



Report

EU BASIN Kickoff Meeting, Copenhagen, Denmark

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Summary

It has been well understood that the North Atlantic plays critical roles in climate change through thermohaline circulation, carbon export and transport–dispersion of marine plankton–fish populations, and in social economics through marine resources protection and utilization. A systematic study of the coupled natural and human processes in North Atlantic is needed for developing ecosystem based management and governance of marine resources protection and usage. At this North Atlantic basin scale, this study can be only achieved through partnerships in international research and education. The international BASIN Program has provided the capability to integrate US, Canadian, and EU scientists and students into a well-coordinated systematic study and education of the coupled natural and human system in the North Atlantic, which is highly endorsed by the European Commission (EC).

The EU kickoff meeting was held between Feb 22 and 25 in Copenhagen. The objective was for all EU BASIN participants to review proposed tasks and to develop detailed plans for their proposed tasks and deliverables. The meeting included:

- An overview of tasks and deliverables for each Work Package (WP)
- Canadian BASIN Status (Pierre Pepin) and the US BASIN North Atlantic Implementation Plan (Meng Zhou)
- Individual WP meetings to discuss detailed research plans
- Mixed WP group meeting to discuss linkages and integrations between WPs
- Plenary discussion on individual and mixed WP reports, planned cruises, experiments, integration between measurements and models, and publications.

The focused areas based on individual and mixed WP are:

- Retrospective study from biogeochemical processes, zooplankton–fish, to economics
- Biological carbon pump and carbon flow in trophic levels
- Role of mesozooplankton and fish in ecosystem, foodweb and carbon pump
- In situ and modeling studies of food webs and ecosystem in regional seas
- Zooplankton and fish vital rates (grazing, growth, and mortality)
- Models from export algorithms, physiology, food web, habitat, to end-to-end
- Data management and service, workshops, and student training

The representative from European Commission (EC) gave a presentation emphasizing:

- EC priorities on ecosystem based resource and maritime management and governance
- New funding mechanism for co-funding marine projects from EC and national grants.

It is clear that 7 million euros from EC contribute a small fraction of the total cost needed to accomplish the tasks and deliverables proposed in the EU-BASIN project. To enhance this EU-BASIN project, Iceland has committed a regional cruise for Iceland Shelf–Basin, Norway has committed a regional monitoring program on Norwegian shelf–shelfbreak and an transatlantic cruise, and Germany has committed a winter convection cruise and proposed an transatlantic cruise adding additional 10-20M euros. Even with the present commitments, to meet the BASIN goals the EU participants must find:

- Additional funding from their national agencies for supporting personnel time, equipment, sensors, and material supplies
- Support from US for scientist to participate in fieldwork and modeling by providing scientific insights, technical support, and ship time for covering different geographic areas and seasons and for process-orientated studies in the North Atlantic.

1. Highlights

1) EU BASIN cruises

Four cruises are specifically discussed as open to US and Canadian participation:

- 2012 German deep-convection cruise (Mar 13–April 27, funded and led by Mike St John):
Focus: Export of winter assemblage after winter convection stops
- 2013 UK PAP cruise (Spring, funded and led by Richard Sanders)
Focus: Meso-scale carbon export and role of grazing and migration of mesozooplankton and midwater fish
- 2013 Norwegian transatlantic cruise (Spring-summer, funded and led by Webjørn Melle)
Focus: Geospatial differences in physical processes, nutrient regimes, plankton-fish community structures, carbon export, and population genetics
- 2013 German transatlantic cruise (Spring-summer, requested and led by Mike St John)
Focus: Geospatial differences in physical processes, nutrient regimes, plankton-fish community structures, carbon export, and population genetics

Note: *A request for a US transatlantic cruise was raised by EU colleagues for either 3 ship operation in spring 2013, or 3 seasons (spring, summer, and fall in 2013 and 2014). The transatlantic cruise is planned to run between Norwegian shelf and North American shelf. If the US cannot participate, an alternative cruise plan was discussed redesigning a transatlantic transect between Norwegian shelf to Greenland shelf by focusing on European shelves and seas.*

2) Regional comparative studies and end-to-end models

Cruises in Greenland, Iceland, and Norwegian shelf and seas were discussed specifically for foodweb, biodiversity, and end-to-end model development. These cruises are composed of already planned monitoring programs for fisheries and plankton-fish communities, and specifically requested cruises. These cruises are generally fully-booked in berths, laboratories, and ship time. In addition, there are existing studies in the Bay of Biscay and North Sea. The comparative study of food web structures, diversity, and models of food webs and end-to-end in regional shelves, slopes, and deep-sea is one of primary BASIN focuses.

