Eur*OCEAN* 2010: Grand Challenges for Marine Research in the next Decade
Ostend, Belgium, 12th – 13th October 2010.

New Innovations in Marine Science and Technology:
Emerging Technologies ..... Converging on the Oceans

With acknowledgements to Prof John Delaney, University of Washington

Mr Geoffrey O'Sullivan
Marine Institute
Ireland

Marine Institute
Foras na Mara

EurOCEAN 2010

Thermae Palace (Oostende, Belgium, 12-13 October 2010)

Challenges – how to:

- feed a growing world population ?
- reduce overfishing?
- harness Renewable Ocean energy ?
- reduce anthropogenic impacts on the seas and oceans ?
- produce reliable climate change scenarios/forecasts to advise mitigation and adaptive strategies?
- promote innovation (Europe 2020 Strategy/Innovation Union)?

URGENCY

There are 1.2 billion people that are under nourished in the world today

World Food Programme

Opportunities

- Feed a growing world population
- Reduce overfishing
- Harness Renewable Ocean Energy
- Reduce anthropogenic impacts on the seas and oceans
- Produce reliable climate change scenarios/forecasts to advise mitigation and adaptive strategies
- Promote innovation (Europe 2020 Strategy/Innovation Union)

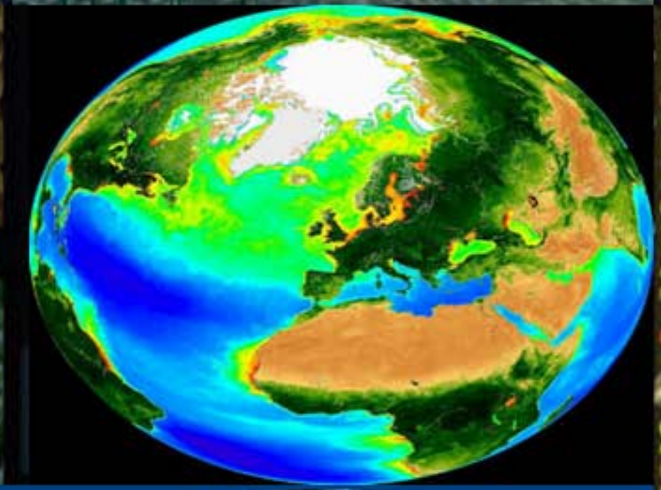
Human Appropriation of Net Primary Productivity

MEDICINE

RENEWABLE OCEAN ENERGY

ROBOTICS

NANOTECH



ECOGENOMICS

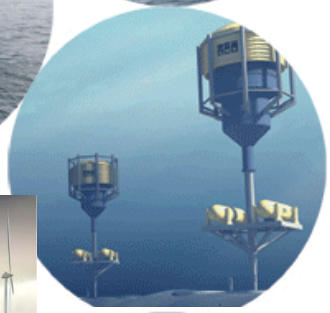
GRID/CLOUD COMPUTING

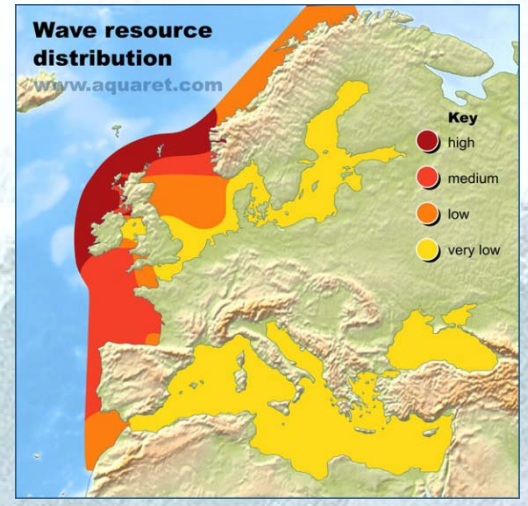
BIODIVERSITY

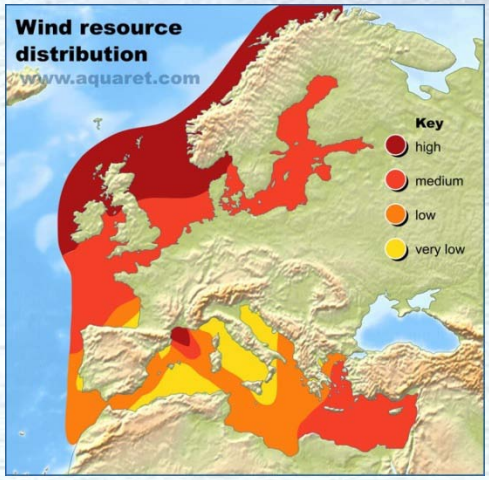
DIGITAL IMAGING

Renewable Energy from the Sea:

