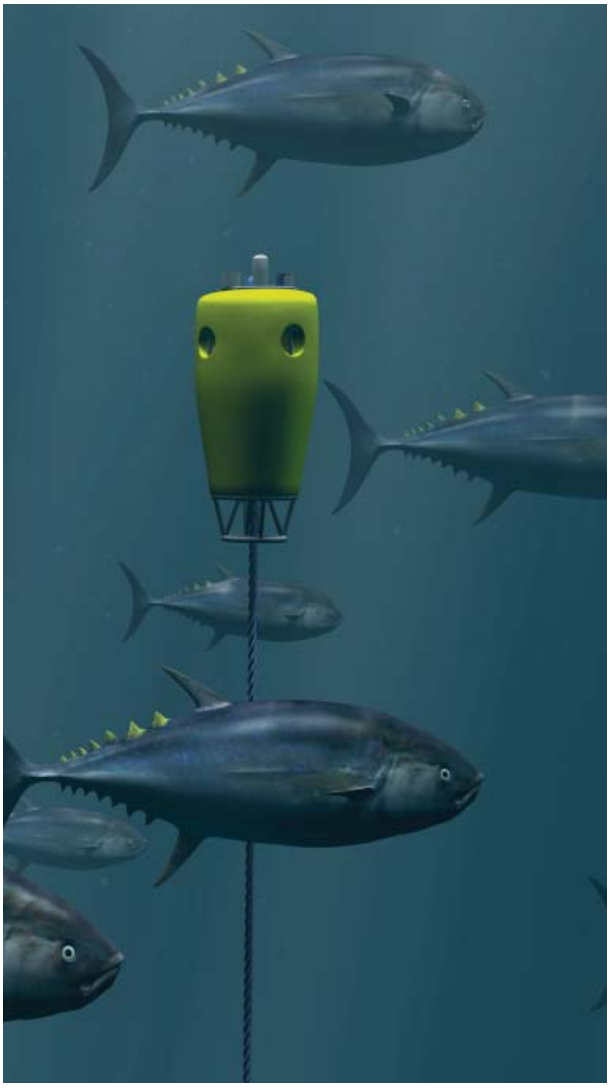
NEPTUNE Canada
Transforming Ocean Science



Upcoming Events

IEEE Underwater Technology 2009
Wuxi, China - April 21 - 24, 2009

AGU/GAC Joint Assembly
Special Observatories Session & NC Workshop
Toronto, ON - May 23 - 27, 2009

IEEE Oceans 2009
Bremen, Germany - May 11 - 14, 2009

CMOS
Halifax, NS - May 31 - June 4, 2009

GLOBEC
Victoria, BC - June 22 - 26, 2009

Director's Report

by Chris Barnes

This year should prove to be a benchmark for NEPTUNE Canada with most of the final installation being completed by the fall and data flowing by the end of the year after full commissioning. There have been a considerable number of developments since our last newsletter issued in December 2008. Of particular note, the various tests by Alcatel-Lucent and its subcontractors have been completed or are in their final stages. Alcatel-Lucent's success with regards to solving the last remaining problems with the medium voltage converter, low voltage converter and high voltage wet mate connector have been resolved sufficiently to allow firm commitments for the schedule of the 2009 marine installation program.

As noted in more detail by Peter Phibbs, Alcatel-Lucent has finalized the combination of the vessels *C/S Lodbrog, C/S Sentinel,* and *R/V Atlantis* along with the ROV ROPOS for the node deployment between 1 July and 17 August. There should be some time within that activity to also deploy some of the extensions and instruments. This schedule represents a slip of a month or two from that reported in the last Newsletter as a result of the extended testing and qualification work. As a consequence, NEPTUNE Canada was not able to use ship time booked on the *CCGS Tully* for instrument deployment in mid-July to mid-August. However, the additional ship time booked on the *R/V Thompson* (University of Washington), with ROPOS will stand, and that period will be used for NEPTUNE Canada to deploy the extension cables, junction boxes and instrument platforms at four of the five node sites. If all goes well, there may still be some ship time to allow a start on the deployment at the fifth node site, Endeavour Ridge, which will otherwise be completed during the 2010 weather window.

Thus, by late September 2009, all of the subsea infrastructure and most of the instrumentation will be installed. There will then be a phase lasting about a month for the final commissioning of the observatory systems, including the data quality and management processes, and also a national security joint review by the Canadian and US navies. Given these activities, it is expected that the flow of real-time data to the scientific and public communities will occur in November-December 2009.

