AI, Automation & Optimization

Thu. Nov 12, 2026 4:00 PM - 5:30 PM JST | Thu. Nov 12, 2026 7:00 AM - 8:30 AM UTC | Room C (201) (2F)

**Oral C3 AI, Automation & Optimization**

Chair: Di Wan, Justin Buck, Yosuke Fujii

4:30 PM - 4:45 PM JST | 7:30 AM - 7:45 AM UTC

# [GW9BIT7e-03] BlueMath: An Open-Source and Modular Python Framework with Interactive Notebooks for the Development of Digital Twins of Coastal Climate Hazards in a Changing Climate

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In the face of increasing global challenges such as coastal hazards and climate change, the use of robust statistical and numerical analysis tools is essential. Tools that facilitate the analysis of multivariate met-oceanic climatic drivers (e.g., waves, storm surges, tropical and extratropical tropical cyclones) acting at multiple spatial and temporal scales are key for predicting flooding events, producing risk assessments or planning for adaptation measures.

Within this context, BlueMath emerges as a collaborative platform of many research groups and universities around the world working together to democratize the access to advanced models and services, empowering both researchers and non-specialists to generate customized, complex solutions. BlueMath (https://gitlab.com/geoocean/bluemath) is an innovative, open-source repository of Python-coded tools. The repository is also accessible from the muti-user cloud-based Jupyter Hub environment, leveraging shared computational resources and the user-friendly interface of Jupyter Notebooks. BlueMath integrates state-of-the art statistical techniques and high-fidelity numerical model wrappers in a system framework that includes from standalone models with straightforward applications to hybrid model-tool combinations that produce comprehensive climate services. The individual modules of BlueMath are designed to be highly adaptable to a wide range of needs and applications:

a) BlueMath-Toolkit: Provides fundamental tools including data mining, interpolation, and wrappers for numerical models such as SWAN, SWASH, Delft3D, and SCHISM. It also supports statistical analyses of waves, tides, and tropical cyclones.
b) BlueMath-Hybrid Downscaling: Integrates statistical and numerical models to optimize computational efficiency. It includes the implementation of hybrid models like metamodels (e.g., HySwash (Ricondo et al., 2024)) and additive approaches (e.g., Binwaves (Cagigal et al., 2024)).
c) BlueMath-Climate Services: Enables the creation of integrated applications by combining functionalities from previous modules, such as coastal digital twins of high resolution waves and storm surge levels, due to extratropical or to tropical cyclones.

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