SEACAMS

Collaborative research in supporting marine renewable energy industry development

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ERDF
Llywodraeth Cymru
Welsh Government
Ewrop & Chymru: Buddsoddi yn eich Dyfodol
Cronfa Datblygu Rhanbarthol Ewrop
Europe & Wales: Investing in your Future
European Regional Development Fund

Introduction

- Background
  - Rationale
  - Initial progress and lessons learnt
  - Challenges of coastal zone research
- Data intensive science
  - Abiotic observations
  - Biotic observations
- Data and information management
  - iMarDIS
  - Data management
  - Visualisation and modelling
  - Products and services
- Summary and conclusions

Seagoing facilities & equipment

Laboratory facilities and equipment

Prior progress and current challenge

- SEACAMS 1 – successful, broad approach and identified renewables industry users as major players
- Developed partnerships with coordinated and collaborative approach between industry and research communities
- Key role in de-risking business decisions and promoting investment (£50M by 2020)
- SEACAMS 2 – new focus on tides and waves
- Integrated approach from data to decisions
- Supporting European strategy for smart, sustainable and inclusive growth

Lessons learned in SEACAMS 1

Business requires:

- **solutions** to specific problems identified through 2-way dialogue
- **high resolution quality assured data** in an industry-agreed format that can be rapidly retrieved and manipulated
- lack of a **single point of access** for existing data and information hampers efforts to acquire knowledge that informs decisions.
- ability to address environmental impacts on **long time scales** (100 years)
- State of the art **data management**

SEACAMS 2

Aim: To translate research and innovation into new & improved commercial products & services (MRE)

- Enhance economic opportunities in Low Carbon, Energy and Environment
- Aligning low carbon marine research with commercial opportunities
- Improve SME access to data, information and tools to create new knowledge
- Develop economic opportunities derived from digital technology
- Sustainable strategy for future delivery of research for Welsh business
- Develop MCW as a collaboration hub to drive innovation
- Expand interaction with SME's to grow inward investment
- Upgrade national data gathering within linked coastal observatories
- Enhance model predictive capability through HPC and cloud computing

