



## Seventh Framework Programme Theme 6 Environment

Collaborative Project (Large-scale Integrating Project)

Project no. **212085**

Project acronym: **MEECE**

Project title: **Marine Ecosystem Evolution in a Changing Environment**

### D0.4: 6 Month Management Report

Due date of deliverable: 28.02.09

Actual submission date: 20.03.09

Organisation name of lead contractor for this deliverable: PML

Start date of project: 01.09.08                      Duration: 48 months

Project Coordinator: Icarus Allen, Plymouth Marine Laboratory

Project co-funded by the European Commission within the Seventh Framework Programme, Theme 6 Environment		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission)	X
RE	Restricted to a group specified by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission)	

## Summary

The MEECE project started on the 1<sup>st</sup> September 2008. Progress has been steady so far and momentum is beginning to build. The kick off meeting was hosted by AZTI in San Sebastian Spain. It provided an opportunity for the participants to meet, get to know each other and gain an overview of the project. The contract with the commission was signed in December 2008 and the pre payment has been dispersed to the partners.

At the time of reporting all the milestones and deliverables have been met (see Appendix 1 and 2) and the deliverables due in month 9 are currently on track. A revision of the DOW is required to take accounts of modifications to the budgets of IRD and U Pied.

Work packages 1, 2, 6 and 0 are underway. WP3 starts in month 6, WP4 in month 9 and WP5 in month 12.

- WP0: All management tasks are up to date and on track
- WP1: The experimental work has been designed and planned and will begin in May 2009. The collation of existing data on key processes and drivers is underway informed by the model description and key species evaluation being undertaken in WP2. The collation of model boundary conditions is progressing.
- WP2: A workshop was held in Plymouth, to resolve the system key species, feedback and forcing. This information is to be fed back to WP1 to inform the data acquisition. Descriptions of all the model systems are being compiled and will be collated and placed on the web. A second workshop to discuss coupling lower to higher trophic level models demonstrated considerable progress in the coupling of ECOPATH, OSMOSE and IMB fish models to planktonic models. However the technical and scientific aspects of the coupling are still subject to robust debate.
- WP6: The formation of a MEECE Advisory User Group (AUG) has been initiated. Four relevant stakeholders have been already joined the group, and the first meeting of the will be held during the summer of 2009. The first fact sheet entitled 'MEECE: managing a changing marine environment' provides an introduction to the project including its aims, objectives and approach' is in production and will be available shortly.

More detailed reporting for all beneficiaries follows.

## **A. Periodic Management report**

### **Beneficiary 1**

**Institute: Plymouth Marine Laboratory**

**Lead PI's: I Allen, J Blackford, M Barange**

#### *A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

### **WP0 Coordination and Management**

1) Contract negotiations: The contract negotiations have been successfully completed. The Description of Work (DoW) and consortium agreement were finalised and signed. The contract with the commission has been signed along with the accession forms by the beneficiaries. The initial payment was made in December and this was dispersed to the partners by the 31<sup>st</sup> December 2009.

2) Monitoring progress: An operating plan and risk register was created for the project (see appendix 2) at the beginning of the project. This was updated

3) Communication. The project webpage was up and running in month 3 - [www.meece.eu](http://www.meece.eu) . It contains general information about the project and the models being used, along with a calendar and blog. All model documents can be accessed from the webpage.

4) Project meetings: The first meeting of the Marine Ecosystem Evolution in a Changing Environment (MEECE) project was hosted by AZTI in San Sebastian Spain from the 29th September – 2 October 2008. It was attended by 35 project scientists.

The goals of the meeting were to initiate the project by

- Ensuring the project participants had a good overview of the aims and structure of the project.
- Identifying and clarifying and establishing responsibility for intra-workpackage linkages
- Identifying and clarifying and establishing responsibility for inter-workpackage linkages
- To establish good working relationships between the project participants.

These goals were successfully met and a report of the meeting can be found on the MEECE website.

The first steering committee meeting was held during the KO meeting in San Sebastian in September 2008. The 6 month SSC meeting was held as a phone conference in Feb 2009. No major issues were raised at either meeting.

### **WP2**

T2.2.2. Both the kick off meeting (San Sebastian, Sept 08) and the WP1/2 workshop (Plymouth, Feb 09) have been attended. The carbonate system module is under development, currently undergoing evaluation and tuning with respect to performance on the NW European shelf. Initial computational plans have been formulated to initiate the process of coupling ERSEM to ECOSIM / ECOPATH.

### **WP6**

The formation of a MEECE Advisory User Group (AUG) has been initiated. Seven relevant stakeholders have been invited to join the group, so far three have confirmed their interest and availability to participate. The first meeting of the will be held during the summer of 2009.

The MEECE Fact Sheet series has also been designed and the first issue will be shortly ready for distribution. This first fact sheet entitled 'MEECE: managing a changing marine environment' provides an introduction to the project including its aims, objectives and approach. The fact sheet will be used to promote and raise awareness of the project amongst stakeholders in both the science and policy communities.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP0**

There are no major deliverables for this workpackage in the next 6 months. Work will continue on developing the website and the project progress will have a similar light touch review in month 12. We will begin preparation for the full project (financial, management and science) in month 18.

**WP2**

T2.2.2 The carbonate system module will be delivered by Month9 as a fortran subroutine, along with recommendations for the treatment of alkalinity and a formula for nitrification response. Delivery of other carbonate system dependant process description will depend on progress and delivery from WP1 and WP2 (T2.2.3.).

**WP3**

Attendance at WP3.4 meeting in Sete mat 09

**WP6**

Over the next 6months, KT activities will continue as appropriate, with Fact Sheet production occurring in line with project achievements, the continued expansion of the AUG and planning for the first meeting. The Knowledge Transfer webpage embedded within the main MEECE website will be developed and an online contacts database for socio-economic users will be made available.

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**Beneficiary 2**

**Institute: University of Bergen**

**Lead PI: Richard Bellerby**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP1**

Data has been assembled for validating the ecosystem model ECOSMO. For this purpose a collaboration has been set up with SAHFOS in order to utilize zooplankton data derived from the continuous plankton recorder for model validation. Datasets of nutrient biogeochemistry and seston stoichiometry have been collated from mesocosm and field campaigns. The MEECE driver experimental plans have been developed and agreed for May 2009 where plankton will be grown under scenarios of different CO<sub>2</sub>, temperature and copper. The science plan has also been developed for an Arctic expedition in May-July 2009 which will study ecosystem drivers and marine biogeochemistry in the Nordic Seas and Arctic.