With this installation schedule and the transition into the full operating phase, we have increased our interaction with the NC scientific community, particularly the principal investigators of the NEPTUNE Canada experiments. The scientists spoke against holding a workshop in 2008 given the installation delay, so it was moved to February 2009. A report on that successful workshop follows, which provided advice on how modifications and new instrumentation could be added progressively after late 2009.

A major development was announced on 16 March and is covered in Martin Taylor's article below. An award of $6.6M over five years with an additional equivalent amount of cash and in-kind support will establish a new Centre of Excellence in Commercialization and Research (Ocean Networks Centre of Excellence in Enterprise and Engagement – ONCEE). This will add several new staff to ONC and promote commercialization of technologies, data and services that can emerge from the NEPTUNE Canada and VENUS cabled observatories.

ONC Awarded a New Federal Centre of Excellence in Commercialization and Research

by Martin Taylor, President and CEO

Canada has gained an international leadership position in a new generation of ocean science and technology with the creation of the VENUS and NEPTUNE Canada cabled ocean observatories managed through Ocean Networks Canada (ONC). These facilities enable researchers to pursue many vital questions about the oceans and, at the same time, create unprecedented opportunities for commercialization, increased public engagement and applications to priority areas of public policy.

A major advance in this regard is the just announced five year funding of $6.6M (equally matched by partners) to ONC to create the **Ocean Networks Centre for Enterprise and Engagement (ONCEE)**. This funding, which comes from the Government of Canada's Centre of Excellence in Commercialization and Research (CECR) program, will maximize the economic and commercial benefits from the major research federal and provincial investments in VENUS and NEPTUNE Canada. Building on existing strong private sector partnerships, ONCEE is focused on commercialization and engagement in four areas: sensors and instruments; ocean system technologies; oceans IT; and public outreach and education. The funding will support new senior staff positions in ONC to lead business development in each area. These positions will be advertised and filled over the next few months with the intent of having the ONCEE program fully operational by the end of the summer.

The national context for the ONCEE program is that Canada is home to a significant and globally competitive ocean technology industry. A recent federal government innovation profile of the oceans technology industry revealed "about 500 Canadian firms and 70,000 employees are involved in operations related to ocean technologies… a significant portion (some 90%) of their goods and services is exported internationally". A separate report (2006) estimated global markets for ocean-based observing systems as $4.6 billion for the period 2007-2011. There are many globally competitive Canadian suppliers in various niches, with 50 ocean technology companies in BC, 140 in Atlantic Canada and an equal number inland, exporting 85% of their sales. ONCEE will help this industry to maintain international competitiveness, its culture of entrepreneurship and its supply of trained people in four market/product areas: sensors and instruments, ocean observatory technology, information and communications technology (ICT), and public engagement. ONCEE's immediate impact will be felt most strongly in the industry sector related to ocean observing systems but the national and international visibility of the world-leading VENUS and NEPTUNE Canada observatories and related outreach will enhance the perceived excellence of all Canadian ocean technology.

Beyond its economic benefits, ONCEE will yield significant broader societal benefits through its outreach and education initiatives, particularly in relation to informed public policy, a knowledgeable public, and increased awareness among young people of career opportunities in ocean-related science and technology.

Watch video of announcment and more at:
http://neptunecanada.ca/news/index.

OCEAN NETWORKS CANADA
A University of Victoria Initiative

Installation 2009

by Peter Phibbs and Brian Bornhold

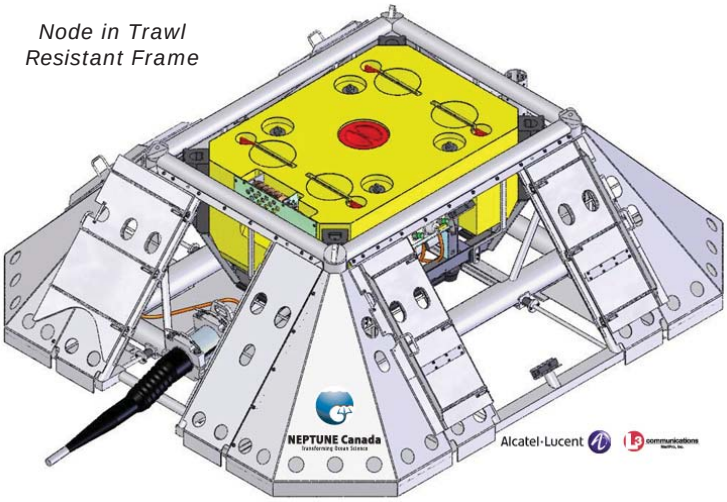
Alcatel-Lucent Install - 1 July - 17 August

Ships are booked for node installation and final assembly is proceeding. In the first week of July, three ships will converge on Victoria: *C/S Lodbrog*, an Alcatel-Lucent cable ship based in Taiwan; *C/S Global Sentinal*, a Tyco cable ship based in Portland, Oregon; and *R/V Atlantis*, a UNOLS ship based at the Woods Hole Oceanographic Institution. These ships will work together to complete the NEPTUNE Canada subsea infrastructure by mid-August.

