Modelling capabilities of the Baltic Sea models to address GES indicators: links, gaps, and challenges.

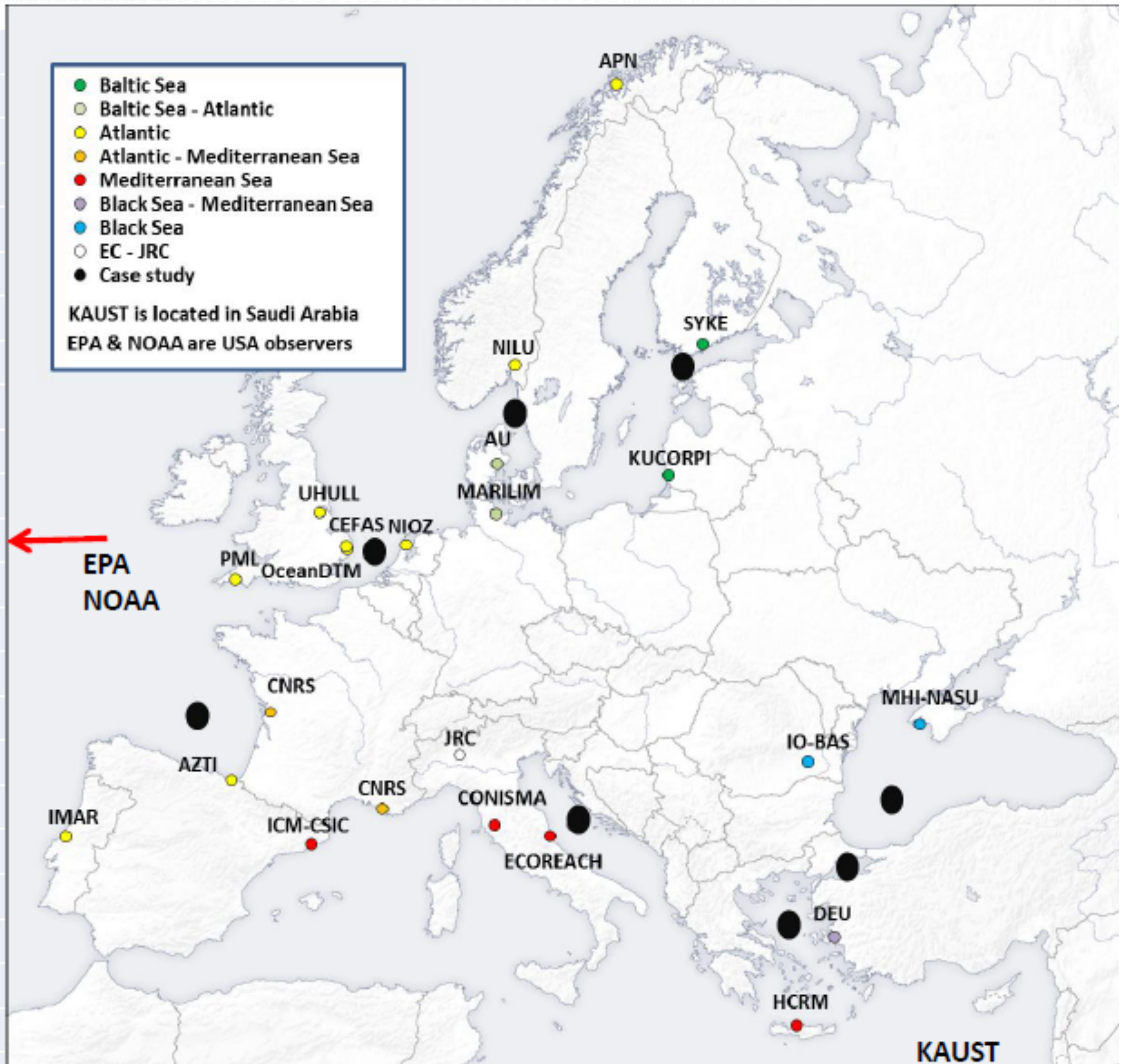
Letizia Tedesco

SYKE

Challenges for biogeochemistry research in the Baltic Sea Region
Baltic Earth WS. 13th of November 2013, IO PAN, Sopot (Poland)

