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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.

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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, inter-annual, 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, the Atlantic Zone Offshore Monitoring Program (AZOMP) began providing an overview of the oceanographic conditions in the Labrador Sea. In 2015, the AZMP scientists reconvened in Montréal from March 16th to 19th 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 dix-septième réunion du programme de monitorage de la zone Atlantique (PMZA)

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. Depuis 2014, le programme de monitorage de la zone atlantique au large du plateau continental (PZMAO) présente un aperçu des conditions océanographiques dans la Mer du Labrador. Les scientifiques du PMZA se sont réunis à nouveau à Montréal du 16 au 19 mars 2015 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.

WORKSHOP – DATA PRODUCTS/AZMP SYNTHESIS

Rapporteur – Gary Maillet

INITIATING DFO-MEOPAR DISCUSSION FOR IMPLEMENTATION OF INTEGRATED ATLANTIC OCEAN OBSERVATION SYSTEM – OPPORTUNITIES FOR COLLABORATION - PIERRE PEPIN

At the request of DFO (Fisheries and Oceans Canada) National Capital Region (NCR) the Chair started a discussion about engagement opportunities between DFO and Marine Environmental Observation Prediction and Response network (MEOPAR) relevant to implementation of the Integrated Atlantic Ocean Observation System (IAOOS). Four primary areas of engagement were identified during the preliminary meeting with MEOPAR.

Joint Highly Qualified Personnel (HQP) Projects

AZMP faces some important challenges in the in-depth investigation of functional relationships among the various data elements. MEOPAR, through the availability of funds to support HQP at various levels (MSc, PhD, post-doctoral fellows) and through its support of partnership activities, could provide a conduit for the development of joint DFO-university projects. Projects would have to involve full partnership, with HQP being jointly supervised by university and government researchers.

Development of Remote Sensing Tools

MEOPAR is involved in development of remote sensing tools. These tools should eventually serve to enhance current observational programs and/or reduce costs of DFO. For these to be effective, they have to benefit or enhance existing observation programs. For the research surrounding such tools to be useful, several issues need to be addressed, which MEOPAR and DFO should, ideally, answer together. (What are the scales at which remote sensing tools are representative? What are the optimal sites for deployment of new instruments, and where would be the greatest benefits be achieved for DFO? What are the analytical frameworks needed to integrate large scale observational systems with remote sensing tools?). Development of any initiative would also aim to create a proposal to obtain funding for long-term deployment (A-base resources) of any tools developed under this initiative.

Areas of Common Interest

The IAOOS White Paper suggests Research Aggregation Devices (RADs) or Sentinel Areas as options to enhance integrated observations and research initiatives (Wallace et al. 2014). Four areas were identified as being potentially useful (Baffin Bay/Davis Strait, southern Labrador Shelf/Slope, eastern Grand Banks and western Scotian Shelf). Before proceeding, a more detailed analysis is needed to determine if deployment of multidisciplinary arrays in these areas would provide the greatest benefit in terms of:

1) Filling gaps in knowledge;
2) Building on what exists and is possible;
3) Providing information most critical for application to operational oceanography; and
4) What types of arrays would have to be deployed to achieve the greatest benefits to points 1 to 3.

This could involve tasking operational oceanography initiatives to address the issues by identifying areas where enhanced physical data would most greatly reduce the uncertainty in ocean forecasts in the northwest Atlantic.

Data Sharing Principles

Data sharing should be based on collaborative initiatives that recognize the investment of DFO and university researchers in the gathering of high quality data. Data from both partners should be made available openly and promptly. The data sharing principles should provide appropriate protection of the intellectual property required for students to complete their theses. The principles should also ensure that DFO's advisory process is not hampered by delays in reporting. The data sharing policy between DFO and university partners is needed and could serve as a model for ongoing and future international agreements (e.g. Galway Statement).

The Chair also referenced a White Paper discussing potential links of DFO with MEOPAR.

The White Paper represents a starting point; more discussion is required between MEOPAR investigators and university partners and DFO to identify specific areas of collaboration and enhancement of an IAOOS. It highlights areas of potential collaboration of DFO-MEOPAR including Aquatic Climate Change Adaptation Science Program (ACCASP) projects such as ocean acidification, autonomous vertical profilers, ocean buoys, and ocean glider technology. The Chair encouraged interested AZMP investigators to consult with him regarding development of proposals.

Discussion

Some reservations were expressed regarding collaboration with MEOPAR owing to difficulties regarding funding of projects. Data management issues and concerns were also expressed which will require additional resources within DFO in order to properly archive and distribute the information. Additional concerns were expressed that many of the MEOPAR university partners are not directly involved in ocean observation have limited access to platforms for conducting work of this type. Despite some challenges, current efforts by Institut Maurice Lamontagne (IML) to instrument the AZMP high-frequency sampling stations with instrumented buoys having real-time data transfer capabilities may be a starting point for further discussions with MEOPAR investigators.

SPATIAL PATTERN IN ZOOPLANKTON SPECIES AND COMMUNITIES ON THE CANADIAN NORTHWEST ATLANTIC SHELVES, 1999-2011 - CATHERINE JOHNSON

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

Zooplankton population and community variability is influenced by multiple drivers in the northwest Atlantic shelf AZMP region. A zooplankton atlas is being assembled to evaluate zooplankton community structure, provide a baseline view of large-scale species distribution patterns, and evaluate hypotheses about how species and community spatial distributions emerge under the competing influences of high dispersal and species responses to spatial variation in environmental conditions. Copepod abundance was dominated by three main species/genera, with nine other sub-dominant taxa, a typical rank abundance pattern. Copepod biomass was strongly dominated by *Calanus hyperboreus* and *Calanus finmarchicus*. At the northwest Atlantic shelf scale, copepod species richness was high, but most species were uncommon or rare. Among the copepods, most energy is likely cycled through the dominant and subdominant species. A comparison of spatial and seasonal patterns and life history traits provided evidence for niche partitioning among the dominant and subdominant copepods.

Among the dominants, *C. finmarchicus* and *Pseudocalanus* spp. focus reproductive effort on the spring diatom bloom and minimize mortality outside of the bloom period. *Calanus hyperboreus* and the subdominant *Calanus glacialis* have similar life history strategies, although the details of their life history traits differ. In contrast, *Oithona similis* has a generalist diet and reproduces year-round; its egg brooding and raptorial feeding traits likely reduce mortality. Three subdominant copepod taxa (*Temora* sp., *Paracalanus* sp., and *Centropages typicus*) are associated with shallow water and are abundant in the summer and fall. The three species appear to have different feeding preferences, and the life histories of two include resting egg dormancy. The four remaining subdominant copepod taxa (*Microcalanus* sp., *Oithona atlantica*, *Metridia longa*, and *Metridia lucens*) are associated with deep water. These taxa are similar in abundance in spring and fall, and they have omnivorous, carnivorous, or detritivorous diets. Among the uncommon copepod taxa, several typical spatial distributions were identified including cosmopolitan deep-water taxa (*Scolecithricella minor*, *Paraeuchaeta norvegica*, *Euchaeta* sp., and the Aetideidae), cosmopolitan offshore taxa (*Mecynocera clausi*, *Spinocalanus* sp., and *Heterorhabdus* sp.), and western Atlantic offshore species (*Clausocalanus* spp., *Pleuromamma* spp., *Nannocalanus minor*, and *Calocalanus pavo*). The dominant influence of depth and temperature identified in multivariate analyses were also evident in atlas distributions. Overall, community assembly in the AZMP region appears to be best described by the mass-effects paradigm (i.e. coexistence of species that are locally competitive and those that disperse from areas where they are locally competitive), but the magnitude of dispersal appears to vary among species. Congeners likely play similar ecological roles but are metabolically adapted to different water temperature ranges; the AZMP region includes range limits of several species. The spatial distributions identified by the atlas provide context for understanding community responses to climate variability. Offshore species may be indicators of change in on-shelf transport on the Scotian Shelf. Temperature changes may drive range shifts or changes in relative abundance of congeners. However, the dynamics of the dominant species are affected by complex interactions between changes in the local environment and changes in advection, and understanding their response to change will likely require a 3D biological-physical modeling approach.

An update of the progress toward completion of the Atlas was provided. Environmental variability (both temporal and spatial considerations) was included in the analyses that will be detailed in the document. In addition, the integration of life history traits contained within the Atlas is a unique feature in terms of an oceanographic perspective and will provide an extension for the analysis of community structure. Progress has been slower than expected because of the large number of demands on the lead investigator's time and because of the extensive research required to present the information for each major taxa within an appropriate contextual framework. It is hoped that the manuscript can be completed within the next year and submitted for consideration in the primary literature.

Discussion

A number of options for the structure and presentation of the information were discussed and will be taken into consideration.

There was some discussion about how to deal with episodic events that are not well captured by routine monitoring. For example, episodic observations of unusual occurrences of plankton, such as salps along southern Newfoundland and eastern Nova Scotia, appear to be increasing in occurrence. Unusual reports are also being routinely reported and documented from the Gulf of Maine.

Herring larval surveys have also noted unusual occurrences of doliolids (in the same Class Thaliacea as salps) in recent years.

FOUR WAYS TO SPLICE AND DICE NUTRIENTS - PETER S. GALBRAITH

Several ways of calculating regional average nutrient inventories were compared in preparation for possible use in next year's Quebec Region biochemical Research Document, and for use in the zonal Science Advisory Report (SAR). Inventories (0-50 m and 50-150 m) are first calculated for each AZMP section station, which are then grouped into Gilbert areas for the Gulf of St. Lawrence (GSL) (although other definitions may be more appropriate for nutrients) for averaging, in addition to section averages. A second estimate is also based on Gilbert areas but uses all available data, including stations outside the main sections. It allows the calculation of estimates for 1997 and 1998 (which has poor section coverage using current station positions) as well as for Mécatina Trough (which has no AZMP section station).

Spatial interpolations were also done which can then be averaged over the same Gilbert areas for comparison. The interpolations are of the average concentration over the available depth spans such that subsequent calculations of inventories can be volumetric and do not decrease when moving into shallow water only because of the reduction in depth. This allows a proper calculation of the 50-150 m inventory on the Magdalen Shallows in spite of none of the stations reaching 150 m in depth. The maps show well resolved patterns for all nutrients.

Comparisons of raw values among the three methods unsurprisingly show tight correlations ($R^2 > 0.98$) and were driven mainly by spatial gradients. Another comparison uses regional inter-annual anomalies, which removes the effect of the spatial gradient. In the latter case, the closest match found is between the box averaging using all data (method #2) and the grid interpolations (method #3) with $R^2 = 0.89$. The slope is close to unity, with an offset of 0.1 mmol m^{-3}. Averaging over only the section stations fails to fully recover the variability observed using all available data.

Larger area averages are proposed for use in the SAR; combining two Gilbert areas for the northwest GSL, three areas for northeast GSL and two for the southern GSL.

The spatial interpolation method was also applied to the March surveys (which are not section based) to estimate 0-50 m nutrient inventories. A climatological map was developed, allowing the production of anomaly maps. Difference maps with June inventories were also produced, showing the pre- and post-bloom difference in nutrient availability. Because these are gridded maps, they are easily averaged into regional averages, including a single GSL average for which a 2000-14 time series was presented.

It was proposed to use the averages based on the interpolation maps, given its many advantages.

Discussion

Some participants expressed concerns about the utility of using spatial interpolation to produce areal maps of nutrient distributions in the other regions outside of the GSL, which are normally based on standard section stations without random station components. It is unclear what the minimum required spatial resolution would be in order to properly apply this interpolation method within the GSL and in other regions. It was suggested to examine the interpolated values with the actual data used and to review the gradients to ensure that unrealistic values would not be generated.

Another question regarded the stability of the de-correlation scales in the GSL where large nutrient concentration gradients are normally present. One advantage identified for application of areal interpolation in the GSL has been the use of the standard "Barnes" interpolation scheme for which the parameters have already been optimized for oceanographic variables such as T/S.

STANDARDIZATION OF AZMP BIOGEOCHEMICAL DATA PRODUCTS - BENOIT CASAULT

A discussion regarding the standardization of AZMP biogeochemical data products was initiated in 2014 involving the Maritimes (MAR; B. Casault), Newfoundland (NL; G. Maillet) and Québec (QC; C. Lafleur, J.F. St. Pierre) regions. The rationale was that standardization would lead to:

1) Definition of a common format for standard data products;
2) Increased efficiency in generating standard data products; and
3) Consistency in calculations performed across the regions.

The key components for the implementation of this process were then identified as:

1) Use of BioChem as the centralized data source;
2) Development and implementation of R scripts as common computing environment for the extraction and processing of the data;
3) Adoption of a platform for the sharing and synchronization of scripts among collaborators; and
4) Identification of standard data products, i.e. products common to all three regions.

The following sections summarize the progress achieved for each of these components.

BioChem as Centralized Data Source

A procedure was developed and scripts were implemented to extract data directly from the BioChem database. The procedure first consists of extracting sample identifiers (IDs) for both the discrete and the plankton data types. Sample IDs are then screened to isolate AZMP specific events for which inventories are maintained - one sample ID inventory for each data type (discrete, plankton) and for each sampling area (high frequency stations, sections, broad-scale). The second step of the procedure consists of extracting the raw data for each inventoried sample ID, either the discrete data values (e.g. chlorophyll and nutrient concentrations) or the plankton data values (e.g. counts and weights).

Data extraction from BioChem is performed directly within the R environment using the R Open Database connection interface (RODBC) package. At each stage of the data extraction process, whether it is sample IDs or the raw data itself, basic quality control checks are performed such as, for example, consistency in sampling location, consistency in start and end depth of sampling, validity of discrete data based on associated quality control code, validity of plankton data based on subsample split fraction values. The raw data extracted at this stage are labelled as Level 0 data, which consist essentially of data as extracted from BioChem (i.e. without undergoing any processing).

The procedure and scripts developed around BioChem as a centralized data source allow the extraction of compact data sets specific to AZMP sampling and follow an efficient and transparent process. However, two main issues remain with the use of BioChem as a centralized data source:

1) The timeline for loading the current year data into BioChem; and
2) The quality of the data already loaded or in the process of being loaded into BioChem.

