



# **Applied Simulations and Integrated Modelling for the Understanding of Toxic Algal Blooms**



# IBIROOS HAB Objectives

The overall product would be improved predictive skills of HAB initiation, development and dispersion based on understanding the physical forces underlying the areas of bloom development

Construction of HAB species datasets from monitoring stations and oceanographic cruises carried out in IBIROOS area

Compilation of other relevant datasets (temperature, salinity, upwelling indices, stratification, species growth rates, current measurements, satellite images, etc)

Identification of specific HAB situations to be used for modelling purposes

Identification of specific circulation patterns favouring bloom initiation, development and dispersion; retention areas, fronts, etc

Development of coupled physical-biological models for the main species that cause toxicity in IBIROOS area especially for those that seem to be subject to along-shore mesoscale transport and exhibit large interannual variability (e.g. *Dinophysis acuta*, *Karenia mikimotoi*)



# ASIMUTH Project Rationale



The early warning of severe harmful algal blooms would provide the opportunity for fish and shellfish farmers to adapt their culture and harvesting practices in order to reduce potential losses.

Using a combination of both modelling and satellite image analysis, the aim of ASIMUTH is to produce produce short-term forecasts of harmful algal events along the European Atlantic coasts and deliver warnings using mobile phone and internet technology to the aquaculture industry.



# ASIMUTH Project Rationale

A HAB forecast system requires co-operation of scientists in collaboration with regulators and stakeholders

- Knowledge of regional physical processes and HAB dynamics
  - >Oceanographers
- Select test sites where a good understanding of HABs has been established
  - >National Monitoring Programmes (NMPs)
- Select target HAB species to model
  - >Biologists
- Use all available existing resources (NMPs, in situ data, remote observation, Met data)
  - >Observational Programmes
- Develop model using historical data, validate and fine tune the model based on the outcome
  - >Modellers
- When happy with results move on to nowcasting, forecasting and delivery of results to end users
  - >Expert opinion / Communications





## ASIMUTH Implementation

**Funding Scheme** - FP 7 Cooperation -Space Theme

**Consortium** - 11 Partners

France  
Ireland  
Portugal  
Scotland  
Spain

**Start date** - December 2010  
(First meeting held in Cork, Ireland)

**Duration** - 36 months

**Funding** - €3,237,137





# Partners

1. Daithi O'Murchu Marine Research Station, Ireland



2. Marine Institute, Ireland



3. IFREMER, France



4. Instituto Español de Oceanografía, Spain



5. Scottish Association of Marine Science, UK



6. Instituto Superior Técnico, Portugal



INSTITUTO SUPERIOR TÉCNICO  
Universidade Técnica de Lisboa



7. IPIMAR, Portugal

8. Hocer, France



9. Nowcasting, Ireland



10. Starlab, Spain



11. Numerics Warehouse, Ireland



NUMERICS WAREHOUSE  
computer simulations of the natural environment

# ASIMUTH Scientific Objectives



**Objective 1.** The identification of key past events which will be re-analysed and used for training the modelling system

**Objective 2.** Incorporation of the GMES Marine Core Services (MCS) with the above selected events will be used to develop model based hindcast products. These will be used to tune the system and move towards an operational model for forecasting events.

**Objective 3.** Design of regional model systems and delivery of nowcast for specific HABs and location information, transport pathways, remote sensed data.

**Objective 4.** Population of HAB-Distributed Decision Support system (HAB-DDSS) (effectively a HAB specific Thematic Assembly Centre) from relevant data streams (phytoplankton, biotoxin, satellite, in-situ, etc).

**Objective 5:** Provision of expert interpretation of the available data by way of the web-portal which will be carried out on a periodic basis depending on risk. This assessment will be then issued via a warning system to end users.



