


TIDAL RECONSTRUCTION OF THREE CRUISE SHIPS HARBOURING SIMULTANEOUSLY IN BENOA HARBOUR IN RESPECT TO MODERN NAVIGATION FILE S-100

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1. Introduction

Bali as a global maritime center under the Bali Maritime Tourism Hub (BMTH) program, combines tourism, port management, and entertainment to stimulate regional and national economic growth. It is expected that the BMTH can drive local economic growth and create jobs for the surrounding community.

In accordance to BMTH, in 2023, Benoa Port makes a new history where three large cruise ships, namely Silver Nova, measuring 244 meters long with 1,185 tourists, Queen Elizabeth, measuring 293 meters long with 2,927 tourists, and Viking Sky, measuring 228 meters long with 1,311 passengers. The all three cruise ships docked simultaneously and successfully at Benoa Port on Friday afternoon, February 21, 2025.

2. Methods

The creation of modern navigation maps S-102, S-104, and S-111 in this study is carried out based on the product specification documents of S-102 Edition 3.0.0 for December 2024, S-104 Edition 2.0.0 for December 2024, and S-111 Edition 2.0.0 for December 2024, from IHO. The data structure of S-102, S-104, and S-111 follows the Metadata specified by IHO. The S-100 Data Viewer used in this research is KHOA Viewer.



Figure 1 Research Location in Benoa Bali indicated with Pink Box representing Band 5 ENC Region, and Gray Box representing Band 6 ENC Region, and Green Dot representing Tide and Current Observation Stations