**WP2**

In WP2 we are planning to enhance our ecosystem model. First, by including cyanobacteria as a third phytoplankton group, necessary to reproduce production in the Baltic Sea, and second by developing a less complex method to include higher trophic levels in the model formulation. Therefore we started these efforts by searching the literature for relevant publications. Further sensitivity scenario runs with a spatially explicit IBM for cod and sprat were performed to investigate climate impacts on early life stages of both species in the North Sea (Daewel et al., in prep.). A module for representing carbon phytoplankton dynamics is under development. Further, the representation of flexible stoichiometry through ecosystems is under evaluation.

**WP3**

For WP3, the last month has been used, to start data collection needed for hindcast scenarios. Since the model runs require a large set of initial, boundary and forcing data this

work is still going on. Some data (i.e. from the 20 century reanalysis project, Compo et al.) are not yet fully available.

#### **WP4**

For WP4 we started with conceptual work in order to develop reasonable scenarios for the North and Baltic Sea system.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

#### **WP1**

Within the next month we are planning to receive and compile the dataset, based on CPR data, needed to validate long term hindcast runs of the ecosystem model. We will undertake a mesocosm experiment at the University of Southern Denmark. We will undertake a shipboard expedition to the Arctic. We will develop datasets on riverine inputs relevant to the MEECE drivers.

#### **WP2**

The majority of the work within the next 6 months is on the enhancement of the model. We plan to have the cyanobacteria included in the model after this time period. And will start to work on the parameterization of the higher trophic levels. We will develop a carbon phytoplankton module

#### **WP3**

We will start the performance of long term hindcast runs with the enhanced ecosystem model.

#### **WP4**

Further conceptual work and development of coupling strategies for consideration of direct anthropogenic drivers in combination to climate forcing.

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### **Beneficiary 3**

**Institute: University of Hamburg**

**Lead PI: Mike St John (WP2 Leader), Wilfried Kuhn (PI)**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

#### **WP2**

- Meeting Coordination (14 January 2009) related to T1.3 Experimental work (together with WP1)
- Meeting Organization (9-13 February, Plymouth) related to WP1+WP2 Workshops (T2.1 and D2.1: Report on system specific key species, feedbacks and forcings (M9, R, PU, Resp UHAM))

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

#### **WP2**

April-May 2009 - T1.3 Experimental work (together with WP1) on to resolve the physiological and biogeochemical responses of key species to the combined effects of acidification, pollution and temperature.

May 2009 – Preparation and delivery of D2.1 (Report on system specific key species, feedbacks and forcings (M9, R, PU, Resp UHAM)). Communication of the main results to the community and potential EU-funded IP programs.

May 2009 - Delivery of D2.2: Sub-model acidification-sensitive calcification rate, including user guide. (M9, R, PU, Resp PML)

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**Beneficiary 4**

**Institute: AZTI (Spain)**

**Lead PI: Xabier Irigoien**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP3**

T3.3: Regional Simulations: phytoplankton / carbon

A coupled regional hydrodynamic-ecosystem model (ROMS+N2P2Z2D2) has been implemented for the Bay of Biscay system. The model domain covers the whole Bay of Biscay, extending from the French and Spanish coasts to the south of United Kingdom. At the moment, the atmospheric forcing has been taken from the NCEP re-analyses database. In order to obtain realistic hydrological forcings, special efforts have been done to collect runoff measurements and rivers data of temperature and nitrate concentration. Thus, realistic hindcast simulation from 2000 to 2006 has been performed. Daily runoffs of most Spanish and French rivers, with temperature and nitrate monthly climatologies when available, are used.

In order to calibrate the model and validate the results, we have collected *in situ* data (AZTI cruises and SISMER server), satellite images (AVHRR, Seawifs) and climatologies (BOBYclim and AVHRR clim). The hydrodynamic validation has been done. The calibration and validation of the NPZD module (nutrients and phytoplankton above all) are in progress. No major effort on zooplankton validation was done as zooplankton compartments will be included in APECOSM module in a future step.

Thus, the coupled ROMS-NPZD model is ready to use initial conditions / forcing fields / boundary conditions from PICSES (T1.2)

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP3**

T3.3: Regional Simulations: phytoplankton / carbon

During the next 6 months, we plan to implement/use the initial conditions, forcing fields and boundary conditions from PICSES (from T1.2, if ready), and calibrate and validate this new coupled ROMS-NPZD configuration in the Bay of Biscay (hindcast simulations). The coupled hydrodynamic-lower trophic levels will thus be ready for coupling to APECOSM.

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**Beneficiary 5**

**Institute: UNIBO**

**Lead PI: Marco Zavatarreli**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP4**

WP4 activities are due to start by M9. The initial meeting is being planned for mid-may. The meeting will be held jointly with WP3.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP4**

The initial activities of WP5 partners will be devoted to the implementation, testing and calibration of the modules describing the impact of the indirect anthropogenic drivers on marine ecosystem functioning, as well as to the LTL-HTL model coupling.

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**Beneficiary 6.**

**Institute: IMARES**

**Lead PI: Gerjan Piet**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP1**

Collation of data on the impact of fishing on fish and benthos

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP1**

Provide input and validation data for the impact of fishing on the various ecosystem components

**WP5**

Commence work on integrated management en management strategy evaluation

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**Beneficiary 7**

**Institute: Cefas**

**Lead PI: Steven Mackinson**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP1**

Collation of time series data on zooplankton (CPR), benthic organisms (NMMP) and environmental variables for use in calibrating the Ecosim model of the North Sea and Black Sea. Developing conceptual approaches for including the indirect effects of habitat damage due to trawling in the model framework.

**WP2**

Developing conceptual and technical solutions to linking Ecosim with Biogeochemical models. Work presented at MEECE workshop in Feb 09. Initial technical solutions look promising but much work is required. Network of collaborations extended to involve other international scientists working on the same problem.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP1**

Time series fitting (calibration) of the North Sea model will comprise the bulk of activity on this WP over the next 6 months. Time series data for the Black Sea will continue to be collated.

**WP2**

A work-plan for collaboration with IRD on developing Osmose in the North Sea will be developed. Coupling of Ecosim to BFM will continue in collaboration with Karsten Bolding, PML, and UBC. We will be preparing material for a technical workshop later in the year.

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**Beneficiary 8**

**Institute: NERC-POL and NOCS**

**Lead PI: Jason Holt and Toby Tyrrell**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP2**

At NERC-NOCS we have started work as follows. We have begun identifying appropriate datasets of in-situ carbon chemistry measurements, for future use in validating models. We have begun reviewing the literature in terms of different approaches to modelling calcification, and its dependence on environmental factors. We are assembling a 0D model of the Bay of Biscay, for which we have monthly carbonate chemistry and other data. We are building on an existing model programmed in Matlab. This model is being converted to FORTRAN, to make it faster.

