NOTE / TECHNICAL REPORT

Importance of environmental and hydrospatial monitoring systems – The UK Hydrographic Office Marine Environmental Monitoring Stations Framework

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Abstract

An ever-increasing need for reliable, real-time marine environmental and hydrospatial data has lead to development of a Marine Environmental Monitoring Stations framework by the UK Hydrographic Office. This framework, executed in partnership with OceanWise, involves the installation, operation, and maintenance of monitoring stations across various global locations, whilst emphasizing the importance of local stakeholders engagement. The framework aims to enhance navigational safety, provide critical data for climate change research, and support various government initiatives. OceanWise's cloud-based data platform enables real-time data visualization as well as access to historical records to support this. This approach not only supports scientific research and maritime safety but also fosters local capacity building and long-term sustainability in data management.

Keywords
environmental monitoring · data sharing · capacity building · informed decision making

1 Introduction

There has always been a need for environmental monitoring across many industries but particularly within the marine environment and the hydrospatial domain, however this need, and importance is growing ever stronger with increasing demand and pressure on global supply chains. Some of the key factors driving its importance are included here with particular attention drawn to digitalisation and data reliability (Fig. 1).

As we move into a digital world with more and more systems and processes becoming digital and even automated through the emergence of Artificial Intellignece (AI) and Machine Laerning (ML), there is a greater need to make data easily Findable, Accessible, Interoperable and Reusable (FAIR). This data must be timely, accurate and reliable for informed decisions to be made whilst ensuring user confidence. Having accurate environmental hydrospatial data available and accessible for a range of users is a key principle behind the UK Hydrographic Office's (UKHO) Marine Environmental Monitoring Stations (MEMS) framework.

2 The requirement

The UKHO identified the installation and operation of MEMS as an important component of several UK Government programmes. Maritime users can benefit from MEMS through improving navigational safety and enhanced knowledge of the marine environment in the hydrospatial domain as well as assisting with scientific research in understanding the implications of climate change.

In 2022, OceanWise were contracted by the UKHO under a 3-year framework agreement to install, operate and maintain a number of monitoring sites in various locations around the world. The framework includes provision of equipment, data management and a display platform. As well as undertaking local training and mentoring through community engagement.

Observational data collected at the sites is provided to local communities and global initiatives such as the Global Sea Level Observation System (GLOSS) and the Intergovernmental Oceanographic

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Fig. 1 The importance of environmental monitoring within the marine industry.

Commission's (IOC) Sea Level Station Monitoring Facility, whilst also assisting in refining tidal modelling and predictions. Additionally, all data collected is automatically analysed, processed and archived in a centralized and dedicated online server. Data is made available for the purposes of maritime and navigational safety, planning and situational awareness including assisting with ongoing programmes to update charts and associated navigational publications, and for Tsunami warnings as required.

3 The solution

To date, OceanWise have attended sites in a number of overseas locations including, Turks and Caicos, the Cayman Islands, Anguilla and Guyana. At each location, site surveys are carried out to establish the current state of existing sensors and infrastructure, alongside undertaking remedial work to re-instate existing sensors as well as installation of new and improved technology to measure environmental and hydrospatial parameters and telemetry systems for the transfer and sharing of data (Fig. 2).

Sites such as those on Anguilla and Montserrat required new full MEMS installations which involves a standard suite of sensors which include met stations, tide gauges and telemetry equipment, tailored to meet the specific requirements of the user and the given locality. Where required, our team of engineers undertake Global Navigation Satellite Systems (GNSS) surveys to establish geodetic benchmarks for tide gauge levelling and establishing a local datum (Fig. 3).

In addition to onshore MEMS installations, OceanWise have also deployed a GNSS tide buoy and profiler on behalf of the UKHO to collect tidal height and stream data offshore of Guyana. The purpose and requirement of this data is to as accurately as possible assess both tidal characteristics and spheroidal separation for the area. The buoy will be collect data for a minimum of 30 days, following which the data will be processed by the UKHO's Tide Department to establish Chart Datum for the area. Once this part of the project is completed the buoy with be reconfigured with additional sensors such as a met station and redeployed on a long-term basis as a metocean data buoy with data being stored and displayed within the UKHO's Port-Log.

A main part of the framework agreement is the provision of an online data platform to host, visualise, store, and facilitate the sharing of environmental and hydrospatial data. OceanWise's Port-Log provides the ideal platform to facilitate this (Fig. 4).

Port-Log is used by a range of customers across the globe and is a quick and easy management and publishing platform for environmental and hydrospatial data. Being a cloud-based data platform, it gives

Fig. 2 Marine Environmental Monitoring Station at Sapodilla Bay, Turks and Caicos Islands. Remedial works was undertaken on the existing Sutron tide gauge, with installation of OceanWise's ip.buffer smart telemetry system, a meterological sensor and GNSS leveling.

Fig. 3 GNSS leveling at Sapodilla Bay, Turks and Caicos Islands to establish geodetic benchmarks for tide gauge levelling and establishing a local datum.

the ability to store data securely and publish it in near real-time via the web as well as maintaining long-term historical records and archive for future reference if and as required. Within Port-Log the user has the ability to view sites in a map view for geographic distribution as well as tabular data feeds from each site as seen here on the right. This latest page shows a list of the most recently received data from all sites and sensors on the network as well as incorporating tidal predictions where available to calculate surge or cut values.

To ensure this table is always showing the most up to date and as reliable data as possible there are several indicators and Quality Control and Assurance factors built into the system to warn of a decrease in data validity. The indicators operate using a simple colour coded warning system which helps to give the user confidence (or not) in the data and to treat it accordingly. Alerts are also displayed and the user can click through to view the received error message to assist with fault finding and resolution.

