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BASIN:
Basin-scale Analysis, Synthesis, and INtegration

Implementation Plan

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A. INTRODUCTION

The North Atlantic Ocean and the adjoining shelf - seas are critical for the ecological, economic, and societal health of the Americas and Europe. Its deep ocean and shelf seas support major fisheries. The basin where the Atlantic Meridional Overturning Circulation (AMOC) unfolds is a focal area for the effects of climate change, and it plays a key role in the global carbon cycle. The more northern regions are dominated by three major ocean current gyres that are interconnected, have similar water properties, and have species complexes that extend across the entire basin from the western to the eastern shores. The shelf seas and deep ocean populations are influenced by a common basin - scale atmospheric forcing, but there is a significant lack of information at a mechanistic level about how the forcing impacts the populations and how impending climate changes will alter the existing ecosystems and the biogeochemical role of the basin. Thus there is an urgent need to better understand the basin - scale processes within the North Atlantic, to be able to predict likely future changes due to climate change, and to be able to integrate from the basin - scale to the local scales of the economically important basin - rim shelf systems.

BASIN is a joint EU / North American research initiative to elucidate the mechanisms underlying observed physical and biological changes in the North Atlantic Ocean and to quantify and predict consequences of climate and environmental variability and change. The ultimate goals are i) the development of an understanding of the links between climate and the marine ecosystems of the North Atlantic basin and the services these ecosystems provide including exploited marine resources, and ii) the use this understanding to develop ecosystem based management strategies that will anticipate the effects of climate change on the living resources of the region. Thus the overarching aim of the BASIN initiative is **to understand and predict the impact of climate change on key species of plankton and fish, and associated ecosystem and biogeochemical dynamics in the North Atlantic basin and surrounding shelves, in order to improve ocean management and conservation**.

This document is an amplification of the BASIN implementation strategy that was provided in the BASIN Science Plan (Wiebe et al, 2009). It is intended to provide a more detailed blue print of BASIN Program scientific activities and their sequence.

B. PROGRAM GOALS

BASIN focuses on resolving the natural variability, potential impacts and feedbacks of global change on the structure, function, and dynamics of ecosystems, and as a result will improve the understanding of marine ecosystem functioning. The overarching aim of the BASIN initiative is to understand and predict the impact of climate change on key species of plankton and fish, and associated ecosystem and biogeochemical dynamics in the North Atlantic basin and surrounding shelf seas, in order to improve ocean management and conservation. The BASIN Program is focused on key processes and organisms, while maintaining a connection to key trophic interactions and their importance for exploited resources within a changing climate. The Program is designed to develop new and improved approaches to ecosystem - based management, based on improved system understanding and modeling. In order to further our understanding BASIN seeks to:

- Understand and simulate the population structure and dynamics of broadly distributed, and trophically and biogeochemically important plankton and fish species in the North Atlantic Ocean;

- Resolve the impacts of climate variability on marine ecosystems and the feedbacks to the climate system;

- Develop understanding and models that will advance ocean management.

C. MAJOR COMPONENTS OF THE BASIN STUDY

The Modeling, Synthesis and Observations sections could be mini reviews of the status and approaches to be used in BASIN, maybe for now extracting what is in the 2005 Science plan as a filler, to be revised and updated by a writing team.

Modeling
Synthesis
Observations

Some text for Observations (an argument about the need for fixed station time series as part of the approach)

Many different types of observations and sampling approaches and methodologies will be required to meet the needs of models, process studies and hypothesis testing in U.S. BASIN. Intensive survey and process oriented sampling will take place on research cruises of relatively short duration. Satellite remote sensing, moorings and Lagrangian-type samplers (e.g. gliders) will provide data over a variety of space and time scales. Sampling with research vessels at one or more time series fixed stations will be needed to measure seasonal cycles in ocean chemistry (e.g. pH, nutrients) and ecosystem (e.g. zooplankton, biodiversity, and abundance) variables not now feasible to collect by new sampling technologies. These fixed stations will be strategically established in U.S. coastal waters so that more economical day-use coastal research vessels can be used, and sampled at sufficient frequency to observe seasonal cycles of key species life histories, phenological variability, and shifts in community diversity. Ship collected samples can be used to groundtruth remote sensors, and demographic data from time series stations will serve to inform and validate the skill of life history models used to predict species and population responses to climate change scenarios. Live zooplankton and phytoplankton samples collected at these stations can also be returned to shore laboratories for physiological and genetic studies related to BASIN objectives. In order to build coherent data sets across the Northwest Atlantic, the basic sampling methods will follow standard protocols (Mitchell et al., 2002) of the Canadian Atlantic Zone Monitoring Program (AZMP) protocols, which has established six fixed stations in waters of eastern Canada and produced time series dating back to 1978.