# ASIMUTH Technical Objectives

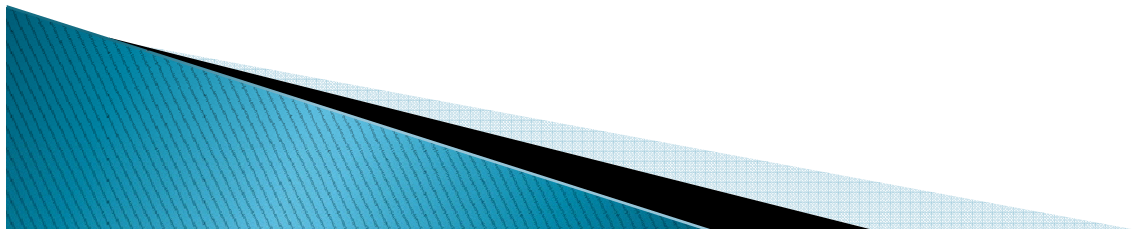
**Objective 1:** The development of model runs for Hindcasting and tuning the system with regard to various HAB species / risks and validation

**Objective 2:** Development of HAB-DDSS to assemble data from MCS and Monitoring Data

**Objective 3:** Provide feedback loop for users to connect with the project experts to comment and progress the objectives in a manner that gives most benefit to the end user.

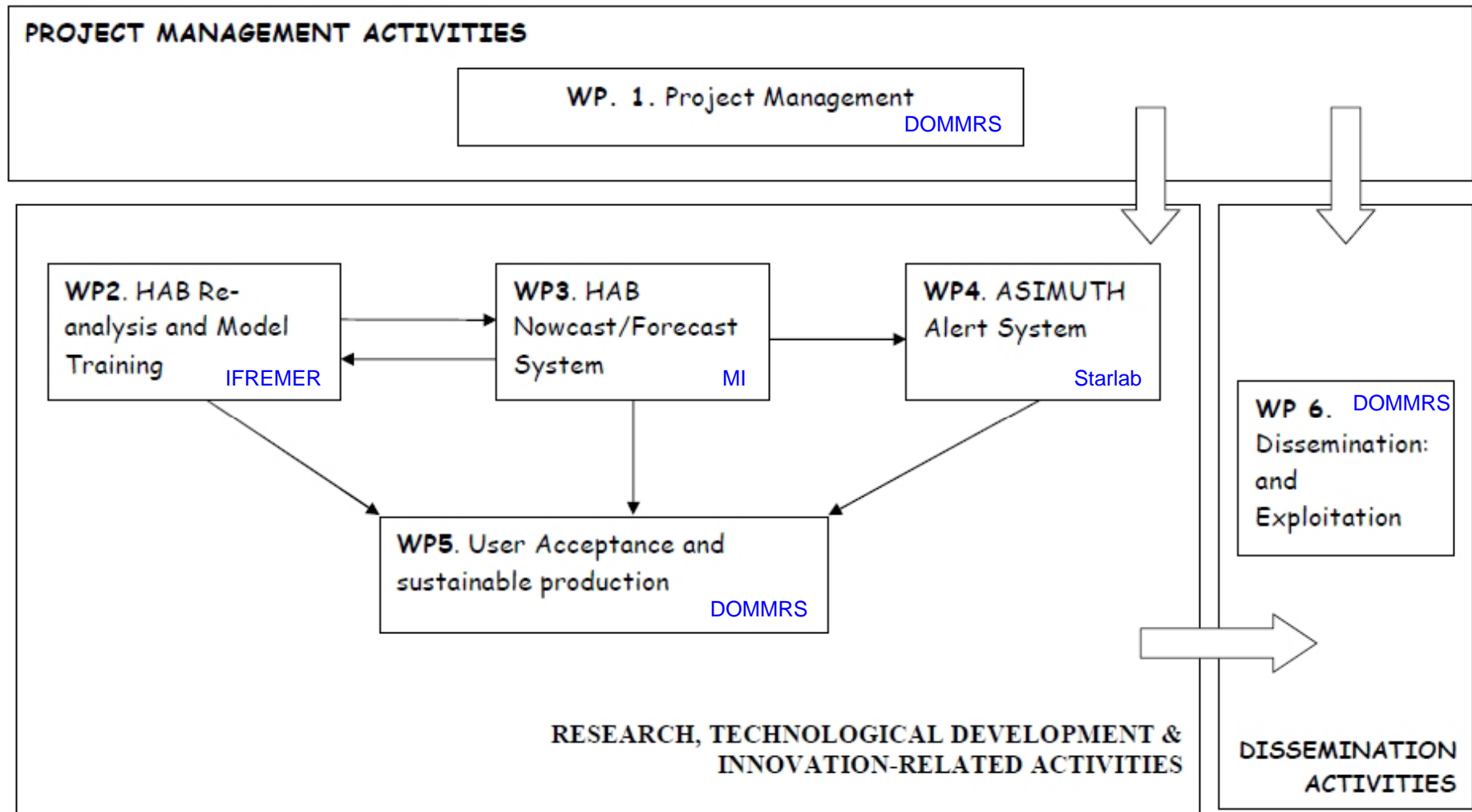
**Objective 4:** An economic assessment will provide metrics on the ability of the ASIMUTH system to mitigate risk and improve productivity.

