STARS4Water

# Policy Brief: Unlocking global data for tailormade water management strategies in Europe

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| **SEN** | Confidential, only for members of the consortium and the granting authority (including other EU institutions and bodies) | |
| **CI** | Classified, as referred to EU Decision 2015/444 and its implementing rules | |

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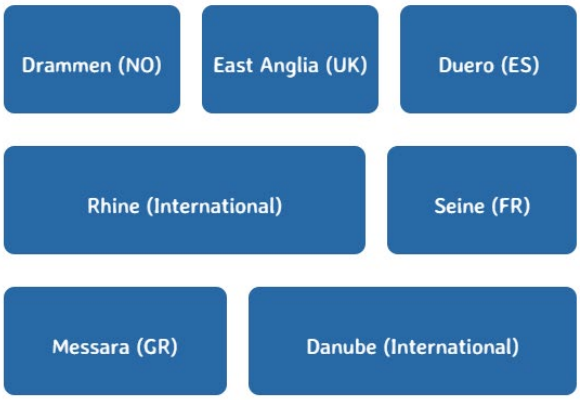
## Summary

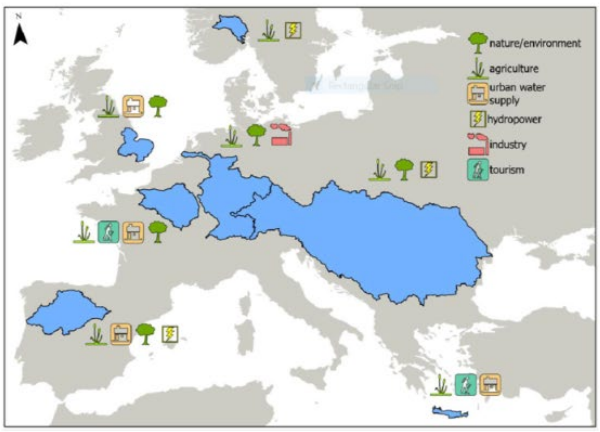
Climate change is significantly impacting water resources, leading to increased risks of water shortages, floods, and ecosystem disruptions. To address these risks, river basin authorities must implement adaptive strategies that account for projected changes in water demand and availability. However, challenges related to data accessibility, quality, and usability continue to hinder effective water management. The STARS4Water project seeks to address these challenges by unlocking global datasets, developing new data services, and providing decision-support models tailored to river basin stakeholders. This policy brief outlines key challenges encountered by the river sasin stakeholders related to data findability, availability, accessibility and usability, highlights the added value of global data, and presents specific recommendations that address these challenges while integrating insights from river basin stakeholders in 7 European basins.

# D6.4: POLICY BRIEF: UNLOCKING GLOBAL DATA FOR TAILORMADE WATER MANAGEMENT STRATEGIES IN EUROPE

Climate change is significantly impacting water resources, leading to increased risks of water shortages, floods, and ecosystem degradation. To address these risks, river basin authorities must implement adaptive strategies that account for projected changes in water demand and availability. This in line with standing European policies and strategies such as the Water Framework Directive and the European Water Resilience Strategy that aims to ensure that water sources are properly managed and scarcity is addressed.

However, challenges related to data accessibility, quality, and usability continue to hinder developing effective and adaptive water management strategies. The STARS4Water project seeks to address these challenges by unlocking global datasets, developing new data services, and providing decision-support models tailored to river basin stakeholders. STARS4Water's approach is rooted in a living-lab approach: our findings are based on a co-creation process in 7 river basin hubs, each involving key water management stakeholders representing water management and water use sectors




This policy brief outlines key data challenges, such as availability, accessibility, usability, the need for additional data. We also highlight the added value of global and supra-regional data, and present specific recommendations that address these challenges while integrating insights from river basin stakeholders in 7 European basins.

## A. Key data challenges for the River Basin stakeholders

In 2023 and 2024 STARS4Water conducted a series of stakeholders' workshops in 7 River Basins Hubs across Europe. Regarding water data, the main identified challenges stakeholders reported revolved around issues of data (1) findability, availability and quality of (meta) data, (2) accessibility and usability constraints, and (3) application for decision-making.