C/S Lodbrog will be responsible for installation of the trawl resistant frames (TRF) and nodes (see image below). *R/V Atlantis* will be an ROV support vessel, hosting and enabling ROPOS to work in support of *C/S Lodbrog*; the *C/S Global Sentinal* will be performing post lay burial and inspection work (PLIB) after node installation. *C/S Global Sentinal* will also install the long extensions from the Barkley Canyon node.

Alcatel-Lucent has generously agreed, as part of its existing contract, to install the two 10km long extensions at the Barkley Canyon node. This additional donation, valued at $400,000, further demonstrates Alcatel-Lucent's commitment to this project and to the field of Ocean Science.

Node in Trawl Resistant Frame

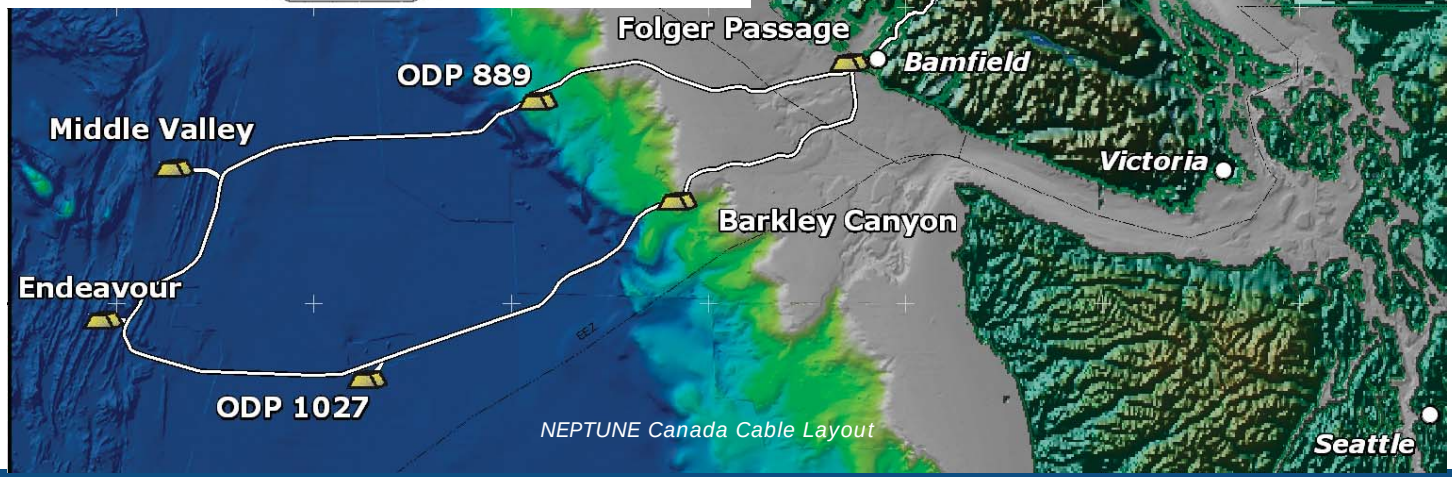


NEPTUNE Canada Science Instrument Install- 19 August - 20 September

Final integration of instruments onto frames, and complete testing of the integrated platforms at UVic's Marine Technology Centre in Sidney, British Columbia, will begin in early April and continue through June into mid-July.

Most of the instruments will be installed during a cruise of the *R/V Thompson* (see image below) between 19 August and 20 September. If sufficient time is gained through good weather and the opportunistic use of *R/V Atlantis* time an attempt will be made to install a long extension cable, a junction box and a few instruments at the Main Endeavour Field; deployment of most instruments at the Endeavour site will be delayed until the late spring of 2010. This delay arises, in part, because of other research programs taking place near the Endeavour Ridge at this time; NEPTUNE Canada's installation activities would seriously conflict with these other programs. With this exception, it is anticipated that the majority of other instruments and extension cables can be put in place and connected this year at: coastal Folger Passage, in Barkley Canyon, on the upper continental slope near Barkley Canyon, near ODP 889 on the lower continental slope and near ODP 1027 on the abyssal plain.