Security of Supply – Reduction in CO2 – New Employment opportunities

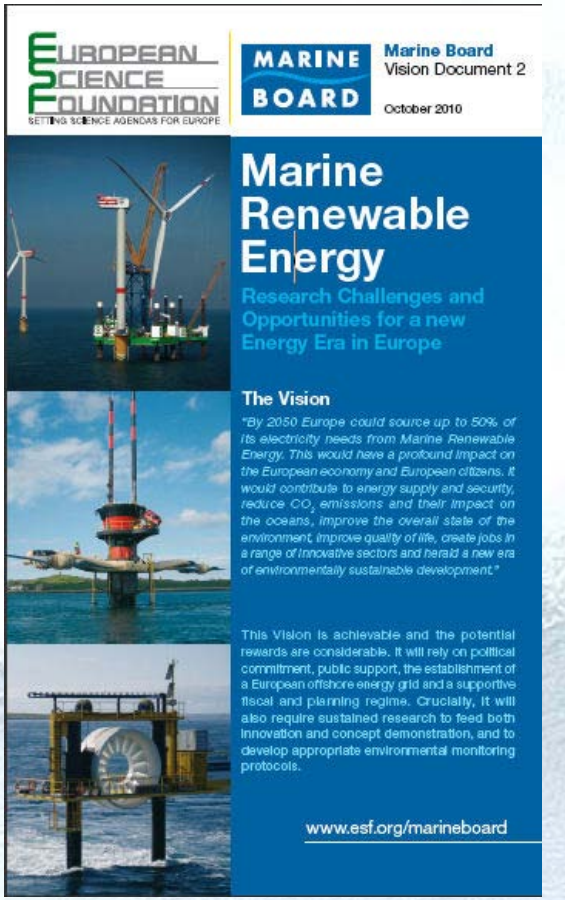






Renewable Energy from the Sea:

Security of Supply – Reduction in CO2 – New Employment opportunities



By 2050 Europe could source up to 50% of its electricity needs from Marine Renewable Energy. This will have a profound impact on the European economy and European citizens. It will contribute to energy supply and security, reduce CO_2 emissions, improve the state of the environment, improve quality of life, provide incentives for a range of new innovative jobs and herald a new era of environmentally sustainable development.

What has Marine Science done for Medicine?

- What has Medicine done for Marine Science?

Extract of the horseshoe crab's blood is used by the pharmaceutical / medical device sector to ensure that their products, e.g., intravenous drugs, vaccines, and medical devices, are free of bacterial contamination.

And then there's the Squid and its Giant Nerve Fiber

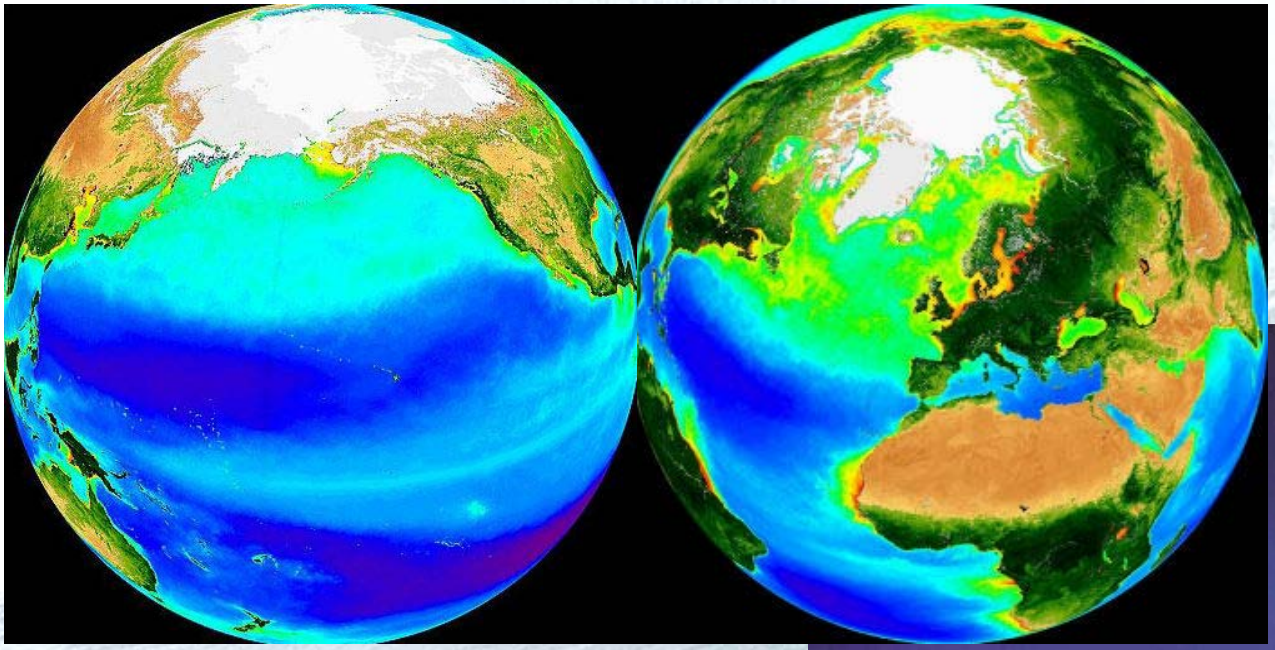
http://www.horseshoecrab.org/med/med.html