**WP3**

IPSL forcing data has been gathered for climate change scenarios (SRESA1B) and corresponding present-day and pre-industrial cases. Processing programmes to generate model forcing from this have been written and tested.

**WP4**

Some preliminary river-loading experiments have been conducted.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP2**

Over the next six months we will continue to accumulate information about carbonate chemistry datasets, and to review previous approaches to modelling calcification. We will construct our own new model of the process. We hope to be able to test this model (module) in a physical-chemical-biological model of the Bay of Biscay, if that can be finished in time.

**WP3**

A scenarios and metrics workshop is planned for month 9 (may'09). A first set of simulations using the data described above will be conducted before this.

**WP4**

Workshop as above.

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**Beneficiary 9**  
**Institute: IRD**  
**Lead PI: Yunne Shin**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP2**

- Participation in the AMEMR workshop on coupling models of LTL and HTL, to the WP2 workshop. February 2009, Plymouth.
- The 2-ways coupling of Osmose to Roms-Npzd is achieved (Travers et al. accepted a, b). The coupled end-to-end model has been applied successfully to the southern Benguela ecosystem.
- Coupling of APECOSM to ROMS, development phase.

**WP4**

Scenarios of overexploitation, combined effects with scenarios of climate change. Simulation runs in the Benguela ecosystem.

**WP5**

WP5 has not yet commenced. However, in order to ensure optimal derivation of indicators for decision support, UCT participated in the AMEMR workshop on coupling models of different trophic levels, held in Plymouth, UK, 10-12 February 2009, convened by the MEECE co-ordinator and held in conjunction with start-up meetings of WP1 and 2.

**WP6**

IRD and UCT are jointly working on the evaluation of the status of world marine ecosystems through leading the Working Group "Indiseas". This WG involves about 20 research institutes and aims at providing a generic set of synthetic indicators to accurately reflect the effects of fisheries on marine ecosystems, to facilitate effective dissemination of these effects to the general public, stakeholders at large and fisheries managers, and to promote sound fisheries management practices.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**General:**

A subcontract agreement between IRD and UCT is presently under scrutiny by the contract managers of both institutes. We expect to resolve the issues during the first quarter of 2009.

**WP2**

- Publications on the coupled model Roms-Npzd-Osmose.
- Starting to couple Osmose to BFM.
- Technical report on the coupling of APECOSM to ROMS.

**WP3**

As a first step, the Benguela configuration has been defined using the ROMS (Regional Ocean Modelling System) model. We will start from the work of Veitch et al., 2009: a parent domain used in the SAFE configuration (Penven et al., 2006) from 46°S to 5°S and 2.5°W to 54.75°E with a ¼° horizontal resolution, a child domain (4°E to 20°E, 12°S to 35.6°S) with a 1/12° degree resolution. Parent and child grids have 32 sigma-levels allowing a reasonable near-surface resolution. Wind forcing is based on the Quikscat climatology (2000-2007). Surface fluxes are based on the climatological mean heat and salt fluxes. The large scale circulation patterns of the Benguela system are well reproduced as well as the separate upwelling cells with the Luderitz cell marking the separation between the northern and

southern regimes. This climatological simulation run will be used to couple with the biogeochemical model.

This biogeochemical model is derived from Kone et al. (2005) and incorporates additional key compartments and processes for fully encompassing the biogeochemical status of the Benguela, namely oxygen, denitrification and the anammox reaction.

References :

Veith, J., Penven, P. and Shillington F., 2009, The Benguela: a laboratory for comparative modelling studies, *Progress in Oceanography*, in press.  
Penven, P., Chang, N; Shillington, F., 2006, Modelling the Agulhas Current using SAFE (Southern African Experiment), *Geophysical Research Abstracts*  
Koné, V., Machu, E., Penven P., Andersen V., Garçon, V., Demarcq H., and Fréon, P., 2005, Modelling the primary and secondary productions of the Southern Benguela upwelling system, *Global Biogeochemical Cycles*, 19, GB4021, doi:10.1029/2004GB002427.

**WP4**

- Publication on the simulation of combined effects of fishing and climate changes in the Benguela ecosystem
- Organisation of a Workshop on OSMOSE modelling, May 2009, CRH, Sète
- Starting to parameterize Osmose in the Adriatic and Aegean Seas

**WP5**

WP5 has not yet commenced.

**WP6**

- A suite of 9 papers on ecological indicators of fishing impacts in 19 marine ecosystems, arising from the IndiSeas WG, are nearing completion and will be submitted to *ICES Journal of Marine Science* in April 2009.
- A website dedicated to inform the general public and stakeholders will be made accessible from April 2009 ([www.indiseas.org](http://www.indiseas.org)).

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**Beneficiary 10**

**Institute: DTU Aqua**

**Lead PI: Fritz W. Köster**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP2**

Partner 10 has participated in the kick-off meeting (Milestone 1) with 2 persons. Partner 10 has contributed to Milestone 3 (MEECE web models) with the two model complexes (SMS+IBM) featured by Partner 10. Partner 10 has participated in the Systems Workshop focused on the technical implementation issues of the pivotal model coupler in the MEECE project, headed by partner 18. Activities relating to task 2.2.5.2 (Sub-model SMS including user guide) and task 2.2.5.1 (Sub-model Library of IBM submodels including user guide) has been initiated and implementation issues are being addressed.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP2**

Activities relating to task 2.2.5.2 (Sub-model SMS including user guide) and task 2.2.5.1 (Sub-model Library of IBM submodels including user guide) are being continued, leading to D2.6 and D2.11, respectively.

### **WP3**

The planning phase has been initialized, and a collaboration with the Danish Meteorological Institute and the Danish National Environmental Institute (NERI) has been set up to address tasks 3.3.4, 3.4.2 and 3.4.3.

### **WP4**

The planning phase has been initialized, and a collaboration with the Danish Meteorological Institute (DMI) and the Danish National Environmental Institute (NERI) has been set up to address tasks 4.2.3 and 4.2.4.

### **WP5**

All work under Task 5 has a starting date month 12, i.e. late in 2009, however, we at the kick-off meeting agreed to start earlier as the resources allow. We start with task 5.1 and task 1.5: Integrated assessment and meta-analysis (contribution under lead of UHAM); this needs to be done in 2009 and it is advantageous to extend the findings and experiences of FP6 STREP IMAGE. With respect to task 5.2 (testing management strategies) we will proceed with harvest control rule testing (defined in management and recovery plans, but also alternatives), with emphasis on cod stocks in the Baltic, but also other gadoid stocks using SMS. For the North Sea, emphasis from partner 10 will be on herring and sandeel and possibly Norway pout stocks. Fisheries and fleet specific issues are considered beyond the scope of the project. With respect to task 5.3 (Management Strategy Evaluation tools) applications target both North Sea and Baltic. Furthermore, key persons from partner 10 involved in D5.3 (Technical reports on management strategies) are being appointed in late 2009.

