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Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2014/034

Newfoundland and Labrador, Québec, Gulf, and Maritimes Regions

Proceedings of the Sixteenth Annual Meeting of the Atlantic Zone Monitoring Program (AZMP)

18-20 March, 2014
Montréal, Québec

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Editor: James Meade

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Fisheries and Oceans Canada
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April 2015

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

ISSN 1701-1280

Correct citation for this publication:

DFO. 2015. Proceedings of the Sixteenth Annual meeting of the Atlantic Zone Monitoring Program (AZMP); 18-20 March, 2014. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2014/034.

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SUMMARY

The Atlantic Zone Monitoring Program (AZMP) was implemented in 1998 with the aim of collecting and analyzing the biological, chemical, and physical field data that are necessary to

1. characterize and understand the causes of oceanic variability at the seasonal, interannual, and decadal scales,
2. provide multidisciplinary data sets that can be used to establish relationships among the biological, chemical, and physical variables, and
3. provide adequate data to support the sound development of ocean activities.

AZMP scientists meet annually to review the activities of the Program and assess business, operational and logistic issues that need regional/zonal intervention, or that must be brought to the attention of the DFO Atlantic Science Directors Committee.The year 2009 marked the 10th anniversary of ocean observation by AZMP. In March 2010, AZMP scientists initiated an effort to synthesize and integrate the oceanographic conditions observed in the Atlantic Zone since 1999, to identify trends or changes, and to provide a critical assessment of the information available. In 2014, they reconvened in Montreal from March 18 to 20 to continue work on the synthesis, discuss logistic and operational issues, review recent oceanographic conditions within the zone, update the plans for the integration and synthesis exercise, and finalize the plan of work for the current year.

Compte rendu de la seizième réunion du Programme Zonal de Monitorage Atlantique

SOMMAIRE

Le Programme de monitorage de la zone atlantique (PMZA) a été mis en œuvre en 1998 afin de recueillir sur le terrain et analyser les données biologiques, chimiques et physiques nécessaires pour :

1. caractériser et comprendre les causes de la variabilité océanique à des échelles saisonnières, interannuelles et décennales;
2. constituer des ensembles de données multidisciplinaires qui peuvent servir à établir des relations entre les variables biologiques, chimiques, et physiques et,
3. fournir des données adéquates pour assurer le développement adéquat de projets en milieu marin.

Les scientifiques du PMZA se réunissent annuellement pour revoir les activités du Programme et identifier les enjeux relatifs à ses opérations et à la logistique qui requièrent une intervention régionale/zonale ou qui doivent être portés à la connaissance du Comité des directeurs des sciences de la zone atlantique du MPO. Le PMZA a complété sa première décennie d'observations océaniques en 2009. En mars 2010, les scientifiques du Programme entreprirent de synthétiser et d'intégrer les conditions océanographiques observées dans la zone atlantique depuis 2000, d'identifier les tendances ou les changements survenus et d'effectuer une évaluation critique de l’information disponible. Ils se sont réunis à nouveau à Montréal du 18 au 20 mars 2014 pour continuer les travaux concernant la synthèse, revoir les enjeux logistiques et opérationnels, discuter des conditions océanographiques récentes dans la zone, évaluer la progression des efforts de synthèse et d'intégration et finaliser le plan de travail pour l'année en cours.

SESSION 1 – AZMP SYNTHESIS WORKSHOP, 17 MARCH 2014

Rapporteur – Gary Maillet

ZOOPLANKTON SYNTHESIS: REVISED ANALYSES – PIERRE PEPIN

Collaborators: C. Johnson, M. Harvey, B. Casault, E. Colbourne, P. Galbraith, D. Hebert, G. Lazin, G. Maillet, S. Plourde, M. Starr

The overall objective of synthesis is to provide integrated perspective of state of the Western Atlantic or Regions based on physical, chemical and biological oceanographic conditions. The analyses seek to identify the fundamental relationships between drivers (processes) and response (state) variables. Phase I has focussed on zooplankton distributions and environmental relationships. The objectives were to:

1. combine data from zooplankton collections from NLS (Newfoundland and Labrador Shelves), GSL (Gulf of St. Lawrence) and SS (Scotian Shelf) from Spring and Fall surveys,
2. develop an Atlas of species distributions,
3. investigate patterns in community structure and similarity/dissimilarity among areas using unconstrained analytical tools (Principal Components Analysis) as an exploration of broad scale patterns in species composition and using constrained analytical tools (Redundancy Analysis) to determine role of environmental variables on species composition.

The biological data were to be supplied and combined by June 2012 but were completed by late July and revised in August; the physical data were completed sometime in late 2012 and revised in 2013. Results of the analyses presented in 2013 were revised, with limited change to the overall outcomes.

Analysis of environmental conditions revealed that temperature-salinity-nutrient gradients are dominant signals in both spring and fall. Spring surveys identified a strong depth-related gradient in surface and subsurface nutrient inventories that defines the onshore-offshore gradient. This variation was nearly orthogonal to the gradients in temperature-salinity versus the thickness of the cold intermediate layer and oxygen-excess silicate concentrations that essentially represent a latitudinal effect. The strongest environmental gradient in the fall was associated with temperature, reflecting a latitudinal effect. Variations associated with depth were nearly orthogonal to the temperature gradient, as in the spring. Phytoplankton standing stock, along with corresponding biogeochemical variables, represents a variable habitat descriptor superimposed over broad scale environmental features, in both spring and fall.

The unconstrained analyses explained 45-50 % of the variation in zooplankton community structure in the first three principal components. Broad-scale biogeographic features identified in the analysis represent dominant features of the pelagic environment in the region. Bathymetry proved to have the strongest and most consistent effect across space and time, which was also apparent in metrics such as richness and diversity. This suggests that the vertical extent and variations in water column environmental features are likely important determinants of community complexity and habitat partitioning among taxa. The potential significance of ecophysiological adaptation appears to be critical in many ways because the second and third PCs of the unconstrained analyses identified important latitudinal and estuarine-versus-oceanic gradients in community structure as significant signals after bathymetry.

The constrained analyses explained slightly less than 40 % of the variation in zooplankton community structure in the first three axes, implying that factors other than those considered in our models are at play. They revealed the dominant influence of only a few environmental

variables and the role of a few dominant species in delineating the overall structure of the zooplankton communities in the northwest Atlantic. Bathymetry was a dominant variable as in the unconstrained analyses, but there was a strong interaction with the relative influence of temperature and salinity variations on community composition. The spring RDA3 differentiated some of the dominant north temperate species from the dominant subarctic species. In the fall, warm temperatures were associated with summer-fall and warm-water shelf copepods along RDA2, with positive RDA2 scores on the Scotian Shelf, southern Grand Bank and Flemish Cap. Similarly, the salinity-CIL (Cold Intermediate Layer) axis (RDA2 in spring and RDA3 in fall) differentiated communities of the Gulf of St. Lawrence, and its outflow on the inshore Scotian Shelf, from the Labrador and Newfoundland Shelves.

From the constrained analyses, we found that RDA and residual PCA analyses highlighted differences between macro- and mesoscale processes on zooplankton communities. The delineation of coastal currents and shelf-break reflect the influence of subarctic species, north temperate species and warm shelf species that are mixed to varying degrees throughout the region, and upon which seasonal variability is superimposed. There were limitations in identifying some features using such large datasets in which relationships are assumed to be linear. The analyses also lacked any consideration of trophic interaction with plankton-feeding fish or the potential effects of differences in ecosystem structure and recovery across the NW Atlantic. We also found that interannual variations in the environment reflected to varying degrees in the predictive skill of RDA at local levels. Differences in the dynamics of local circulation may contribute to the limited explanatory power of the RDA.

Discussion

A participant noted a substantial difference in the seasonal abundances of zooplankton taxa based on scorecard indices between successive occupations of the Cabot Strait section by Maritimes and Quebec Regions that are offset in temporal coverage resulting in some interpretation issues. The speaker indicated the different time scales of the AZMP surveys were likely to influence the outcome in seasonal abundance and distribution patterns observed across the zone and require consideration for a consistent approach in the analysis.

The speaker noted that further work is needed to transition from the current investigations into broad-scale zonal patterns of zooplankton abundance and distribution to more detailed regional analyses. In addition, the speaker noted regional analyses may permit more explanatory power beyond the core zonal analyses to date.

A participant noted the use of water mass indicators (e.g., contributions of polar, temperate, and sub-tropical waters) in addition to standard bathymetry would be useful to include in the analysis.

A participant asked whether percent composition of zooplankton taxa was evaluated in the zonal analysis. The speaker indicated that this typically leads to distribution extremes when using this approach. The main criterion for choosing a suitable transformation of the data is to eliminate extremes, and this is the main reason why the Hellinger transformation was selected rather than percent composition.

Additional concerns were briefly discussed about the influence that seasonally ice-covered areas (ice extent and volumes) may have for the regional biogeographic analyses of zooplankton. There were also general comments regarding the identification of the important environmental variables and drivers, and the possible need to enhance the regional analyses and zooplankton attributes (e.g., warm- versus cold-water adapted species).

The speaker indicated that the plan is to submit the manuscript in progress to “Progress in Oceanography” sometime in 2014. Any additional suggestions were welcomed.

AZMP MESOZOOPLANKTON ATLAS – CATHERINE JOHNSON

Collaborators: B. Casault, P. Pepin, M. Harvey

An atlas of mesozooplankton distributions is being developed as a baseline overview of the spatial distributions of the mesozooplankton taxa of the northwest Atlantic shelf system. The atlas will provide context for interannual zooplankton community responses to environmental change, and it provides an abundance-based perspective on community structure and possible niche separation among dominant and subdominant copepod species. Recent work to complete the atlas has focused on identifying the most appropriate method for estimating the central tendency of abundance, on enhancing the presentation of the data to enhance comparability among taxa, and on interpreting spatial distributions of dominant and sub-dominant copepod species.

AZMP abundance data for dominant copepod species had log-normal probability distributions, typical of zooplankton data, but the probability distributions of all but the three most abundant species were over-dispersed due to frequent zero-value observations ("zero-inflated"), which include a mixture of true absences and probable low abundance values below the abundance detection limit. Zooplankton abundance data are often log (n+1) transformed before calculating the mean to normalize the distribution and reduce positive bias from skew associated with their lognormal distribution. However, zero-inflated distributions introduce a negative bias in the means which is greater for means calculated using log-transformed data than for means calculated using untransformed data. For zooplankton enumerated using the AZMP protocol, means of untransformed data were determined by visual inspection to provide a more reasonable representation of the central tendency than means of log-transformed data, and thus the means of untransformed abundances will be presented in the atlas.

Spatial distributions of approximately 67 taxa will be presented in the atlas, including 49 copepod species or genera and 18 non-copepod groups. Presentation of the copepod taxa was organized by evaluating their rank order of abundance and occurrence in spring and autumn. The three most abundant copepod taxa, which had >89 % occurrence in both spring and autumn, were defined as dominant taxa, while nine other taxa in the highest 95 % of ordered cumulative abundance in spring or autumn were considered sub-dominants. The next most abundant taxa comprising up to 99 % of ranked cumulative abundance were defined as uncommon, while others were defined as rare. The differentiation of uncommon and rare taxa, in particular, is subjective and sensitive to sampling error; however, it provides a general organizational structure to present the numerous atlas distributions. Atlas figures were limited to three possible abundance scales (0 to roughly 50,000, 5,000, or 500), to allow patterns to be visualized across the range of abundances observed while also maximizing the comparability among taxa distribution plots.

Geographic distributions, life history traits, and seasonal variability suggest the dominant and subdominant species may occupy different ecological niches in the northwest Atlantic shelf system. For example, the two most abundant species, *Oithona similis* and *Calanus finmarchicus*, were both present at nearly every station occupation (occurrence >98 % in both seasons). Both of these species are considered omnivorous feeders, but *C. finmarchicus* preferentially feeds on large phytoplankton and focuses its reproductive effort on the spring bloom, while *O. similis* is a generalist feeder that is abundant year-round and appears to have a greater role in grazing on species associated with the microbial food web such as ciliates. The most abundant of the subdominant copepod species, *Temora longicornis* and *Microcalanus* spp., both small copepods, overlap little in their horizontal distributions, with *T. longicornis* abundant in shallow waters and *Microcalanus* spp. abundant in deep, off-shelf waters. Congeners among the dominant and subdominant species, such as the three *Calanus* species

in the region, likely play similar ecological roles, but they appear to be metabolically adapted to different water temperatures ranges. Species richness is enhanced by the offshore/deepwater and estuarine species, but most of these uncommon or rare species probably play a minor ecological role. The perspective on community composition and patterns of abundance and distribution provided by the atlas analysis provides the basis for understanding how different types of environmental change will influence the zooplankton community in the northwest-Atlantic shelf system.

Discussion

A participant inquired about the generation times of the different zooplankton species and how this life history trait might influence response to environmental changes. The speaker indicated this information is known for many of the dominant taxa but may require additional work for some of the sub-dominants and uncommon species. The speaker also suggested additional investigation into the life history traits such as the ecological roles of taxa would also be useful to incorporate into the atlas where such information is available.

A suggestion was made regarding consideration of working with rare-uncommon species to uncover detection of additional environmental signals of importance. In addition, water mass indicators might be useful to explore with environmental relationships. At this time, only calanoid copepods are selected for additional assessment in the AZMP protocol, which is largely based on biomass consideration of these taxa.

A comment was made whether more resources should be directed toward sorting of additional fractions to acquire more data on rare species but was considered not to be cost effective at this time given the limited resources available to the program.

It was suggested that uncommon-rare species in the offshore, coastal, and estuarine habitats should be included in future additions to the atlas.

OPTIMAL HABITAT AND PREDICTING POTENTIAL CHANGES IN SPATIAL DISTRIBUTION OF PELAGIC FORAGE SPECIES IN THE NORTHWEST ATLANTIC: COPEPODS – STÉPHANE PLOURDE

Collaborators: C. Lehoux, C. Johnson, P. Pepin, P. Galbraith, D. Hebert

The optimal habitat of four copepods species (*Calanus finmarchicus*, *Calanus glacialis*, *Calanus hyperboreus* and *Paracalanus*) was modeled with generalized additive models (GAM). Zooplankton and bio-physical environmental data were collected from 1999-2012 as part of the Atlantic Zone Monitoring Program (AZMP) on oceanographic sections on the Newfoundland-Labrador Shelf, in the Gulf of St Lawrence and on the Scotian Shelf. Count data of rare species or species not randomly distributed had a higher number of zeroes than expected by a Poisson distribution. To respect conditions of application, a two-step conditional method was applied. Twenty percent (20 %) of data were randomly selected and used exclusively to test GAM predictions (independent observations). Presence and absence were modelled before fitting a model on abundance given presence. Abundance and associated environmental variables were averaged by depth intervals (0-200 m, 200-500 m, and > 500 m) on each transect, which provided a better predictive ability than models at the station level. T0_50 (upper 50 m integrated temperature), T_NB (near bottom temperature), DEPTH, S0_50 (upper 5 0m integrated salinity), STRAT (stratification in upper 50 m) and CHL0_100 (upper 100 m integrated chlorophyll *a* concentration) were included in models and were selected by a stepwise backward selection. Final models explained 30 to 60 % of deviance and predicted accurately independent data.

Discussion

A participant inquired about the criteria used for backward selection of parameters in the GAM versus the forward selection process. The backward selection process was deemed superior to forward selection, but the individual currently involved with this work was not present to provide a detailed explanation of the criteria used.

A comment was made regarding the utility of GAMs for investigating environmental drivers (chlorophyll *a*, temperature, salinity) on individual species versus community dynamics.

