MSc. Thesis Proposal

Title: Modelling Surf Waves in the Ericeira World Surfing Reserve

Supervisors

Tiago Gomes: researcher at blueOASIS
Hans Bihs and Widar Wang: professor and researcher at NTNU

Introduction

Motivation

Since 2011 Ericeira is a World Surfing Reserve, the second ever, home to seven unique waves. Several reasons justify the need for a more in-depth analysis of them:

- Simple forecast models (e.g. using WAM or SWAN), with poor resolution due to coarse grids used, providing insufficient information for surfers. These must usually corelate that information available online, such as open-sea swell, with pre-gathered experience, or direct visual confirmation on the beaches, to assess the quality of the waves for surf at a given time.
- Increasing mean sea level due to climate change, which will inevitably re-shape the coastline and potentially affect the surf waves.

Through the usage of adequate tools, these and other considerations can be tackled in better understanding the mechanics of surfing waves, provide better forecast for surfers and prepare mitigative actions to preserve the waves in certain locations. One promising tool is **REEF3D**, an open-source hydrodynamic framework that provides multi-fidelity tools that can be used for that purpose.

Existing work

blueOASIS, together with the REEF3D developers at NTNU, was awarded an EEAGrants Bilateral Fund project back in 2023 to model surfing waves in the Ericeira World Surfing Reserve. A conference paper was already submitted [1], detailing the first results obtained, and a stakeholder workshop is planned to take place in the first half of 2024. At the moment, only REEF3D::FNPF [2] was applied, due to its high-efficiency to simulate large-scale phase-resolved sea states. Yet, other tools within REEF3D, such as NHFLOW and CFD [3], present themselves as promising alternatives to continue this work in the future.

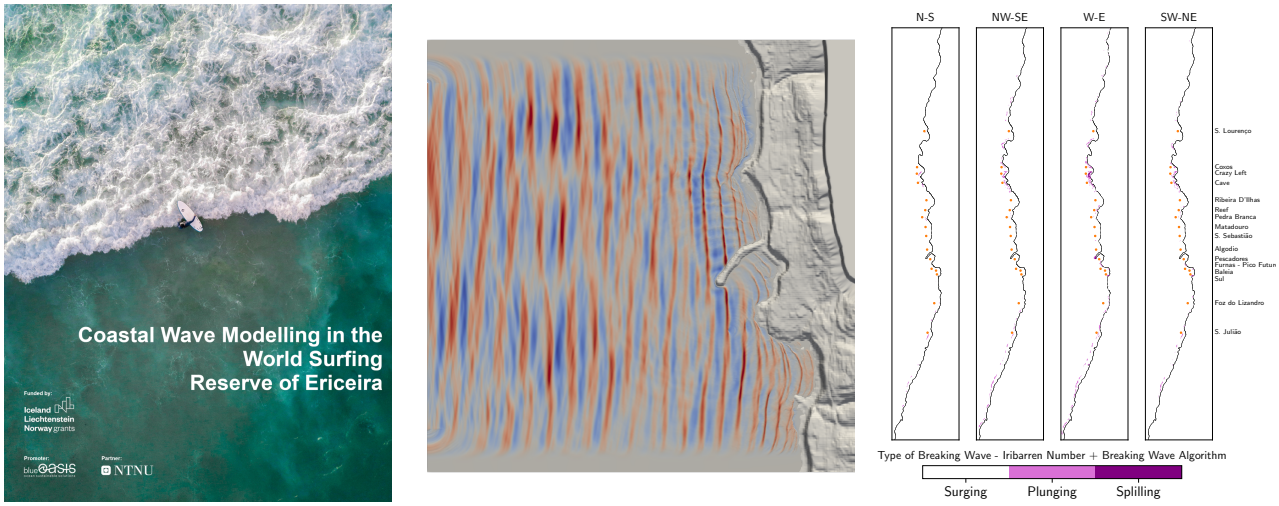

Figure 1 - Poster of surf wave modelling project (left), wave simulation around Porto dos Pescadores in Ericeira using REEF3D::FNPF (center), types of breaking wave based on REEF3D::FNPF simulations for different wave headings (right, to be published).

Objectives

1. Literature review, on the characterization and modelling of surf waves, such as in [4];
2. Preparation of REEF3D::NHFLOW/CFD models, based on existent ones for REEF3D::FNPF;
3. Implementation of post-processing techniques, or in-code developments, to extract useful parameters to characterize surfing waves.

Requisites

Applicants must have:

- Coding experience with Python or similar.
- Good knowledge of numerical methods applied to hydrodynamics and coastal engineering.

Good to have:

- C++ experience.
- Linux experience.
- Latex experience.
- Git experience.

Added value to have:

- Surf knowledge.

Location

The student must be present at the office at least 3-4 days per week. This is mandatory.
blueOASIS (www.blueoasis.pt) offices at Ericeira
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Companies Involved

blueOASIS is a young team with more than 60 years of combined knowledge and experience on Aerospace, Mechanical, Naval and Maritime engineering. The multicultural and multidisciplinary team is committed to make our oceans safer and greener, using state of the art numerical and data science tools. BlueOASIS focuses on renewable energies, ocean cleaning, decarbonization, sustainable offshore structures and green ships optimization.

References

[1] Gomes, T., Bihs, H., Wang, W., and Vaz, G., "Simulating Waves at the Beaches of the Ericeira World Surfing Reserve," Jun. 2024. [Paper submitted for presentation at OMAE2024]

[2] W. Wang, C. Pákozdi, A. Kamath, and H. Bihs, "Fully nonlinear phase-resolved wave modelling in the Norwegian fjords for floating bridges along the E39 coastal highway," *J. Ocean Eng. Mar. Energy*, Apr. 2023, doi: 10.1007/s40722-023-00284-z.

[3] H. Bihs, A. Kamath, M. Alagan Chella, A. Aggarwal, and Ø. A. Arntsen, "A new level set numerical wave tank with improved density interpolation for complex wave hydrodynamics," *Computers & Fluids*, vol. 140, pp. 191–208, Nov. 2016, doi: 10.1016/j.compfluid.2016.09.012.

[4] B. E. Scarfe, M. H. S. Elwany, S. T. Mead, and K. P. Black, "The Science of Surfing Waves and Surfing Breaks - A Review," 2003.