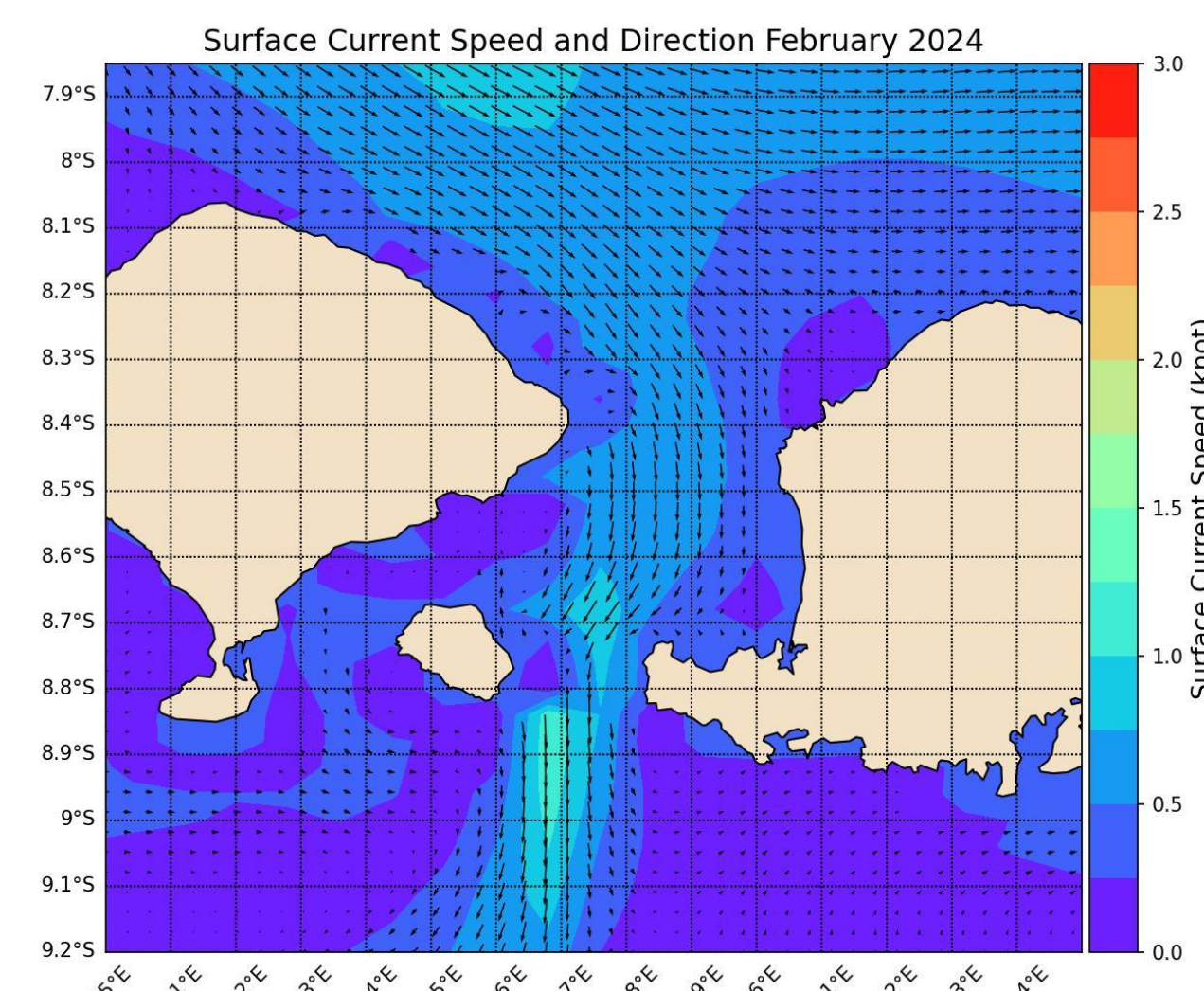


Figure 2 Climatological Surface Currents Speed and Direction in February averaged from 2013-2023 in Benoa Bali and Lombok Strait

