EVALUATION OF NEARSHORE WAVE CHARACTERISTICS AND DYNAMICS BY COMBINING REMOTE SENSING TOOLS

Ph.D. Candidate: Muhammed Said Parlak[1]

[1]Università Politecnica delle Marche, DICEA, Ancona, Italy – m.s.parlak@univpm.it
[2]Nottingham University, Department of Civil Engineering, Nottingham, UK

Tutors: Maurizio Brocchini[1]
Nicholas Dodd[2]
Matteo Postacchini[1]

Introduction

- Nearshore wave propagation is dominantly nonlinear due to several processes (e.g., shoaling, bottom friction, refraction)
- In-situ measurement devices are not practical in very shallow waters. The maintenance cost is high and observed data is spatially limited.
- Remote sensing tools are alternative to in-situ instruments, and they can collect data from a relatively wide area.
- Video Monitoring (SGS) and X-Band Marine Radar (XBR) are the mostly used remote sensing tools to extract information about the sea state and wave characteristics.
- In this study, SGS and XBR located in our study site is combined to resolve wave characteristics and dynamics *(Fig 1)*.

Study Site

- Misa River estuary located in Senigallia, Italy [1].
- Accommodates strong interactions between sea and river.
- SGS station consists of 5 cameras, 10 min-long recordings for each hour at 2 fps.
- XBR consists of commercial grade marine X-Band radar. Sampling interval is ~0.5 Hz and 63 scans are collected for each sequence.

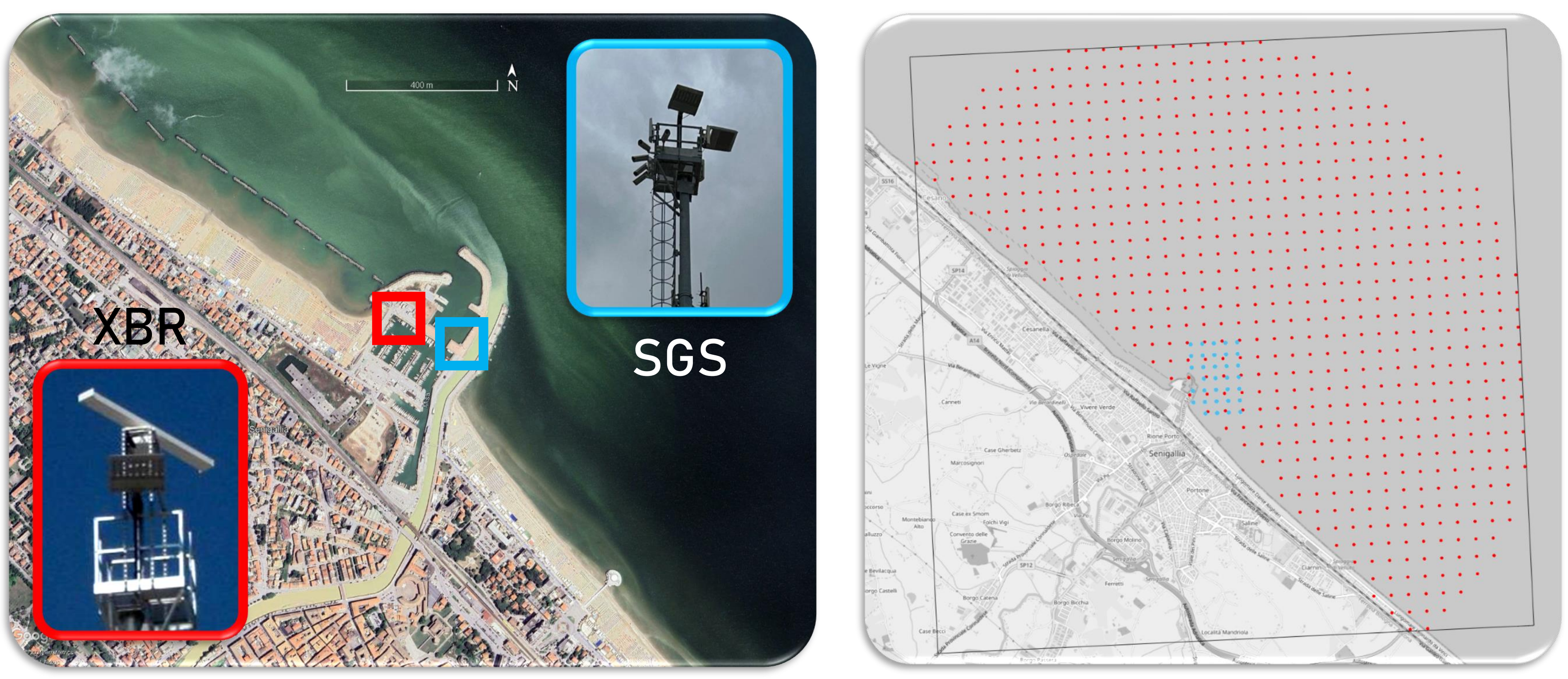


Fig 1: The location of the remote sensing tools and the coverage area (red and blue colours indicate XBR and SGS, respectively)