R/V Thompson



NEPTUNE Canada Cable Layout

Test Deployment Proves Instructive

by Kim Wallace, Dwight Owens, and Peter Phibbs

Junction Box

The trial deployment of a NEPTUNE Canada junction box and instruments on the VENUS node in Saanich Inlet, September 2008 through February 2009, was a very worthwhile learning experience. It brought up many issues on a variety of subjects, including isolation of power supplies from ground, instrument interactions, material selection, presentation of data to permit system control, timely analysis of junction box data, and, of course, testing, testing and more testing.

Ground faults in instruments and/or connectivity (as opposed to instruments whose design requires some medium to high resistance to ground at the instrument) have been identified as a significant problem on cabled observatories, particularly by the Rutgers University's LEO 15 observatory. Not only do ground faults damage the faulted instrument and may render its data unreliable, they also can impact other instruments in the vicinity, and the observatory infrastructure. We are now taking steps to reduce the vulnerability of the junction boxes and their attachments to the affects of ground faults. However the Saanich deployment has demonstrated that we need to have the instrument platforms including junction boxes fully assembled and tested well before the cruise date to allow identification and correction of ground fault issues and other instrument interactions.

Instrument Platform

NEPTUNE Canada's test instrument platform deployment has run its course, with the platform now recovered (see image of recovery) and follow-up analyses is underway. For the most part, the instruments performed as expected and we were able to successfully gather data and make it searchable via our Data Management and Archive System (DMAS). However, there were some malfunctions and surprises, which have afforded an opportunity to make adjustments for our upcoming installations.

Deployed Instruments:

- acoustic current meter (Nortek)
- acoustic Doppler current profiler (RDI)
- bottom pressure recorder (NRCan)
- hydrophone (Naxys)
- rotary sonar (Kongsberg Mesotech)
- Tempo-mini (Ifremer), including a 2 megapixel streaming video camera, LED lights, an oxygen sensor, and an innovative 10m-long 10-sensor temperature probe.

NEPTUNE Canada platform retrieval February 2009

OBSERVATIONS:

Acoustic Current Meter

Our Nortek acoustic current meter presented two difficulties during the experiment. For several months, NEPTUNE Canada's technicians were puzzled by unusual shifts in noise levels in output data. After extended testing and consultation with Nortek, the source of these shifts has been identified. Our technical and engineering team is working with vendors to implement a solution for this problem.

In addition to the noise level problem, the Nortek aquadopp developed an electrical isolation fault in September 2008, which gradually led to very erratic swings in the electrical signal. These problems spurred extensive monitoring, testing and vendor consultation, which will greatly benefit operations supporting installation and commissioning this summer.

Acoustic Doppler Current Profiler (ADCP)

The RDI ADCP performed flawlessly for the test deployment. We were able to gather and archive data. This device did not have any isolation faults or anomalous current, nor was there any corrosion. The one difficulty we experienced was interference between this device and a nearby Zooplankton Acoustic Profiler (ZAP) in use on the VENUS observatory. After revising the instrument driver, we were able to successfully interleave the ADCP pings with those from the ZAP instrument.

Bottom Pressure Recorder

NRCan's bottom pressure recorder performed well throughout the test period, reporting temperature and two pressure measurements. If you search for data through our website however, you will notice a series of large spikes in the data. These were not errors in the data, but rather caused by menu commands getting parsed as data by our data processing system. When these are removed, the bottom pressure data was excellent. In fact, Alison LaBonté of the Pacific Geoscience Centre reported noise levels of 0.05 mm in pressure and 0.5 mK in temperature.

The pressure can and sensor canisters were affected by rust and corrosion, but these effects were minimal, as the containers are designed for extended deployment.

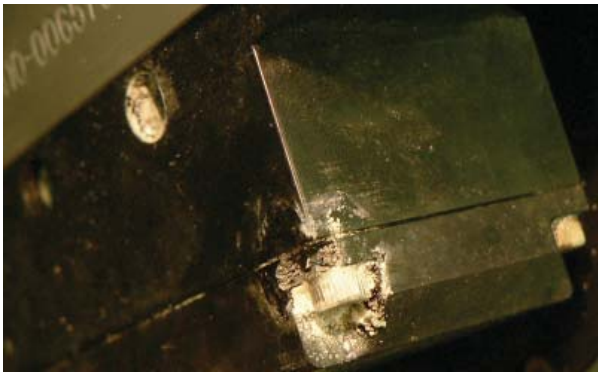
Hydrophone

The Naxys hydrophone functioned throughout the testing period, and we were able to parse and play recordings successfully once the gain was properly adjusted.