To that end, the MAR region has undertaken a complete “reboot” of BioChem to address issues of data quality control. This exercise is currently in progress and has been identified as a priority.

Data Processing using R

A procedure was developed and scripts were implemented in the R environment for the processing of both discrete and plankton data. Data processing follows essentially three steps that differentiate the level of integration of the data. Level 1 data are obtained by converting Level 0 data from long to wide format (pivoting) thus presenting the different data (e.g. method-specific chlorophyll or nutrient concentration, or taxa-specific zooplankton abundance or size-specific zooplankton biomass) for each individual sample ID. Level 2 data consist of the calculated indices (e.g. layer-integrated chlorophyll or nutrient concentration, or taxonomic grouping of zooplankton abundance) for each individual sample ID. Finally, Level 3 data are obtained by merging Level 2 data with a template that defines all individual factor levels for either high frequency stations sampling (i.e. station/year/month as factors) or sections sampling (i.e. section/station/year/season as factors). Level 3 data are deemed complete, and this is the format required for subsequent data analysis/plotting. For each processing level, the data are saved in both binary (RData) and text (tsv) formats.

The procedure and scripts developed allow for efficient data processing using R. The different data levels provide a convenient way of backtracking any questionable data point from its calculated index value to its raw data origin. Moreover, the process is entirely reproducible whenever data updates are performed in BioChem. The use of R as computing environment takes advantage of efficient data processing routines (e.g. melts, cast, merge). Moreover, R is freely accessible, portable across different platforms (Windows, Mac, Linux) and requires no dedicated license.

Code Sharing and Synchronization

Github was selected for the sharing and synchronization of the scripts developed for the AZMP data processing and generation of AZMP data products. Github is a collaborative platform and is modeled as a social network targeted at collaborative work where upon creating a user account, one can start to collaborate with other users on a given project. At the heart of Github is the version control software Git which comes under different flavors:

- Git shell - command line;
- Github application - graphical; or
- Git plugin - e.g., for R-Studio.

Git's basic functionality include, among others:

- Managing of changes to a project by saving a snapshot of every change (through "commit");
- Allowing backtracking of changes (through access to previous commits and/or version branching); and
- Synchronizing scripts between users (through "push" and/or "pull" requests).

A project "AZMP" was uploaded to Github and is available online. The AZMP repository is organized with different folders:

- Data folder, which contains sample IDs and raw data extracted from BioChem as well as processed data for the different sampling areas (high frequency stations, sections) and data types (discrete, plankton);
- Data products folder, which contains preliminary data products in the form of data files or graphics;

- Inventory folder, which contains sample ID inventory for the AZMP sampling areas (high frequency stations, sections) and data types (discrete, plankton);
- R folder, which contains R scripts for data extraction from BioChem, data processing and data analysis (plotting, model fit, climatologies/anomalies); and
- Structured Query Language (SQL) folder, which contains the program scripts for data extraction from BioChem for the different sampling areas (high frequency stations, sections) and data types (discrete, plankton).

On the one hand, the use of Github and Git for code sharing and synchronization requires a learning effort. On the other hand, Github allows for easy accessibility through basic internet connection, transparency as content is publicly available, and safety since a project is saved both locally and remotely.

Identification of Standard Data Products

A comprehensive assessment of the AZMP data products was undertaken in order to identify the differences and similarities between the products currently generated within the three AZMP reporting regions. This assessment was done by comparing side-by-side the data products contained in each region's latest CSAS Research Document available at the time of the review (Johnson et al. 2014; Pepin et al. 2013; Plourde et al. 2014). The review looked at every single data product in terms of:

- The sampling extent - high frequency stations, sections, broad-scale (e.g. remote sensing, trawl surveys);
- Category of reported variable - physical variables (e.g. mixing, stratification, optics), biochemical variables (e.g. chlorophyll, nutrients) and plankton variables (e.g. zooplankton abundance and biomass); and
- Specificity of each reported variable (e.g. surface value vs. vertical distribution vs. layer integrated concentration).

The assessment also compared the indices included in each region's scorecard as well as auxiliary plots (e.g. station occupations, special data analysis, and region-specific data analysis). The results of this assessment are available online; the results were assembled in a matrix format.

The assessment revealed issues with different degrees of concern. Among the minor issues identified were:

- Redundancy in some data products, e.g. time series bar plot of anomalies compared to the same information conveyed in scorecard;
- Application of data transformation, e.g. log-transformation of raw data (surface or integrated chlorophyll and zooplankton abundance) not applied consistently across regions; and
- Reporting of variability (standard deviation, standard error, confidence interval) not done uniformly across regions.

Moderate issues were also identified and included:

- Wide disparity in reporting efforts, where the number of data products for the high frequency stations is considerably larger than for the sections and/or the broad-scale (trawl) surveys;
- The reporting uniformity across regions does not always allow side-by-side comparison of basic variables (e.g. zooplankton biomass – wet vs. dry weight); and

- The statistical treatment of the data appearing in some of the final data products differs significantly across regions (e.g. raw data vs. seasonal/annual arithmetic means vs. annual means estimates reported in plots and scorecards).

Finally, higher-level issues were also identified and included:

- Relevance of reporting synthesis data products such as correlation analysis between environmental and biological variables (MAR) and principal component analysis of zooplankton abundance (NL); and
- Data products requirements from a client perspective in terms of the significance of current indices and the optimal format for data products (e.g. data files, graphical products).

Concluding Remarks

Significant progress was made at all levels towards the standardization of AZMP biogeochemical data products, although it remains an ongoing effort as the process is still at an early stage. The procedures and scripts developed and implemented as well as the sharing and synchronization platform put in place could likely be extended in the future to related programs such as AZOMP, Bedford Basin Monitoring Program and the Continuous Plankton Recorder. The immediate discussion for moving forward should be focused on:

- The identification of common products among the three reporting regions;
- The optimal format of the data products from a client's perspective.

Discussion

There was considerable interest expressed in the utility of adopting common data products and standardization through the use of R-scripts, developed in Maritimes and to be applied in other regions in the production of CSAS research documents.

Some additional discussion and work are required to decide on the common data products among regions that will be identified within future CSAS research documents.

The consensus was that non-standard products could also be presented since they can be useful to researchers and to a wide variety of clients.

The use of providing standard measures of uncertainty in various indices was identified for further consideration in future CSAS research documents.

HABITAT MODELLING OF KEY COPEPOD SPECIES IN THE NORTHWEST ATLANTIC OCEAN BASED ON THE ATLANTIC ZONE MONITORING PROGRAM - SÉVERINE ALBOUY-BOYER

Collaborators: S. Plourde, C. Lehoux, C. Johnson, P. Pepin, P. Galbraith, D. Hebert, G. Lazin, C. Lafleur

The habitat of four copepod species (*Calanus finmarchicus*, *Calanus glacialis*, *Calanus hyperboreus* and *Paracalanus* sp.) was described using zooplankton and bio-physical environmental data collected as part of the AZMP on oceanographic sections on the Newfoundland-Labrador Shelf, in the Gulf of St Lawrence and on the Scotian Shelf. The habitat modelling was performed with Generalized Additive Mixed Models (GAMMs) including year and season (spring, summer and autumn) as nested random effects. The choice to include random effects in our models was a way to avoid the potential influence of a long-term trend in environmental parameters that could induce bias for future predictions. To address the problem

of zero-inflated data for three species (*C. glacialis*, *C. hyperboreus* and *Paracalanus* sp.), we adopted a statistical framework including a two-step conditional method where occurrence and abundance were modelled independently. Abundance and associated environmental variables were averaged by depth intervals (0-200 m, 200-500 m, and > 500 m) on each section, which provided a way to deal with spatial auto-correlation and a better predictive ability. T0_50 (upper 50 m integrated temperature), T_NB (near-bottom temperature), DEPTH S0_50 (upper 50 m 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 with an automated procedure by comparing all competing GAMMs including all possible combinations of explanatory variables. Selected environmental variables for the occurrence models were not always similar to those selected for the abundance models. In general, selected GAMMs explained 21 to 57% of the total deviance for abundance models, and TSS ranged from 0.35 to 0.72 for occurrence models. Selected GAMMs showed a marked contrast in environmental envelops occupied by the different species, especially between arctic and temperate species. Our analyses also underlined the importance of using integrated data (T0_50 m, S0_50 m) instead of surface data (AZMP versus Continuous Plankton Recorder (CPR)) to model habitat of *Calanus* species. The application of these results to model the effect of climate change and environmental variability on the distribution and abundance of these species will be discussed.

Discussion

A new post-doctoral fellow is continuing the work and using a slightly different analysis than last year. Statistical models for four species of copepods for habitat conditions were built. The predictor data for habitat conditions were surface and bottom temperature, salinity, stratification and chlorophyll. The plan is to apply these models to future projections using the same environmental variables.

It was suggested to use the hindcast model output to make estimates of past conditions when sampling was not done or was limited. The limited data available from the past can be compared to the model projections.

There was a question of what is missing from the model to explain the missing variance. It was suggested the missing factors are items like predation and the presence of fronts.

Calanus finmarchicus was present throughout the area, thus it is hard to constrain in the model. There is likely spillover to habitats not optimal as a result of the high abundances in the Atlantic Zone. There was a suggestion to investigate whether there were regional differences in the rate of change in species occurrence and abundance that might reflect differences in life history characteristics in response to local ocean dynamics, as well as report the parameter fits for each region.

PROGRESS TO DATE ON COUPLED BIOGEOCHEMICAL MODEL FOR THE GULF OF ST. LAWRENCE - DIANE LAVOIE

In the last two years considerable effort has been invested to construct new forcing fields and update initial and boundary conditions for the simulation of biogeochemical conditions over the period covered by the AZMP program (> 1998) with Canadian Océan Parallisé Gulf of St. Lawrence Scotian Shelf Biogeochemical Model (CANOPA-GSBM). The two main goals for this year were:

1) To obtain realistic chlorophyll *a* and nitrate concentrations (that were too low) for a given year;

2) To maintain stable biogeochemical conditions on the long term (a slow decline from one year to the other was present), without resorting to data assimilation, restoring of variable towards climatological conditions, or re-initialization.

This is indeed necessary to study the influence of the highly variable physical forcing and to perform projections of these conditions in the future. These two goals were achieved, despite the very slow computer at IML (which takes about two months and a half to simulate 14 years) and the difficulty in transferring the model output from the Bedford Institute of Oceanography (BIO) (by mail, using portable hard drives) when using their faster HPC02 cluster. Nevertheless, after including nitrification, modifying the phytoplankton nutrient uptake formulation, the zooplankton grazing formulation, slowing down particulate organic matter sedimentation and enhancing recycling of organic matter, we now have results that are stable in time and reproduce the main observed features reported in the research documents for the Gulf of St. Lawrence for chlorophyll *a* and nitrate concentration. We can now start using the model output to explain the observed inter-annual variability in primary production over the model domain. However, two different forcings are used with CANOPA-GSBM, and the one used for the AZMP simulations (long term, National Centers for Environmental Predictions (NCEP) forecasting system version 2 still needs to be looked at in greater detail. The differences in forcing lead to a bloom that is delayed by a few weeks in the long-term simulation. Additional adjustments thus need to be done. Finally, there are hardly any data to validate the microbial loop (particulate organic matter, dissolved organic matter, ammonium concentration, etc.), and thus we rely on the comparison of the simulated and observed oxygen concentrations. However, some problems were reported with the BioChem database, from which our data were extracted, and the preparation of initial and boundary conditions for the oxygen will also have to be redone when the data are corrected and available again.

Discussion

There is an issue with the dissolved oxygen data in BioChem, and concerns were raised about the climatology and initial conditions of this parameter in the model.

There was a question on the impact of atmospheric forcing on the phytoplankton bloom: is light or physical circulation responsible for timing? It could be light or salinity (affecting light penetration) for the Gulf region.

As in the past, issues with access to faster computers and more resources are limiting progress of this work.. We need Shared Services to make this a priority. The network is too slow to transfer model output electronically from the high performance machines for post-processing locally. USB drives are physically shipped when enough model output is available. Post-processing is not available on the clusters so the output has to be transferred. It was suggested that a document listing the problems be prepared to give to the RDSs.

GENERAL MODEL DEVELOPMENT IN THE ATLANTIC ZONE – RESULT AND ANALYSES - DAVE BRICKMAN

Collaborators: Brendan DeTracey, Z. Wang

Two Nucleus for European Modelling of the Ocean – Océan Parallisé (NEMO-OPA) circulation models of the AZMP region are run by researchers at BIO:

1) A model of the entire North Atlantic ocean, from which the AZMP region from the Labrador Sea to the Gulf of Maine is extracted; and
2) A regional shelf model of the Gulf of St. Lawrence, Scotian Shelf and Gulf of Maine (GSL-SS-GoM).

Both models have a nominal horizontal resolution of 5-6 km at mid-latitudes.

Results for **model-I** from a hindcast run for the period 1990-2014 were presented. The model was able to reproduce the anomalous warming on the SS region for the high NAO (North Atlantic Oscillation) years 2012 and 2014. Analysis of model output showed that the mechanism entailed the pinching-off and subsequent westward propagation of warm eddies at the tail of the Grand Banks.

With its large domain, the model is well suited to cover AZMP/AZOMP physical modelling needs. With this in mind, the model is presently being improved (addition of more rivers, and tidal forcing) with a 1999-to-present hindcast run planned to be completed by the next AZMP meeting.

Model-II is typically run for the AZMP years, with its output used in the annual Maritime AZMP Research Document. In addition to the above, the model was used this year in a seasonal forecast experiment using Canadian Seasonal to Inter-annual Prediction System (CanSIPS) output for a 20 member ensemble of predictions for 2015, 01-12. The output was used to predict the regional ice field for the AZMP cruise periods, and also for applications to the eastern Scotian Shelf snow crab fishery. Although the results are preliminary, due to client interest, the plan is to routinely produce seasonal forecasts for the Maritime shelf regions.