Methodology

- cBathy is designed to evaluate bathymetry by using video recordings of ocean waves [2].
- In this study, raw radar signals are treated as an image and time-stacks are created with sequential radar scans *(Fig 2)*.
- Bathymetry and the wave characteristics corresponding to the most coherent frequency are extracted from cBathy.
- It is assumed that the most coherent frequency is closer to the peak frequency, f_P. Hence, peak celerity, $C_P = 2\pi f_P / k$

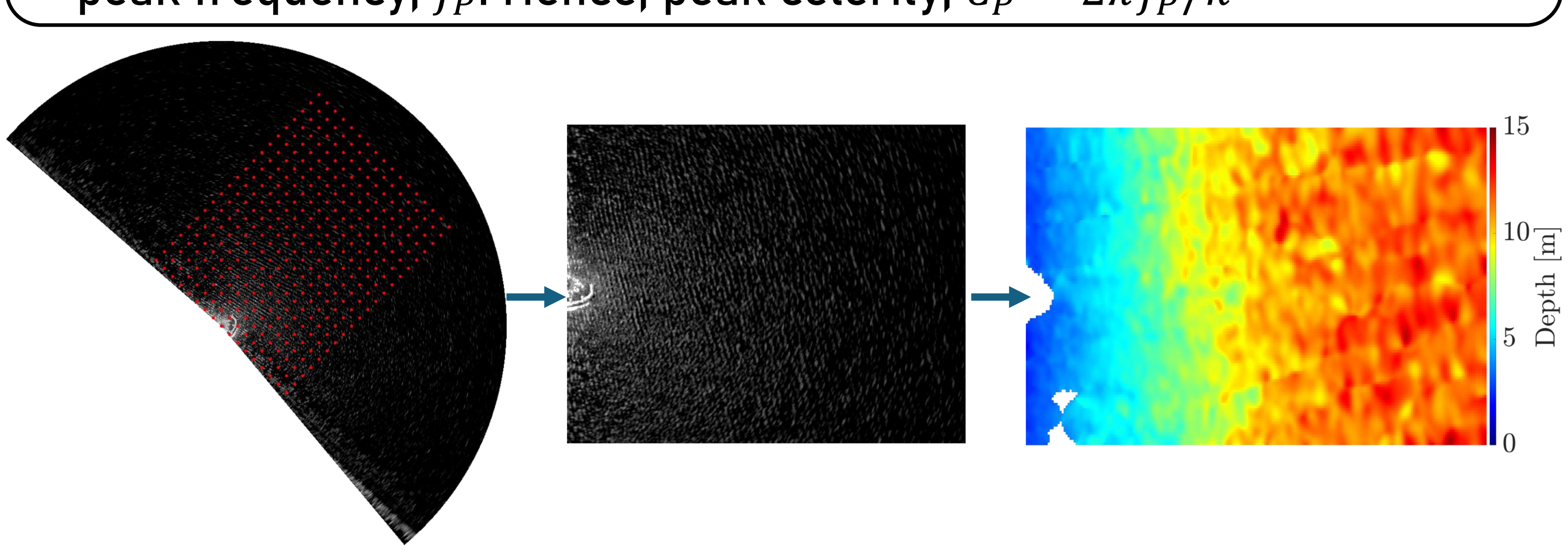


Fig 2: Extraction of the domain from the radar coverage, converting raw signals to an image intensity, and input to the cBathy to obtain results