**Objective 5:** Dissemination activities and exploitation of the project output will include Website/Bulletin Board, Conferences, Scientific publications.





# Work Packages



## Summary of Work packages

**Project Management:** This WP concerns the overall management of the project and the organisation, administration and progressing of all tasks associated with the running of the project.

**Reanalysis and Training:** Initial assignment of key areas and species for study, collate marine core service data and satellite data , develop model to run hindcast simulation, validate and fine tune model runs.

**Nowcast / Forecast:** Design of Regional VØ Model System running for specific species and location, Develop transport pathways and acquire remote and in-situ measured data which will all feed into HAB-DDSS

## Summary of Work packages

**Alert System:** Design and develop HAB-DDSS system, User acceptance testing, design of web portal to HAB-DDSS, Expert interpretation of the regional information assembled within HAB-DDSS

**User Acceptance and Sustained Production:** User requirement workshop, economic assessment to assess improved ability to mitigate risk and increase productivity, develop business model for project sustainability. Successful integration of system into current user practices and their working environment

**Dissemination and Exploitation:** Develop project Website and bulletin board, assign publicity of project and present at workshops and conferences, develop warning system and circulate industry guidelines

1.3 ii) GANTT CHART: Tasks, Project Milestones and Timetable

No.	Workpackage/Tasks	Year 1 Months												Year 2 Months												Year 3														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36			
10	Project management	MT											R	MT					MT							R	MT													
1.1	Co-ordination of the project																		M1.2																				M1.3	
1.2	Planning and task management	M1.1																																						M1.3
1.3	Co-ordination of dissemination of information																																							M1.3
1.4	Co-ordination of exploitation																																							M1.3
2	HAB reanalysis and model training																																							
2.1	ID of key HAB events and observations																																							
2.2	Choice of appropriate model				M2.1																																			
2.3	Hindcast model runs												M2.2																											
2.4	Model validation													M2.3																										
2.5	Training of model for nowcast/forecast																																						M2.4	
3	HAB nowcast/forecast																																							
3.1	Forecasting modelling system: regions																																						M3.1	
3.2	Transport pathways of HAB organisms																																						M3.1	
3.3	Nowcast of HAB using remotely sensed data																																						M3.1	
3.4	Measured HAB data nowcast																																						M3.1	
3.5	Scientific system evaluation																																						M3.2	
4	ASIMUTH Alert system																																							
4.1	HAB distributed descision support system												M4.1																											
4.2	Web portal development																		M4.2								M4.3													
4.3	Expert interpretation																																						M4.4	
5	User acceptance and sustainable production																																							
5.1	User requirements																																						M5.1	
5.2	Economic acceptance for providers/users																																						M5.2,3,4	
5.3	Exploitation of results and business model																																						M5.2	
6	Dissemination and Exploitation																																							
6.1	Website design and maintenance																																						M6.1	
6.2	Rapid warning system mechanism																																						M6.1	
6.3	Scientific dissemination																																						M6.1	
6.4	Development of industry guidelines																																						M6.2	
6.5	Publicity																																						M6.1	