Discussion

The model results highlight the short term events that are not properly sampled by the observation programs. It was suggested to look at key points to understand the processes explaining the variability of the region. The model results can help plan future modifications or improvements to the observation programs.

A 67-YEAR HINDCAST (1948-2014) OF THE GULF OF ST. LAWRENCE, SCOTIAN SHELF AND GULF OF MAINE - JOËL CHASSÉ

The presentation described the recent 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 study is to produce an ice-ocean hindcast, covering 1948-2014, to fill the data gaps in the observational system to support fisheries studies, stock connectivity studies, invasive species research, biogeochemical modeling, climate change, etc.

The hydrodynamic model (NEMO-OPA) is coupled to an ice model (LIM) and is 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. All of the data required to force the model from 1948 to 2014 have been collected. The NCEP temperatures were adjusted (corrected) with historical observations from nine stations around the GSL. Boundary conditions were 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. The model results compare very well with observed sea-surface temperature (SST) and observed temperature and salinity profiles. The modeling approach is proving to be useful in filling the data gap for the GSL-SS-GoM.

The rest of the presentation focused on giving an update of the regional climate downscaling project for the same domain (GSL-SS-GoM). Some details of the improved downscaling technique were presented along with the latest Representative Concentration Pathways (RCP) 8.5 downscaling results from CCSM4 (Community Climate Systems Model version 4 and

Hadley global climate models. The results show that the HADLEY RCP8.5 simulation produced a warmer and wetter future climate compared to the previous A1b simulations.

Discussion

The goal of the hindcast of ice-ocean dynamics is to fill in the scorecards where no observations are available. There were periods (e.g. the 1980s) of disagreement between the hindcast and the observations. The source of the problem was with the NCEP forcing in the Gulf of St. Lawrence. This was corrected by adjusting the mean of the forcing to agree with the Adjusted Homogenized Canadian Climate Data (AHCCD) data. The model needs to be rerun with this new forcing. For future projections, six 130-year simulations with downscaled forcing have been completed.

It was noted that a lot of the effort is invested in trying to make sure that the model is predicting the observations correctly. There was concern expressed that the Newfoundland shelf is not included in this model.

A COMPARISON OF THE CONCEPTS GLOBAL OCEAN ICE PREDICTION SYSTEM RESULTS TO AZMP SEASONAL OBSERVATIONS DURING 2014 - EUGENE COLBOURNE AND JINSHAN XU

The Global Ocean Ice Prediction System (GOIPS) of the Canadian Operational Network of Coupled Environmental Prediction Systems (CONCEPTS) was used to generate profiles of depth, temperature, salinity and density corresponding to the spring, summer and fall AZMP conductivity-temperature-depth (CTD) sensor casts as well as all profiles collected at Station 27 during 2014. The model equivalent profiles were then used to generate standard physical habitat indicators typically used by AZMP to assess the state of the physical environment in the Newfoundland and Labrador region.

At Station 27, modelled temperatures appeared slightly warmer than observations at depth but colder in the upper water column where the modelled seasonal heat penetration appeared limited. Modelled salinity was generally saltier than observed, possibly linked to insufficient river runoff providing reduced freshwater in the upper layer. Stratification at Station 27 was over estimated during spring and fall, with the mixed layer depth shallower than observations. There was good agreement, however, with peak stratification and minimum mixed layer depth (MLD) during summer months.

Along standard AZMP sections, modelled spring temperatures were higher than AZMP observations in most areas, particularly in the offshore, shelf edge and Flemish Pass regions. As a result the area of $< 0^{o}C$ (Cold Intermediate Layer: CIL) was smaller than observed along all sections sampled (southeast Grand Banks, Flemish Cap and Bonavista Bay sections) during the spring. Modelled salinity was in good agreement with observations on the Grand Banks but saltier offshore in Flemish Pass and Cap areas.

During the summer upper-layer temperatures were generally lower than observations while at depth they were warmer, particularly around Flemish Cap where differences of $> 2^{o}C$ were noted. The area of $< 0^{o}C$ (CIL) during the summer was smaller than observations off Newfoundland but in good agreement off Labrador. Across the shelf the stratification was generally over estimated with the MLD shallower than observations.

In general, the GOIPS produces reasonable results when compared to the seasonal AZMP surveys. The larger-scale oceanographic features are reproduced to a large degree, although there are seasonal differences possibly related to mixing parameterization, a lack of real-time freshwater runoff fluxes and the lack of ice thickness data to constrain winter ice volume.

Discussion

A comparison of the ¼ degree CONCEPTS model output with 2014 data was undertaken. Plans are to use higher resolution models in the future. The model did not get enough heat down in the upper layer and was too warm at depth. There were also issues with the mixing in the fall. It was suggested that the 25 km resolution winds for the forcing might be inadequate and resulted in lower mixing rates.

There was some discussion of the domains for the higher resolution models and concerns about the boundary locations. Making scorecards of model output comparable to the observations would be good for comparison.

There was no freshwater runoff in the model but it is simulated by data assimilation.

COMPARISON OF 30-YEAR HINDCASTS FOR THE NEWFOUNDLAND AND LABRADOR SHELF WITH THE AZMP DATA - GUOQI HAN

Collaborators: Zhimin Ma, Joël Chassé, Will Perrie, and Zhenxia Long

Under the ACCASP, a three-dimensional ice–ocean coupled model with a 7 km horizontal resolution was developed to hindcast variability of hydrography and circulation over 1979-2010 and to project their changes over 2011-2070 on the Newfoundland and Labrador Shelves. The model results over 1979-2010 are evaluated against temperature, salinity and current data collected by the AZMP as well as other oceanographic and ice measurements. The evaluation shows that the model has fair to good skills in reproducing seasonal cycles, interannual variations, and secular trends in ocean temperature, salinity, coastal sea level, current, volume and freshwater transports, and sea ice extent. The projections over 2011-2070 under a medium emission scenario shows coastal sea level rise, ocean temperature increase, salinity decrease, sea-ice extent reduction, and Labrador Current transport increase.

Discussion

It was suggested to derive metrics similar to the AZMP scorecards to make it easier to compare with data and for projections. If the biases are constant, output may be corrected for biases to see if variability matches. There was a question whether AZMP will use the projected values to make comments on how things might change in the future. The ACCASP Impacts and Vulnerability report did not have the tools at the time for projections. It was also suggested to use the hindcast model output to project observations back in time to help understand changes in the ecosystem in the past. It was stated that there is a need to be cautious and to reiterate that climate projections are a research topic. It is important to be careful in explaining uncertainties for clients.

There was discussion on what models should be used for the biological components in hindcast and projections. Can shifts in species composition be simulated?

The question of how to get funding for this work was raised. It was suggested that the modellers get together and draft a document that explains the importance of model output and the limitations imposed on this work. Also, the importance of this work should be outlined as part of future COMDA (Centre for Ocean Modelling Development for Application) activities.

SESSION 1 - AZMP BUSINESS MEETING

Rapporteur – Andrew Cogswell

WELCOME AND INTRODUCTION/ACCEPTANCE OF AGENDA

The chair reviewed the action items from the 2014 meeting:

- The multivariate analysis is in pre-print.
- The zooplankton atlas (generated by Johnson et al.) is almost complete.
- There was a review of trends for stock assessments and links to environmental parameters.
- AZMP website review was not completed (but later in the meeting Peter Galbraith, Andrew Cogswell, Stéphane Plourde and Catherine Johnson were assigned to review the website and provide recommendations to the AZMP Permanent Management Committee – PMC).
- Issues identified in the discussions from the 16th AZMP Meeting were raised to regional directors of each region. Some progress was made on national ocean observation coordination group but not as much as anticipated. There has been no progress on integrating the AZMP with regional GOOS (Global Ocean Observing System) activities.

Phytoplankton data from remote sensing observations will be included in this year's SAR. Work was done on grouping some sections so the appearance of GSL results will be a little different this year.

Most of the research documents reviewing 2014 conditions are complete or nearly complete.

The SAR reviewing 2013 conditions was submitted in July 2014 but not posted until November 2014. The AZMP meeting proceedings from last year are finished but still not posted at the time of the meeting. Such a delay in publication of the SAR from the previous year makes the information nearly irrelevant. Lengthy delays in publication are a cause for concern.

Action items for this year's SAR:

- Add a section dealing with Labrador Sea transport indices;
- The Cabot Strait indices are to be combined; and
- There were some gaps in the Maritimes, and the approach has changed to adopt the approach applied in the NL region.

SUMMARY OF BIOCHEM WORKSHOP - LAURE DEVINE

AZMP data managers met for two half days (March 16-17, 2015) before the start of the regular AZMP meeting. An agenda had been drawn up based on a review of recent activities (or lack thereof) centred on the AZMP Data Management Project Plan, which was drafted following the March 2013 meeting. Input was received prior to the meeting from IML, BIO, and OSD (Ocean Services), but not NAFC (Northwest Atlantic Fisheries Centre). In addition, NAFC staff could not attend, so there was no information available on the current state of data management in that region.

The 10 points in the project plan are listed below, with brief descriptions of recent and planned activities.

1) Improved tracking of where the data are in the processing stream. IML sent an updated inventory to OSD, and BIO will soon update theirs and send it as well. OSD will put these on AZMP website and make the link available to AZMP members.

2) Improved/standardized quality control. All regions have access to the same standardized list of Quality Assurance/Quality Control (QA/QC) tests. BIO nearly completed coding for CTD; coding for bottle to follow within the next month or so. Personnel are identified to begin the QA/QC activity. IML personnel are available for support.

3) Standard scripts. BioChem steering committee to overhaul all code tables (e.g. correct spellings, remove duplicates, remove unused scripts). Start with plankton, then move to discrete data types (BIO to lead).

4) Improved timely availability of processed CTD data. Status quo for now, but OSD to start processing BIO profiles from shared drive (need timeline of this from OSD). Bring data from other regions on-line when the BIO to OSD exchange mechanism is fully functional. Explore possibility of using a system already in place for distributing data (Québec region's St. Lawrence Global Observatory and Oceanographic Data Management System).

5) Improve work flow and processing/loading of data to BioChem. Preload tests/best practices have been shared among regions. BIO is making improvements to workflow procedures (more detail in separate presentation by Shelley Bond).

6) Improve accessibility to BioChem data. Corporate email available and monitored by IML, BIO, and OSD. Applications to access database need to be improved, but a recent submission for such improvements received middling priority ("Priority 3"). It will have to be pushed by higher managers to receive more attention. The data management group is exploring ways to make improvements that they can implement themselves (table views are available to DFO personnel that simplify queries; improvements to code tables would make queries simpler for the public; query interpretation guide will be produced). It had been suggested that the CPR data be removed from BioChem and the AZMP group agreed.

7) Audit BioChem content. See presentation by Shelley Bond.

8) Review current content of AZMP web site. Link for regional inventories needs to be added. Data availability: CTD is in good shape, but the bottle or plankton data are not. The review of the website raised many questions, and Mathieu Ouellet will need to be contacted to clarify several points. He had been waiting for direction from the AZMP management. Lack of funding for website development is a perennial problem. M. Ott discussed several points related to the website in his presentation and suggested that a method be implemented for tracking visits (if the website is frequently visited, more reason to fund it and put effort into its improvement).

9) Website: data availability and accuracy. Are all data types up to date? CTD: pretty much; discrete and plankton: no. Regions need to check their data and report any discrepancies so that coding can be corrected. We should consider removing areas where links are dead (plankton) and put links to BioChem. This needs discussion from the group at large to determine what is required. Look at IML's AZMP website as a possible alternative.

10) Improved communications and support. Communication is good between IML, Maritimes, OSD, but very little communication with NL. Currently good communication with OSD people assigned to BioChem, but it is not clear how long they will remain.

Action Items for 2015-16:

OSD:

- Link to inventories on AZMP website;
- Update discrete and plankton data (BIO to provide extracted data from BioChem); and

- Modify website as decided by AZMP PMC.

IML:

- User guide for interpreting query returns (make available from BioChem website).

BIO:

- Extract flat files for AZMP website (w/ OSD); and
- Lead on clean-up of plankton code table (with IML).

NAFC:

- Review and update 2014-2015 activities.

Discussion/Questions

We have heard the lack of resources argument (concerning the website), but there needs to be a redesign of the website. To do this, we need a push (or support) from above. OSD might have some ideas but they are not getting communicated to the PMC. The data management is one aspect, but the data managers have to be able to act independently. Mathieu Ouellet indicates he does not have time to work on the website and the site is also obsolete. If there is no time to do the work, then someone in Ottawa needs to make it a priority, but if the Chair is not informed about the issues dealing with the site he cannot do anything about it.

A list of action items for 2015 broken down by region was produced by the Data Management Sub-Committee.

Shelley Bond spoke to Tobias Spears to convince NSDMC (National Science Data Management Committee) to push this (BioChem work) up the priority list, but we have no information for why it was ranked Priority 3. Tobias is wondering if they have a budget that if they put money towards it, it could be moved up. We should include priority areas and key points to highlight the importance to include in the summary to senior managers.

The NAFC has a shortage of data management personnel and the only person that has been hired is working on a very steep learning curve. It is proposed that this person might visit BIO or (IML and BIO to meet everyone and develop/adopt agreed-upon standard operating procedures. There is a willingness to have the other regions train her up. If Jay (Bugden) is going to be doing bottle data, then perhaps both Jay and Jennifer (Holden) could sit with Laure Devine at IML for training.

People at this table do not rely on the website, it is now an afterthought. It would be nice to have a functioning website, but it's not functioning now. We need a group of 3-4 people to review the website and make a decision on what we would like to keep or remove. This was forgotten after last year. We have to identify people to be tasked with this and give them deadline.

All information should have been given to OSD for the website, but this is not the case. We are going internally for the data.

Action Item

- Peter Galbraith, Andrew Cogswell, Stéphane Plourde and Catherine Johnson have been tasked with reviewing the website and providing recommendations to the PMC by the end of May.

