DRAGONESS Project
WP 5
Capacity Building

Part 5.3: The European Perspective

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Overview

This presentation provides an overview about capacity building in Europe with respect to marine remote sensing concerning the issues addressed by GMES / GEOSS:

- Protection against natural and human-induced disasters,
- Understanding of the environmental sources of health hazards,
- Management of energy resources,
- Response to climate change and its impacts,
- Safeguard of water resources,
- Improvement of weather forecasts,
- Management of ecosystems,
- Promotion of a sustainable agriculture / fishery,
- Conservation of biodiversity.

GMES is the Global Monitoring of Environment and Security Program of the European Community. It is part of GEOSS, the Global Earth Observation System of Systems.

Definition of Capacity building

- The term *Capacity building* is used in slightly different ways. Here we summarize definitions, as provided in Wikipedia:

- ***The process of equipping individuals, organisations, institutions or society at large with the understanding, skills and access to information, knowledge and training, as well as infrastructure that enables them to develop and perform effectively, sustainable and safe on a regional and global scale.***

- So we have to ask here, what is the role of marine remote sensing to contribute to these tasks and how is capacity building organized and performed concerning marine remote sensing for these tasks.

Key Requirements for Capacity Building

- Operational assimilation of marine remote sensing data into numerical models, such as:
  - the assimilation of maps of suspended matter into suspended matter transport models, or
  - Combination of plankton distribution maps with drift models to forecast the advent of potential HABS at mariculture sites.
- Combination of
  - remote sensing data, automatic observations from fixed stations, drifting buoys and ship of opportunities (FerryBoxes)
  - with numerical models
  - to achieve a synergistic and integrated information system with web services.
- Introduction of remote sensing into operational services
- Definition and computation of uncertainties on a pixel by pixel basis
- Training and Education

Organisation of capacity building in Europe in general

- Capacity building is organized and funded in different ways on all levels from local communities, provinces, states and on the level of common European institutions.
- Funding by the European Commission or by ESA is dedicated in most cases only to international consortia.
- This rule has forced cooperation between institutes of different countries in joint projects.
- This funding mechanisms has induced cross-education, round robin exercises, exchange of ideas and skills between countries and institutes.
- The integration of institutes and scientists of new EU member states into projects of the European science community has promoted the process to reach a joint quality level in research.

ESA‘s Elements in Capacity Building

ESA‘s Living Planet Program (related to Ocean)

- Earth Explorer Missions
  - CRYOSAT
    - precise monitoring of changes in the thickness of marine ice and variations in the thickness of the ice sheets of Greenland and Antarctica
  - SMOS
    - soil moisture and ocean salinity mission
  - GOCE
    - Gravity field and steady-state Ocean Circulation Explorer
- Scientific Programs
  - GlobColour
    - Support of global ocean carbon cycle research
  - CoastColour
    - Utilisation of MERIS full resolution data for coastal research
  - CCI ECV
    - Determine essential climate variables from satellite data

For ESA's Living Planet Program see: www.esa.int/esaLP/index.html, www.globcolour.info/, www.coastcolour.org, http://earth.eo.esa.int/workshops/esa_cci/ITT.html

GMES / GEOSS: Natural and Human-induced disasters

- Marine environment:
  - storm surges and flooding,
  - coastal protection,
  - protection of the coastal sea against oil pollution,
  - warning of harmful algal blooms
- Examples:
  - Oil pollution surveillance systems, which uses satellite data, aircraft surveys and in situ observations and samples
  - Satellite data together with in situ observations to establish electronic oil sensitivity maps (GIS)
  - Combination of radar systems from land based stations and satellites to monitor activities of cargo and fishery vessels

Capacity building is needed to integrate remote sensing in operational services as it is already the case for oil pollution surveillance

Environmental sources of health standards

- Monitoring of coastal water quality parameters with respect to recreation and swimming as well as food from the sea
- Bathing water quality (e.g. cyanobacteria)
- Maricultures (e.g. illness caused by consumption of mussels during some Red Tide plankton blooms in particular in summer months)
- Warning systems, which use satellite data, already established at some coasts in Europe
- Capacity building needs:
  - Algorithms have to be improved
  - Combination of different data (ocean colour, SST, wind) with models to be improved