Management Applications: BASIN, as a science program, has the opportunity to inform a number of critical management issues: overfishing, protected species, spatial management, and ocean acidification. Overfishing remains a primary concern in marine management. There is a growing appreciation that the population dynamics of fishery species are controlled by more than just fishing (Hillborn and Walters 2004). Environmental effects and species interactions change the productive capacity of target populations and thus benchmarks used in making management decisions are continually changing (Keyl and Wolff 2008). To improve the sustainability of exploited marine resources, the factors and processes responsible for changing population productivity must be understood, incorporated into scientific assessments, and communicated to managers.

Most nations bordering the North Atlantic have legislation designed to protect and rebuild marine mammal and sea turtle populations. In some cases, these protections have lead to increases in protected species, which has created conflicts with fisheries (Trzcinski et al 2006). In other cases, populations remain low and are in danger of extinction; understanding the effect of natural processes (Greene and Pershing 2004) and including this understanding in assessments are critical to recovery of these species.

Spatial management is one tool that is being used globally to support fisheries and to protect endangered species. Under the Convention of Biological Diversity, many nations have committed to establish comprehensive, effectively-managed and ecologically representative national and regional systems of Marine Protected Areas (MPAs) by 2012. The objectives of spatial management are multifaceted and the science is species and region specific and there have been notable successes in the North Atlantic. The recovery of the Atlantic sea scallop is in part attributed to the creation of large closed areas on the northeast U.S. shelf (Hart and Rago 2006). Spatial management can also be used in strategies to further protect marine mammals (Vanderlann and Taggart 2009). There also remain a number of complex science questions including defining priority areas for protection, understanding the movement of animals among protected and non-protected areas, the roles of protected areas in supporting habitat and ecosystem services, and including protected areas in spatially-explicit descriptions of population dynamics.

Climate change is a major issue for marine resource management that impacts exploited species, protected species and protected areas. The exploitation of some species may become unsustainable under climate change. The status of marine mammal populations may change and protected areas may no longer meet their objectives owing to changes in species distribution and underlying ecosystem function. One critical component of climate change is ocean acidification, which is caused by increasing concentrations of CO_2 in seawater. Acidification may interfere with the ability of organisms to form calcium carbonate structures and may affect seawater chemistry with indirect affects of marine animals. Although the potential impacts are large and numerous, the resiliency of marine populations and ecosystems to acidification is largely unknown. Information on climate change and ocean acidification in the North Atlantic is needed to ensure management goals and objectives are met in the long-term.

Escience: Based on a successful regional efforts undertaken in other programs (e.g GLOBEC, etc.) and organizations (e.g. ICES, DFO, Pangea, BCO-DMO) that have been utilizing modern escience and informatics data infrastructures to organize and conduct science, BASIN will carry out working group level activities in support of BASIN science and technology working groups.

This working activity will be organized around the principle that progress in basin-scale investigations require new forms of scholarly publishing, and the structure needed to bring researchers into contact with data sets, models, and each other, across disciplines and national boundaries and perform the diverse analyses and modeling required to gain new insights and achieve the BASIN science goals. Due to the heterogeneity of vocabularies, complexity and diversity of data structures and formats, an informatics approach is needed that focuses on defining and answering science questions (use cases) to drive the required semantic and syntactic technical developments. As such, partnerships between scientists, their teams, data managers, and informatics practitioners need to be created.

