Report of the Fifth Annual Line P Workshop, Institute of Ocean Sciences, Fisheries and Oceans Canada, Sidney, BC, March 6 and 7, 2012

Chaired by **Marie Robert**, Line P program manager, Institute of Ocean Sciences, Fisheries and Oceans Canada (IOS/DFO).

Introduction

Fifty ocean scientists and technicians met in March 2012 to share recent observations along Line P, as well as to present their current research interests and proposed future sampling plans. "Line P" is a 1400-km-long set of ocean stations off Canada's West Coast, monitored for over 50 years by weatherships and research vessels. It began with sampling from weatherships during their transits to and from Ocean Station Papa (OSP) at 50N, 145W, from the 1950s until 1981. Fisheries and Oceans Canada has financed ship time and core scientific programs since 1981. With more international and academic partners joining the program, leading to more diverse studies, it became useful to meet annually to compare insights and plan future programs. At the 1st workshop in February 2008 scientists met to discuss future experiments and techniques. The 2nd workshop in March 2009 focused more on scientific results, as well as on promoting collaborations and optimizing ship time and space. For the 3rd workshop in March 2010, optimizing ship time and space became critical since all cruises are fully booked with more people on waiting lists. The main concept coming out of the 4th workshop was collaboration among all groups, not only for ship time and space, but for the sharing of scientific data, resources and ideas. This 5th workshop was somewhat simpler than the previous four. Part of the reason is that many collaborations were developed during the past years, and the logistics of the cruises got fine-tuned during the previous years, so less time had to be spent talking about lab or deck space on the ship. This said, the workshop still allowed for important discussions among the participants.

Marie Robert (IOS/DFO): *Overview of the Line P Program.*

Marie first stated the goals of the Line P Workshop: to promote collaborations between all scientists in order to better understand the Pacific Ocean; to maximise the use of ship time; and finally to discuss some issues that can potentially affect everyone involved in the program. She then described the basics of the Line P Program; what sampling is done at what station, what is the distance/timing between stations, how long each cruise lasts, etc. She also described the paperwork needed and schedule for the next year:

- Requests for security clearances and radioisotope use have to be started at least two months prior to the cruise.
- Please contact **Marie Robert** if you want to participate in a cruise. Do NOT contact the DFO security clearance officer directly.
- The name of a student's supervisor will be sent to the security clearance officer with the intent that the supervisor can help his/her student fill-in the paperwork if there are any questions. Too many unnecessary questions are asked repeatedly to the security clearance officer.

- Paperwork for radioisotope use has to be started in April for the June and August cruise and in November for the February cruise. The IOS radioisotope safety officer is **Michael Arychuk**.

Marie then showed the line up for berth reservations for the cruises of the next three years and the dates of this fiscal year's cruises. She concluded her talk with an update about the Line P Website (http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/line-p/index-eng.htm), where the data from the most recent cruises are now available. There is still a gap of four cruises from February 2008 to February 2009, which will hopefully be filled-in this year. There will also be a new "Publications" link on the Webpage where an extensive list of most publications will be posted.

Meghan Cronin (NOAA/PMEL, Seattle): *Station P mooring activities.*

Meghan Cronin presented an overview of Station P Mooring Activities. At present there are two moorings deployed at Station P: the NOAA surface mooring, led by **M. Cronin** and with sensors also provided by **C. Sabine** (NOAA PMEL) and **S. Emerson** (UW), and the UW/Applied Physics Laboratory (APL) wave-rider mooring, led by **J. Thomson** (UW APL). These moorings are part of the network of OceanSITES time series reference stations (http://www.oceansites.org). On the June 2012 Line-P cruise, we plan to deploy a fresh NOAA surface mooring first, and then recover last year's NOAA surface mooring. The Line-P contribution towards the maintenance of the surface mooring is gratefully acknowledged. The UW/APL Waverider mooring is planned to be refreshed during a *R/V Thompson* cruise in November 2012. Those interested in participating on this cruise should contact Jim Thomson (jthomson@apl.washington.edu).