Management of energy resources

- Monitoring of currents, surface wind, waves and water turbidity for
  - offshore work: drilling and production of oil and gas, installation of pipelines
  - during the construction and operational phase of offshore wind parks
  - environmental impact studies before, during and after the installation of offshore structures.
- Capacity building needed to integrate different information from remote sensors and in situ observations into models

Climate change and its impact

- Of interest are for the marine section:
  - SST -> temperature
  - Altimeter -> sea level change, currents, circulation, waves
  - Gravity field (for mass balance, glaciers, water)
  - Scatterometer -> wind, waves
  - Ocean colour -> phytoplankton -> food chain, carbon cycle, exceptional blooms and HABS occurence
- Capacity building needed:
  - Reduce uncertainties
  - Calculate uncertainties and provide uncertainty as products
  - Improve long term stability
  - Cross calibration / validation between different instruments
  - Combination with in situ data (ARGO floats and gliders)
  - Time series analysis of synergy of data

Safeguard of water resources

- Management and safeguard of fresh water resources one of the most challenging issues
- Requires continuous monitoring of water quality and water level
- MERIS FR data (300 m resolution) can only be used for larger lakes
- Hyperspectral imaging spectrometers are required with sufficient spatial resolution (< 100 m)
- Of most interest are cyanobacteria, turbidity and temperature
- HICO on board the International Space Station first experimental data (100 m resolution)
- ENMAP (launch 2013) 30 m resolution with > 200 bands in VIS, NIR, SWIR
- Water level with altimeter in „lake mode“

- Capacity building:
  - New area with little experience concerning space borne applications
  - Requires aircraft experiments, basic research, new algorithms and training

Weather forecast

- Longest tradition and experience in using satellite data and ground networks
- Assimilation of satellite data (partly) operational
- Major operational variables: water temperature, currents, surface wind and waves, clouds, aerosols and radiation
- Missing or experimental variables over ocean, where capacity building is needed:
  - Rain rates or precipitation
  - It will be studied if this can be solved using SMOS data (sensitive to fresh water on the surface / change in surface salinity)

Management of (marine) ecosystems

- Important application of remote sensing, e.g.:
  - coral reefs, mangrove forest, tidal flats, estuaries,
  - effect of mariculture on water quality,
  - coastal protection measures
  - effect of tourism on coastal habitats
  - Sensitivity maps oil pollution
- Remote sensing can provide information about the far field, which influences local ecosystems
- Capacity building is required on many levels:
  - improvement of sensors and data processing procedures,
  - determination of uncertainties and out of scope cases,
  - quality control on a pixel by pixel bases,
  - assimilation of the data into monitoring concepts and procedures,
  - acceptance by environmental authorities