Key elements for the BASIN eScience effort include:

A BASIN Virtual Observatory (BVO) that

- Integrates regional data repositories and VOs
- Provides access to computing resources
- Provides regional data management and preservation

The definition and formation of an International BASIN Observatory Alliance that includes representation (voting) from application, science, and technical members, and meets regularly to facilite the eScience developments

A clearinghouse for informatics tools and services

Objectives:

- A formed and functioning IBOA
- Propose a suite of interoperability standards and implementations for implementation by assessing nascent activities
- Identify implementing organization (program office).
- Implement a BVO that is in regular use by scientists and managers

Desired outcomes and metrics:

- IBOA formed and meet at least every 6 months in Phases 2 and 2, and at least once per year in Phase C/D and twice in Phase E
- BVO in operation starting in Phase B and evaluated in Phase E

Phasing:

- A - start up
- B - development and implementation

- C and D primary production capabilities
- E - evaluation and assessment for next 5 years

Timeline/phase:

- A - first 6 months
- B - next 12 months
- C - next 24 months
- D - next 12 months
- E - last 6 months

D. BASIN DELIVERABLES AND ACTIVITIES REQUIRED TO ACHIEVE THEM.

There are nine deliverables and a number of science needs required to be addressed to provide them.
I might suggest just listing the deliverables and not providing a lot of general text below each on. Instead, developing a new section that lays out specific components of a US response to BASIN that will flesh out deliverable details. These could perhaps be developed more at the workshop next week.

1. **Enhanced basin-scale coupled climate/ocean/ecosystem modeling systems linking basin- and shelf-scale processes and identification of the climate forcing processes that have the greatest influence on ocean and ecosystem variability.**

2. **Hindcasts of the state and variability of North Atlantic ecosystems for the past 50 years or more and the construction of future scenarios based on the predicted evolution of climate (e.g., IPCC scenarios) as well as the ecosystems themselves**.

3. **Provision of all model results to the community for further analysis and comparisons.**

4. **Estimates of the current state, variability, and vulnerability of North Atlantic and associated shelf ecosystems and their services (e.g., fisheries and carbon sequestration) in response to climate change and exploitation patterns.**

5. **An assessment of the ecosystem and key species spatial connectivity throughout the North Atlantic and associated shelf seas.**

6. **An assessment of the top-down effects of upper trophic levels and effect of their exploitation on ecosystem structure and carbon cycling.**

7. **Identification of the key ecosystem and biogeochemical components and processes that modify population dynamics and their feedbacks to marine ecosystems and climate.**

8. **Estimates of local (shelf) versus remote (deep ocean) natural and anthropogenic impacts on ecosystem dynamics and exploited resources.**

9. **Improved assessment and management tools for exploited resources such as fish stocks based on basin-scale forcing.**

BASIN approach to informing management will be two-fold. First, BASIN results will be incorporated into targeted assessments. The assessments will be identified through a process that includes identifying important management needs and the likelihood that BASIN could contribute to these needs. Second, BASIN results will be used in the context of supporting future assessment and management activities. These emerging issues will also be identified through a formal process. In both cases, BASIN seeks to support scientists to bridge the gap between research and assessment with the goal of improving the advice provided to managers. ICES already hosts several working groups that work between research and assessments and participation of these groups in BASIN will be encouraged (e.g., WGOOFE, http://www.ices.dk/workinggroups/ViewWorkingGroup.aspx?ID=322).

In year 1, the various marine management processes in the North Atlantic will be identified and mapped in a common framework. This will provide the BASIN program and BASIN scientists with a clear view of how the science needs to be transferred to management. These management processes include: Fishery Management Councils of the U.S., Regional Directors in Canada, European Commission, International Council for the Exploration of the Sea, the North Atlantic Fisheries Organization, the International Whaling Commission, national protected species legislation, and the Convention on Biological Diversity. Once the management processes are mapped, priority research needs will be obtained from each organization. These needs will then be considered in the context of BASIN's goals and science questions; specifically, will BASIN be able to provide concrete products to improve specific assessments or management processes. Based on this review, 2-3 specific management activities will be targeted by the BASIN program. Starting in year 2, support will be sought for a bridging activity between the BASIN program and the specific scientists involved in the management process. These activities will be pursued during the first phase of BASIN and then a formal review process will be undertaken at the end of Phase I (year 5).

In addition to targeted current management activities, BASIN will also contribute to emerging management issues. Emerging issues will be identified through a formal process and then the ability of BASIN to contribute to these issues will be assessed. Several important and BASIN-relevant issues will be selected by the end of Year 1. Starting in year 2, a scientist will be supported to work as a bridge between BASIN research and the emerging management issue. These activities will also be reviewed at the end of Phase I.

An important component of the application of BASIN science to management is the perspective from management to BASIN. In addition to incorporating BASIN science into assessments and management, the scientists identified above will also work with BASIN researchers to make sure that the information necessary for management is generated by BASIN. This two-way communication is important to ensure that BASIN research and applications to management continued to be matched during the program.