Three "flanking moorings" are planned to be deployed in 2014 as part of the NSF Ocean Observatories Initiative (OOI). NOAA does not expect to get any funding or ship time from OOI to support the NOAA surface mooring, even though OOI will be relying upon the NOAA surface mooring to act as its "central mooring" for the station P OOI global node. All data on the NOAA and Waverider surface moorings are publicly available through various websites and collaborations are welcome. See:
http://www.pmel.noaa.gov/ocs/, http://www.pmel.noaa.gov/co2/story/Papa,
http://cdiac.ornl.gov/oceans/Moorings/Papa_145W_50N.html, and http://cdip.ucsd.edu.

The suite of sensors on the NOAA surface mooring can be used to monitor ocean acidification; air-sea CO2, heat, moisture, and momentum fluxes; and key variables in the upper ocean budgets. Numerous studies are underway, including 3 PhD theses at University of Washington. On 3 April 2012, **Meghan** will be holding a Station P Science Workshop at NOAA PMEL. If you wish to participate in this workshop, please contact **Meghan Cronin** (Meghan.F.Cronin@noaa.gov). Since NOAA PMEL is a U.S. government facility, a list of all visitors must be submitted in advance.

Noel Pelland (U. Washington): *Subthermocline eddies over the Washington slope as observed by Seaglider, 2003-09.*

A 5.5 year time series of cross-shore Seaglider surveys along two transects in the Washington slope region revealed the presence of multiple subsurface, anticyclonic eddies with core water properties similar to those found in the California Undercurrent ("cuddies"), along with cyclonic features of comparable size and strength though without an undercurrent water mass signature. Glider transects made 40 anticyclone and 20 cyclone crossings; closer inspection grouped these into approximately 17 anticylonic and 9 cyclonic independent eddies. The eddies' size and characteristics -- horizontal radii of 25-30 km, vorticity anomalies in some cases almost 50% below or above ambient values, mean propagation velocity (inferred by repeat occupations of multiple eddies) of about 1 cm s^{-1} westward -- are on average consistent with Submesoscale Coherent Vortices. A survey of glider profiles near anticyclonic (lens-like) cuddy edges found numerous examples of along-isopycnal interleaving between lens core water and the surrounding subarctic water. A parameterization of effective cross-frontal diffusivity (using typical interleaving scales) compares well with horizontal diffusivity inferred from an assumed eddy lifetime. Anomalous transport of salt from the upper slope due to the warm-core anticyclones from 2003-2009 accounts for a lateral flux of approximately 110 x 10^9 kg salt yr^{-1}; this represents 45% of the alongshore loss of salt from the undercurrent as inferred from the poleward freshening observed between the two glider transect locations, and provides a novel quantification of cuddies' role in offshore flux of subsurface water.

Noel Pelland (U. Washington): *The 18-month Seaglider time series at Station P: application to heat, salt and oxygen budgets.*

In his second talk, **Noel Pelland** first presented the characteristics of the Seaglider study around Station P between June 2008 and February 2010 – pattern, cycles, sensors, etc. – and asked: how did the glider complement the mooring? He described the methods used to analyse the glider data: Horizontal Velocity, Vertical Velocity, and Vertical Diffusivity. He then described the Research Goals of this time series: 1) What is the role of advection in heat and salt budgets in the subarctic; 2) What is the Oxygen Production and Respiration. **Noel** concluded his talk by describing the studies still planned with the Seaglider Time Series data, mainly the study of Export Attenuation.

Lisa Miller and Jim Christian (IOS/DFO): *Our place in the world: Incorporating Line P into global ocean carbon data products.*

The PACIFICA data synthesis project has been sponsored by PICES to construct a uniformly calibrated basin-scale data set of carbon parameters, nutrients, oxygen, and salinity in the Pacific Ocean. The synthesis builds on the work and methods of GLODAP and CARINA, providing greater spatial and temporal resolution in the Pacific than the GLODAP data product does. The cruises included in PACIFICA are intercalibrated using crossover analysis, whereby the results from deep waters (>1500, >2000 when available) for stations within 250 km of each other are compared, with the assumption that properties are not changing at those depths over the time period of the data set. Offsets in the deep water results that are higher than established thresholds are corrected by applying corrections to the outlier cruises. Time series data overwhelmed the original crossover algorithms and produced inappropriate adjustments, and the analysis method

was modified to limit the weighting of individual time series cruises. Specifically, the analysis is first run without any time series stations, to create an average reference, and then the individual time series stations are compared to that average reference. Using the modified analysis method offsets in Line P cruises have generally been decreasing with time, consistent with continuing improvements in protocols. The resulting internally consistent data product will be used for applications such as model validation and Earth system change studies.