PROGRESS ON DATA MANAGEMENT ACTION PLAN IN MARITIMES REGION - SHELLEY BOND

Since 2013, analyses have been on-going on the BioChem content audit. Version 1 of the audit resulted in the quarantine of all data loaded in Maritimes until further analyses and corrections can be made. In the past year, additional analyses have shown that issues exist that cannot be identified or rectified programmatically.

Given the nature of the issues discovered in the BioChem Maritimes discrete data, it was agreed that the only option was to reload these data. In the past, ad hoc methods were used to process and massage the data, resulting in many issues and difficulty finding original source files. Changes in work flow and methods are being implemented, which will result in improved provision, quality assurance, archival of source data, and understanding of the data as loaded to BioChem.

Work is on-going on the full implementation of the web application ELOG for metadata capture at sea and the AZMP data-entry template. The second tool is almost complete for dealing with discrete data, both in the field and at the lab. The next phase will focus on biological data. In combination, these two tools have already improved the quality of the data and decreased the amount of effort to load to BioChem.

The focus of this presentation is on the handling of legacy data and improvements to the loading of data to BioChem. A full inventory of the legacy data is being performed to identify files for reprocessing and archival, and to identify possible gaps. Work will begin in the new fiscal year on development and testing of improved quality assurance and load procedures for these data. Once these processes are in place, the reload will begin.

Changes in the provision of data include notification to a corporate mailbox monitored by multiple members in the unit and inclusion of metadata and specifics on data in the tracking database used in the unit. Source data are now archived in a flat file archive available to any interested parties as read only.

The content audit also makes recommendations for improvements to the data model itself. This document and other known issues with the edit and query applications have resulted in a project submission to Information Management and Technology Services (IM&TS) for improvements and expansion of the current system.

Priority for this project is being given to the Maritimes AZMP and AZOMP monitoring programs. Current estimate for completion of this portion of the reload is three to five years depending on the allocation of resources.

Discussion/Questions

Comment: Have you found a difference between AZMP data and anything else? Are there any errors that might have been propagated through BioChem?

Answer: For a long time the bottle data were not used, the oxygen data are not used. Where we switched to using the data from BioChem, we compared rigorously, the products we are producing via BioChem and source data. A limited set of data are used for the reporting. For ancillary stations there are likely problems but a lot fewer with high frequency stations. There is a lack of QA/QC: we do a lot of common sense QA/QC, so there is limited concern about propagation of errors.

Comment: There is a notice on the website (concerning the risks of using BioChem).

Question: Are we talking about 3-4 years of work to reload BioChem data for just AZMP and/or AZOMP?

Answer: Some of the other data could be cleaned up (historical data). Some is probably gone – no source files. Just the way the data was rescued is concerning. Plankton data is not in bad shape.

Comment: Anything that is found while querying BioChem or reviewing derived data, please inform Shelley Bond. The plankton side should be addressable through programming efforts without a reboot.

Questions: What resources have you been allocated for fixing the problem?

Answer: Shelley indicated that she is allocating 1.5 full time staff. However, contractors are involved and many other people have been tasked with this indirectly.

Comment: Our metadata is questionable so we are generating that information from other places as an example.

Comment: There is concern that the format of the raw zooplankton is not optimal. There are scripts that get copied and pasted and I can track back and find that there was a miscoding. Some of the information may be problematic.

Response: We are trying to shore up (improve upon) some of those areas by creating standardized templates to reduce transcription errors.

Comment: The Chair indicated that it will be important to capture (these problems) in the abstract and be brutally honest about the consequences of a lack of action. Last year's statements were a little touchy, but mention to people (upper management) that there are issues and they should read the proceedings. It is critical to make upper management aware of the concerns, importance and impact of short-comings in the allocation of resources for data management.

Question: Was there no version control (for BioChem); is there no way to undo a change?

Answer: The data was loaded incorrectly and data QA/QC procedures were not properly either. That is the problem.

Comment: BIO and IML have come up with some new QA/QC for biological data. We are working on the plankton side. There was more care concerning plankton data (in the past) but less for discrete.

Comment: The technical report we wrote identifies some basic guidelines.

Response: We will be using the report and some others (QA/QC procedures), the AZMP database template will help with this.

IMPROVED AZMP MARITIMES META-DATA AND DATA COLLECTION PROTOCOLS - ANDREW COGSWELL

Collaborators: R. Benjamin, S. Bond

The Maritimes AZMP has been working with the Ocean Data and Information Section (ODIS) as they audit BioChem and QA/QC associated datasets, inventory "raw" and "processed" data holdings and associated folder structures, develop and adopt existing QC protocols, develop data flow diagrams and associated documentation, standardize data submission guidelines and templates, develop standardized ship-board meta-data collection standards, create semi-

automated load procedures, and develop database templates to ease the burden traditionally associated with seasonal data archiving, etc.

While recent advancements are numerous, this presentation focuses on efforts to improve metadata and data collection protocols. In 2013, a relatively simple weblog application, ELOG was adopted on a trial basis to address shortfalls in metadata collection during seasonal shelf and fisheries surveys. Early trials demonstrated its ability to efficiently and accurately capture relevant operational metadata. These metadata and associated profile data from CTD.QAT files now serve as the backbone to an operational AZMP Maritimes database template to house all incoming mission data. This Microsoft Access database has a frontend/backend design, with the backend designed similarly to BioChem. The frontend application can be used to import data/metadata (from ELOG) to generate summaries for a variety of purposes, including: mission reports, salinity/oxygen QA/QC procedures, data scoping, etc.

The combined ELOG/AZMP database template strategy has been employed through one full field season with success. The presentation will touch on what aspects of development still remain and the plans for future development.

Discussion/Questions

No issues were raised.

ISDM PROGRESS AND WEBSITE OVERVIEW - MICHAEL OTT AND MATHIEU OUELLET

Web

The OSD group which formed in late 2013 when Integrated Science Data Management split and saw some of its units merged with the Oceanography and Climate branch, continued maintenance on the AZMP website and national data integration activities that support AZMP during 2014-15.

The AZMP website was designed and developed in 1999 using technologies that have been superseded by most websites. Unfortunately there were never any resources allocated to redesign and modernize the AZMP website. As it currently stands, the AZMP website relies on an infrastructure consisting of 3 servers, all of which are with Shared Services Canada, and one of them has been tagged for decommissioning. The servers are in different operating systems (OpenVMS, Linux) and use a variety of Fortran, java and Matlab programs, all of which exchange data through SSH and FTP protocols. The OpenVMS server is the one that has been tagged for decommission and is the primary server for the AZMP website, as it contains the primary data archives (except for BioChem).

Of the current website sections, the “Water Levels” one is definitely subject to questioning and a good candidate to decommission. When the website was established in 1999, water level data was still difficult to access online. Since then, DFO created two water level websites: one with all historical tides and water levels data and another one with predictions and real-time data. The AZMP “water level” website section adds little to both websites and creates a possibility for more than one source of data and synchronization problems between data versions. The time spent to maintain that water level section would be better reused in core data management activities.

The “Plankton” section used to rely on individual scientists’ submissions of data in Excel format and posed timeliness and consistency issues. Since the advent of BioChem as a national database for plankton, it would be more consistent to drop that section and provide a link to BioChem instead.

The OSD group would like to hear from the PMC whether it can go forward dropping these sections from the website (water level and plankton), replacing them with links.

The “Meteorological Data” section is also somewhat redundant as it only serves to make available data that is collected by EC (Environment Canada) and made available on their website, though in smaller subsets. It is, however, not as costly to maintain as the “Water level” section. It has been updated in 2015 with data from existing and new stations.

In 2014-15, OSD has been updating the Climate Indices section with products generated by Roger Pettipas and Guoqi Han. There were challenges associated with new version of Matlab on a different Operating Systems (OS) and filenames, graphics, etc. Several indices are available in Excel spreadsheets and thus require manual intervention to standardize them in machine readable format. It has also been noted that the indices calculated and shown on the website were agreed upon ~15 years ago and are not entirely in line with indices generated by actual AZMP scientists who are generating research and advice documents. The list of indices featured on the website should be reviewed by PMC.

OSD has updated the “Research Data” section with new data from the 2014 CSAS report by Johnson et al. (2014), covering conditions in the Scotian Shelf and eastern Gulf of Maine. OSD also created a data/figure index, with help from BIO, to help users find the data. The PMC could consider whether it encourages other regions than Maritimes to submit datasets from their CSAS research documents. OSD otherwise maintains a list of AZMP related publications (CSAS, NAFO, ICES reports, primary papers, etc.) on its website but also needs the regions to provide their list of publications. Twenty-four publications were added in 2015.

The hydrographic section of the website has some issues with its definition of what an AZMP section is; the definition is based on the time between station occupations, the ship’s direction while taking CTD/bottle profiles, and the total coverage of each section. This set of criteria is not perfect and leads to underrepresentation of the Flemish Cap section sampling among others.

OSD also set up a filter to prevent quarantined data from BioChem from showing on the website. Currently this filter only allows 2013-14 data from BIO and removes dissolved oxygen; while it doesn’t block data from NAFC or IML.

Data Ingestion

With help from NAFC, OSD identified a problem that prevented ingestion of CTD data from NAFC with oxygen, PAR (photosynthetically active radiation) and fluorescence present (all three). This problem extended back to 2011 and was caused by a legacy FORTRAN program that has since been fixed.

OSD made significant progress in setting up an automated process to ingest CTD and bottle data from the Institute of Ocean Sciences (IOS) in the national CTD and bottle databases. This work started prior to work with other regions because IOS was the first DFO institute to provide OSD with a shared drive with a complete inventory of their data. BIO has now set up something equivalent and provided access to OSD in early 2014. OSD is planning to complete work to automate ingestion of CTD data from BIO in the national database by the end of 2015. The current process sometimes takes up to 2-3 months, depending on the time of year and other tasks at hand.

From March 2014 to February 2015, OSD ingested data from 83 cruises in the Atlantic zone, 19 from IML, 36 from NAFC, 12 from BIO, 5 from SABS and 3 from GFC. The bulk was from 2013, then 2014, and a few older ones. OSD also edited or added data or metadata to an additional 49 “existing” cruises; either adding bottles to a CTD cruise (NAFC), or fixing metadata or data after having been notified.

To improve its efficiency on data ingestion, OSD needs to spend less time on AZMP website maintenance, especially when it comes to redundant web sections and spend more time modernizing ingestion processes.

Website Renewal

For the second consecutive year, OSD submitted a proposal to IM&TS Business Intake list. The proposal was granted “Priority 3” (out of 5) and ranked 12 in the “Priority 3” group, just under BioChem (rank 11). This proposal needs to be resubmitted every year.

At the same time, OSD is pursuing an IT-funded capital major funds project to modernize the “backbone” on which the website resides. This project is just in its beginning (preliminary approval) and it is not clear yet whether it will address all of the scoped objectives, so we shall not rely entirely on it to renew the AZMP website, but it can help.

The unit that used to perform website maintenance and development within the former Integrated Science Data Management group was split in two; one unit went to IM&TS and the other under the Products and Services group of the Canadian Hydrographic Service & Oceanographic Services directorate. It could be worthwhile for the AZMP chair or PMC to solicit the group to work on a new AZMP website.

As a quick solution to the many shortcomings often pointed out by users, OSD is considering serving zip files of all AZMP “good” data, grouped on a year basis, on the website. This would make data available in between “sections” and “stations”. This work would likely happen in 2015.

Discussion/Questions

Comment: Terry Fanning might be available to help modify or build a new AZMP website (he developed the CONCEPTS (General Science Website, ACCASP)). He (Terry) has the resources and expertise (SEC committee and regional managers would have to allow Terry’s group to take over the running of the website).

Comment: Website renewal was ranked 1 behind BioChem, but Capital funds to modernize the backbone received Treasury Board acknowledgement. This may not address AZMP issues.

Comment: Keith Lennon was introduced as new director of OSD. He has been asked to focus on 3 priorities – Data Management, Ocean Services Framework, and Renewal of ACCASP.

Comment: The Chair indicated that AZMP needs to set up a task group to discuss what priority areas and needs we want to focus on in terms of the website and data management before we can move on. Peter Galbraith, Stephane Plourde, Andrew Cogswell and Catherine Johnson have agreed to volunteer to deal with the website.

Comment: Is the approach of a shared drive a workable one as well?

Response: Shelley Bond indicated that there are BIO data on the shared drive and is not sure what is going on. It appears as though OSD is still serving quarantine data even though they think they might not be.

Comment: AZMP researchers expect that data will be readily and easily accessible. It is critical to identify priority areas.

REGIONAL SUMMARY OF ACTIVITIES (NEWFOUNDLAND REGION) - GARY MAILLET

In 2014, three AZMP oceanographic surveys were successfully carried out during spring (TEL129), summer (TEL132), and autumn (HUD114) totaling over 400 hydrographic profiles and 200-plus plankton net tows across the NL standard sections and high frequency sampling Station 27. Ships- of-opportunity occupations of Station 27 were once again limited during the winter and fall periods owing to a lack of availability of suitable sampling platforms in 2014. The spring and autumn Multispecies Surveys provided limited spatial and temporal coverage compared to previous years, particularly over the southern NL Shelf, with less than 1,000 hydrographic profiles collected in 2014 across the seasonal surveys. Overall, the effort and performance of AZMP sampling program in NL region in 2014 was equivalent with previous years in coverage of the standard sections, but lowest in terms of physical profiles and the third lowest in biogeochemical sampling since the inception of the monitoring program at the high frequency station. 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 as well as succession planning.

REGIONAL SUMMARY OF ACTIVITIES (MARITIMES REGION) - JEFF SPRY

High frequency station sampling frequency in 2014 was similar to recent years with 23 occupations of Halifax-2, 13 of Prince-5, and 8 of Shediac-8. Intended core sampling was accomplished for the spring Scotian Shelf, Labrador Sea, and fall Scotia Shelf survey missions. AZMP also participated, as usual, in three seasonal groundfish missions winter/spring Georges Bank, Summer Scotian Shelf, and Fall Southern Gulf. In all, there were 663 hydrographic occupations and 245 zooplankton net tows made in 2014. This is consistent with the sampling effort of recent years.