SEACAMS

Collaborative Research

marine renewable energy

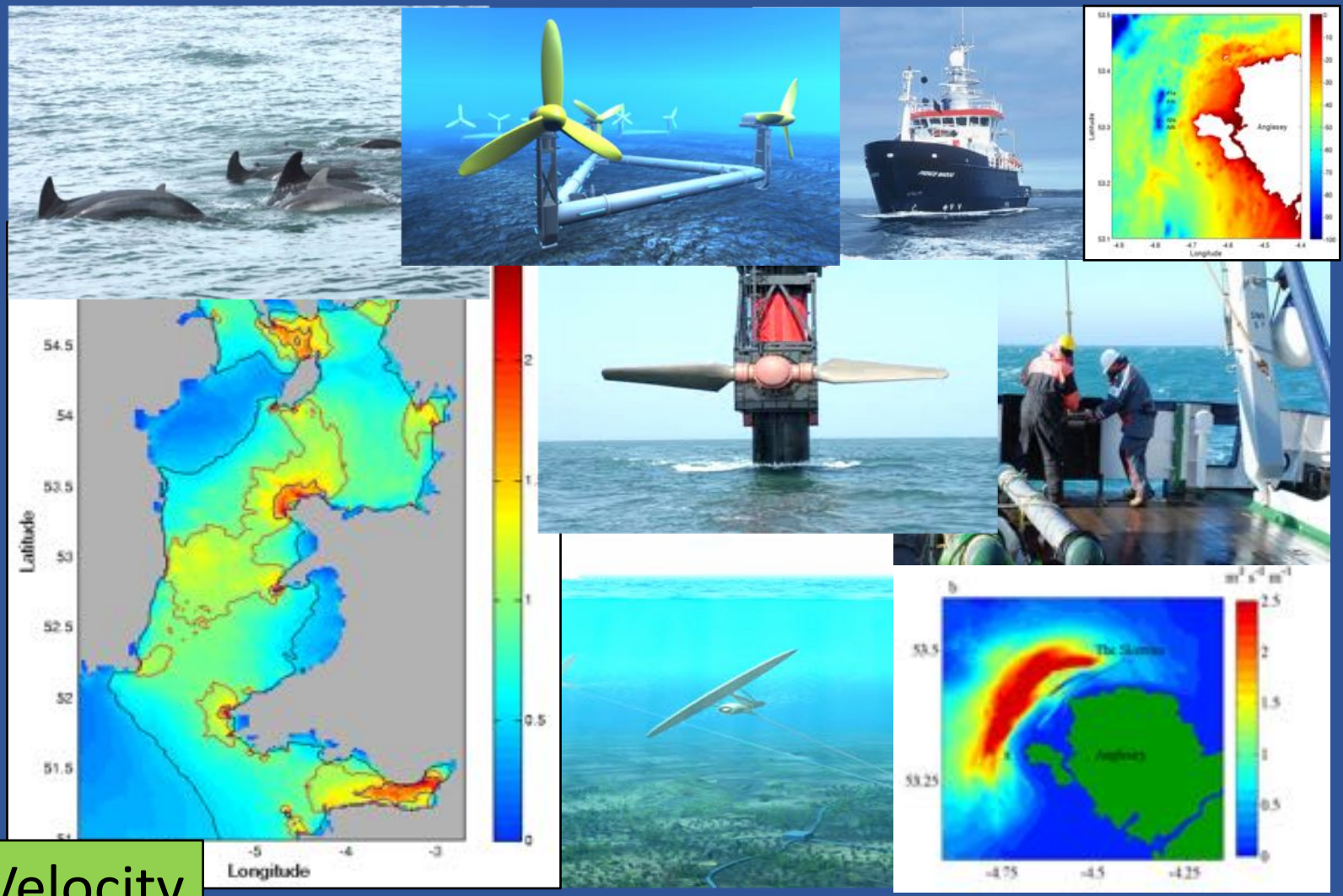
PRIFYSGOL BANGOR UNIVERSITY

morlais

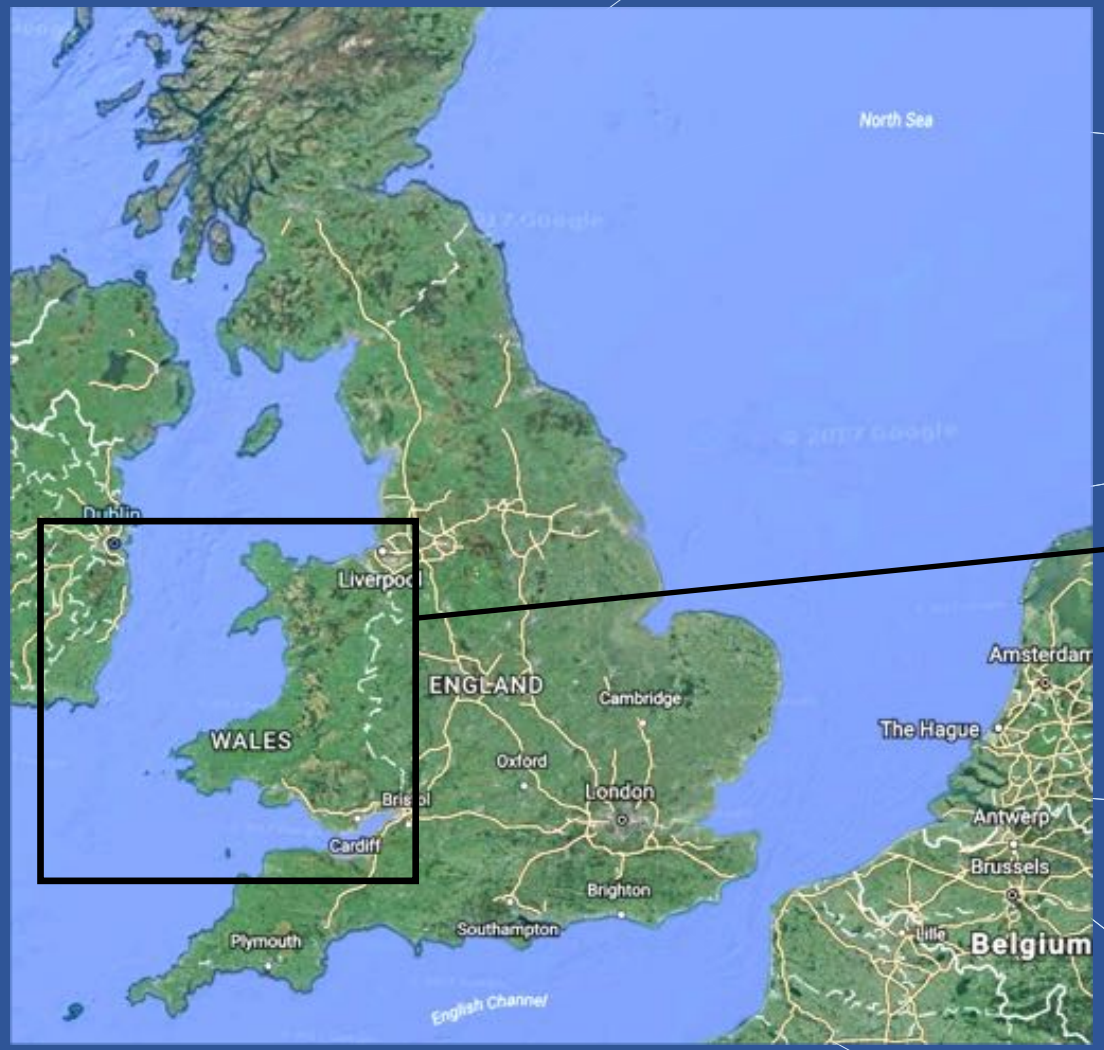
Minesto

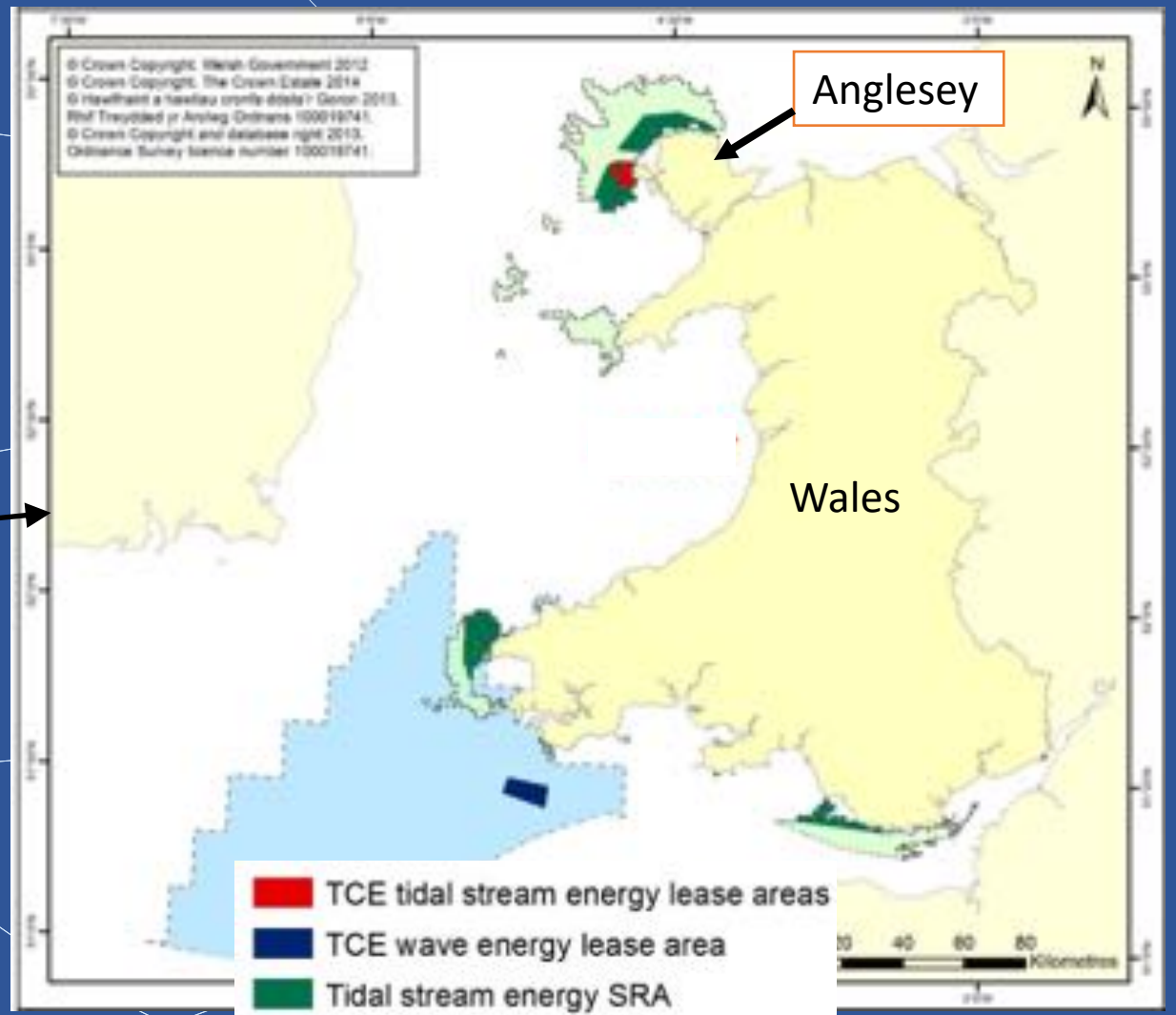
Wave Hub

TIDAL LAGOON POWER



SEACAMS Operational Areas





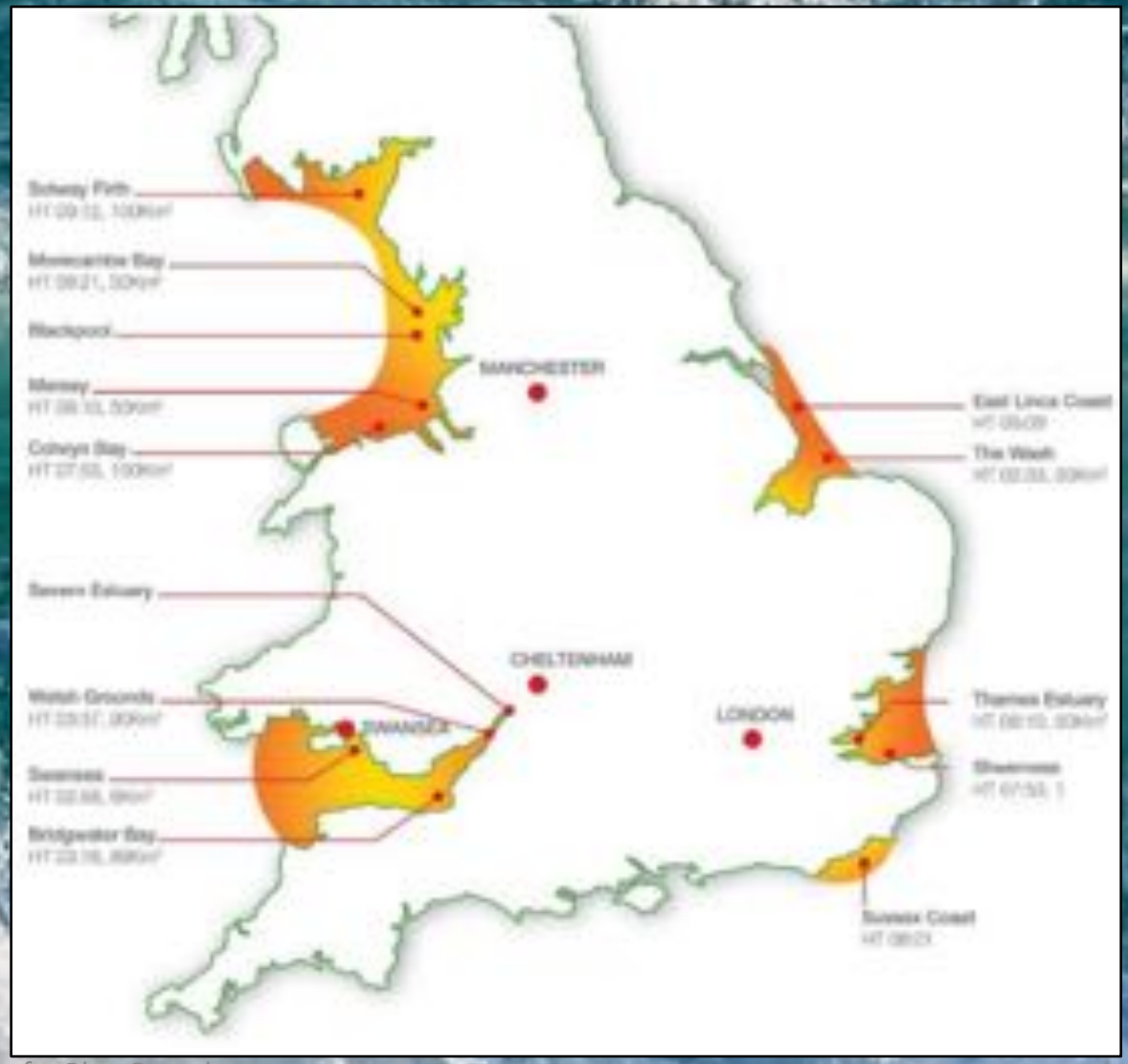
Tidal range energy from south and north Wales coasts

Tidal lagoons
- Sensitive to tides, waves and river flow
- Impacts on dynamics, sedimentation and water quality

Commercial collaborators:
Tidal Lagoon Power
North Wales Tidal Energy

Key Questions about Waves and Tides

- How predictable is the energy resource?
- How does energy extraction affect the resource and the environment?
- How can we optimise schemes to maximise production and minimise impacts?
- How much energy can we exploit before impacting the Earth System?



Examples of collaborative research

- Distribution of marine mammals & pelagic ecology in high current areas
- Detection probability of acoustic recorders to monitor bottlenose dolphins
- Behavioural response study of marine mammals in relation to MRE activity