Andrew Ross (IOS/DFO): *Strategic long-term measurements of iron along Line P.*

As an essential micronutrient, iron plays a key role in maintaining the biological processes (e.g. photosynthesis, nitrogen fixation) on which healthy and productive marine ecosystems depend. Iron measurements along Line P have been carried out sporadically over the last 14 years (1997-2011) but, at present, are not included as a core activity of the IOS Line P Monitoring Program.

The Line P stations span a strong natural gradient from productive, iron-replete coastal waters to the iron-deficient, high nutrient-low chlorophyll (HNLC) waters of the Alaska gyre. By exploiting this natural laboratory, Line P program-supported research has demonstrated that subsurface transport, mesoscale eddies and, potentially, volcanic ash represent significant mechanisms by which terrestrial sources of iron are transported to the gyre.

Increased stratification, upper ocean acidification, and declining oxygen concentration in subsurface waters all have the potential to affect the supply of iron to the northeast Pacific, with concomitant effects on ecosystem structure and biogeochemical rate processes. Hence, it is more important than ever to maintain a comprehensive monitoring program that supports hypothesis-driven research and process studies while complementing ongoing Line-P investigations (e.g. DMS production, plankton ecology, climate modeling) that require long-term iron measurements.

Andrew Ross and **Jay Cullen (U. Victoria)** propose to establish a core program of such iron measurements along Line P through a collaboration between DFO (IOS/Ocean Sciences Division) and other participating organizations (UVic, UBC, ULaval) that will provide the resources and expertise necessary to collect seawater samples on all Line P time-series cruises and analyze them for various forms of iron, using appropriate techniques and standardized methods. The main goals of this program are:

1) to further characterize the sources and sinks of Fe in the northeast sub-arctic Pacific.
2) to support ongoing research into the microbial utilization of Fe in marine ecosystems.
3) to reduce uncertainties in the biogeochemical cycle of Fe, and model the impact of Fe limitation on primary productivity, carbon export, and the cycling of climatologically active gases in the NE Pacific.
4) to enable future studies of how the distribution and speciation of Fe will respond to the increased stratification, deoxygenation and acidification associated with ongoing climate change.

Nadja Steiner (IOS/DFO): *A diel cycle study of dimethylsulfide at OSP.*

Nadja started by presenting the 1-D model she developed to help understand the observed dimethylsulfide (DMS) data along Line P, as well as the general dimethylsulfoniopropionate (DSMP) and DMS cycles in the upper ocean (according to Gabric *et al. 2002*). She then showed the results of her model, with and without S-N ratio and Fe-limitation, and compared these with the actual DMS measurements performed along Line P. The recent observations are lower than all model results in June, which could be explained by the absence in the ocean of dinoflagellates – one of the main DMSP producing species at OSP – in early summer in recent years. The 2004 observations published in Wong *et al.* have a better agreement with the model. When **Nadja** adjusts the S-N ratio seasonally to reflect the absence of dinoflagellates in late spring, her model results are much closer to recent low observations. The second part of **Nadja'**s presentation was on the DMS diel cycle study performed at Station Papa in August 2010. DMS, DMSP-t, DMSP-d, Nutrients, and Chlorophyll were sampled at 5 and 20 dbar every 2 hours for 28 hours, with High Performance Liquid Chromatography (HPLC) sampled every six hours. The diel cycle was most obvious in DMSPd; the DMS only showed a weak diel change. One point that was showing up really well in the actual DMS measurements was the patchiness present within a Niskin bottle – duplicates taken one after the other from the same bottle showed an important difference between results. Finally, **Nadja**'s model shows the largest diel signal to be from photolysis, however at the surface gas exchange is the dominant loss process, obscuring a diel cycle in DMS. This is especially true for the second part of the study due to an increase in wind and related mixed layer depth. This study of the diel cycle is not yet complete, with bacterial rates and Membrane Inlet Mass Spectrometry (MIMS) data still to be added to the study. Once all data are put together it is hoped that the study can be repeated to further study this cycle.

