Defining a Safe Operating Space (SOS) for water resources in a changing climate and society

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SOS-Water

Proposal addressing the topic **HORIZON-CL6-2021-CLIMATE-01-01: Improved understanding, observation and monitoring of water resources availability.**

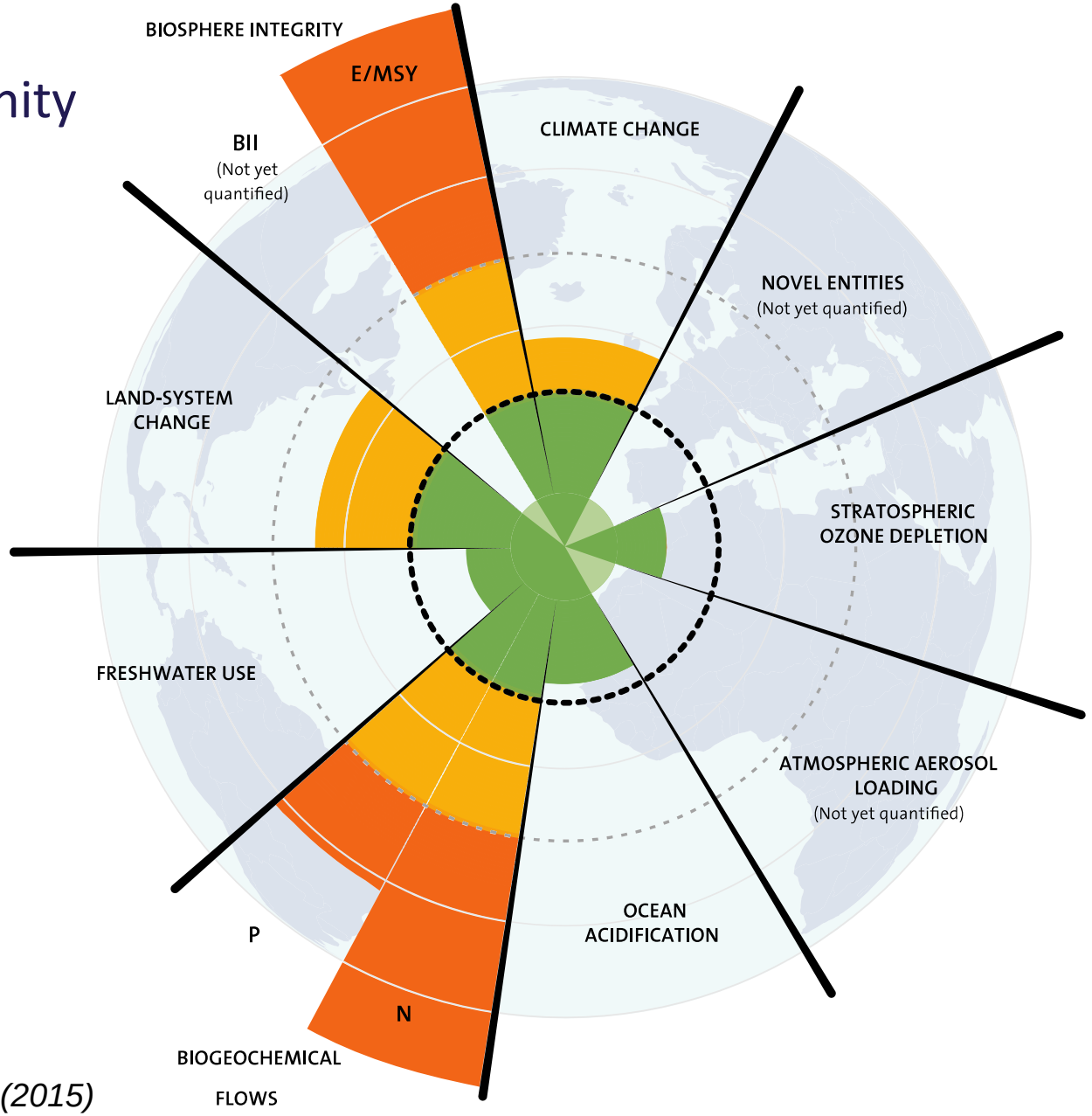
Within the call: **Land, oceans, and water for climate action**

www.sos-water.eu

The 9 planetary boundaries:

A safe operating space for humanity

(Rockström et al. 2009)

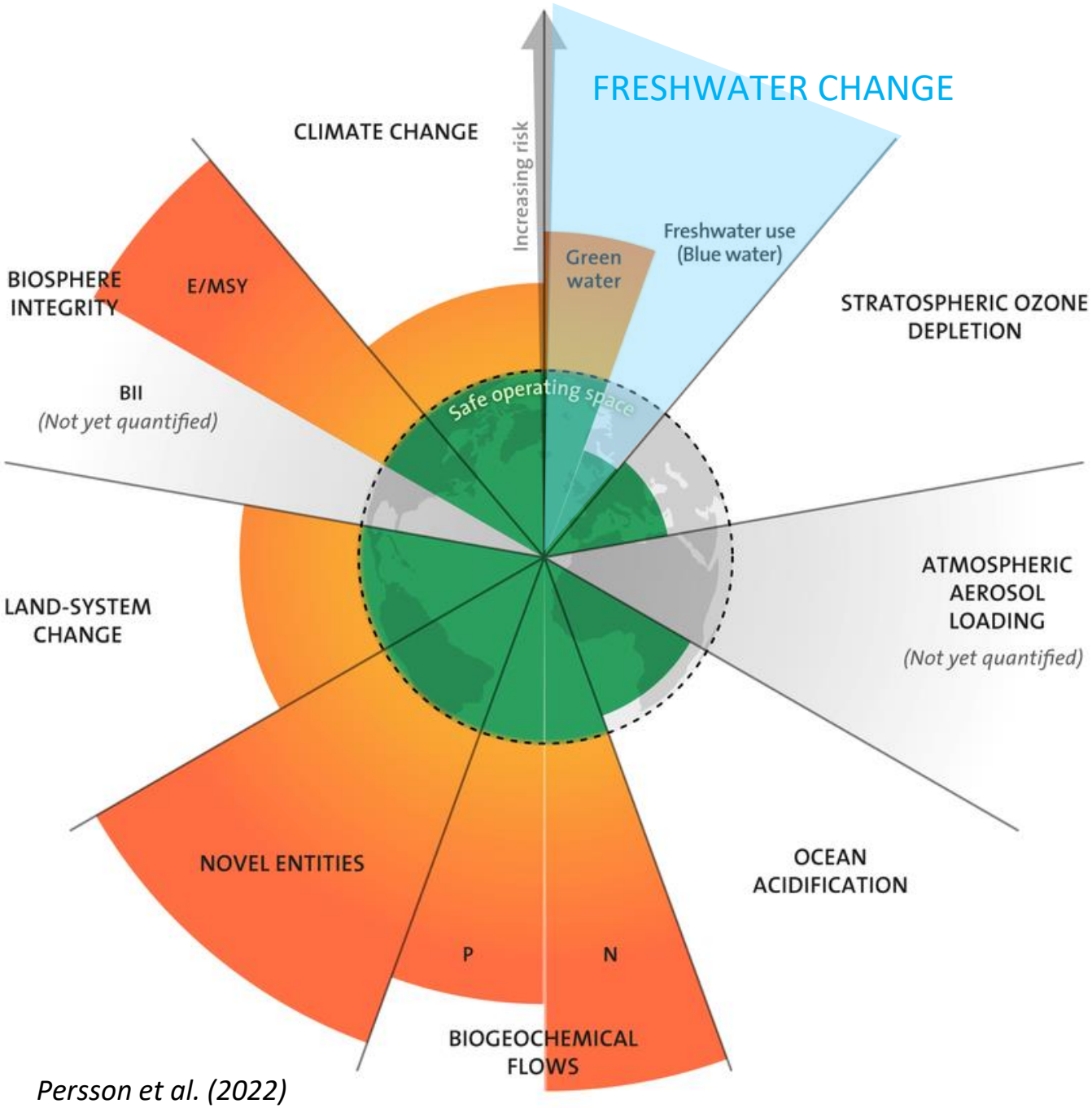


Below boundary (safe)