The dissemination of data to all users who require it is at the forefront of how Port-Log operates and therefore the platform can be viewed through a web-browser on any device. There is also the ability to integrate within third-party systems such as dredge management software or Portable Pilot Units (PPU). Of course, it is not only the real-time data that is important, historical data and long-term records and archival are also significant and the good management of these datasets is vital for decision making and coastal resilience.

All data collected can be accessed for each site, along with associated statistics and graphs such as time series all of which are customizable to the records you are interested in. There is also the ability to download the data in numerous formats for ongoing analysis in other software environments.

4 Outreach and training

Education and awareness ensure communities and local users understand the purpose of the environmental and hydrospatial monitoring equipment and potential impacts of it not being operational.

Throughout the processes of installing equipment and carrying out required maintenance and improvements to existing infrastructure, our team of engineers have provided onsite training to local organisations and users in the setup of the equipment as well as the importance of regular maintenance to ensure accurate and reliable data continues to be received. Good maintenance of equipment also assists in prolonging the longevity of the sensors and extending

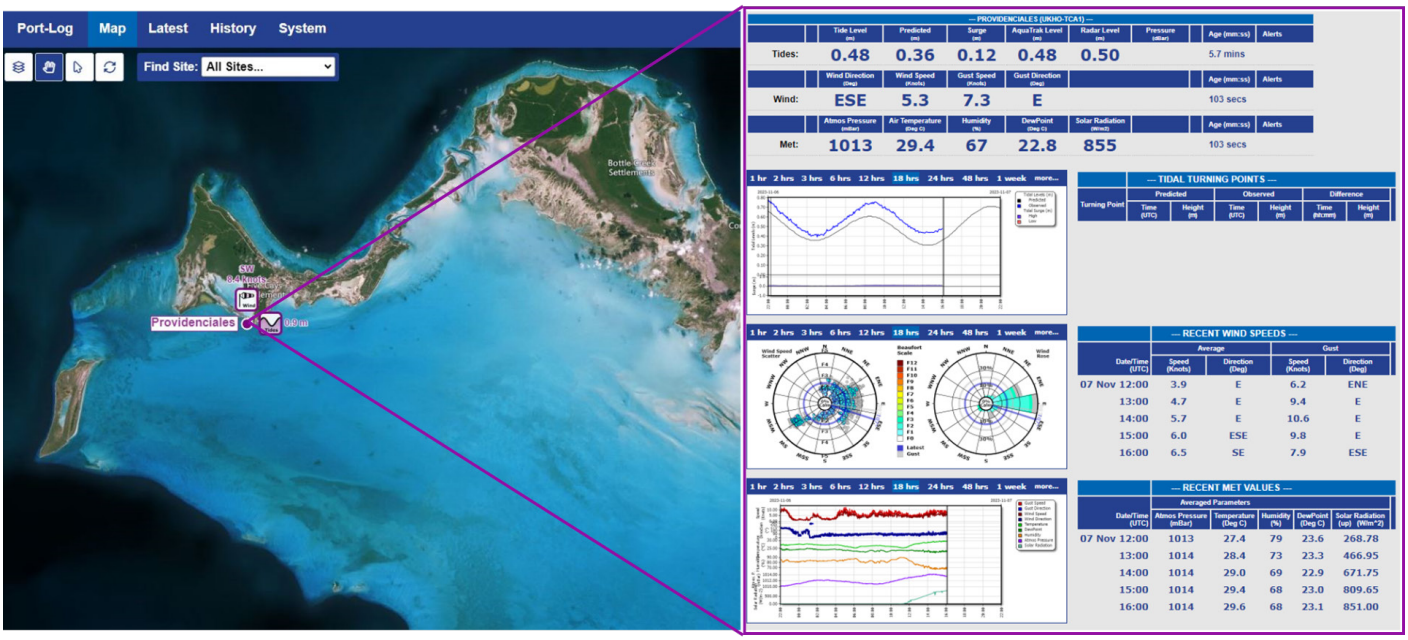

Fig. 4 Example of data visualization within OceanWise's Port-Log online data platform, showing real-time and historical records for tide and meterological parameters.

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Fig. 5 Onsite training for Montserrat Port Authority provided by OceanWise in the functionality of the MEMS and the importance of proactive maintenance to ensure continuity in reliable data.

the asset lifespan. Of great importance when trying optimize and stretch out limited budgets!

An example of this is the training provided to Montserrat Port Authority to ensure the users get the most out of the system and its data (Fig. 5). This training also led to discussions and changes to their Hurricane Preparation Plan which OceanWise assisted with by marking cables with green and red tags to help with the removal of the met mast in preparation for a storm event – (red cables should be removed, green should remain in place).

5 Conclusion

In conclusion, the UKHO's MEMS framework delivered by OceanWise, represents a beneficial approach to marine environmental data management and accessibility. By deploying modern and reliable monitoring equipment worldwide, the framework delivers accurate, real-time data that can be used to the safety of navigation, climate research, and coastal resilience. For the UKHO, this initiative has delivered data to support hydrographic survey efforts required to update nautical charts and publications in the locations where they have been installed. The UKHO has provided this data to local and regional stakeholders to enable improved marine situational awareness and better inform decision-making. The Port-Log online data platform also facilitates seamless data integration and sharing, which benefits local communities by improving their access to marine environmental data.

The model presented in this paper could offer a useful example for other Hydrographic Offices and Hydrospatial Organisations globally, demonstrating how to effectively combine technology, community engagement, and data management to support local blue economies and strengthen global maritime safety and environmental monitoring efforts.

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