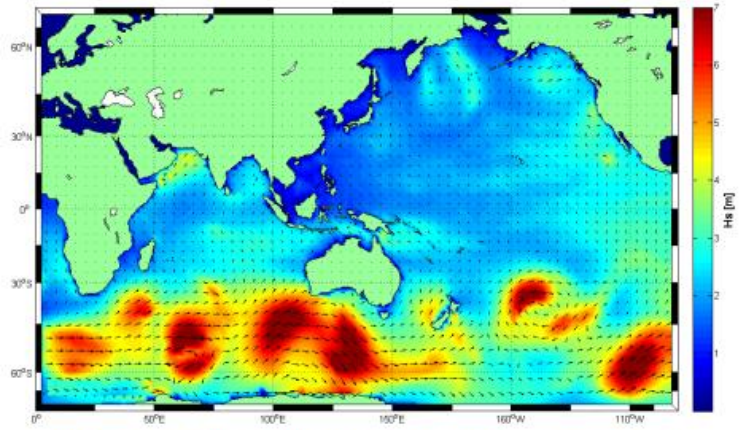
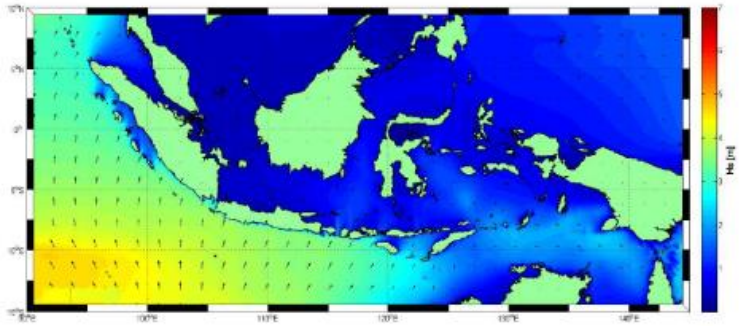
Artificial Intelligence based System for Port and Offshore Platform Operations

Abstract (200-300 words)
Wave forecasting is indispensable for the navigation of large ships, onshore and offshore operational activities, such as ports and offshore platforms. The wave prediction system currently available in Indonesia is only relatively accurate for prediction of waves on the high seas, while for complex geometry areas such as the coast and small islands, this prediction system is relatively less accurate. In addition, currently available wave prediction systems use high performance computing (HPC) to simulate spectral wave equations to obtain wave predictions, which require considerable computational resources to perform wave predictions. In this research, a wave prediction system will be designed using a machine learning approach. The purpose of this study is to build an accurate wave prediction system for areas with complex geometries for an archipelagic country such as Indonesia. computationally. The specific objective of this research is to build a machine learning-based system that can be used by research partners, namely the Meteorology, Climatology and Geophysics Agency (BMKG) so that it can be used for wave prediction systems in Indonesia, especially coastal areas. The machine learning methods that will be used to build this prediction system are Support Vector Regression (SVR), and Artificial Neural Network (ANN), namely Generalized Regression Neural Network (GRNN) and Long Short-Term Memory (LSTM). To build the training data that will be used by the machine learning method, high-resolution wave simulations using spectral wave models for the last 40 years are used. The accuracy of the simulation results will be compared with the results of wave measurements that will be carried out by the research partner, namely the Ministry of Marine Affairs and Fisheries (KKP). The training data built will be the basis for the wave prediction system, which is combined with wind prediction data released by GFS NOAA, USA. Besides being accurate, this built wave prediction system requires lower computational costs compared to conventional systems. The main output of this research is the establishment of a wave prediction system that can already be operated and used by prospective user partners (BMKG) at the end of the research period. In the first year of research, the mandatory output of this research is 1 Copyright computer program for ocean wave prediction, and additional outputs are 2 reputable International Journals and 2 International Proceedings in the second and third years. This research is already at TKT 3, it is hoped that by the end of the third year, it will increase to TKT 6.