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### **Beneficiary 11**

**Institute: Institute of Marine Research (IMR)**

**Lead PI: Svein Sundby**

#### *A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

### **WP2**

Our emphasis has been on linking models from phytoplankton to juvenile fish with focus on growth survival of the three Arcto-boreal/Arctic fish species cod, herring and capelin. The temperature is shown to be a strong driver with respect to growth variability in these regions across trophic level.

### **WP3**

Physical downscaling is a needed activity to obtain adequate scenarios for ecosystem simulations. We have worked with downscaling the circulation in the North Sea from our global circulation model. The results emphasize that downscaled model must resolve the Rossby radius to simulate important physical processes for ecosystem effects.

### **WP4**

There has been no direct activity in MEECE WP4 during the first 6 months. However, we have finalised a highly relevant work from a German-Norwegian project which was terminated in 2007: Kuhlbrodt, T., Rahmstorf, S., Zickfeld, K., Vikebø, F., Sundby, S., Hofmann, M., Link, P., Bondeau, A., Cramer, W., Jaeger, C. 2009. An integrated assessment of changes in the thermohaline circulation. *Climate Change*. DOI 10.1007/s10584-009-9561-y.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP2**

We will focus on the effects of light on growth/behaviour on lower trophic levels, particularly on larval fish. Light is a very important climate driver in addition to temperature in high-latitude ecosystems. Based on developed IBMs we are exploring the influence of latitudinal difference in light climate on larval growth.

**WP3**

In the Barents and Norwegian Seas ecosystems ice extent is a strong determinant on ecosystem productivity. Such effects can only be simulated by high-resolution models. We will be working on downscaling models in the Barents Sea and Norwegian Sea.

**WP4**

We will start test runs on SYSTMOD fish model. The test will be done on the interaction between cod, capelin and herring in the Barents/Norwegian Seas. We will investigate how the temperature in SYSTMOD is a proxy for other ecosystem processes forcing the fish production.

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**Beneficiary 12**

**Institute: IMS-METU**

**Lead PI: Temel Oguz**

*A.1 - Justification of major cost items and resources*

***Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)***

**WP2**

T2.1 During Months 1-6

Key species: Anchovy and *Mnemiopsis Leidyi*.

Identified drivers are ocean climate, circulations, overfishing and eutrophication.

Forcings: Top-down and bottom-up controls.

**WP3**

Starting event month 6

**WP4**

Starting event month 9

***Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)***

**WP2**

IMS only participates in T2.1 as given above, however IMS will contribute to this WP by developing Anchovy and *Mnemiopsis Leidyi* modules.

**WP3**

T3.3 Starting event month 12

T3.4 Starting event month 12

**WP4**

T4.1: Starting event month 9

During months 9-12,

1) the LTL-anchovy coupled model will be tested in a 1D multi-layer setting (representative of the interior Black sea ecosystem) using eutrophication, over-fishing and invasive species as

critical drivers. This model will be forced by both monthly and inter-annually varying climatic conditions, subsurface nutrient flux and fishing mortality.

2) The invasive species population dynamics model (for *Mnemiopsis leidy*) will be tested under changing climate and eutrophication conditions.

T4.2 Starting event month 18

T4.3 Starting event month 24

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**Beneficiary 13**

**Institute: HCMR**

**Lead PI: Chris Smith**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP1**

Planning and collation of metadata on fishing impacts (anthropogenic ecosystem driver)  
Full description of Regional Model (N. Aegean Sea ERSEM-POM) for assessment of model requirements for data.

**WP2**

Involvement in model coupling and higher trophic level workshop.  
Testing of acidification module and implementation with a 1-D version of the biogeochemical model.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP1**

Collation of fishing impact data

**WP2**

Acquisition of the OSMOSE higher trophic group module, planning for coupling/nesting in Regional Model (N. Aegean Sea ERSEM-POM). The key species are to be identified for incorporation into the module and data sought for their parameterisation (biomass, rates, processes).  
Implementation and set up of the acidification module for 3-D simulations.

**WP4**

Hindcast simulations. Model calibration and validation against available data. Collaboration with WP1 for collecting additional data.

**WP6**

Production of a one-page information pamphlet in English/Greek for localised promotion of the project.

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**Beneficiary 14**  
**Institute: CNRS**  
**Lead PI: Cyril Moulin, LSCE**

### **A.1 - Justification of major cost items and resources**

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

#### **WP1 & WP3**

Climate-change scenarios:

Some of the climate simulations have been carried out as part of the FP6-ENSEMBLE project by IPSL. Some additional simulations (scenario SRESA2 in particular) have been run for MEECE. All biogeochemical simulations have been carried out for MEECE.

1. Realization of climate simulations over 1860-2000 and 2000-2100 with the IPSL-CM4-v2 model (simulations from Stream 2 of the FP6-ENSEMBLE project).
  - Over 1860-2000: forced by GHGs, aerosols and land use; 3 ensemble members for 1860-2000
  - Over 2000-2100: 3 different scenarios for 2000-2100 (SRES-A2, SRES-A1B, Image-450); 1 or 2 ensemble member per scenario
2. Output of the climate simulations available on a DODs server:
  - An example for one of the 1860-2000 simulations
  - [http://dods.extra.cea.fr/data/p86denv/IPSLCM4\\_v2/LU20C3/ATM/Analyse/TS\\_HF/](http://dods.extra.cea.fr/data/p86denv/IPSLCM4_v2/LU20C3/ATM/Analyse/TS_HF/)
  - High frequency (6 hours) output to force regional models.
3. Realization of ocean biogeochemical simulations over 1860-2000 and 2000-2100 with the PISCES model.
  - Same simulations than the climate ones.
  - All variables from PISCES (nutrients, DIC, Alk, CO<sub>3</sub>, O<sub>2</sub>, pH, DOC, ...) available to force regional models.