A participant asked about sensitivity analyses of GAMs. The speaker indicated this work has not been completed but 20 % of the data were reserved for validation purposes and testing of the GAM.

The speaker indicated that results of GAMs could be further directed into future modelling efforts but spatial scale considerations still need to be evaluated, which will require additional resources.

SESSION 2 – NEW AVENUES FOR SYNTHESIS, 18 MARCH 2014

Rapporteur – Dave Hebert

PROGRESS TO DATE ON COUPLED BIOGEOCHEMICAL MODEL OF GSL – DIANE LAVOIE

Many improvements/additions were made to CANOPA-GSBM (Canadian Océan Parallisé Gulf of St. Lawrence Scotian Shelf Biogeochemical Model): improved initial and boundary conditions for nitrate and oxygen, addition of nitrate and dissolved inorganic carbon flux from rivers, addition of a 24 h cycle for the photosynthetically available radiation (PAR), increased mixing in upper estuary and reduction of the transport at the Strait of Belle Isle in winter. New atmospheric forcing was also prepared with NCEP (National Centers for Environmental Predictions) data to cover the AZMP period (1997-2012), and inclusion of aragonite and calcite saturation state. Scorecards were prepared to compare simulations with observations. And finally GSBM was coupled to the downscaling system.

Discussion

There were discussions about the collection of data to help improve the models in data-poor regions. In this sense, the model is a useful tool to determine the locations where measurements should be made. Data collected by AZMP not on the core sections should be made available, especially near the eastern boundary of the model (i.e., St. Pierre Bank region).

There was a question of how the zooplankton in the model compares to the observations. This led to a discussion of how to compare the model zooplankton groups to the actual classifications of observed zooplankton. At this stage, only trends and seasonal to interannual variations can be compared. A question of how grazing affects the spring bloom was posed. It would be hard to use the observations, given the sampling rate, to address this question. We need to rely on the models to address what controls the spring and fall blooms.

There was a discussion of whether the data/model synthesis group should meet in mid-year. This could be an opportunity to discuss immediate versus strategic planning. There would also be more time to develop the interactions between the groups.

GENERAL MODEL DEVELOPMENT IN THE ATLANTIC ZONE: RESULTS AND ANALYSES – DAVE BRICKMAN

Collaborators: Z. Wang, Brendan DeTracey

Overview: The presentation reported on a hindcast simulation of the entire North Atlantic for the years 1990-2013, run by Z. Wang (BIO). The utility of a large domain, high resolution model is that [1] it can simulate the interaction of the Labrador Current and the Gulf Stream at the Tail of the Grand Banks, which is necessary to capture interannual variability on the Scotian Shelf and Gulf of Maine, and [2] it can capture the upstream influences on the NL Shelf and the GSL. The model details are: approximately 1/12 degree resolution → 1.6 M horizontal grids x 50 levels ~ 80 M cells (this is computer intensive; and more resources needed); GLORYS (Global Ocean reanalysis and Simulation) open boundary conditions; NCEP (National Centers for Environmental Predictions) surface forcing; there are no tides (although does run tides) and no data assimilation; there are crude NEMO (Nucleus for European Modelling of the Ocean) rivers (Hudson Bay west, James Bay, Ungava Bay west and east, Happy Valley, St. Lawrence Estuary (SLE)); outputs are monthly averages.

Analysis of model output: Focussed on the AZMP domain: Newfoundland and Labrador shelves (NLS), Gulf of St. Lawrence (GSL), Scotian Shelf (SS), and Gulf of Maine (GoM) (Figure 1). We extracted nearshore +/- shelfbreak transport time series (24 years x 12 months) for 8 standard AZMP sections plus the Northeast Channel (NEC) and Strait of Belle Isle (SBI). There were two analyses: [1] General system properties, and [2] AZMP specific standardized anomalies of selected transport series (monthly + annual) through AZMP sections. For the system properties, we looked for interrelationships and correlations between the time series. We considered: [1] annual timescale and whether there was seasonality in the transports, and [2] interannual timescale and whether there are correlations between annual averaged transports through the various subsections.

Results: System properties. A seasonal cycle was found for all onshelf/nearshore time series. Phases were all within ± 1.5 months, with mid-year minima. Seasonal cycle can be traced to the arctic sea-ice melt cycle. At interannual timescales, correlation between transports at AZMP sections is generally weak (0.4-0.6) and decreases with distance downstream from a given section. Implication is that AZMP sections are relatively independent of each other.

Results: Standardized anomalies. We broke the transport series into two categories: Onshelf streams, Shelf break streams. Scorecard and sum-of-anomaly time series plots were created for the two categories. These can be used in the regional AZMP Res. Docs or in the zonal SAR.

The model output was analyzed to see if the 2012 “warm event” was simulated. Climatological monthly three-dimensional temperature and salinity (T&S) fields, for the AZMP domain, were created from the 22-year model simulation. T&S anomaly plots were made for various levels, including the bottom, by subtracting the climatology from the T&S (year, month) field. The warm event of 2012 appeared in the model anomaly fields, in a way that was distinct from any other year. Further investigation of this result will be done by re-running the 2012 model year with higher frequency output, and analyzing the results.

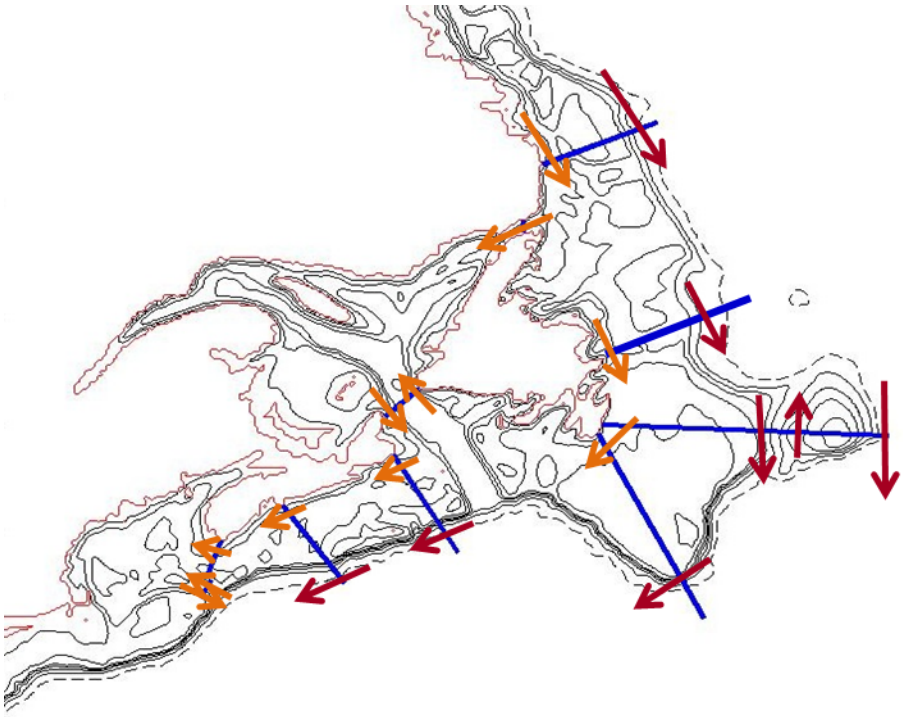

Figure 1. AZMP domain showing sections and transports that were used in the analyses.

Discussion

Zeliang's paper describing his model is under internal review. There are plans to submit a paper on the seasonal cycle for the special Atmosphere-Ocean issue. Over the next year, plans are to enhance the understanding of the model/data inter-comparison and synthesis through the use of indicators such as presented here.

Preliminary results of a 65 year hindcast (1948-2012) of the Gulf of St. Lawrence, Scotian Shelf and Gulf of Maine – Joël Chassé

We presented the progress related to the development of a three-dimensional ice-ocean modeling system for the Gulf of St. Lawrence, Scotian Shelf and Gulf of Maine (GSL-SS-GoM). The goal of the work is to produce an ice-ocean hindcast, covering 1948-2012, to fill the data gaps in the observational system to support fisheries studies, stock connectivity studies, invasive species research, bio-geochemical modeling, climate change, etc.

The hydrodynamic model (NEMO-OPA) is coupled to an ice model (LIM) and driven with the NCEP atmospheric forcing interpolated to the model grid. The model also includes tidal forcing and freshwater runoff of the 78 main rivers within the domain. Boundary conditions have been fine tuned to reproduce the main circulation features of the study domain. These circulation features include the cyclonic circulation in the GoM, the Nova-Scotia coastal current, the along-slope Scotian Shelf current, circulation around Western Bank, the Anticosti Gyre and the Gaspé current. All of the data required to force the model from 1948 to 2012 have been collected. A calibration run was first done for the 2006-2012 period. The results of the model compared very well with observed Sea Surface Temperature (SST) and observed temperature and salinity profiles. The modeling approach is proving to be useful in filling data gap for the GSL-SS-GoM. The full run (1948-2012) was made, but the analysis of the results showed that there was a mistake made when pointing to the air temperature files used to force the model and the run will need to be redone.

The rest of the presentation focused on the regional climate downscaling project for the same domain (GSL-SS-GoM). The results of the downscaled A1B scenario from the Canadian GCM (Global Circulation Model) were presented.

The results showed that by 2040, there will be a general increase of SST, increase in stratification in winter, diminution of sea ice concentration and cover, increase in bottom temperature in shallow waters and a decrease of estuarine circulation resulting in longer residence time for the deep water in the Laurentian channel. One of the key findings of the downscaling system is that there will be significant spatial variability of the change at the scale of the GSL, and the modelling system is providing spatial details of the estimated changes.

Discussion

The limiting factor in doing the downscaled forecasts is the amount of computing power available for the modelling. Cost of the hardware is not a factor, but the ability to actually buy the hardware is a limiting factor.

There was discussion of who is the most interested in our information. We need to prioritize questions that are the most important for clients (e.g., Fisheries – who, what to present, who to talk to?). The consensus was that we should be presenting the data to the fisheries scientists who are advising managers. We should be providing the overall environmental context and not how the upper ecosystem responds. We should not be doing someone else's job. We should be interacting with those scientists. Some groups appear willing to interact and others not.

GENERAL DISCUSSION OF THE SYNTHESIS WORKSHOP

A clear need to start synthesis of the physical and biological components of AZMP was recognized in the discussions. There is a need to discuss what, if any, trends are occurring in the ecosystem. A plan was proposed to evaluate 4 or 5 assessments in each region to see what trends they are showing and how they are related to the environmental observations of AZMP.

The success of the AZMP Synthesis Workshop (i.e., meeting of a small group of AZMP personnel) at this meeting suggests that this model should continue for next year's meeting. As well, a mid-year meeting focussing more on the interaction of the groups was suggested.

SESSION 3 – AZMP BUSINESS MEETING, 18 MARCH 2014

Rapporteur – Andrew Cogswell

REVIEW OF PRESENTATION TO NSDC (OCTOBER 2013) – PIERRE PEPIN

In October of 2013, the major issues to emerge from the 2013 meeting of the AZMP were presented to the National Science Directors Committee via teleconference. The presentation started with an overview of the vision for AZMP and a summary of current efforts for synthesis and integration focussed on an Ecosystem Approach to Management.

Three primary areas of concerns were raised: Data Management – Significance to advisory efficiency and accuracy; O&M (Operations and Maintenance) funding – Impact of 1998 funding levels; and Capital – Consequences to operational capacity. For each item, the Chair summarized the nature of the issue, the impact on Ocean Sciences and AZMP, and provided recommendations for action on the part of senior managers.

ISDM (Integrated Science Data Management – now OSD Oceanography and Scientific Data) is currently not meeting the needs of the Ocean Sciences community. The T&S database is not readily accessible online. There are no nationally adopted standards that ensure that all

available data are archived. The AZMP Website design and technology are obsolete and time consuming to maintain. BioChem (bottle and plankton database) is not user-friendly and accessed principally by data managers, not users. And finally, the allocation of resources for Data Management is uneven among regions. The impact on Ocean Sciences comes in three forms:

1. there is a loss of efficiency because data assembly from diverse sources takes up 60-80 % of researchers time (e.g. Aquatic Climate Change Adaptation Services Program (ACCASP) rather than focussing on analysis and interpretation;
2. there is an increased potential for inaccuracies because individuals are maintaining their own archives rather than relying on single authoritative and quality-controlled source; and
3. the issues with data management have significant implications for our ability to respond to Departmental (e.g., ACCASP) and client (e.g., advisory) requests for information in a timely manner.

The AZMP-DM (data management) group has identified a list of 10 priorities (data inventories, quality control (QC) standards, workflow, etc.) that can serve as a starting point. The work can be handled partly in the regions but also needs involvement from OSD to ensure that changes are reflected in accessibility at National level and will be discussed further as part of this meeting.

Funding levels of O&M resources for the program are still at those set in 1998. Taxes and increased operational costs lead to inefficiencies because AZMP leads have to supplement operational needs with external resources or face the elimination of elements. The O&M funds represent a fraction of the total Departmental investment in the program yet they represent a crucial resource because the real costs for AZMP are in [1] *post survey sample processing* (e.g., chemistry, taxonomic identification), and [2] *(very) basic equipment maintenance*. Real costs cannot be dealt with through “efficiencies” because the increased costs are out of the Department’s control (e.g., contract, supply costs have increased by 60-100% since 1998).

Limited capital funding has reached a critical level. Most AZMP equipment is far beyond its normal operational life time. This results in an increased burden on limited O&M resources in order to maintain obsolete equipment. This also results in reductions in effective use of vessels because of at-sea breakdowns. In the long-term, this is likely to result in reduced capacity to contribute to significant DFO-backed collaborative initiatives as well as meet other client needs. The solution involves the need to prioritize the 5-year capital action plan to a high level in the Departmental acquisition plan. The Chair has coordinated the plan to provide a National strategy that includes not only AZMP but also Pacific and Central and Arctic regions.

Discussion

The progress has not been rapid but we are encouraged that there is a communication plan with regional directors. Scientists from Maritimes region recently held a meeting with their regional director but noted that not much progress has been achieved to date, due to other pressures on the region. However, management is aware of the issues and welcomes ongoing communication from AZMP. The Maritimes is now scheduling regular meetings with their Regional Director of Science.

The other regions will be trying to use the same approach to ensure that there is awareness of the pressures on AZMP, and the associated risks, at the National Science Directors level. Efforts to coordinate with the Pacific region in communicating about ocean monitoring with the National Science Directors should be continued.

OVERVIEW OF BIOCHEM WORKSHOP – LAURE DEVINE, SHELLEY BOND

The BioChem steering committee meeting was held 17 (PM) to 18 (AM) March 2014. Participants included members of the SC (Laure Devine [IML, chair], Shelley Bond [BIO], Mathieu Ouellet [OSD], and Terry Sowden [IOS]) as well as invited users and experts (Greg Levonian [IMTS, HQ], Caroline Lafleur [IML], Dave Senciall [NAFC], Helen Hayden [BIO]). An overview of recent activities was first presented (updated ToR; website updated fall 2013; load tables available online; BioChem technical report published Jan. 2014). The group then worked together to improve the IM/IT Requirements Submission Document that is required for planning future maintenance on the database. Many issues were discussed briefly, including data exchange with the US NODC, migration of the "MEDS" bottle archive, whom to contact with technical problems, non-usage by some regions, and knowledge transfer from the former chair (Claude Guay, who had acted as the Database (DB) Administrator but has now been transferred to the Canadian Hydrographic Service).