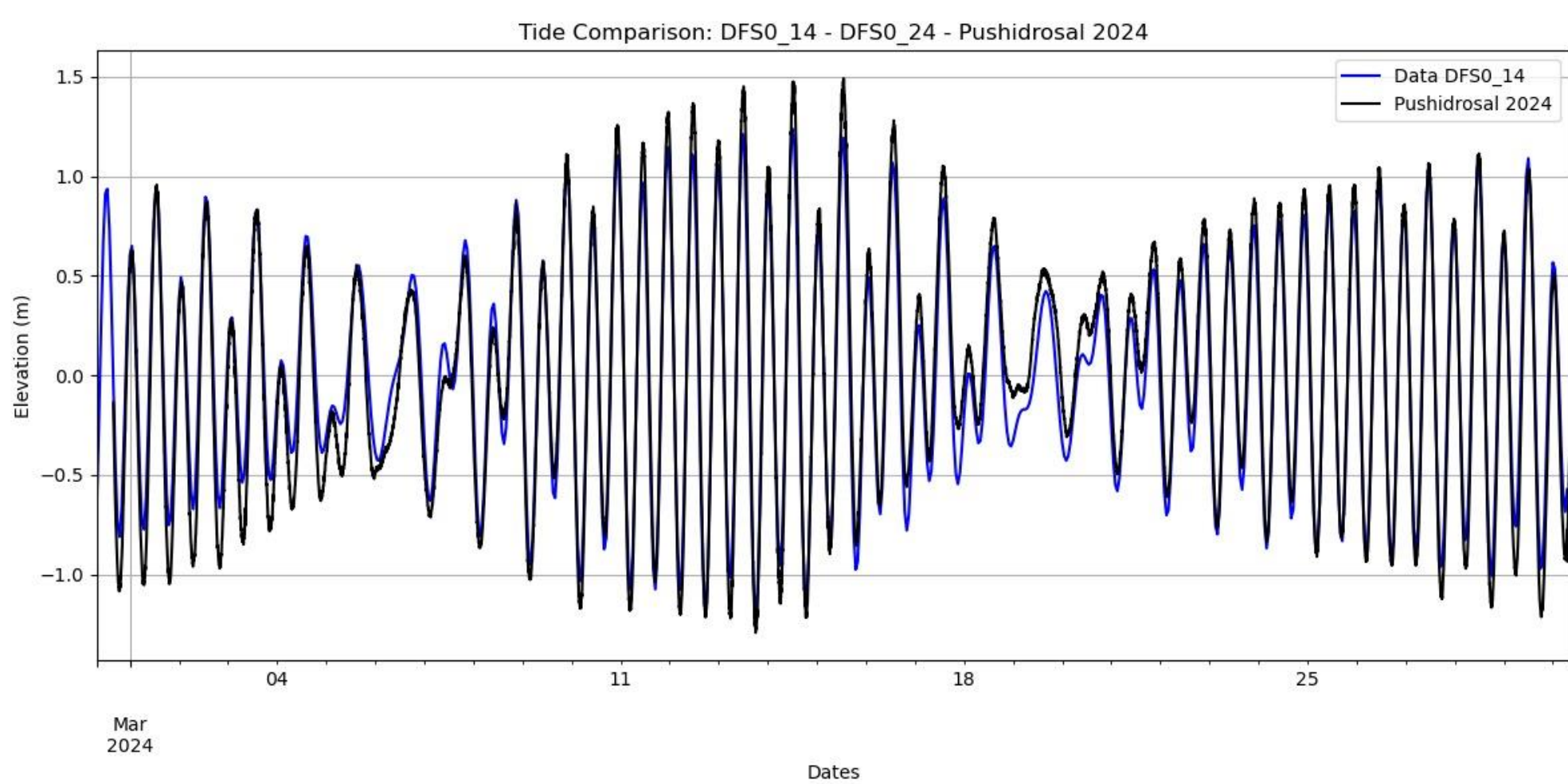


Figure 3, Tidal elevation verification between Pushidrosal Tide Observation in 2024 (Black line) and Mike 21/3 model results (Blue line)

3. Results and Discussion

The development of S-104 and S-111 data requires the use of hydrodynamic models, such as Mike 21/3 and MITgcm, to produce spatial forecasts of tidal conditions and ocean currents in the waters of Benoa, Bali.

