

Supervisor: Prof. Bjørn-Egil Asbjørnslett  
Co-supervisor: Dariusz Fathi, SINTEF Ocean

by Runar Stemland

## OBJECTIVE

- Increase the knowledge and insight of service vessel operations in exposed aquaculture, with a particular focus on vessel-structure interaction.
- Determine quantitative limits of operation for the selected vessel design
- Assess the long-term operability of the vessel through simulation

## PROBLEM DESCRIPTION

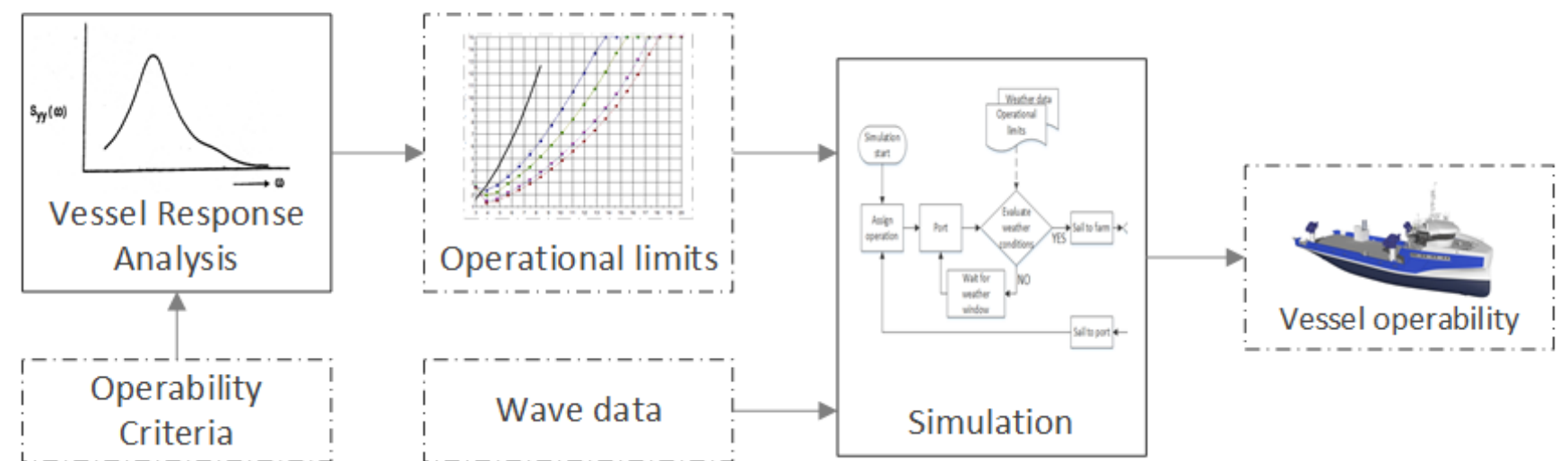
The aquaculture production in Norway has gradually moved towards more exposed locations, where harsh weather conditions affect the operations. Operability criteria and tools for decision-making are identified as key issues for safe and efficient operations at exposed locations [1]. The work of this thesis address these issues through an assessment of the Macho 40 vessel design.



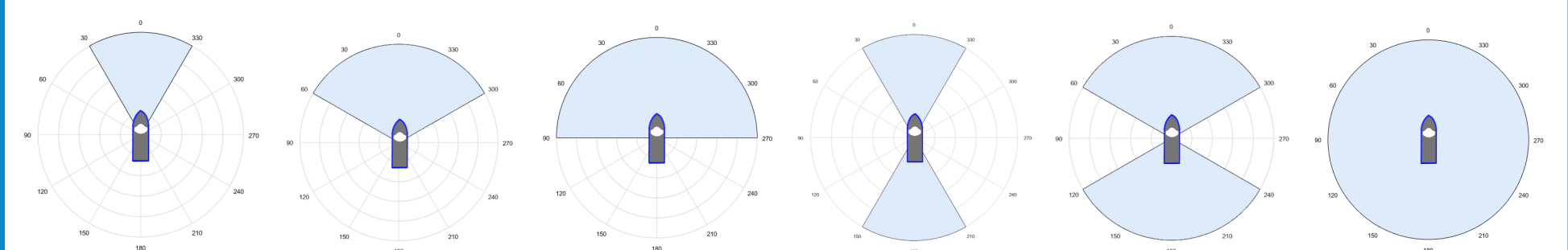
In order to assess the vessel performance, attention is given to the definition of operability criteria which, in combination with a vessel response analysis in VERES, provides quantitative limits of operation. Along with measured wave data from two oceanographic buoys, the operational limits are used as input in a simulation model to assess the long-term operability of the vessel. The model provides information on vessel operability for decision-making in a design process, which in turn can contribute to develop new and improved designs with increased operability.