Three major topics took up most of the discussion time, one of which was the database audit being conducted by BIO. The issues identified during the audit include critical and non-critical concerns: database infrastructure, standards and best practices, duplicated data, data and metadata errors, unit conversions, and general housekeeping. The critical problems are of a magnitude that the data loaded by Maritimes have been "quarantined" (taken off-line) until the datasets can be reviewed for accuracy and re-released. BIO personnel have elaborated a plan to address these issues.

Discussions on the query and edit applications were productive. All recognize that the query app is problematic, especially for the plankton functional area. Many solutions were proposed, with the preferred short-term fix being two-fold: (1) users who are able to use SQL can be provided with access to views of the DB to perform their own queries, while (2) those who are technically challenged would have access to a set of standardized query returns (updated on a regular basis) that represent the queries most commonly run. Users would then filter the queries to obtain more precisely what they want.

The edit application has proven problematic for some data managers. It was agreed that the best solution is to run automated tests (to ensure that data meet DB restrictions before attempting to load) so that there is little chance of a load fail. The IT person present at the meeting expressed surprise that most of the complexity of the edit application—the ability to edit the data within the application—was avoided by data managers because it is unreliable and unwieldy. He said that a simplified "load" app might be a good solution. Everyone agreed that best practices should be discussed and documented, and that field meanings should be carefully defined.

The DB has not been life-cycle managed, so major work will eventually have to be done to rectify this and to address other changes that could be made to improve functionality. However, it is important to note that any action of this kind is long-term (years away), and we need measures that allow the system to be functional now.

All participants felt strongly that the face-to-face meeting was especially useful in putting people from various backgrounds in the same room for fruitful exchange. Discussions between scientists/data managers and IT personnel were particularly enlightening. All realize the necessity of the two groups working closely together to complete tasks in the most efficient manner. (The full meeting report is available for further information.)

Discussion

Comment concerning the migration of BioChem to new IMTS infrastructure: The servers are old and outdated; the new servers are run by the IMTS data group. There should be limited

problems and little impact for users during migration. A Development server will be set up to test and then the production server will be set up. The old server is always going to be there until the development is complete.

Comment: The source code for the query app will be provided (or a part of the code that has the logic) so we can see why there are errors in the queries and how that might impact output.

Comment: Query specifications have always been logged, so the SC wants to examine them to get a clear idea of the types of common queries that are made with the aim of simplifying the query app or providing views to clients. A simplified version gives the individual a sense of what is there. If you are doing the standard views in SQL, then people can modify as necessary. Options provided are not mutually exclusive and some of the query application solutions are definitely doable.

Comment: If there are a series of bullets to include in the Chair's summary, priority areas related to BioChem would be useful. IMTS agree that BioChem from a maintenance standpoint is a difficult problem, but they don't realize its importance. The Chair will elevate its importance by moving the executive summary to higher levels.

Comment: The BioChem Edit application has not been used to edit datasets because the application is so buggy. The code is bad, so people were finding alternatives to get around the edit application; it has mainly been used only to load and validate datasets. It was proposed that the "edit" app be modified and a future version will function to load, validate, and delete only, with no edit capabilities. This point needs to be clarified and future development planned.

Comment: National headquarters has been approached to load regional data into BioChem (Pacific), but headquarters has declined. OSD cannot be responsible for loading data into a regional database.

Comment: The NL data is safe and archived but not in BioChem.

BioChem Content Audit (Shelley Bond)

Question(s): Given that there are data from other regions, should regions assess what is in BioChem against their cruise histories for AZMP? Do regional users have a sense of how many entries should be there? If this was done for all regions then we could provide counts for data types.

Question(s): How bad is the problem associated with improperly loaded data? This is an issue that needs to be discussed extensively.

Comment: Technical data management skills are essential and this should be mentioned in the summary (both data management summary and NSDC summary). DG's are the audience and will/should pay attention. Everything below that has been tried and it does not work.

Comment: There has been a great deal of work done to deal with problems with BioChem and it is appreciated. It reflects the ongoing issues though; the audit is a helpful document for communications to highlight the need to get the problems fixed. People have been responsive because of the audit document. In earlier discussions, SOPs for loading data, if properly coordinated, should prevent future problems and make all regions much more efficient. Standard data formats and scripts make entry similar across regions to QA the data and properly enter it into BioChem.

Comment: Documentation and communication is very important. Science is the client group and the input is what the scientists need.

PROGRESS ON DATA MANAGEMENT 10 POINT ACTION PLAN FROM 2013 – SHELLEY BOND, LAURE DEVINE, MATHIEU OUELLET

The essential points of this presentation are contained in the overview of the BioChem Workshop.

Discussion

Comment: QC implementation plan was not discussed during the DM subcommittee meeting so this will have to be done by e-mail at a later date.

Question: If there is access to drives at BIO, then we will not need to send OSD processed CTD data?

Response: That is correct.

Comment: Conversations with IMTS have opened each other's eyes. We've been allowed to see each other's worlds and this has been positive. Dissociation of these data managers and computer support groups has proven to be a very big problem. Informal conversations like this have been really useful. A back and forth interaction works better than a form. It is much clearer when we are face to face. An offhand comment during a face-to-face discussion can identify a major source of difficulty. We are pushing the boundaries to do things more effectively. Scientists are approaching data managers in a more proactive and consistent way (this has to continue).

Comment: The website is important to the program, but we've not been making major changes for updates or improvements unless we absolutely must because it is obsolete.

Response: The technology is obsolete but the content is not. The data products from the CSAS report was a nice addition, these new additions will make the website less obsolete. Incremental improvements should be made to make the website more useful until we can overhaul it.

Suggestion: The permanent management committee members are directed to have discussions with scientists to identify strengths, gaps, etc., for the website and this should be submitted to the Chair to act as a conduit to OSD (item timeline for the end of May for feedback).

Comment: The only way to currently make the CTD data available is through the website and it is usually a month before files received from regions are included. This should be improved by linking to a shared drive at BIO (turn-around in just a few hours, after the programs are written). This should improve request turn-around times as well.

Question: Will it be possible to query these data?

Answer: This has been put to IMTS but it has not been deemed a priority. IMTS is needed to make or allow this to happen but they do not see it as a priority. Whatever is produced will be a work-around. The Oracle database could be a long term solution.

Comment: The lack of response from IMTS is a major problem. This does not meet our needs or requirements. These work-around solutions waste a lot of time.

PROGRESS ON LOGISTICS GROUP ACTION PLAN – JEFF SPRY, FRANÇOIS VILLENEUVE, GARY MAILLET

The AZMP Logistics subcommittee reviews the main challenges and priorities for field and laboratory activities along with options and recommendations. The main issues for logistic operations include the loss of key personnel through attrition along with the extensive knowledge base which may have an impact on future operations. Various strategies are being explored in the different Regions that include mentorship opportunities and cross-training of

junior staff to broaden the skill sets and develop multidisciplinary field staff, development of succession plans for senior staff nearing retirement, and properly document field and laboratory work activities through preparation of detailed standard operating procedures (SOPs). The renewal of major equipment for field and laboratory operations is necessary in order to maintain and sustain zonal operations. The equipment and instrumentation now in use across the Atlantic Zone was largely inherited from earlier Science Programs and has now well exceeded its normal life expectancy in many cases. Sampling of the AZMP Fixed (high-frequency) Stations at some remote locations during winter has been a difficult challenge in some Regions due to a lack of properly equipped CCG platforms for gear deployments and availability of vessels during this period. Different options are being explored to resolve access to vessels for occupations at these sites.

Discussion

Comment: In the Major Capital Funding Application there is an attempt to standardize equipment across regions. All of the equipment is standardized and is mirrored through the Atlantic region. The Central and Arctic and Pacific Regions are using different gear. There is more consistency among the regions involved with AZMP.

Comment: The original list had broken things into large and small items (minor and major capital). It was all lumped together for ease of understanding. This bumped the numbers up slightly. The submission is adjusted for inflation. US dollars conversion and Euro conversion may not have been included; this should be considered if it was not. This entire proposal is standard for field equipment, but it differs in bench-top equipment. CTD (conductivity-temperature-depth sensor) Rosette is virtually all the same. If the allocation is less than what we want, then we will prioritize and have to live with the outcome.

REGIONAL SUMMARY OF ACTIVITIES (NEWFOUNDLAND) – GARY MAILLET

Three AZMP oceanographic surveys were successfully carried out during spring (TEL114), summer (TEL117), and autumn (HUD113) totaling nearly 400 hydrographic stations and 225 plankton profiles across the NL standard sections and fixed sampling Station 27 in 2013. Ship-of-opportunity occupations of Station 27 were once again limited during the winter period due to a lack of availability of suitable sampling platforms but increased to approximately biweekly intervals during the remainder of the sampling year in 2013. The spring and autumn Multispecies Surveys provided good spatial and temporal coverage over the NL Shelves with nearly 1200 hydrographic profiles collected in 2013. Overall, the effort and performance of AZMP sampling program in NL Region in 2013 remains consistent with accomplishments in previous years. Standard processing of biochemical and zooplankton samples collected as part of the AZMP continues to be challenged by higher sampling costs and shortage of experienced and trained personnel, resulting in significant financial pressures and succession planning.

Discussion

Comment: The recent weather issues have likely driven down the occupations for temperature profiles for station 27. The Needler's schedule might also be contributing.

REGIONAL SUMMARY OF ACTIVITIES (MARITIMES) – JEFF SPRY

A reasonably successful 2013 was experienced on the logistics part of the monitoring equation. Very few ship problems meant most survey requirements were carried out as planned. CCGS Hudson in good condition meant spring and fall AZMP missions were carried out with a new high for stations occupied. The full extended Halifax Line was sampled by the returning Labrador Sea mission in early summer. The *CCGS Alfred Needler* experienced significant

problems after a questionable refit such that 60+ % of the mission time allotted for late winter was lost. The July summer survey on *Needler* went off very well (near high stations), and the AZMP had its usual presence for the Sept. Gulf survey onboard *CCGS Teleost* (somewhat fewer stations). Fixed station occupations of the high resolution Halifax-2, Prince-5, Shediac Valley sites utilizing the small vessel fleet were at the high end of the range as well in 2013. Overall the monitoring program performed at a level consistent with recent years, generating some 671 CTD profiles with water collection and 281 ring net tows.

CPR (Continuous Plankton Recorder) data have been acquired for 2012 (always one-year lag) with somewhat better coverage than in recent years. This program is subject to significant funding pressures.

All analysis of baseline samples collected during 2013 (nutrients, salts, oxygen, chlorophyll, zooplankton ring net tows) have been completed. As always, the challenge is to carry out analysis with the funding allocated and within an acceptable time frame given the manpower with skills available.

Discussion

Question: Is the same AZMP protocol used on non-core lines?

Response: Yes, the same protocol is used.

Comment: The total cost of AZMP zooplankton sample analysis was $26 K or $27 K.

REGIONAL SUMMARY OF ACTIVITIES (QUÉBEC) – STÉPHANE PLOURDE

Oceanographic sampling in the Gulf comes from AZMP transect surveys in June and October-November, including a grid of stations in the southern Gulf taken during the June mackerel survey, the multi-species bottom trawl surveys in the northern Gulf by our Region in August and in the southern Gulf by Gulf Region in September, as well as summer sorties at the Rimouski station by Québec Region and at the Shediac Valley station by the combined efforts of Maritimes, Gulf and Québec Regions. In addition, physical parameters and surface nutrients were sampled in March during the helicopter-based survey. Temperature-salinity casts sampled during other surveys are also used for the analysis of physical oceanographic conditions, most of which come from Gulf Region sampling efforts.

The 2013 AZMP surveys resulted in complete coverage of the standard transects during spring and fall, with extra stations taken again in the fall between transects that allows for a more comprehensive 3D analysis of conditions not possible with transect data alone. Extra stations were again also carried out on the shelf south of Newfoundland during the fall survey. The multi-species surveys had good coverage of the Gulf as did the March survey, with the highest number of casts done in the history of the survey (since 1996).

The high-frequency station at Shediac Valley was sampled about every two weeks from May to July and every month thereafter until early November. Rimouski station was sampled every two weeks in April, weekly from May to late October, but unfortunately only twice afterwards, in early November and early December, because small-craft deployments are tide-dependent after the marina closes at the end of October (and high water levels did not coincide with daylight very often), and because the onset of winter came early, with freezing conditions that ended the season. Both stations were also sampled for physical parameters during the March survey.

Discussion

Question: Are you also reporting on macro-zooplankton with Jack Net?

Response: Because we are sampling larger volume, some zooplankton will be better counted, but with limited resources we are focussing on krill. It could be used for other macro-zooplankton but it currently is not. It is easy to deploy if we want to address this lack of information.

Comment: The CG restriction on helicopters is affecting sampling in the region.

AZMP REMOTE SENSING PRODUCTS – CARLA CAVERHILL

Collaborators: H. Maass, C. Porter, G. White and C. Fuentes-Yaco

A new product from BIO's Remote Sensing Unit for 2013 is the MERIS RR (1 km) TSM (Total Suspended Matter) bi-weekly composites for the AZMP region. It was necessary to include the ICEHAZE flag so that the images would not interpret ice as sediment. The images will be posted on the BIO website and statistics are available on the ftp server. GEOTIFF format will also be an option. The MERIS mission started in 2002 and the satellite died in April 2012.

MODIS calcite (8-day 4 km PIC) values have been summarized for the satellite boxes, for the MODIS mission (2002-present). These values are available on the ftp server. Also, fall bloom fitting has been completed for the satellite boxes using MODIS and SeaWiFS data. It is recommended that SeaWiFS data be used from 2003-2007, after which MODIS data can be used. The fitting was done with a Gaussian curve superimposed on a constant background, assuming the bloom to start and end when biomass reached 20 % of the peak. The approach is similar to that used by Zhai et al (2011), except that the parameter βt is not used.

A primary production calculation has been completed for 1998-2010 for all Canadian waters. It is a monthly estimate (based on method of Platt et al., 2008) on a 9 km spatial grid. It uses SeaWiFS chlorophyll data and Pathfinder 5.2 SST data as input, as well as ship-based measurements of the vertical distribution of phytoplankton and its photosynthetic response to light. It was found that the Pathfinder 5.2 data have lower values than the SST data that were used in the previous primary production estimate. The lower temperatures result in lower PI parameters being retrieved from the archive and hence lower primary production values. This is still an evaluation dataset, but stats for the satellite boxes are available on the ftp server.

One of our improvements to the BIO Website can be seen on the Individual Satellite Passes page; all images that make up a given bi-weekly composite are now displayed on one page.

NASA will be reprocessing all ocean colour data in 2014 using SeaDAS 7, and all data files will be available in netCDF (Network Common Data Form) format. This will necessitate changing our scripts and processing method. All our products will eventually be recalculated and available in netCDF format.

Plans for 2014 include extending the primary production estimates to 2014 using the MODIS dataset, reprocessing SeaWiFS 1 km dataset now that has entered public domain for the entire mission (1997-2010), adding sea-ice mask to images, and creating composites of MODIS-Terra SST. We also plan to create composites of MODIS kd_490, and hope to use this product to define a mask for Case-2 waters. Plans for this year include making the new products available on the website and ftp server and continuing a comprehensive satellite / *in situ* data matchup and validation. We still have plans to provide ocean colour products (chlorophyll and primary production) for all Canadian waters to the St. Lawrence Global Observatory Website.

Reminder: the address for the ftp server ftp server (formerly starfish) has changed.

Platt, T., S. Sathyendranath, M-H Forget, G. N. White III, C. Caverhill, H. Bouman, E. Devred and S. Son (2008). Operational estimation of primary production at large geographical scales. Remote Sens Environ 112: 3437-3448.