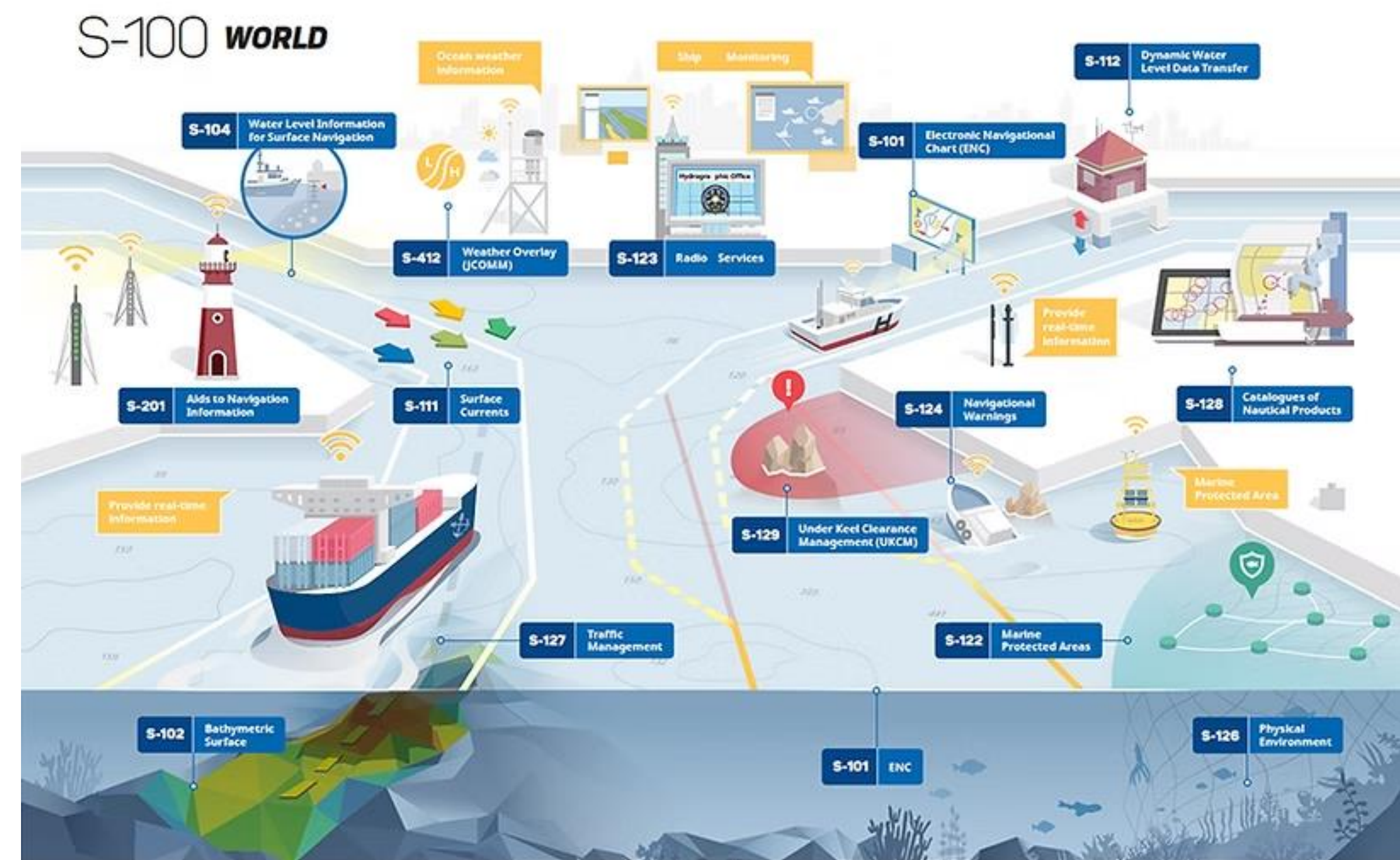


Figure 4 The Scope of S-100 data including S-111 for Surface Currents

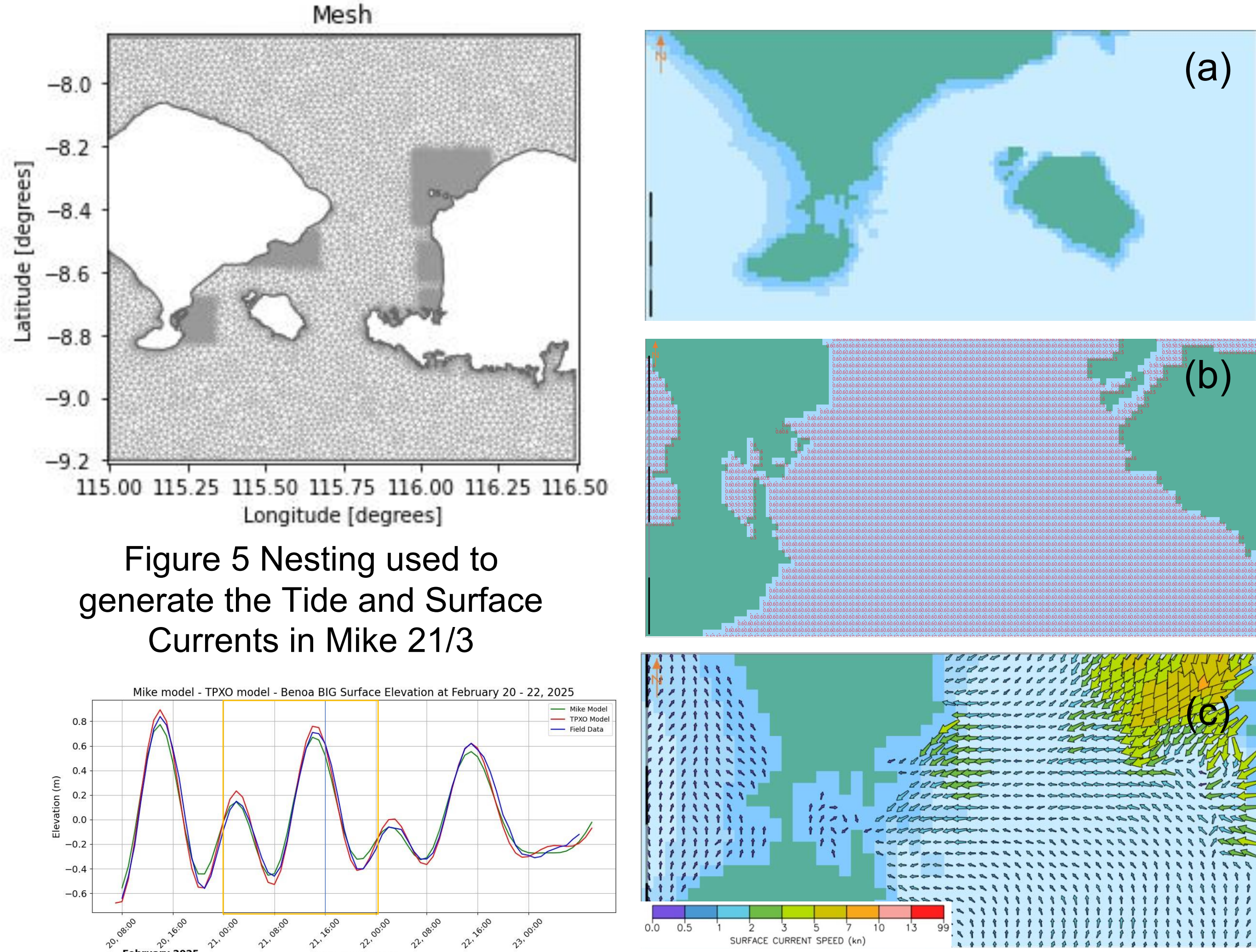


Figure 5 Nesting used to generate the Tide and Surface Currents in Mike 21/3

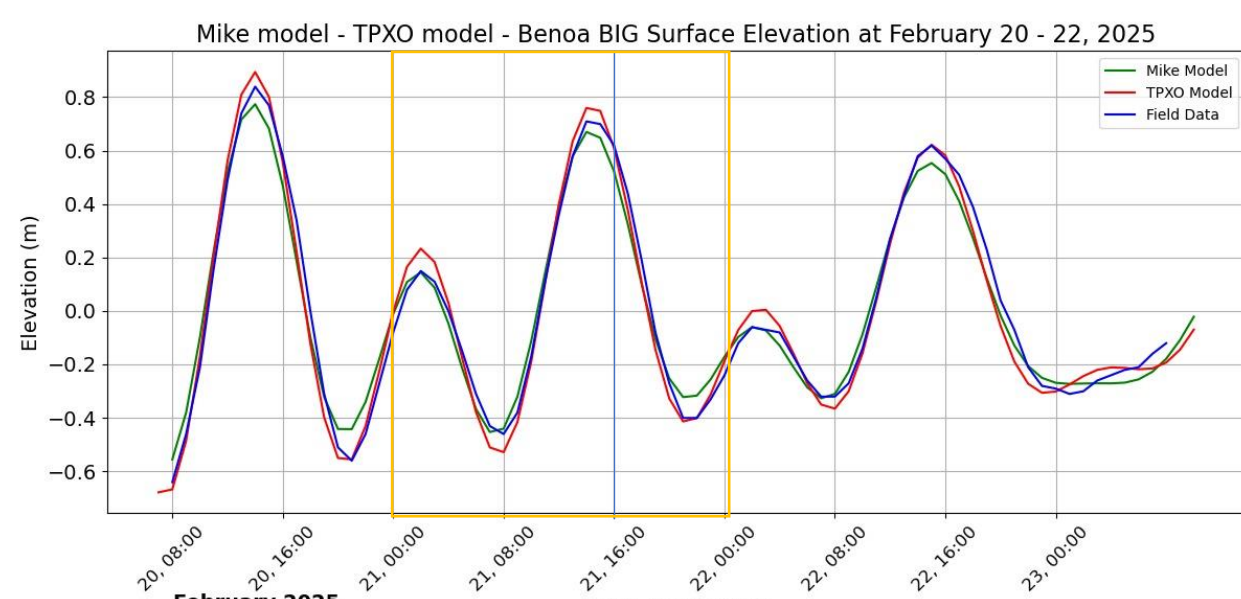


Figure 6 Tide Verification in February 21st 2025 from BIG Field Data (Blue line, Mike 21/3 (Green line), TPXO (Red line)

Figure 7 KHOA Viewer on February 21st 2025 for (a) S-102 Bathymetry (b) S-104 Spatial Tide Prediction (0.6m) (c) S-111 Surface Currents Converted (0.5-1.0kts) into S-100 standards

4. Conclusion

This research successfully developed and integrated the S-100 data in KHOA Viewer to support modern navigation in Benoa Port, Bali, particularly regarding bathymetry, tidal and surface current conditions. Using the Mike 21/3 hydrodynamic model and observational data from Pushidrosal. The research generated tidal and surface current conditions on February 21, 2025, when three large cruise ships docked at the harbour. The simulation revealed that Benoa Harbour experiences a mixed semi-diurnal tide with a tidal range of approximately 280cm, characterized by surface currents flowing toward the northwest during high tide and toward the southeast during low tide.

The creation of S-104 and S-111 products for modern navigation data requires a conversion process that has been well executed in this research to be shown in KHOA Viewer (S-104, and S-111). For the Benoa Harbor region in Bali, an operational model is needed to produce outputs that can be converted to hdf5 format, and a larger infrastructure is necessary to prepare for operational simulations throughout Indonesian waters.

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