In zone of unceratinty (increasing risk)

Beyond zone of uncertainty (high risk)

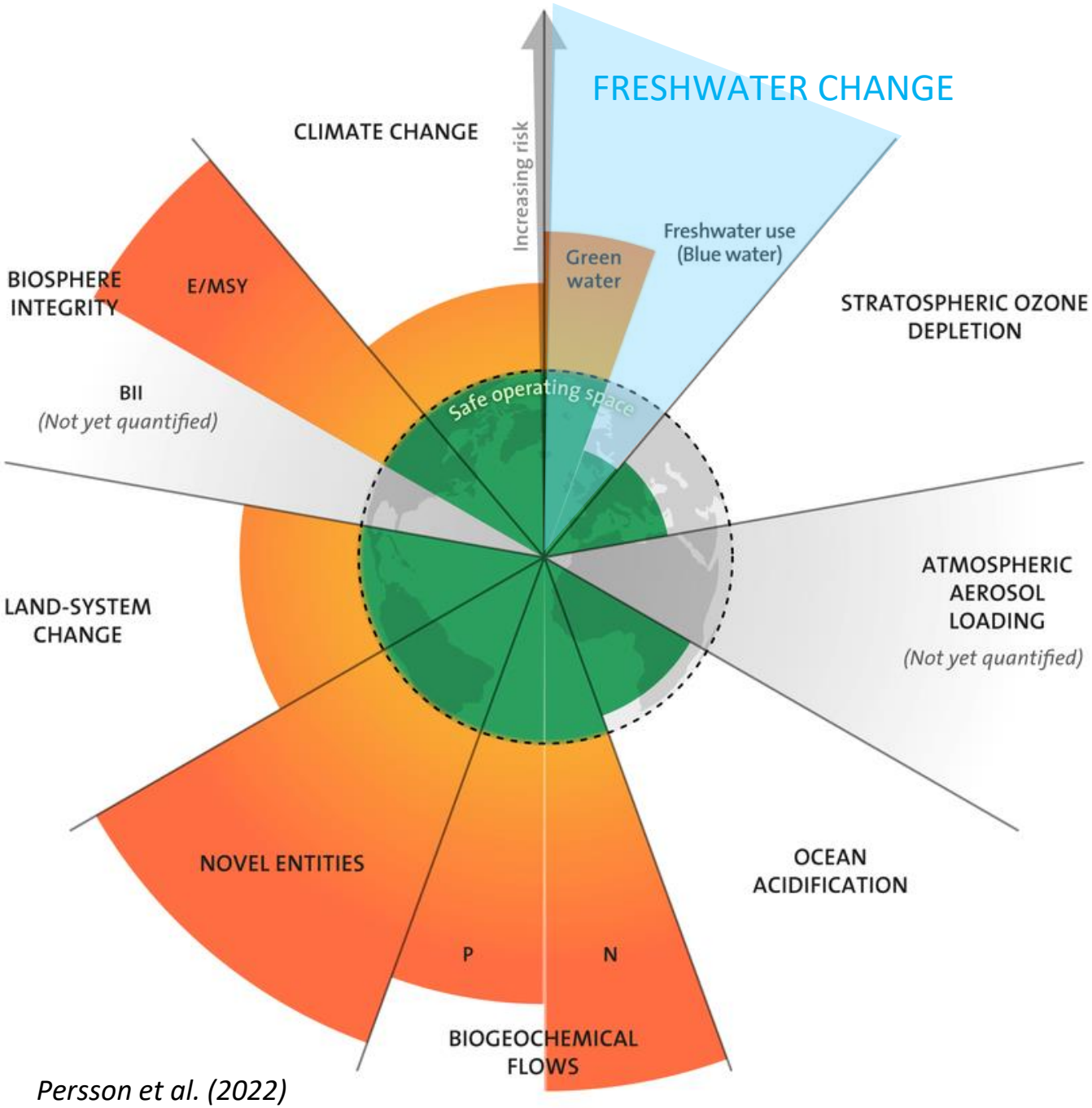
Steffen et al. (2015)



Persson et al. (2022)

What is SOS-Water about?

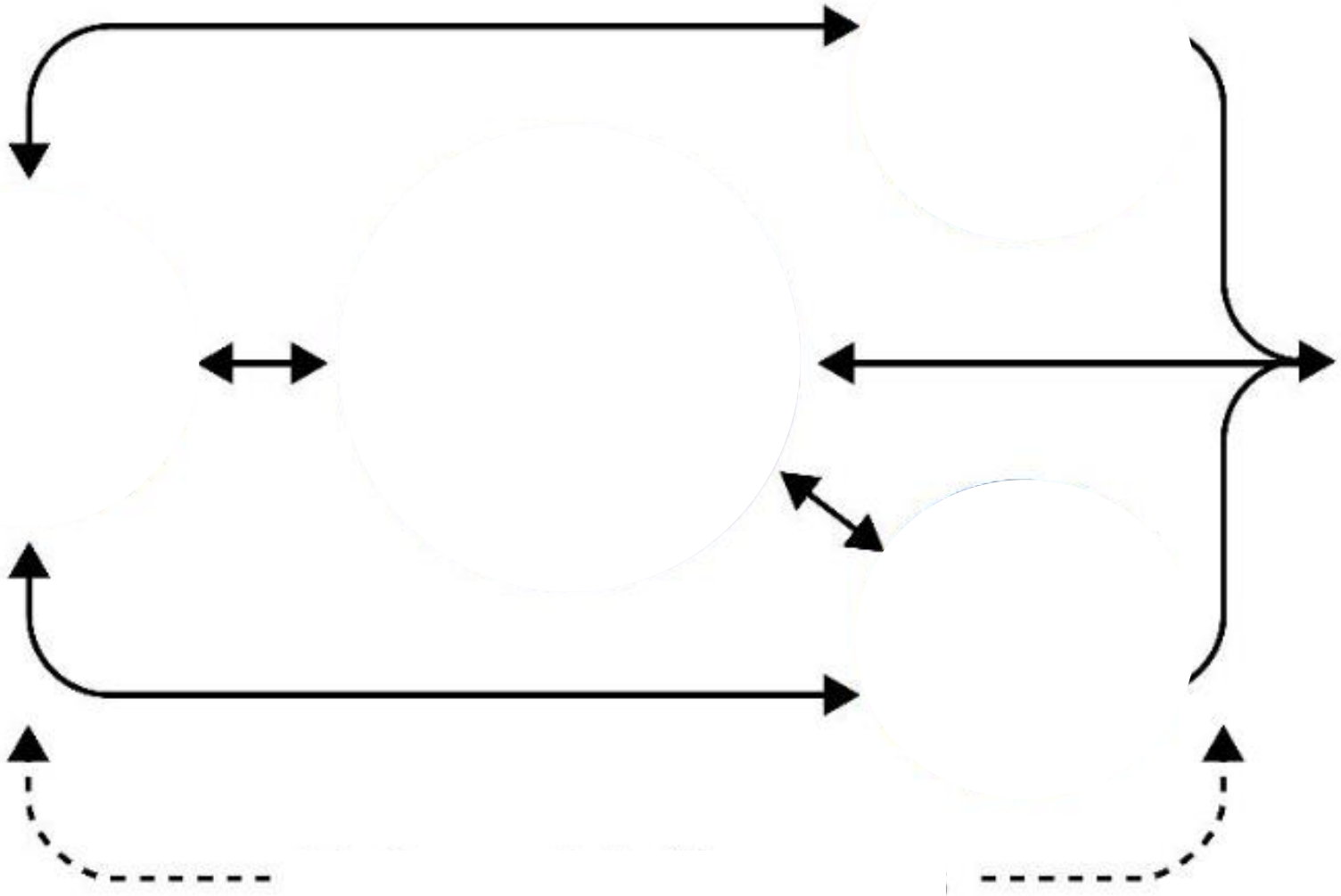
SOS-Water is a multi-disciplinary project that aims to create the foundation for a **participatory assessment framework of the SOS for the entire water resources system**, accounting concurrently for all relevant water dimensions across multiple sectors and spatial scales under the influence of socio-economic, policy, technological, and climatic changes.