Zhai, L., T. Platt, C. Tang, S.Sathyendranath, and R.H Walls. Phytoplankton phenology on the Scotian Shelf. ICES Journal of Marine Science (2011), 68(4), 781–791.

Discussion

Question: On the remote sensing web page with SST and Chlorophyll we can see the image but can the data be available for download.

Response: The data are not available for download at that site.

Comment: If it was an option, it will be useful to download the data. If it is easily accessible, then this data would be preferable. NetCDF would be useful but GeoTiff's (TIFF based interchange format for geo-referenced raster imagery) are currently provided. It might be useful to have a button to click to download the GeoTiff or NetCDF file.

Comment: The ftp and the website are available, but the location of data product on those sites is still really confusing. There is excitement that these products exist, but maybe putting a little notice on the website about what's new this year might be useful. There is no link to the ftp site, but maybe a page on GCConnex would be useful? Most individuals who want data want a considerable amount. The images are not necessarily in the ftp site, but the stats are. Some ideas about how to get the images out there might be useful.

Comment: If we define our needs, the remote sensing group at BIO is pretty responsive. What we need is a site somewhere with new items and a link to the ftp.

PROPOSAL FOR A COORDINATED BASELINE SURVEY OF THE OCEAN CARBONATE SYSTEM AND PH FOR FALL 2014 – PIERRE PEPIN

Collaborators: K. Azetsu-Scott, M. Starr, D. Lavoie, S. Punshon, B. Greenan, C. Johnson, P. Galbraith, J. Chassé, G. Maillet

Rising anthropogenic CO_2 emissions is increasing dissolved CO_2 and decreasing ocean pH, carbonate ion concentration, and calcium carbonate mineral saturation state ($CaCO_3$). The concept is to take advantage of the coordinated efforts of the Atlantic Zone Monitoring Program (AZMP) using *CCGS Hudson* for at-sea sample collection in fall 2014. This would ensure a comprehensive and systematic assessment of the continental shelf area from southern Labrador to southwest Nova Scotia and the Gulf of St. Lawrence.

The goals are: [1] establish the baseline conditions of the saturation state of seawater and pH to assess the potential of future changes on the Canadian continental shelves in the northwest Atlantic, [2] map the state of acidification risks including saturation horizons for $CaCO_3$ (aragonite and calcite) along with long-term variation of pH compiled using historical data in each region (Lavoie et al. 2013), and [3] develop a preliminary risk evaluation for the fishing grounds of the Atlantic Zone.

We identified 102 sites (27 – Maritimes; 30 – Québec and Gulf; 45 – Newfoundland) at which sampling will be conducted during three successive dedicated AZMP missions aboard *CCGS Hudson* in autumn 2014 (Maritimes – 20 Sep to 13 Oct; Québec/Gulf – 16 Oct to 11 Nov; Newfoundland – 15 Nov to 9 Dec) (Figure 2). At each site, samples would be collected at 10, 20, 50, 75, 100, 150 m and bottom. At sites with waters deeper than 250 m, samples at 250, 500 and 1000 m will be collected to provide complete profiles. The current scheme will result in 614 samples after modifications from discussions among meeting participants. At each site, samples will be collected for dissolved inorganic carbon (DIC), total alkalinity (TA) and pH along with other variables normally measured by AZMP to ensure that all parameters relevant to ocean acidification are measured to international standards (Global Ocean Acidification Network). We will also collect samples for O^{18} analysis. DIC and TA would be measured using

the protocols outlined in Azetsu-Scott et al. (2010) and pH would be measured by photospectrometry (Dickson et al., 2007) at BIO under the supervision of Steve Punshon.

The $CaCO_3$ (aragonite and calcite) saturation state will be estimated from DIC and TA. Water mass characteristics (temperature, salinity, nutrients, and oxygen) identified using multivariate analyses will serve to delineate $CaCO_3$ saturation states and pH. These results will be applied to the development of regional maps of saturation state based on data collected from regional multispecies surveys, from which only temperature and salinity data are available. Funds have been requested from the Aquatic Climate Change Adaptation Services Program (ACCASP) for technical and O&M (+ taxes) needs to complete survey.

REFERENCES

Azetsu-Scott, K., A. Clarke, K. Falkner, J. Hamilton, E.P. Jones, C. Lee, B. Petrie, S. Prinsenberg, M. Starr, and P. Yeats, 2010. Calcium carbonate saturation states in the waters of the Canadian Arctic Archipelago and the Labrador Sea. Journal of Geophysical Research-Oceans 115. 10.1029/2009jc005917.

Lavoie, D., N. Lambert, S. Ben Mustapha, and A. van der Baaren. 2013. Projections of future physical and biogeochemical conditions in the Northwest Atlantic from CMIP5 Global Climate Models. Can. Tech. Rep. Hydrogr. Ocean Sci. 285: xiv + 156 pp.

Dickson, A.G., C.L. Sabine and J.R. Christian (Eds.). 2007. Guide to best practices for ocean CO_2 measurements. PICES Special Publication 3, 191 pp.

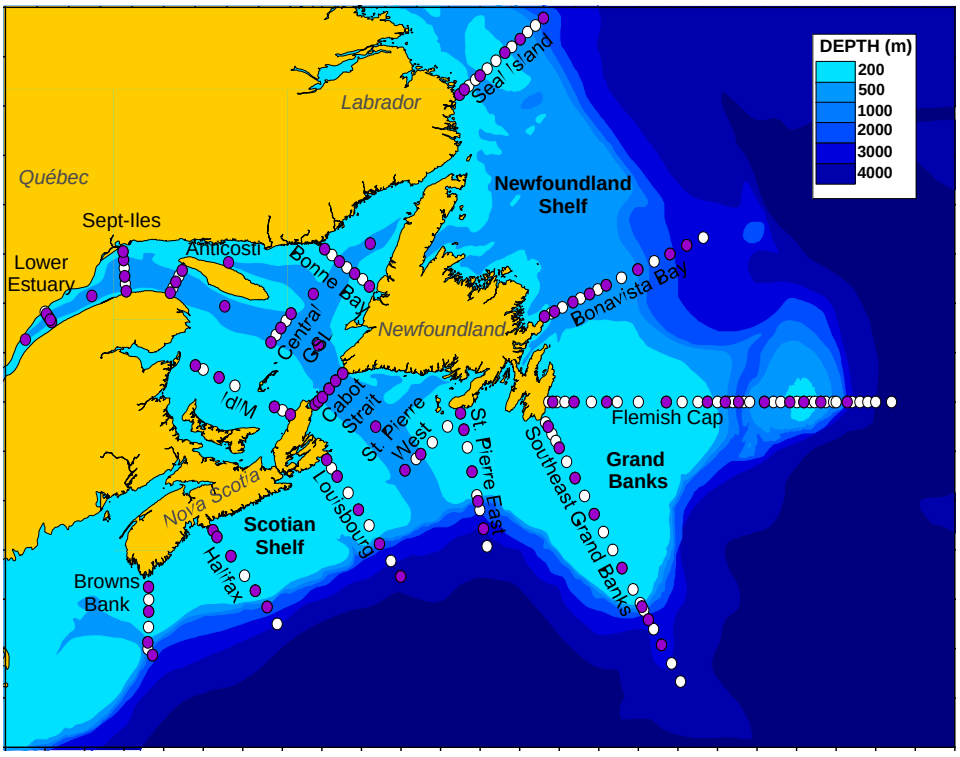

Figure 2. Atlantic Zone biogeochemical monitoring stations (circles) with sites proposed for the acidification survey in purple.

Discussion

Question: Do we have the money to do this?

Response: If we don't get the money from ACCASP then the work will not get done It is a fairly low cost project and pretty cost effective. We are currently negotiating with directors to get support to do this.

Question: Why do this in the fall instead of the spring (where you can catch the lowest pH on the shelves)?

Response: The fall is the only time we can do this. The spring sampling is limited to the Bonavista section and south. A station has been proposed between Bonavista and the northern most section. The fall surveys for each region are close together, on the same vessel, same equipment.

SESSION 4 - REVIEW OF PHYSICAL AND BIOGEOCHEMICAL CONDITIONS IN THE NORTHWEST ATLANTIC, 19 MARCH 2014

Rapporteur – Benoit Casault

PHYSICAL, CHEMICAL AND BIOLOGICAL CONDITIONS IN THE LABRADOR SEA (AZOMP) – MARC RINGUETTE

The NCEP (National Center for Environmental Prediction) reanalysis of Surface Air Temperature (SAT) indicates above normal conditions with an anomaly of 3 to 7°C in the Labrador Sea during the winter period, with spring, summer and fall experiencing close to normal temperatures throughout the entire Northwest Atlantic region. This temperature trend directly transfers to the Sea Surface Temperature (SST) seasonal patterns, anomalies in the Labrador Sea following the same seasonal pattern observed by SAT, negative (0 to -1°C) in the winter and positive (1 to 3°C) in the summer. The average ice extent for the winter period (January-February-March) is following a general decreasing trend since 1978. In 2013, anomalies were 20 % below normal in January on the Labrador Shelf and 15 % above normal in March on the Northern Labrador Shelf.

The annual AZOMP (Atlantic Zone Off-Shelf Monitoring Program) survey of the AR7W Line in the Labrador Sea took place on CCGS *Hudson* during the period of 6–28 May 2013. Due to severe ice condition on Hamilton Bank, a new section (7 stations) east of the Strait of Belle Isle was added. The remaining 20 stations of the AR7W line were sampled along with 13 opportunistic stations, all located along the line. A supplement of 10 ARGO floats was deployed and while 3 moorings were successfully recovered and the two on the Labrador slope was redeployed for another year. A stopover at the Gully allowed for the deployment of 3 ARAL moorings. The survey includes the sampling of the 13 stations of the Extended Halifax Line (XHL) to monitor variability on the Scotian Rise in the deep western boundary flows of the NW Atlantic and to obtain additional information on oceanographic and lower-trophic-level variability. Here again, 5 additional ARGO floats were launched. Finally on our way to the Halifax harbor, the regular 7 stations of the Halifax Line (AZMP) were sampled.

Physical oceanography measurements along AR7W indicates a continuing warming trend in the deep layer of the central Labrador Sea, gaining more than 1.5°C in temperature below the 2000 m isobath since 1993. Over the same period, the surface layer has experience more intense and frequent freshet events over the last decade while the density increased throughout the rest of the water column all the way to the bottom. Despite this warming, we see from the ARGO array that fairly deep convection tends to reoccur at least once within the five-year

period. In 2012, the convection was quite deep; past the 1500 m mark, and it was down to almost 1000 m in 2013. Unfortunately the ARGO float results presented here are only preliminary and incomplete due to IT problems preventing access to the data.

About one quarter of carbon dioxide (CO_2) released by human activities (anthropogenic CO_2, mainly by fossil fuel combustion) has been taken up by the oceans, altering the basic ocean chemistry, specifically the marine carbonate system, thus favoring a decrease ocean pH by 0.1 units over the past 200 years. Total inorganic carbon (TIC) and pH are monitored over the 1996-2013 period in the newly ventilated water masses (150–500 m) of the central part of the Labrador Basin. DIC & pH experienced their regular opposite trends, showing the uptake of anthropogenic CO_2 that translates in a continuous lowering of the pH. DIC increased by 16 µmol kg^{-1} from 1996 to 2013 as a result of the local uptake of anthropogenic CO_2. As a result, pH has decreased by 0.08 units (in the total pH scale) during the same period at a rate of 0.0031 units $year^{-1}$. This is higher than the global average of 0.002 $year^{-1}$.

For a second year in a row, the ocean color, used as a proxy for abundance of chlorophyll-a, estimates are around the average for the 3 regions (Labrador Shelf: 0.59, Central Basin: 0.55 and Greenland Shelf: 0.82 mg m^{-3}). The SST however is below average for the 3 regions. There was a negative relationship between ocean colour and SST on the Labrador Shelf/slope, a positive relationship in the Labrador basin, and what seem to be 2 parallel positive relationships for the Greenland shelf/slope. The time series extracted from MODIS sensors runs only from 2002 to 2013.

Systematic biological measurements have been made along the AR7W line since 1994 and include major components of the lower trophic level (phytoplankton and zooplankton abundance or biomass) metabolic rates (phytoplankton productivity and respiration on occasion, copepod egg production) and total biogenic carbon. All biological components exhibit high interannual variability. Annual spring bloom starts and ends earlier on the Labrador and Greenland Shelves (mid-April to early June) compared to the Central Basin (early May to late June. It remains true in 2013 for the Greenland shelf but the beginning of the bloom was relatively weak and late on the Labrador Shelf.

Between 1996 and 2013, *Calanus finmarchicus* abundances were low in spring on the Labrador Shelf, there was no trend in the Central Labrador Sea, and generally higher in the eastern Labrador Sea (the area most influenced by the Irminger Current). The total copepod abundance however tends to decrease over the same period despite the higher abundances of *Calanus hyperboreus* and *Oithona* spp. observed in all 3 regions. Euphausid and gastropod abundances also exhibit an increasing trend.

Continuous Plankton Recorder (CPR) data provide us with one of the longest biological time series in the North Atlantic running over 5 decades. Multi-decadal phytoplankton colour index changes from low to high abundances around the nineties. Year 2012 continues this trend throughout the entire North Atlantic. Younger stages (CI-CV) were found in larger abundances in the Northeastern and Northwestern Atlantic in 2012 while remaining rather low on the Scotian Shelf. The CV and adult *Calanus finmarchicus* population seems to fluctuate from low to high abundance from one decade to the other. In 2012 however, the abundance was consistently low, except for the longitude 35-45 (Greenland) that follows a continuous trend of increasing abundance.

To summarize, all the variables were presented as normalized anomalies in 2 different scorecards, the former presenting mostly modelled and remote sensed estimates that allows us to encompass large scale area and to look in seasonal and interannual variability, the latter is presenting direct measurements on the AR7W line typically sampled in late May - beginning of June.

The temperatures in the Labrador Sea tend to be warmer, the atmosphere transferring a large amount of heat to the sea surface. Under this trend ice extent also decreased on the Labrador Shelf for the winter period. Increasing TIC and decreasing pH reacts as predicted by absorbing the excess anthropogenic atmospheric CO_2. The temperature trend cascades through the lower trophic levels with the observed earlier phytoplankton blooms in both shelves regions. The intensities of the production integrated annually however show a decline highlighted by the chlorophyll-a biomass. The earlier and more intense production in the spring is certainly beneficial for the *Calanus* spp. younger stages, but the overall annual average decrease in chlorophyll is also reflected in the total copepod abundance.

Discussion

A suggestion was made to investigate the relationship between the development index of *Calanus finmarchicus* and the timing of the bloom. This was not done in the past but will be looked at in future analyses.

