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Developing High-Resolution Models for Forecasting Sea Surface Currents and Marine Effluent Dispersion

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The Gulf of Trieste is the northernmost part of the Mediterranean and the Adriatic Sea. It is home to lively shipping traffic, tourism, and fishing. The Gulf of Trieste is home to two of the most important ports on the Adriatic coast - Trieste and Koper. We have developed high-resolution operational numerical models for the operational prediction of the distribution of sea surface currents and the dispersion of wastewater from the sewage treatment plant into the sea:

(1) Prediction of the distribution of surface currents in the Gulf of Trieste (northern Adriatic Sea) to complement measurements from four HF radars stationed in the Gulf of Trieste. The radar provides current measurements at 30-minute intervals, except during maintenance work and occasional technical faults. In some areas, there are also occasional outages and unreliable current measurements, so high-resolution current models are of additional benefit. The two-day hourly forecast of sea currents provided by our model is displayed on the website along with the HF radar measurements. The most typical user of the HF radar measurements is the Slovenian Maritime Administration, which is responsible for the safety of navigation, management of maritime traffic and maintenance of safety facilities and waterways. The results of our numerical model can provide reliable information on the direction and strength of sea currents, which helps ship operators to plan their routes more efficiently, reduce fuel consumption and emissions, increase shipping safety, and enable better control of oil spills.

(2) Predicting the dispersion of wastewater from a wastewater treatment plant into the coastal sea. The Rižana wastewater treatment plant is located in the Gulf of Trieste, just upstream of the mouth of the Rižana river into the port of Koper. The results of the numerical model show whether the wastewater from the treatment plant enters protected areas or bathing waters. The results can help the relevant authorities to predict and prepare for potential pollution events, contribute to a better understanding of the processes in the coastal sea that control the transport, mixing and fate of pollutants, and show which marine areas are particularly vulnerable to pollution.

The high-resolution numerical models for predicting surface currents and the dispersion of sewage in the Gulf of Trieste represent a significant advance in maritime safety and environmental management. This underlines the valuable role of advanced modeling in promoting sustainable maritime practices and protecting the fragile ecosystem of the northern Adriatic.