## METHOD

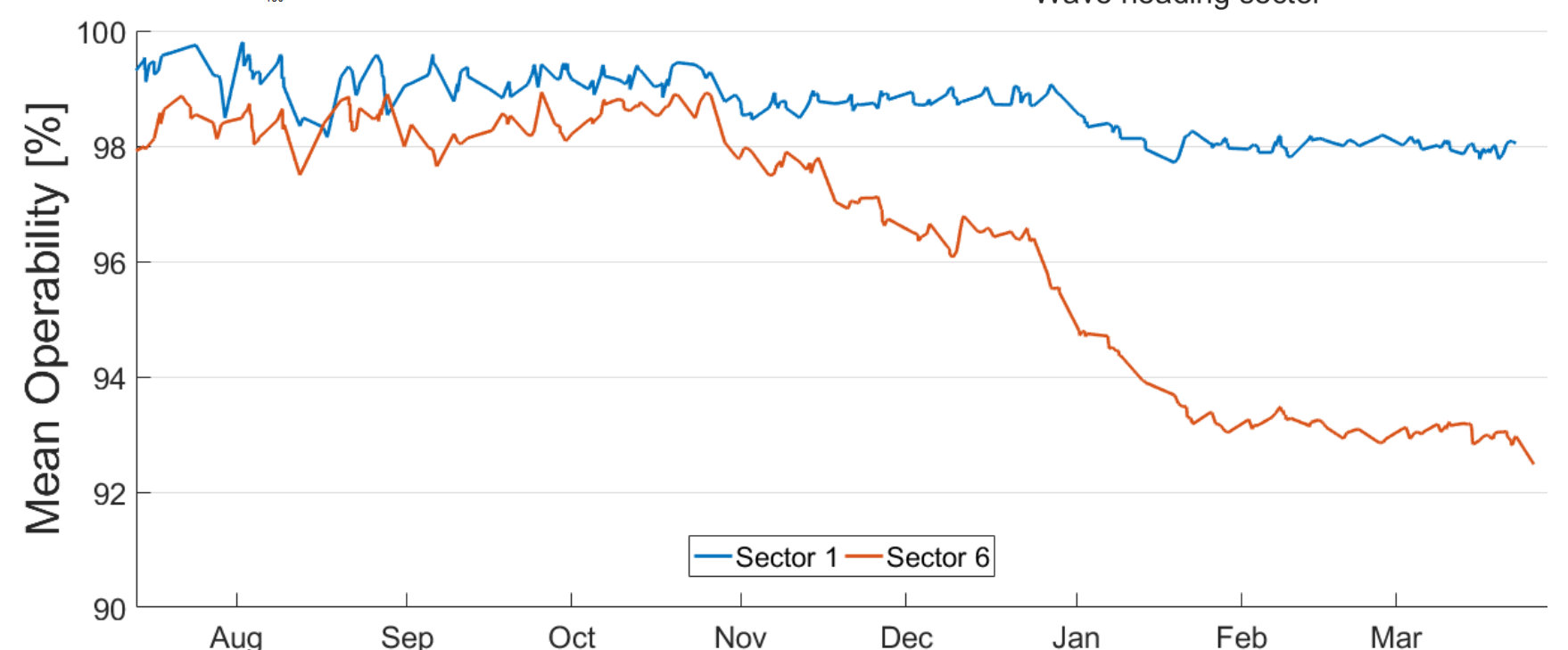
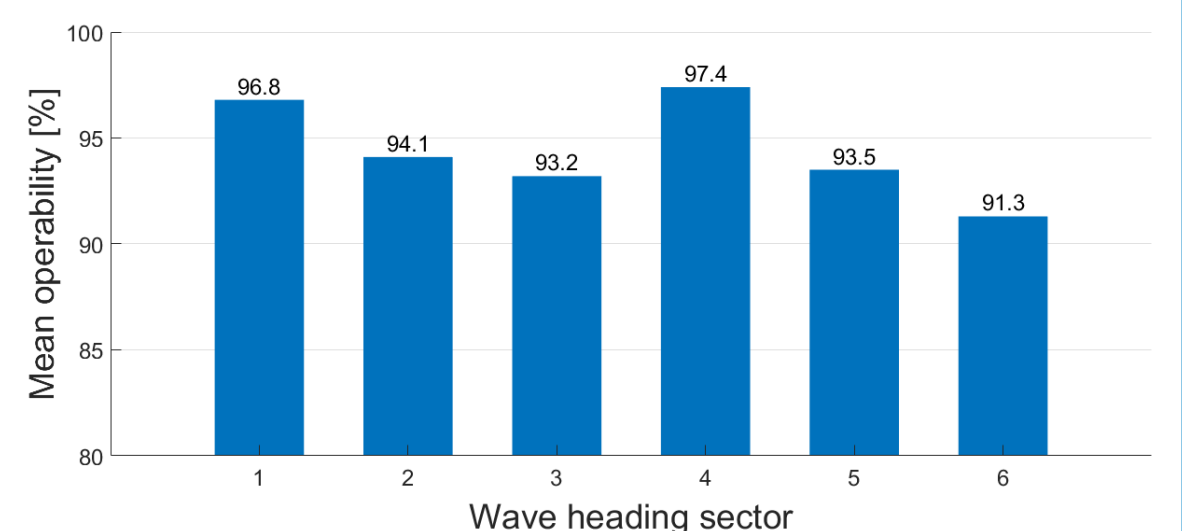
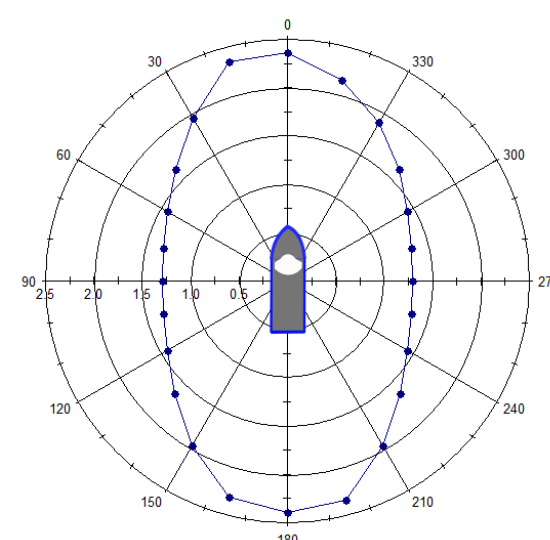
The work has addressed several aspects regarding hydrodynamics and system design. A vessel response analysis and specification of operability criteria provides quantitative limits of operation. Along with measured wave data from oceanographic buoys, the operational limits are used as input in a simulation model to assess the long-term vessel operability.