Possible Components of an NSF Contribution to BASIN

1. Ecosystem dynamics of the Western North Atlantic Gyre (WNAG) and the relative roles of the WNAG and Labrador Subarctic Slope water in exchange into the Gulf of Maine. (The research will address essentially all of the general BASIN deliverables).

2. Local vs remote forcing of plankton abundance and distribution on the Gulf of Maine coastal shelf, banks and ledges. (Deliverable 8)

The coastal shelf, banks and ledges (< 100m depth including Georges Bank but also the inner fishing grounds) are the primary locations for the Gulf of Maine fisheries. Planktivorous fish (herring, mackerel, sand lance) are key prey for higher trophic levels in these areas, and these planktivores in turn rely on dominant mesozooplankton, including Calanus finmarchicus and euphausids. What are the sources and dynamics controlling abundance of these zooplankton prey in these shallow fishing grounds? On the Norwegian shelf, C. finmarchicus are directly supplied by cross–shelfbreak transport from the deep Norwegian Sea basin (Samuelson et al 2010). This contrast in shelf-basin exchange will prove useful in the analysis of ecosystem processes, phenology and population dynamics along coastal shelves in each side of the North Atlantic. In the NW Atlantic, C. finmarchicus supply to the coastal fishing grounds is mediated by local production in the relatively deep shelf seas (GoM and Gulf of St. Lawrence), fed indirectly by sources on the Scotian Shelf and Gulf of St. Lawrence, the Labrador Sea and the western North Atlantic Gyre,

3. Climate change impacts on key populations in the deep N. Atlantic Basin
4. etc., etc.

E. PROGRAM PHASING

Prioritization and timing of BASIN research activities

BASIN research will involve a combination of modeling, data synthesis, regional and basin scale surveys and time series, and process studies including laboratory and field measurements of vital rates and biogeochemical processes (Table xxx). Each of these activities and components thereof is prioritized in terms of the timing of its contribution to the overall program. The resulting chronology of execution of these components is broken down according to major activity.

The modeling activity is high priority as it will be used to help design and refine the field surveys and process studies. The 1st deliverable involves all the modeling activities, from model development to skill assessment to hindcast/forecast, and eventually to the implementation of basin-scale modeling/observing system. Within the overall modeling effort, it is first necessary to couple the regional and basin scale physical models, as subsequent modeling activities including OSSEs depend on completion of this task. In parallel with this effort, other first priority modeling activities include the integration of biological and physical models, the development of trophic interaction, species population dynamics, and biogeochemical models, the identification of data gaps, and experimental design (OSSEs). Once these initial modeling tasks are completed the second tier modeling can begin, including hindcasting and skill assessment and implementation of data assimilation methods. These modeling activities are essential for the hindcast/forecast of the ecosystem state and variability (deliverable 2 and 4), for assessing population connectivity across the basin (deliverable 5), and for understanding regional to basin-scale ecosystem and biogeochemistry processes (deliverable 6 and 7). Third tier modeling efforts include forecasting and skill assessment, and the design and initial implementation of a basin-scale modeling/observing system. . The model results should be accessible for the community through a distributed database structure for further analysis and comparisons (deliverable 3), and should be closely linked to the observing system design and implementation. The end product of a modeling/observing system, along with the results from data synthesis (see below), will provide improved assessment and management tools for exploited resources (deliverable 8 and 9).

Synthesis activities should begin in parallel with the modeling effort. High priority is retrospective data analysis/synthesis to identify extant knowledge and determine data gaps. Also, at the outset of the program it is important to develop management mechanisms and begin implementation of knowledge transfer and outreach. The management and educational outreach perspectives need to be incorporated from the start of the program. The initial historical data synthesis is needed for the identification of mechanisms of variability and assessment of predictability, which then will be used to help design and refine the field program.

The field program will clearly need to include time series observations, which need to be started at the outset of the program. The time series will be done using moorings, fixed stations occupied repeatedly by research vessels, remote sensing (satellite, CODAR), and combinations of floats, drifters (e.g ARGO), and AUV transects. These platforms should sample physics, chemistry, and biology to the highest taxonomic resolution possible, depending on the platform type.