- Wake characteristics of Tidal Energy Converters and device-environment interactions
- **Phase optimization of Welsh MRE developments (including lagoons) to provide balanced baseload generation to the UK grid**
- Wave-current interaction and analysis of impacts on the tidal resource
- Effect of man-made structures (e.g. wrecks) on ecology in high current areas
- Tools for assessment of impact & benefits of Marine Renewables on fish assemblages

The problem – industry pull

Energy sector needs information & evidence

Information needs:

- Site selection
- Seabed bathymetry
- Resource availability
  - Intermittency
  - Multi-decadal variability
- Habitat vulnerability
- Coastal morphology
- Policy compliance

The evidence must be:

- Based on sound science
- Underpinned with reliable quality assured data
- Transparent and auditable (from data to decision)
- Able to withstand legal scrutiny
- Collected efficiently and cost effectively

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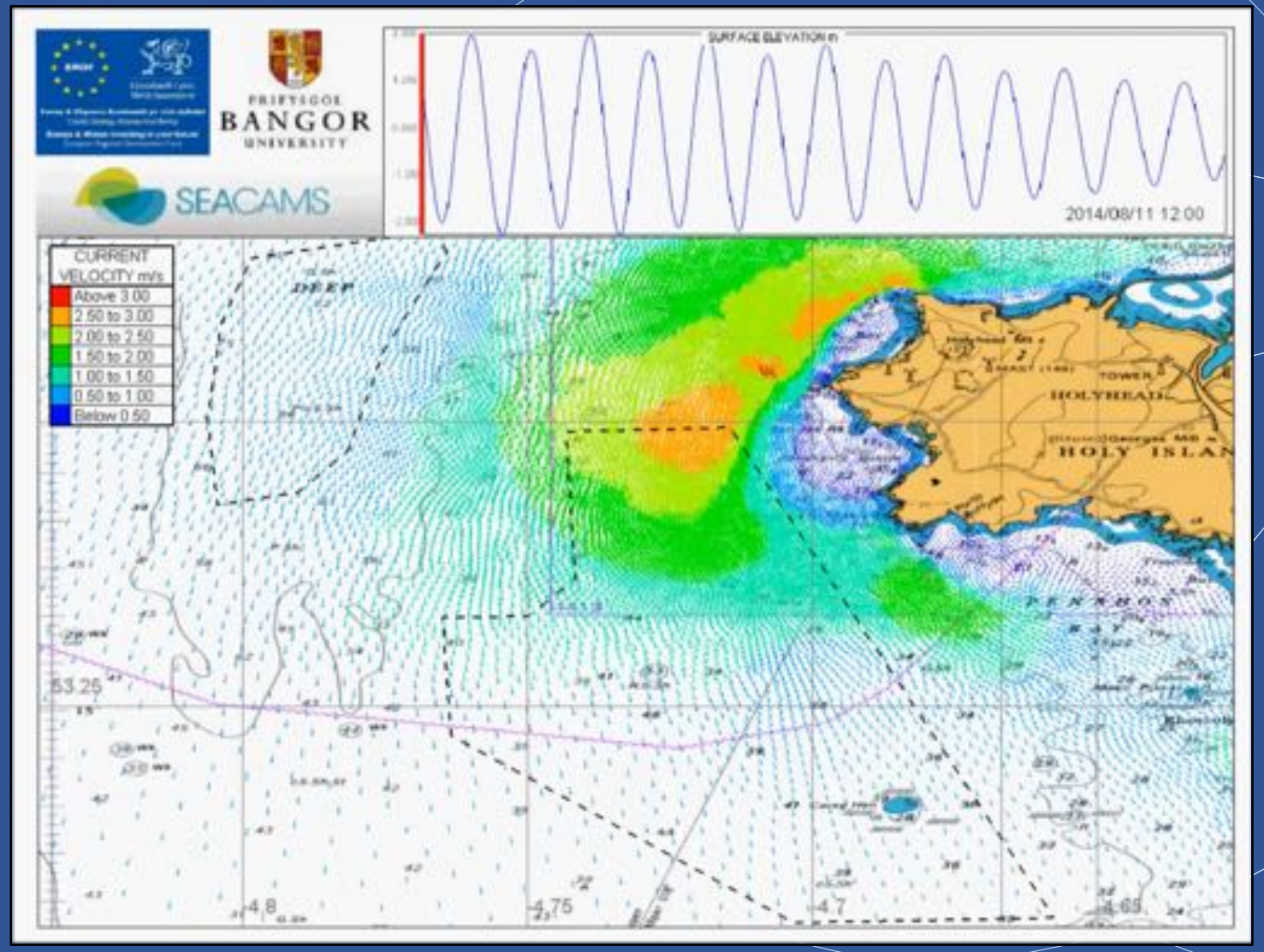
The age of observation & simulation

