

## MEECE Science Meeting 2011, San Sebastian Meeting Report

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### Executive Summary

The goal of this meeting was to establish an overview of the state of the MEECE project, identifying both where progress has been made and where extra effort has to be made. Icarus Allen provided a state of the nation presentation highlighting progress and work to be done in the next period of the project. The project was found to be on track with a few key areas needing focus predominantly around outstanding deliverables and how to ensure and develop effective flow of information between work packages.

The meeting was divided into 4 Sessions to highlight to work of MEECE's different work package activities; exploiting meta analysis and experiments to define new parameterisations (WP1), the status of the model coupler (WP2), progress in regional model simulations (WP3&4) and management decision support tools and knowledge transfer (WP5 & 6). Presentations from the meeting can be downloaded from <http://www.meece.eu/meetings.html>

### Meeting Minutes

#### Session 1 Highlights: Model parameterization

Chaired by Richard Bellerby

The focus of this session was to showcase the outputs from multi-driver experiments, with a focus on new model parameterisations, driver response scenarios and synthesis of experiments and meta analysis into model parameterisations. This is the final period for WP1 as all works should be completed by August 2011.

##### *Acidification and model parameterisation, 1D and 3D Model applications*

The statistical approach to determining new representations of carbon:nitrogen stoichiometry response to ocean acidification was presented and this highlighted the sensitivity of carbon flow in future model scenarios. The parameterisation has been implemented in a 1D ERSEM setup for the English Channel.

##### *Temperature, allometric and life-history evolution effects on the physiology of plankton, fish and jellyfish*

Work was presented on the testing of the sensitivity of variable Q10 over three trophic levels (autotrophs, zooplankton and bacteria). MTE predicts a differential temperature scaling of heterotrophic processes and autotrophic rates. Our meta-analysis of heterotrophic respiration rates and photosynthetic rates of marine plankton both in laboratory and in the field supports this theory suggesting that models should be reparameterised to account for these

differences. The Q10 formulation is an approximation to Arrhenius factor and because most models represent temperature dependence on growth rates through Q10 relationships, we have recalculated these different activation energies for autotrophs and heterotrophs and provide them as new parameters for the models.

#### *Metadata Analysis of invasive alien species for new model parameterisations*

The presentation described metadata analysis and parameterisations of invasive alien covering zooplankton, zoobenthos, fish and phytoplankton species. The BPL (Biopollution Level) index takes into account the abundance and distribution range of an alien species in relation to native biota and aggregates data on the magnitude of the impacts in three categories: 1) impacts on native communities, 2) habitats and, 3) ecosystem functioning. At least 29 species qualified as "invasive", widely distributed and/or spreading intensively and having significant environmental impact. Of them, eight have not been reported yet from the North Sea or North East Atlantic (but may have spread to these regions due to extensive shipping)

#### *Fisheries: Scenarios definitions: dealing with fishing mortality*

The presentation discussed whether (maximum sustainable yield)  $F_{msy}$  was a safe value for global community scenario and is  $s_{Flim}$  or a function of  $F_{lim}$  suitable for the World Markets Scenario. Discussion was had on the validity of "guestimates" for  $F_{msy}$  where we do not have parameters in some areas, or for some species? It was agreed as an initial state for the "guestimate" for  $F_{lim}$  will be set to approximately  $3 \times F_{msy}$

#### *Multiple driver pollution experiments*

Experiments have identified that there is different sensitivity to TBZ by different phytoplankton species. There is growth inhibition due to the presence of the herbicide increases with temperature increase. A general response of these phytoplankton species is an increase in Chl a content. Correspondingly, the phosphate uptake is higher in the presence of TBZ. Preliminary evaluation of extracellular polysaccharide content highlights their role in promoting resistance towards the herbicide.