Note: *Adding studies in North American shelves, slope, and deep-sea will significantly expand the geographic coverage of the BASIN study region and allow a comparative study of shelves and regional seas crossing the entire North Atlantic. This also provides an opportunity for US scientists and students to be involved into North Atlantic regional comparative study of climate impacts on ecosystems, fisheries, and social economics.*

3) Model development

The model development in the EU BASIN is broad from biogeochemical process, ecosystem, food web, to end-to-end models:

- Export algorithms: The generation 1 and 2 models are suffering from the variation of POC scavenging processes how fast it is remineralized as a function of depth. The Southampton group is going to conduct retrospective study to summarize literature value and produces a new formula.
- 3-D hydrodynamic and ecosystem models: The NEMO framework was adapted by the EU-BASIN. The results of these models will be provided online for all BASIN participants including scientists from North America. Scientists can build their work on NEMO framework and results or in parallel.
- Foodweb carbon or nitrogen (fish) model for regional seas: a Bayesian-statistics based

1-D vertical model for the North Sea has been developed. The advantage using Bayesian statistics is to compute probability functions and to compute variance and correlations between state variables by considering uncertainties in measurements.

- Spatial and temporal explicit end-to-end models: an End-to-end model has been developed and will be refined during the project- which is the primary reason for this project to be funded and has the interests of EC. It has been emphasized and linked with all Work Packages from carbon export to fisheries.

Note: *This EU BASIN project is funded under the primary objective to develop food web and end-to-end models applicable to ecosystem based management and governance. The retrospective analysis, fieldwork measurements, and process studies are designed toward developing these models. This provides US scientists an opportunity to join the EU effort developing models needed for protecting and managing our marine resources and economics.*

4) International partnership

The EU BASIN project is supported by EC with the strong international theme to understand the differences in natural and human processes between different seas and countries, the need of international partnerships, and the future research and education at the global and international level.

Note: *US scientists and students will gain significantly from such international partnerships, not only by international experience working with foreign partners, but also by thinking about coupled natural and human processes and using approaches at global and international levels. This will be a golden opportunity for training our next generation of young scientists.*

2. Specific Opportunities

1) 2012 German deep-convection cruise

Ship: RV Meteor

Date: March 13 – April 27, 2012

Chief Scientist: Mike St John

Study Site: Norwegian Sea, Subpolar Gyre, and Iceland Sea

Objectives: The cruise focuses on carbon export associated with winter deep convection:

- Deep phytoplankton distribution due to winter deep convection
- Carbon export from winter-phytoplankton settling when winter convection stops
- Spring bloom and carbon export associated with spring bloom assemblages
- Effect of grazing and migration of zooplankton and fish on carbon flow and export

Participants will study:

- Phytoplankton-microbes and primary production
 - C13-14 primary production (NOCS)
 - Phytoplankton and microbe abundances and assemblages (NOCS)
 - Phytoplankton physiology and fatty acids (UH)
- Mesozooplankton-fish
 - Towed undulating multi-frequency acoustic system-LOPC-VPR (IMR, UH)
 - ROV for phytoplankton, aggregates, and zooplankton (UH)
 - LOPCs mounted on the rosette (UN-University of Northland)
 - Multiple net system (IMR)
- Carbon export: Southampton group
 - Drifting traps (NOCS)

- Thorium export (NOCS)

Opportunities for US scientists to close the loop:

- Nutrient (trace metals and macronutrients) dynamics
- Size spectra from phytoplankton, microbes to zooplankton
- Zooplankton-fish migration behavior and grazing
- Trophic dynamics based on gut contents and molecular and isotope technologies
- Data analysis and synthesis (Especially for VPR, LOPC, acoustics data)

2) 2013 UK PAP cruise

Ship: To be decided

Date: Spring 2013

Chief Scientist: Richard Sanders

Study Site: Porcupine Abyssal Plain (PAP) time-series station off southwest Ireland

Objectives: The cruise focuses on carbon export associated with meso-scale physical processes and zooplankton grazing in the meso-scale-resolving mooring array site studying:

- Submeso-meso-scale distribution of phytoplankton responding to meso-scale physics and nutrient dynamics
- Impacts of nutrients on phytoplankton assemblages and carbon export
- Effect of grazing and vertical migration of zooplankton and fish on carbon export

Participants will study:

- Phytoplankton-microbes and primary production
 - C13-14 primary production (NOCS)
 - Phytoplankton and microbe abundances and assemblages (NOCS)
- Carbon export: Southampton group
 - Drifting traps and Thorium export (NOCS)

Opportunities for US scientists to close the loop:

- Nutrient (trace metals and macronutrients) dynamics
- Size spectra from phytoplankton, microbes to zooplankton
- Zooplankton-fish migration behavior and grazing
- Trophic dynamics based on gut contents, and molecular and isotope technologies
- Two ship operation integrating meso-scale survey and process studies

3) 2013 Norwegian and German transatlantic cruises

Ships: RV GO Sars (funded) and RV Meteor (funded)

Date: Spring/summer/fall 2013

Chief Scientist: Webjørn Melle (GO Sars) and Mike St John (Meteor)

Study Site: Transects from the Norwegian Shelf to North American Shelf

Objectives: The cruises are designed to examine spatial and seasonal variability in physical, biogeochemical and biological processes:

- Spatial and temporal variability in meso-scale physical processes (scale and strength) superimposed on large basin-scale hydrography, currents and circulation
- Spatial and temporal variability in nutrient compositions that leads to different phytoplankton community dynamics
- Differences in plankton community structures responding to spatial variability in physical and biogeochemical processes, and impacts on carbon flow between trophic

levels and export

- Transport and dispersion of plankton-fish populations crossing shelves and gyres driven by basin-scale circulation and meso-scale dispersion.