#### **Regional satellite data:**

1. Search for a postdoc candidate: A very good researcher, Italo Masotti, has been found to adapt the global PHYSAT method (that allows the detection of several phytoplankton species in addition to total chlorophyll) to regional waters around Europe. Because he is currently working on another project at LSCE, he will start this work in September 2009.
2. The adaptation of PHYSAT has nevertheless already started:
  - A graduate student is working for 5 months (Feb - June 2009) on the validation/improvement of PHYSAT for the Mediterranean Sea using pigment inventories from the French DYFAMED oceanographic station. These data were not used to validate the original PHYSAT algorithm.
  - A collaboration with Severine Alvain (LOG, CNRS) in Northern France aims at improving the PHYSAT performances to detect Phaeocystis blooms in the Channel and in the North Sea. This collaboration was not expected when MEECE was designed and relies on national funding, but will also benefit to the MEECE project.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

#### **WP1**

**Climate-change scenarios:**

All the climate simulations and biogeochemical simulations done at the global scale will be achieved.

The requested variables & diagnostics will be provided for the participants of MEECE on a dedicated server.

The analysis at the global scale on how climate change and ocean acidification affect marine productivity will be pursued.

A post-doc will be hired starting in April 2009.

**Regional satellite data:**

The work performed by the graduate student will be done by June 2009, but it is hard to anticipate the results as this kind of short-term work is not always fully conclusive without additional analysis. Nevertheless, for Month 12, we expect to have a good analysis of the PHYSAT performances in the Mediterranean and perhaps some suggestions to improve them. But the main advances are mostly expected in early 2010 once the postdoctoral work has started.

First results on the adaptation of PHYSAT to the detection of Phaeocystis blooms should also be available for Month 12.

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**Beneficiary 15**

**Institute: SAHFOS**

**Lead PI: Priscilla Licandro**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP1**

Preparation of CPR data to be used for model validation – (plankton abundance and biomass)

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP1**

Release data for modelling validation in the North Sea

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**Beneficiary 16**

**Institute: U Piedmont**

**Lead PI: Prof. Aldo VIARENGO**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP1**

- In the first 6 months of the project, the UPiedmont activities have been focused on planning future exposure experiments with marine mussels (*Mytilus* sp.). In fact, during the MEECE project, the analytical activities will be aimed to investigate the biological effects induced in marine mussels, due to different environmental drivers. First of all, in agreement with the other partners in WP1, the environmental drivers for the study have been selected; in particular, among physical stressors, temperature has been identified as the driver to test, while copper and the antibiotic oxytetracycline have been chosen as testing pollutants for the future studies. The experimental seawater temperature range has been also identified in the range of 14-24°C. Afterwards, an experimental protocol

draft concerning mussel treatment has been realized and applied in preliminary exposure experiments.

- From the technical point of view, three laboratories have been equipped with a temperature programming and control system, to guarantee a constant seawater temperature during the four days exposure and to allow multi-temperature testing, i.e. to perform exposure experiment with the different temperature scenarios at the same time utilizing the three aquaria equipped with temperature control devices.
- From the analytical point of view, a protocol concerning protein extraction and separation, utilizing a two-dimensional gel electrophoresis has been realized and will be applied in analyzing biological samples after exposure to pollutants at different temperatures. Furthermore, a thorough research with major databases concerning marine environments analyses has been performed with the aim to evaluate the distribution of copper concentration in marine ecosystems. During the critical selection of available data, diverse sources have been considered: peer-reviewed scientific articles as well as public databases on environmental monitoring data from different international institutions, i.e. ICES (International Council for the Exploitation of the Sea), UNEP (United Nations Environmental Program) and EEA (European Environmental Agency).
- Finally, preliminary exposure experiments have been carried out to test and set up the experimental system. Moreover, mussel exposure to different concentrations of oxytetracycline and copper has been performed to determine the range of concentration suitable to induce significant effects in the organisms; the results obtained during this preliminary experiment will be useful to correctly plan future experimental activities.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

#### **WP1**

- During the next six months of the project, experimental exposures of mussels to the selected contaminants (i.e. copper and oxytetracycline), at different condition, i.e. temperature and metal concentrations, will be performed. In particular, the pollutant-induced stress syndrome in the organisms will be assessed by the evaluation of a battery of different biomarkers, e.g. lysosomal membrane stability, stress on stress, lipofuscin and neutral lipids lysosomal accumulation. The effects on lysosomal membrane stability as well as on survival rate will be utilized to identify experimental conditions, i.e. concentrations, suitable for proteomics analyses.
- Moreover, a database concerning pollutant concentrations and main biological effects in seawater ecosystem will be realized; obviously, data on the pollutants selected for the experiments, i.e. copper and oxytetracycline, will be included in the database. Different data sources will be considered in the database realization, such as peer-reviewed scientific articles and public databases on environmental monitoring data from different international institutions, i.e. ICES (International Council for the Exploitation of the Sea), UNEP (United Nations Environmental Program) and EEA (European Environmental Agency).

#### **Beneficiary 17**

**Institute: Coastal Research and Planning Institute, Klaipėda University**

**Lead PI: Sergej Olenin**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1-6 (September 08 – Feb 09)*

#### **WP1**

##### T1.1. Collating existing data on key process and drivers

Two activities have been performed within this WP task:

1) Analysis of phytoplankton data and selection of model phytoplankton species. A dinoflagellate *Prorocentrum minimum*, the most successful invasive phytoplankton species in the Baltic Sea, was chosen as a model species. Long term data (1992-2008) were compiled and analyzed in order to establish the environmental tolerance limits for this species and assess its impact on structure of phytoplankton community. The species occurs from fully marine to nearly limnic conditions; its abundance shows a very high annual variability: in some years the species causes algae blooms (density - up to 350 mln cells/litre), while during other periods it is absent in plankton samples.

2) Selection of model zooplankton species. Preliminary analysis of data availability was performed for the copepod *Acartia bifilosa*. The species inhabits a wide range of brackish-water habitats along the Atlantic and Mediterranean European shores and is a dominant species in mesohaline regions of the Baltic Sea.

*Relevant accounts:*

Olenina I., D. Vaičiūtė, and S. Olenin. Biological pollution caused by the potentially toxic invasive dinoflagellate *Prorocentrum minimum* (PAVILLARD) SCHILLER 1933 in the brackish water environment (paper in preparation).

T1.4. Validation data

Application of biopollution assessment method (Olenin et al, 2007). The method was applied to assess the magnitude of impacts of the zebra mussel *Dreissena polymorpha* on native communities, habitats and ecosystem functioning of the Curonian Lagoon, Europe's largest boreal coastal lagoon, situated in the south-eastern part of the Baltic Sea. The biopollution level (BPL) caused by this invasive species was estimated as strong (BPL=3).

*Relevant accounts:*

Olenin S, Minchin D, Daunys D (2007) Assessment of biopollution in aquatic ecosystems. – Marine Pollution Bulletin 55:379-394

Zaiko A. 2009. Habitat engineering role of the invasive bivalve *Dreissena polymorpha* (Pallas, 1771) in the boreal lagoon ecosystem. Doctoral dissertation. Klaipeda University. Klaipeda. Lithuania; pp. 134.

