

# DEVELOPMENT OF A DECISION SUPPORT SYSTEM FOR NAVAL PLANNING AND PREDICTION OPERATIONS: SIAAMETOC PROJECT

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## INTRODUCTION

The SIAAMETOC project (Integrated Automatic Meteorological-Oceanographic Support System for Maritime Operations) is responsible for the identification, analysis, and exploitation of currently available meteorological and oceanographic data worldwide. Its purpose is to automatically adapt/interpret this information to reliably, efficiently, and realistically support missions and maritime operations of the Ministry of Defense of Spain. It is an Research, Development, and Innovation system applied to military use, utilizing, modifying, and adapting pre-existing information to provide practical added value for maritime operations involved in Rapid Environmental Assessment (REA) support. This contributes to the decision-making process for METOC officers and Beach Naval Groups (GNP).

Throughout the period from 2019 to 2023, the SIAAMETOC project has been developed and is currently a reality as a METOC/REA system that provides ad-hoc environmental information to naval military units during their operations.

Specifically, the project introduces four innovative products, all integrated into a single Graphical User Interface (GUI). This interface allows for immediate application in the involved maritime missions and operations, aiding decision-making processes. These products include:

1. Historical knowledge of maritime climate and dynamic functioning of any maritime/coastal area of interest.
2. Early and secure planning of amphibious landing maneuvers, mine-hunting planning, support for the management of autonomous vehicles in any oceanic and coastal area worldwide.
3. Predictive planning for beaching and navigation from the amphibious ship to the coastal zone.
4. Management and decision support for the safe docking of landing units within amphibious ships.

All of this, validated with in-situ instrumental data through two custom-made field campaigns tailored to the project's needs. The GUI (Graphical User Interface) has reached a level 8 Technology Readiness Level (TRL), meaning that after three years of the project, it has evolved from the basic idea, conceptualization of the system's technologies, and proof of concept, successfully validating it in relevant and real environments. It is currently being used successfully in 19 maneuvers conducted by the Spanish Navy / NATO from 2021 to 2023, serving various purposes, such as:

As a contribution of naval power to joint action, it can support a diversity of operations, with amphibious operations being a fundamental tool for their development. Below are some of the possible operations:

- Non-combatant Evacuation Operations (NEO): Extracting civilian personnel in areas of high uncertainty with the possibility of rapid transitions from permissive to hostile environments.
- Information Collection Operations, including insertion and extraction teams for naval special warfare forces.
- Support operations for a friendly state in the early stages of a conflict.
- Special operations at sea or on land.
- Mine-hunting reconnaissance operations.
- Deterrence of an aggressor through timely and early deployment of a force with projection capability.
- Attacks against key enemy targets, employing a gradual use of force to prevent the simultaneous use of force while maintaining control of the conflict scale.
- Support to the main effort of a joint operation through precision attacks.
- Withdrawal operations under pressure of a deployed force on land, with support and protection provided by a Naval Force.
- Initial entry or establishment of force operations, leveraging the versatility of the Naval Force.

## METHOD

The project followed two different work packages (WP), which are briefly described below:

Work Package 1 (WP-1): Meteorological and Oceanographic Databases. This task involves the identification, search, adaptation, extraction, and normalization of globally available meteorological and oceanographic databases (wind data, sea level, waves, salinity, temperature, currents, etc.). An exhaustive catalog of information sources, formats, extensions, private or public repositories, etc., has been included to design algorithms and protocols for data reading, adaptation, and normalization, enabling the system to be easily and directly fed. A fundamental product is the creation of a website where the METOC officer can access both historical and predictive databases (see Fig. 1).