While core sampling was accomplished, time was lost for some of AZMP's ancillary sampling. *CCGS Alfred Needler* lost approximately 50% of the window allocated to the winter groundfish through ship problems and weather. *CCGS Hudson* lost approximately a week of the fall 2014 survey period due to ship problems. Reliable platforms continue to be one of the main concerns in carrying out the program. Personnel issues in the short term are being covered. Success with the Investment Summary Note (ISN) funding proposal to Ottawa means equipment/hardware renewal can proceed in next few years.

The Continuous Plankton Recorder contract has been renewed for five years and funding has been secured for next fiscal year.

REGIONAL SUMMARY OF ACTIVITIES (QUÉBEC AND GULF REGIONS)- CAROLINE LAFLEUR

The Québec region conducted four main cruises in 2014. The first one, by helicopter in March, was led by Peter Galbraith. They sampled from the sea ice and collected CTD data as well as surface nutrients. The second one took place in June on the *CCGS Hudson*. The AZMP team performed the standard sampling of the seven sections of the program and participated in the mackerel egg survey on the Magdalene Shallows. The third cruise was held in August as part of the Québec multi-species survey. A reduced team performed rosette casts and zooplankton tows at many trawl stations. Finally, the 2014 year was completed by the November AZMP survey. Again, the seven sections of the Gulf of St. Lawrence were visited along with many ice forecast stations. At about half of those stations, pH measurements were carried out and water

samples were preserved for alkalinity analysis. In addition to these cruises, the Gulf region had provided us with data from the Southern Gulf.

Along with section station occupations, IML regularly occupies one high frequency station, Rimouski station. In 2014, Rimouski station was very well sampled from April to November (nearly every week), but we didn't have the opportunity to get there on a Coast Guard icebreaker during winter. We also contribute to the Shediac Valley sampling efforts. In total, the Shediac Valley station was visited eight times, four of which were Québec region occupations. Unfortunately, despite our combined efforts, there still exist logistic issues that preclude more frequent sampling.

Québec region has equipped the Rimouski and the Shediac Valley stations with a buoy system during the ice-free season. Meteorological as well as oceanographic data are transmitted to land many times a day, and anyone can access the data through the St. Lawrence Global Observatory (SLGO). In addition, some products produced by the Québec region AZMP program are published there.

Finally, there are some upcoming changes to the Québec AZMP team. The biogeochemical team will now be comprised of Michael Scarratt and Sonia Michaud. The zooplankton team will lose Jean-François St-Pierre after his retirement next summer.

BIO REMOTE SENSING UPDATE 2014 - CARLA CAVERHILL

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

A primary production calculation has been completed for 2002-14 for the extended North Atlantic zone. It is a monthly estimate (based on method of Platt et al. 2008) on a 4 km spatial grid. It uses Moderate Resolution Imaging Spectroradiometer (MODIS)/Aqua chlorophyll, SST and PAR as input as well as ship-based measurements of the vertical distribution of phytoplankton and its photosynthetic response to light. This calculation compares well with the previous (Sea-viewing Wide Field-of-view Sensor (SeaWiFS) based, 1997-2010) estimate, except in areas where the chlorophyll estimates from the two sensors show significant differences. Statistics for the satellite boxes and monthly GEOTIFF (GEOreferenced Tagged Image File Format) images for the full calculation are available on the ftp server.

A new product available in the past year is the Medium-spectral Resolution Imaging Spectroradiometer (MERIS) FR (300 m) chlorophyll *a* dataset processed by NASA for the MERIS mission (2002-12). These values are relevant for Case-1 waters, and form an excellent high-resolution time series for offshore areas. Comparison of this new dataset with the MERIS algal_2 values, which are geared for Case-2 waters, shows the NASA values are much higher due to the NASA algorithm interpreting sediment and yellow substances as chlorophyll. For now, the ESA calculation for MERIS algal_2 is the best estimate available for coastal areas, at least for ESA Reprocessing 2. Reprocessing 3 is now available for the entire time series, and that dataset will be evaluated in 2015.

Plans for 2015 include adding VIIRS (Visible Infrared Imaging Radiometer Suite) chlorophyll *a* data to our suite of products. VIIRS, the follow-up to MODIS, was launched in 2011 but has just recently moved from the evaluation stage to standard product stage. Another primary production calculation will be done using the VIIRS dataset. Also on our proposed workplan is reprocessing the SeaWiFS 1 km dataset for the entire mission (1997-2010). 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. Many of our plans are contingent on hardware and software upgrades that are required for the processing.

Discussion

The Chair indicated that AZMP is now using remote sensing data in this year's SAR.

The current approach uses two-week composites when 8-day composites are available. Moving to the short-term composite could affect resolution of metrics for bloom tracking.

Response: From now on there are huge changes and we will reinvent everything we do. If there is a feeling that 8 days is appropriate, then we can do that.

The presenter indicated that BIO uses 8-day composites for Gaussian fitting. These are the data that were provided for the score cards.

Comment: The Chair indicated that he has managed to find the shared intranet drive on which the remote sensing statistics are stored but the task was not a simple one. The Chair asked that a better map of path to access these products be created and broadly distributed to AZMP researchers. It would be useful to get an update of the revamping so AZMP researchers can find the files with ease.

SUB-COMMITTEES

Breakout Discussions – Data Management Sub-Committee

Outline of progress to date

- BioChem content audit has resulted in the identification of issues to be addressed, plus recommendations for arequired major over-haul of the database, and issues with associated applications;
- QA/QC procedures developed at IML have been provided to NAFC with associated climatologies and land masks; BIO is almost complete in the inclusion of land masks and climatologies, use of these for CTD and bottle data at BIO will begin early 2015-16;
- Communication and support among regions has progressed and continues to improve;
- Plan to clean up content of "look-up" or code tables for BioChem in development, to be started early fiscal year 2015-16;
- Technical report outlining database details, recommended practices for loading of data, and structure of BioChem published in 2014-15 (Devine et al. 2014); and
- Simplified methods for access to data outside of the query application for DFO users.

Need to prioritize issues/resource needs

- Need additional staff dedicated to data management. The current staffing levels with responsibilities related to Ocean Sciences data:
    - NL – 1 human resource (still in training).
    - MAR – 5 human resources; with 1 retiring in approx. 1.5 years, 1 still in training, 1 currently on leave; an additional position to be filled. Significant new responsibilities have been added to this unit (BioChem, bottle data, forward lab flow-through, and GIS Archive).
    - IML – 4 human resources; 1 on leave, 1 on assignment.
    - NCR – 7 human resources; 2 on leave; 1 on assignment.
- IM&TS submission for BioChem major overhaul and expansion, currently sitting in "Priority 3." IM&TS cannot deal with known application related bugs/fixes, considered unsupportable by them; as applications cannot be changed, database needs to remain

static in structure. Anticipate a multiyear project, until completed, tested, and rolled out, *ad hoc* methods will continue to be the norm in attempting to ensure data quality and database integrity.

- BioChem:
    - Clean up content of 'look up' or code tables for BioChem in development in fiscal year 2015-16;
    - IM&TS understands the database part but lacks the science knowledge required to properly manage these data. Science requires data managers with in-depth knowledge/understanding of the data, the business rules, the protocols, and the ability to react quickly to new output requirements. The ability to deal with the ever-changing requirements of the end users is paramount to the long-term success. IM&TS is currently not meeting the needs of Science.
- AZMP Website
    - Review the data currently available and served for quality and completeness.
- CTD database
    - A prototype Oracle database for Maritimes data developed and tested; Next fiscal year expect to see expansion (look up tables to aid in searches, etc.) and beginning of load of legacy data; OSD has been kept in the loop and has shown interest in leveraging this.
- Responsiveness of IM&TS
    - IM&TS and SSC (Shared Services Canada) have both been problematic as they focus inward since the re-organization;
    - Requests for space allocated on the network (shared drives) can be an issue; While the BioChem Steering Committee has a good relationship with the current IM&TS staff slated to support BioChem, these staff members are not able to deal with bug fixes or changes to the applications, and as a result the database structure. Changes implemented to date have been focussed on implementation of new Treasury Board standards for logins, and stripping out of some code identified as problematic and therefore not in use (edit application). Documentation by IM&TS staff last year was referenced in the submission to IM&TS as part of the justification for the overhaul (document referred to the applications as 'unsupportable' by their own staff).

Breakout Discussions – Logistics Sub-Committee

The logistics sub-committee identified the following action items for 2015-16:

- Logistic leads to review "new" Regional Individual Standing Offer (RISO) with Sea-Bird Electronics pending outcome of ISN-Year #2.
- Logistic leads to consult with AZMP colleagues regarding priority equipment for year 2 and prepare budget.
- Major capital equipment (> $10 K) outside of standing offer status will require additional work and advance planning with PWGSC. It is recommended to start as early as possible in the new fiscal year to ensure procurement deadlines can be achieved.
- Further consultation with Peter Galbraith regarding Autonomous Buoy Systems ISN proposal to enhance collection of biophysical data at AZMP high frequency stations. What are the preferred sensors and development of regional plans to handle O&M in support of monitoring buoys if ISN proposal moves forward?

- Logistic leads to continue to seek strategies for emergency replacements of critical equipment (i.e. year-end funds).
- Logistic leads to assist in planning for continued ocean acidification study pending outcome of ACCASP renewal proposal.
- Logistic leads to evaluate use of automated software systems (e.g. ELOG application) for metadata capture and sample tracking. Evaluate software for tracking laboratory analyses (George Sheppard (NAFC), in progress).

Breakout Discussions – Data Products Sub-Committee

Procedures and software (in the form of R and SQL scripts) have been developed and implemented in the MAR region. They allow the extraction of discrete and plankton data directly from BioChem and the processing of extracted data into desired biogeochemical indices. These procedures and scripts were used this year to automate the generation of the MAR contribution to the SAR biogeochemical scorecard data product. The process is time effective, transparent and reproducible.

The procedures and scripts developed in the MAR region rely heavily on BioChem as a centralized data source, and hence on the efforts of the data management group to assure the quality of the data already existing in or to be loaded into BioChem.

The procedures and scripts developed in the MAR region are available and accessible to the other AZMP regions. Their adoption in the QC region is deemed challenging due to the loss of existing personnel (through reallocation or retirement) with suitable skill set in R/SQL programming.

Action: Galbraith/Scarratt/Plourde will seek funding to support the adaptation of the R scripts in the QC region.

The scripts are to be extended to include the calculation of additional indices such as the abundance index of warm/cold zooplankton species, the indices of which are set to become part of the standard SAR data products for next year. Biological, chemical and environmental indices derived from the Bedford Basin Monitoring Program are also set to become part of the standard SAR data products for next year, and efforts will be invested to adapt the current scripts for their calculation.

Each region will identify and prioritize products (target date: end of April) based on the inventory prepared by B. Casault. Products in the SAR are a good starting point, but products specific to one region that could be useful in other regions should be identified as well. This will result in a subset of data products common to all three AZMP regions. A priority for the MAR region is a heat plot of *C. finmarchicus* development/phenology. Also, special efforts will be made towards defining data products better representing the data collected on sections as they are currently under represented compared to the high frequency stations.

Scripts will be developed and implemented to automate the process of generating the data products. These scripts will be made available and accessible to all three regions.

The MAR region applied the linear model fits approach developed in the NL region to compute annual estimates of chemical, phytoplankton and zooplankton indices in 2014.

Action: QC region will try the same approach to their data.

The MAR region will investigate solutions to make standard data products easily available and accessible to AZMP clients or the public in general, whether this is done through the current AZMP website or an alternate website to be developed locally.

The merging of the QC and MAR region data collected on the Cabot Strait section was implemented and tested using the data for 1999-2013.

Action: Galbraith/Plourde will provide nutrients, chlorophyll and zooplankton data for 2014 and Casault will recalculate the annual indices for this year's SAR.

General Discussion of Business Meeting

The general outcome of the breakout groups and issues identified during the workshop and business sessions highlighted several areas of concern:

1) Funds to maintain the operational program are being stretched to the breaking point and there are serious concerns that certain elements of the program may not be sustainable on the long term;
2) Personnel renewal and replacement (following retirement) must be a priority if the quality of monitoring activities, sample processing and analyses are to be maintained. Succession plans are critical to ensure that knowledge and expertise are shared prior to the departure of key personnel. Training and intellectual development plans need to be a priority in order to maintain skills and remain current;
3) Despite funding for capital/rust-out renewal in 2014/2015, much of the equipment routinely used in activities related to the monitoring program is well past normal operational life cycles. It is critical to ensure that funding of the 5-year national monitoring capital plan presented to NCR last year be continued;
4) Data management remains a critical activity that requires stronger commitment of resources to achieve the long-term needs of the program and other Ocean Science activities; and
5) We need IM&TS and SCC to recognize and give high priority to Ocean Science needs. The poor response to requests for services is harming the program's ability to manage access to information and carry out the research needed to interpret the observations.

Action: The Chair will provide an executive summary of the 2015 meeting to Regional Directors of Science (RDS), Director General, Ocean Sciences, and Assistant Deputy Minister for Science outlining AZMP concerns. This is to be completed by the end of April.

SESSION 2 - REVIEW OF PHYSICAL AND BIOGEOCHEMICAL CONDITIONS IN THE NORTHWEST ATLANTIC

Rapporteur – Benoit Casault

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

The AZOMP provides observations of variability in the ocean climate and plankton affecting regional climate and ecosystems off Atlantic Canada and the global climate system. In the Labrador Sea, losses of heat in winter are a key process in the formation of deep dense waters that drive the global ocean overturning circulation. In the winter of 2013-14, primarily forced by strong northerly winds, the mid-high latitude North Atlantic experienced the most extreme heat loss for the region since 1979. This heat loss from the ocean to the atmosphere led to the most significant formation of Labrador Sea Water (LSW) since 2007-08. Winter-time mixed-layer depths in 2013-14 exceeded 1,700 m, outlining a reservoir filled with a newly ventilated, cold and fairly fresh LSW, which is rich in carbon dioxide and other dissolved gases. This new LSW is evident and is associated with a layer with low temperature (< 3.4°C) and salinity (< 34.86)

between 1,000 and 1,500 m. In a similar manner to the last significant renewal of LSW (winter 2007-08), the deep and intense winter mixing of 2013-14 has interrupted the general warming trend that has persisted in the intermediate waters of the Labrador Sea since the mid-1990s. Preliminary analysis of research cruise measurements made north of Flemish Cap in June 2014 indicate that the new LSW was already spreading in the subpolar North Atlantic away from its source following the ocean's western boundary and interior pathways.