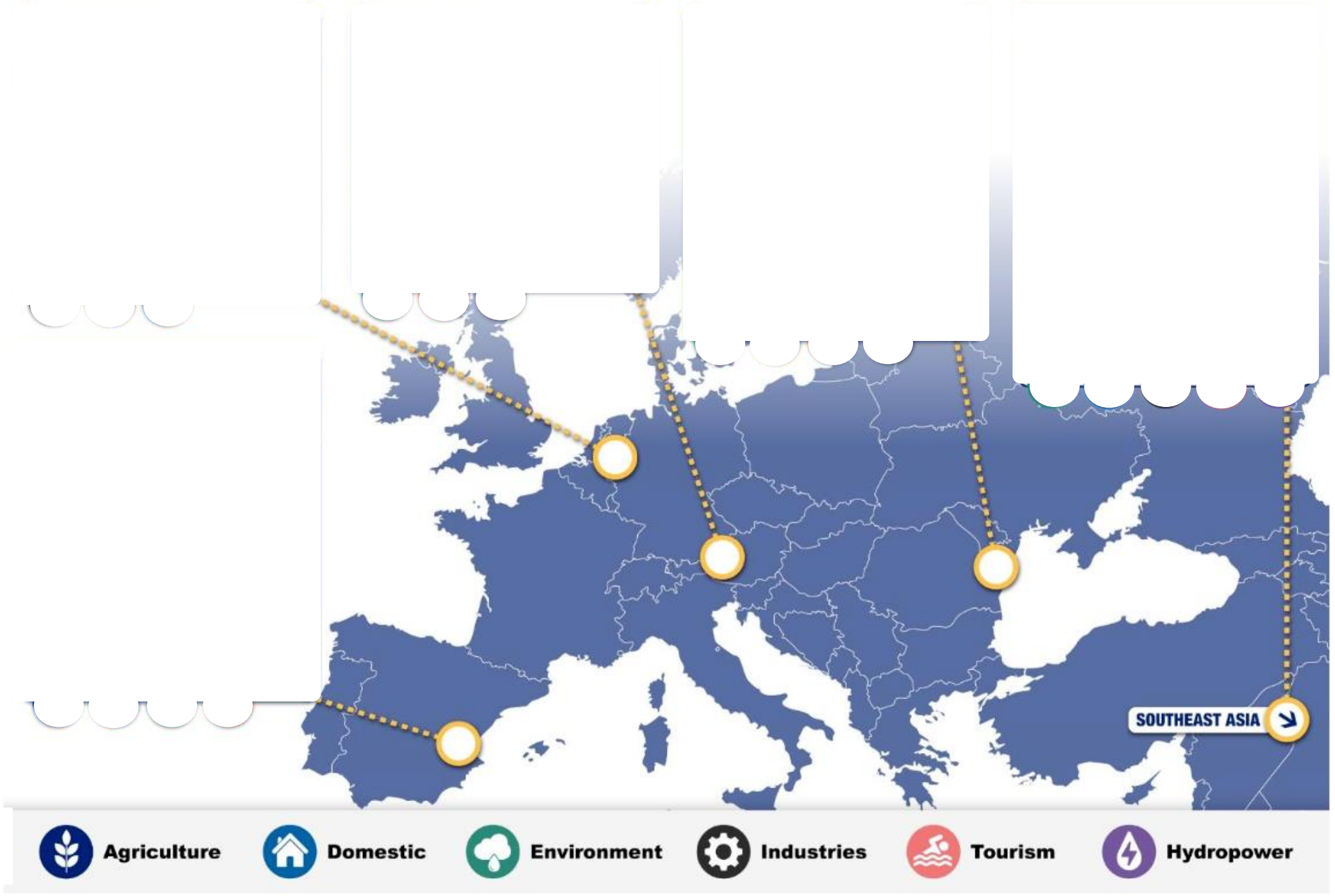
Persson et al. (2022)

What is novel about that?

…to link **improved versions of state-of-the-art water system models**, i.e. models that assess the impacts of climate variability and change and human activities on water resources availability, **to impact models,** i.e., models that assess the impact of water availability constraints on the economy, society, and environment (biodiversity, ecosystem services).



”WATER USERS”


SOUTHEAST ASIA
Agriculture
Domestic
Environment
Industries
Tourism
Hydropower

”WATER USERS”