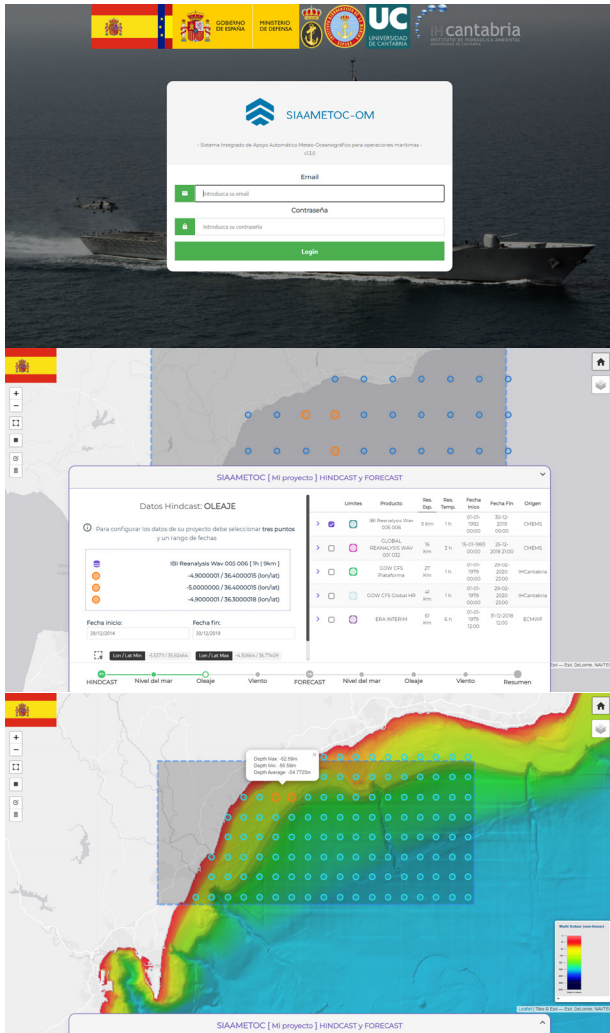


Figure 1 - WEB system for database selection and downloading, hindcast and forecast.

Work Package 2 (WP-2): Automatic Wave Downscaling on the Coast. This task determines wave conditions in any coastal area worldwide with high resolution, considering local bathymetric conditions. A hybrid downscaling method is employed, automating and making efficient the numerical propagation of waves from deep waters to the coast by chaining different numerical models such as SWAN, REF-DIFF, SHORECIRC, etc. The system provides the METOC officer with historical coastal climatology, dynamic beach functioning, and historical, seasonal, and monthly analysis of any area of interest for potential Ministry of Defense maritime missions or operations. This product represents a significant qualitative leap in tactical operational planning, as a proper understanding of the physical environment (shoreline waves, currents, relevant dynamics) allows the METOC officer to comprehend the operational zone's functioning for maneuvers, operations, and missions. Additionally, it produces sub-products such as the operational navigability limit of any vessel or the widely

used Modified Surf Index (MSI) in amphibious landing operations (see Fig. 2).

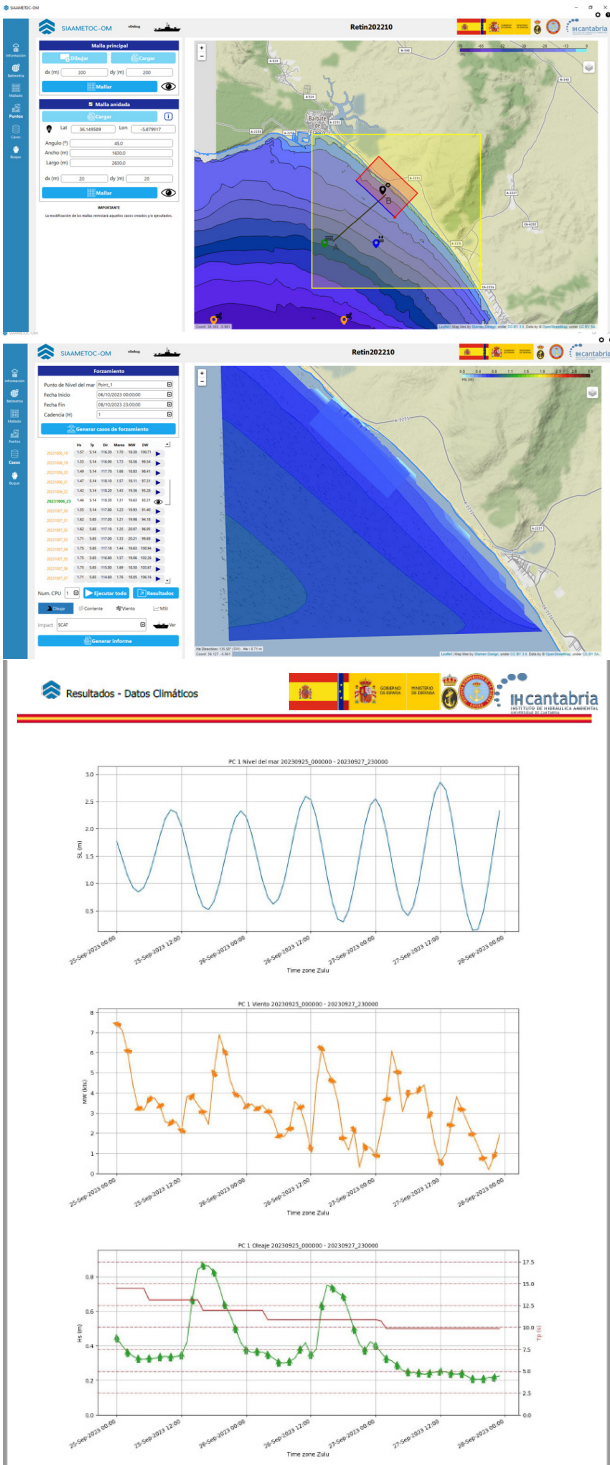


Figure 2 - GUI for downscaling, post-processing and analysis of results for all different products generated.