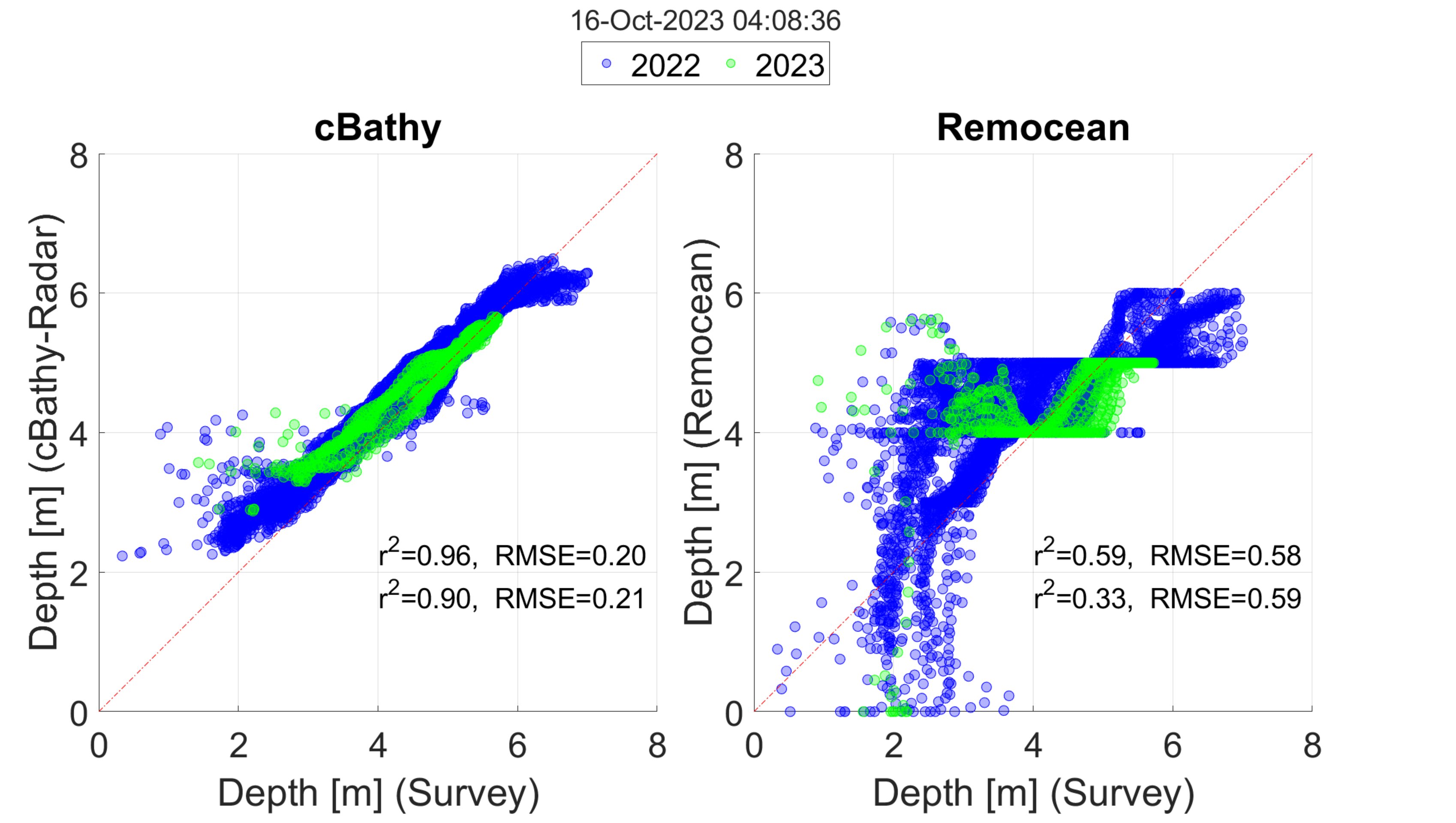


Fig 3: Statistical performance of cBathy and Remocean compared to bathymetric surveys from 2022 and 2023.

Results

- cBathy is based on dispersion relation, thereby, the evaluated bathymetry is compared to available surveys and alternative radar processing tools (e.g., Remocean [3]) *(Fig 3)*.
- After obtaining reliable bathymetry, wave characteristics are evaluated for the most coherent frequency *(Fig 4)*.
- SWAN model is conducted and forced by waves and winds where data is obtained from RON buoy and Copernicus, respectively. Then, the results are validated with MEDA buoy.
- When two models are compared, it is evident that cBathy can resolve wave characteristics fairly good except H_s and θ. The methodology needs to be improved for wave height reconstruction.