Maurice Levasseur (U. Laval): *Testing the Kasatochi hypothesis: The early response of the NE subarctic ecosystem to ash deposition.*

Maurice presented the results of his PhD candidate **Josiane Mélançon** who studies the effect of the Kasatochi volcanic ash on the NE Pacific Ocean. Mainly, they want to know if it is possible to trigger a phytoplankton bloom with the Kasatochi ash; if so, how much ash is needed; what is the initial response of the algal community to the ash (stimulating versus toxic); and finally how does this response compare to the response to desert dust. Since the ash from the Kasatochi volcano was quite hard to obtain they also used some ash from the Chaiten volcano in Chili. Their field work occurred on the June 2011 Line P cruise, during which they performed 6-day incubations in 10-litre bags. After discussing quantities of ash and Fe added and showing results of each treatment individually – all done in triplicate – Maurice concluded that it is indeed possible to trigger a bloom using the Kasatochi ash. Not much Kasatochi ash is needed – the half-maximum growth being reached at 0.5 mg/l – but more Chaiten ash is required. Both initial total dissolved iron (ambient concentration plus iron addition - leached from added ash or iron sulfate) and dissolved iron (ambient concentration) are good predictors of algal growth. In June 2011 there was a lag of 4 days before the maximum growth rate was achieved, but no toxic effect was observed. Finally, similar maximum growth rates were achieved when using dust instead of ash, but in the case of dust the initial total dissolved iron is not a good predictor of algal growth.

Roberta Hamme (U. Victoria): *Using dissolved gases to quantify productivity and denitrification.*

Roberta presented two main research objectives for Line P data collection for her lab, both involving dissolved gas measurements. First, she is using global measurements of dissolved N_2/Ar to investigate the marine nitrogen cycle. Some estimates of the nitrogen budget suggest that removal processes far exceed sources. In an NSF-funded study with **Steve Emerson**, **Roberta** is seeking to quantify the removal of bioavailable nitrogen from the ocean by looking at increases in N_2 (the product of denitrification). Station P will be a key location in their sampling strategy because it allows sampling of some of the oldest deep ocean water. **Roberta** requests multiple deep casts on the August 2012 cruise for this project. Second, **Roberta** is using dissolved O_2/Ar measurements to estimate net community production in order to investigate key fluxes in the global carbon cycle. She reviewed the recent MSc work of **Karina Giesbrecht**, who compared net community production from this dissolved gas method to new and primary productivity from more traditional incubation techniques, finding consistent relationships under some circumstances. **Roberta** hopes to attract a new graduate student to continue this work, including development of new methods and collaborations with scientists measuring productivity by other means.

Philippe Tortell (U. British Columbia): *CH_4 and N_2O work along Line P.*

Philippe first stated the overarching research goals of his group, which are to 1) Understand the quantitative and qualitative nature of primary productivity (PP) along Line P; 2) Examine the response of PP to key environmental variables, such as light, iron, CO_2, temperature, etc.; 3) Quantify the spatial/temporal distribution of climate active trace gases (DMS, CH_4, N_2O) in the subarctic Pacific; and 4) Quantify the underlying source/sink terms for these gases and examine potential environmental sensitivities. **Philippe** discussed many methods of measuring productivity along wide ranges of space and time. He presented some very recent results – from the February 2012 Line P cruise – of photosynthetic efficiency. He also showed how satellite algorithms have to be tuned in order to represent specific types of phytoplankton. After presenting the inverse relationship between O_2 and N_2O at Station P, **Philippe** presented the methane depth profiles from the June 2008 Line P cruise, indicating a high level of methane at station P4 at a depth of 1000 dbar. **Philippe** concluded his talk by introducing a recent paper on DMS written by E. Asher, his doctorate student, *et al.*

Steven Hallam (U. British Columbia): *From fjords to open seas: ecological genomics of expanding oxygen minimum zones.*

