Optimizing MEDSLIK-II : Parametrization through a bayesian search algorithm applied at the Baniyas oil spill incident (Syria, 2021)

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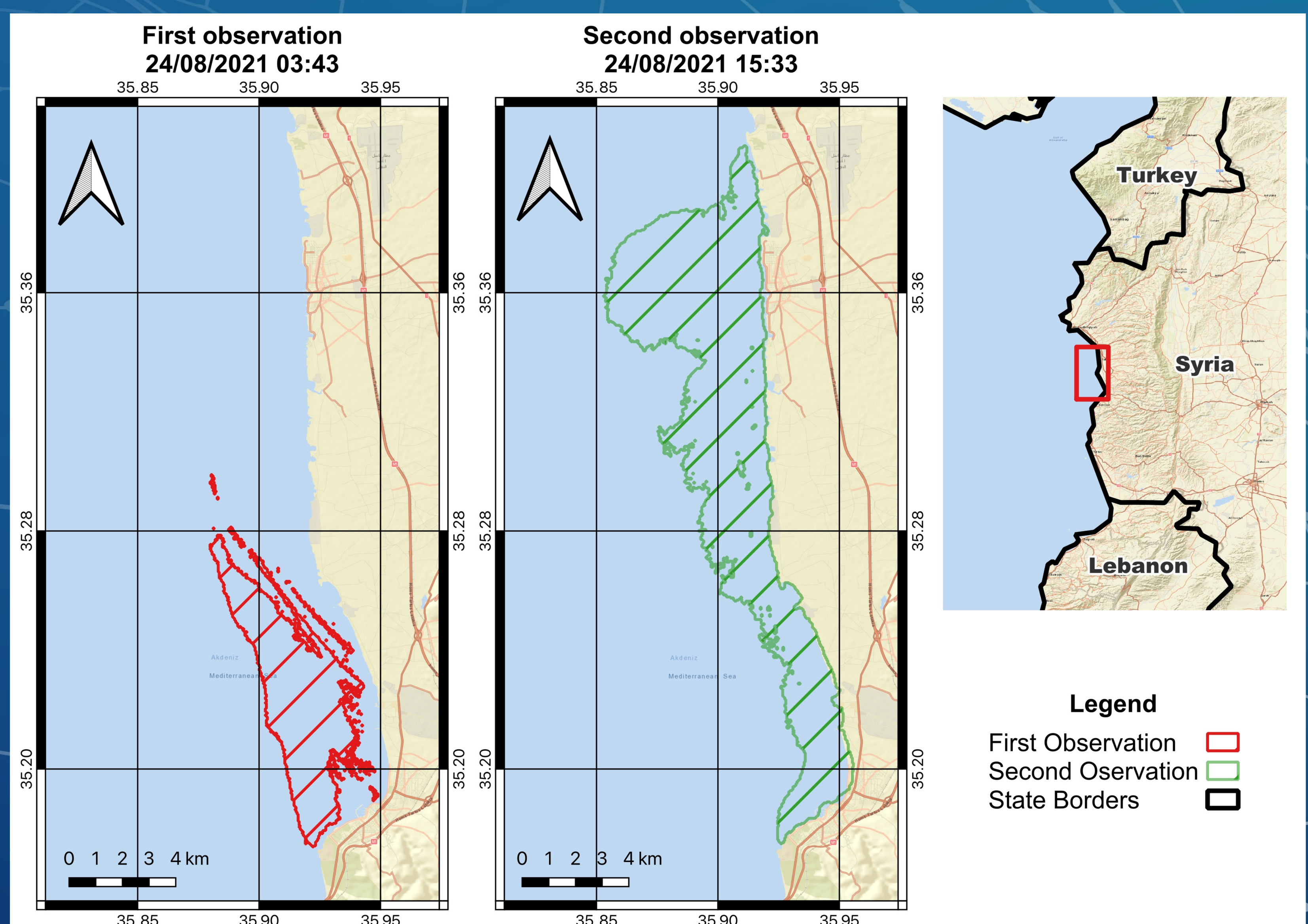
Check the abstract!

Introduction

Oil spill incidents can have a significative negative impact on coastal and marine ecosystems as well as human activities. The accurate prediction of the transport and transformation of the oil slick is a key aspect for assessing the impacts of the spill on coastal and marine areas. In this work we demonstrate how the application of AI based methods in synergy with numerical oil spill model (MEDSLIK-II) can enhance the forecast skill of simulations.

Syria Oil Spill Event (2021)

On 24 and 25 of August 2021, one of the biggest oil spill registered on the Mediterranean Sea on the Syrian coast, due to a rupture in one of the fuel tanks on the Baniyas Thermal Station. Different states of the resulting oil spill were captured and processed into imaged by Orbital EOS, which provided the contours used in this work.