M= Milestone R = Report MT = Meetings

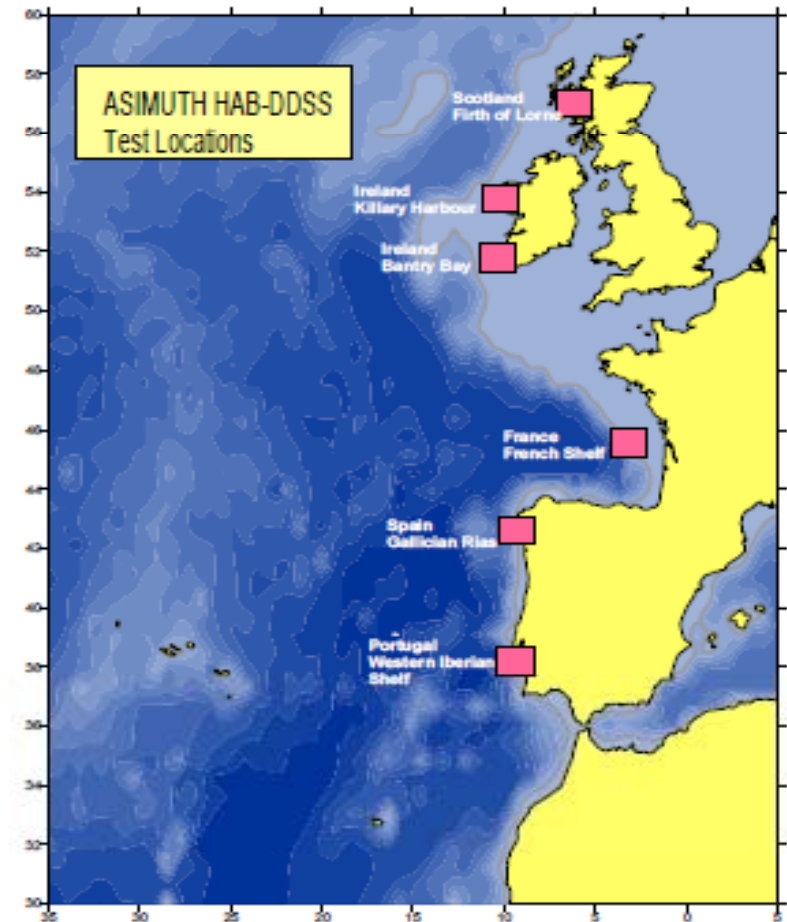
# Key sites



Test sites will be selected on the basis of locations where there are existing HAB events with defined impacts.

The locations will also be decided upon on the basis of data availability.

Indicative sites have been suggested by the project partners as suitable locations for implementations of HAB Distributed Decision Support System (DDSS) and ASIMUTH test sites.





