# IMARDIS - A Marine Data Infrastructure Serving the Needs of the Welsh Marine Sector

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The step change in our ability to measure and simulate the marine environment can lead to improved decision making based on an improved evidence base underpinned with data. Building the data infrastructure to capitalise on the next generation of data intensive science is beyond the capacity of many commercial or public funded bodies and limits its potential impact across multiple societal benefit areas. Against this background, IMARDIS (Integrated Marine Data and Information System) has been developed as part of the £17M SEACAMS2 (www.seacams.ac.uk) project at Bangor University (BU) part funded by ERDF (European Regional Development Funds) through the Welsh government. With an initial focus on the Welsh Ocean Renewable Energy (ORE) sector IMARDIS is already in demand from other government and commercial users to deliver services that support improved decision making and further improve understanding of marine systems.

SEACAMS2 collaborative research between BU and the ORE sector encompasses multi-scale and multidisciplinary (physical, chemical, biological and ecological) observations from intertidal, shallow coastal and offshore domains. The datasets gathered are large, complex and require rapid processing to enable timely delivery of quality assured data and information required by stakeholders. Furthermore, SEACAMS has a legal and contractual requirement to share publicly funded data assets.

A review of existing data services within the UK showed they could not meet the demands of our users in terms of data access speed, access to raw and processed data, very high spatial resolution data requirements or that would retrieve data on a machine-to-machine basis for further processing. IMARDIS architecture is based on a series of services, each capable of operating semi-independently and accessible through a RESTful JSON based Application Programming Interface (API) layer. The services support a range of key functions including security and authentication, metadata management, metadata catalogue, file upload and download, tabular data manipulation, point cloud (or generic raster) data processing and time-series data manipulation. The services are implemented in Java and Python and deployed within the Amazon Web Services cloud infrastructure. This is scalable in terms of storage capacity and throughput. The publicly available API allows a range of services to be delivered as required by end-users. The data discovery and download service has been implemented and is accessible via the recently launched IMARDIS portal (portal.imardis.org). A service to ingest and publish real-time data to the web has also been implemented as part of the SEACAMS2 coastal observatory initiative.

Through these services, IMARDIS is beginning to address the requirements of three main societal benefit areas: decarbonising the UK economy, environmental policy implementation and maritime safety.

The UK Crown Estate has designated two demonstration zones for the development of wave energy (Pembrokeshire, south Wales) and tidal stream energy industries (Anglesey, north Wales). IMARDIS

was specifically developed to streamline industry access to SEACAMS2 quality assured data derived from the extensive observational and modelling programmes. Data collection was driven by the ORE sectors need to address a range of critical requirements: policy compliance, fulfilling licencing requirements, Environmental Impact Assessments, resource assessment and site selection. For example, high-resolution seabed bathymetry is a key requirement for site selection for the ORE industry and has been prioritised in the initial phase of IMARDIS. A screenshot (Fig. 1) of the new portal shows the results of a typical search returning results that include seabed bathymetry.

As part of Welsh governments coastal monitoring strategy real-time and delayed mode observations are carried out at key coastal locations of meteorological variables and sediment transport processes. In response to a request from National Resources Wales (NRW) we have used IMARDIS to ingest NRW data and publish to the web in real-time. Data are used to support policy compliance, flood management and managed realignment and to improve understanding of the impact of extreme events (e.g. storms) and longer-term changes (e.g. wind direction) on coastal morphology in dynamic systems such as dune evolution. Real-time meteorological data published to the web also informs decisions made by beach goers and water sports participants and addresses the requirement of government to deliver 'public good' services.

Cemex UK Ops Ltd operate a pier on the North Wales coast that has been instrumented by BU with meteorological and sub-surface sensors (temperature, pressure, salinity, suspended load, chlorophyll). IMARDIS ingests and publishes real-time data on tidal height, wind speed and direction at the pier. This enables the operators of a bulk cargo carrier to make better informed decisions regarding berthing on the pier leading to increased safety and operational efficiencies. Generic forecasts for this specific site had previously proven unreliable due to the proximity of the pier to steep cliffs resulting in inaccurate predictions of sea state. While the maritime operations benefitted primarily from specific real-time meteorological and water depth observations the water quality parameters informed large scale studies of marine environmental status and coastal dynamics.

IMARDIS is now delivering on its promise to extract value from data and address the needs of business, government and communities. A measure of the success of IMARDIS is that it is a data infrastructure that data users already want to use. Next steps include ingestion of SEACAMS2 legacy data and the development of new analytical capabilities to serve the needs of the low carbon energy sector as part of the new Smart Efficient Energy Centre (seec.bangor.ac.uk), funded by the EU through the Welsh European Funding Office.

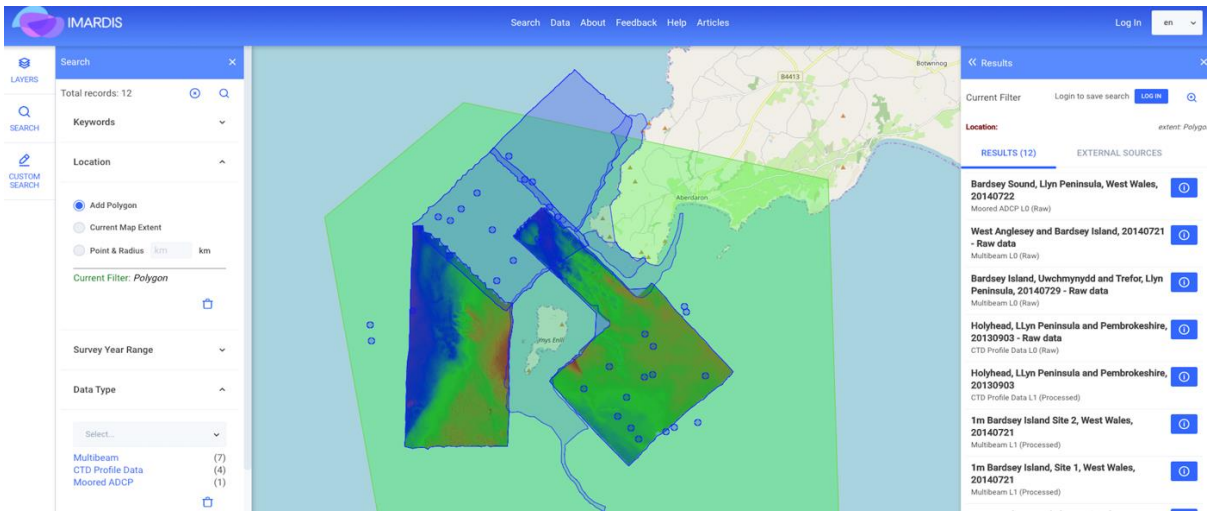

Figure 1: IMARDIS portal showing an example of the results of a search for available SEACAMS2 data in south Wales