According to the Project Work Plan KU CORPI is not involved in activities under WP2 – W6 during the Months 1- 6 (September 08 – Feb 09).

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP1**

Activities over the next 6months include:

T1.1. Collating existing data on key process and drivers

To finalize data analysis on the invasive phytoplankton species environmental tolerance limits and impact on structural characteristics of native phytoplankton communities.

To develop the database of alien invasive plankton types, containing information on the physiological parameters and including rates of spreading and environmental tolerance of alien invasion plankton types to underpin model development in WP2 and the biopollution index development in WP5.

T1.3. Experimental work

Experiments with model zooplankton species (*Acartia bifilosa*) to determine egg production under different temperature (12-22 C) and salinity (2-8 PSU) regimes.

T.1.4. Validation data

T.1.5. Meta analysis of driver databases and development of new parameterisations relevant to the ecosystem models reconciling

To initiate work on biogeochemical role of invasive zebra mussels in the Curonian Lagoon.

**WP2**

T2.2.7. Module Invasives

In cooperation with PML to start adaptation of biopollution index to assess changes in vulnerability of for invasion due to climate change.

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**Beneficiary 18**

**Institute: Bolding & Burchard ApS (BB)**

**Lead PI: Karsten Bolding**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP2**

BB has been involved in defining and collecting descriptions of the different models to enter in the MEECE Model Library (done in corporation with Mike St. John, Uni. Hamburg). BB has together with Cefas planned, and are in the process of, coupling GOTM to ECOPATH/ECOSIM.

Participated in AMEMR workshop and MEECE WP1 and 2 meeting in Plymouth Feb. 9-13 2009.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP2**

Further work on the coupling with Cefas. Workshop between key ECOPATH/ECOSIM people, Cefas and GOTM developers in the planning phase. Coupling of GOTM with SMS from DTU/Aqua.

BB will hire Jorn Bruggeman to work on MEECE from mid March 2009.

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**Beneficiary 19**

**Institute: Centro Oceanográfico de Gijón. Instituto Español de Oceanografía**

**Lead PI: Ángel Lopez-Urrutia**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP1**

Our goal in this WP is to build on pervious work using metabolic theory of ecology (MTE) (Allen et al., 2005) in marine systems (Lopez Urrutia et al 2006), we will further develop a synthetic theory to explain the effects of body size, temperature and resources on the metabolism of the oceans going from organism to population and communities to whole ecosystems. Although this task is scheduled to start until the end of Year 1 some progress has already been made, especially in data collation to analyse the relationship between temperature, size and resources for determining the structure of phytoplankton communities.

**WP3**

Our objective in this WP focuses on Task 3.3 on regional simulations. The equations for metabolic responses (production and respiration), based on the metabolic ecological theory developed in WP1 and incorporated into PISCES in WP2, will be used to base the fluxes of CO<sub>2</sub> in the system. This general theory (Lopez Urrutia et al., 2006; Lopez Urrutia & Moran, 2007) is used in order to better evaluate the predicted generalized decrease of productivity in marine ecosystems (Sarmiento et al., 2004). Again this task is not supposed to start until

M13 when the first results of task 1.6 (on which this task depends) will be obtained. Progress on this task has been towards the acquisition of the equipment necessary to run this model, and on the contract of a post-doc researcher who will collaborate on the task.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP1**

There are no expected deviations from the work programme, as mentioned above both tasks our Institute is involved in will formally begin at the end of Year 1. Some progress has already been done so we expect to complete both tasks within the schedule proposed.

**WP3**

Same as for WP1. No expected deviations from the work programme.

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**Beneficiary 20**

**Institute: CEA**

**Lead PI: Laurent Bopp**

No reporting required.

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**Beneficiary 21**

**Institute: Biological Institute, Syddansk Universitet**

**Lead PI: Poul Bjerregaard**

*A.1 - Justification of major cost items and resources*

*Brief description of the work performed by each contractor during the period, Months 1- 6 (September 08 – Feb 09)*

**WP1**

- Participation in MEECE start-up meeting in San Sebastian.
- Participation in 3 planning meetings for preparation of the multi-stressor parameterisation experiment starting April 2009.

*Brief description of the anticipated future delivery over the next 6 months, Months 7-12 (March-August 09)*

**WP1**

Completion of the multi stressor experiment examining population dynamics of *Acartia tonsa* at different copper concentrations, CO<sub>2</sub> levels and temperatures.

**B.2 – Dissemination of knowledge**

*[The dissemination activities section should include past and future activities].*

**Presentations at meetings**

Author	Title	Oral, Poster, Proceedings	Name of meeting	Place	Date
Westgård, T., Johansen, G.O., Kvamme, C., Ådlandsvik, B., and Stiansen, J.E.	A framework for storing, retrieving and analysing marine ecosystem data of different origin with variable scale and distribution in time and space.	Oral	Fourth International Symposium in GIS/ Spatial Analyses in Fishery and Aquatic Sciences	Rio de Janeiro, Brazil	25-29 Sept 2008
Allen JI	On the simulation of the impacts of multiple climatic and anthropogenic drivers on marine ecosystems	Oral	PICES Science Board	Dalian China	October 2008
Allen JI	Some thoughts on assessing the skill of marine ecosystem models	Oral	PICES CCCC/ESSS AS Workshop Marine ecosystem model inter-comparisons	Dalian China	October 2008
Sundby, S.	Climate Change: Long Term Trends and Equitable Solutions – Marine Ecosystems and Fisheries.	Oral	Annual Meetings of International Monetary Funds – The World Bank Group Washington,	Washington DC	10 October 2008
Eike Breitbarth Richard J. Bellerby, Craig C. Neill, Murat V. Ardelan, Michael Meyerhöfer, Eckart Zöllner, Peter L. Croot, and Ulf Riebesell.	Ocean acidification effects on iron speciation in seawater	Oral	The Oceans in a high CO <sub>2</sub> world II,	Monaco	6-9 October, 2008
Pedro P Scheel Monteiro, Richard G Bellerby,	Are eastern boundary upwelling systems good analogues for a future high co <sub>2</sub> ocean?	Poster	The Oceans in a high CO <sub>2</sub> world II,	Monaco	6-9 October, 2008