PHYSICAL OCEANOGRAPHIC CONDITIONS ON THE NEWFOUNDLAND AND LABRADOR SHELVES – EUGENE COLBOURNE

A key indicator of ocean climate conditions on the Newfoundland and Labrador (NL) Shelf, the North Atlantic Oscillation (NAO) index, returned to a weak negative phase in 2013 and as a result arctic air outflow to the Northwest Atlantic during the winter decreased over the previous year. This appears to have resulted in an increase in winter air temperatures over much of the Labrador Sea area causing a continuation of less sea-ice than normal on the NL Shelf. Annually however, air temperatures decrease over 2012 but remained above the long-term mean in southern Labrador by 0.5 SD (0.7°C at Cartwright) and Newfoundland by 0.7 SD (0.7°C at St. John's). The winter sea-ice extent on the NL Shelf remained below normal (1.5 SD) for the 16th consecutive year, a decreased of 0.6 SD over 2012. As a result of these and other factors, local water temperatures remained above normal in most areas in 2013 but showed a decrease over 2011-12 values. Average sea surface temperatures on the NL Shelf decreased from 1.6 SD above normal in 2012 to about 0.4 SD above normal in 2013, and near shore at Station 27 they were 1.1°C (1.6 SD) above normal, similar to 2012. Bottom temperatures at Station 27 were 1 SD (0.4°C) above normal, nearly identical to 2012 values. Spring bottom temperatures in NAFO Div. 3P decreased to about 1 SD above normal in 2012-13 down from +2 SD in 2011 and in 3LNO they decreased to slightly less than 1 SD above normal. Fall bottom temperatures in 2J, 3K and 3LNO decreased from 2, 2.7 and 1.8 SD above normal in 2011 to 1.1, 1.2 and 0.2 SD above normal in 2012 and to 0.8, 0.5 and 0.1 above normal in 2013, respectively, a significant decrease in the past 2 years. The area of the cold intermediate layer (CIL) water mass with temperatures <0°C along standard AZMP sections on the NL Shelf during the spring, summer and fall were below normal ranging from 0.7 to 1.5, 0.5 to 1.4 and 0.3 to 0.9 SD, respectively, implying a continuation of less cold shelf water than normal. In general, most environmental indices show a continuation of a warmer than normal trend throughout the area. During the past 2 years however, temperatures have decreased compared to the record warm conditions of 2011. A composite climate index derived from 27 meteorological, ice and ocean temperature and salinity time series declined from 8th highest in 2012 to the 18th highest in the 64 year time series in 2013.

Discussion

It was pointed out that there were no CTD data collected at Station 27 during the winter months but yet the mixed layer plot showed interpolated values between December 2012 (i.e. last data collected in 2012) and March 2013 (i.e. first data collected in 2013). It was suggested to "white out" that part of the mixed layer plot for 2013 as the interpolated values are highly questionable.

A participant remarked that the “flip flop” pattern in the indicators of the physical environment was similar in both the observations and model results.

Comments were made on the apparent difficulty in interpreting the mixed layer depth and the stratification index signals. The increase in the mixed layer depth is normally contradictory to the corresponding increase in the stratification index and suggests that one parameter or the other is likely not representing the observations in a suitable manner. For example, in 2013, the mixed layer depth signal is biased by the inconsistent sampling in March/April and therefore, the summer mixed layer depth might be a better overall indicator.

BIOGEOCHEMICAL CONDITIONS ON THE NEWFOUNDLAND AND LABRADOR SHELVES – GARY MAILLET

The spring bloom inferred from ocean colour imagery declined in 2013 throughout many of the statistical sub-regions throughout the Newfoundland and Labrador (NL) Shelves compared to above average levels observed in recent years (2008-2011). The timing of the spring bloom was earlier on average for sub-regions in the Flemish Pass and Cap sub-regions in 2013 but was not observed further north on the Grand Bank, and northeast and Labrador Shelf. The duration of the spring bloom has gradually diminished across the NL sub-regions although high inter-annual variability is evident. Shallow and deep inventories of nitrate (also silicate) across the AZMP Sections and Station 27 (S27) declined abruptly after 2008 and have remained well below average to present. Phytoplankton standing stock also declined in general along standard sections and S27 in 2013 consistent with satellite imagery. In general, the abundance of different functional zooplankton taxa has remained relatively stable on the NL Shelves. The abundance of calanoid copepods remain high in 2013 and stable for the past decade based on the NL seasonal oceanographic surveys. The overall abundance of dominant copepod species has trended upwards during the time series, particularly on the Grand Bank and northeast Shelf. Non-copepod taxa, consisting mostly of meroplankton and carnivorous zooplankton, increased substantially in 2013 on the Grand Bank and have remained stable during the observation period. Continuous Plankton Recorder (CPR) taxa for small and large grazing copepods and some macrozooplankton groups increased substantially in 2012, consistent with the general trends observed on AZMP Sections and S27.

Discussion

A participant asked whether the decrease in chlorophyll observed in 2013 could be explained by the corresponding increase in zooplankton abundance. This was acknowledged as a possible explanation although other conditions observed in 2013 could also be considered such as the decrease in surface nitrate across the region and the deepening in the winter mixed layer compared to previous years. It was also noted that not only the chlorophyll index but both the magnitude (peak) and the duration of the spring bloom were also lower in 2013. This brief discussion prompted some participants to suggest looking at primary production as a better overall phytoplankton index rather than the integrated chlorophyll.

It was also suggested to look at the trends in the abundance of higher trophic predators (e.g. capelin) to try to explain the low chlorophyll and high zooplankton abundance conditions observed in 2013 and to determine whether or not a top-down effect is a possibility.

PHYSICAL OCEANOGRAPHIC CONDITIONS IN THE GULF OF ST. LAWRENCE – PETER GALBRAITH

An overview of physical oceanographic conditions in the Gulf of St. Lawrence in 2013 is presented as part of the Atlantic Zonal Monitoring Program (AZMP). AZMP data as well as data from regional monitoring programs are analyzed and presented in relation to long-term means.

St. Lawrence River runoff was near normal, but the spring freshet was above normal. It began early, in March, consistent with early melt associated with the third warmest March air temperatures since at least 1945, and persisted much longer than usual with peak runoff in May and an average runoff nearly as high in June. Sea ice reached a seasonal volume that was the 6th lowest since 1969. A large portion of the winter mixed layer remained above freezing by at least 0.6°C in early March, preventing further sea-ice formation. The summer cold intermediate layer (CIL) had the third lowest volume (T < 1°C) since at least 1985. The CIL minimum temperature index for the Gulf was the fifth highest since 1983. The sea-surface temperature averaged May to November over the Gulf was near normal (with some air temperatures used as proxies to complete still unavailable SST data from latter months). Deep-water temperatures and salinities are increasing overall in the Gulf, with inward advection from Cabot Strait, where temperature and salinity reached a record high (since 1915) in 2012 at 200 and 300 m, respectively. Temperature at 300 m increased slightly overall, to reach the highest value since 1986. Temperatures at the depth of the temperature maximum (250 + m) were above normal in Esquiman Channel and the central Gulf, exceeding 6°C, causing large areas to be occupied by waters with temperatures > 6°C. However, salinity at Cabot Strait at 300 m decreased to normal in 2013, accompanied by a decrease in temperature, signifying an important change in water masses entering the Gulf at depth.

Discussion

A comment was made with respect to the speed of propagation of the temperature [anomaly] signal from the Cabot Strait to the Estuary as to whether observations and model results were in agreement. Although seemingly long, the two year period for the propagation of the temperature signal is very reasonable and it was argued that such signal propagation is typically faster in model results than it is *in situ*.

BIOGEOCHEMICAL CONDITIONS IN THE GULF OF ST. LAWRENCE – STÉPHANE PLOURDE, MICHEL STARR

We present an overview of the biogeochemical conditions in the Gulf of St. Lawrence (GSL) in 2013. The late winter (March) nitrate concentrations measured during the helicopter survey were near normal for most regions of the Gulf of St. Lawrence, with the exception of an area east of Magdalen Islands where nutrients were very low because of an early onset of the spring phytoplankton bloom. The analyses of satellite-based chlorophyll *a* biomass in different sub-regions revealed a start of the spring phytoplankton growth earlier than normal in many regions of the GSL, confirming a tendency initiated in 2009. However, the timing of the spring bloom peak was near normal across the region. On an annual basis, chlorophyll *a* levels in 2013 were above normal in the southern, northeast and eastern GSL (Cabot Strait) and close to or below normal in the northwest GSL. The difference between winter (maximum) and late spring (minimum) nitrates inventories was below or close to normal, suggesting that primary production was lower during spring 2013. In the St. Lawrence Estuary, chlorophyll *a* was well below normal during spring and early summer, probably due to high freshwater runoff. Abundance of *Calanus finmarchicus*, large calanoids, and total copepods were lower than normal (average 1999-2010) in 2013, which represented a decrease relative to 2012. Abundance of *Pseudocalanus* and non-copepods were greater than normal in 2013, an increase relative to 2012. Both *Calanus hyperboreus* and small calanoids showed near-normal abundances in 2013, while abundances of copepod species indicative of cold/arctic and warm/temperate water masses decreased to lower than normal levels in 2013. *Calanus finmarchicus* phenology at Station Rimouski was characterized by a timing of emergence of CVI in spring close to normal, while the timing of development of the G_1 (peak CI-III abundance) occurred later than normal. Probably due to the combined effect of a higher than normal freshwater runoff, and low phytoplankton biomass in

June, and a negative surface water anomaly during summer in the estuary and northwestern GSL.

Discussion

A comment was made with respect to the delayed development of *Calanus finmarchicus* observed in 2013 and to whether or not this had been observed in previous years. The speaker answered that the phenology of *Calanus finmarchicus* is strongly affected by the specific environmental conditions observed in the Northwest Gulf of St. Lawrence, up to and including the Rimouski station.

BAY OF FUNDY: 2013 PHYTOPLANKTON, ZOOPLANKTON AND OCEANOGRAPHY SUMMARY (WITH COMPARISONS WITH EARLIER YEARS) – JENNIFER MARTIN

Sampling for salinity, temperature and turbidity was initiated at Prince 5 in 1924 and continues today (with the addition of phytoplankton, zooplankton and nutrients in 1999). A phytoplankton monitoring program was initiated in southwest New Brunswick in 1988 in response to a rapidly growing aquaculture industry and concerns about environmental impacts and harmful algal blooms (HABs). Earlier results on the paralytic shellfish poisoning (PSP) producing organism, *Alexandrium fundyense*, and its distributions in the Bay of Fundy showed that Prince 5 was not the best indicator site for *A. fundyense* studies whereas sampling at the Wolves Islands gave a better representation of offshore phytoplankton populations and their transport to the inshore regions. As a result, the long-term phytoplankton sampling site at the Wolves Islands was initiated and continues to be monitored.

Sampling at the Wolves site occurs at weekly intervals between April and late October, resulting in 683 total visits from 1988-2013, and monthly during winter months whereas Prince 5 samples are collected monthly resulting in 12 samplings per year. Sampling at the Wolves includes CTD casts and secchi depth as well as phytoplankton species abundance and nutrients at the surface, 10 m, 25 m and 50 m; sampling from Prince 5 is at the surface, 10 m, 25 m, 50 m and just above bottom (approximately 90 m). Phytoplankton samples from the Wolves are collected from each of the discrete depths every week during bloom periods whereas at Prince 5, 100 ml from each depth is integrated into one sample from the mid-month sampling. As the phytoplankton samples from the Wolves separate the surface from those collected a depths, higher numbers of most species that tend to concentrate in the surface layers are captured whereas the integrated sampling at Prince 5 shows higher numbers of species such as pennate diatoms that can concentrate in the deeper waters.

A comparison between concentrations of total phytoplankton, diatoms, dinoflagellates and “other” species (smaller zooplankton, silicoflagellates and ciliates) from the Wolves and Price 5 shows similar trends for the total phytoplankton and diatom densities for the two sites, but significantly lower concentrations of dinoflagellates and “other” species (Figure 3 and Figure 4). Phytoplankton densities in 2011-13 were lower than normal due to increased spring winds (2011), high water temperatures (2012) and elevated rainfall (2013). Additionally, monthly sampling does not capture all phytoplankton blooms.

It is becoming more evident that chlorophyll *a* values do not reflect actual phytoplankton densities (Figure 5).

During 2013, nitrate values at the Wolves decreased, for the first time since sampling was initiated, to levels below the detection limit.

Archived zooplankton data from 1935-1970 shows a wealth of data for comparison with samplings from recent years from both Prince 5 and the Wolves Islands.

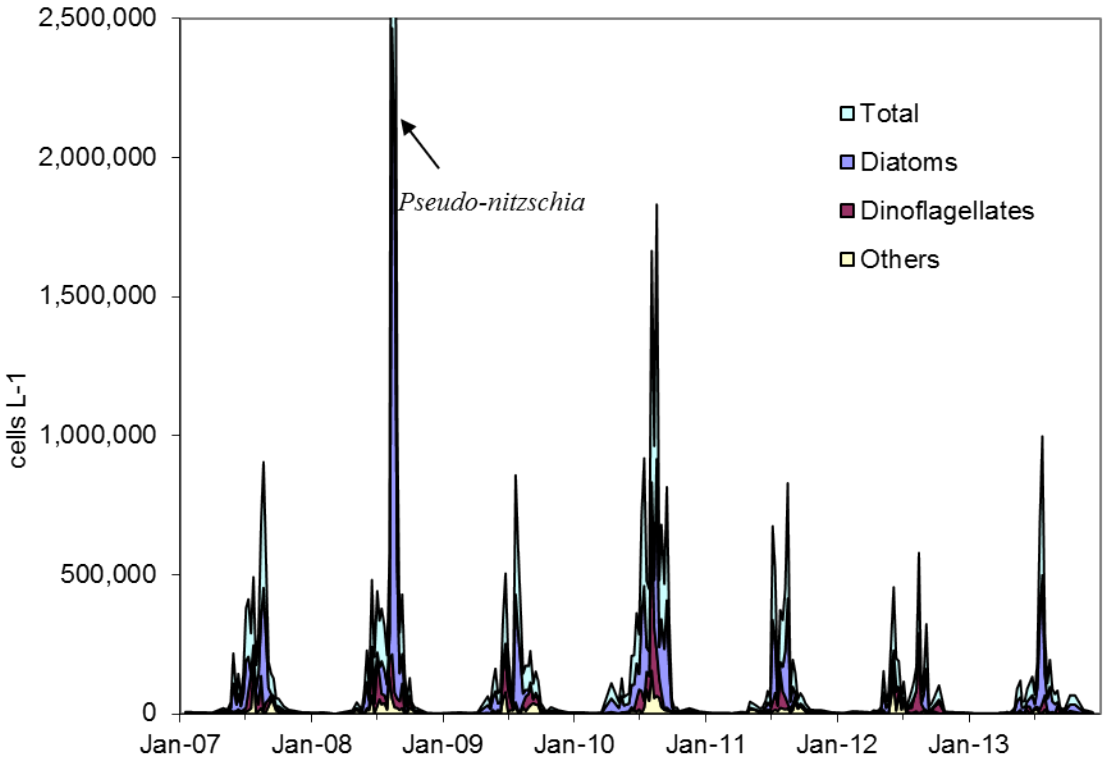

Figure 3. Densities of total phytoplankton, diatom, dinoflagellate and "other" species at the Wolves Islands (2007-2013).

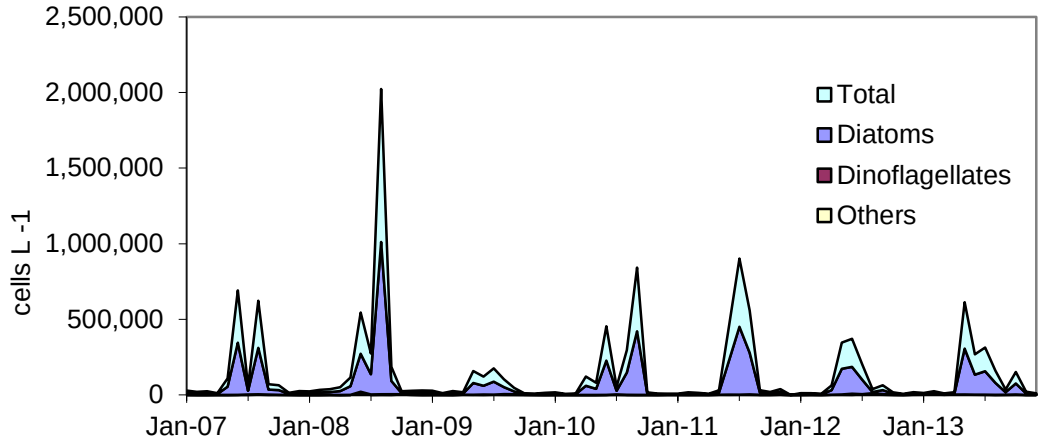

Figure 4. Densities of total phytoplankton, diatom, dinoflagellate and "other" species at Prince 5 (2007-2013).