Steven's talk comprised three subjects: expanding oxygen minimum zones (OMZ); exploring the north eastern subarctic Pacific; and microbial sentinels of environmental change. **Steven** first presented a global map of oxygen minimum zones, showing how the NE Pacific is a zone with very low minima. He then showed how these minima, in the depth range between about 500 and 1500 m, have been steadily decreasing since 1974 at Station Papa. Then he showed how hypoxia alters the ecosystem energy flow and explained the redox-driven niche partitioning. After a few words about the nitrogen cycle, **Steven** introduced his work about microbial community genome analysis and talked about bacterial group abundance, and different pathways and coexistence networks. His conclusions are that, according to his results, the taxonomic structure of the North Eastern Subarctic Pacific (NESAP) resembled that of others OMZs with four major taxonomic

groups dominating OMZ waters; the metabolic pathways co-varied between photic and interior OMZ waters consistent with redox-driven niche partitioning; spring, summer and winter depths profiles were ~72% similar in pathway composition consistent with a stable functional core; and NESAP provides an exceptional natural laboratory in which to explore microbial community structure and function in relation to changing levels of water column oxygen deficiency.

Jody Wright (U. British Columbia): *Distribution of the uncultured bacterial phylum Marine Group A in the oxygen minimum zone of the Northeast subarctic Pacific Ocean. .*

Marine Group A (MGA) is a candidate phylum of bacteria that is ubiquitous and abundant in the pelagic ocean. Small subunit ribosomal rRNA (16S rRNA) gene sequences affiliated with MGA subgroups are most prevalent in the dark ocean, particularly in regions with distinct haloclines or oxyclines including oxygen minimum zones (OMZs). Here, we quantified MGA population structure and diversity in relation to nutrients and dissolved gases in the OMZ of the Northeast subarctic Pacific Ocean (NESAP) using a combination of CARD-FISH and 16S rRNA gene diversity screening (clone libraries and V6 pyrotags). Five previously defined MGA subgroups were recovered in 16S rRNA gene clone libraries and five novel subgroups were defined (HF770D10, P262000D03, P41300E03, P262000N21, and A714018). Moreover, operational taxonomic units (OTUs) affiliated with MGA clones SAR406, Arctic95A-2, Arctic96B-7, ZA3648c, and ZA3312c partition across the oxycline indicating subgroup-specific habitat selection. Consistent with previous reports, the OTU distributions of specific subgroups were correlated with decreasing oxygen concentration. These results posit a potentially important role for MGA in community metabolism and biogeochemical cycling in oxygen deficient marine environments.

Christina Schallenberg (U. Victoria): *Redox partitioning of iron in the northeast subarctic Pacific Ocean.*

The availability of iron (Fe), an essential trace metal for biota, is thought to limit primary production in approximately 40% of the global ocean surface waters (Moore *et al*. 2001). The reduced form of iron, Fe(II), is often thought to be more bio-available than the oxidized state, in part because of its higher solubility in seawater, and also because Fe reduction may be an essential step in iron uptake by phytoplankton (Shaked *et al*. 2005). However, there is limited data on Fe(II) concentrations, production and supply mechanisms in the open ocean. Here, **Christina** presented three offshore profiles of dissolved Fe measured along a transect (Line P time series) in the northeast subarctic Pacific Ocean, to a depth of 2000 m. There is evidence hinting at biological production of Fe(II) associated with the chlorophyll max, and surface Fe(II) concentrations are consistently above subsurface values, even when measured after hours of darkness. Below the mixed layer, all profiles show increased Fe(II) concentrations with depth. This trend is especially pronounced at the station closest to shore, where Fe(II) concentrations up to 100 pM were measured at a depth of 1400 m. **Christina** discussed the relationship between these features, total dissolved Fe concentrations and local hydrography.

Jason McAlister (U. British Columbia): *Pb concentrations and isotopes along Line P.*

Lead concentrations in the Atlantic Ocean provide a classic example of targeted measures of pollution reduction, following the introduction of unleaded gasoline. In contrast, **Jason** showed that a similar decrease in Pb concentrations is not observed in the North Pacific based on profiles from 1980, 1992, 2003, and 2010. Additionally, he reported a transect of Pb concentrations across 5 stations along Line P collected in August 2010. Concentrations of Pb exhibit maxima at 150-200m at P16 and P20, while at P26, a similar maximum is not observed. Observed Pb maxima are consistent with positive salinity anomalies observed in the halocline. Complementing Pb concentration data, Pb isotopic ratios are being measured. Comparison of isotopic ratios of August 2010 with those from 1980 demonstrates that anthropogenic Pb has infiltrated the upper 400m. Isotopic signatures distinct from the surface are not observed in the upper water column. Future work will continue to investigate the Pb maxima associated with the halocline and potential sources of Pb based on additional isotope data.