Regional and basin scale sampling is second priority in terms of timing since the exact locations and sampling designs will require results from initial modeling, OSSEs, and historical data synthesis. The regional and basin sampling will include a combination of robotic vehicles such as AUVs, gliders, profiling floats as well as transect sampling using research vessels.

The process studies will involve both field and laboratory measurements, including life history parameters and vital rates of key species as well as biogeochemical transformation processes. The laboratory studies have the higher priority here as they are critically needed for modeling studies. The field measurements will follow as guided by the retrospective data synthesis and modeling.

A critical aspect for the success of BASIN is transition of new technology through further development, so that the new sampling capacity needed for the program can be attained soon after the program begins. These new technologies include sampling on small platforms and moorings using acoustics, optical imaging systems, and nutrient sensors. In addition, operational underway instruments need further development. This new technology development is viewed as high priority.

Table xxx

Activities	**2011**	**2012**	**2013**	**2014**	**2015**	**Contributes to deliverables**
Modelling						
Coupling of basin – regional-scale physical models	I	I				1, 4, 8
Hindcasting and skill assessment		II	II			1, 2, 3, 4
Identification of information and data gaps, experimental design (OSSEs)	I	I				1, 2, 9
Integration of biological and physical models	I	I				1, 2, 3, 5, 6
Implementation of data assimilation methods		II	II			1, 2
Forecasting and Skill assessment			III	III	III	1, 4, 9
Development of trophic interaction, population dynamics, species, and biogeochemical models	I	I				1, 6, 7, 8, 9
Design and initial implementation of a basin-scale modeling/observing system			III	III	III	1, 9
Synthesis						
Retrospective data synthesis.	I	I				2, 3
Develop management mechanisms and begin implementation, knowledge transfer and outreach.	I	I	I	I	I	8, 9
Identification of mechanisms of variability and assessment of predictability.	II	II	II			1, 2, 4, 9
Time Series						
Moorings	I	I				
Fixed stations	I	I				
Remote Sensing (satellite, CODAR)	I	I				
Floats/drifters (e.g ARGO)	I	I				

Activities	**2011**	**2012**	**2013**	**2014**	**2015**	**Contributes to deliverables**
Regional and Basin Scale						
Vehicles – AUVs, gliders, floats	II	II	II			
Ship Transects	II	II	II			
Process Studies						
Field – key species and biogeochemistry	II	II	II			
Laboratory – vital rates and biogeochemical rates	I	I				
Technology Development						
Acoustics for small platforms	I	I				
Imaging systems, operational underway and small platforms	I	I				
Nutrients – moorings and small platforms	I	I				
E-Science						
Basin Virtual Observatory (BVO)						
Formation of BVO alliance						
Informatics tools and services						

F. RELATED EXISTING PROGRAMS RELEVANT TO BASIN.

USA

In addition to entertaining new proposals, NSF and NOAA have also encouraged investigators with existing BASIN-related projects to participate in the program. There are a number of existing and anticipated efforts supported by NSF, NOAA, NASA, and other agencies in the US that will allow close collaboration with the proposed BASIN program. The following is a list of existing US Projects and Programs relevant to BASIN that represent complementary activities.

Existing US Projects and Programs relevant to BASIN
NERACOOS: Northeastern Regional Association of Coastal Ocean Observing Systems (http://www.neracoos.org/) – A NOAA IOOS funded association for ocean observing