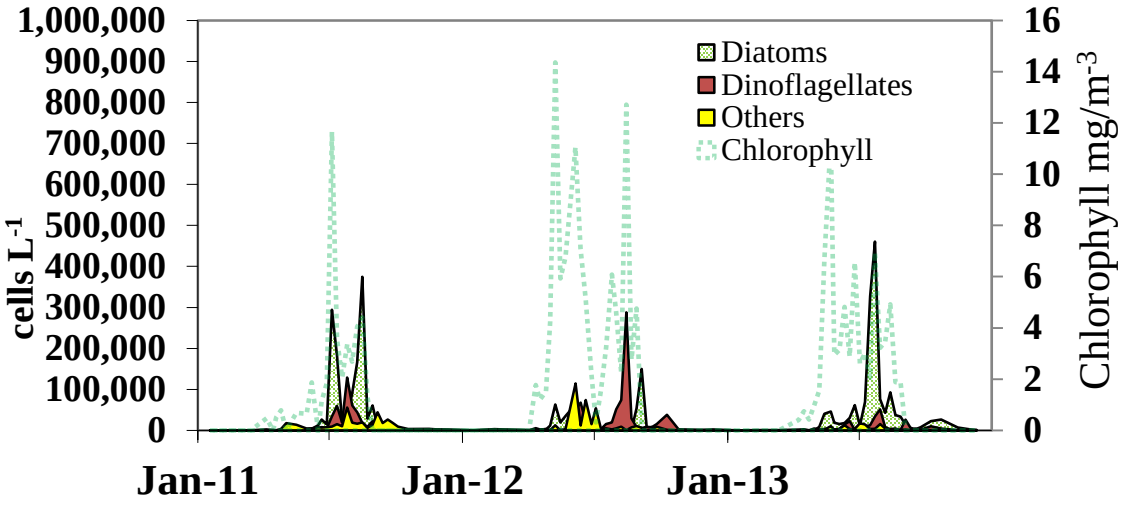

Figure 5. Chlorophyll a and phytoplankton values form the Wolves (2011-2013).

Discussion

A comment was made regarding the decreasing trend observed in the abundance of diatoms and dinoflagellates at Prince 5 and the Wolves and whether or not this had also been observed for flagellates. The speaker confirmed that although there is significantly less information on flagellates, their abundance has followed a similar decreasing trend as that observed for diatoms and dinoflagellates.

As a general observation, it was suggested that a scorecard approach be used in the future to summarize the observations collected at Prince 5 and the Wolves.

PHYSICAL OCEANOGRAPHIC AND METEOROLOGICAL CONDITIONS ON THE SCOTIAN SHELF AND IN THE GULF OF MAINE – DAVE HEBERT

In 2013, air temperature anomalies were positive for Sydney, Sable Island, Halifax (Shearwater), Yarmouth, Saint John and Boston, ranging from +0.1°C at Saint John to +0.8°C at Sable Island above normal. Other than Sable Island, air temperatures were lower than in 2012. Other than Saint John, the decrease was more than 0.4°C. Monthly temperatures were below normal at the end of 2013.

In 2013, satellite sea surface temperature was above the 1981-2010 average temperature ranging from 0.4°C (0.4 SD) for Cabot Strait to 1.2°C (2.2 SD) for the Bay of Fundy, Lurcher Shoals and by 2.0°C (2.1 SD) for Georges Bank. Temperatures were lower than 2012, ranging from 0.5°C at Western Bank to 1.7°C at Western Scotian Shelf and Lurcher Shoals.

Annual surface temperature anomalies at St. Andrews and Halifax were 1.0°C (1.7 SD) and -0.04°C (-0.05 SD) from the 1981-2010 average temperatures. They were more than 0.8°C lower than the 2012 average temperatures.

The July bottom temperatures for the shelf portions of NAFO Regions 4Vn, 4Vs, 4W and 4X were 0.2°C (0.5 SD), 0.8°C (1.1 SD), 0.6°C (0.8 SD) and 1.0°C (1.5 SD) above the 1981-2010 average values. They were 0.3°C, 0.5°C, 1.2°C and 1.1°C below the 2012 values.

Discussion

It was suggested that the observed trends in stratification in the Gulf of St. Lawrence are such that a decrease in stratification on the Scotian Shelf should be expected. The speaker commented that the increasing trend in the stratification index observed across the Scotian Shelf was essentially driven by a decrease in the surface salinity. Other possible contributions can also be considered such as the intrusion of offshore water and the transport of Newfoundland shelf water. A participant commented that this was a good example where model results can be useful to complement observations and to provide insight into the dynamics of the system through the ability of models to integrate information.

The speaker commented that the stratification index is typically calculated using data collected at somewhat irregular intervals from different programs (e.g. summer groundfish surveys; currently looking at incorporating glider data). A participant suggested that the frequency at which the stratification index is calculated might be a reason why the freshwater signal from the Gulf of St. Lawrence is not completely captured on the Scotian Shelf.

BIOGEOCHEMICAL CONDITIONS ON THE SCOTIAN SHELF AND IN THE GULF OF MAINE – CATHERINE JOHNSON

Plankton community condition on the Scotian Shelf and eastern Gulf of Maine at the end of 2012, a year marked by unusually warm and stratified ocean conditions, set the initial conditions for 2013. In particular, zooplankton biomass and the abundance of the two dominant herbivorous copepod species, *Calanus finmarchicus* and *Pseudocalanus* spp., were low and there appeared to be a shift to a smaller-size phytoplankton community on the Scotian Shelf. The record low abundance of *C. finmarchicus* led to poor feeding conditions for right whales in the Bay of Fundy and Roseway Basin, but Gulf of Maine herring and scallop condition were good in the fall of 2012, perhaps due to a strong summer fall phytoplankton bloom in the Gulf of Maine.

In 2013, annual average temperature anomalies were still positive in the Maritimes Region, but less so than in 2012, and temperature and stratification anomalies were marked by spatial and sub-annual variability. Variability in the physical environment was reflected in nutrient and plankton conditions. Deep-water and winter nitrate supply were similar to average overall, but surface nitrate was higher than average. Spring bloom chlorophyll *a* levels were high or average on the eastern Scotian Shelf and low or average on the western Scotian Shelf and Gulf of Maine, but summer-fall blooms were above average in all areas. Zooplankton biomass and abundance were lower than average on the eastern transects, but anomalies were mixed on the central and western Scotian Shelf and Bay of Fundy. The abundance of *Pseudocalanus* spp. was higher than average in the central and western part of the region. Although *Calanus finmarchicus* abundance was variable and lower than average overall, its abundance was high on the western Scotian Shelf and in the eastern Gulf of Maine during the summer ecosystem trawl survey, higher than average at the Halifax-2 station in autumn, and high in the Emerald Basin in autumn, suggesting a stronger population in the western part of the region going into 2014.

An initial evaluation of relationships among annual anomalies of physical variables, nitrate, and zooplankton variables at Halifax-2 from 1999 to 2013 was made using corrgrams. The strong influence of changing water mass contributions at the station was evident in strong relationships between physical and immigrant group variability, but the shifting contributions from different water masses also complicate evaluation of changes in the phytoplankton production in response to environmental variability. Strong water mass variability is a typical property of the central and western Scotian Shelf, as a transition zone, implying a variable pelagic habitat for

upper trophic levels and highlighting the need to incorporate numerical modeling approaches to understand the drivers of plankton variability in the region.

Discussion

The correlation analysis [corrgrams] between different environmental and plankton variables was done using the annual anomaly values over the period 1999-2013. This analysis was initiated this year and will likely include more variables in the future. A participant suggested extending the analysis to investigate correlation patterns between Halifax 2 and Prince 5. Although the dissimilarity between the two stations is seemingly not conducive to this, it would nevertheless help to assess whether what is observed at Halifax 2 is most often transported to Prince 5 or not.

A participant pointed out that the high abundance of some zooplankton species as witnessed during the fall survey might help explaining the generally low abundance of copepods in 2013. For example, the link between the abundance of salps and that of copepods could provide some explanation although not easily interpreted due to, for instance, differences in feeding preferences. The analysis has not yet looked at all the data but rather focused on presenting abundance data in a spatial context.

SESSION 5 - SYNTHESIS OF PHYSICAL AND BIOGEOCHEMICAL CONDITIONS IN THE NORTHWEST ATLANTIC, 19 MARCH 2014

Rapporteur – Stéphane Plourde

SUMMARY OF ZONAL SCORECARDS – PETER GALBRAITH, PIERRE PEPIN

NAO (North Atlantic Oscillation) is back to normal after strong negative and positive anomalies in recent years. Ice volumes were low but not at record levels. The CIL (Cold Intermediate Layer) was warm and thin across the zone unlike differences between NL and GSL+SS last year; cooler than 2012 in GSL and SS, warmer than 2012 for NL. Bottom temperatures were generally just above average across the zone. Overall, temperatures were generally normal or above normal, salinities demonstrated no clear pattern, but anomalies were weak, and stratification was generally normal or above normal.

Nutrients showed a high degree of inter-annual variability in the surface layer. The Newfoundland region showed a strong decline in deep NO_3 inventories. There has been a higher frequency of positive anomalies in GSL and SS in last two years. Phytoplankton inventories showed limited inter-annual variability, but they were more variable in the early 2000s. Conditions in the Newfoundland region were generally lower than average in last 3 years while the Gulf of St. Lawrence has been near average since 2009 and the Scotian Shelf has been above average except on the eastern section. Copepods were above average in Newfoundland and lower in the Gulf of St. Lawrence and most of Scotian Shelf. *Calanus finmarchicus* abundance has been slightly above average in Newfoundland and below average throughout much of zone. *Pseudocalanus* has been above average at most sampling sites but only slightly so in the Gulf of St. Lawrence. Non-copepods were above average in Newfoundland and many parts of the Gulf of St. Lawrence but near average on Scotian Shelf.

The Chair presented a number of suggestions for additional information to be included for this year as well as in the future. The most immediate suggestion is to add a section dealing with the Labrador Sea to this year's Science Advisory Report (SAR). In addition, development of a scorecard for the region should be considered in the future.

There should be further consideration of the following:

- Physical variables
  - Large-scale salinity and stratification indices
- Phytoplankton
  - Summary of remotely sensed chlorophyll concentration from Petrie boxes?
- Zooplankton
  - Relative abundance of small *versus* large copepods
  - Species diversity (richness, evenness)
  - Development state of *Calanus* and *Pseudocalanus* (surveys *versus* high frequency sites)
  - Issues with missing observations (GLM, seasonal adjustments) / surveys
  - Making a greater effort at quantifying shifts in distribution along sections
- Zonal
  - Composite index nutrients – phytoplankton – zooplankton
  - Should other elements of food web be considered?
  - Linking nutrient inventories with water mass analyses
- Additional physical indices
  - Transport indices
  - Model forecasts

Discussion

Participants agreed that the Zonal SAR 2013 was good and a useful product to make AZMP results more accessible to management. Participants discussed several aspects of the Zonal SAR, including the need to combine phytoplankton bloom dynamics indices derived from remote sensing and sampling at high-frequency sites, to base the selection of taxa to derive new indices of small and large zooplankton or functional groups on the twelve most abundant species, and using GLM/seasonal adjustment of zooplankton abundance to fill sampling gaps across the whole AZMP region. Participants also discussed the relevance of using indices of large sub-regions in the Gulf of St. Lawrence, developing indices to describe variations in phenology of key copepod species, and adding indices of Labrador Current transport to the Zonal SAR.

Participants decided it would be useful to include a Labrador Sea Line section in the 2014 SAR as several indices are ready and a research document will be produced.

A participant also asked why air temperature was not included in the SAR.

A participant pointed out that air temperature was considered a driver, as suggested by its high correlation with sea surface temperature.

Participants also suggested exploring the development of an upwelling index, maybe for 2015.

SESSION 6 – ENHANCEMENTS AND OUTCOMES FROM AZMP

THE CANADIAN WILDLIFE SERVICE SEABIRD AT-SEA PROGRAM: TEAMING UP WITH DFO AZMP – FRANÇOIS BOLDUC (ENVIRONMENT CANADA)

An earlier Canadian Wildlife Service seabirds-at-sea program covered much of the Eastern Canadian seaboard during the 1970s and 80s. With a new amendment to the Migratory Birds Convention Act (1994) protecting waters frequented by birds in 2005, the Eastern Canadian Seabirds At-Sea program (ECSAS) has been revived. Since this amendment, 51 % of the ECSAS data comes from our partnership with DFO AZMP. Within ECSAS, 50 % of the data has been collected between April and July, whereas 31 % was between August and October, and 19 % between November and March. Alongside the data collection activities, we developed tools to extract least-biased seabirds-at-sea densities, with possibilities for spatial stratification by species and periods. We hope to develop an online seabirds-at-sea atlas in the next few years to allow users to access our data and hope this will help to strengthen our partnership with DFO scientists and optimize seabird conservation in Canada.

Discussion

The presenter mentioned that spatially explicit seabird density data and products will be probably hosted on a web page at the University of Québec at Rimouski because it was too complicated to implement at Environmental Canada with ITSD.

A participant pointed out that it would be useful to examine seabird data in conjunction with AZMP environmental data. The presenter agreed but also said that seabird data collected during AZMP surveys are mostly restricted to the nesting period but that the data are suitable for the identification of areas of high occurrence.

A participant suggested potential ways to improve the collection of environmental data to describe mechanisms underlying the existence of seabird ‘hotspots’.

Participants indicated that it would be interesting to develop indices to explore potential trends in population abundance and individual condition in relation to environmental conditions. The presenter agreed but mentioned that variations in inventory protocols through time represent a problem that could be overcome with some standardization work. The presenter confirmed the existence of times series of chick growth/condition for some key species.

META-DATA CAPTURE SYSTEM (ELOG) – ANDREW COGSWELL

Shipboard meta-data collection systems are a critical component for capturing operational details during oceanographic missions. Until recently, the operational details of the Atlantic Zone Monitoring Program (AZMP) were captured in written logs. Written logs are inherently prone to transcription errors and depend heavily on the competence of the log keeper. ODIN, a meta-data capture system once utilized by the Atlantic Zone Offshore Monitoring Program (AZOMP), has been abandoned because it does not operate on Microsoft Windows 7 and is not feasible to update. Over the last 3 decades, there has been numerous meta-data capture systems developed for various science programs, each with their shortcomings.