Note: EU colleagues have discussed the need of a US ship participating either a 3-ship operation study simultaneously covering 3 trans-atlantic transects at different latitudes, or a 3 season (spring/summer/fall) study covering one trans-atlantic transect. The 3-ship operation study focuses on scientific questions associated with basin scale variability in both the longitude and latitude while the 3-season study focuses on seasonal evolution in meso-basin scale physics, biogeochemical and biological processes.

Participants will study:

- Phytoplankton-microbes and primary production
 - C13-14 primary production (NOCS)
 - Phytoplankton and microbe abundances and assemblages (NOCS)
 - Plankton physiology and rates (UH)
- Mesozooplankton-fish
 - Towed undulating multi-frequency acoustic system-LOPC-VPR (IMR, UH)
 - LOPCs mounted on the rosette (UN)
 - Multiple net systems (IMR)
- Carbon export: Southampton group
 - Thorium export (NOCS)

Opportunities for US scientists to close the loop:

- Nutrient (trace metals and macronutrients) dynamics
- Size spectra from phytoplankton, microbes to zooplankton
- Zooplankton-fish migration behavior and grazing
- Water-column and benthic coupling
- Biodiversity
- Trophic dynamics based on gut contents, and molecular and isotope technologies
- Population genetics
- Data analysis and synthesis (Especially for VPR, LOPC, and acoustic data)

3. Specific needs from North America

1) Basin scale studies

The EU BASIN project sincerely needs the support from US in both the spatial coverage on meso-basin-scale processes in the northwestern Atlantic and Subpolar Gyre, and the scientific collaboration in developing new understandings and models. If there is no US support, the EU BASIN project will fail to complete work at the basin-scale, will become a focused study in European seas only, and will not have any BASIN Phase II funding from EC. Specifically, there is a need for US:

- **To cover scientific topics in the northwestern Atlantic and subpolar gyre.** The Gulf Stream not only transports heat from the southwestern Atlantic to the northeastern Atlantic, but also transports zooplankton-fish populations to invade or mix with local ecosystems while the hydrography and ecosystems in the shelf, shelf slopes, and basins in the northwestern Atlantic are impacted by Arctic and deep water outflows, and plankton-fish populations. Thus the northwestern Atlantic is a critical

link in the entire loop of currents, heat, ecosystems, carbon export, and food webs in the North Atlantic. Missing the northwestern Atlantic, gives rise to a gap in essential data acquisition and will result in a failed BASIN Program.

- **To participate in studies of coupled natural and human processes.** The marine resources and social economics in the North Atlantic are closely coupled by fisheries management, trade, and government political and economic policies throughout countries in North America and West-North Europe. The US has the biggest economy in the world. It is essential for the US to understand coupled natural and human processes for sustainable economic and social development. The EU BASIN provides us a golden opportunity to work closely with EU natural and social scientists. Without US participation, US scientists will be isolated from international science communities.
- **To form the International BASIN Program.** The US has invested significant efforts in the BASIN Program for years. We should take the recently funded EU BASIN as a compliment to the US vision of basin-scale studies. Engaging and collaborating with EU BASIN Project will allow US scientists to work with EU scientists in parallel. Though the EU BASIN is already funded, they are still facing challenges to obtain supplementary funds from individual countries, sort out personnel needs, and negotiate commitments for each member-country. The US NSF system is efficient at selecting the best of proposed research science. As a proposal is funded, scientists can quickly move research activities forward without any need of financial and political supplements so that an integrated US-Canada-EU BASIN project can be formed. But we need to respond now.

2) Advancing science and technology

EU scientists have been closely examining US scientists on emerging scientific questions and breakthroughs in science and technologies. In the EU BASIN Project, EU scientists have been seeking scientific answers and technologies associated with the EU objectives from US scientists. They have been openly asking assistances in:

- Fast analytical methods for trace metals to resolve meso-scale physical and biogeochemical processes
- Capability to resolve submeso-meso-scale physical, biogeochemical and biological processes, understand their impacts on plankton-fish community evolution and export carbon flux, and parameterize these processes in global models
- Capability to resolve particular organic carbon (POC) scavenging processes in order to understand their impacts on carbon flux and parameterize these processes in models
- Capability to estimate zooplankton-fish grazing and migration behavior, and understand their impacts on carbon redistribution in water column
- Capability to measure plankton-fish community structures and trophic dynamics, understand these processes, and develop models for these processes
- Capability to link in situ measurements (especially optical and acoustic sensors) with rate estimates and model development
- Collaboration in developing molecular and isotope methods for prey-predator interaction and trophic dynamics studies
- Comparative analysis between different ecosystem and food web models