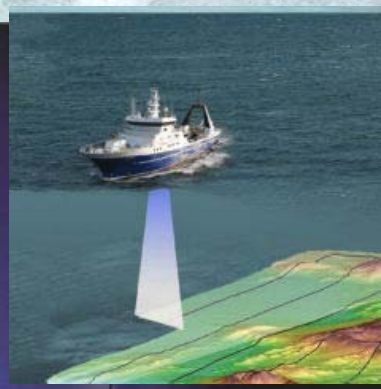
Medical CT and MRI Scanners now being used to determine impact of Noise Pollution on Cetaceans

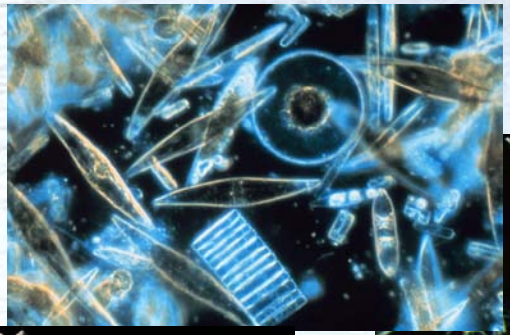
http://jeb.biologists.org/cgi/content/full/209/15/2902

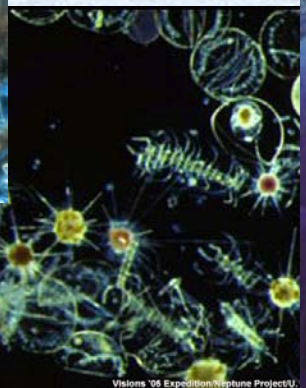
Digital Imagery

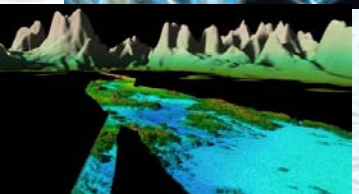
From the Macro View to the Micro View and all stages in between