- Modern science
  - Data- and compute-intensive
  - Integrative, multi-scale
- Multi-disciplinary collaborations to address complexity
  - Individuals, groups, teams, communities

Tidal current measurements and predictions

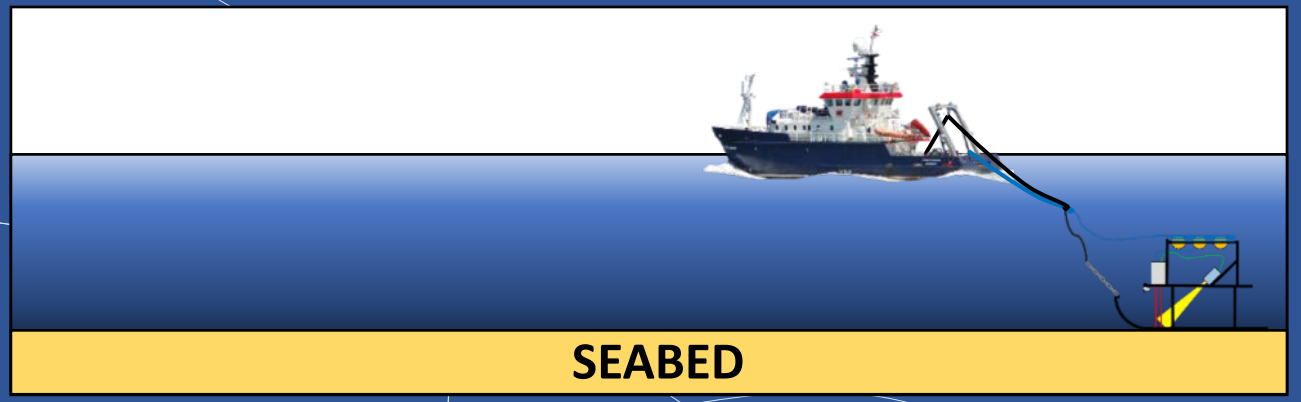


- Quantify the hydrodynamic resource
- Optimising turbine location
- Assessing environmental impacts

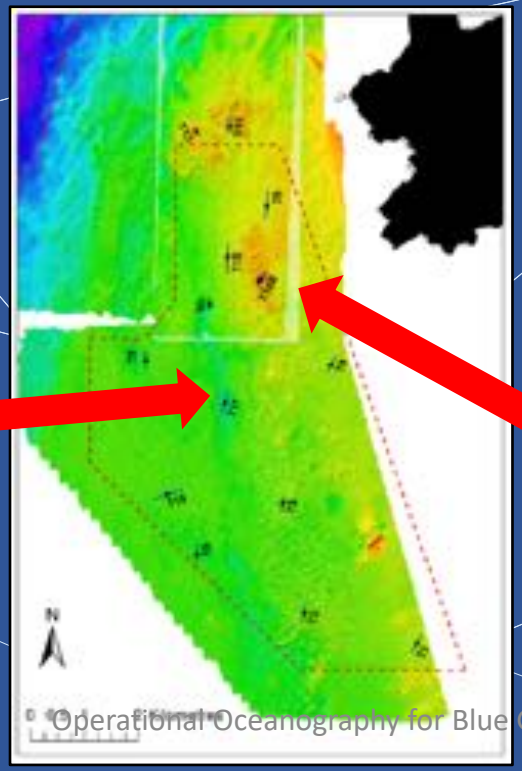
ADCP - Seabed mounted fixed point high frequency measurements of depth resolved current speeds and direction

Seabed habitat observations

Imaging of rocky seabed habitats typical of tidal energy development sites

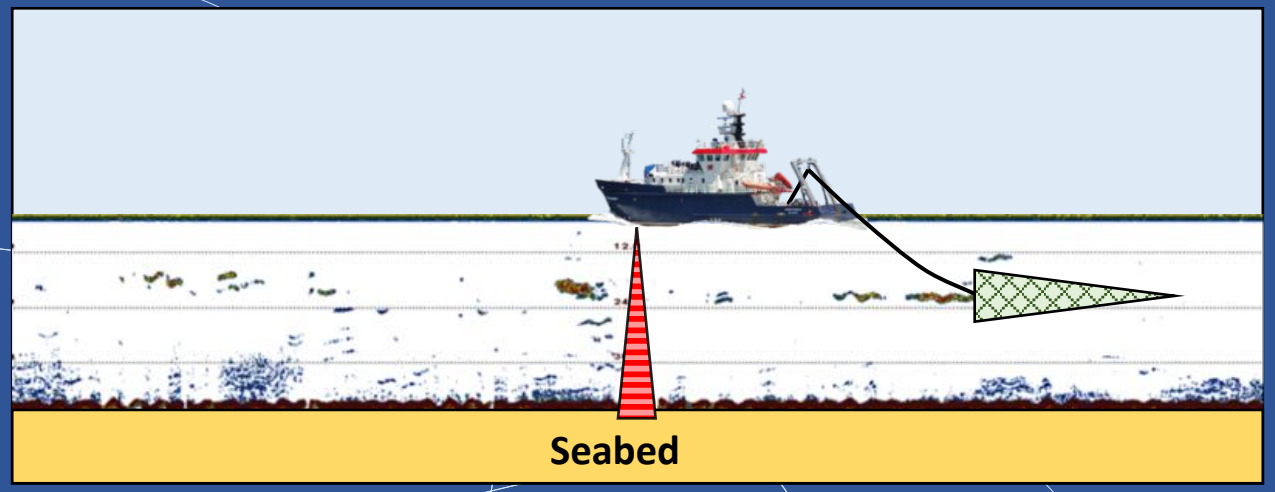


Observations from Morlais West Anglesey Demonstration Zone for tidal marine renewable energy



Ecological observations

- Marine renewable energy (MRE) devices have actively moving parts
- How will MRE devices interact with the environment and the biota?
- Acoustic devices in the ships hull and nets determine intermediate and higher trophic level abundance and distribution (time, space, depth).