**Findability, Availability and Quality of (meta) data**

Data sources are often being unknown or not findable by end-users and basin stakeholders. Despite the abundance of global and supra-regional datasets, river basin managers often struggle to identify relevant datasets and assess their usability in terms of variables or temporal and spatial resolution. Data gaps persist, particularly for critical variables such as groundwater levels, low-flow conditions, and long-term climate trends, but also in terms of temporal and spatial resolution. Inconsistent methodologies across data providers and lack of quality meta-data hinder mutual comparability and integration.

For example, all Basins identified a noticeable lack of water use data from economic sectors and water needs for ecosystems which further complicates the assessment of current and future water resources availability and the development of water management strategies.

**Data Accessibility and Usability Constraints:**

Data silos and fragmented ownership limit access to comprehensive datasets. Licensing restrictions and administrative barriers prevent seamless data sharing between agencies. Once access to data has been obtained, pre-processing and assessing the added value of data is challenging and time consuming, as stakeholders frequently lack the technical capacity to familiarize themselves, process and interpret large raw datasets effectively.

For example, the Duero River Basin notes that while the European Space Agency provides a wide range of global data, accessing and utilizing these datasets in a way that meets operational needs is not straightforward. More user-friendly interfaces and standardized formats that enable easy access for decision-makers are required.

**Limited Integration into Decision-Making:**

Existing datasets are often underutilized because they are not designed for nor easily integrated in policy and planning applications. A gap exists between the multitude of raw and available data and the aggregated, actionable information at the basin scale stakeholders require. Poor cross-sectoral coordination and data-accessibility (e.g., between water, agriculture, and energy sectors) further complicates the integration of data into water resource planning. The lack of user-friendly visualization and decision-support tools makes it difficult for stakeholders to extract actionable insights.

For example, the Danube River Basin lacks an integrated, transnational dashboard for stakeholders, limiting timely data access and utility.

## B. The added value of global data in supporting water resources management and planning at river basin level.

Based on STARS4Water stakeholders' workshops we conclude that global and supra-regional, European datasets offer complementary benefits, particularly where local monitoring is sparse or inconsistent. The STARS4Water project has demonstrated that there is untapped potential in global datasets and even more so in global datasets combined with data driven modelling. To be more specific, global data is of great value

- To fill in gaps or complement local hydrological data. In the Messara basin the ERA5 data have been used to complement the in-situ precipitation and temperature data.
- To develop data services for better understanding of hydrological processes. In the Rhine basin data services on agricultural water demands are developed to have a better understanding of the use of water for agricultural production.
- To provide standardized, high-resolution, tailormade water and climate data that assure the sound knowledge base for enhancing scenario planning, forecasting and developing water management strategies. In the Seine basin prospective scenarios of water availability developed in France based on global data are adapted to the regional scale and used to inform local management on reservoir filling conditions to sustain low flow management under climate change.
- To support transboundary water management by offering harmonized datasets across multiple jurisdictions. In the Rhine basin, differing regional data, models, and methodologies create inconsistencies and uncertainties in transboundary water management. To address this, efforts are shifting from data aggregation to harmonization and integration, ensuring a unified decision-support system across jurisdictions.
- To enable long-term trend analysis, supporting strategic decision-making for climate adaptation. The MIRAME Duero viewer integrates global datasets and AI tools to enhance both long-term planning (e.g. trend analysis) and routine management in the Duero basin. Amongst others Sentinel-1 and Sentinel-2 data are used to aid irrigation planning and track water availability through ESA hydrological models for sustainable resource use.
- To foster the development of innovative machine learning models for improved water availability assessments and use projections. In the Drammen basin a novel approach to represent snowmelt by machine learning is investigated. The aim is to train a model on combined local observations and global data, such that assessments can be made on locations with based on global data only.