# Past Events

## List of selected toxic and harmful algal events in NE Atlantic waters

Location	Organism type	Toxin group	Bloom Extent (geographic)	Year	Bloom Duration (months)
Portugal	<i>Gymnodinium catenatum</i>	PSP toxins	Lisbon Bay to Galician Rias	2005	early Sep - Jan 2006
Portugal	<i>Gymnodinium catenatum</i>	PSP toxins	Setúbal Bay to Porto	1994	Sep - Dec
Portugal	<i>Gymnodinium catenatum</i>	PSP toxins	Sagres to Setúbal Bay	1995	Oct - Nov
Portugal	<i>Lingulodinium blooms</i>	Yessotoxins	SW Iberia	2005	Jul - Aug
Portugal & NW Spain	<i>Gymnodinium catenatum</i>	PSP toxins	IBERIA	2005	late Oct - early Nov
Portugal & NW Spain	<i>Dinophysis acuta</i>	DSP toxins & Pectenotoxins	IBERIA	2005	early Oct - early Jan 2006
NW Spain	<i>Dinophysis acuminata</i>	DSP toxins	Galician Rias	2005	May - Jun
NW Spain	<i>Dinophysis acuta</i>	DSP toxins & Pectenotoxins	NW Iberia	2005	Oct - Dec
NW Spain	<i>Gymnodinium catenatum</i>	PSP toxins	NW Iberia	2005	Oct - Jan
NW Spain	<i>Dinophysis acuminata</i>	DSP toxins	NW Iberia	2010	Jul - Oct
France	<i>Dinophysis acuminata</i>	DSP toxins	NW France	2004	May - Jul
France	<i>Dinophysis acuminata</i>	DSP toxins	N & NW France	2005	
France	<i>Dinophysis acuminata</i>	DSP toxins	SW, NW & N France	2006	
Ireland	<i>Karenia mikimotoi</i>	Ichtyotoxins	W Ireland	2005	May - Jun
Ireland	<i>Karenia mikimotoi</i>	Ichtyotoxins	SW Ireland	2005	Jul
Ireland	<i>Dinophysis acuminata</i>	DSP toxins	SW Ireland	2005	May - Sept
Ireland	<i>Dinophysis acuta</i>	DSP toxins & Pectenotoxins	SW Ireland	2010	May - Nov
Scotland	<i>Pseudo-nitzschia</i> spp.	ASP toxins	N and W Scotland	2010	May - Oct
Scotland	<i>Karenia mikimotoi</i>	Ichtyotoxins	W & NE Scotland	2006	Aug