DEVOTES: who we are

Number	Partner	Country
1	AZTI	Spain
2	NILU	Norway
3	SYKE	Finland
4	Aarhus University	Denmark
5	University of Hull	UK
6	CEFAS	UK
7	PML	UK
8	IMAR	Portugal
9	IO-BAS	Bulgaria
10	JRC	EU
11	HCMR	Greece
12	KUCORPI	Lithuania
13	APN	Norway
14	University of Ancona	Italy
15	NIOZ	Netherlands
16	CSIC	Spain
17	Dokuz Eylul Uni	Turkey
18	MHI-NASU	Ukraine
19	MARILIM	Germany
20	CNRS	France
21	OceanDTM	UK
22	Ecoreach	Italy
23	KAUST	Saudi Arabia



Duration of 48 months, from 1st November 2012 to 31st October 2016

Total cost: 12 million euros, requested EC contribution: 9 million euros

DEVOTES: what we aim to do

- Improve our understanding of the impact of human activities and climate change on marine biodiversity.
- Identify the barriers and bottlenecks that prevent GES from being achieved
- Test indicators and develop new, innovative ones to assess biodiversity in a harmonized way throughout the regional seas.
- **Develop, test and validate innovative integrative modelling and monitoring tools to improve our understanding of ecosystem and biodiversity changes, for integration into a unique and holistic assessment.**
- Propose and disseminate strategies and measures for ecosystems' adaptive management, including the active role of industry and relevant stakeholders

WP1: 'Human pressures and climate change'.

WP2: 'Socio-economic implications of GES'.

WP3: 'Indicator testing and development'

WP4: 'Innovative modelling tools'

WP5: 'Innovative monitoring techniques'.

WP6: 'Integrative assessment'

WP7: 'Outreach, stakeholder engagement and product dissemination'.

DEVOTES: where we do

Biodiversity and MSFD

Biodiversity in terms of MSFD Descriptors:

- D1 Biological diversity
- D4 Food webs
- D6 Sea-floor integrity (benthic ecosystems)

with some relevance for:

- D2 Non-Indigenous species
- D3 Commercial species
- D5 Eutrophication

WP4: Innovative modelling tools

- **Coordinators**: Chrystopher Lynam (CEFAS) & Christian Wilson (Ocean-DTM)
- **General Objective**: To develop a suite of modelling tools to address key questions regarding the state of biological diversity and its relationship to food-webs, seafloor integrity, human impacts and climate change
- **Specific objectives**:
  - 4.1: Review modelling capabilities and develop models to explore sensitivity of indicators of biodiversity to potential ecosystem change
  - 4.2: Model habitat and biological community for selected pilot areas
  - 4.3: Modelling of functional diversity within regional seas and connectivity across seas
  - 4.4: Facilitate the access of outputs to stakeholders and end-users
- **Main outputs**: A published and detailed understanding of the interactions between descriptors 1, 4 and 6, and the complementary use of indicators to assess biodiversity and ecosystem functioning

WP4.1: Review modelling capabilities

Task 4.1.1: Catalogue the capabilities of GES assessment models for biodiversity

Participants: Leader: JRC, Partners: CEFAS, OceanDTM, AZTI, CNRS, HCMR, MHI-NASU, DEU, IMAR, SYKE

Aim: Determine which models are able to demonstrate: 1) the linkages between indicators and ecosystem structure and function; 2) the impact of pressures on state and thus indicators. Based on this knowledge, we report on gaps in model capability and suggest needs for development.

→ D4.1 Report on available models for biodiversity and needs for development (Month 12).