Ania Posacka (U. British Columbia): *Distribution of the total dissolved copper in the Northeastern subarctic Pacific.*

Copper (Cu) is a bioactive trace metal required for a suite of physiological processes in marine biota with a particular nutritional role in iron (Fe) limited phytoplankton (Annett et al. 2008, Semeniuk et al. 2009). Biological availability of Cu is strongly dependent upon its speciation, which in the oceanic surface waters is dominated by complexation with strong organic ligands (Cu-L). The focus of this study is to establish the speciation of Cu along the line P transect in the northeast Pacific including the concentrations of the dissolved copper (DCu), labile Cu, Cu-L as well as the stability constants of Cu binding ligands (log*K*). Using a flow injection analysis (FIA) method, we measure the total dissolved Cu from vertical profiles (22 depths, 0-2000) at five major stations along the line P. Analysis of our data on both vertical and horizontal scales revealed that the supply of dissolved copper to this region originates from atmospheric, continental and benthic sources. We observed a strong correlation of copper with phosphate for the most part of the data (DCu = 0.4 + 8.76, R^2=0.9) indicating the involvement of biological uptake and remineralization processes in Cu cycling in our study area. The ratios of Cu:P within the nutricline displayed a declining trend with distance towards the open ocean, Fe-limited region (OSP), which is in contrast to the observations of increased Cu demand in Fe-limited phytoplankton. Finally, the analysis of Cu:P ratios within the water column indicated a deficit of the metal relative to phosphate at depth, suggesting that non-biological processes such as scavenging onto particles might be influencing the vertical behavior of copper. Currently, we are conducting speciation analyses in order to gain a better understanding of the copper biogeochemistry along Line P.

David Semeniuk (U. British Columbia): *Role of copper speciation in mediating phytoplankton copper assimilation and community growth.*

Dissolved copper (Cu) speciation in oceanic surface waters is dominated by organic ligand complexation. Historically, it has been hypothesized that microorganisms produce strong ligands in order to bind and detoxify Cu. However, **David**'s recent fieldwork has demonstrated that Cu bound to *in situ* ligands in the subarctic NE Pacific Ocean is bioavailable to the native microorganism community, suggesting that these ligands may facilitate Cu acquisition. As such,

the role of strong Cu ligands remains clear in oceanic waters, and the possibility for *in situ* Cu toxicity or limitation remains undetermined. To elucidate the role of the *in situ* ligands in controlling Cu bioavailability and community growth, **David**'s group performed a four-day bottle incubation with surface water collected in the NE subarctic Pacific. Total dissolved Cu (1.2nM) and the *in situ* Cu speciation (expected 2-3 fold excess [L]) were modified with additions of CuSO4 (1.5 and 10nM), and a strong Cu(II) ligand, Cyclam (5 and 30nM), respectively. Cu:C assimilation ratios and Cu uptake rates increased proportionally with increases in total dissolved Cu compared to the unamended control. Conversely, Cu:C assimilation ratios and Cu uptake decreased proportionally with the Cyclam additions. Biomass normalized productivity (mol C µg chl-1 d-1) was anticorrelated with Cu:C assimilation ratios, possibly suggesting that the *in situ* community was undergoing Cu toxicity; however, at this time, **David** is unable to definitively say this was the case, and is awaiting corroborating data. These results suggest that oceanic phytoplankton Cu assimilation and nutritional status are more nuanced than previously thought.

Bill Crawford (IOS/DFO): *Global and Gulf changes.*

Bill started his talk with a figure of global surface temperature anomalies (STA) for 2011 (with respect to a 1971-2000 base period), showing how, even though most of the globe sees warmer temperatures, the eastern Pacific presents negative STA. He then presented various graphs of average sea-surface temperature anomalies (SSTA), sea-surface salinity anomalies (SSSA) and sea-surface pressure anomalies (SSPA) showing how the eastern Pacific was somewhat cold in the last four or five years, culminating in colder, fresher waters and low SSP in the winter of 2011. Summer 2011 was also cool and fresh, although waters were warmer near the coast. February 2012 shows the same pattern – La Niña-like pattern – according to the NOAA site data.