Further biopollution work was presented on work on the mechanistic relationship between changes in abiotic variables and changes experienced by the organisms (organism sensitivity to environmental changes), quantitative understanding of the physiological mechanisms underlying tolerance to abiotic stress (organism vulnerability to environmental changes). Exposure to biopollution may hinder the ability of the organism to acclimate and thus be more susceptible to other stressors. This is more problematic for species living at the edge of their physiological tolerance range. In general, the effect of temperature increases on pollutant effects seems not linear; there are identified tipping points where interactions of stressors lead to relevant responses.

## **Session 2 Highlights: Model coupling**

### **Chaired by Mike St. John**

This session present the work carried out in developing the model coupler and model library and highlighted the most recent achievements in model developments over the past six months that had not been presented at previous meetings.

### **Module: ECOTOX Contribution**

#### *Putting Tox into Eco. Moving forward.*

Ecotox parameterizations will be modifications of equations (penalty functions) for organism vital rates rather than modules in their own right. Critical for implementation are estimates of point sources of pollutants as well as knowledge as to their mode of toxic action. Due to the vast number of toxins in the marine environment and the complexity of their synergistic as well as antagonistic interactions the development of a realistic coupled ecosystem model incorporating ecotox is impossible. Ecotox modelling should be focused on IBMs or structured population models assessing the impact of point sources or spills in particular in relation to MPA strategies.

### **Module: IBM Contribution**

*Fish-larvae IBM run for today and future climate*

*Coupled Climate ecosystem IBM model to project habitat condition for North Atlantic Cod stocks.*

Coupled 3-d Ecosystem and a 0-D IBM identifying the role of climate change on primary production and reduction in optimal habitat available for cod survival and identifying a reduction in survival due to loss of optimal habitat.

### **Module: Invasives Contribution**

*Modelling invasive species in MEECE: a two headed approach*

1. Adaptation of a bio pollution index to assess changes in vulnerability for invasion due to climate change. A biogeochemical models was used to assess the distribution and frequency of occurrence of favouring conditions. Test suggested that physically defined niche captured the observed distribution of the invasive species *P. minimum*.
2. Approach presented which builds on the Darwinian 'Follows' model approach (Follows et al 2007). Presents a plankton model with a number of plankton types, based on functional groups and a number of species per functional group. Species" are defined during initialization generating random value for some parameters (max growth rate, rest respiration rate, min N:C and P:C, nutrient affinity, max Chl:C and minimum Chl production. These were parameterized per species by putting noise on the bulk parameters. 1-D systems are then assessed for the potential for invasion of phytoplankton species.

### **MODULE: Model Coupler**

Model coupler has been successfully developed and applied for LTL at tregional and global sclaes. Future activities are focused on coupling LTL to IBM models for fish larvae.

## **Session 3: Management decision support tools and knowledge transfer**

### **Chaired by GerJan Piet and Manuel Barange**

The session started off with an update on the WP6 KT activities (M. Barange, PML), describing progress on tasks such as development of factsheets, the website interaction with user group and planning of summer school. Remainder of the session was dedicated to WP5 with an introduction to the state of affairs.

Task 5.1 is now almost completed and deliverables 5.1 (Integrated assessments) and 5.2 (Decision support tools) are near completion.

The integrated assessment that was conducted in three MSFD (sub)regions was presented in the first presentation (G.J. Piet, IMARES) followed by three presentations on decision support tools (DST). The first DST presented by M. Eero (DTU) is an aid to devaluate the status of an ecosystem and was applied to the Baltic Sea. The second DST was a Biopollution Expert System (S. Olenin, KUCORPI) initially developed for the Baltic Sea but is now available to aid the assessment of global biopollution. The tool translates the existing data on miscellaneous invasive alien species impacts into uniform biopollution measurement units. The third DST was developed as an aid to manage the environmental risk in marine ecosystems (A. Dagnino, UPiedmont) and applied to evaluate the hazard related to sediment dredging.

Finally there was an update on indiSeas progress focussing on the phase II (Lynne Shannon, UCT) which involves additional indicators. These indicators do not cover only the environment but also the climate as well as the human dimension.

