

# Tagus river-to-ocean collaboratory for thematic digital twins and collaborative management

Tuesday, 1 October 2024 16:00 (15 minutes)

Digital Twins provide a virtual representation of a physical asset enabled through data and models. They can be used for multiple applications such as real-time forecast of system dynamics, system monitoring and controlling, and support to decision making. Recent tools take advantage of the huge online volume of data streams provided by satellites, IoT sensing and many real-time surveillance platforms, and the availability of powerful computational resources that make process-solving, high-resolution models and AI-based models possible, to build high accuracy replicas of the real world.

The Tagus estuary is the largest estuarine region in the Iberian Peninsula and holds a multitude of services of huge economic, environmental and social value. The management of this large system is quite complex and there are often conflicting uses that require high resolution, complex tools to understand and predict its dynamics and support any interventions. Simultaneously, the Tagus basin raises concerns related to inundation and erosion (Fortunato et al., 2021) and water quality (Rodrigues et al., 2020). A variety of models have been applied here to address multiple concerns from physical to water quality and ecology. At the same time, the Tagus holds several observatories supported by data (e.g. CoastNet, <http://geoportal.coastnet.pt/>) and integrated model and data (UBEST, <http://ubest.lnec.pt/>). In spite of all these efforts, no integrated infrastructure, from river to ocean, accounting for the city of Lisbon and other important cities' drainage, was available to support management and research alike, allowing for users to interact with data and models to build customized knowledge.

The CONNECT project, funded through the CMEMs coastal downscaling programme, developed a multi-purpose collaboratory that combines digital twin technology, a smart coastal observatory tool (Rodrigues et al., 2021) and a monitoring infrastructure –CoastNet, to address both inundation and water quality concerns. The work takes advantages of the on-demand, relocatable coastal forecast framework OPENCoastS (Oliveira et al., 2021) to build a user-centered, multi-purposes DT platform that provides tailored services customized to meet the users' needs. A combination of process-based modeling in the estuary, using SCHISM suite, and AI modeling for the river inflow, using the AI4Rivers model builder, supports the automatic creation of both 2D and 3D predictions daily. Model performance is automatically shared with the users, both through online comparison with the in-situ and remote sensing data from CoastNet and CMEMS, and the calculation of indicators at several time scales.

Fortunato, A.B., Freire, P., Mengual, B., Bertin, X., Pinto, C., Martins, K., Guérin, T., Azevedo, A., 2021. Sediment dynamics and morphological evolution in the Tagus Estuary inlet. *Marine Geology* 440, 106590.

Oliveira, et al, 2021. Forecasting contrasting coastal and estuarine hydrodynamics with OPENCoastS, *Environmental Modelling & Software*, Volume 143,105132.

Rodrigues, M., Cravo, A., Freire, P., Rosa, A., Santos, D., 2020. Temporal assessment of the water quality along an urban estuary (Tagus estuary, Portugal). *Marine Chemistry* 223, 103824.

Rodrigues, M., Martins, R., Rogeiro, J., Fortunato, A.B., Oliveira, A., Cravo, A., Jacob, J., Rosa, A., Azevedo, A., Freire, P., 2021. A Web-Based Observatory for Biogeochemical Assessment in Coastal Regions. *J ENVIRON INFORM.*

## Topic

Needs and solutions in scientific computing: Digital Twins

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**Session Classification:** Replicating and predicting complex systems with scientific Digital Twins