

## Abstract

Due to their complex and interconnected nature and the multiple demands placed on them by human activities, trade-offs may arise in the provision of ecosystem services by aquatic ecosystems and sometimes these services may not meet their demand. These tensions are exacerbated by climate changes and higher occurrence of extreme events but also by increasing water demand and land use changes.

Finding new innovative ways of managing water resources, while preserving freshwater ecosystems and ensuring equitable access to their services, is a major challenge that must be addressed by accounting for the intertwining of societies and ecosystems. To advance research on this burning topic, WaterWeave brings together an interdisciplinary and international consortium to develop an integrative and interactive tool (IIT) to promote social learning and help managing water resources and freshwater ecosystems in a context of land-use and climatic change.

The IIT will combine biophysical determinist, probabilistic or data-driven models to represent ecosystem functioning and ecosystem service provision and multi-agent-based interactive models to represent the social components of the system. It will be kept simple to ensure easy handling, straightforward interpretation, and adaptability to local context. Its development will be nurtured by interactions with a panel of key stakeholders (i.e., managers, decision-makers, and different groups of end-users such as local traditional communities' representatives), recruited from three test sites in Brazil (Sao Paulo, Rio Grande do Sul and Pará states) and one in Luxembourg.

In each site, starting from a diagnosis of freshwater ecosystems, including the associated services and demand using existing scientific and local knowledge, datasets, and models, we will debate water and related ecosystem issues, identify the main direct and indirect drivers (including governance systems), and frame the scope of the IIT within the project lifetime.

Next, we will initiate a retrospective analysis using existing datasets and models completed by sediment core sampling targeting e-DNA and anthropogenic contaminants. This will be conducted in close collaboration with the stakeholder panel and through the lens of public policies and management decisions. This will highlight past successful/unsuccessful measures and define realistic management scenarios they would like to explore as a guide for further development of the IIT.

Finally, we will explore prospective scenarios driven by future climatic projections for different greenhouse gas emission scenarios. The IIT will enable the stakeholder panel to test their management proposals for different time horizons and explore alternative scenarios by modifying decisions or social behaviour to collectively find more sustainable ways forward for their territory.

WaterWeave is relevant to several dimensions of the Water4All call.

- First, we will deeply rely on existing data, especially remote-sensing data, and artificial intelligence (machine learning to extract key-information on the links between ecosystem state and services trends) (Topic 1.1), that will support the IIT development and the diagnosis, retrospective, and prospective analyses.
- Work with the stakeholder panel and questionnaires targeting different social end-user groups will provide a wide range of views on the values given to nature and its services (Topic 1.3).
- Second, the analyses conducted in each site will allow assessing the effects of different anthropic pressures and their cumulative effects and to identify how policy, governance and management decisions shaped their evolution (Topic 2.1, 2.2).
- Finally, the retrospective and prospective activities with the IIT aiming to investigate the effectiveness of past decisions and collectively define new governance systems and water and ecosystems management strategies will increase socio-ecological resilience while guaranteeing equitable access to ecosystem services (Topic 3.1, 3.2).

## KEYWORDS

### ► Project coordinator

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### ► Project partners

- LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY - LUXEMBOURG
- INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS - BRAZIL
- UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL - BRAZIL
- UNIVERSIDADE DE BRASÍLIA - BRAZIL
- UNIVERSIDADE FEDERAL DO OESTE DO PARÁ - BRAZIL

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### ► Duration

3 years

### ► Contact

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aquatic socio-ecological systems  
integrative and interactive multi-agent-based modelling  
remote sensing  
artificial intelligence  
participatory research  
Nature's Contributions to People