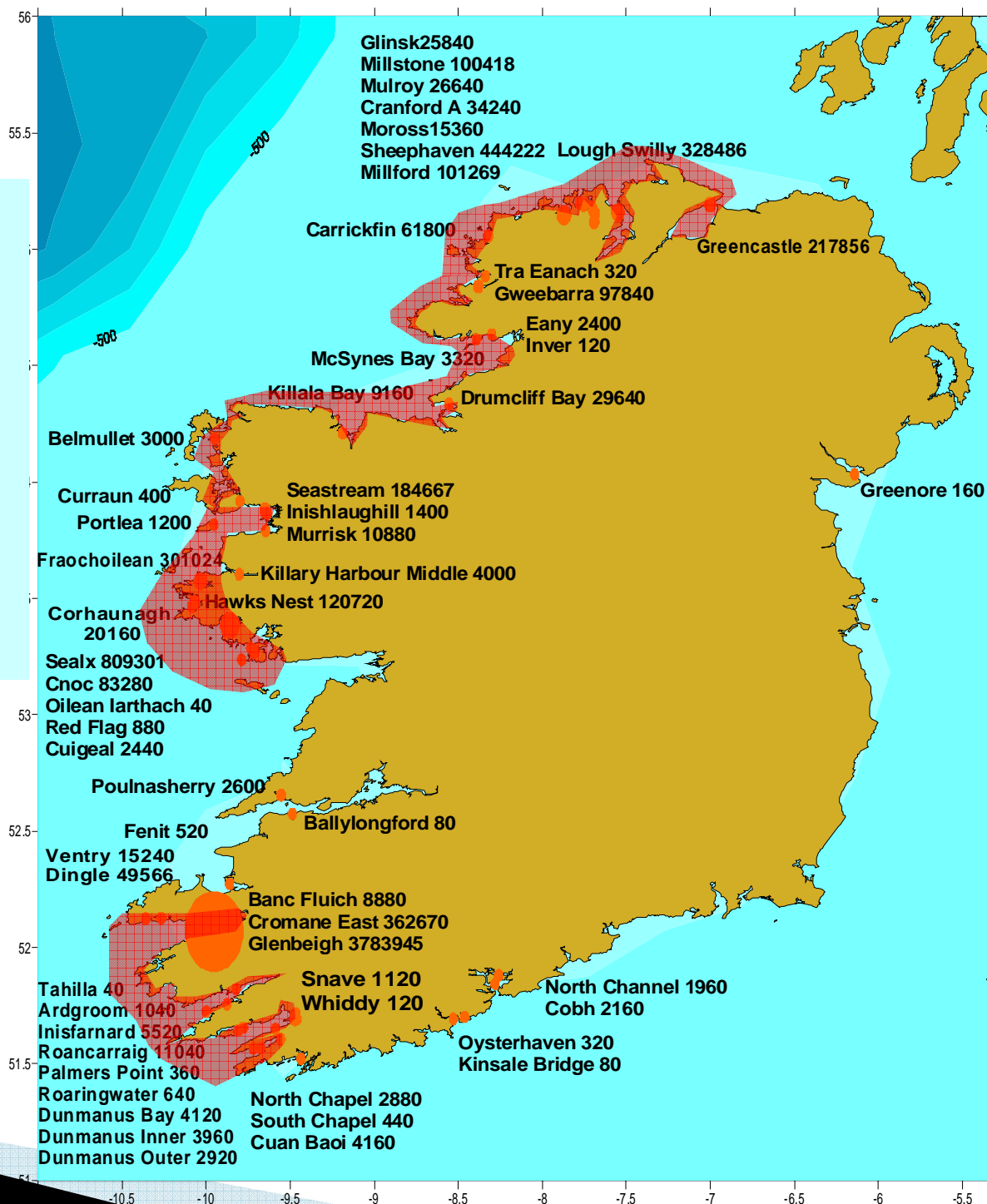
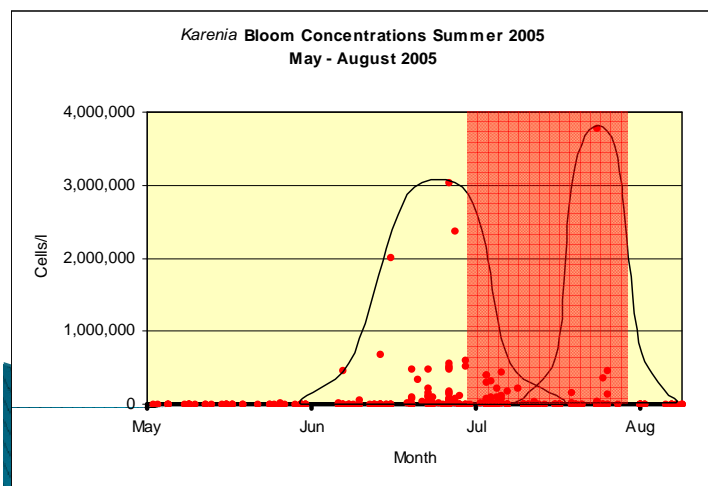
# Irish example: Karenia mikimotoi – 2005