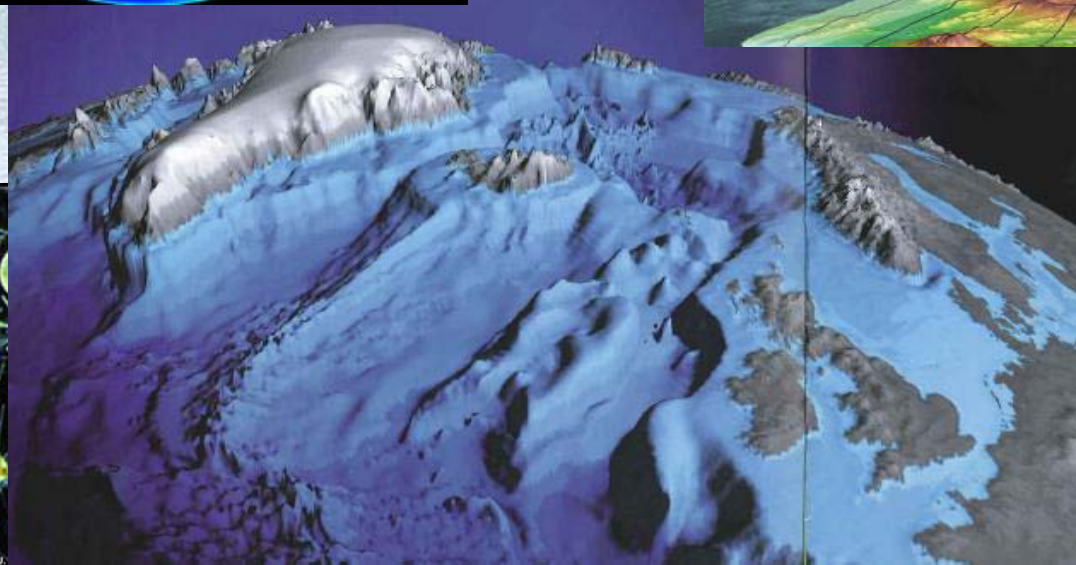




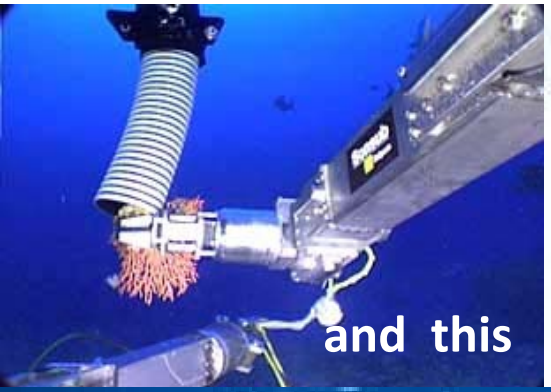


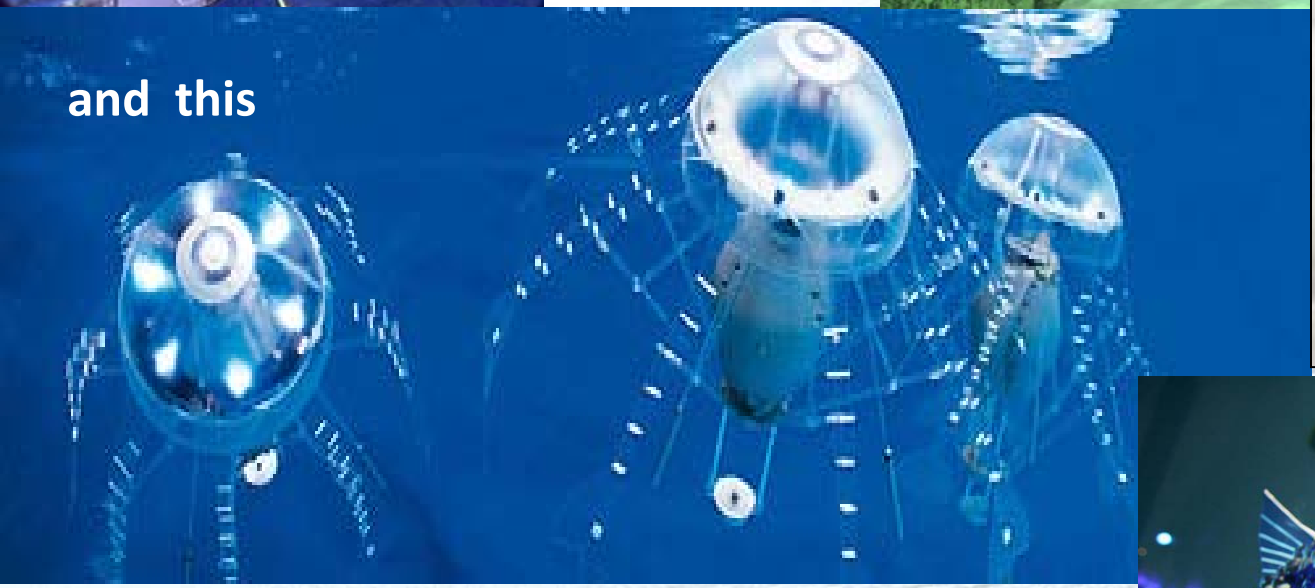






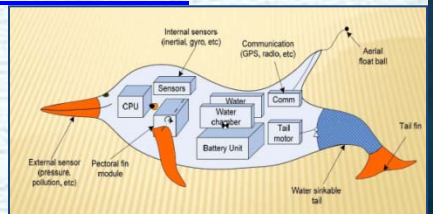
ROBOTICS

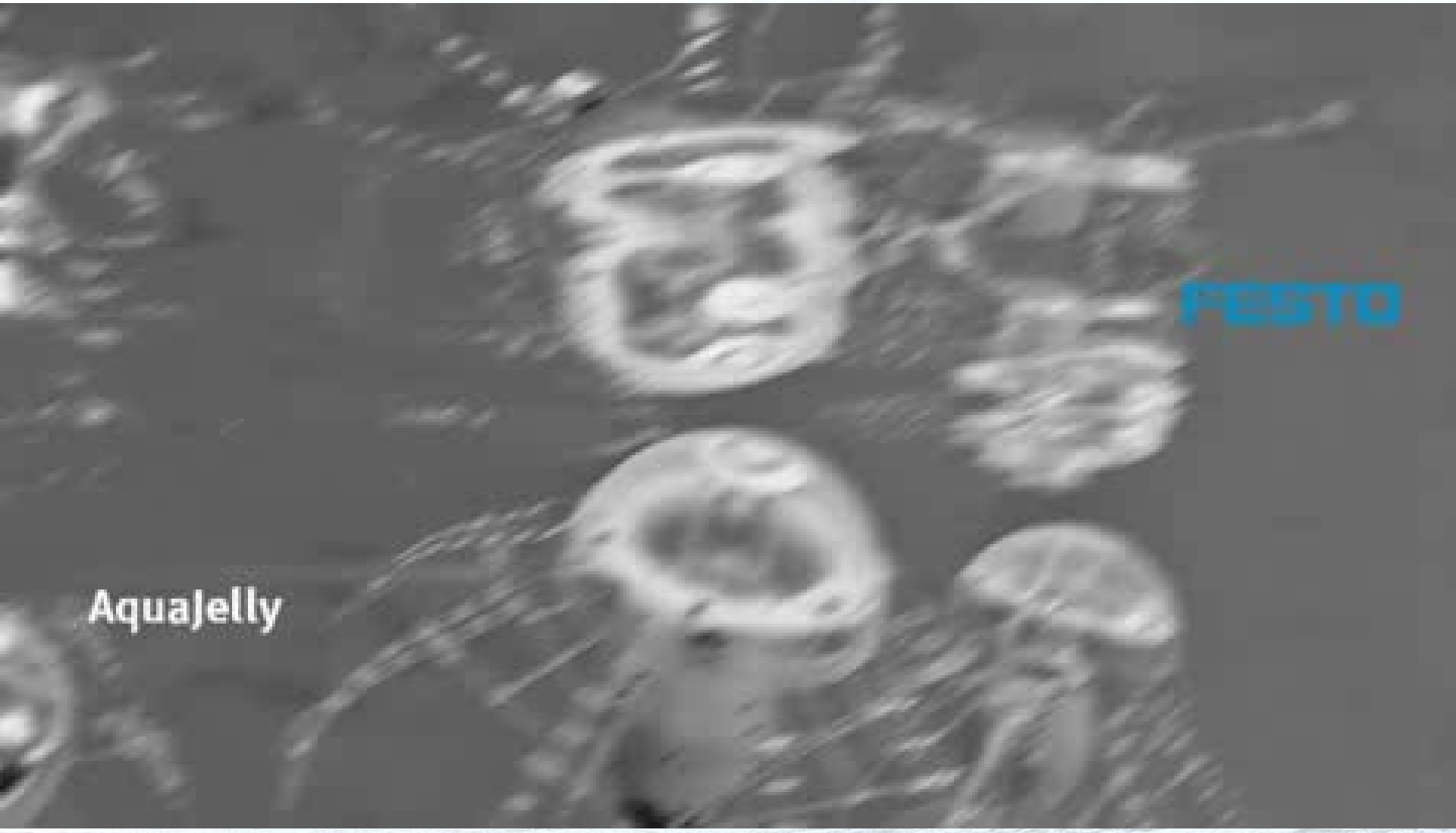




www.festo.com/cms/de_de/5889_6297.htm

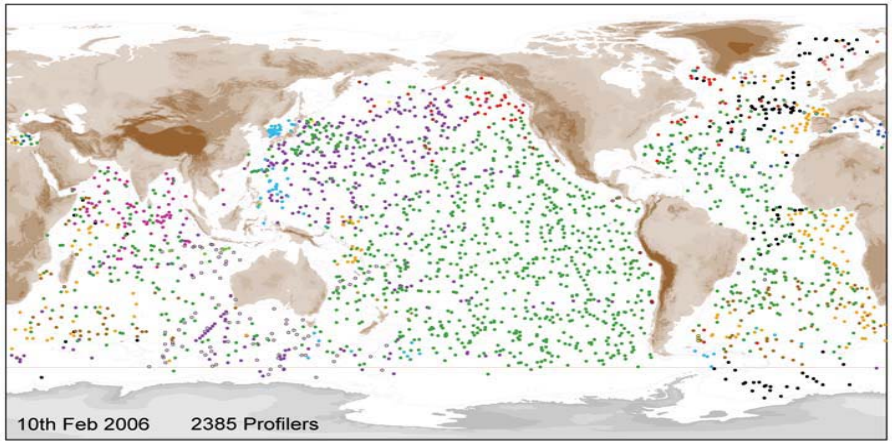
FP7 SHOAL Project



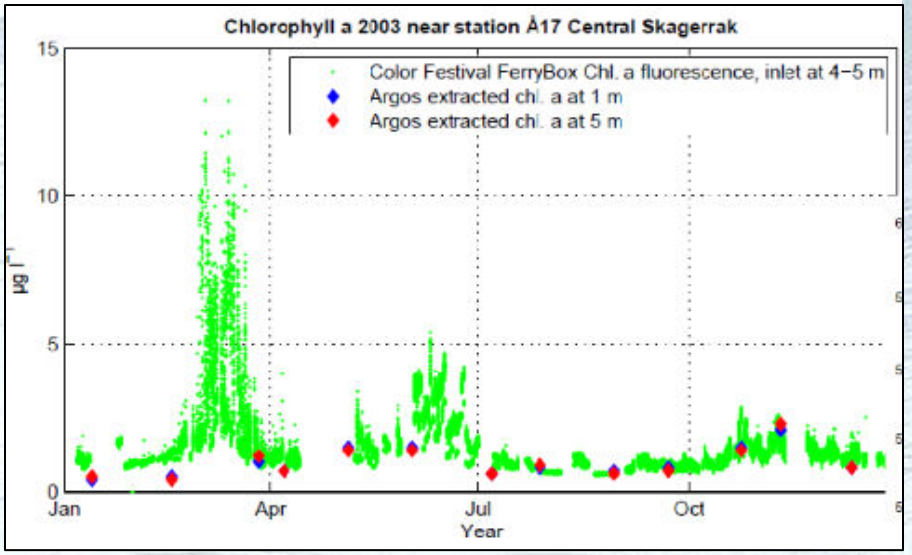

FESTO
AquaJelly

Computing Power: Grid/Cloud Computing

Crunching the BIG numbers

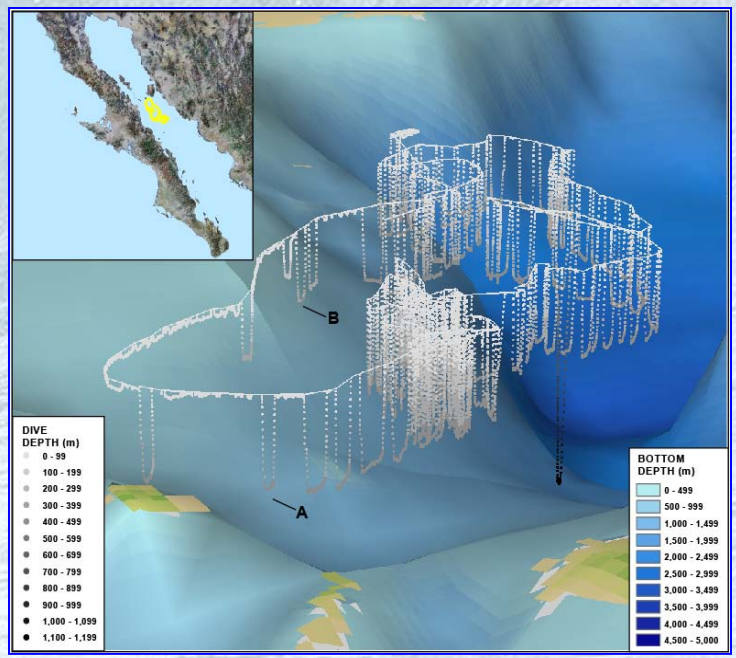


Argo Floats: Profiling the Earth's Oceans

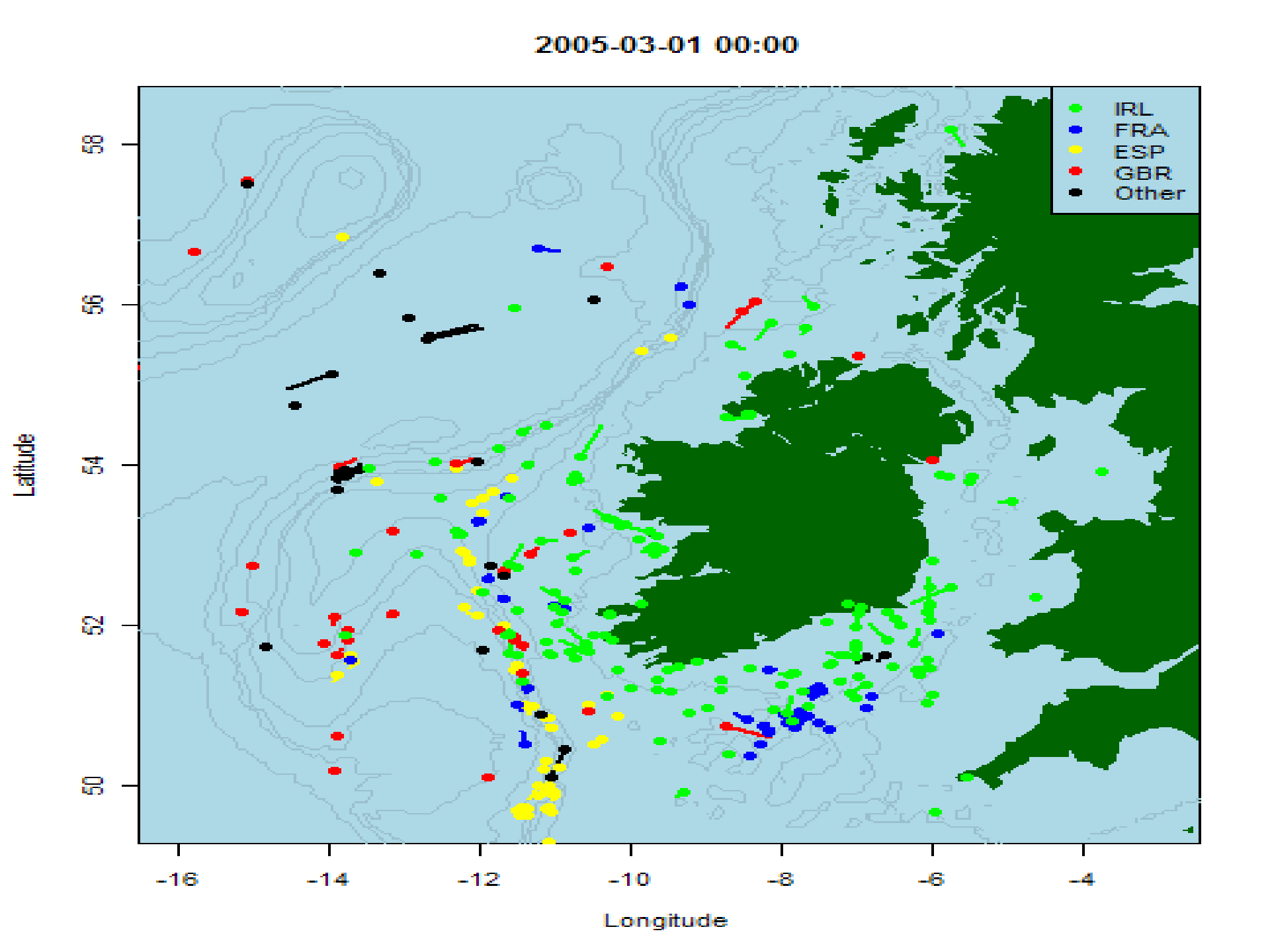


Analysing continuous data sets : H.Dahlin/2nd MB Forum 2010

Climate Change Scenarios



Tracking tagged animals


2005-03-01 00:00
IRL
FRA
ESP
GBR
Other
Latitude
58
56
54
52
50
-16
-14
-12
-10
-8
-6
-4
Longitude

Deep Ocean

OCEAN OBSERVATORIES