Two noticeable surface freshening events were observed in 2008-10 and 2011-14 that spread across the Labrador Sea with the largest near-surface salinity anomalies observed over the Labrador slope. In the earlier period, freshening of the upper layers on the Greenland side of the Labrador Sea more or less coincided with freshening on the Labrador side, while in the latter period freshening in the western Labrador Sea lagged the Greenland-side by almost a year. Furthermore, a delay of about one year was observed in the spreading of this freshening from either side of the Labrador Sea into the interior. During the convection period, this fresh anomaly was mixed into the intermediate depth layers of the Labrador Sea and helped shape the LSW vintage observed in 2013-14.

These extreme atmospheric and physical ocean properties in the winter of 2013-14 also had profound impacts on the biological properties of the Labrador Sea that can be easily tracked until at least mid-summer. A climatology of chlorophyll *a* constructed from a time series of remotely sensed ocean colour from 2003 to 2014 indicates that the annual spring bloom of phytoplankton starts and ends earlier on the Labrador and Greenland Shelves (mid-April to early June) compared to the central Labrador Basin (early May to late June). However, initiation of the spring bloom was 2-3 weeks late in 2014, beginning in the first week of May on the Greenland Shelf and late May on the Labrador Shelf. It is also worth noting the observation of a strong bloom on the Labrador Shelf in October with a concentration of chlorophyll > 2 mg m^{-3}. The annual average chlorophyll-*a* concentration normalized anomalies for 2014 were below normal across the Labrador Sea region.

Calanus finmarchicus dominates the mesozooplankton biomass throughout the central region of the Labrador Sea, while on the shelves *C. finmarchicus* abundances show regional variations that are generally consistent from year to year and are related to regional differences in the timing of the life-cycle events and environmental conditions. The intense deep convection in 2014 in the Labrador Sea seems to have delayed the spring season conditions leading to a low abundance of *Calanus finmarchicus*. On the Labrador Shelf, *C. finmarchicus* abundances are generally relatively low in spring, as was the case in 2014. There was no significant trend in springtime abundance of *C. finmarchicus* between 1996 and 2014 on the Labrador Shelf, Labrador Basin or the Greenland Shelf. In the Central Labrador Sea, total *C. finmarchicus* abundance was relatively low in spring and summer, with a low proportion of young stages. *Calanus finmarchicus* abundances are generally higher in the eastern Labrador Sea than further west in spring, because the spring bloom starts earlier there, which leads to earlier reproduction in *C. finmarchicus*. The population development Index (PDI) represents the proportion of copepodite C1 to C3 over the entire population expressed in percent and shows the magnitude of recently produced young stages within the region. In all three regions of the Labrador Sea, the indices in 2014 were among the lowest observed between 1995 and 2014.

In summary, the severe winter heat loss of 2013-14 was remarkable in magnitude and impacts were observed both in the Labrador Sea and across the mid-high latitude North Atlantic. Furthermore, we can measure these impacts on the biological properties of the Labrador Sea, all the way to the lower trophic level. The biological response in 2014 was similar to that observed during the previous deep convection event in 2008.

Discussion

The physical conditions in the Labrador Sea showed the strongest anomalies in winter surface heat flux observed since 1979 despite strong positive anomalies in the winter air temperature and corresponding strong positive anomalies in the winter sea surface temperature. This led to the suggestion that the heat budget was likely driven by winds rather than the air–sea temperature gradient.

The current sea-ice distribution (concentration and extent) data product has very broad spatial coverage and a better product adapted to the Labrador Sea is being looked at.

The deep convection event that occurred in 2014 was striking. Caution was expressed at attempting to associate it solely with the strong positive NAO index anomaly of 2014.

Part of the current analysis of the Labrador Sea biological data relates the surface chlorophyll biomass concentration to the sea-surface temperature. A suggestion was made to enhance the analysis by relating the phytoplankton spring bloom parameters (e.g. amplitude and timing) to the SST.

Caution was expressed about the interpretation of the development index for *C. finmarchicus*. The index has proved to be robust for the Labrador Sea. However, a relatively low index as observed in 2014 across the Labrador Sea does not necessarily indicate that the development of stage I-III had not already started at the time of sampling.

PHYSICAL OCEANOGRAPHIC ENVIRONMENT ON THE NEWFOUNDLAND AND LABRADOR SHELF, DURING 2014 - EUGENE COLBOURNE (NAFC)

Collaborators: J. Holden, D. Senciall, W. Bailey, J. Craig and S. Snook

The NAO index, an indicator of the direction and intensity of the winter wind field patterns over the North Atlantic, returned to a positive phase in 2014 that was associated with strong arctic air outflow in the northwest Atlantic during the winter months and consequently lower-than-normal winter air temperatures. Sea-ice extent increased substantially during winter 2014 with the first positive anomaly (higher-than-normal extent) observed in 16 years. Annual SST based on infrared satellite imagery remained above normal in most areas across the Newfoundland and Labrador shelves in 2014; however, values have declined from record-high values observed in 2012. The annual bottom (176 m) water temperature at the inshore monitoring station (Station 27) was below normal in 2014 by -0.6 SD (standard deviation), a significant decrease from the record high in 2011. The cold-intermediate layer (CIL; volume of < 0°C) in 2014 was at its highest level since 1985 on the Grand Bank during the spring and the highest since 1991 off eastern Newfoundland during the summer. Spring bottom temperatures in 3Ps remained above normal by about + 0.5 SD but were slightly below normal on the Grand Banks by - 0.3 SD. Fall bottom temperatures in 2J and 3K decreased from 2 and 2.7 SD above normal in 2011 to 0.7 and 0.3 above normal in 2014, respectively, which is a significant decrease in the past three years. As a result, the area of bottom habitat covered by water < 2°C increased to near-normal values in 2014 during both spring and fall. A standardized climate index derived from 28 meteorological, ice and ocean temperature and salinity time series declined for the 3rd consecutive year, reaching the 11th lowest in 65 years and the lowest since 1994.

Discussion

No comments to report

BIOGEOCHEMICAL CONDITIONS ON THE NEWFOUNDLAND AND LABRADOR SHELVES - GARY MAILLET (NAFC)

Collaborators: P. Pepin, S. Fraser, T. Shears, G. Redmond, E. Colbourne

Ocean colour metrics indicate reduced magnitude, duration, and associated delay in the timing of the production cycle in 2014 throughout many of the statistical sub-regions. In general, trends in the timing indices indicate transition to earlier production cycles, but the extent of the spring bloom may be regulated by local processes. Lower phytoplankton standing stocks along the NL standard section in recent years may be the result of reduction in deep nutrient inventories ongoing since 2008. The preliminary (awaiting fall survey results) trend for calanoid copepods indicates lower abundance in 2014 along the NL standard sections. Large reciprocal changes in zooplankton biomass of small and large size fractions and developmental phenology of copepods remain ongoing throughout the AZMP time series. Long-term changes in plankton taxa based on the CPR indicate increased standing stocks of phytoplankton but lower levels of cold-water adapted calanoids and certain macro-zooplankton during recent years on the Newfoundland Shelf, consistent with AZMP indices. CPR macro-zooplankton indices have varied with large changes evident for certain taxa: higher levels of amphipods but reduced abundance of euphausiids. Despite record warming during 2010-11 on the NL Shelf, the abundance of a number of cold-water copepod species was at their highest level in the time series. Warm-water copepods have also flourished during this record-warming period, and despite the recent return to near-normal temperatures in 2013 and 2014, annual abundance anomalies ranged from 1 to 4 standard deviations units above normal.

Discussion

The decline of the deep nutrient inventories (silicate and nitrate) has been ongoing on the Newfoundland Shelf since 2009. At first sight, this appears to be consistent with observations from the Labrador Sea. A more comprehensive analysis is suggested in order to explain the observed trend that should include an analysis of the nutrient ratios and an analysis of water masses in terms of their temperature, salinity and nutrient characteristics in an effort to determine the source of that water.

The reciprocal shifts observed in the zooplankton biomass size fractions (small vs. large) along the standard NL sections are ambiguous. A suggestion was made to investigate whether these shifts could be related to the timing of the phytoplankton spring bloom.

With regard to *C. finmarchicus* phenology, the correlation between the proportion of different stages and the ice index appears consistent with development index reported for the Labrador Sea, although more exploratory work is recommended.

It was suggested that the analysis of the phytoplankton spring bloom metrics (magnitude and timing) be expanded to include sea-ice parameters (e.g. concentration, extent and retreat). Such information is available and is being looked at, but the relationships investigated so far are not as straightforward as expected. Some sea-ice metrics appear to work better in some geographical areas but don't seem applicable globally.

PHYSICAL OCEANOGRAPHIC CONDITIONS IN THE GULF OF ST. LAWRENCE - PETER GALBRAITH (IML)

The annual average runoff of the St. Lawrence River measured at Québec City and RIVSUM II (freshwater runoff flowing into the Estuary) were above normal in 2014 (+ 0.7 SD and + 1.1 SD respectively), as was the spring freshet (+ 1.9 SD). The cold winter of 2014 created a deep surface mixed layer that had near-freezing temperatures as well as a sea-ice cover with the 3rd

highest seasonal maximal since 1969, at nearly double the climatological average. The August-September cold intermediate layer (CIL) returned to near-normal conditions after four years of warm conditions as a result of the cold winter. The sea-surface temperature averaged from May to November over the Gulf was above normal by + 1.2°C and second highest on record after 2006. A record high was reached in August with a Gulf-average anomaly of + 2.5°C, breaking the + 2.0°C record of August 2012. Record highs were also set in the following regions: Estuary (+ 4.2°C, + 4.4 SD), Northwest Gulf (+ 4.1°C, + 4.4 SD), Anticosti Channel (+ 2.8°C, + 3.2 SD) and Cabot Strait (+ 2.9°C, + 3.2 SD). Deep water temperatures are increasing overall in the Gulf, with inward advection from Cabot Strait, where temperature have reached a record high (since 1915) in 2012 at 200 m. Temperature averaged over the Gulf at 200 m increased overall to reach 5.3°C, the highest on record. Temperature at 300 m increased slightly in 2014 to reach 5.9°C, the highest value since 1980. Bottom area covered by waters warmer than 6°C increased in 2014 in Anticosti Channel, Esquiman Channel and Central Gulf, and reached a record value in Esquiman Channel while reducing its bottom habitat area in the temperature range of 5-6°C.

Discussion

The northward progression of the deep temperature maximum from Cabot Strait toward the St. Lawrence Estuary and toward the Esquiman Channel appears reasonable based on the observations, but model results are to be reviewed to see whether it is possible to replace the deeper waters of Esquiman Channel within a single year.

It was noticed that the plot of sea-ice properties in relation to the air temperature showed much less variability in the 1990s compared to the 2000s, and the question arose as to whether this could be due to different monitoring efforts between the two periods. The inherent error in reporting some sea-ice properties (except for ice coverage) likely has more to do with it than the monitoring effort itself. Parallels were made where similar inter-decadal variability patterns have also been observed for sea level extremes and for the temperature index in the Maritimes region.

BIOGEOCHEMICAL CONDITIONS IN THE GULF OF ST. LAWRENCE IN 2014 - STÉPHANE PLOURDE (IML)

Collaborators:, Michel Starr, Liliane St-Amand, Jean-François St-Pierre, Peter Galbraith, Laure Devine, Jeff Spry, Isabelle St-Pierre, Michael Scarratt

We present an overview of the biochemical conditions in the Gulf of St. Lawrence (GSL) in 2014. For a second consecutive year, the late winter (March) nitrate inventories measured during the helicopter survey were near normal for most regions of the GSL, with the exception of an area around Anticosti Island and the southern Gulf where nutrients were above normal. The analyses of satellite-based chlorophyll *a* biomass in different sub-regions revealed that the initiation of the spring phytoplankton bloom was later than normal in many regions of the GSL, coinciding with a later-than normal ice retreat. In addition, the spring bloom magnitude was below normal and of shorter duration across the region. The difference between winter (maximum) and late spring (minimum) nitrate inventories was below normal in many regions of the GSL, confirming that primary production was lower than normal during spring 2014. In the fall, chlorophyll *a* levels were nevertheless above normal in many regions of the GSL. For a third consecutive year, highly positive deep-water (> 200 m) nitrates were atypically associated with high temperature and salinity. The conditions in the St. Lawrence Estuary were markedly different compared to the GSL: chlorophyll *a* was above normal during spring, summer and fall.

Abundance of *C. finmarchicus* was lower than the long-term average (1999-2010) in 2014, a feature observed since 2009. Abundances of *Pseudocalanus* and non-copepods were well above normal in 2014 whereas total copepod abundance was slightly above or near the long-term average in 2014, both representing increases relative to 2013. *Calanus hyperboreus* and small calanoids showed above-normal abundances in 2014, while abundances of copepod species indicative of cold/arctic and warm/temperate water masses were generally near or above their long-term average respectively. The zooplankton dynamics at Station Rimouski is driven by local conditions (winter– spring) and connectivity (summer–fall) with the adjacent western GSL. In 2014, *C. finmarchicus* abundance was well below average until late July but increased to values above normal afterward. *Calanus finmarchicus* phenology was characterized by a timing of emergence maximum CVI abundance earlier than normal but similar to 2013. The development of the first generation (increase in CI-III abundance) began earlier than in 2013 but the peak in CI-III abundance occurred in August (similar to 2013), i.e. later than the long-term average. These dynamics could reflect the influence of warmer-than-normal deep water, a St. Lawrence freshwater runoff well above the normal in May and June, and a delayed onset of the spring bloom over most of GSL in 2014 due to a late sea ice break-up.