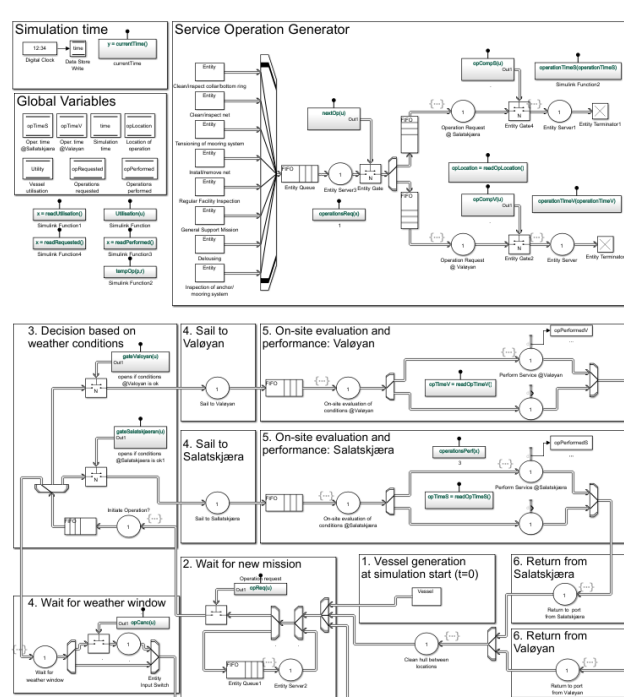
## RESULTS



For each of the six sectors above, an analysis is performed under the assumption that the vessel is able to keep the wave heading within the particular sector during the operations. The polar curve below shows the limiting significant wave heights ( $H_s$ ) as a function of wave heading obtained from VERES. It can be observed that the limits are decreasing as the wave heading approaches beam sea. The bar chart shows the simulation results as mean operability for each wave heading sector. The graph below shows seasonal variations in operability for the most and least affected wave heading sectors.



## SIMULATION MODEL



## REFERENCES

- [1] Merete G. Sandberg, Andreas M. Lien. Experiences and analyses on operation of exposed aquaculture facilities

## CONCLUSIONS

Through the simulation model the Macho 40's long-term ability to perform its intended missions at two specific aquaculture locations has been estimated. The reliability of the results vary due to simplifications and assumptions in the model, and should only be considered estimations of the true performance characteristics. Despite this, the results provide useful knowledge on the vessel's sensitivity to incident wave headings and changing weather conditions.