Recently, members of the Ocean Data and Information Section (ODIS) met with interested scientists and technicians from AZMP and AZOMP to demonstrate and discuss a promising meta-data capture system called ELOG. ELOG is currently utilized by the University-National Oceanographic Laboratory System (UNOLS) in the USA as part of their Rolling Deck to Repository (R2R) program. ELOG is a free and open source program and is part of a family of applications known as weblogs1. The general purpose of weblogs is to make it easy for people to put information online in a chronological fashion, in the form of short, time-stamped text

entries with optional HTML markup for presentation, and optional file attachments (images, archives, etc.). As well, weblogs make it easy for other people to access this information through a Web interface, browse entries, search, download files, and optionally add, update, delete or comment on entries. This would allow users on an oceanographic mission to log simultaneous entries that can be subsequently modified from any computer on the ship's network. ELOG is simple to use and requires one executable file, a simple and modifiable configuration text file, and no Web server or relational database is required. Through its single configuration file, ELOG can be made to display a variety of meta-data capture options tailored to capture the data important to a particular science program. There are options for what to display, how to display it, what commands are available and to whom. Moreover, a single server can host several weblogs, and each weblog can be autonomous (This section is paraphrased from the ELOG website). Finally, ELOG can run executables that can capture other ship-board meta-data to be held in the log (e.g., GPS data).

For the Maritimes Region Spring 2014 AZMP mission, an ELOG template will be utilized to capture mission specific meta-data. This template was demonstrated during the 16th Annual meeting of the Atlantic Zone Monitoring Program.

As well as developing the ELOG template for the AZMP mission, ODIS is working to create a method for transferring meta-data captured by ELOG to a relational database that will serve as the basis for shipboard and land based analytical data. It is hoped that this Access database will serve to house all biological and chemical data generated by this and subsequent AZMP missions. It is also expected that this database will significantly ease the transition and improve the quality of AZMP data entering BioChem. Ultimately, this should advance the timeline for data availability and improve data accuracy for yearly reporting purposes.

Discussion

A participant pointed out a potential limitation concerning the number of revisions allowed by the software to the event meta-data history, but others thought that ELOG showed an interesting versatility. An example provided by the presenter was that several users can simultaneously contribute to the meta-data entry. The group expressed an interest for the tool and is interested to see an update of the trial planned during the Maritimes Spring AZMP Survey.

OCEAN SERVICES FRAMEWORK (OSF) – MICHAEL OTT

No summary was provided.

Discussion

During the presentation, the presenter said that there might be potential for Canadians to obtain funding as part of a future North Atlantic Monitoring Program in collaboration with several European countries. Two participants mentioned that this statement was not realistic and such funding opportunities unlikely.

A participant asked if AZMP was included in the Ocean Forecasting Program, which was not implicitly the case. Several participants agreed that AZMP should be included. The presenter also discussed the need to have consistent monitoring programs across Canada, a point considered unrealistic by several participants considering the weakness of sampling programs in the Arctic in comparison to those in the Pacific and AZMP. Participants asked questions about how current modeling work and tool development done by DFO as part of COMDA (Centre for Ocean Modelling Development for Application) in close collaboration with AZMP was considered in the OSF plan. Model development also includes bio-physical ecosystem models (Nutrient-Phytoplankton-Zooplankton-Detritus: NPZD) or 'green models'. The presenter only

provided a general agenda for NEMO downscaling and admitted that the reflection about tools and green models that will be developed and supported by OSF was not done yet.

Participants expressed concerns regarding the fact that no models already developed as part of COMDA and AZMP were mentioned in the current version of the OSF. They said that it could suggest that no significant developments have been made. A participant suggested adding AZMP (monitoring) staffing and resources in the section 'improve/modernize' DFO services of the OSF plan would be appropriate. The presenter agreed and added an item in the section.

After the presentation, a participant expressed concerns about expectations implicit in the OSF plan on an observing system (AZMP) already strained. Participants agreed that such expectations would be unrealistic if no additional resources are made available. The presenter answered that there is a need to get commitment from other sectors in order to support any request for addition funding for AZMP. Concerns about the level of communication between National and AZMP levels about priorities and activities to prioritize were also raised.

CANADIAN CONTRIBUTION TO OVERTURNING IN THE SUBPOLAR NORTH ATLANTIC PROGRAM (OSNAP) – BLAIR GREENAN

Overturning in the Subpolar North Atlantic (OSNAP) is an international program designed to provide a continuous record of the full-water column, trans-basin fluxes of heat, mass and freshwater in the subpolar North Atlantic, is proposed herein. The OSNAP observing system consists of two legs: one extending from southern Labrador to the southwestern tip of Greenland across the mouth of the Labrador Sea (OSNAP West), and the second from the southeastern tip of Greenland to Scotland (OSNAP East). The observing system also includes subsurface floats (OSNAP Floats) in order to trace the pathways of overflow waters in the basin and to assess the connectivity of currents crossing the OSNAP line. The location of the OSNAP East and West legs purposefully melds with a number of long-term observational efforts in the North Atlantic: the Canadian repeat AR7W program in the Labrador Sea; the German Labrador Sea western boundary array at 53°N; the global Ocean Observatories Initiative node to be placed in the southwestern Irminger Sea; the repeat A1E/AR7E hydrographic sections across the Irminger and Iceland basins; and the Ellett line in the Rockall region. Substantial international collaboration has been garnered for OSNAP, including measurement contributions from the UK, Germany, the Netherlands and Canada. Importantly, this proposed observing system, in conjunction with the RAPID/MOCHA array at 26°N and the EU THOR/NACLIM program will provide a comprehensive measure of the Atlantic Meridional Overturning Circulation (AMOC) and provide a means to evaluate inter-gyre connectivity in the North Atlantic.

The primary observational components are: (i) a mooring array across the eastern margin of the Labrador Sea, where the subpolar boundary current enters the basin. This array will complement an analogous array across the western margin at the exit point of the Labrador Sea, maintained by institutions in Germany (GEOMAR) and Canada (Bedford Institute of Oceanography, Northwest Atlantic Fisheries Centre and Memorial University); (ii) a sequential release of acoustically tracked floats in the lower limb of the AMOC at OSNAP East and OSNAP West boundary arrays. These floats will be seeded in the two densest components of North Atlantic Deep Water (NADW) over the four-year period of the measurement program (2014-2018). The mooring design details for the 53°N array was presented along with a discussion of the risks related to fishing activity in the area.

Discussion

The presenter and a few participants pointed out potential problems regarding mooring locations and the spatial distribution of fishing activity in the targeted region. A participant asked if such an

extended mooring deployment was necessary in addition to the ARGO floats program. The presenter answered that ARGO floats do not provide an accurate measure of transport throughout the water column which is needed by OSNAP.

AN UPDATE ON THE LABRADOR CURRENT INDEX – GUOQI HAN

The transport of the Labrador Current has substantial interannual-to-decadal variability that may significantly impact the ocean climate and marine ecosystem off Atlantic Canada and Northeast United States. Here we have used satellite altimetry data and model output to derive the upper-layer Labrador Current transport from 1993 to 2013. An empirical orthogonal function (EOF) analysis supports recent findings that the Labrador Current transport over the Labrador and northeastern Newfoundland Slope is out of phase with that over the Scotian Slope and that the Labrador Current transport is positively and negatively correlated with the winter North Atlantic Oscillation (NAO) index over the Labrador and northeastern Newfoundland Slope and over the Scotian Slope), respectively. The Labrador Current transport was close to average in 2013. Finally, the temporal pattern of the first-mode EOF is used to create a standardized transport index, which is defined as the annual anomalies divided by the standard deviation.

Discussion

Participants agreed that it would be interesting and useful to add these indices of transport in the Zonal Scorecard (AZMP SAR). A participant suggested that we need to consider two distinct indices for the northern (Newfoundland Shelf) and southern (Scotian Shelf) shelves, given new evidence provided by the HYCOM (HYbrid Coordinate Ocean Model) model showing the importance of physical processes occurring at the tail of the Grand Banks in defining the type of slope water that would transit to the south and influence the Scotian Shelf. Participants mentioned the need to include statistics associated to the anomalies, and to clearly/simply describe the process in the Zonal SAR 2014.

EDDIES IN THE NORTHWEST CORNER OF THE NORTH ATLANTIC CURRENT – DAVE HEBERT

The Gulf Stream travels along the eastern seaboard of the United States and Canada bringing warm water northwards. South of Newfoundland, the Gulf Stream separates into two currents, one that moves around the Grand Banks and travels northward until approximately 50°N where it heads eastward across the North Atlantic. This current is known as the North Atlantic Current (NAC). In this region where the NAC turns eastward, the Northwest Corner (NWC), eddies are generated on a quasi-regular basis and some of them seem to disappear in places. It was hypothesized that these eddies become denser due to a large latent heat flux to the atmosphere and that they sink in place. The mechanism for their formation and their evolution is unknown.

To address these ideas, two ~30 day expeditions separated by approximately 1 month (27 Feb – 1 Apr; 23 Apr – 22 May) were undertaken. During each cruise, two high-resolution hydrographic surveys of the eddy region were conducted. Between the two surveys of each expedition, a larger scale, coarse resolution survey of the region was undertaken. Evidence of interaction of eddies with the NAC, including spin up and decay of eddies and interleaving and subduction between water masses in the region were observed.

Observations from these surveys agree well with the output from the data assimilative HYCOM+NCODA (Navy Coupled Ocean Data Assimilation) Global 1/12° Analysis model, which has higher spatial/temporal resolution of the region. The model shows large amplitude meandering where the NAC turns and the appearance of warm-core eddies to the north of the NAC. A two-layer numerical model illustrates that the evolution of a turning baroclinic jet may result in large-amplitude meanders coupled with locally generated deep eddies that resemble

the HYCOM output. The two-layer model predicts the formation of warm-core eddies during the interaction of upper-layer meanders with nearby barotropic eddies (like those found in the Labrador Sea). Both models show an interaction of upper ocean eddies with eddies in the lower ocean which results in the NAC becoming unstable.

Discussion

A participant was surprised by the good correspondence between results obtained by the HYCOM model and observations. The presenter answered that data assimilation in the model had certainly contributed to it.

SESSION 7 – INTEGRATION AND SYNTHESIS, 20 MARCH 2014

Rapporteur – Carla Caverhill

SUMMARY OF ACTION PLANS: DATA PRODUCTS – BENOIT CASAULT

Every year data products in the form of scorecards and various plots are generated within each region participating in the AZMP. These data products represent a significant contribution to the different reporting activities involving the data collected through the AZMP (e.g. AZMP annual general meeting, CSAS Research Documents, CSAS Scientific Advisory Reports). These data products are generated independently, and sometimes differently, by the three regions although a given product is meant to convey a consistent message across all three regions. A short discussion was initiated this year to look at the feasibility of standardizing and streamlining the generation of data products that are common to the three AZMP regions. The participants in that discussion included: Benoit Casault (MAR), Gary Maillet (NL), Caroline Lafleur (QC), and Jean-François St-Pierre (QC).

The discussion was centered exclusively on the biological and chemical data products, i.e. products derived from data already, or soon to be, archived in BioChem. These products typically include nutrient, phytoplankton and zooplankton indices presented either as scorecard anomalies or plots depicting climatological conditions contrasting with current year observations. These products are common to all three AZMP regions although it is recognized that other region-specific products (e.g. due to differences in the sampling design) would still need to be generated locally.

The benefits of standardizing and streamlining the generation of AZMP data products are threefold: i) ensure consistency in calculations across regions through the use of a unique set of procedures (e.g. general linear model estimates currently used in NL region for missing sample dates, stations, missions); ii) provide common format of standard data products; and iii) efficiency in generating data products (e.g. for CSAS and SAR reports) while freeing time for exploratory or in-depth data analysis.

Four mandatory components were identified as part of the process of data products standardization:

1. Identification of standard data products: This step relies on the input from the lead scientists to identify which data products are common to the three regions (e.g. scorecards, plots) and which algorithms are to be used for the processing of the data.
2. BioChem as central data repository: The successful use of BioChem as the unique data source for the biological and chemical data products is conditional to fixing existing problems with the database, and also to each region committing their data to the database. Using BioChem as central data repository is desirable as updates to the data would automatically show in the final data products.

3. Adoption of common computing platform: Data products are currently generated by various software packages (e.g. Matlab, SAS, Excel, gri, etc.) within the different regions. The R software is suggested as a common computing platform for its portability, the availability of auxiliary packages (graphics, mapping, database connectivity), and the ability to save intermediate data in a format ready for further statistical or exploratory analysis. Significant efforts, however, are required to port existing codes to R.
4. Code synchronization: A version control system (e.g. CVS, Git) is desirable in implementing the codes for the generation of standard data products as it allows concurrent development and efficient sharing between the different contributors. The idea is to implement common codes that can be run across all regions and for which region-specific processing is handled through “if” blocks.

Over the past couple of years, significant efforts have been invested in the Maritimes Region toward developing codes for the generation of various data products. The efforts have resulted in significantly reducing the time required to generate most data products (i.e. approximately 2 week period), as well as allowing early detection of erroneous data (e.g. P5 chlorophyll 2013 data) and freeing time for new analysis (e.g. corrgrams).

Discussion

Participants are happy with how data loading procedure went this year; it was better than previous years. Progress is incremental, and there needs to be trust in the data within BioChem. Once data are loaded, generating products is quick. Documenting procedures on how to load data would make it easier to transfer task of loading to other people. The next issue is where the data should be shared. GCConnex was suggested.

It was asked how people feel about using R as a programming language. One participant said that transferring scripts to R and testing could be time-consuming. It was agreed that we do not have the capacity to develop a library in R. This year, codes developed at BIO were shared with IML with limited success due to differences in processing requirements between the two regions and therefore old procedures were used to produce documents. At BIO, it took a couple of years to write scripts to work directly from BioChem. Most scripts are in Matlab, some are in R. Benoit could have time devoted to porting Matlab scripts to R. It needs to be an adjustable module of code where the user can specify where the data come from, since not all regions have yet committed their data to BioChem.

In Newfoundland there is always missing data and they use model estimates to fill in the gaps; this method is not currently used in other regions. They have shown that 45 to 65 percent of variance comes from model, and this is fairly stable. Missing stations appear to be less problematic in the Quebec and Maritimes Regions, although complete sections have not been sampled in some circumstances. A model fit could be incorporated into the procedure. In the short term there will be differences in procedures but some should be in common and these need to be identified. The AZOMP group should be included in these discussions to extend standardization.

Reliance on BioChem is a concern. The quarantine on Maritimes data should be removed as soon as possible. What is critical and what is not-critical need to be identified. Duplicates are not quarantined. IML data managers offered to help fix the oxygen data, but BIO is concerned that there are big problems that are not yet discovered. This issue received high priority from both the Director of Science and the Division Manager at BIO, so it will be high priority on the work plan in the Data Shop. It is hoped that most of the problems will be fixed within 6 months, and then the data can be released again. It will probably take 18 months to get everything fixed.

As of yet, there is no plan of action for synchronizing the standardization of products across regions. This plan should be a priority. Scientists can name the products, and then model fits can be applied to scorecard products (7 products), standardized and shared. For the first year this could be the plan.

SUMMARY OF ACTION PLANS: 2014 AZMP LOGISTICS – GARY MAILLET

- Logistic leads are to coordinate with Don Belliveau regarding the Regional Individual Standing Offer (RISO) with CTD suppliers (current expiry in Sep. 2014) pending outcome of Major Capital Plan (MCP).
- Logistic leads are to consult with AZMP colleagues regarding priority equipment for year 1 on MCP equipment listing.
- Consultation with Pacific and C&A to determine CTD equipment suppliers.
- Consideration for National Master Standing Offer (NMSO) with CTD suppliers given national MCP submission. Further consultation with personnel in Finance Department is required.
- Equipment outside of RISO/NMSO status will require additional work and advance planning with PWGSC.
- Further consultation with J. Hamilton (BIO) regarding Autonomous Vertical Profiling proposal to enhance collection of biophysical data at AZMP high frequency stations.
- Logistic leads to continue to seek strategies for emergency replacements of critical equipment (i.e. year-end funds).
- Logistics leads to assist in planning for zonal ocean acidification study pending outcome of ACCASP proposal.