## **Session 4 Global and regional modelling**

### **Chaired by X. Irigoien and M. Zavatarelli**

This session provided reports on modelling activities by region including status of: hindcast modelling, use of scenarios and future climate scenarios, anthropogenic drivers and coupling

to higher/lower trophic level. Plans for multi driver simulations.

Summary of presentations relevant to WP3 (Ecosystem response to climate scale drivers)  
The session included presentations for global and all regional models (Barents, NE Atlantic, North Sea, Bay of Biscay, Adriatic, Aegean and Black Sea).

### **Global models**

At the global scale comparisons have been made between different models all showing a decrease of net primary production in the North Atlantic. However different global models present important differences at regional scales that limit their use at such scales. A sensitivity exercise showed models to be very sensitive to different pathways for CO<sub>2</sub> entering in the system. In terms of next steps the main exercise will include a different answer to temperature (Q10) for autotroph and heterotroph metabolic rates derived from analysis in WP1 and to test its effects on global simulations.

### **Regional models**

All regional models are confronted with the problem of downscaling the forcing from the global model. As said earlier the model does well globally but in each region there are important features that are not well represented by global models (as some examples temperature in the Barents sea, upwelling in Benguela, thermocline in the Black Sea, wind direction in the Bay of Biscay etc). Each region has dealt with the problem in different ways in order to sort out the specific issues of the region (delta change approaches and other mathematical approaches, see Goubanova et al., 2010). This results in a common global forcing (IPSL) but with different adaptations in each area. Further, other uncertainties remain for future projections. As an example policies in rivers nutrient loads, that influence regional models.

All in all, the long term predictive power of the performed simulations has to be taken as it is: an exercise carried out with state of the art tools and the best available knowledge, but limited in terms of climate scenarios and global models used to force the regional models. Ideally, different future scenarios, global models and downscaling approaches should be used to produce an envelope of potential future conditions. However such a massive exercise of simulation was out of the scope of MEECE.

*The higher trophic level models can be divided into three families:*

1. Models linking NPZD or scenarios to a species, or limited set of species. These include IBM models (eg cod larvae in the North Atlantic), and single or multiple population models such as SMS or Gadget (Baltic and Bay of Biscay). Such models are well suited to answer specific questions about how some species will answer to future conditions or fishing pressure. However they cannot answer about changes in the whole community or ecosystem.
2. Ecosystem models based on trophic links such as Ecosim/ecopath or Osmose. Such models are well adapted to test the effect of different fishing scenarios, as well as scenarios with changing primary production. However, including effects other than changes in trophic links, such as temperature preferences, influence on transport or local effects is difficult. Basically the models are designed to represent situations and not really for dynamic changes along time where species come in and come out, increase and decrease as a function of environmental conditions.
3. Size spectra models such as Apescom including a Dynamic Energy Budget (DEB) approach for the individual metabolism coupled to transport models. Such models have the potential to evaluate in a dynamic way both the effect of fishing pressure as well as changes in the environment, other than changes in system productivity (temperature, transport etc). However these models are still at an early stage of development, too early for general implementation to different areas.

Progress is generally satisfactory although problems remain at solving local issues with the global forcing. In terms of higher trophic levels it appears that there is not yet a model approach that can be used to answer different questions at the time at the ecosystem level.

However a range of approaches that can be used to answer specific question has been developed and made available.

### **Summary of presentations related to WP4 (Ecosystem response to direct anthropogenic drivers)**

The session included several presentations directly related to the WP4 activities and can be summarised as follows:

#### **Barents Sea Model (IMR-UiB)**

The circulation module has been upgraded with a module dealing with transport of pollutants.

#### **North Sea and NW Shelf Model (PML)**

The biogeochemical model has been upgraded with:

Pollutants (heavy metals) effects on mussels. The parameterisation is based on WP1 activities.