JUCAR
Urgent challenges:
• Limited water availability
• Intensive agricultural water use
• Groundwater depletion
• Change less precipitation
• Increased evaporative demand
• More frequent and intense extreme events
• Reduced environmental flows
• Increasing water temperatures
• Eutrophication
• Water pricing, allocation conflicts
SOUTHEAST ASIA
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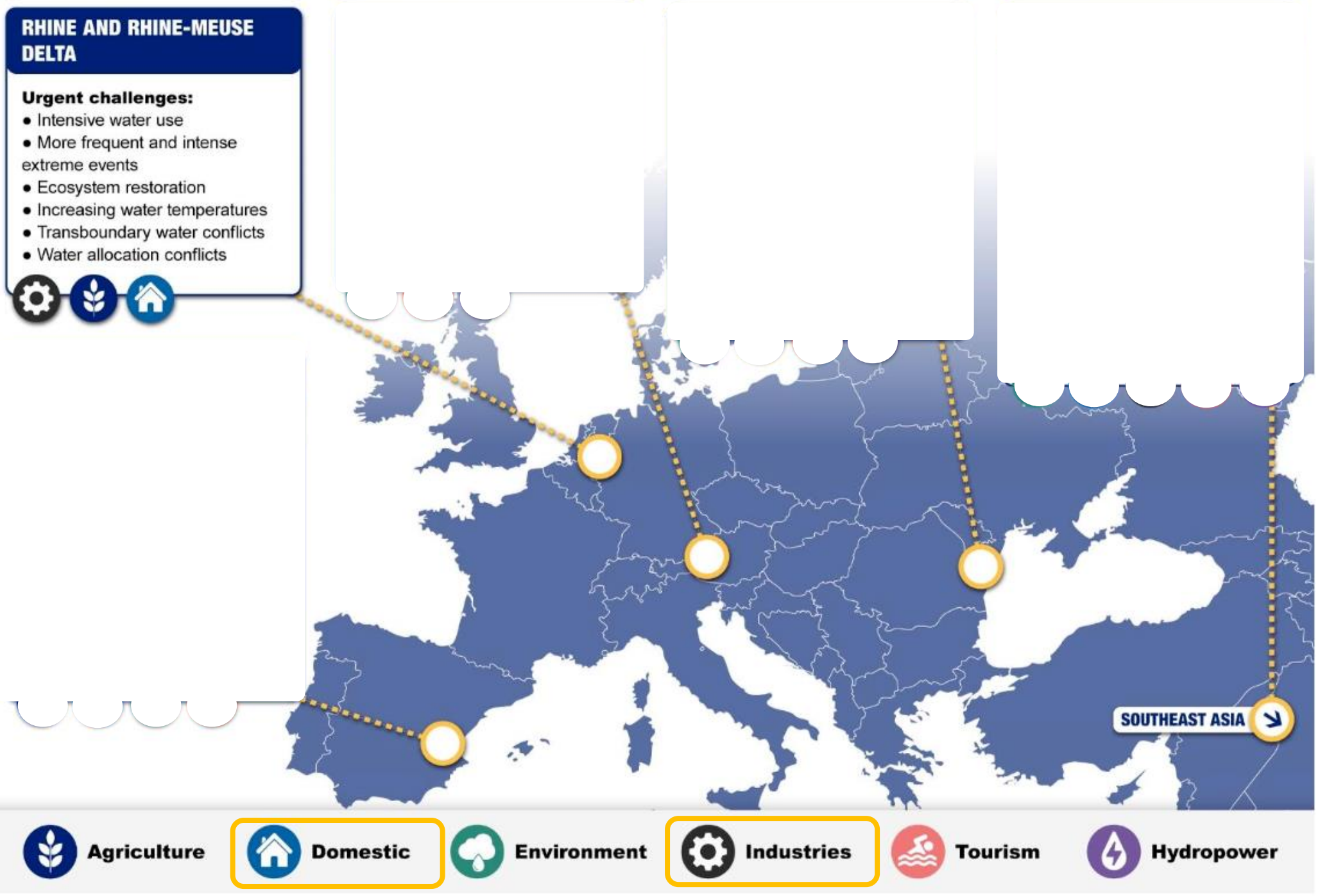
RHINE AND RHINE-MEUSE DELTA
Urgent challenges:
• Intensive water use
• More frequent and intense extreme events
• Ecosystem restoration
• Increasing water temperatures
• Transboundary water conflicts
• Water allocation conflicts
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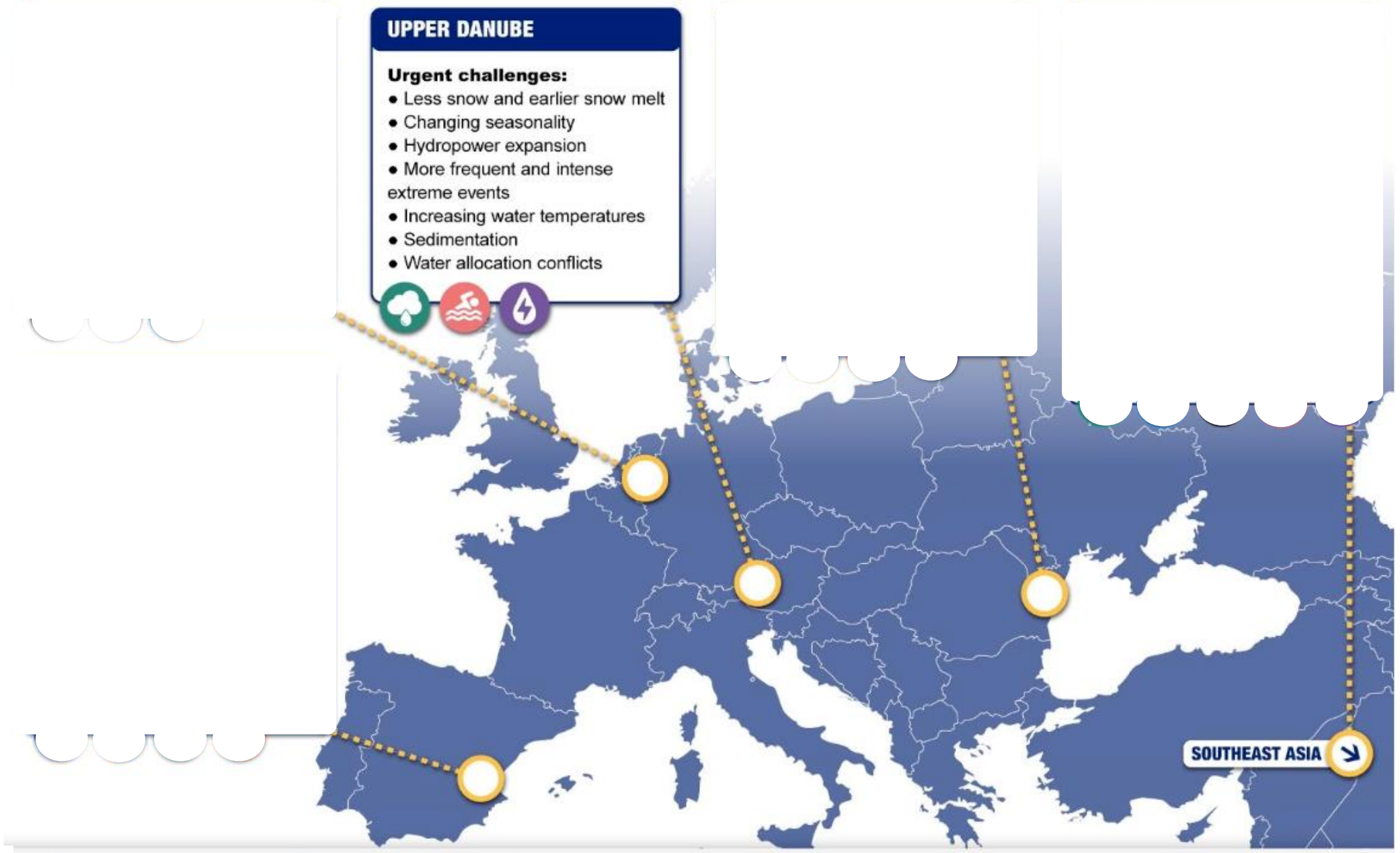

”WATER USERS”