Discussion

The Chair will consult with Finance about creating an NMSO with CTD suppliers. All Atlantic regions currently use Sea-Bird as supplier for most of the instruments on the CTD rosettes. It is Finance's responsibility to ease interactions with suppliers. A conference call of the Logistics and BIO managers will consider options to deal with the issue. Adding a new supplier can be difficult and we need to be prepared.

One participant noted that buying new equipment can sometimes require new manpower to run the equipment and turn the data around in a timely manner. It can be hard to get buy-in from managers for new manpower. Often, the cost of equipment is not the stumbling block. There is new technology out there but HR concerns make it untenable. If we start something new we have to be prepared to stop doing something else.

AZMP DATA MANAGEMENT PLAN SUMMARY 2014-15 – LAURE DEVINE, MATHIEU OUELLET, DAVE SENCIALL, SHELLEY BOND

This year's meeting included a separate session for the BioChem Steering Committee. The summary for that meeting also includes information and action items associated with the AZMP Data Management Subcommittee.

Each of the Regions will continue to assist and inform each other of issues and solutions regarding the management of the data. Communications have been greatly improved over the past year and there have been obvious benefits.

BioChem was a primary focus this year and will be into the future. The Maritimes content audit has resulted in data loaded from that Region being made unavailable to the query application until such time as identified issues can be resolved. On-going work will be performed to further

quality assure the data loaded to the archive. Scripts will be developed to assist in performing quality assurance checks prior to load. As historical data are cleaned missions will be re-released for public use. Maritimes management has committed to making this a priority. Work towards the implementation of quality assurance scripts based upon IML's processes will continue and should be completed in 2014.

IML will continue to support NAFC on the development of expertise in the processing and loading of the bottle data. They will also work in conjunction with BIO on implementation of taxon hierarchies, analyses of the current BioChem query application arriving at recommendations for a solution to current issues and concerns, and development/ documentation of best practices for handling and processing of the data meant for BioChem.

NAFC will commit new resources to work with IML on provision of data to BioChem and create a network share to facilitate provision of CTD data to OSD.

OSD will continue to maintain the website as needed, though it should be noted that this will take resources away from other work and changes resulting in major upgrades should be done only as absolutely required. As a short-term solution to the availability of CTD data, OSD will automate ingestion of these data from available network shares and forego the visual quality checks previously performed. OSD will also explore the possibility of loading some data in IML's SLGO database for discovery and download. Sample mission data from BioChem using IML's scripts will be provided to WOD for comments.

Work towards loading of CTD data into Oracle has begun at BIO, and OSD will leverage this work to develop a more readily accessible and searchable database for CTD data over the next two years. The initial focus of population of this database will be with data collected since 1999. Ultimately this will enable development of a public facing application to enable geospatial-temporal queries against the data, and the development of a product which would replace the BIO Climate/Hydrographic Database.

Discussion

If we want changes to the AZMP website, this will take time away from developing better ways to distribute data and make it accessible. The Chair should review what needs to be added to website.

OSD has access to Pacific IOS bottle and CTD data and they are loading it in their databases (not BioChem). It was asked if OSD needs to keep every profile from every sensor. Since 1999 this has been a priority but this does not just mean our reference period; earlier dates will be included as well. All Newfoundland data are in same format regardless of date. One participant noted that while recently going through Climate database, large differences (~1deg) were found between CTD and XBT done at same time. Reverse thermometer data will now be in BioChem and not OSD. Climate has both. It was suggested that the OSD database could add CTD data first, then add other data, then clean it up.

It was suggested that a shadow scientific advisory group of data providers and producers be formed, since NSDMC does not represent scientists. Scientists need to be better informed and given voice on data management issues. The Chair will raise this issue with NHQ. There is a new data management policy that most of us have not seen. It is expected that there will be an information session on this. It was suggested that standards for interoperability would work better than one centralized archive. Another participant said he has never seen it work.

A number of participants raised concerns with the poor response by IMTS to issues facing Ocean Science needs. Tickets dealing with shortfalls in data storage or access to computing power have gone for extended periods without any apparent action. Many feel that Science

Branch is not a priority client for IMTS because many requests for action fall outside the norm of nominal computing needs associated with Windows-based applications. The issue should be highlighted in the executive summary the Chair will present to NSDC.

Overall it was agreed that slow progress is being made.

SYNTHESIS OF ACTION ITEMS – PIERRE PEPIN

The following action items were identified:

- Workshop
  - Complete multivariate analysis manuscript
  - Complete Atlas
  - Investigate patterns of variation (inter-annual) of uncommon taxa
  - Plan inter-sessional meeting of synthesis group – model/data interplay, investigate potential for model-based indices as part of regular reporting
  - Review regional stock assessments for trends that might be closely linked to variations in environment and lower trophic levels
- Permanent Management Committee
  - Coordinate review of AZMP website – provide results to OSD
  - Raise issue of succession planning with Regional Directors
  - Investigate development of a national ocean observation coordination group
  - Investigate requirements for GOOS (Global Ocean Observing System) regional network for Atlantic Canada
  - Develop Executive Summary of meeting for RDSs, DG Oceanography, ADM Science
- Possible additions to Reporting 2014
  - Physical variables
    - Larger scale salinity and stratification indices?
    - Investigate development of upwelling index rather than wind.
  - Phytoplankton
    - Summary of remotely sensed chlorophyll concentration and primary production from selected areas to replace survey indices
  - Zooplankton
    - Composite index based on dominant taxa
    - Quantify developmental state of *Calanus*, *Pseudocalanus* (from surveys)
    - Investigate and quantify shifts in distribution along sections
    - Investigate shifts in subdominant and uncommon species distribution along sections

Regional managers should review AZMP website, send remarks to the Chair, who will contact OSD. It was suggested that we keep a list of documents and research papers that use AZMP data on the AZMP website. This is already done, but everyone should let the OSD coordinator know when a Research Document or paper is published so that he can update the list.

Catherine Johnson will look at functional groups of zooplankton as an alternative to the currently applied composite index. Stéphane Plourde will make a draft of zooplankton developmental stages and circulate it.

All regions intend to submit physical and biogeochemical Research Documents this year. Authors need to provide the Chair with a title so that publication numbers can be assigned by the Secretariat. Reviewers have been assigned. Pierre Pepin and Peter Galbraith will complete SAR with the goal of completing the task by end of April (they will translate as well). Blair Greenan or Marc Ringuette will write a summary of conditions in the Labrador Sea and Guoqi Han will provide a draft paragraph summarizing the Labrador Current index, both of which will be included in the SAR.

It was noted that two DGs in Ottawa should get copies of the proceedings and executive summaries (CHS and Ecosystem Science) in addition to the Atlantic Science Directors.

It was requested that presenters put their presentations into pdf format and send to Andrew Cogswell so he can load them onto GCConnex for access.

It was noted that many seagoing computers are very old. If ELOG is to be implemented, there needs to be a common system for acquiring seagoing computers; this should be handled zonally and perhaps integrated into ship design. The Chair will talk to ship design coordinators about this issue. The Chair will also discuss with Andrew Cogswell, Dave Senciall, and Peter Galbraith about coordinating needs for shipboard computers across regions.

There was general agreement that the meeting achieved all its goals for the year. The next meeting of AZMP will keep the same format and will be held at approximately the same time and at the same locations. The Data Management group would like to meet at the same time as the synthesis workshop.

APPENDIX I – TERMS OF REFERENCE

SIXTEENTH MEETING OF THE ATLANTIC ZONE MONITORING PROGRAM (AZMP)

Zonal Peer Review – Newfoundland and Labrador, Québec, Maritimes and Gulf Regions

March 18-20, 2014
Montreal, QC

Chairperson: Pierre Pepin

Context

The Atlantic Zone Monitoring Program (AZMP) was implemented in 1998 with the aim of collecting and analyzing the biological, chemical, and physical field data that are necessary to:

1. characterize and understand the causes of oceanic variability at the seasonal, interannual, and decadal scales,
2. provide multidisciplinary data sets that can be used to establish relationships among the biological, chemical, and physical variables, and
3. provide adequate data to support the sound development of ocean activities.

The program sampling strategy is based on:

1. seasonal and opportunistic sampling along sections to quantify the oceanographic variability in the Canadian NW Atlantic shelf region,
2. higher-frequency temporal sampling at more accessible fixed sites to monitor the shorter time scale dynamics in representative areas,
3. fish survey and remote sensing data to provide broader spatial coverage and a context to interpret other data, and
4. data from other existing monitoring programs such as CPR (Continuous Plankton Recorder) lines, sea level network, nearshore long-term temperature monitoring, toxic algae monitoring, or from other external organizations (e.g., winds and air temperatures from Environment Canada) to complement AZMP data.

The collected data are edited and archived in databases managed by DFO's Oceanography and Scientific Data (OSD) Branch.

Objectives

1. Assess the biological, chemical and physical oceanographic conditions since 1999 through a peer review of the outcomes of monitoring activities in the four Atlantic regions;
2. Synthesize the multidisciplinary information gathered over the course of the programme;
3. Evaluate and develop new data products aimed at meeting client needs based on regional input;
4. Review the activities of the Atlantic Zone Monitoring Program during 2013 and assess business, operational, logistical, database and remote sensing activities that require regional/zonal intervention or that need to be brought to the attention of Science Directors.

Expected Publications

- Science Advisory Report
- Research Documents
- Proceedings

Participants

- DFO Science Branch
- Environment Canada

APPENDIX II – MEETING AGENDA

16TH ANNUAL MEETING OF THE ATLANTIC ZONE MONITORING PROGRAM

18-20 March, 2014

Delta Hotel, 475 Avenue Président Kennedy, Montreal, QC

"Concerto" Meeting Room

AZMP synthesis workshop

Monday March 17 PM to Tuesday March 18 AM

Part A – Review of work planned in 2014 (March 17)		
(*Rapporteur : Gary Maillet*)		
13:00 – 17:00	Pierre Pepin	Welcome
		Revised analyses - Progress to date and review of results
		Progress on manuscript
		Elements for Discussion section and next steps
	Catherine Johnson	Zooplankton Atlas – Results, draft plan for completion and approach to publication
	Stéphane Plourde	ACCASP – Optimal habitat of zooplankton and pelagic species
General discussion of next steps re: zooplankton synthesis		
Part B – New avenues for synthesis (March 18)		
(*Rapporteur : Dave Hebert*)		
08:30 – 12:00	Diane Lavoie	Progress to date on coupled Biogeochemical model of GSL
	Dave Brickman	General model development in the Atlantic zone – result and analyses
	Joël Chassé	GSL – Preliminary results of a 65 year hindcast (1948-2012) of the Gulf of St. Lawrence, Scotian Shelf and Gulf of Maine
General discussion		
Possible topics: [1] Model survey inter-comparison. How can data synthesis contribute to modelling efforts? [2] How can we move synthesis forward beyond zooplankton analyses? Assessment of linkages between physical properties with T/S, nutrient, chlorophyll data among regions.		

NOTE: There is a parallel meeting of the BioChem working Group

AZMP Business Meeting and Review of Environmental Conditions

Tuesday March 18, 2014

Chair P. Pepin (NL)

"Concerto" Meeting Room

Session 1 – AZMP Business meeting (March 18)		
(*Rapporteur : Andrew Cogswell*)		
13:00 – 13:10	Pierre Pepin	Welcome and Introduction / Acceptance of Agenda
13:10 – 13:30	Pierre Pepin	Review of presentation of NSDC (October 2013) – outcomes and short-comings
13:30 – 13:50	Laure Devine	Overview of BioChem workshop
13:50 – 14:20	Shelley Bond, Laure Devine, Mathieu Ouellet	Progress on Data Management 10 point Action Plan from 2013
14:20 – 14:40	Gary Maillet	Progress on Logistics group Action Plan
14:40 – 15:00	Gary Maillet Jeff Spry Peter Galbraith	Regional summary of activities (5 minutes each)
15:00 – 15:20	**Health Break**	
15:20 – 15:40	Carla Caverhill	AZMP remote sensing products
15:40 – 16:00	Michael Ott	Ocean Services Framework
16:00 – 16:20	Pierre Pepin	Proposal for a baseline survey of the ocean carbonate system and pH for fall 2014
16:20 – 17:00		Breakout discussions for Data Management (Devine/Bond), Logistics (Maillet), data products (St. Pierre/Lafleur/Casault): [1] Identify issues still outstanding [2] What is needed to move forward [3] What to stress to Regional Directors
17:00 – 18:00	**Permanent Management Committee**	

Wednesday March 19, 2014

"Concerto" Meeting Room

Session 2 - Review of physical and biogeochemical conditions in the Northwest Atlantic (March 19)		
Morning Session (*Rapporteur : Benoit Casault*)		
09:00 – 09:30	Marc Ringuette	Physical, chemical and biological conditions in the Labrador Sea (AZOMP)
09:30 – 09:50	Eugene Colbourne	Physical oceanographic conditions on the Newfoundland and Labrador Shelves
09:50 – 10:10	Gary Maillet	Biogeochemical conditions on the Newfoundland and Labrador Shelves
10:10 – 10:30	Peter Galbraith	Physical oceanographic conditions in the Gulf of St. Lawrence
10:30 – 10:50	**Health Break**	
10:50 – 11:20	Stéphane Plourde & Michel Starr	Biogeochemical conditions in the Gulf of St. Lawrence
11:20 – 11:40	Jennifer Martin	Bay of Fundy – 2013 Phytoplankton, zooplankton and oceanography summary (with comparisons with earlier years)
11:40 – 12:10	Dave Hebert	Physical oceanographic and meteorological conditions on the Scotian Shelf and in the Gulf of Maine
12:10 – 12:30	Catherine Johnson	Biogeochemical conditions on the Scotian Shelf and in the Gulf of Maine
12:30 – 13:40	**Lunch**	
Afternoon Session (*Rapporteur: Stéphane Plourde*)		
13:40 – 14:10	Peter Galbraith & Pierre Pepin	Summary of Zonal Scorecards
14:10 – 14:30		General Discussion of Environmental Conditions Review of Zonal SSR 2013 Additions and improvements for 2014 edition
Session 3 – Enhancements and Outcomes from AZMP		
14:30 – 15:00	Francois Bolduc	Results of Canadian Wildlife Service seabird observation program
15:00 – 15:20	**Health Break**	

15:20 – 15:50	Andrew Cogswell	Meta-data capture system
15:50 – 16:10	Blair Greenan	Canadian contribution to Overturning in the Subpolar North Atlantic Program (OSNAP)
16:10 – 16:30	Guoqi Han	An update on the Labrador Current Index
16:30 – 16:50	Dave Hebert	Eddies in the northwest corner of the North Atlantic Current
16:50 – 17:00		General discussion
17:00	**Close**	

Thursday March 20, 2014

"Concerto" Meeting Room

Session 4 – Integration and Synthesis (*Rapporteur: Carla Caverhill*)		
09:00 – 09:40	Pierre Pepin	Work plan for 2013-14 [1] Zonal SAR [2] Research Documents [3] Any other publications
09:40 – 10:40		Summary of Action plans: [1] Data Management (Bond/Devine) [2] Logistics (Maillet) [3] Data Products (St. Pierre) [4] Synthesis (Pepin)
10:40 – 11:00	**Health Break**	
11:00 – 11:45	Matters Arising and General Discussion	
11:45 – 12:00	**Close**	
12:00 – 13:00	**Permanent Management Committee Wrap-up (if needed)**	

APPENDIX III – LIST OF PARTICIPANTS

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