After clean up, evidence of "crevice corrosion" was observed in several places, especially under tape bands beneath the plastic mounting brackets. This type of corrosion occurs in restricted nooks and crannies where oxygen levels can be depleted, allowing seawater to become especially corrosive.

Sonar

The Kongsberg sector-scanning radial sonar performed nominally until it stopped functioning on 22 November, when a power spike was followed by an electrical isolation fault. Anodes attached to the instrument body protected it from corrosion, but the rotating sonar head did not escape damage. We suspect that corrosion may have eaten into a corner of the rotating sonar head, eventually allowing seawater to enter the chamber and short out the instrument.



Sonar Corrosion

Tempo-Mini

Ifremer's Tempo-mini combined a video camera, lights, oxygen sensor, and temperature probe on a single platform, connected to VENUS via an extension cable. With the camera running constantly, the camera lights were configured to switch on for three minutes every half hour for video recording. After installation, this scheme worked perfectly, and we collected high-resolution video for several months. Eventually, two of Tempo-mini's lights failed, forcing Ifremer technicians to lower the video frame rate to compensate for low light levels.

The oxygen sensor was affixed to a metal paddle, staked in the seafloor sediment by ROPOS, within the video camera's field of view. We were also able to collect and archive measurements from this device for more than two months, before the unexpected happened. Seals, apparently attracted by Tempo-mini's lights, descended 100m to visit and "play" with Tempo-mini; eventually, their activities dislodged the oxygen sensor paddle, causing it to fall, face-forward, into the sediment (see image below).

Dislodging of Tempo-mini oxygen sensor paddle 4 Dec 2008

The paddle became a popular hideout for local squat lobsters, while direct contact with the oxygen-poor sediment accelerated corrosion. Eventually, corrosive deposits on a plug in its oil-filled connection chamber burst the plexiglas wall. The resulting isolation fault led to severe corrosion of a fitting in the connection between Tempo-mini and the junction box.

Conclusions

The seafloor is a very harsh environment for operation and maintenance of precision science instruments. Challenges are especially difficult in the hypoxic waters of Saanich Inlet. Although some devices were damaged and even failed during this trial installation, the test deployment has been highly instructive in helping NEPTUNE Canada fine tune its approaches, technologies and procedures for this summer's large-scale deployment.

DMAS

by Benoît Pirenne

The DMAS team continues to make steady advances on multiple fronts. On the data acquisition side, more instrument types have seen new data acquisition drivers ready to go in service, while at the same time plans to integrate the GIS and DMAS data with the help of consultants were drawn. A 3-stage plan was also established to provide a specific interface to both monitor and control the 14 OceanWorks Junction Boxes with integrated software. Work is in progress on all these fronts with most deliverables planned for the April-May timeframe.

In the area of user interfaces to the data and the infrastructure, good progress was made in both the support and improvement of the NEPTUNE Canada web site and in the area of the Oceans 2.0 features. A demonstration of the facility to upload and run data analysis and visualization code on NEPTUNE Canada data directly from within the web browser was conducted on the third day of the Workshop held 14 - 16 February - see report on following pages.

In the past couple months, there were a number of opportunities to report on NEPTUNE Canada's progress with some of our more remote ocean community partners. A visit to the University of Bremen and to Jacobs University, Germany, allowed us to make progress on the interoperability project with the Pangaea database (http://www.pangaea.de/). We were able to check on the progress of the Barkley Canyon crawler and its sensors. The crawler is being re-assembled following successful tests in the Baltic and a change of tracks (see image). The crawler is now being fitted with new "light rods" comprised of 10 3-Watt LEDs that will provide better illumination of the seabed underneath its belly. An electronic compass is being added to its suite of sensors that now include a CTD, a methane "sniffer" and a benthic flow simulation chamber. The crawler is expected to arrive in Victoria in late April.

A visit to the University of Western Australia in Perth to participate at a science data archive workshop was also an opportunity to build ties with the Western Australian Marine Science Institution (WAMSI: http://www.wamsi.org.au/). Collaborations with this new institution could open up interesting opportunities in the future.