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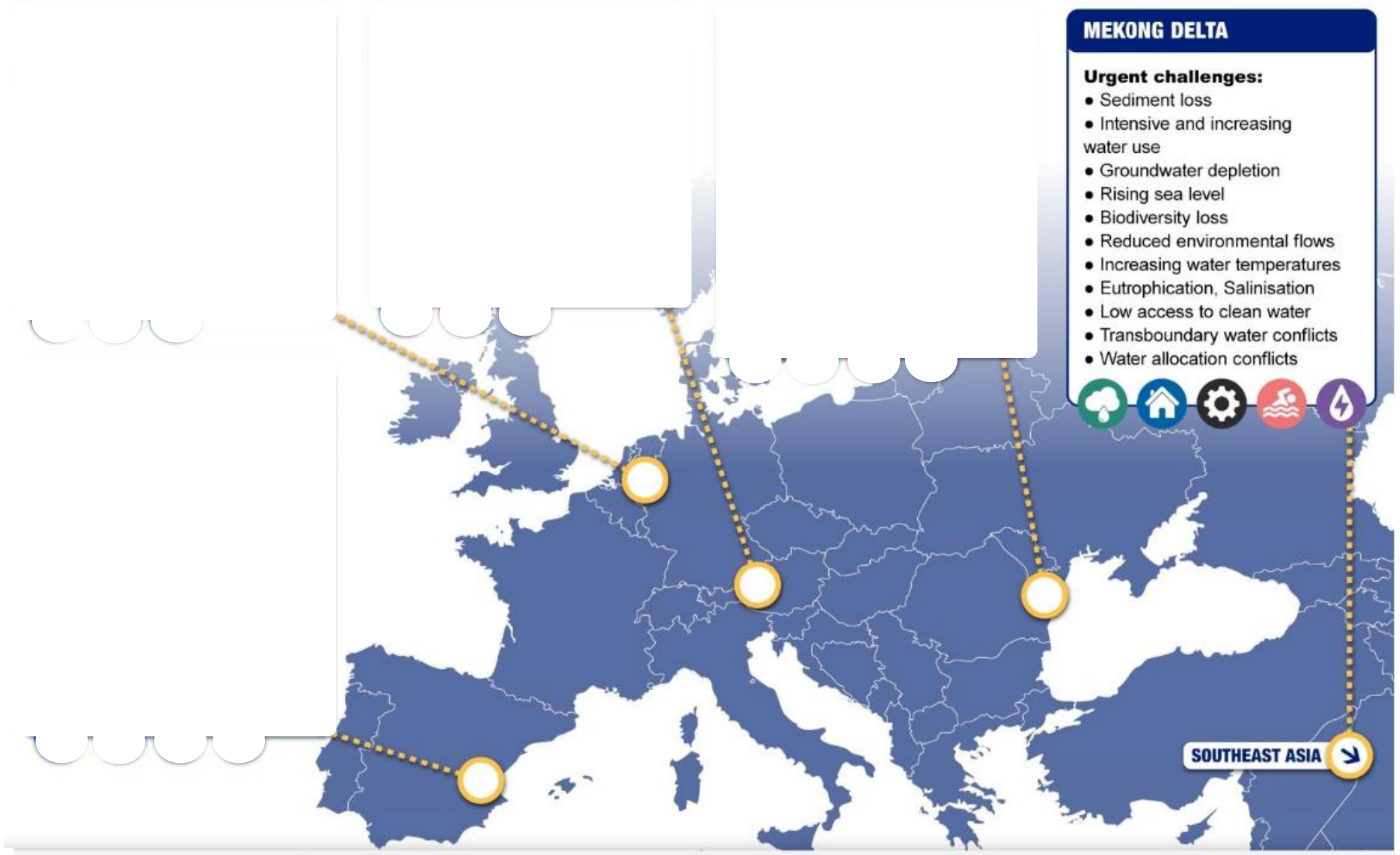

”WATER USERS”

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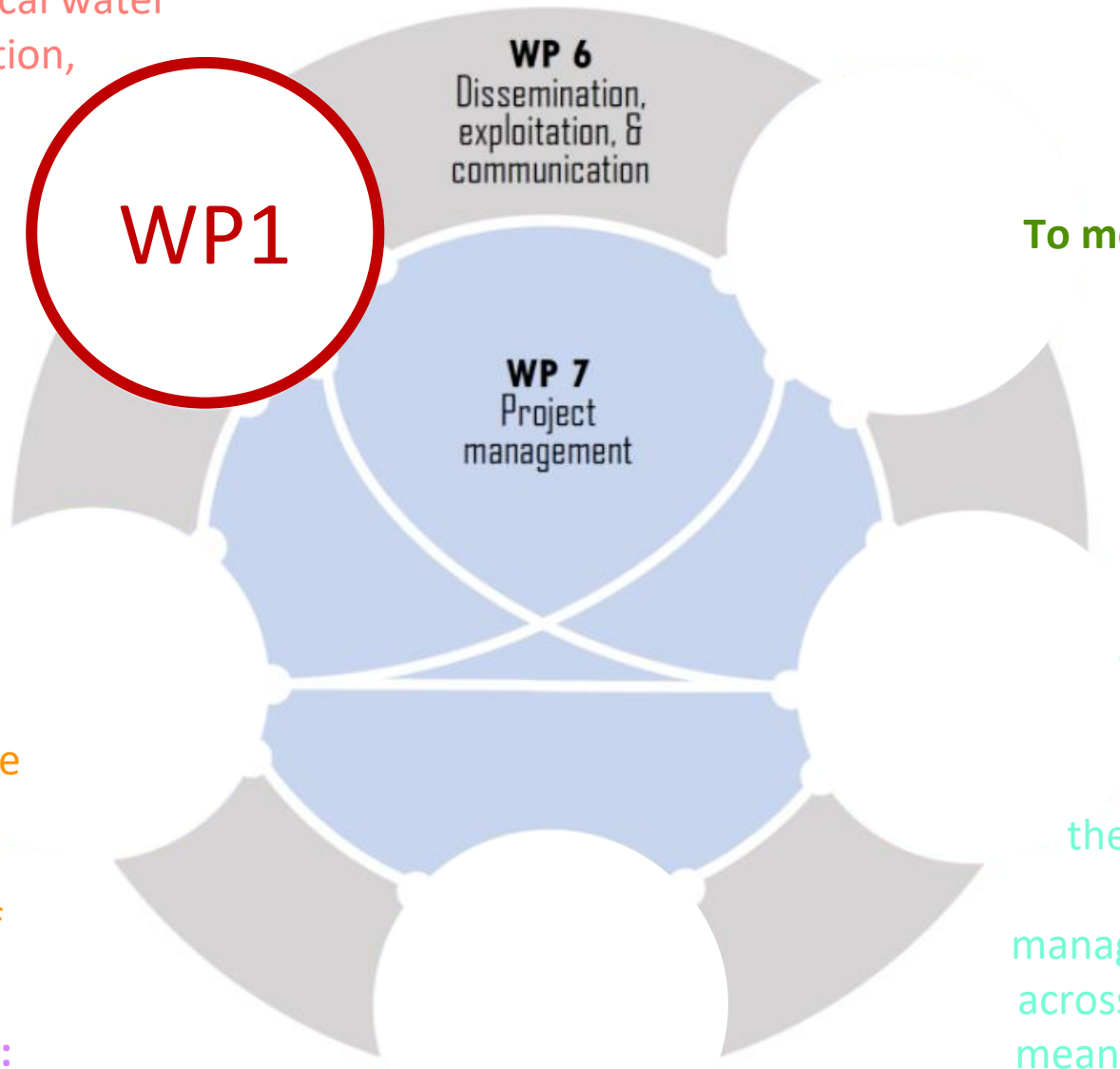
To close the gap between theory and practice of the water system SOS:

Linking water modelling tools with local water values (e.g., food and energy production, drinking water supply, biodiversity conservation), informing the identification of water system indicators, the monitoring process, and scenarios with stakeholder knowledge and preferences

To understand the boundaries of the water system SOS:

Exploring the spatiotemporal space, parameters, and information sources covered by state-of-the-art water indicators; co-design innovative indicators that cover the gaps identified; and to build a system of indicators to improve assessments of water resources



To model the water system SOS:

Advancing hydrological models to assess climate and human impacts on water resources and link them to biodiversity and ecosystem services models

To define the water system SOS:

Developing the concept of the SOS as a multi-dimensional space of policies and water management pathways evaluated across a broad set of scenarios by means of the indicators identified

To benchmark the modelling system:

Capitalizing on available monitoring techniques and data to identify discrepancies between available environmental information services and information needs for water system SOS assessments and to infer from these assessments how critical environmental shifts can be identified using Earth Observation

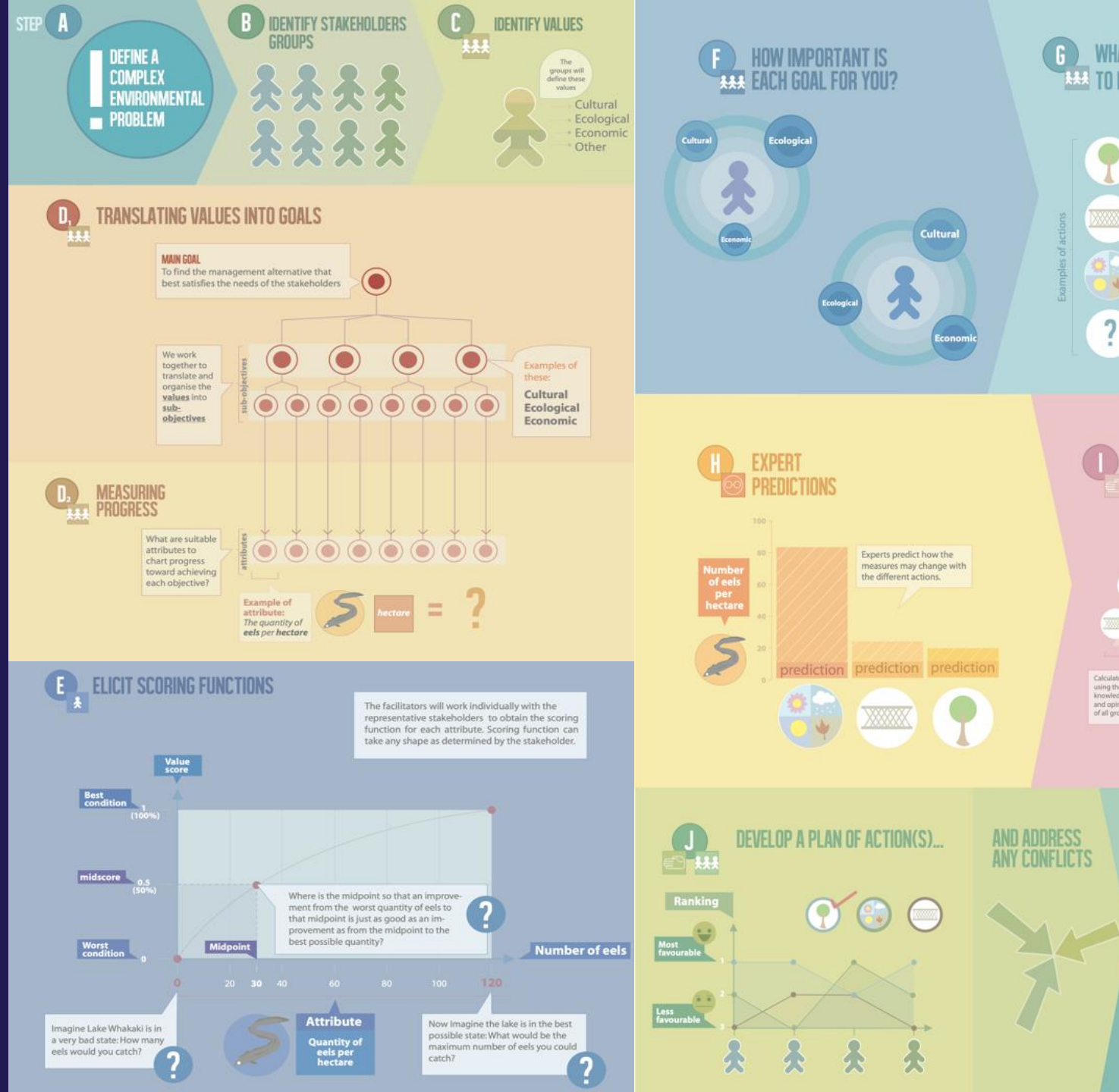
WP1: Closing the gap between theory and practice

Simone Langhans (lead) + Katarina Cetinic (NIVA), Sami Domisch & Jaime Marquez (IGB Berlin)

Main objective:
Co-developing water values and scenarios

More specifically:

- Develop roadmaps for stakeholder engagement process
- Co-develop objectives, indicators and value preferences
- Model distributions of water values (biodiversity, ecosystem services) and link them to hydrological models
- Co-develop freshwater management plans that ensure to stay within the SOS-water (for each case study)



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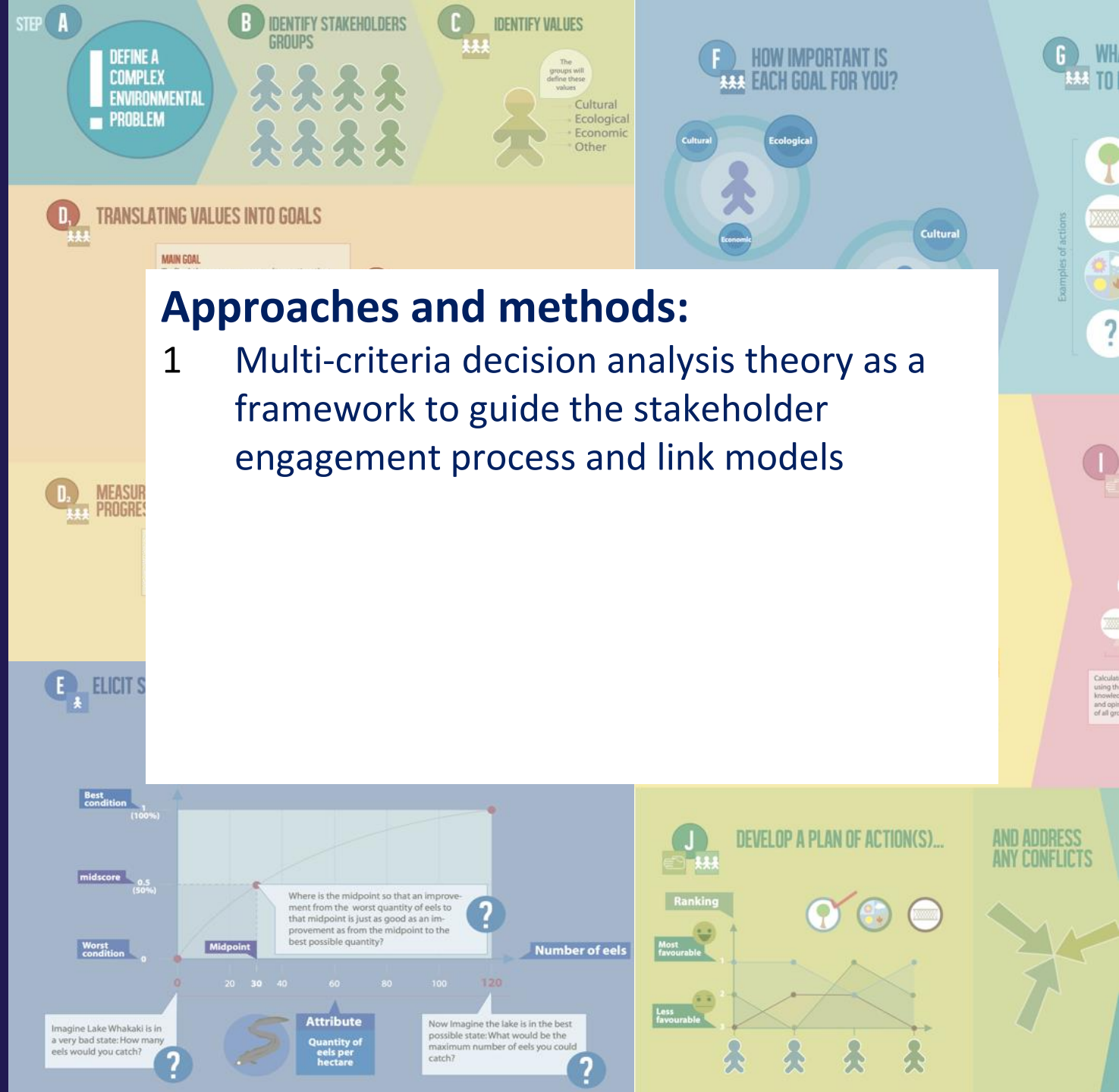