## C. The STARS4Water recommendations for "unlocking" global water data and enhancing their use by river basin stakeholders

The main challenges that the river basin stakeholders are facing regarding data indicate a pressing need for enhanced collaboration, technological harmonization and integration, and co-creation of tools with stakeholders to ensure data is not only available but also accessible and actionable for planning and decision-making. The STARS4Water recommendations are summarized below.

1. **Establish co-creating, data-driven river basin hubs:** Following the STARS4Water learnings, facilitate the setup of **river basin hubs in which** data providers, modelers and end-users can co-design and co-creation data services and tools for stakeholder communities. Guidelines on the establishment and operations to foster collaborations between local governments, researchers, and industry to integrate water data into broader socio-economic planning should be developed and prioritized, taking local specificities, e.g. language administrative boundaries or cultural issues, into account.

2. In these hubs and elsewhere in general, **demonstrate the potential of global data use, data driven modelling and their added-value in pilot basins**: Demonstrated use of data and data-driven models helps to raise awareness, stimulates discussion on data needs and enhances acceptance and uptake digital products and services. This in turn will improve the river basin modelling frameworks to better address the changes in water resources due to climate change and water use as well as extreme events and assessing strategies and actions to enhance water resilience.

   The STARS4Water data services are demonstrated in practical use cases in 7 river basins that have been selected as living labs (hubs). The demonstration of the data service in these basins, which have a diverse range of needs, climate vulnerabilities and adaptation needs, can serve as accelerators for further upscaling of these services and tools to other river basins worldwide.

3. Continue by **co-design stakeholder data needs, complementing local data with global data and data originating from data-driven models.** Bridging the gap between data availability and information needs is essential and requires a targeted approach where datasets are processed and combined with other data and model outputs, meeting the demands of stakeholders. End-user requirements must be systematically gathered through structured co-design processes, ensuring that data producers align their outputs with real-world operational needs, which, inter alia also means a link to policy and regulations must be considered and established. This structured approach allows building dedicated, asked-for information services and dashbords, and informs European and global data strategies and service providers, ensuring that future data production initiatives are guided by local realities and emerging challenges.

4. The use of asked-for services will require **capacity building in using data services and decision support tools.** Structured training programs should be organized on data processing, scenario modelling, and impact assessment, with initiatives such as the capacity-building program in East Anglia, UK, serving as effective models. Additionally, the development of user-friendly, interactive data visualization tools can enable local decision-makers to explore key indicators, future scenarios, and potential policy responses in real time.

5. STARS4Water shows promising results on data-driven modelling. To harvest the promises of this novel modelling approach, **investment in advanced AI-driven forecasting models**

**is crucial to improving climate projections and hydrological assessments,** particularly in basins with high variability and uncertainty.

6. **All of** the **aforementioned is rather superfluous if available data are not published or adhering to the FAIR-principles Findable – Accessible – Interoperable – Reusable**: Water management strategies require combining water data and projections, with a range of other data, e.g. on water use, environmental quality, etc. All these data need to be available and findable. To make global data for river basin stakeholders findable, accessible, interoperable and reusable STARS4Water developed a searchable Metadata Portal listing already more than 400 relevant datasets. These include, but are not limited to, datasets used in hydrology, water resources management, flood and drought risk management. We recommend promoting the further population, use and maintenance of this portal.

   Enhancing the availability of local-regional, actual water-use data or their proxies at appropriate spatial resolution is key to developing water management strategies and hence is strongly advocated.

   The STARS4Water metadata-portal contains the FAIR-based metadata information, greatly enhancing the information on accessibility, interoperable and reusability of the underlying data. This also opens the door to more transboundary data exchange. However, this only holds if local data are also published openly and FAIRly, which STARS4Water recommends strongly advocating for in favor of in the new Water Resilience Strategy.

In summary, STARS4Water provides a concrete foundation for improving water management by unlocking global data, enhanced data access, tailored analytical tools, and collaborative stakeholder engagement. We are convinced that our findings and recommendations can greatly contribute to reaching policy objectives, such as the objectives of the anticipated Water Resilience Strategy.