Discussion

The deep nitrate (300 m) anomaly was strikingly high in 2014 and for a third consecutive year in the Gulf of St. Lawrence. It is likely that the source of deep nutrients could be associated with the intrusion of warm slope water with low oxygen content.

The extreme anomaly values of non-copepod species observed in the eastern GSL and southern GSL, and at the high frequency sampling stations can be misleading by way of zero-inflated data that typically introduce abnormally high or low anomalies.

Similarly, the high abundance of warm copepods in 2014 in the western GSL and at Rimouski appears to be associated with the warmer conditions observed in the Gulf of St. Lawrence. However, caution must be exercised in associating warm/cold zooplankton species to warm/cold physical conditions as the effect of timing of sampling must be taken into account.

With regard to the *C. finmarchicus* phenology, it was suggested that the signal for the CIV stage appeared not to be coherent with that of CI-III and it was questioned whether this could be an indication of local production.

METEOROLOGICAL, SEA ICE AND PHYSICAL OCEANOGRAPHIC CONDITIONS ON THE SCOTIAN SHELF AND IN THE GULF OF MAINE DURING 2014 - DAVE HEBERT (BIO)

In 2014, the North Atlantic Oscillation index was above the 1981-2010 mean (+ 11.5 mb, + 1.3 SD [standard deviation]) after last year's slightly negative value, and was nearly as large as the index in 2012, which was fourth largest value. Mean annual air temperature anomalies were positive at all sites except Boston at - 0.3^{o}C (- 0.4 SD), with values ranging from slightly positive at Saint John, New Brunswick, to + 1.2^{o}C (+ 1.7 SD) at Sable Island, Nova Scotia. Positive satellite-based sea-surface temperature (SST) anomalies prevailed throughout the region in 2014, with values from + 0.5 to + 1.2^{o}C (+ 0.4 to + 1.5 SD) above the 1981-2010 mean values. Long-term coastal monitoring sites at St. Andrews (New Brunswick) and Halifax (Nova Scotia) recorded annual SST anomalies of + 0.6^{o}C (+ 1.0 SD) and + 0.1^{o}C (+ 0.2 SD), respectively, in 2014. At selected sites across the region, annual water temperature anomalies were positive in 2014: + 0.9^{o}C (+ 2.7 SD) for Cabot Strait 200-300 m depth range (the second largest anomaly; 2012 was the largest), + 0.6^{o}C (+ 1.0 SD) for Misaine Bank at 100 m, +1.4^{o}C

(+ 1.7 SD) for Emerald Basin at 250 m, + 1.7°C (+2.2 SD) for Lurcher Shoals at 50 m, and + 1.2°C (+ 2.3 SD) for Georges Basin at 200 m (2013 was the warmest year). Bottom temperature anomalies in Northwest Atlantic Fisheries Organization areas 4VWX were all positive in 2014 and ranged from + 1.1°C (+ 1.6 SD) in 4Vs to + 2.0°C (+ 2.6 SD) in 4W. Average stratification on the Scotian Shelf weakened compared to 2013 and was nearly equal to the 1981-2010 mean value. Since 1948, the stratification has slowly been increasing on the Scotian Shelf, mainly due to half freshening and half warming of the surface waters. A composite index consisting of 18 ocean temperature time series from surface to bottom across the region indicated that 2014 was the second warmest of 45 years (2012 was the warmest), with an averaged normalized anomaly of + 1.5 SD relative to the 1981-2010 period.

Discussion

A brief comment was made as to whether a spike in sea level observed in 2010 could be related to the Atlantic Meridional Overturing Circulation (AMOC) index but was deemed not likely to be the case.

OPTICAL, CHEMICAL, AND BIOLOGICAL OCEANOGRAPHIC CONDITIONS IN THE MARITIMES REGION IN 2014 - CATHERINE JOHNSON (BIO)

Collaborators: B. Casault, J. Spry, E. Head, W. Li

Biogeochemical conditions were assessed in the context of warmer than average surface and deep ocean temperatures and sub-annual and spatial variability in temperature anomalies in the Maritimes region 2014. Stratification index values and mixed layer depths were variable at sub-annual scales at the high frequency stations, with very deep mixed layer depths observed at Halifax-2 in late winter and spring. Although annually averaged anomalies of surface and deep layer nitrate were close to average in most areas, anomalies observed at the fixed time series stations, particularly deep-layer nitrate at Halifax-2, were variable at sub-annual time scales. Scotian Shelf spring phytoplankton bloom magnitudes observed by remote sensing were below average, while summer–fall blooms were high or early. Blooms at the high frequency stations were unusually deep; the magnitude of these deep blooms would not have been accurately represented in satellite ocean colour observations. Both zooplankton biomass and *Calanus finmarchicus* abundance were lower than average overall in 2014. The abundance of Arctic *Calanus* species, an indicator of cold water on the Scotian Shelf, was lower than average in 2014, while the abundance of warm offshore species was higher than average on the central and western Scotian Shelf. Despite numerous sightings of thaliaceans (mainly salps) by the public in 2014, zooplankton community structure observed by AZMP was not substantially different from typical conditions. Ocean conditions in the Maritimes region have been characterized by strong sub-annual and mesoscale variability in 2013 and 2014, in addition to warmer temperatures, and interannual variability has been strong during the AZMP period since 1999. It is important to evaluate how the ecosystem will respond to changes in mean conditions, but also changes in sub-annual to interannual scale variability.

Discussion

Sub-annual physical variability was observed in 2014 on the Scotian Shelf with colder winter/spring and warmer summer/fall conditions. Similarly, an increase in the interannual physical variability has been observed between the 1990s and 2000s, being coherent with different parameters reported in other regions. How the ecosystem responds to the increased sub-annual and interannual scale variability is difficult to answer considering that the interaction between the location and the time of sampling can bias the interpretation based on an annual index only.

SESSION 3 - DISCUSSION OF ENVIRONMENTAL OVERVIEWS AND DEVELOPMENT OF SCIENTIFIC ADVISORY REPORT

Rapporteur – Jeff Spry

Following discussion of the environmental overviews, the group was presented with a series of highlights that would form the summary elements for the (SAR. Once consensus of the wording of the bullets was attained, breakout groups were asked to comment and edit the draft elements for the various portions of the SAR. The Chair led the discussion surrounding the resulting documents until final consensus was achieved.

The resulting SAR will be passed on to the four Atlantic Regional Directors of Science for final approval and publication.

TECHNOLOGIES FOR PLANKTON IDENTIFICATION AND MONITORING - GARY MAILLET

Collaborators: G. Doyle, P. Pepin (NAFC)

The FlowCAM, a camera-based microscopy imaging system, permits rapid enumeration and sizing of particles in a flow field. The instrument has the capability of imaging particles over a large dynamic range from 5 um to over 2 mm. Various hardware configurations with fluorescence detectors and laser sources can be used to further discriminate between chlorophyll (phytoplankton cells) and non-pigmented cells (zooplankton and detrital like particles). FlowCAM visual spreadsheet software allows construction of various filters and classification systems to sort images into specific categories of interest. Testing and development of specific filters and classification routines are underway to enumerate and size AZMP plankton collections. Initial efforts focussed on investigating the distribution and abundance of copepod nauplii along standard oceanographic sections. Use of this technology will permit rapid assessment and general characterization of the phyto- and zooplankton community structure along with detailed sizing that is not feasible with conventional microscopy methods. FlowCAM technology will provide enhanced capabilities and time savings to the aquatic researchers engaged in identifying, classifying and enumerating plankton.

Discussion

A participant asked whether the system works with fresh or preserved samples. The presenter indicated that both types of samples with the exception of preserved phytoplankton samples. He also indicated that the system has been applied to new and old preserved microzooplankton samples with good success.

In response to queries about the need to stain samples, the presenter indicated that staining was not necessary with this utility – but that fresh material is better for colour and shape.

In response to questions about the need to filter the samples, the presenter indicated that it is important to screen the material first with appropriate mesh but then you have access to electronic filters as well as application of image classification and identification as methods to sort the data into size and/or taxonomic categories.

When asked whether filters/class system can be shared or whether they are specific to each instrument, the presenter indicated that we should theoretically be able to share templates built among users.

Questions were raised about what caveats should be considered and what were the personnel requirements to operate the system. The presenter responded that time and experience are needed to operate and fine tune filters. There is greater difficulty for certain taxa and size

ranges. Investment of effort depends on question being asked. Fresh samples need a dedicated operator to maintain throughput – maybe good idea anyway. Preserved samples may be analyzed piecemeal. It is possible typically to process 10-15 samples/day consisting of 2000 particles per sample run.

How do we deal with volume of data generated? There is the potential to acquire 10,000 images daily, which would require a huge storage volume. It is possible to use 'collage view' to minimize images stored and still get useful information.

What is the cost of such a system? This unit is on loan to AZMP NL, but costs range from $80,000-$100,000, depending on the options selected.

If you are targeting groups like phytoplankton; can you use water directly rather than net samples? There are some applications set up as flow-through systems.

AUTOMATIC BUOYS AT EVERY AZMP HIGH FREQUENCY STATION? - PETER S GALBRAITH

Québec region has maintained and operated a network of five automatic buoys around the Gulf that were originally purchased using DFO funding (two buoys) as well as funding obtained by the Institut des Sciences de la Mer (ISMER). The ISMER buoys are now at the end of their life cycle. More advanced buoys have since been developed by Multi-Électronique Inc. (MTE) and three were deployed last year at Old Harry, AZMP station Rimouski, and AZMP station Shediac Valley. This coming year, two will be deployed at the AZMP stations, with new 0-100 m profiling CTD capability. Québec region Science management supports seeking a Major Capital Acquisition grant (> 1M$) for new buoys, and it is proposed here to deploy these at each AZMP station. The buoys are 2.1 m (7 ft) wide and 4.5 m (15 ft) tall and weight 1,030 kg. They come equipped with Iridium communication, Global Position System (Garmin), compass (Honeywell), meteorological station (Vaisala), flow meter, pumped CTD (Sea-Bird), Eco-Triplet-W fluorometer (WET Labs), photosynthetically active radiation sensor (Satlantic), and wave monitor (MTE). Options include acoustic doppler current profiler (RDI), ocean colour radiometers (irradiance and radiance), and Bioshutter (Satlantic), SBE49 CTD + mini-winch (Sea-Bird), and mooring gear.

Discussion

The cost of a base unit is~$145,000, but a fully loaded mooring would require ~$271,000 per sampling station/site.

The system is durable. Test case lasted through all ice-free season in Gulf St. Lawrence, with remote log-in to change parameters.

Power requirements are done through built-in battery-pack, which recharges using solar array on buoy.

Following discussion, the group agreed to develop a major capital request to outfit at least four high-frequency sampling sites: two would be located in the Gulf of St. Lawrence, one at Station 27 on the eastern coast of Newfoundland, and one at Halifax-2 on the Scotian Shelf.

SESSION 4 - INTEGRATION AND SYNTHESIS

Rapporteur – Carla Caverhill

ACTION PLANS FROM BREAKOUT GROUPS

Data Management

There was agreement that progress has been made. The BioChem audit has shown issues to be fixed.

Action: Peter Galbraith will lead a group to examine the AZMP website and make recommendations for change. The data management team will wait for that report before reviewing data on the website. The aim is to complete the review by the end of May.

Action: Laure Devine will create a document to help users interpret BioChem data; it will be posted on the BioChem website.

Action: Shelley Bond will lead the cleanup and reboot of BioChem with assistance from IML.

Logistics

There was consensus that much of the equipment used for monitoring program activities needs updating despite an influx of capital resources in 2014. Also, it is imperative that retiring staff be replaced. Maritimes and Newfoundland regions are documenting Standard Operating Procedures and annual cycle of activities to prepare for loss of senior personnel.

Peter Galbraith will coordinate the proposal for purchase/upgrade of monitoring buoys. Part of the plan needs to include the operational costs for support and maintenance of the equipment after their initial deployment. Excessive operating costs can kill a program, as was found with the plan to buy gliders; it was realized that O&M of $100,000/year and two FTEs are required to support the technology. We need to know what the buoys will really cost; also need a data management plan for buoys and other new technology, which should be included in the plan. We have the advantage that all technology will be the same in each region. It was agreed that data management is part of operational resources and it will be included in plan. Plans for this program should not have to rely on participation from partner organizations over which the Department has no control and limited influence.

Action: Andrew Cogswell has been talking to George Shepherd about routines that track samples, in order to implement new procedures in Maritimes. This is a longer-term strategy and should be on next year's agenda.

It was noted that acidification sampling will be continuing on Newfoundland, Maritimes and Québec spring surveys. There has been no additional funding allocated for this activity, which will place additional burdens on already limited O&M resources. All fall acidification samples from the 2014 fall surveys have been run and compiled, but there has not been an opportunity to compile a zonal perspective or create data products for this year because the information was available only a few weeks before this meeting. The plan is to present the data at the NAFO meeting in June as well as provide a comprehensive analysis for next year's AZMP meeting.

Data Products

There has been great progress made in Maritimes region to provide common tools that can be applied across regions. Newfoundland and Québec regions are interested in adopting the same methods and scripts that are used in Maritimes region. Another participant suggested that a

zonal approach to analyzing data could reduce cost of buoys and other technology, giving other staff more time to work on synthesis.

Meeting Format 2016

The PMC believes the business element discussions are rushed. The consensus decision was to extend the business meeting by half a day to add time for business discussions and for breakout groups. The proposed dates for 2016 are from 9:00 on Tuesday March 15th to 12:00 on Friday, March 18th. It is proposed that Tuesday will be for the workshop, and Wednesday-Friday (midday) will be for business/review. There was concern that an extra half day would add to the cost of the meeting, but that would only be the case for the few people who would show up on the first day of the meeting if it were to start at 12:00, as has been the case in the past. Most people have to arrive a day in advance anyway, and the cost for the meeting itself will not be increased.

