

MMS program (Maritime Meteorological System)

Executive Summary

This document describes the main elements of the MMS program, contracted by Indonesia, through the meteorology and climatology agency BMKG to CLS.

Overview

The MMS (Maritime Meteorological System) program is a large-scale initiative designed to **enhance maritime safety and optimize the use of Indonesia's vast maritime territory**. It supports a wide range of stakeholders including fishermen, shipping operators, port authorities, and public institutions.

The program combines **advanced ocean observation systems, high-performance computing (HPC), AI, and forecasting models** to deliver accurate, near-real-time maritime and weather data.

- Initial phase (MMS1): 2020–2025 with ~€43 million investment
- Expansion phase (MMS2): 2024–2028 with ~€63 million investment (48 to CLS)

System Scope and Architecture

MMS is a **fully integrated end-to-end system**, covering the entire meteorological value chain:

- Data acquisition
- Processing and storage
- Advance Ocean-Wave-Atmosphere coupled modelling
- Analysis and forecasting
- Dissemination to users and international systems (e.g., WMO, GTS)

The system includes:

- **200+ observation instruments**
- **Supercomputing infrastructure (2 petaflops)**
- **Big Data & AI platform**
- Advanced forecasting and user services



Observation Network

The MMS program deploys a dense observation network to fill critical data gaps across Indonesian waters.

Ocean Monitoring Instruments

- Anchored buoys: current, waves, weather
- Drifters and profilers: temperature, salinity, currents

Weather Stations

- Marine AWS: tides, sea temperature, salinity, pH, weather
- Vessel AWS: sea temperature and weather conditions

HF Radar Systems

- Real-time monitoring of:
 - Surface currents
 - Waves
 - Tsunami-related data
- Multiple radar installations along the coast

Data Quality Control

- Up to **40,000 sensor measurements per day**, ensuring continuous validation and availability of data

IT Infrastructure & High-Performance Computing (HPC)

At the core of MMS is a powerful and compact computing system:

- **2 petaflops CPU supercomputer (~558 nodes)**
- **~10 petabytes of storage capacity**
- Energy-efficient liquid cooling system
- Big Data and AI platform with GPU capabilities

This infrastructure enables:

- Real-time data processing
- Complex modeling and simulations
- Scalable storage and analytics



Forecasting and Modeling: InaCAWO System

The system features **InaCAWO**, a cutting-edge coupled ocean-atmosphere-wave forecasting model:

- 10-day deterministic forecast
- Runs every 6 hours
- High resolution (3 km grid, hourly timestep)

Capabilities:

- 34 atmospheric variables (multi-layer)
- 27 ocean and wave variables

Future enhancements (MMS2):

- Ensemble forecasting
- Data assimilation
- Higher-resolution regional models

Big Data, AI, and Applications

MMS leverages AI and analytics for operational and predictive use cases:

Key applications include:

- Wave and ocean current nowcasting (using HF radar data)
- Augmented digital weather forecasting tools
- Coastal Flood Early Warning System (CFEWS)
- Drift modeling for objects at sea (e.g., search & rescue)

Production and Dissemination

The system provides user-friendly outputs:

- Automated, customized weather reports
- Advanced visualization tools
- 3D broadcast studio for communication of weather events

Data is disseminated to:

- Government bodies
- Maritime operators
- International meteorological networks



Capacity Building and Training

A major component of MMS is **human capital development**:

- Technical and operational training (factory, local, and on-the-job)
- Mid-term advanced training programs
- Academic programs (2 Master's and 1 PhD)
- Over **3,000 training days delivered**

Key Value Proposition

The MMS program delivers:

- **Improved maritime safety**
- **Enhanced forecasting accuracy**
- **Operational decision support for maritime industries**
- **Stronger resilience to extreme weather and coastal hazards**
- **Technological sovereignty through local capacity building**

Conclusion

The MMS program represents a **state-of-the-art maritime meteorological ecosystem**, combining observation, computing, and analytics into a unified platform. With the upcoming MMS2 expansion, the system will further strengthen Indonesia's ability to **monitor, predict, and respond to maritime and climate-related challenges**, positioning it as a regional leader in marine meteorology.