between New York and Nova Scotia, which includes both U.S. and Canadian scientists.
MACOORA: Mid-Atlantic Coastal Ocean Observing Regional Association (http://www.macoora.org/) – A NOAA IOOS funded association for ocean observing between New York and Virginia.
OOI: Ocean Observatories Initiative (http://www.oceanleadership.org/programs-and-partnerships/ocean-observing/ooi/) – A NSF funded program of science-driven sensor systems to measure the physical, chemical, geological and biological variables in the ocean and seafloor. Specific to BASIN, there are sites on the northeast U.S. continental shelf and in the Irminger Sea.
NOAA/CPO: Climate Program Office –(http://www.oco.noaa.gov/) - Builds, sustains, and coordinates a global climate observing system with a wide variety of assets in the North Atlantic including U.S. contributions to the Global Drifter Program, support for high density XBT lines across the North Atlantic, and pCO2 measurements on NOAA and merchant vessels.
NOAA FATE: Fisheries And The Environment (http://fate.nmfs.noaa.gov/) – Improves single species and ecosystem assessments across the US. There are several projects in the North Atlantic including habitat modeling of fishery species, integrative modeling focused on cod recruitment, and work examining the dynamics of Atlantic herring. A number of other relevant proposals were recently submitted to the 2010 funding call.
BCO-DMO: Biological and Chemical Oceanography Data Management Office (http://www.bco-dmo.org/) – Supports the scientific community through improved accessibility to ocean science data. The BCO-DMO provides continuing curatorship for the US GLOBEC and US JGOFS data repositories as well as several others, which are highly relevant to the BASIN program.
CAMEO: Comparative Analysis of Marine Ecosystem Organization (http://cameo.noaa.gov/) - A partnership between the NOAA and NSF that supports fundamental research to understand complex dynamics controlling ecosystem structure, productivity, behavior, resilience, and population connectivity, as well as effects of climate variability and anthropogenic pressures on living marine resources and critical habitats. There are currently two funded projects and a funded post-doc that are relevant to the BASIN program as well as several submitted proposals that are under consideration for funding in 2010.
NOAA/NEFSC: The Northeast Fisheries Science Center (http://www.nefsc.noaa.gov/) – Responsible for the assessment, conservation and protection of living marine resources within the northeast United States' Exclusive Economic Zone (water three to 200 mile offshore). There are a number of activities relevant to BASIN including fishery and oceanographic observing programs (trawl survey, EcoMon, SOOP-CPR), data integration and management activities, measurements of vital rates and habitat, trophic and food web

modeling, population modeling, and a wide variety of bioecomic modeling and ocean management activities. Most of the programs are ongoing.
US GLOBEC: US Global Ocean Ecosystems Dynamic Program (http://www.usglobec.org/) - a multi-disciplinary research program that examines the potential impact of global climate change on ocean ecosystems. The Georges Bank / NW Atlantic GLOBEC Program was one of three national level programs which was funded during the 1990's. The national program is now in a Pan-synthesis phase with several funded projects working in the North Atlantic that are highly relevant to the BASIN program.
CINAR: Cooperative Institute for the North Atlantic (http://www.whoi.edu/page.do?pid=30715) - Conducts and coordinates cutting-edge research engaging both NOAA and academic scientists to enable informed decisions by NOAA for sustainable and beneficial management of the northwestern Atlantic shelf ecosystem. There are numerous activities underway by CINAR members that are relate to the EU BASIN program
COML: Census of Marine Life (http://www.coml.org/) – An international effort to assess and explain the diversity, distribution, and abundance of life in the oceans. As part of COML, a program was established in the Gulf of Maine; the goal of this regional program is to advance knowledge of both biodiversity and ecological processes over a range of habitats and food-chain levels, from plankton to whales
BATS: Bermuda Atlantic Time-Series Study (http://bats.bios.edu/) – A funded program south of Bermuda that maintains deep-ocean time-series, with a focus on the importance of biological diversity in understanding biological and chemical cycles and in particular the Biological Carbon Pump.

Canada

The Department of Fisheries and Oceans has as a major priority for both the Maritimes and Newfoundland regions of DFO to describe and understand coupled ocean and shelf processes in order to assess and predict the impact of climate variability and climate change on marine ecosystems and exploitable resources. This is in agreement with the overarching aim of BASIN and provides a solid basis for cooperation. Under the BASIN umbrella, DFO is pursuing a number of initiatives that could become contributions and the following lists projects under the major components of the BASIN Science Plan. These initiatives have varying levels and duration of approved funding, from the proposal stage for some to current multi-year funding for others. Resources invested in each activity are in dollar-equivalent are per year.

Existing Canadian Projects and Programs relevant to BASIN
Modelling
• Climate variability and shelf-ocean coupling: NEMO at global (1 deg), basin (1/4

deg) and shelf (1/12 deg). Simulations from 1950 to present. *Contacts:* Youyu Lu and Dave Brickman; *Resources:* $100K (computer equipment depreciation) + $100K (personnel) (approved to 2010, with possible follow-on)

- Climate change simulations: dynamical downscaling of atmospheric scenarios to the ocean shelf model. Simulations from 1970 to 2070 . *Contacts:* Joel Chasse, Will Perrie; Resources: $100K (computer equipment depreciation) + $100K (personnel), (approved 2008-2011, with possible follow-on)

- Physical-biological modelling: coupling of shelf model with simple NPZ. *Contacts:* Alain Vezina, Diane Lavoie Resources:$25 K (equipment / depreciation) + $40K (personnel) (approved to 2011).