Impact of trawling fisheries on benthic organisms.

#### **North Sea and Baltic Sea Model (UiB)**

The coupled Physical /LTL model module has been upgraded with:

A module dealing with transport of pollutants.

Several HTL modules for shrimps and fishes (mostly individual based).

#### **North Aegean Sea Model (HCMR)**

The coupled LTL/HTL model has been already used to simulate fisheries and productivity scenarios.

Other WP4 regional models are preparing the planned activities to be carried out in the last part of the MEECE Project lifetime.

## **Summary**

The meeting concluded with a summary of the status of the project. Overall the MEECE project is making good progress. WP's 1 & 2 are on track and nearing completion. The regional models are being developed and run and tested and the management tools work progressing well. The timeline for the completion of deliverables for inclusion in the 2 full report was agreed as follows;

### **WP1**

D1.4 New model parameterisations (UHAM) – delivered by 30 July 2011

D1.5 Driver response envelope scenarios – to be updated (PML) delivered by 30 July 2011

D1.6 Report on the multi-driver experiments (UHAM) delivered by 30 July 2011

### **WP2**

D2.12 Sub-model Ecotoxicology: including user guide (UHAM) delivered by 30 July 2011

D2.13 Sub-model alien invasives species including user guide (PML) delivered by 30 July 2011

D2.14 Users guide and report for models in the MEECE library (BB) delivered by 30 July 2011

### **WP3**

D3.1 Common set of forcing scenarios (NERC-POL) delivered by 30 July 2011

D3.2 Common set of metrics (NERC-POL) delivered by 30 July 2011

### **WP4**

D4.1 Hindcast Simulations of isolated direct anthropogenic drivers (IRD) delivered by 30 July 2011

### **WP5**

D5.1 Generic framework for the integrated assessment of marine resources (IMARES) delivered by 30 July 2011

D5.2 Technical report on decision support tools (IMARES) delivered by 30 July 2011

## Meeting participants

### Participants

Aldo Viarengo  
Alessandro Dagnino  
Angel Lopez-Urrutia  
Briac Le Vu  
Chris Smith  
Corrina Schrum  
Elena Fabbri  
Emanuela Clementi  
George Triantafyllou  
GerJan Piet  
Gisle Nodal  
Heather Cannaby  
Icarus Allen  
Irina Olenina Zaiko  
Ivo Grigorov  
Jason Holt  
Jerry Blackford  
Jessica Heard  
Jonathon Beecham  
Karsten Bolding  
Laurent Bopp  
Leire Ibaibarriaga  
Lynne Shannon  
Manuel Barange  
Marco Zavatarelli  
Marina Chifflet  
Martig Eero  
Mike St. John  
Momme Butenschon  
Nadia Papadopoulou  
Priscilla Licandro  
Richard Bellerby  
Rosella Pistocchi  
Sergej Olenin  
Thomas Arsouze  
Trond Kristiansen  
Veronique Garcon  
Volodymyr Myroshnychenko  
Xabier Iriogien  
Yuri Artioli

### Institute

Upiedmont  
Upiedmont  
IEO  
IRD  
HCMR  
UiB  
UNIBO  
UNIBO  
HCMR  
IMARES  
UiB  
IMS\_METU  
PML  
KUCORPI  
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NERC  
PML  
PML  
Cefas  
BB  
LCSE  
AZTI  
UCT  
PML  
UNIBO  
AZTI  
DTU-Aqua  
UHAM  
PML  
HCMR  
SAHFOS  
UiB  
UNIBO  
KUCORPI  
LCSE  
IMR  
IRD  
Black Sea Commission (User Advisory Group)  
AZTI  
PML

## Annex 1 Agenda

### MEECE Science Meeting 2011 Agenda 14-15 June 2011, San Sebastian, Spain

#### Day 1

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09:00 Welcome and Summary Overview of MEECE (I. Allen)