Approaches and methods:

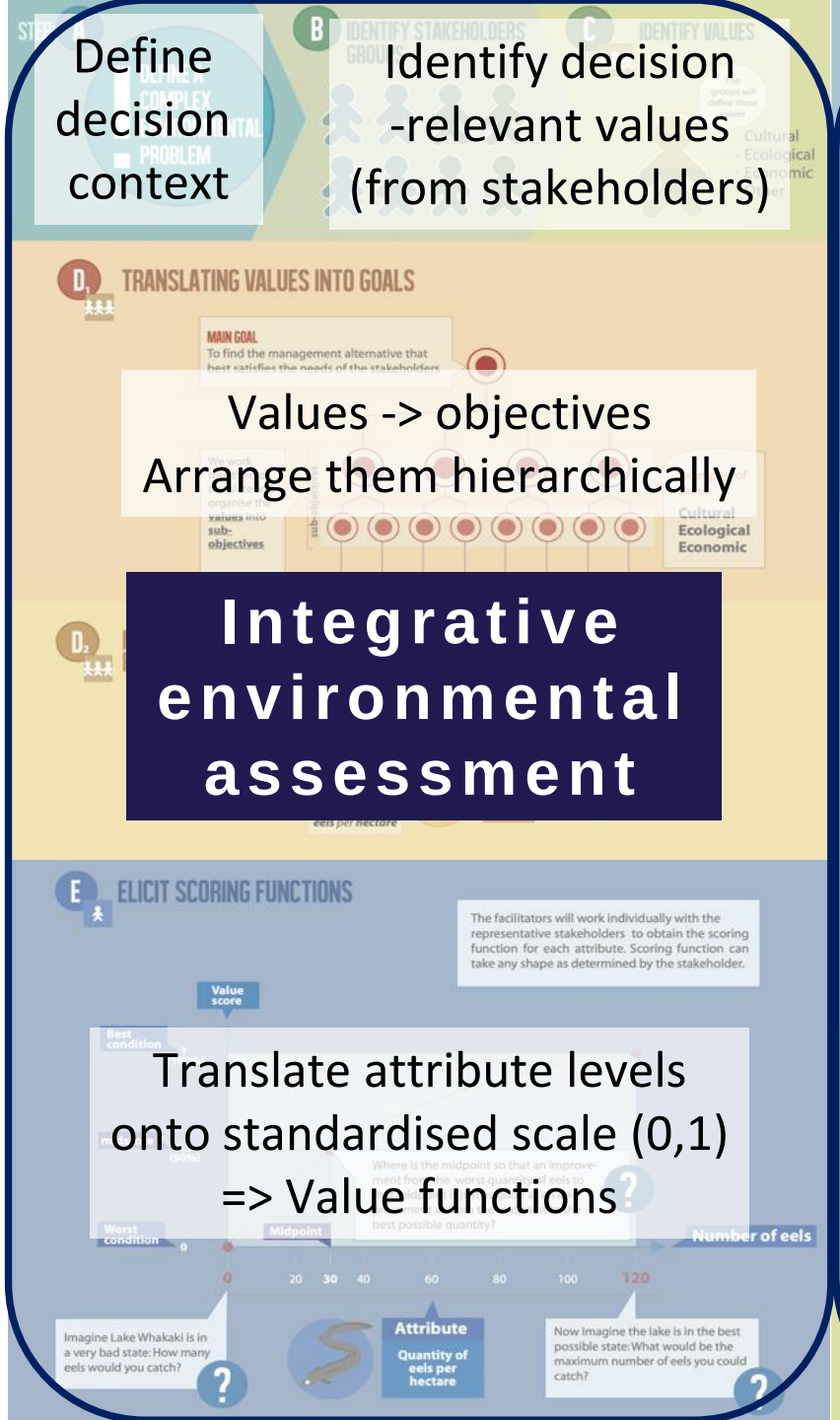
1 Multi-criteria decision analysis theory as a framework to guide the stakeholder engagement process and link models

Multi-Criteria Decision Analysis Theory

Langhans et al., River Res Appl. (2018)

*"... a **formalization** of **common sense** for decision problems which are **too complex** for informal use of common sense."*

Keeney, OperRes (1982)



WP1: Co-developed water values and scenarios

Simone Langhans (lead), Sami Domisch, Jaime Marquez (IGB Berlin) + new postdoc NIVA

Main objective:

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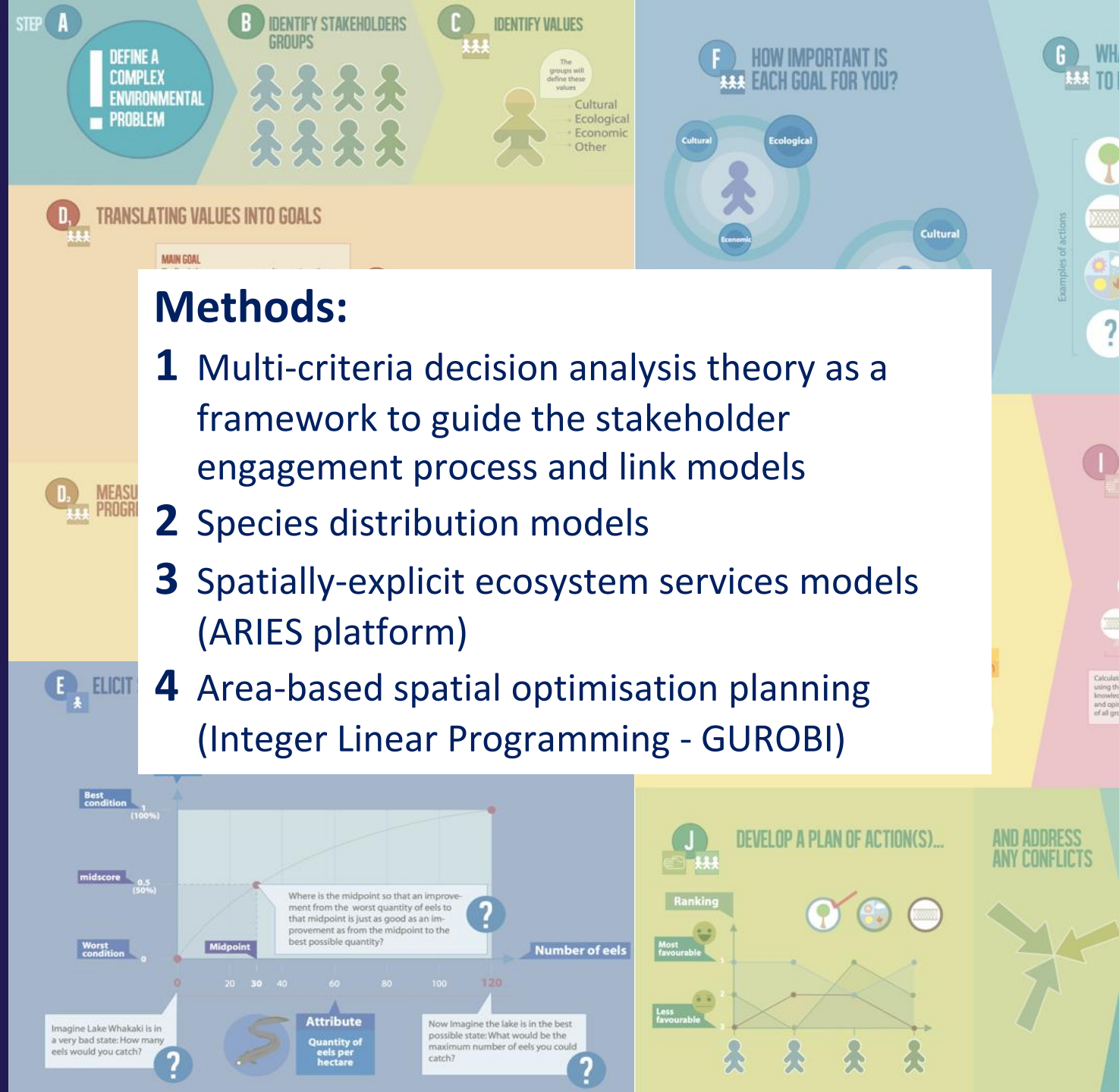


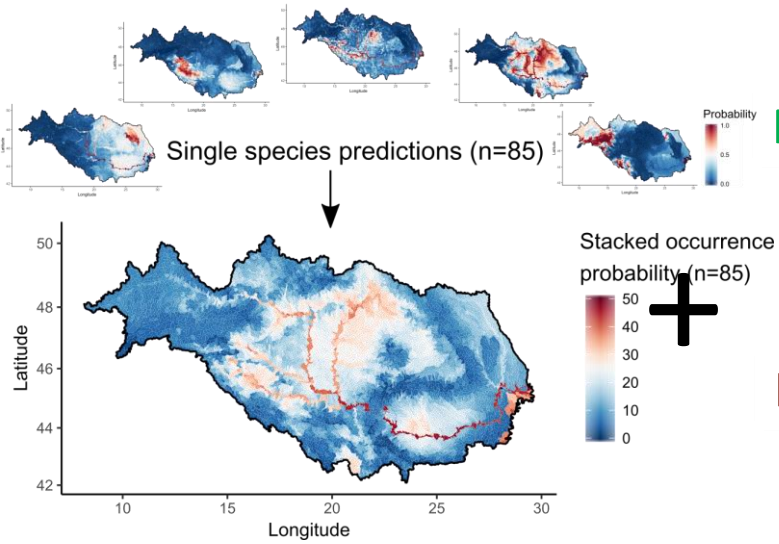
Methods:

1. Multi-criteria decision analysis theory as a framework to guide the stakeholder engagement process and link models
2. Species distribution models
3. Spatially-explicit ecosystem services models (ARIES platform)
4. Area-based spatial optimisation planning (Integer Linear Programming - GUROBI)

Co-developing management plans for staying within SOS-Water

Species distribution modelling

Fish species distribution (biodiv)



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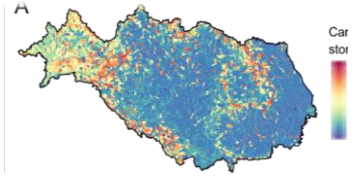
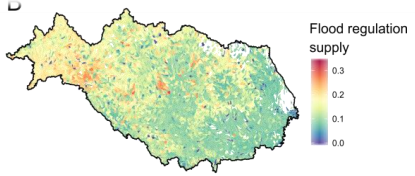
Ecosystem services modelling

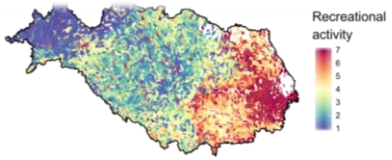
Carbon Storage (CS)



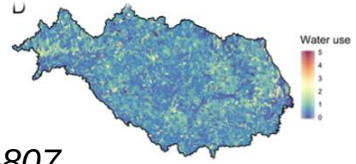
Flood Regulation (FR)



Recreational Activity (RA)



Water Use (WU)



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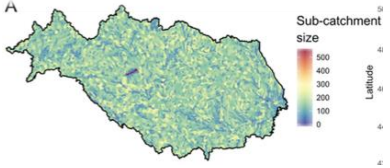
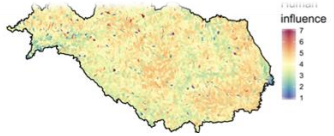
Cost layers

Subcatchment size

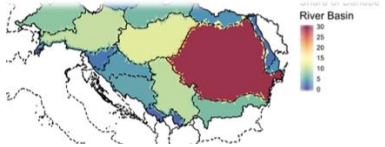


GDP

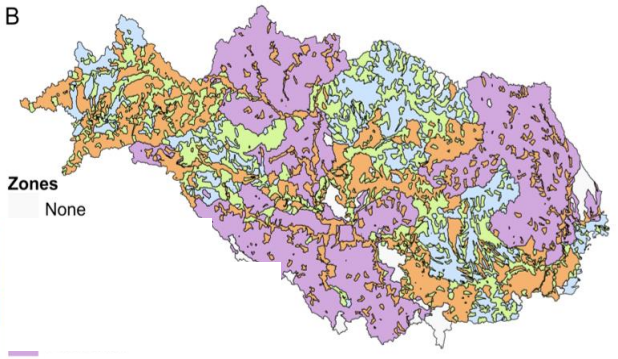
Human influence



Country-specific share of Danube basin



Spatial optimisation of biodiversity conservation and ecosystem services use areas



Focal conservation:
biodiv+CS+FR

Critical management:
biodiv+CS+FR+RA

Catchment management:
biodiv+CS+FR+RA

Production:
RA+WU

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https://sdlanghans.weebly.com