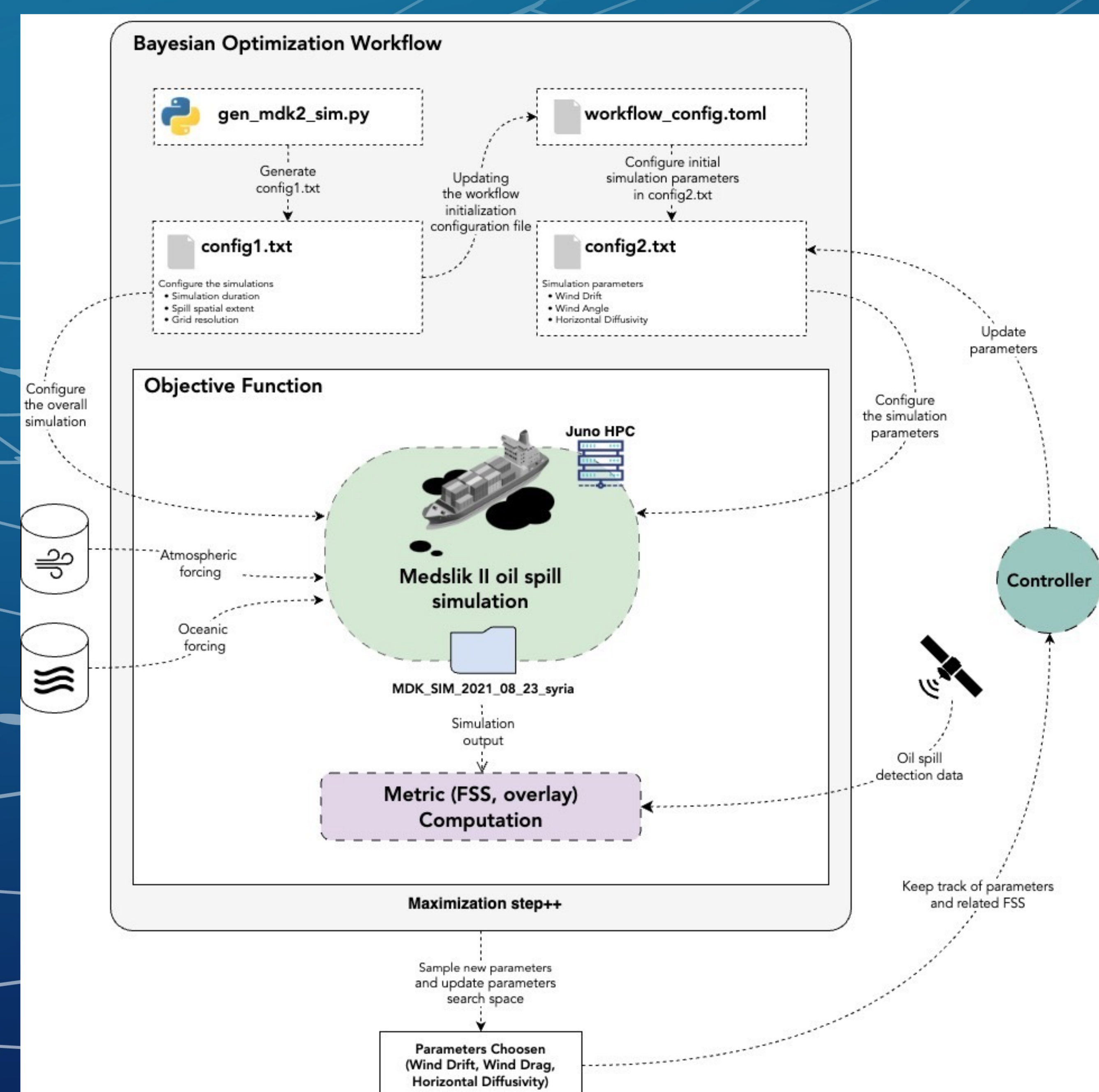


Challenge

From given satellite processed images, how numerical simulation could represent better the event seen on the slick displacements over time?

