

A Bayesian Optimization workflow for improving oil spill numerical simulations

Thursday, 3 October 2024 09:50 (10 minutes)

The release of oil into marine environments can result in considerable harm to coastal ecosystems and marine life, while also disrupting various human activities. Despite advances in maritime safety, there has been a noticeable uptick in spill occurrences throughout the Mediterranean basin, as documented by the European Maritime Safety Agency's Cleanseanet program. Precisely predicting the movement and transformation of oil slicks is crucial for assessing their impact on coastal and marine regions. Numerical modeling of oil spills plays a pivotal role in understanding their unseen consequences and addressing observational gaps. However, these models often rely on manually selected simulation parameters, which can affect result accuracy. We propose an innovative approach integrating satellite observations, the Medslik-II oil spill model, and Machine Learning techniques to optimize model parameterization, thereby enhancing the accuracy of oil numerical simulations. Utilizing a Bayesian Optimization Framework, the study seeks the optimal configuration within the parameter space for which model simulations best represent actual oil spill observations.

Validation of the proposed approach is performed using a real case of an oil spill in the Baniyas area (Syria) in 2021. Preliminary evaluations of this framework show promising results, suggesting that combining physics-based and data-driven methodologies can lead to more precise risk assessment and planning for oil spill incidents. Furthermore, the resulting workflow represents an integrated solution for optimal and automated selection of model simulation parameters.

The work is being developed within the framework of the EGI coordinated iMagine project, which focuses on a portfolio of "free at the point of use" image datasets, high-performance image analysis tools empowered with Artificial Intelligence (AI), and best practice documents for scientific image analysis.

Topic

Environmental informatics: Climate Change/Environment

Primary authors: DE CARLO, Marco Mariano (CMCC Foundation); ACCARINO, Gabriele (Euro-Mediterranean Center on Climate Change (CMCC Foundation)); RUIZ ATAKE, Igor (CMCC); ELIA, Donatello (CMCC Foundation); COPPINI, Giovanni (CMCC Foundation); ALOISIO, Giovanni (CMCC Foundation)

Presenter: DE CARLO, Marco Mariano (CMCC Foundation)

Session Classification: Processing Research Data with Artificial Intelligence and Machine Learning