Examples of SEACAMS information products and use

Information product	Requirement
Marine mammal (presence, absence)	Kill quotas for MRE schemes
Bedload transport	Cable siting
Sediment/contaminant studies	Baseline for environmental impact studies
Subsurface geotechnics	Foundation design
Tidal range, water level	Resource characterisation
Wave height and period	Wave regime characterisation (model calibration & validation)
Tidal current (power)	
Multibeam acoustics (bathymetry)	Inputs to models that support multiple requirements

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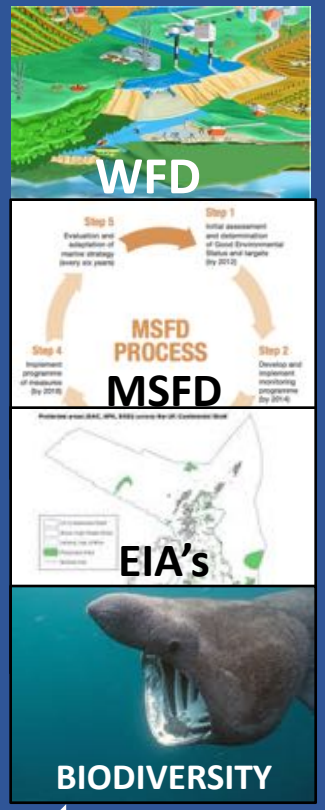
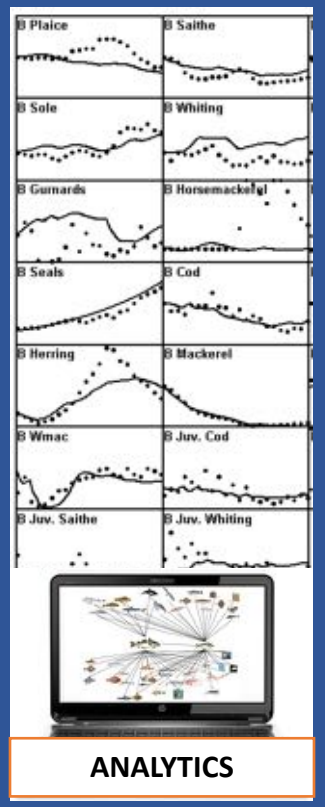
Engineering a solution to a problem