- → Catalogue of models for each Regional Seas (Baltic Sea, North Sea, Bay of Biscay, Mediterranean Sea, Black Sea)
- → Short summary of each model (44 models)
- → 5 Regional sea chapters (ecosystem overview)
- → Identification of links to D1, D4 and D6, gaps and required developments

D. 4.1: Report on available models for biodiversity and needs for developments

Type of models (44):

- coupled ecosystem models more than 50% (2/3 only lower trophic levels, 1/3 coupled to upper trophic levels)
- niche/habitat suitability models
- remote sensing models
- food web models

Type of model-derived indicators (201):

Category	Types of indicators	%
1	Biomass	57
2	Biodiversity indices	11
3	Primary or secondary production	9
4	Species/habitat diversity, proportions in community	2
5	Species distribution	6
6	Species life-history	1
7	Flows, energies and efficiencies	2
8	Physical, hydrological and chemical	12

D. 4.1: Baltic Sea models available for biodiversity and needs for developments

DEVOTES Model name	Model type	Status	Model derived indicators
BALTSEM	couple	op	7
BaltProWeb (Ecopath with Ecosim)	food-web	op	6
ECOSMO	couple	op	6
ECOSMO-SMS	couple	ud	+2
ERGOM+MOM	couple	op	7
ERGOM+MOM +fish model	couple	op	2
NEMO-BFM	couple	ud	10
RCO-SCOBI	couple	op	7
SPBEM	couple	op	7

Model derived indicators, e.g.:

- phytoplankton, bacteria and zooplankton biomass (→D1 and D4)
- chlorophyll (→ D4)
- primary production (→ D1 and D4)
- benthos biomass (→D1, D4 and D6)
- fish biomass (→ D1 and D4)
- marine mammal biomass (→D1 and D4)

→ Models refer to biomass (D4), not directly to diversity at species level (D1) and poorly to seafloor integrity (D6)

D. 4.1: Baltic Sea models available for biodiversity and needs for developments

Pressures that models address:

- Physical disturbance
- Nutrient and organic matter enrichment → eutrophication
- Fishing

Pressures that models partially address:

- Interference with hydrological processes → climate change
- Marine acidification → climate change
- Extraction of living resources

Pressures that models do not properly addressed:

- Physical damage to marine habitats
- Physical loss of marine habitat
- Underwater noise
- Marine litter
- Contamination/Acute pollution
- Contamination by radionucleids
- Introduction of microbial pathogens
- Non-indigenous species

D. 4.1: Baltic Sea models available for biodiversity and needs for developments

Conclusions

The range of models developed for the Baltic Sea region are able to model many of the key functional groups structuring the marine ecosystem and the processes that lead to the production of ecosystem services. Yet..

- The type of operational indicators were almost all biomass-related. Missing biodiversity indices, species diversity, species distribution..
- Benthic habitats are poorly represented
- Many relevant pressures are not addressed
- Missing the Setting of targets/reference values in the context of the MSFD

→ how to associate ecological meaningful targets to models' outputs (derived indicators) without a clear vision of where and what the model would be used for in a specific MSFD context?

→ how demanding should those targets be? Should thresholds and/or reference values reflect the good condition of the assessed component per se or should they be set in function of MSFD minimum requirements?

…More work is required to address MSFD descriptors

DEVOTES
www.devotes-project.eu
Development of innovative tools for understanding marine biodiversity and assessing good environmental status

Grant agreement nº 308392

SEVENTH FRAMEWORK PROGRAMME

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)

www.devotes-project.eu

Operational definition of GEnS

GEnS is achieved when physicochemical and hydrographical conditions are <u>maintained</u> at a level that main structuring components of the ecosystem are present, allowing the <u>functionality</u> of the system to provide *resistance* and *resilience* against deleterious effects of human pressures/activities/impacts, maintaining and delivering the <u>ecosystem services</u> that provide societal benefits in a *sustainable way*

Physicochemical conditions include contaminants, litter and noise

Resistance is the ability to withstand stress

Resilience is the ability to recover after a stressor

Sustainable way: i.e. pressures associated with uses cumulatively do not hinder the ecosystem components ability to retain their natural diversity, productivity and dynamic ecological processes, and recovery is rapid and secure if a use ceases