Conservation of (marine) biodiversity

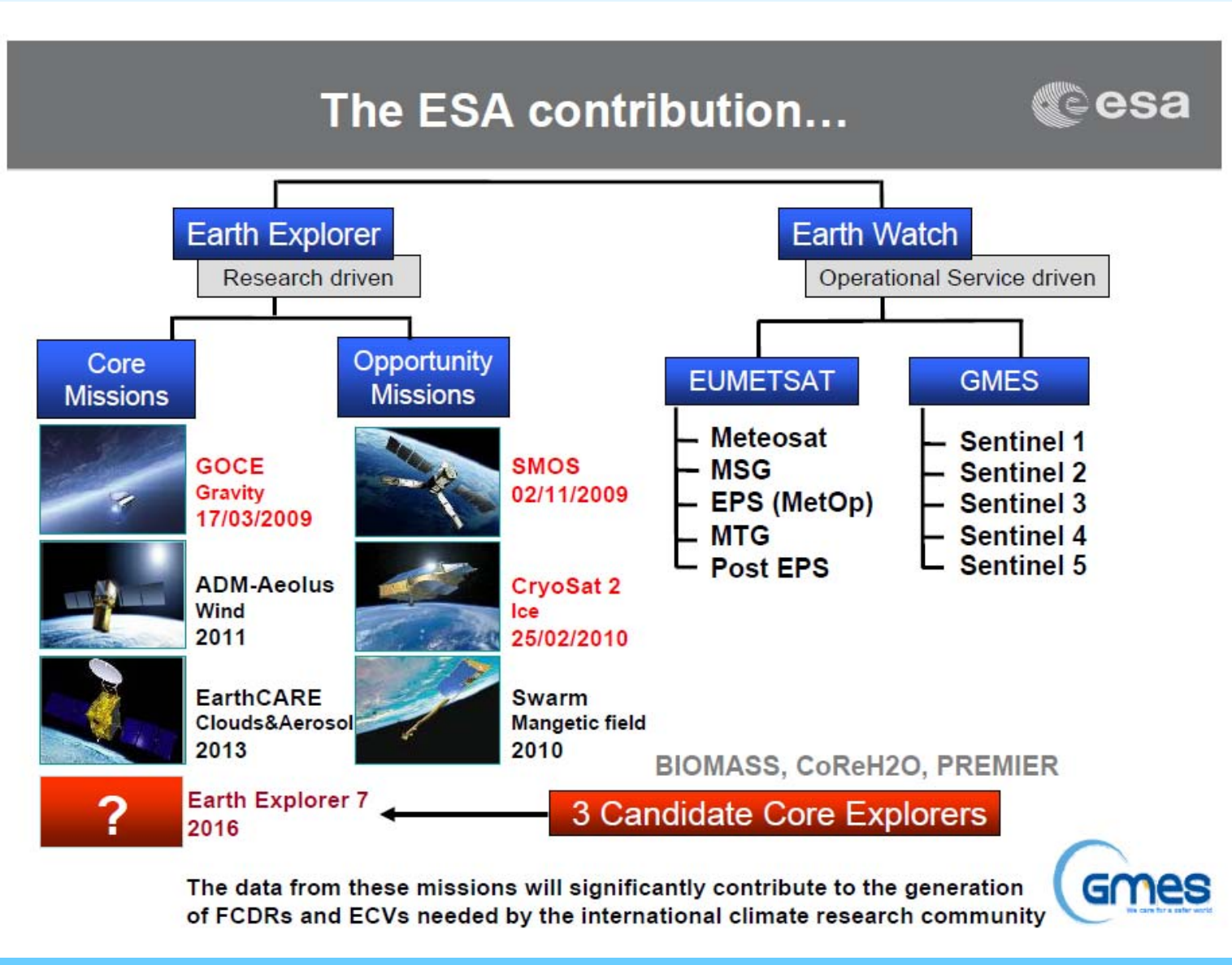
- Species cannot be observed directly
- exception
  - Some phytoplankton species or higher taxa
  - High resolution cameras (space or aircraft): counting of marine mammals, sea bird colonnies
- Remote sensing can be used as an aid
  - to protect the biodiversity of marine organisms
  - to use marine life as food in a sustainable way
- Examples
  - Reduce fishery in areas or during season, where and when endangered species are breeding or migrating
  - Example: TurtleWatch to reduce turtle bycatch in the longline fishery
  - data of SST, ocean colour, altimetry and wind have been used to locate the oceanographic habitats of loggerhead turtles in the North Pacific
- Application only partly developed, needs capacity building

European Programs

GMES: Global Monitoring of Environment and Security

- Joint program between the European Community (EC) and the European Space Agency (ESA)
- Objective is to develop and install a system and services, which provide information about our environment and elements concerning security on an operational basis
- Includes public and private entities
- Comprises in situ and remote sensing observations, modeling, information processing and consolidation, recommendations, training and outreach
- Remote sensing part is covered by ESA and partly EUMETSAT
  - includes the exploitation of data of present missions
  - development of the Earth Explorer and operational Sentinel missions
- Complementary national programs have been initiated and carried out

ESA Missions related to GMES



European Programs: MyOcean

- European Network of 61 teams with about 300 people from 29 countries
- Goal:
  - *to develop and establish a chain from observation via analysis and forecast to information for the user of the marine environment on a global scale*

