TWIN-STREAM – TWIN-based STRategic TEchnologies for Improved WAter Management

Summary

Digital Twins are revolutionising the way water resources are monitored, managed, and optimised. While challenges remain, ongoing advancements in technology and increasing adoption are driving the field towards a future where water resources are managed with unprecedented precision and resilience.

TWIN-STREAM proposes to deliver a set of services supporting water management and flood risk management, integrating multiple data sources (ex. local monitoring, Sentinel-1, -2, and -5P, meteorological radar, etc.), models (ex. hydrological and hydraulic models) and algorithms (ex. machine learning for precise crop monitoring, yield prediction and reservoir-level forecasting). The services, offered via a secure, customizable web-based platform, ensuring real-time data access, scalable and regularly updated, aligned with AMA's thematic priorities, will allow service beneficiaries to easily assess the result of different options for the territory management (e.g. impacts of a different crop in water availability, impact of a different soil use, including those result of forest fires, in flooding risk management, etc.).

The consortium includes universities (2), Research institutes (2, one of them the National institute for meteorology), three companies and the Portuguese Environmental Agency, putting together the knowledge innovation and the national data necessary to set up a Digital Twin for water setting up a value chain, integrating infrastructure and data providers, different applications and user's needs, capable to offer Water Resource Analytics (Real-time and predictive monitoring of water availability) Agricultural & Ecosystem Insights (Crop water demand forecasting, irrigation optimization) and AI & Machine Learning Applications for predictive analytics, anomaly detection, scenario modelling for climate resilience.

The goal is to make use of a wealthy data availability from different providers including SNIRH (precipitation, river flow, reservoir levels), Municipal Data (water consumption, urban drainage), ESA (Sentinel-1, Sentinel-2, Sentinel-3 for soil moisture, NDVI, evapotranspiration, water quality indicators), IPMA (meteorological data, forecasts), ECMWF (seasonal precipitation forecasts, climate scenarios), INIAV (soil properties, crop water needs).

The project is organised into four main tasks, each of them organised into subtasks:

1. National-Scale Water Management System
2. Agricultural Parcel and Reservoir Monitoring and Prediction System
3. Optimised soil use, groundwater and surface water management for green and climate resilient agri-food systems.
4. Stakeholder Engagement, Training & Dissemination Activities.

Tasks 1 to 3 correspond to a pilot project organised by spatial scale, using specific models and types of data. The technological developments necessary for each pilot are subtasks of the major tasks. Task 4 aims to capitalise on the project developments.

In terms of methodology & innovation, the project TWIN-STREAM includes:

- Multisource Data Fusion: Sentinel-1, Sentinel-2, and Sentinel-5P satellite data, meteorological radar, drone surveys, and in-situ sensors.
- Hydrological and Hydrogeological Modelling: Coupling surface and groundwater models, calibrated with real-time and historical data.
- Digital Twin Architecture: Cloud-based, modular, and scalable platform that can simulate, predict, and visualise system behaviour.
- Stakeholder Co-Creation: Participatory workshops and decision-support dashboards tailored to end-user needs.

The MOHID Modelling System, the platforms AQUASAFE, OMEGA and IrrigaSys, developed by the consortium, will play a major role in the project together with the worldwide-used USGS ModFlow and SWAT models, which, with their flexible, multi-model architecture and ability to incorporate various hydrologic processes, will provide a robust framework for creating the digital twins.

The pilots selected for the project build on previous projects developed by the consortium in the framework of national and international projects. The TWINSTREAM platform will be used to transform them into a consistent product and real real-time decision support tool.

Project Reference

2025.00314.DT4ST

Leading Institution

IST – Instituto Superior Técnico (Portugal)

Partners

IST-ID Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (Portugal), Hidromod – Modelação em Engenharia (Portugal), IPMA – Instituto Português do Mar e da Atmosfera I.P. (Portugal), UA – Universidade de Aveiro (Portugal), BLUEFOCUS (Portugal), WATERWAYS Lda. (Portugal), APA – Agência Portuguesa do Ambiente I.P. (Portugal)

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Period

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1 370 815.49€

CERIS

(scattered in IST and IST-ID budgets)

Project website

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