Judith Hauck, Mario Hoppema, Christoph Völker, Richard Bellerby, Dieter Wolf-Gladrow, ,	Observations of acidification in the Weddell Sea on a decadal time scale	Poster	The Oceans in a high CO2 world II,	Monaco	6-9 October, 2008
Fosså, Jan Helge; Bellerby, Richard	Consequences of Ocean Acidification for Fisheries	invited oral presentation,	The Oceans in a high CO2 world II,	Monaco	6-9 October, 2008
Bellerby Richard,	Polar ocean acidification: a bipolar view on changes to the marine carbon dioxide system	Oral	Southern Ocean Biogeochemistry Meeting	University of Cape Town, South Africa,	October 15 <sup>th</sup> , 2008
Bellerby Richard; Quillfeldt, Cecilie von	Ocean acidification from increasing CO2: potential ecological consequences and climate feedbacks,	Oral	Northern Dialogue meeting	Ottawa, Canada	October 17 <sup>th</sup> , 2008
Vikebø, F., Ådlandsvik, B.	Operational fish larvae drift modelling - updates and validation	Oral	Opnet meeting, Geilo,	Geilo, Norway	6 November 2008
Salihoglu, B., Oguz, T., Fach, B.A.	Simulation of Anchovy-Mnemiopsis regime shift.	Oral	IMBER-IMBIZO,	USA	November 2008
S. Olenin et al.	Recent bio-invasion trends in European coastal seas and inland waters	Oral	MALIAF International Conference Management of Alien Species for Sustainable Development of Aquaculture and Fisheries.	Florence, Italy	November 5-7, 2008
Olenina I. et al.	Impacts of the invasive dinoflagellate <i>Prorocentrum minimum</i> (Pavillard) Schiller on pelagic habitat and phytoplankton community in the Baltic Sea	Poster	World Conference on Marine Biodiversity. Valencia, Spain	Valencia, Spain	November 12-15, 2008
Olenin S. et al.	Patterns and impacts of bioinvasions in European coastal seas	Oral	World Conference on Marine Biodiversity. Valencia, Spain	Valencia, Spain	November 12-15, 2008
Bellerby,	Havet forsures av	Kronikk	Forskning.no		December

Richard; Olsen, Are; Nondal, Gisle.	økende CO <sub>2</sub>				2008
Olenin S. and Gollasch S.	Biological invasions in European seas: patterns and impacts	Oral	Seminar on European Marine Strategy and Issues at High Seas	IFREMER, Brest, France.	December 9-11, 2008
Richard Bellerby, Judith Hauck, Mario Hoppema, Pedro Monteiro, Howard Waldron, Christoph Völker and Dieter Wolf-Gladrow	Southern Ocean acidification: rates and regionality with ecological responses and climate feedbacks	Oral	5th Alexander von Humboldt Conference on Iphakade: Climate Changes and African Earth Systems - Past, Present & Future	Cape Town , South Africa	11 – 16 January 2009
Llope M., Licandro P., Chan K., Stenseth N.C.	Spatio-temporal shift in the plankton trophic interactions in the North Sea in the last 50 years.	Poster	ASLO	Nice (France)	25-30 January 2009
Schrum, C	EU FP7 project MEECE	Oral, presented by Frode Flatøy	Bjerknes Centre for Climate Research Getaway Workshop	Geilo, Norway	January, 2009
Frigstad, H.; Hessen, D. O.; Anderson, T.; Magnusson, J.; Bellerby, R.	Carbon to nutrient ratios in marine seston: departures from Redfield.	Poster	ASLO Aquatic Sciences Meeting	Nice	25-30 January 2009
Sonja Ziehm, Richard G. J. Bellerby, Myron A. Peck, Michael A. St. John	Resolving the Dynamics of Phytoplankton Bloom Phenology and Trophic Transfer in Ecosystem Models	Poster	ASLO Aquatic Sciences Meeting	Nice	25-30 January 2009
Allen JI	Coupling Lower and higher trophic level models	Oral	Advances in Marine Ecological Modelling	Plymouth	10-12 February 2009

			Research Workshop (AMEMR)		
Mike St John	Model Complexity and Complex Adaptive Systems	Oral	AMEMR Workshop	Plymouth	10-12 February 2009
SHIN Yunne	A size-based world: modelling trophic interactions in the Benguela ecosystem using OSMOSE-NPZD-ROMS	Oral	AMEMR Workshop	Plymouth	10-12 February 2009
Y Shin	OSMOSE	Oral	AMEMR Workshop	Plymouth	10-12 February 2009
K Bolding	Technical aspects of model coupling	Oral	AMEMR Workshop	Plymouth	10-12 February 2009
C. Smith	Modelling higher trophic groups – problems and priorities from an application point of view	Oral Presentation	AMEMR Workshop	Plymouth	10-12 February 2009
Olenin S.	Biological pollution: what it is and why it is called like this?	Oral	Workshop “Marine Introduced species: can they be good?”	University of Bergen, Norway	February 19-20, 2009
Bellerby, Richard.	Nordic Seas Acidification: Changes to the Marine Carbon Dioxide System and ecosystem response	Oral	Management plan for the Nordic Seas	Oslo	February 13, 2009
Svendsen, St and Schrum, C	Impact of tides on primary production in the North Sea	Oral or Poster (not decided yet)	EGU Annual Science Meeting	Vienna, Austria	April, 2009
Daewel, U Schrum, C Alekseeva, I	Develop strategies to utilize regional climate scenarios to understand marine ecosystem response to climate change, a contribution from the EU project MEECE	Oral	2 <sup>nd</sup> Lund Regional-scale Climate Modelling Workshop	Lund, Sweden	4-8 May 2009
SHIN Yunne	Coupling plankton and fish models for addressing the combined ecosystem effects of overfishing and climate change. Towards a pathways-oriented approach	Oral	3d GLOBEC OSM	Victoria	24-26 June 2009
SHIN Yunne	Comparing indicators across fished marine ecosystems: the IndiSeas experience	Poster	3d GLOBEC OSM	Victoria	24-26 June 2009

Daewel, U and Schrum, C	Preliminary title: Decadal variability of lower trophic level production in the North Sea and Baltic Sea	Oral	ICES Annual Science Conference 2009	Berlin, Germany	September, 2009
Schrum, C, Daewel, U, Alekseeva, I	Preliminary title: Sensitivity ranges of the North Sea-Baltic Sea ecosystem to climate forcing	Oral	ICES Annual Science Conference 2009	Berlin, Germany	September, 2009