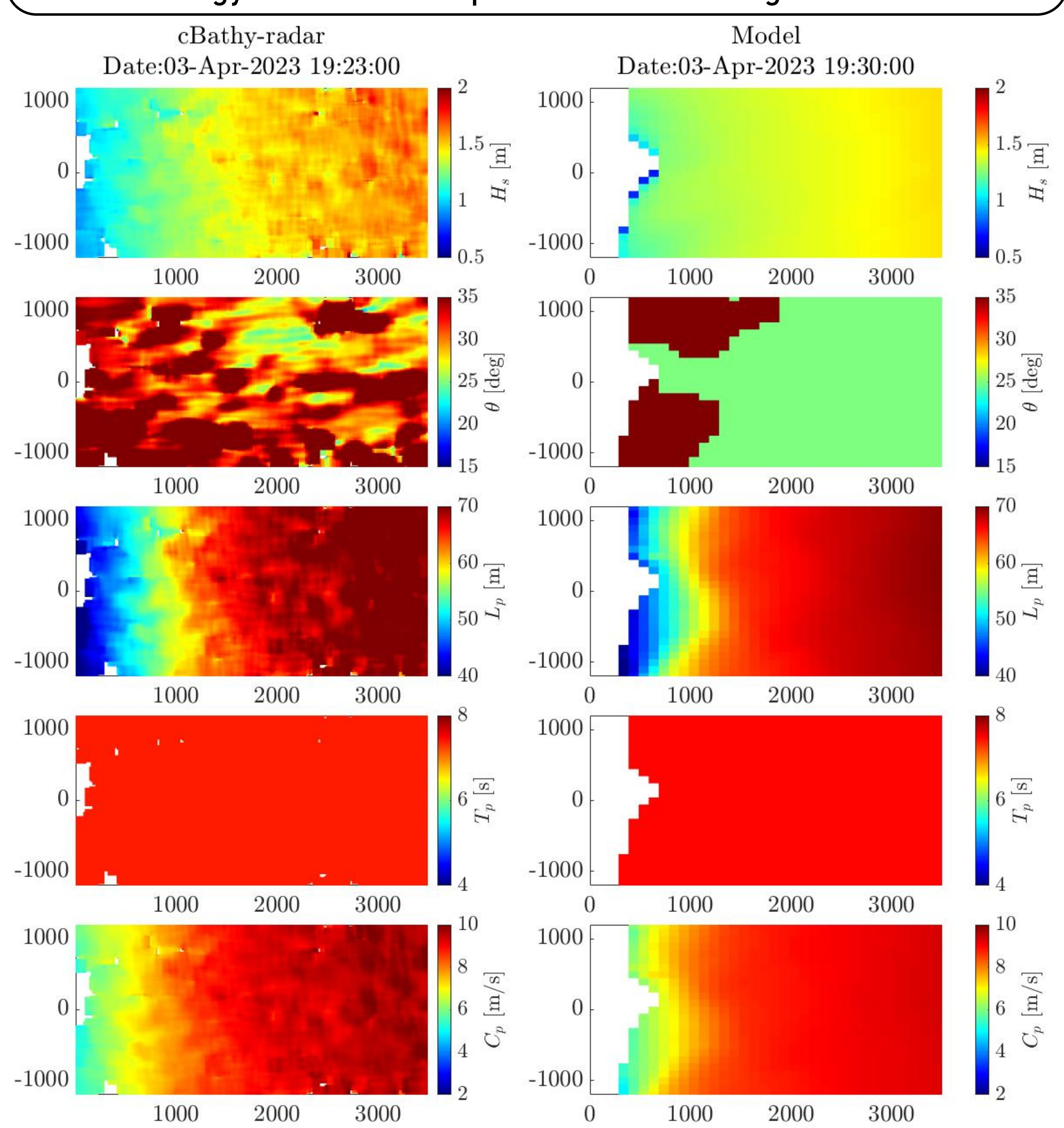
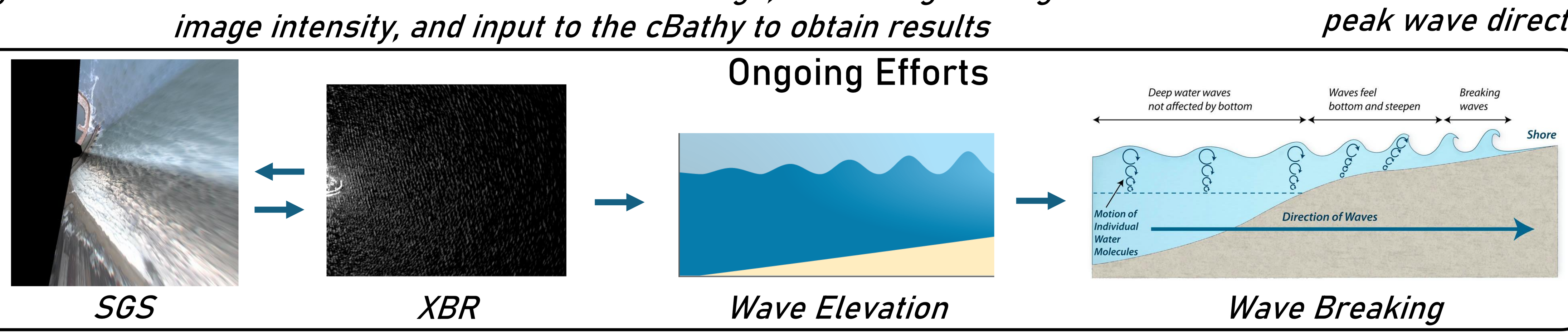


Fig 4: Comparison of wave characteristics obtained from cBathy and SWAN for the date of 3 April 2023, around 19:30. H_s, θ, L_p, T_p and C_p stands for significant wave height, peak wave direction, peak wavelength, peak period and peak celerity, respectively.

Ongoing Efforts



References

[1] Brocchini et. al.
[2] Holman et. al.
[3] Serafino et. al.

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