- It is dedicated to the following GMES Marine Core Service :
  - Marine Safety
  - Marine Resources
  - Coastal and Marine Environment
  - Climate and seasonal forecasting
- Targeted applications:
  - Maritime security, oil spill prevention, marine resources management, climate change, seasonal forecasting, coastal activities, ice sheet surveys, water quality and pollution.

www.myocean.eu.org

MyOcean Partners

ESA: **MARCOAST**

- MARCOAST belongs to the Downstream Services program of ESA
- The MARCOAST consortium consists of 18 EU partners of 10 countries
- Provides information about European seas:
  - concentrations of e.g. chlorophyll and suspended matter, gelbstoff absorption,
  - water transparency, harmful algal blooms (HABs),
  - oil pollution
  - sea surface temperature
- All products are quality controlled and continuously monitored by an independent validation bureau
- Initial phase was funded by ESA.
- Now the project is funded in addition from a variety of different public and private sources

MarCoast Network

- Long term sustainable network of European WQ Service Providers

MarCoast2 Project

- ESRIN/ESA funded project
  - "GMES MARINE AND COASTAL INFORMATION SERVICES EXTENSION AND TRANSFER 2009 - 2012"
- 3 years project duration / 3 phases (1 year each)
- Started the 15 December 2009
- Consortium: 18 EU partners: Belgium, Denmark, Finland, France, Germany, Greece, Italy, Norway, Spain, UK
- Project lead by Thales Alenia Space France

ESA: CoastColour

- Project to fully exploit the potential of the MERIS instrument in full resolution mode for remote sensing of the coastal zone
- Product requirements have been derived from a user consultation process.
- Sites to be investigated in close cooperation with local teams are distributed all over the world.
- All data will be made online available from a Website.
- Period: 2010-2011
- Elements of CoastColour:
  - Production of MERIS FR L2 data with special advanced algorithms
  - Generation of special products required by the users
  - All data with uncertainties
  - Validation by the users
  - Round robin comparison of different user supplied algorithms
- Impact on capacity building in the field of coastal remote sensing not only in Europe but in all participating countries

www.coastcolour.org

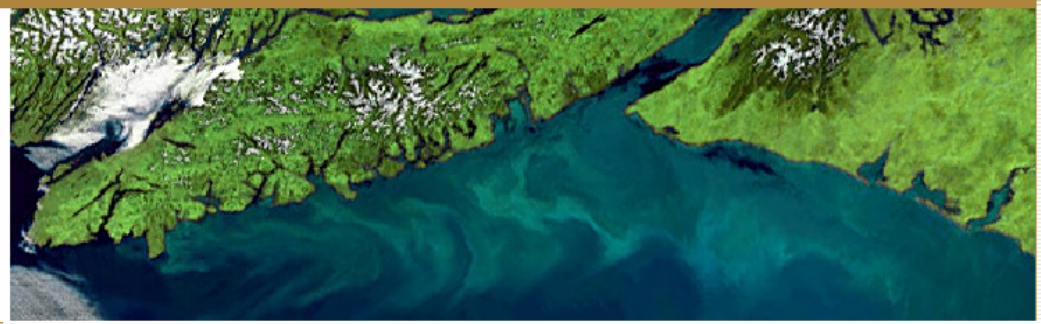
coastcolour

esa

ESA DUE Project

Brockmann Consult

| Project info | Users & Sites | Products | Publications | Round Robin | Internal | Contact |



News

April 2010
Report available

September 2010
Distribution of COASTCOLOUR data to participants of the multi-sensor Round Robin

17./18. February 2010
COASTCOLOUR presentation at SAFARI Remote Sensing and Fisheries International Workshop in Kochi, India

04.-05. 02. 2010
Kick-off meeting attended by 15 scientists and ESA staff members.

01. 01. 2010
Start of COASTCOLOUR.

16.-17. 11. 2010
User Consultation Meeting ESRIN, Frascati, Italy

The COASTCOLOUR Project

The European Space Agency has launched the COASTCOLOUR project to fully exploit the potential of the MERIS instrument for remote sensing of the coastal zone. The product requirements have been derived from a user consultation process. All data will be made online available from this Website. COASTCOLOUR is developing, demonstrating, validating and intercomparing different Case 2 algorithms over a global range of coastal water types, identifying best practices, and promoting discussion of the results in an open, public form.

