



## TETRA – From Methodology to Operational Tools for Water-Based AI Projects

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The development of efficient and interoperable tools for monitoring water resources remains essential to ensure the sustainable availability of this vital resource for both society and ecosystems. Recent events such as the fish die-off in the Oder River further emphasize the urgent need for improved river monitoring and protection strategies.

Building on work previously presented, the TETRA project aims to enable and accelerate the practical adoption of artificial intelligence (AI) in water management, while fostering a shared European AI ecosystem through close collaboration between German and French partners. To establish a harmonized approach, the project builds on the PAISE methodology for the development of AI-based products and adapts it to the domain of public water management.

Since the previous contribution, TETRA has progressed toward an operational data pipeline: SEBA contributes an automatic data pipeline for its in-situ measurement stations into the FROST server. The acquired datasets include velocity profiles and bathymetric measurements, which are accessed by the TETRA knowledge base and visualized through an interactive web application.

The application provides a map-based overview of sensor stations and a dedicated analysis view featuring 3D visualizations of velocity and bathymetry profiles (s. Figure 1), including filtering options such as water level and temporal range. Ongoing work focuses on refining the UI/UX to further support data exploration and expert-driven analysis.

Figure 1: 3D visualization of a river's surface velocity profile over time

Initial experiments in AI-based analysis revealed that the currently available measurement data are not yet sufficient in volume to robustly train data-driven models. To address this limitation, synthetic datasets derived from numerical simulations are used as a first step to evaluate model behavior and feasibility. While not a substitute for real-world measurements, this approach provides initial insights and establishes a foundation for future integration of increasing amounts of real sensor data.

In parallel, significant progress has been achieved within the restoration use case: ICUBE has advanced ontology-driven methods for the automated population of a case-based reasoning knowledge base from unstructured texts using large language models, while THALES has developed a semantic search module enabling concept-based retrieval of multilingual restoration documents beyond keyword-based search.

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