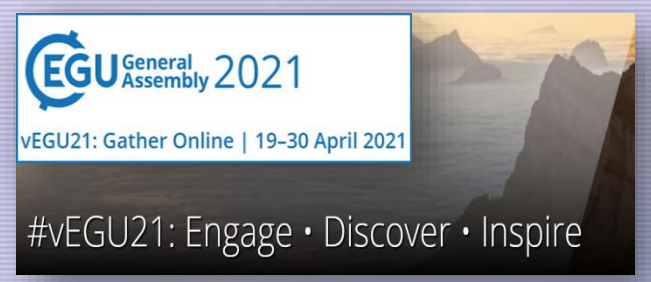

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COASTAL Collaborative Land-Sea Integration Platform

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