First bloom in May-June 2005 off west coast and later in northwest

Bloom decreased in the north west over the month of July

Second bloom in South west in July

3,783,945 cells/litre Glenbeigh



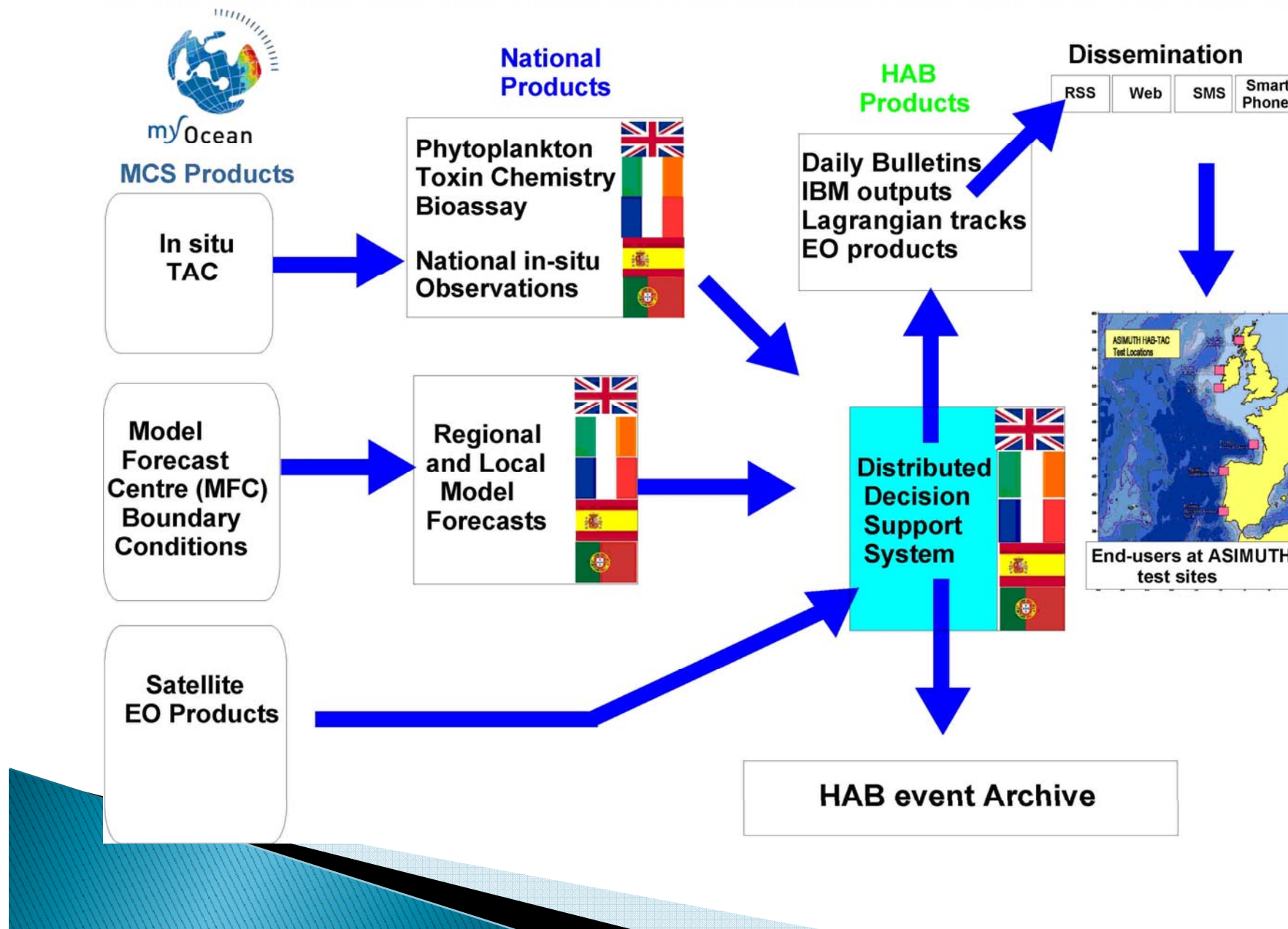
## ***Karenia mikimotoi* bloom, 2005**

**Widespread mortalities of marine fauna due to anoxia/toxicity:**  
wild fish, farmed fish, benthic fauna (e.g. sea urchins and lugworms)





# HAB Distributed Decision Support System



# Dissemination - Example

Example of an existing HAB operational forecast system (HAB-OFS) run by NOAA (US National Oceanic and Atmospheric Administration )

## NOAA HAB News bulletin

1. information on the location, extent, and the potential for development or movement of harmful algal blooms in the Gulf of Mexico.
2. The forecast system relies on satellite imagery, field observations, models, public health reports and buoy data to provide the large spatial scale and high frequency of observations required to assess and predict bloom conditions, location and movements.
3. HAB conditions reports, including potential impacts for the next 3–4 days, are posted to this Web page twice a week after confirmation of a HAB, and once weekly during the inactive HAB season. Additional bloom analysis is included in the HAB Bulletin that is provided to state and local coastal resource managers in the region.