#### Science Achievements

##### Session 1: Model parameterisation - Chair R. Bellerby

- 09:20 WP1 Introduction and brief state of play (R. Bellerby)  
09:30 Acidification and model parameterisation, 1D and 3D Model applications (R. Bellerby)  
09:50 Temperature, allometric and life-history evolution effects on the physiology of plankton, fish and jellyfish (A. Lopez-Urrutia)  
10:10 Metadata Analysis of invasive alien species for new model parameterisations (S. Olenin, KU CORPI)  
10:30 Scenario definitions: dealing with fishing mortality (C. Smith, HCMR)  
10:50 Effects of pollutants on microalgae. Laboratory results and numerical modeling (M. Zavatarelli/R. Pistocchi, UNIBO)  
11:10 Coffee  
11:40 Multiple driver expts (M. St. John, UHAM)  
12:00 Biological effects of copper and temperature: from molecular responses to potential effects at individual/population level (A. Viarengo, UPiedmont)  
12:20 Cytoprotective responses developed in *Mytilus galloprovincialis* after exposure to oxytetracycline or copper at different temperatures (E. Fabbri, UNIBO)  
12:50 Lunch

##### Session 2: Model coupling - Chair M. St. John

- 14:00 Status of model library and coupler, final deliverables etc (M. St. John, UHAM)  
14:10 Model Library: status & sustainability prospects (I. Grigorov, DTU)  
14:25 Putting Tox into Eco. Moving forward. (M. St. John, UHAM)  
14:40 Fish-larvae IBM run for today and future climate (T. Kristiansen, IMR)  
15:00 Modelling invasive species in MEECE: a two headed approach (Y. Artioli, PML)  
15:20 Status of model coupler and Deliverable (K. Bolding, BB)  
15:40 Questions and Discussion, followed by coffee

##### Session 3: Management decision support tools and knowledge transfer - Chairs: G. Piet and M. Barange

- 16:30 Report on KT activities, MEECE outputs relevance and application for user groups (M. Barange, PML)  
16:50 Integrated assessments (G. Piet, IMARES)  
17 :20 Decision support tools (M. Eero, DTU)

**Day ends around 18:00**

18:00 Summer School planning meeting (summer school lecturers)

Conference dinner 20:30 (Restaurante Branke, directions below)

## DAY2

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### **Session 3 cont: Management decision support tools and knowledge transfer - Chairs: G. Piet and M. Barange**

- 09:00 Welcome and brief summary of day before
- 09:10 Biopollution expert system (KUCORPI)
- 09:40 New tools for managing environmental risk in marine ecosystems (Alessandro D. UPiedmont)
- 10:10 IndiSeas phase II (Lynne Shannon, UCT)
- 10:30 Coffee

### **Session 4: Regional modelling - Chairs X. Irigoien and M. Zavatarelli**

- 11:00 Introduction on state of play for WP3/4, including working towards the Atlas of marine ecosystem climate response (X. Irigoien and M. Zavatarelli)
- 11:30 Global models (L. Bopp, CNRS)
- 12:00 Barents Sea (C. Schrum. UiB)
- 12:30 North Sea (J. Holt, NERC-POL, with PML and CEFAS)
- 13:00 Lunch
- 14:00 Baltic Sea (C. Schrum. UiB)
- 14:30 Biscay (M. Chifflet, AZTI)
- 15:00 Adriatic Sea ecosystem dynamics: 20th century hindcast simulations and 21st century predictions (E. Clementi, Bologna)
- 15:30 The North Aegean model: Hind-cast and future scenario simulations; coupling to OSMOSE HTL model. (G. Triantafyllou)
- 16:00 Coffee
- 16:30 Update on MEECE modelling activities in the Black Sea region (H. Cannaby)
- 17:00 Bengula (IRD, V. Garcon, E. Machu)
- 17:30 Summary and science meeting close, planning for workshop next day
- 18:30 Meeting close
- 20:00 Steering Committee meeting dinner