AZMP Synthesis

Plans for next year's workshop will be developed during 2015/16 through discussions between the Chair and AZMP/AZOMP lead researchers.

METEOROLOGICAL DATA CONCERNS - DAVE HEBERT

Time series of annual temperature using EC's AHCCD were used during the last couple CSAS reports instead of the EC Climate Data on the recommendation of EC. This update to this series is generally provided for the previous year. The timing of this update is becoming later. In 2014, the update for 2013 was provided in fall. Thus, the data presented for 2014 are from the unadjusted monthly mean temperatures from the EC Climate Data site. It appears that some of the EC sites have been taken over by NAV Canada and several of those sites, which we use, are no longer included in the AHCCD updates. This goes back to 2012 and the number of stations missing is increasing. There are periods where AHCCD monthly values are missing yet the data is either available as monthly values on EC or missing monthly values are present where daily values are available. Some of this reduction of AHCCD might be due to the new numbers assigned to the NAV Canada and not included in the AHCCD series. There is a concern that the Sable Island might disappear in this conversion. John Loder contacted the EC person responsible for the AHCCD and received an unsatisfactory response.

Action: Blair Greenan has agreed to pursue contact with EC to inform them that their data is important for our monitoring program and we would desire updates as soon as feasible each year, as well as continuing key sites that we use in our reporting. AZMP lead researchers in each region will provide Blair with a list of stations and issues, if any, with them.

MATTERS ARISING

CSAS and Document Release

The time required to obtain the Zonal (RDS) approvals, and final posting of some of these documents was unnecessarily delayed (up to nine months) last year. These lengthy delays in publication are a cause for concern.

Action: the Chair will draft a note for distribution to the CSAS leads in the four Atlantic regions, to be copied to regional Directors of Science, expressing the concerns raised by AZMP lead researchers.

AZMP – University Collaborations

MEOPAR has taken the lead on providing a Canadian perspective on our contribution to the Integrated Atlantic Ocean Observing System. This system involves the EU, the US and Canada. Ottawa would like feedback on thoughts about engagement opportunities between DFO and MEOPAR relative to implementation of this observing system.

The Chair reiterated four areas of potential interface between DFO and MEOPAR:

- Joint projects where grad students or post-docs are trained to work on questions relevant to AZMP, working on AZMP data, considering that AZMP is the primary observing system for the Atlantic Zone. Projects and collaborators within one of the MEOPAR-affiliated institutions would have to be identified. These would have to be full partnerships; we don't just give them the data. Students would be funded by MEOPAR, trained by DFO.
- Development of remote-sensing tools; MEOPAR is looking at development projects for observation systems. Eventually the system would be passed on to the Agency responsible (e.g. DFO). Any system needs to be relevant to the questions we need answered, the data we need to collect (buoy system is an example of DFO moving forward), and contribute and enhance our observation program. When you put out an observation system, you need to know how representative the data will be of a broader scale of issues. We need to see how such devices could enhance the current observation program. We need a series of questions: also need estimates of O&M and personnel required to support the technology. Part of any agreement with MEOPAR involves developing a proposal for sustained resources to keep the program going long term. Funds are needed to keep the device operational and staff are required to deal with data and make data available.
- Research Aggregation Devices (RADs). MEOPAR has identified four areas of interest where a coordinated effort to collect multidisciplinary data would be useful: Baffin Bay/ Davis Strait, Southern Labrador Shelf/Slope (VITALS [Ventilation, Interactions and Transports Across the Labrador Sea] and AZOMP), Eastern Grand Banks and Western Scotian Shelf. The first step is to identify what gaps need to be filled while building on what exists. Sites that would provide relevant data, for long-term and short-term monitoring, need to be identified. Initial questions are what type of arrays need to be deployed and where are critical areas; the goal is to greatly reduce uncertainty in ocean forecasting for the North Atlantic.
- This is an international exercise that needs data sharing principles. It is necessary to ensure that intellectual property is respected, and the effort put in by participants is recognized and acknowledged. It needs to be clearly stated that involvement of scientists is not set aside.

Although integration and communication between DFO and academic researchers has been poorly coordinated in some instances, the group feels the White Paper and the Galway Statement provide us with an opportunity to engage in a substantive way. The Chair indicated he would appreciate if people could let him know if they are interested in being involved. It was noted that MEOPAR is having a data management meeting in the fall. Data managers should be involved as well as principal AZMP scientists who deal with issues regarding access to data.

It was noted that there should be greater engagement of DFO experts in Remote Sensing (e.g. buoys, satellites) with MEOPAR.

There are communication issues between DFO and MEOPAR. MEOPAR's messages do not always get to AZMP, and AZMP's interests are not always represented effectively to MEOPAR.

Action: the Chair will brief NCR about the concerns raised by AZMP lead researchers. Paul Lyon (NCR) has indicated that we need to coordinate observation activities around ocean monitoring initiatives on a national basis. In addition it is recommended that:

1. Ocean Sciences managers and PIs should meet and decide where emphasis needs to be placed for observation, interpretation or research.
2. The outcome of those discussions should be used promptly to engage MEOPAR and other groups.

Maritimes AZMP steering committee has discussed collaborative agreements and the problems with ancillary programs that DFO supports. There are currently no mechanisms to accept funds from external collaborators; it must be done through in-kind sharing which makes collaboration difficult. There is a need for the creation of a collaborative agreement template that can easily be applied when the potential for joint projects presents itself but this will have to be carried out through inter-agency discussions.

Shediac Valley High Frequency Site

There are questions about the viability of the Shediac Valley station. It was noted that PMC had a discussion about retaining Shediac Valley station, and decided that there are elements of knowledge that need to be acquired before a decision can be made. There are a number of discussions underway, but for now, Shediac Valley remains a high frequency sampling site. Discussions will include how to facilitate its sampling by the Moncton DFO staff.

Action: AZMP scientists from Maritimes, Québec and Gulf regions need to assess the usefulness of data from the Shediac Valley site.

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APPENDIX I – TERMS OF REFERENCE

Seventeenth Annual Meeting of the Atlantic Zone Monitoring Program (AZMP)

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

March 16-19, 2015

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 Integrated Science Data Management (ISDM) 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 2014 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

17th Annual meeting of the Atlantic Zone Monitoring Program

March16-19, 2015

Delta Hotel, 475 Avenue Président Kennedy, Montréal, QC

Monday, March 16 (PM): Data Products/AZMP Synthesis

Rapporteur: Gary Maillet

Time	Presenter	Activity
13:00 – 15:40	Pierre Pepin	Welcome
-	Pierre Pepin	Initiating DFO-MEOPAR discussion for implementation of Integrated Atlantic Ocean Observation System (IAOOS) – opportunities for collaboration
-	Catherine Johnson	Zooplankton Atlas – Results, draft plan for completion and approach to publication
-	Peter Galbraith	Four ways to splice, slice and dice nutrients
-	Benoit Casault	Standardization of AZMP Biogeochemical data products
-	-	General discussion: • Developing a common approach (i.e. indices) to describe temporal changes in the pelagic 'habitat' • Assessing linkages between physical properties with T/S, nutrient, chlorophyll data among regions.
15:40 – 16:00	N/A	Health Break
16:00 – 17:00	-	Breakout groups: 1) Physical Oceanographers – Meteorological data concerns (Hebert) 2) Biogeochemical group – Identifying a common products and formats that would be easier for a broad range of client

Tuesday, March 17 (AM): Review of Progress in 2015

Rapporteur: Dave Hebert

Time	Presenter	Activity
08:30 – 12:00	Stéphane Plourde	ACCASP – Optimal habitat of zooplankton and pelagic species
-	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
-	Eugene Colbourne and Jinshan Xu	A comparison of the CONCEPTS Global Ocean Prediction System results to AZMP Seasonal Observations during 2014
-	Guoqi Han	Comparison of 30-year hindcasts for the NL Shelf with the AZMP data
-	-	General Discussion: • Model – data comparison: what is needed to move projects forward (people, $$$, etc.) • Client-oriented products • Regional and zonal synthesis

NOTE: There is a parallel meeting of the BIOCHEM and Data Management working Group.

Tuesday, March 17 (PM): AZMP Business Meeting (Session 1)

Rapporteur: Andrew Cogswell

Time	Presenter	Activity
13:00 – 13:15	Pierre Pepin	• Welcome and Introduction / Acceptance of Agenda • Outline of meeting goals: o Progress o Development of briefing note for SEC o SAR preparation and completion process
13:15 – 15:15	Laure Devine	Summary of BIOCHEM workshop
-	Shelley Bond	Progress on Data Management Action Plan in Maritimes region
-	Andrew Cogswell	Progress in implementation of E-log system
-	Michael Ott	ISDM progress overview
-	-	General Discussion
15:15 – 15:35	N/A	Health Break
15:35 – 16:00	Gary Maillet Jeff Spry Caroline Lafleur	• Regional summary of activities (5 minutes each) • Progress • Logistic Issues
16:00 – 16:20	Carla Caverhill	AZMP remote sensing products
16:20 – 17:00	-	• Breakout discussions for Data Management (Devine/Bond), Logistics (Maillet/Cogswell), Data Products (St. Pierre/Lafleur/Casault): o Identify progress on issues and action items o What is needed to move remaining issues forward o What to stress to Regional Directors concerning program needs • Identify areas of progress • Outstanding issues • Develop one or two bullets for each
17:00	-	Permanent Management Committee

Wednesday, March 18: Review of Physical and Biogeochemical Conditions in the Northwest Atlantic (Session 3)

Rapporteur: Benoit Casault (AM) and Jeff Spry (PM)

Time	Presenter	Activity
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 – 10:20	Gary Maillet	Biogeochemical conditions on the Newfoundland and Labrador Shelves
10:20 – 10:40	Peter Galbraith	Physical oceanographic conditions in the Gulf of St. Lawrence
10:40 – 11:00	N/A	Health Break
11:00 – 11:30	Stéphane Plourde Michel Scarratt	Biogeochemical conditions in the Gulf of St. Lawrence
11:30 – 11:50	Dave Hebert	Physical oceanographic and meteorological conditions on the Scotian Shelf and in the Gulf of Maine
11:50 – 12:20	Catherine Johnson	Biogeochemical conditions on the Scotian Shelf and in the Gulf of Maine
12:20 – 13:30	N/A	Lunch
13:40 – onward	Peter Galbraith & Pierre Pepin	• Summary of Zonal Scorecards • Presentation of draft bullets
-	-	• Review and agreement of SAR bullets • Work to be completed and timelines – Edits, Figures, Translation • Possible additions and improvements for next year : o Bedford Basin section o Warm/Cold water zooplankton indicator groups
15:00 – 15:20	N/A	Health Break
-	-	Breakout groups (Physical/Biogeochemical/LabSea) to review and edit draft SAR text. Other groups (Data Management / Data Products) can make use of this time
16:20 – 16:40	Gary Maillet	Application of FlowCam to quantify plankton abundance
16:40 – 17:00	Peter Galbraith	Automatic buoys at every AZMP high frequency station?
17:00	N/A	Close

Thursday, March 19: Integration and Synthesis (Session 4)

Rapporteur: Carla Caverhill

Time	Presenter	Activity
09:00 – 09:30	Pierre Pepin	Report of Monday's Breakout Groups: • Data Management • Logistics • Data Products • Physical Group from Workshop
09:30 – 10:30	Pierre Pepin	• Work plan for 2015-16: o Briefing note (Hoping for 23 but maybe more realistic by 27 March 2015) o Zonal SAR (Completed by 27 March 2015) o Research Documents to be produced o Any other publications o Abstracts (25 March 2015) o Rapporteur Notes (week of 30 March 2015) o Proceedings (End of April) o Website review (???) o PDF copies of presentations • Summary of Work Plans: o Data Management (Bond/Devine) o Logistics (Maillet/Cogswell) o Data Products (Casault/Plourde/Johnson) o Synthesis (Pepin) • Meeting Format 2016 o Proposed dates (15-18 March, 2015) o Alternate (22-25 March, 2015) • Tuesday workshop • Wednesday – Friday midday (Business/Review)
10:30 – 10:50	N/A	Health Break
11:00 – 11:45	-	Matters Arising and General Discussion: • CSAS and document release • DFO – University Collaborations • AOB
11:45 – 12:00	N/A	Close

APPENDIX III – MEETING PARTICIPANTS

Participant	Affiliation
Pierre Pepin	DFO – NL Region
Gary Maillet	DFO – NL Region
Eugene Colbourne	DFO – NL Region
Guoqi Han	DFO – NL Region
Dave Senciall	DFO – NL Region
Jinshan Xu	DFO – NL Region
Peter Galbraith	DFO – Quebec Region/IML
Stéphane Plourde	DFO – Quebec Region/IML
Michel Starr	DFO – Quebec Region/IML
Michael Scarratt	DFO – Quebec Region/IML
Diane Lavoie	DFO – Quebec Region/IML
Laure Devine	DFO – Quebec Region/IML
Caroline Lafleur	DFO – Quebec Region/IML
Jean-François St. Pierre	DFO – Quebec Region/IML
François Villeneuve	DFO – Quebec Region/IML
Sonia Michaud	DFO – Quebec Region/IML
Joël Chassé	DFO - Gulf Region/IML
David Brickman	DFO - Maritimes Region (BIO)
Dave Hebert	DFO - Maritimes Region (BIO)
Catherine Johnson	DFO - Maritimes Region (BIO)
Andrew Cogswell	DFO - Maritimes Region (BIO)
Shelley Bond	DFO - Maritimes Region (BIO)
Benoit Casault	DFO - Maritimes Region (BIO)
Carla Caverhill	DFO - Maritimes Region (BIO)
Jeff Spry	DFO - Maritimes Region (BIO)
Jack Fife (SABS)	DFO - Maritimes Region (BIO)
Blair Greenan	DFO - Maritimes Region (BIO)
Marc Ringuette	DFO - Maritimes Region (BIO)
Michael Ott	DFO - NCR