Project: **1540**

Project title: **Steering Coastal Resilience to Extreme Events Through Multiple Adaptive What-If Scenarios Using Coupled Modeling and Artificial Intelligence**

Principal investigator: **Douglas Vieira da Silva**

Report period: **2025-11-01 to 2026-10-31**

Progress and Status

Following the initial proposal submitted for project 1540, I provide an overview of the project's current status. Table 1 shows the status of the planned activities sent at the start of each month in 2026. At this stage, we have completed the development of the scientific workflows and most numerical experiments for the German Bight and Western Black Sea setups (green squares in the table). Compared with the original plan, we need to extend the simulation period to month 12 to run additional What-if scenarios with Nature-positive solutions against extreme events and idealised experiments (grey squares in the table).

Activities related to implementing AI-based emulators for process-based models and using them for long-term simulations were delayed in the last quarter of the project. Project users had already implemented these methods with AI emulators and similar model setups. Further work will focus only on applying and adapting these methods to the specific cases of the German Bight and Western Black Sea conducted in bg1540.

Post-processing of the simulation results has also progressed alongside the completion of the experiments in recent months. This work will continue until the end of the current quarter, with subsequent publication of the results, acknowledging the computational resources provided by DKRZ under project 1540. In summary, bg1540 has fully met its research objectives, linking advanced methods for multi-scenario coastal simulations with enhanced efficiency and scalability.

Table 1: Planned and progress of activities for 12 months of the project in 2026. Green=completed; Black (planned); Grey (new estimate).

Planned Activities	Months of Project											
	1	2	3	4	5	6	7	8	9	10	11	12
Development of scientific workflows for climate projections with process-based models from GCOAST												
Development of scientific workflows for AI-based emulators of process-based models												
Simulations of climate scenarios for regions of German Bight and Western Black Sea												
Simulations of What-If Scenarios for development of strategies to increase coastal resilience against extreme events												
Use of Emulators for long-term assessment of coastal impacts												
Post-processing of simulations results for assessment of coastal impacts												

Use of resources and experiments

In previous quarters, experiments covered the German Bight and Western Black Sea, using specific setups for coupled hydrodynamic-wave-morphological simulations with the SCHISM modelling suite. The scientific outcomes relate to the dynamics of coastal processes and associated hazards. More specifically, the research focused on the interaction of river-derived sediment input and its spreading on continental shelves, its interaction with marine vegetation (parameterised in SCHISM), and long-term erosion/accretional trends. We are exploring the current results from the different applications, and planned publications will provide novel understanding of these processes in key regions of interest. In the next quarter, additional experiments will explore more scenarios related to nature-positive solutions and extreme events. Table 2 provides an overview of the resources used in previous quarters and the projected consumption through the end of 2026.

Table 2: Resources granted in 2026 (including the request at 2026-07-01), consumption and projection for use until the end of 2026.

	Allocated for 2026	Consumed (until 15.10.2026)	Projection of consumption to end of 2026
CPU nodes [node h]	35250	21924	13327
Levante storage (TB)	248.00	70.52	170
Archive project (TB)	100	0	100
Archive long term (TB)	*	*	*
Swift Object Storage (GB)	10240	0	0

Scientific results

The following publication is based on experiments conducted for the Western Black Sea and acknowledges DKRZ bg1540. Upcoming publications are ongoing and will be reported when accepted :

- Gramcianinov, C. B., Stanev, E. V., Jacob, B., & Staneva, J. (2026). On the genesis and development of coastal submesoscale eddies in the Northwestern Black Sea shelf. Ocean Modelling, 102749. https://doi.org/10.1016/j.ocemod.2026.102749

Data Management

Currently, the amount of data produced is still limited and is being post-processed for applications and publications. In the coming months, files will be archived in definitive open-science repositories when the results' exploitation life cycle ends.

References

Zhang, Yinglong J., Fei Ye, Emil V. Stanev, and Sebastian Grashorn. "Seamless cross-scale modeling with SCHISM." Ocean Modelling 102 (2016): 64-81