Decision | Evidence | Information | Data

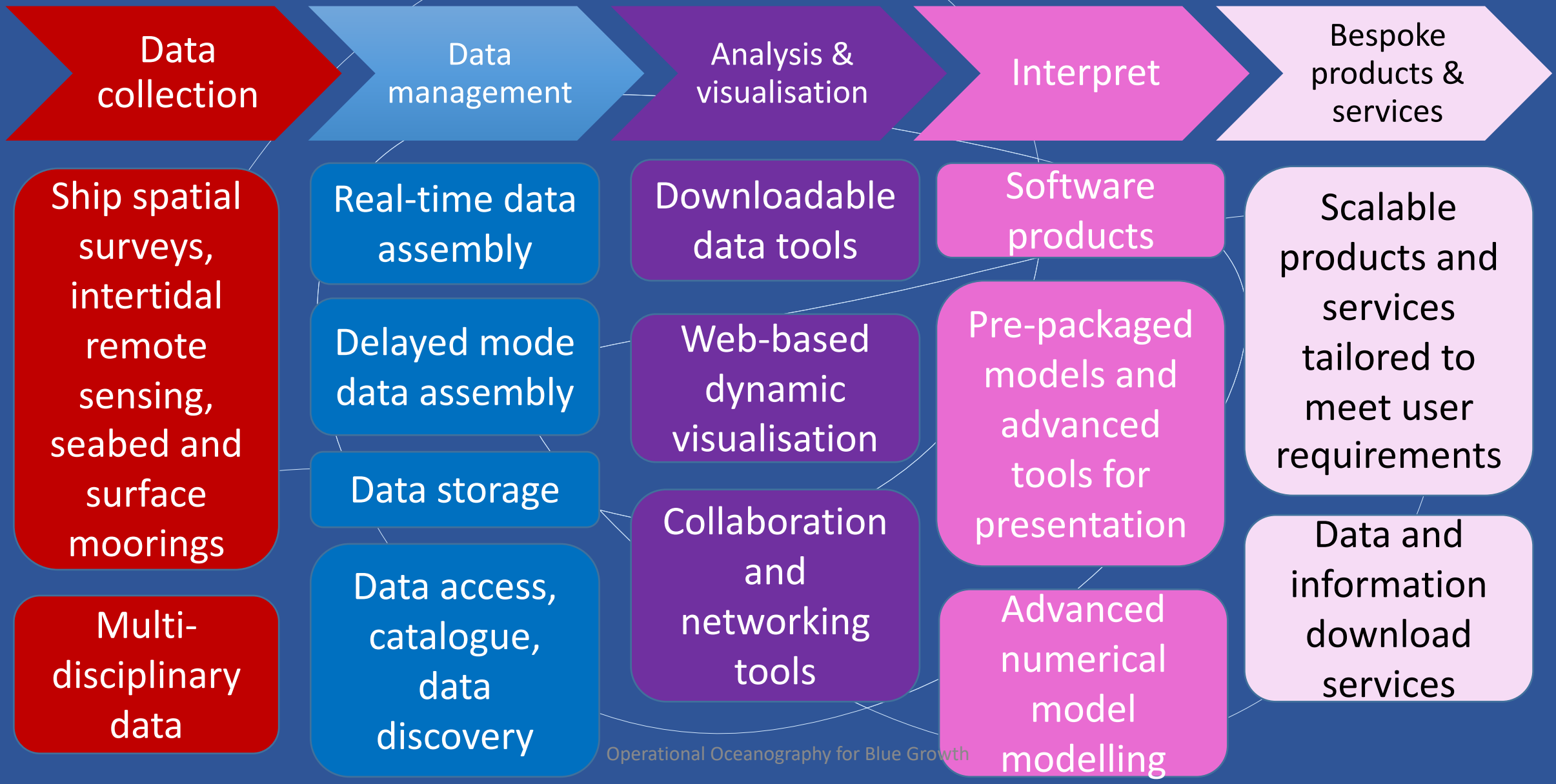
Actions



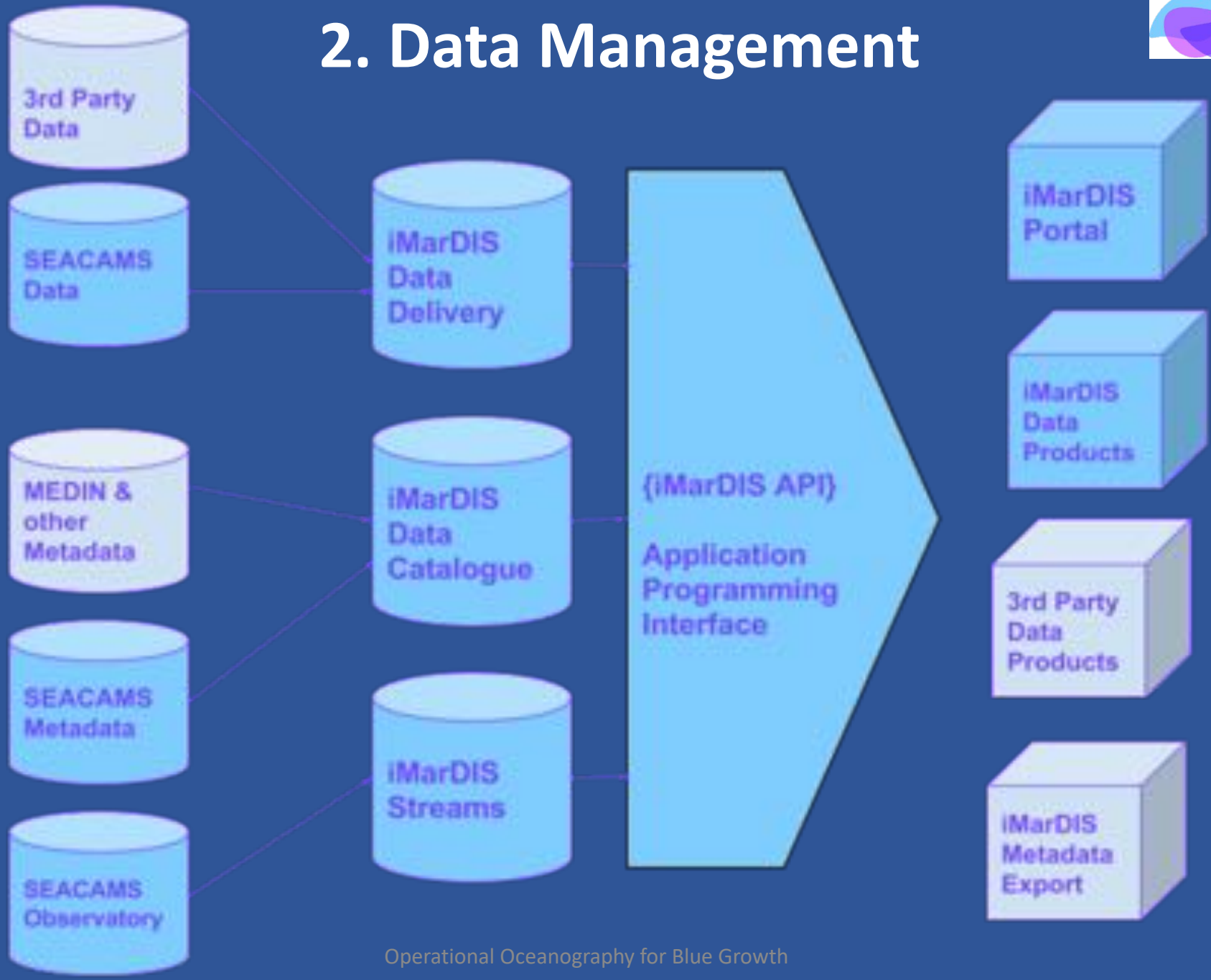


ROBUST, TRANSPARENT, REPEATABLE, & EFFICIENT

iMarDIS Scope

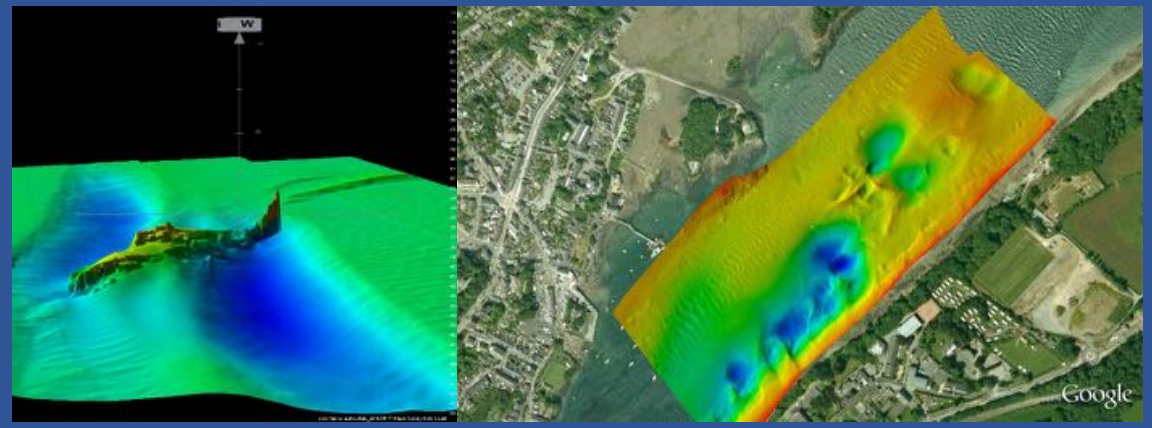


2. Data Management



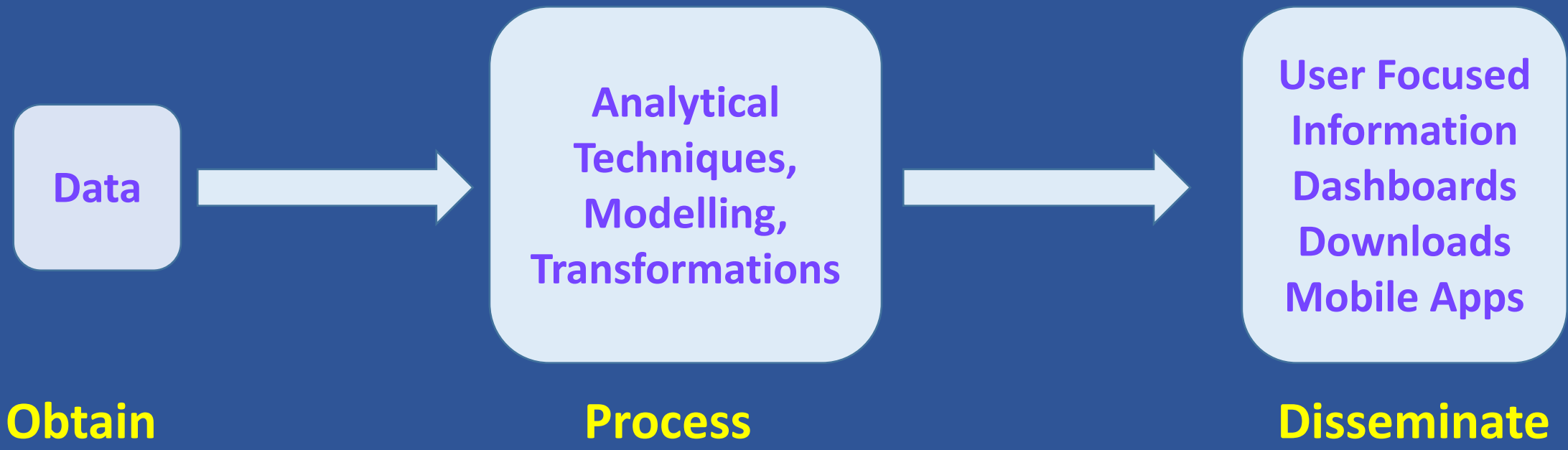
3. Visualise Data

Location data



Time series data

4. Products and Services



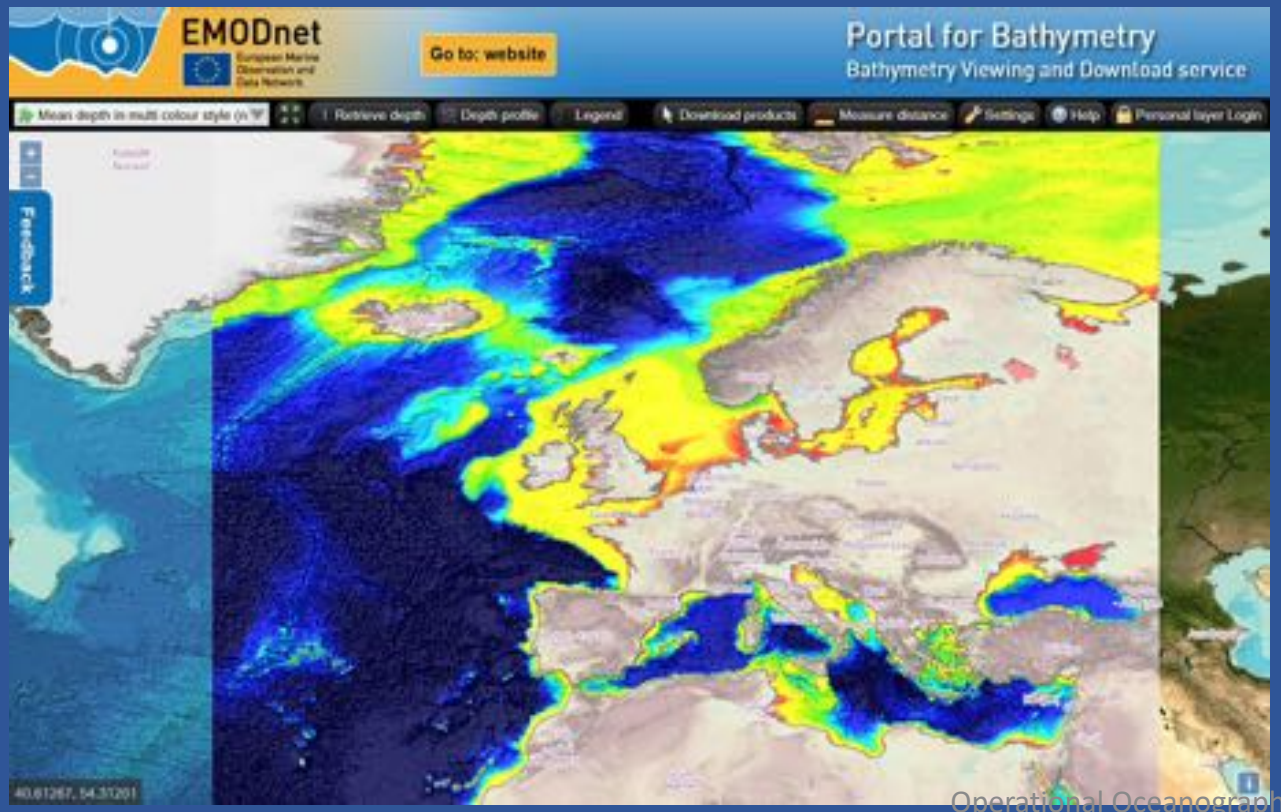
Example product

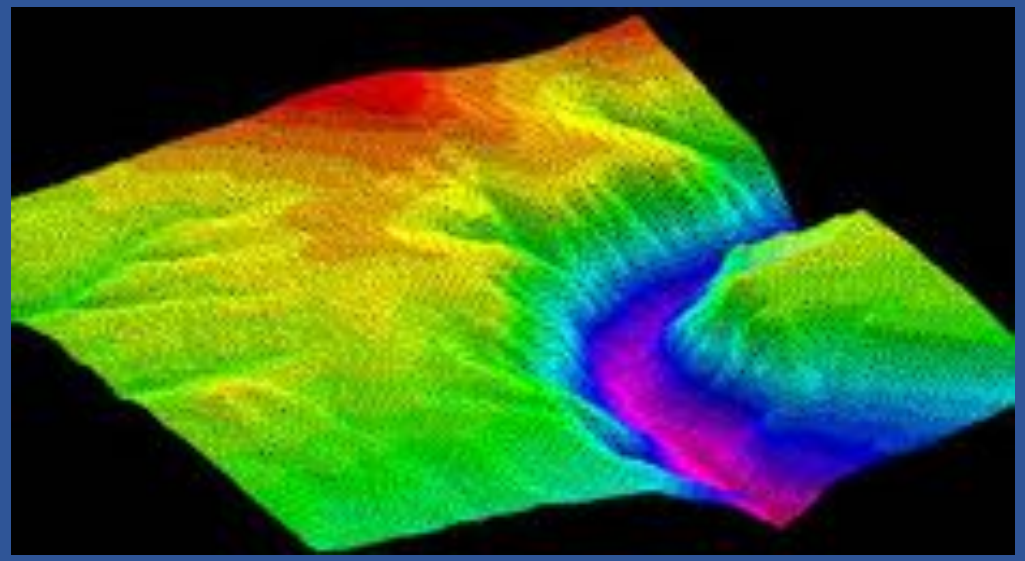
Digital Terrain Map (Derived Data Product)

One informative terrain map to replace a patchwork of files

Data available from EMODNET and GEBCO

Fine resolution bathymetry available from SEACAMS





Data Selection Algorithm

Automated production of hybrid DTM (variable resolution)