Bill then continued his presentation by showing **Marie Robert**'s graphs of temperature (T), salinity (S), and sigma-t from the most recent Line P cruise (February 2012), as well as graphs of temperature anomaly, salinity anomaly, sigma-t anomaly, and dissolved oxygen field along Line P for June 2011, August 2011 and February 2012. The anomaly graphs all showed a positive signal for each cruise at about 150 m. **Bill** then compared different indices related to the NE Pacific Ocean – the North Pacific Index (NPI), Pacific Decadal Oscillation (PDO), North Pacific Gyre Oscillation (NPGO), Southern Oscillation Index (SOI), Oceanic Niño Index (ONI) – from 1950 to 2010, as well as Hovmöller diagrams of T and S anomalies along Line P. The second part of **Bill**'s presentation focussed on dissolved oxygen (DO) data. He showed a map of DO concentrations in the entire NE Pacific, then presented **Frank Whitney**'s graphs of DO trends, clearly showing a decline in DO at Station Papa at all depths since the 1950s, but with a slight increase since 2003. Finally **Bill** presented his graph of near-bottom DO concentrations on SW Vancouver Island Shelf, showing not only that these values have been low since 2000, but clearly indicating that they were at their lowest in 2006 and 2009. He concluded by showing two graphs of chlorophyll concentration and sea-level height in the NE Pacific as seen by satellites.

Steve Romaine (IOS/DFO): *Ship time updates and Water Properties Website.*

Steve gave an overview of the ship time requests procedures and outlined the timeline of such requests: how the requests have to be completed by as early at July of one year in order to get ship time during the following fiscal year, and how quite often the ship time is not fully approved even as a new fiscal year starts. **Steve** then explained in detail all the various links and

documents on the Water Properties Website (www.waterproperties.ca), with special emphasis to the "Dashboard login" where students can offer their services as sea-going personnel, and where participants of a cruise and access documents such as Cruise Plans, Cruise Reports, Scientists Sea-Going Guidelines, etc.

General discussion

The first topic of discussion was: *Is there a need for wind, solar irradiance, or any other meteorological-type data from every Line P cruise.*

The general answers were favourable to having meteorological-type data from every Line P cruise.

- The data "wished for" included: Winds (speed and direction), Irradiance (PAR), atmospheric pressure, air temperature, and relative humidity.
- There is already some meteorological data being recorded on board the *CCGS John P Tully* by AXYS for Environment Canada, but we don't know at this moment if the data is publicly available, and how often the instruments are calibrated.
- **Marie Robert** is to contact all PIs of the Line P Program to inquire what data sets would be required and what precision each data sets has to be provided with.
- Following this survey, **Doug Yelland** is to look at what is already available and if it is possible to set-up a weather station on the *Tully* and what the costs would be.
- **Angelica Peña (IOS/DFO)** is willing to lend a PAR sensor to Line P for the irradiance data, depending on the type of light data most PIs are wanting.

The second general "announcement" was a request from **Gillian Stewart** from Queens' College, City University, New York. Her group (along with **Brad Moran** at University of Rhode Island and **Michael Lomas** at Bermuda Institute of Ocean Sciences) have participated to four Line P cruises so far. This coming June should be the last cruise for their project, but they are short of technician for this cruise and were looking for someone to help them with C14 manipulations. **Philippe Tortell** suggested asking **Nina Schuback**, a student in his lab who was part of the recent February 2012 Papa cruise, to see if she would agree to help the **Stewart** group.

Finally, we discussed the use of the Radiation-Van (Rad-Van) on the *Tully*. The present "rule" is that only one group can use the Rad-Van during a cruise. The danger of having more than one group in the Rad-Van is that one group relies on the other for certain aspect of security or cleanliness in the Van. Wipe tests have to be done in the Rad-Van as well as along the route from the van to the incubators before the cruise, every 7 days while at sea, and at the end of the cruise in order to decommission the van. It two groups were to work in the van during a specific cruise, it would be important that **both** groups take the responsibility of wipe tests and paperwork.