Planning		
Background		Prediction of ocean waves is very necessary for ship navigation purposes, operational activities on the shore and offshore [1, 2]. This prediction becomes very important especially when there are extreme waves such as storms [3]. Several companies providing paid wave prediction system services such as Fugro [4], Bouyweather.com [5], StormGeo [6] and BMT-Argoss [7] are based on modeling and simulation of wave models using high-performance computers. The type of wave model used to calculate wave predictions with this numerical simulation is the Spectral wave model, which includes the SWAN model, WaveWatch III, and WAM model [8, 9, 10], where large computational resources are required. In addition, due to the geometry of Indonesia, which consists of many large and small islands, wave prediction using numerical simulations requires a high-resolution grid for get accurate results. Wave prediction services such as the Global Forecast System (GFS) [11], and ECMWF [12], have an accuracy of 2.5° (277.5 km) and 0.25° (27.75 km), which are considered relatively less accurate for archipelagic areas such as Indonesia. . Furthermore, BMKG as a user partner in this research, has a need for accurate and efficient wave predictions, especially for wave prediction in coastal areas in Indonesia. Indonesia. In this research, we will build a wave prediction system based on machine learning. The machine learning method that will be used is Support Vector Regression (SVR), and Artificial Neural Network (ANN), namely Generalized Regression Neural Network (GRNN) and Long Short-Term Memory (LSTM).
Subject (Names & titles)	Initiator(s)	Didit Adytia
	Leader(s)	Didit Adytia
	Team members	1. Ongko Cahyono

		2. Sri Redjeki Pudjaprasetya
Environment	Nature/society	Ports and offshore platforms
	Industry/market	-
	Government/others	1. Kemdikbud-Ristek 2. Marine Research Centre, Kementerian Kkp Center For Applied Climate Services, Bmkg
Resources	Human requirements	-
	Financial requirements	external funds
	Technological/other requirements	In this research, we will build a wave prediction system based on machine learning. The machine learning methods that will be used are Support Vector Regression (SVR), and Artificial Neural Network (ANN), namely Generalized Regression Neural Network (GRNN) and Long Short-Term Memory (LSTM).
Mechanism	Strategic options available	-
	Their relative importance	-
	Their sequences for execution	-
Content		The specific objectives of this research are as follows: 1. Build training data that will be used as input in a machine learning-based wave prediction system, namely by simulating spectral wave models, and applying machine learning algorithms for ocean wave prediction systems, detecting water level anomalies for high wave and tsunami early warning systems. 2. Calculating the accuracy of the wave prediction system 3. Testing the stability of the wave prediction system application prototype.
Key points		Wave forecasting; machine learning; artificial neural network.
Differences from traditional approaches		This project uses a new method or approach, resulting in better output. In addition, the application of information technology and IR 4.0 can increase efficiency and productivity.
Doing		
Launch date		July 1, 2021
Responsible organization		1. Kemdikbud-Ristek 2. Marine Research Centre 3. Kementerian Kkp Center For Applied Climate Services 4. BMKG 5. Telkom University
Progress as of today		On Going
Problems in implementation		Ocean wave data is relatively difficult to obtain
Approaches to solve the problems		We work with research partners to measure ocean waves
Completion date, if completed		December 2023
Seeing		
Impacts on students		1. Students can get directly involved in the industrial world and add insight into the application of systems in the industry
Impacts on professors and university		1. journal publication 2. intellectual property rights
Responses from industry/market		Very satisfied with the result
Responses from government		Very satisfied with the result,giving funds and as a partner for research
Measurable output		1. Calculating the accuracy of the wave prediction system 2. prototype product
Cost-benefit analysis for effectiveness		The cost used is very effective, because if we have to buy a similar application then the cost is more expensive
Future Planning		
Where does the project go from here?		demonstration of a prediction system prototype on a lab scale and continued demonstration at the port. Can be used by research partners and companies using wave forecasting services

Miscellaneous	
Exhibits, pictures, diagrams, etc.	 GAMBAR 1. Simulasi prediksi gelombang dengan SWAN pada domain global.  GAMBAR 2. Simulasi prediksi gelombang dengan model SWAN pada domain nesting kedua.
Reports, mimeos, monographs, books, etc.	
Others which may help explain the project	