- Ecosystem modelling: Bioenergetic modelling of the coupled pelagic-benthic ecosystem. *Contacts:* Alida Bundy, Mariano Koen-Alonso. *Resources:* $30K (operations) + $100K (personnel) (approved to 2011).

Retrospective/reanalysis

- Assessment of climate change and impacts in the NW Atlantic: analysis and synthesis of existing data supported by CCSI and IGS. *Contacts:* John Loder**.** *Resources:* $30K (vessels) + $100K (operations and computer/field equipment depreciation) + $100K (personnel), confirmed through 2011 only

- Compilation and synthesis of ecosystem data to support assessments of fishng and climate impacts. *Contacts:* Ken Frank, Bill Li. *Resources:* $15K (operations) + $100K (personnel) (Ongoing research plus support from DFO programs confirmed to 2010-2011).

Observations

- Labrador Sea Line (AR7W) Monitoring: occupied once a year, with measurements of physical, chemical and biological properties across deep Labrador basin and both the Greenland and Labrador shelves. Long-term near-bottom current-meter mooring on Labrador Slope. Piggy-back opportunity for additional sampling such as eddies and ocean acidification. Extended Halifax Line Monitoring: occupied once a year with measurements of physical, chemical and biological properties across Scotian Slope and Rise. *Contacts:* John Loder, Glen Harrison. *Resources:* $480K (vessels) + $120K (operations and equip depreciation) + $180K (personnel) (ongoing monitoring with variable funding for add-on research)

- Atlantic Zone Monitoring Program (AZMP): combination of shelf time series and sections that run across the shelf to the continental slope where physico-chemical and lower trophic level variables are measured. The program also includes measurements of these same variables during bi-annual multispecies (ecosystem) surveys to link with higher trophic levels. *Contacts:* Pierre Pepin, Glen Harrison;

Resources: $2550K (vessels) + $480K (operations) + $540K (personnel) (ongoing monitoring with variable funding for add-on research)
• Ocean climate variability from Argo floats: updated time series of key water mass properties such as Labrador sea Water. *Contact:* Igor Yashayaev; *Resources:* $120K (floats) + $30K (personnel) (ongoing monitoring with variable funding for interpretation)
• Ocean SST, SSS, SSH, sea-ice and ocean colour:processing and validation of data from SeaWiFS / MERIS, TOPEX/Poseidon and other satellites, production of imagery / data sets for the NW Atlantic, and research on improvements of algorithms for optically complex waters. *Contacts:* Ed Horne, Peter Smith. Resources: $100K (equipment/depreciation) + $50K (operations) + $180K (personnel) (ongoing monitoring) and $3350K in research and development (confirmed to 2011).
• NW Atlantic slope currents variability: Since 2000, moored current measurements of 1-6 years duration have been made in several deep-water slope regions with petroleum, climate and/or ecosystem interest. These have included Orphan Basin, Flemish Pass, Laurentian Fan and the Scotian Slope/Rise. Moorings are presently deployed in the Orphan Basin/Knoll, Laurentian Fan and Scotian Rise (as part of UK RAPID) regions, and are expected to be re-deployed in the latter two regions for at least one more year. There is potential for planned analyses for seasonal and interannual variability in subpolar gyre currents and water masses to be a contribution to BASIN. *Contacts:* John Loder and Blair Greenan; *Resources:* $480K (vessels) + $250K (operations and equip depreciation) + $100K (personnel) (funded through 2010-11, with possibility of follow-on).
• Ocean Tracking Network: deployment of gliders along Halifax lines with physical and biological sensors. *Contact:* Peter Smith. *Resources:* $250K (vessel time) + $250K (equipment) + $150K (personel) (funding confirmed to 2012).
• Data management and integration: The data generated by these programs are processed, quality-controlled and entered systematically in DFO-managed databases. With respect to BASIN data integration objectives, DFO is investing and participating in the development of standards that facilitate interoperability and international exchange of data (e.g. IOC/IODE). We are already in touch with the leader of the Data integration WP (Stephane Pesant) and will cooperate with the effort to integrate data sets across the N Atlantic basin. *Contact:* Mary Kennedy; *Resources*: $70K (operations) + $100K (personel).

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