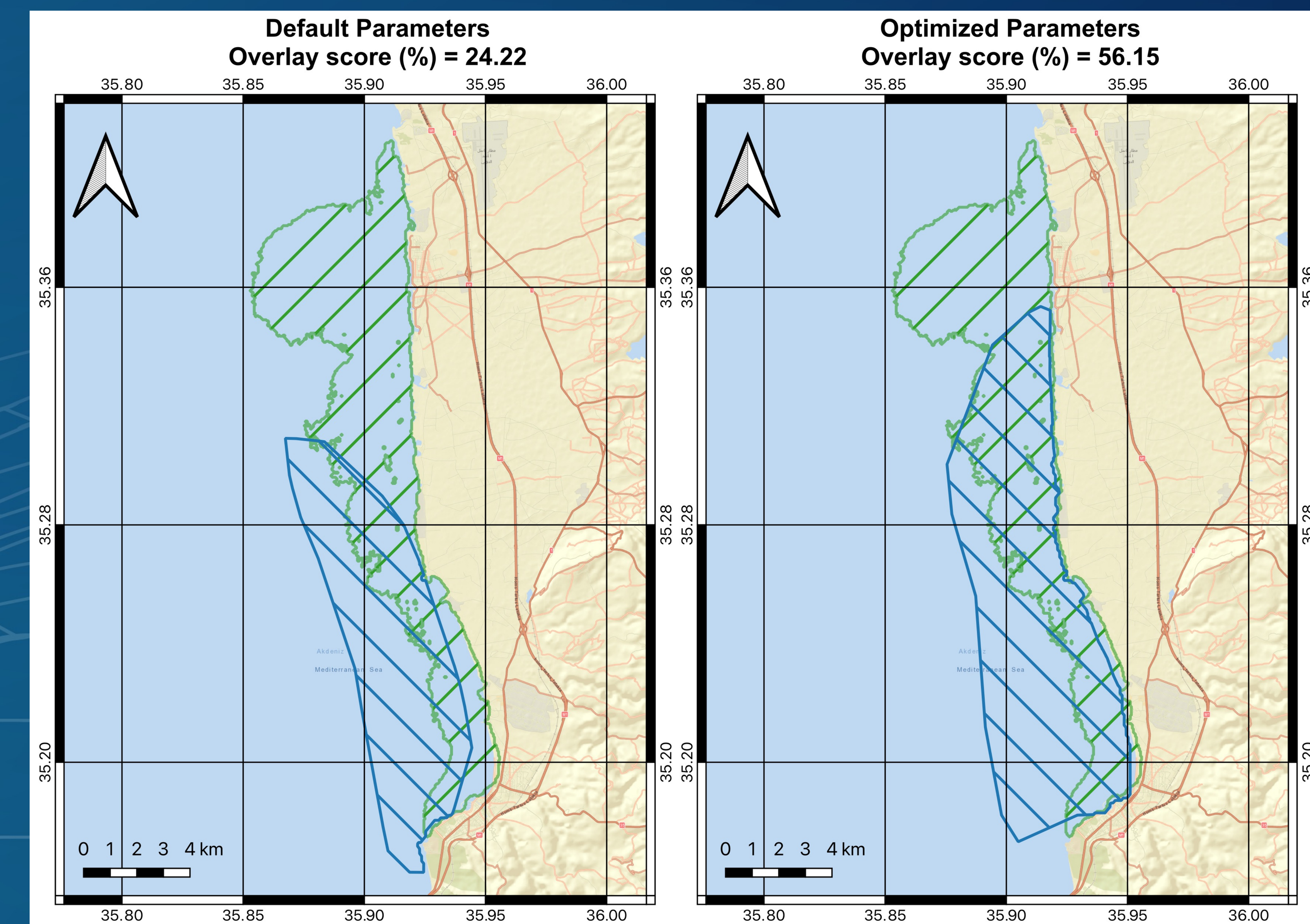
Methodology

We propose a workflow that combines available satellite oil spill observations and Bayesian Optimization to improve the skills of the MEDSLIK-II numerical simulations. Bayesian Optimization act on MEDSLIK-II physical parameterizations, such as wind drift, wind angle and horizontal diffusivity by searching an optimal configuration in the parameters space in a statistical way. This is intrinsically performed by solving an optimization problem which aims at maximizing an objective function defined as the overlay between actual observations of the spill and the numerical simulation which has been previously configured with the parameters sampled at that iteration of the procedure. Therefore, the workflow allows sampling the optimal configuration of parameters iteratively, as well as improving oil spill simulations which proved to be closer to actual oil spill trajectories. This avoids trying many different combinations, which would result in a computationally intensive and time-consuming procedure. Moreover, the approach is physically consistent since the parameters are sampled in their physical ranges.



Results

An oil spill simulation using the default parameters obtained 24.22 % in the overlay score, while the BayesOpt simulation was able to obtain 56.15 %. This highlights the importance of proper parameter sensitivity and how numerical oil spill can be enhanced by adding AI methods.



Conclusion

Coupling oil spill numerical models and machine learning methods demonstrates an increased capability of reproducing events observed in the real world. The technique will be applied on other real-world events to understand if the relationship of the parameters is similar and if changes, why could the causing factors for that.

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