For illustration purposes only!

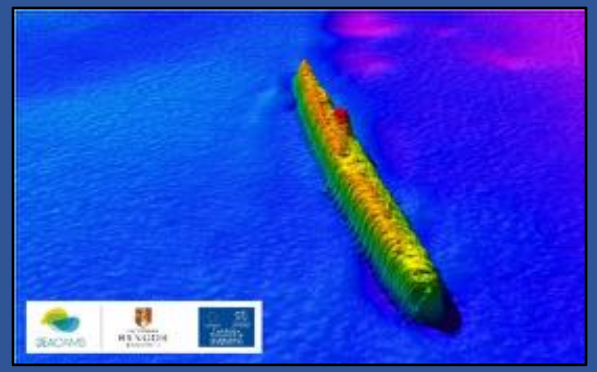
e-Infrastructure for Smart Irish Sea Toursim (e-INSIST)

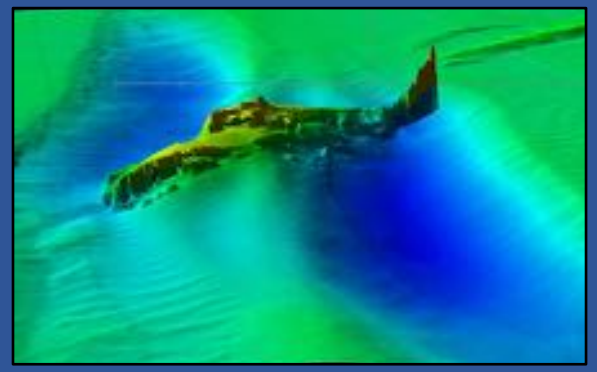
- New EU funded programme (Wales-Ireland)
- Aim to increase visitor numbers (repeat visits, lengthen stays) and drive economic growth in the tourism sector
- How
  - Cross-border collaboration with a focus on sustainable exploitation of natural and cultural heritage of Irish Sea and bordering coastal areas
  - Digital products providing (i) quality and novelty, (ii) remote accessibility and ease of use, and (iii) incorporation of visitor experience via direct digital feedback from users
  - User driven design – tourism SME's, governmental bodies (Visit Wales), industry bodies…….

