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More eelgrass in the Baltic Sea thanks to AI – Kick-off meeting for SEAGUARD research project at the IOW

How can eelgrass beds in the Baltic Sea be efficiently restored with the help of artificial intelligence (AI) in the most climate-resilient way possible? This is the core question of the new SEAGUARD research project, which is coordinated by the Leibniz Institute for Baltic Sea Research Warnemünde (IOW). The project combines marine research, data science and environmental management and is funded with about 1.8 million euros until November 2027 as part of the German federal environment ministry's AI flagship initiative. Now, for the first time, researchers from all participating partner institutions are coming together for two days at the IOW to develop strategies for the joint work ahead.

Eelgrass as a key factor for biodiversity and climate protection

Eelgrass beds belong to the 'multi-talents' among coastal ecosystems: They are nurseries for various fish populations and habitats for numerous other marine organisms, they protect coasts from erosion, stabilise sediments and store the greenhouse gas carbon dioxide. However, over the last century, the Baltic Sea's eelgrass ecotopes have declined dramatically due to human influence – primarily eutrophication and its consequences, such as altered light conditions in the sea, and pressure from coastal land use. Climate change is also playing an increasingly important role with the associated temperature stress for eelgrass plants in summer. These losses not only have consequences for biodiversity, but also weaken the Baltic Sea's ability to store carbon in the long term. At the same time, there is no reliable data basis to date that would enable the successful restoration of eelgrass: Existing models often provide only rough approximations and barely take into account the uncertainties arising from different climate and nutrient scenarios.

New decision-making tools derived from AI based methods

This is precisely where the SEAGUARD project (short for: **SE**Agrass **G**rowth and **A**daptation **U**sing **A**I **R**esearch and **D**evelopment) steps in. The researchers want to use AI systematically to better understand the ecological processes and interactions in coastal waters and to realistically predict future developments. They plan to utilise very large existing and newly generated measurement and remote sensing data sets – for example, on water turbidity, temperature and nutrient inputs – as well as model calculations, which will be supplemented by additional AI-supported models. The AI will analyse these highly complex data sets, recognise patterns and, on this basis, can make well-founded predictions about where eelgrass could grow successfully in the future. These analyses also take into account various climate scenarios and nutrient loads from rivers, in particular phosphorus and nitrogen.

As a result, high-resolution maps of potential restoration areas will be generated, which enable the precise planning of efficient and climate-resilient eelgrass rehabilitation measures. An additional advantage is that AI partially will replace computationally intensive numerical models, thereby significantly reducing the energy footprint of the simulations. In this way, the project also contributes to the sustainable use of resources in research itself. "With SEAGUARD, we are building a bridge between cutting-edge AI research and practical nature conservation," says Florian Börgel, junior research group leader at the IOW and project coordinator. "We want to show that AI not only helps us to better understand ecological processes, but can also provide real-world support in the systematic protection and restoration of marine habitats."

Practice-oriented application, which sets an example

By combining AI, modelling and remote sensing, SEAGUARD combines scientific excellence with practical environmental applications. The models and tools developed in the project – including a web app for visualising potential eelgrass locations – will be made openly accessible and usable for other coastal regions. There is already considerable interest in the results: the state environmental

agencies in Schleswig-Holstein and Mecklenburg-Western Pomerania have announced that they will incorporate the data generated in future into their environmental and monitoring programmes. In this way, SEAGUARD is making an important contribution to the implementation of national and European environmental strategies.

Kick-off in Warnemünde: Interdisciplinary exchange and joint strategic planning

The two-day kick-off meeting at the IOW on November 6 and 7, 2025, marks the first intensive exchange between the approximately 20 participating researchers, who already began their work in July this year. In addition to the IOW, project partners include Kiel University and the German company EOMAP GmbH, which specialises in satellite-based remote sensing and map generation. In presentations, workshops and discussion rounds, the methodological approaches of the participating teams will be presented and work plans fine-tuned. In addition to scientific and technical issues, the focus will also be on developing strategies for data use, communication with authorities and the integration of results into environmental management systems.

SEAGUARD is one of eight new AI flagship projects funded by the Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN). The funding initiative aims at contributing to climate and environmental protection in numerous operational areas, supporting projects that use their digital know-how and creativity to tackle ecological challenges.

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