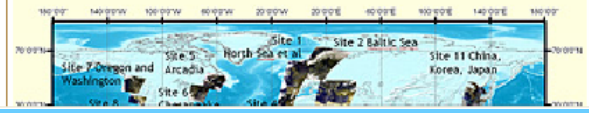
User profile: Emmanuel Devred, Bedford Institute of Oceanography, Canada
Dr Emmanuel Devred is a research scientist at Bedford Institute of Oceanography. His current research focus is on the field of bio-optical modelling, inversion of inherent optical properties, identification of phytoplankton functional types and validation (i.e., ground truth) of algorithms.

Coastal Water Challenges
The task of retrieving water optical properties and concentrations from reflections spectra in coastal waters is a complex matter. In contrast to case 1 water, where by definition, only 1 component determines the variability of the water leaving radiance reflectance, ...

The test sites.

In the description below it should be recognised that a given site is likely to have a wide range of oceanographic and hence optical characteristics and the user interest may be focussed on one small part.

North Sea, English Channel, Bay of Biscay, Celtic Sea
Baltic
Eastern Mediterranean & Black Sea
Morocco (Atlantic and Mediterranean coasts of Morocco
Acadia
Chesapeake Bay
Oregon and Washington
Plumes & Blooms
Puerto Rico
Benguela
China, Korea, Japan



ESA‘s climate change initiative (CCI)

- Initiated via the Global Climate Observing System (GCOS) and the Committee on Earth Observation Satellites (CEOS)
- Main objective is the Global Monitoring of Essential Climate Variables (ECV) using remote sensing data
- Essential climate variables concerning ocean:
  - sea ice
  - sea level
  - sea surface temperature
  - ocean colour
- Delivery of climate variables derived from all available satellite data sets (not just ESA) via international collaboration
- ESA explorer missions such as CRYOSAT, SMOS, GOCE and EARTHCARE will play a major role in understanding and quantifying climate change and in the development of future operational missions

ESA CCI

CCI Selection criteria => First 11 ECVs

Atmosphere	Surface	*Air Temperature; Precipitation ; Air pressure; Water vapour; Surface radiation budget; Wind Speed & direction;*
	Upper air	*Cloud properties* *Wind speed & direction* *Earth radiation budget; Upper-air temperature; Water Vapour*
	Composition	*Carbon dioxide Methane & other GHGs; Ozone; Aerosol Prop.*
Ocean	Surface	*Sea-surface Temp; Sea-level; Sea-ice; Ocean colour;* *Sea state; Sea-surface salinity* *Carbon dioxide partial pressure*
	Sub-surface	*Temperature; Salinity; Current; Nutrients; Carbon;* *Ocean tracers; Phytoplankton*
Terrestrial	*Glaciers & ice caps; Land Cover; Fire disturbance* *FAPAR; LAI , Albedo, Biomass, Lake levels, Snow cover, Soil moisture* *Water use, Ground water, River discharge, Permafrost & seasonally frozen ground*	

GCOS requirements: 45 ECVs → In scope of ESA CCI: 21 ECVs

CCI first steps (11 ECVs) Later in CCI (10 ECVs) Not in ESA CCI (24 ECVs)

Criteria for the selection of ECVs to be addressed within the CCI were set in conjunction with the Climate Science Advisory Board (CSAB)

Courtesy: P. Regner, ESA

Education and Training

- Training and education is an essential component in capacity building in the field of satellite oceanography
  - Training of the new generation of scientists
  - Train the active scientist: enable teams to adopt new technologies
  - Generate common quality standard
- Most of the national and European projects include a training part
  - special training courses
  - by participation of students of different levels in projects
- Special training courses in marine remote sensing organized by ESA, the European Joint Research Center and national research centers on behalf of organisations such as the IOCCG.
- Examples:
  - Training courses of JRC in African countries
  - ESA training courses in China and Europe
  - Training course in inversion techniques in OC-RS by GKSS / IOCCG

Training Course: Inversion Procedures in Ocean Colour Remote Sensing
Lauenburg, August 2009