Shelf and coastal seas

Satellites
Active and passive sensors:
enable measurements of ocean surface parameters (SST, wind, sea level height, sea state, sea ice, ocean colour) and of the geoid
Data gathering (e.g. from drifter, Argo profilers)
www.esa.int

Ocean reference sites
Wide variety of variables
Time series
Surface to full ocean depth
www.oceansites.org

Moored buoys arrays
Surface meteorology, SST, SSS, SLP
Ocean T, S V profiles
www.meteo.shom.fr/egos

Argo profiling float array
T, S profiles every 10 days
V at ~2000m
www.ifremer.fr/euro-argo

Gliders
Provide long path T, S and vertical water velocity with depth
www.locean-ipsl.upmc.fr/gliders/EGO/

Autonomous underwater vehicles
Sensors include compasses, depth sensors, sonars, magnetometers, thermistors and conductivity probes

Remote operating vehicles
Includes benthic landers and corers
Sampling of the deep ocean and sea bed

Ship of Opportunity Programme
Repeat XBT line network measuring temperature profiles
www.jcommops.org/soopip/

Sustained and repeated ship-based hydrography and carbon network
Research ship full depth T, S & carbon profiles
Identified lines
www.ioccp.org

Volunteer Observing Ship (VOS) fleet
Surface meteorology, SST
VOSClim
Includes extensive ship metadata
www.jcommops.org/sot
Carbon VOS
pCO_2 and surface T&S
www.ioccp.org

Satellites
Remote sensing of shelf sea ecosystems
www.esf.org/research-areas/marine-board/publications.html

Sea ice observations
in situ and remotely sensed
www.damocles-eu.org

Oil and gas platforms
Meteorological data

Shelf and near-shore moorings; coastal observatories
SST, SSS, S, V profiles
Chemical and biological sampling
Coastal HF radar networks

Ferry box
Measurements include:
SST, SSS, oxygen, nitrate, sound velocity, fluorescence, light, redox levels, PH, dissolved organic material, turbidity, chlorophyll
www.ferrybox.org

Surface drifter array
Surface V, SST, SLP
www.meteo.shom.fr/egos

Research vessels
Discrete sampling
e.g. T,S, biology, chemistry
www.gosud.org
www.iode.org
www.eurocean.org
www.ioccp.org

Tide gauges networks
Sea level
Regional and national
www.gloss-sealevel.org

Continuous plankton recorder
Measures ecology and biogeography of plankton
www.sahfos.ac.uk

Drifters, autonomous vehicles, gliders, ROVs
Measurements include temperature, salinity, velocity, biogeochemistry, positional and other information, depending on vehicle

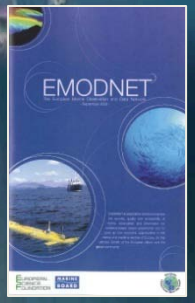
Cable networks, ocean transport measurements.