E-INSIST proposed application

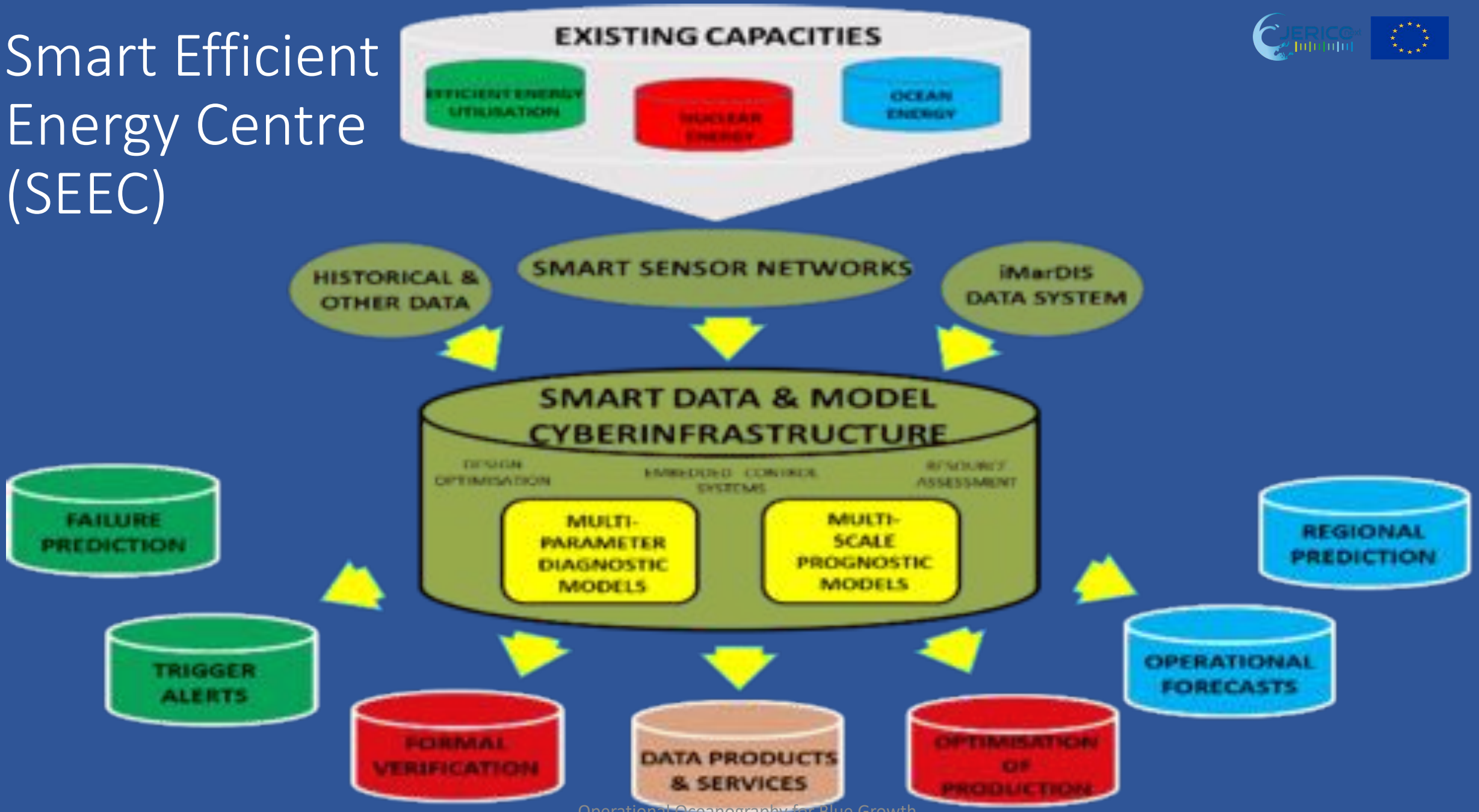
'iSea' – making the invisible visible

SS Derbent, an oil tanker sunk by U-96 in November 1917 off North Anglesey; and U-87, sunk on Christmas Day 1917, rammed by HMS Buttercup at 20+ knots which sliced off the end (this piece is small and slightly further south), just after sinking the SS Agberi (en route from Dakar, no casualties, multibeam image also available). All 36+ crew of U-87 were lost.





Smart Efficient Energy Centre (SEEC)



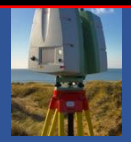
iMarDIS - Integrated Marine Data and Information System

Data

Intertidal

Spatial offshore survey

Moorings







Data transmission

Delayed mode

Delayed mode

Real-time

Real-time

Data upload interface

Data storage

NRW

BGS

BODC

iMarDIS Database

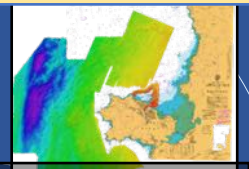
EMODnet

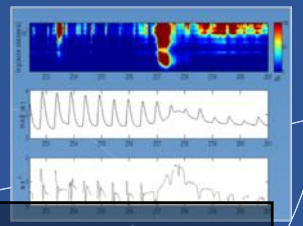
Copernicus

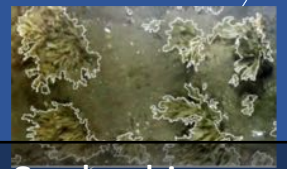
Model results

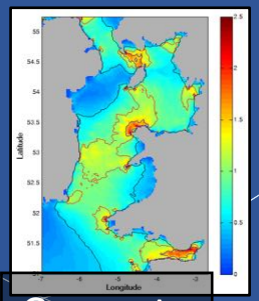
Analytics and visualisation

Information


Bathymetry


Particle size


Seabed image


Currents

User Query

Application

Policy Compliance

Licensing

Environmental Impact Assessment

Resource assessment

MRE Site selection

Planning

Operational management

Tourism

Decision taker

ACTION

Operational Oceanography for Blue Growth

Summary and conclusions

- De-carbonising European Economies through MRE – tidal stream, wave energy and tidal power
- Adoption of innovative data intensive science techniques within SEACAMS critical to meet user needs
- iMarDIS will provide a state of the art data and information management system designed to meet end-user needs
- iMarDIS design facilitates multipurpose applications and an enabling infrastructure to underpin new cross-disciplinary collaborations
- Collaborative approach between science and business sector is key to maximising impact and effectiveness of investment
- De-risking business decisions through application of oceanography