### B.3 – Publications

#### a. *Refereed Journals*

- Ådlandsvik, B. 2008. Marine Downscaling of a Future Climate Scenario for the North Sea. *Tellus* 60A:451-458.
- Bellerby RGJ, K. G. Schulz, U. Riebesell, C. Neill, G. Nondal, E. Heegaard, T. Johannessen, and K. R. Brown **Marine ecosystem community carbon and nutrient uptake stoichiometry under varying ocean acidification during the PeECE III experiment** *Biogeosciences*, 5, 1517-1527, 2008
- Findlay H.S., T. Tyrrell, R.G.J. Bellerby, A. Merico, and I. Skjelvan 2008 **Carbon and nutrient mixed layer dynamics in the Norwegian Sea** *Biogeosciences*, 5, 1395-1410.
- Huse, G., Ellingsen, I.H. (2008). Capelin migrations and climate change – a modelling analysis. *Climatic Change* 87(1):177-197.
- Kristiansen, T., Vikebø, F., Sundby, S., Huse, G., Fiksen, Ø. (2008). Growth of larval cod (*Gadus morhua*) in large-scale seasonal and latitudinal environmental gradients, *Deep Sea Res. II* (2008), doi:10.1016/j.dsr2.2008.11.011
- Kristiansen T., Jørgensen, C., Lough, R.G., Vikebø, F. and Fiksen Ø. (2009). Modeling rule-based behavior: habitat selection and the growth-survival trade-off in larval cod. *Behavioral Ecology Advance Access published February 20, 2009.* doi:10.1093/beheco/arp023.
- Husebø, Å., Stenevik, E.K., Slotte, A., Fossum, P., Salthaug, A., Vikebø, F., Folkvord, A.. 2009. Effects of hatching time on year-class strength in Norwegian spring-spawning herring (*Clupea harengus* L.). *ICES Journal of Marine Science*. Accepted with review
- Riebesell U, Richard G. J. Bellerby, Anja Engel, Victoria J. Fabry, David A. Hutchins, Thorsten B. H. Reusch, Kai G. Schulz, and François M. M. Morel Comment on "Phytoplankton Calcification in a High-CO<sub>2</sub> World" *Science* 5 December 2008 322: 1466 [DOI: 10.1126/science.1161096]
- Travers M, Shin YJ, Jennings S, Machu E, Huggett JA, Field J, Cury P, (accepted a). Two-way coupling versus one-way forcing of plankton and fish models to predict ecosystem changes in the Benguela. *Ecological Modelling*.
- Travers M, Watermeyer K, Shannon LJ, Shin YJ, (accepted b). Changes in food web structure under scenarios of overfishing in the southern Benguela: comparison of the Ecosim and OSMOSE modelling approaches. *Journal of Marine Systems*.
- Wassmann P.F., Carroll J. and Bellerby R.G.J., Carbon flux and ecosystem feedback in the northern Barents Sea in an era of climate change: An introduction *Deep Sea Research Part II: Topical Studies in Oceanography, Volume 55, Issues 20-21, October 2008, Pages 2143-2153*

#### b. *Other publications: technical reports, thesis*

- Zaiko A. 2009. Habitat engineering role of the invasive bivalve *Dreissena polymorpha* (Pallas, 1771) in the boreal lagoon ecosystem. Doctoral dissertation. Klaipeda University. Klaipeda. Lithuania; pp. 134

**Appendix 1 Deliverables List to Month 18: shaded areas indicate completed deliverables.**

Del. no.	Deliverable name	WP no.	Lead beneficiary	Estimated Indicative person months	Nature	Dissemination level	Delivery date
D0.1	Risk register, and process diagram and Gantt chart	0	PML	3.00	R	CO	M2
D0.2	Report on kick off meeting	0	PML	1.98	R	PU	M3
D0.3	Project web site	0	PML	12.00	O	PU	M3
D0.4	6 month management report	0	PML	6.00	R	PP	M6
D2.1	Report on system specific key species, feedbacks and forcing	2	UHAM	10.70	R	PU	M9
D2.2	Sub-model acidification-sensitive calcification rate, including user guide	2	PML	9.00	R	PU	M9
D2.3	OSMOSE - plankton models coupled	2	IRD	10.00	R	PU	M12 (delayed 3 months due to maternity leave)
D2.4	APECOSM plankton models coupled	2	IRD	10.00	R	PU	M9
D1.1	Structured databases	1	UiB	30.00	R	PP	M12
D1.2	Initial conditions, boundary conditions and forcing functions	1	CNRS	15.00	O	PU	M12
D1.3	Validation data sets	1	UiB	24.00	O	PU	M12
D2.5	Sub-model Carbon Phytoplankton including user guide	2	UiB	10.00	R	PU	M12
D2.6	Sub-model SMS	2	DTU-AQUA	10.00	R	PU	M12

	including user guide						
D2.7	User guide and report outlining validation methodology	2	PML	8.00	R	PU	M12
D6.1	User Database	6	PML	5.00	O	PP	M12
D6.2	KT webpage	6	PML	6.00	O	PU	M12
D2.8	Sub-model ECOSIM ECOPATH including user guide	2	CEFAS	12.00	R	PU	M15
D2.9	Sub-model of coccolithophore ( <i>E. huxleyi</i> ,) & user guide	2	NERC-POL	7.00	R	PU	M15
D0.5	18 month scientific, management and financial report	0	PML	12.00	R	PP	M18
D2.10	Sub-model Copepod Structured population model including user guide	2	UHAM	12.00	R	PU	M18
D2.11	Sub-model Library of IBM submodels including user guide	2	UHAM	12.00	R	PU	M18
D2.10	Sub-model Copepod Structured population model including user guide	2	UHAM	12.00	R	PU	M18
D2.11	Sub-model Library of IBM submodels including user guide	2	UHAM	12.00	R	PU	M18

**Appendix 2: Milestones List to month 18: : shaded areas indicate completed deliverables.**

<i>List and schedule of milestones</i>					
<b>Milestone number</b>	<b>Milestone name</b>	<b>Work package(s) involved</b>	<b>Lead Beneficiary</b>	<b>Expected date</b>	<b>Comments</b>
1	Kick-off meeting	ALL	PML	M1	
2	Risk register complete	0	PML	M2	
3	MEECE web	0	PML	M3	
4	Systems Workshop	2	UHAM	M3	Achieved M6
5	Formation of user group	6	PML	M3	Achieved M6
6	Experiment design workshop	1	UiB	M9	Held early at month 3
7	Scenario and metrics workshop	3,4	AZTI/UNIBO	M9	
8	Advances in module coupling workshop	2,3,4,5	UHAM/AZTI/UNIBO/IMARES	M12	
9	KT webpage	6	PML	M12	
10	Experimental work complete	1	UHAM	M15	
11	Integrated assessment workshop	5	IMARES	M15	
12	Modules (T2.2.1-3) implemented in regional models	3	NERC-POL	M15	
13	Advances in model Parameterisation workshop	1,2	UiB /UHAM	M16	
14	18 Month Project meeting	ALL	PML	M17	
15	Advances in module coupling workshop	2,3,4,5	UHAM	M18	