Acoustic doppler current profilers
Moored or ship-based

Coastal zone monitoring
Land and sea-based instrumentation
Physical, biological and chemical sampling
Sediments

Key

SST	= Sea surface temperature
SSS	= Sea surface salinity
SLP	= Sea level pressure
T	= Temperature
S	= Salinity
V	= Ocean current data
pCO_2	= Partial pressure of carbon dioxide
XBT	= Expendible bathy-thermograph

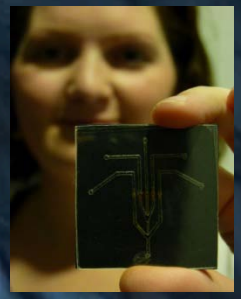


GOOS illustration modified for Plymouth Marine Laboratory by glynn@gorick.co.uk

www.ioc-goos.org

ECOGENOMICS

Lab-on-a-chip



OutReach:
Telepresence - Connectivity - Education

www.turtle.ie

Emerging Technologies ..... Converging on the Oceans

Medicine

Nano Sciences

Space

ICT

Transport

Energy

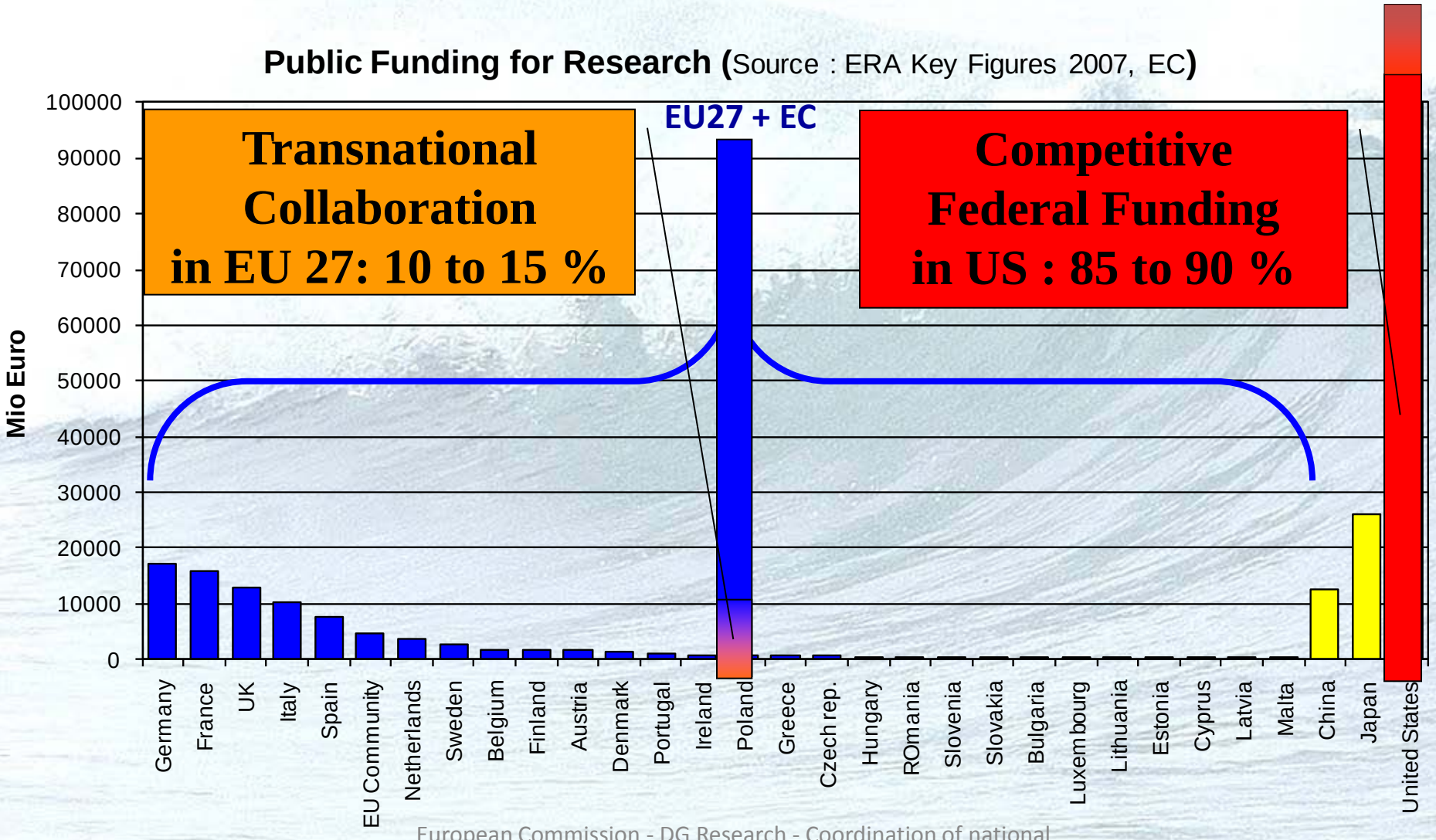
Genomics

Life Sciences

Socio-Economics

Engineering

A Fragmented European Research Area



Finally Innovations that changed the World.

The Wheel

The Printing Press

Radio-TV-Internet

Marine Sector

The Sextant

The Shipping Container

Acoustic Sounder

Radar

GPS

?

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Thermae Palace (Oostende, Belgium, 12-13 October 2010)