A subsequent visit to the ALOHA observatory at the University of Hawaii, (SOEST http://www.soest.hawaii.edu/GG/DeepoceanOBS/aco_home_page.htm) provided an opportunity to hear about the current status of this deep-sea cabled observatory and about the challenges that its engineering and science teams have experienced. The lessons learned are a benefit to all involved in our nascent world of cabled observatories.

An Ocean Tracking Network (OTN: http://oceantrackingnetwork.org/) data managers workshop took place in Halifax on 3-5 March where this author represented the NE Pacific region together with POST (http://www.postcoml.org/) and TOPP (http://topp.org/) envoys. OTN is the recipient of important grants from CFI and NSERC that will go toward the procurement of fish tag receivers to be deployed in many coastal oceans around the globe.

The workshop was comprised of about 20 people from various continents involved in the collection of data from OTN's fish tag receivers. Going forward, there is a strong interest in connecting some of those receiver "curtains" to VENUS and NEPTUNE Canada, thereby allowing a much more frequent download of data about the movements of pelagic fish and marine mammals in our area.

Bremen Crawler gets new tracks

Science

by Mairi Best

As we progress through the final months prior to deployment of the first suite of scientific instruments on NEPTUNE Canada, many threads of understanding need to be woven together. In the previous sections you can see that the details of how these networks will operate continue to firm up. Our update on the Saanich test platform underlines the complexity of one six-instrument platform, and highlights the work required to get us ready for installation. A key person in much of this weaving has now been hired, our Scientific Instrument Manager, Reece Hasanen. Welcome!

Integral to the fabric we are weaving is the scientific community who has helped build NEPTUNE Canada over these many years, and whose clearly defined projects now dictate how instruments should initially be installed, configured, calibrated, and how the data could be processed as the firehose of data starts to flow. To frame this weaving of the next few months and beyond, these science builders and NEPTUNE Canada staff gathered for a workshop in mid-February, which has served to kick preparations into high gear.

Workshop
14 - 15 February 2009

by Mairi Best, Dwight Owens, Murray Leslie, and Reyna Jenkyns

Participants from the four corners of the continent and across the Atlantic gathered with NEPTUNE Canada staff in Victoria for a busy 3-day workshop to firm up plans ahead of this summer's major deployment, and to prepare for the coming firehose of data that will be streaming from the ocean sensors.

Following introductions, representatives for each research project presented quick overviews and updates of their plans and science objectives.

Day One focused on installation preparation. Break-out sessions for each team commenced with detailed discussions of project plans for:

- Testing
- Location, position and orientation of instruments
- Schedule and participation during installation
- Starting configuration
- Calibration interval and means
- Maintenance necessary, interval, tasks

The day wrapped up with a presentation and reception hosted by Ocean Networks Canada, President & CEO, Martin Taylor.

Day Two contined with installation planning focused on data coordination discussions:

- Test data analysis
- Data use by multiple users
- Event detection
- Initial data products
- Initial steps toward modeling

Key discussions addressed how data QA/QC would be performed. Researchers from various disciplines discussed the roles and responsibilities for maintaining known-state quality of data during commissioning, as well as ongoing operations.

These topics naturally led into the third day of the workshop, which focused on the exciting possibilities being developed as part of our Oceans 2.0 project environment (see below).

In the afternoon of day two, we discussed approaches for future proposal funding both for individual researchers and for ongoing operation of the facility. This underlined the new territory ocean science is entering where an operating real-time facility is only part of realizing the vision we have all been building towards; scientists across Canada and around the world need support to engage graduate students, run experiments, monitor long time-series, and develop the next generation of instrumentation to expand our capacity to sense and interact with the ocean.

Throughout the workshop a number of researchers were interviewed for informal video podcasts, which hopefully will give the public humorous and insightful anecdotes into the careers and personalities of both young and senior researchers. Those podcasts will be made available on the NC web in due course.

Oceans 2.0 Project Environment

Workshop (cont'd)

On **Day Three**, the NEPTUNE Canada DMAS team offered a demonstration of an exciting suite of software tools under development for scientists, researchers, and students – an online project work environment within **Oceans 2.0**. This environment will help researchers develop projects from beginning to end. Users can interact with one another, access data, analyse data, write manuscripts, and more. Presenters demonstrated a scenario in which multiple collaborators worked together to diagnose anomalies, using Matlab routines to access and plot data. A key motivator for developing the Oceans 2.0 project environment is the need to manipulate large amounts of data remotely, freeing a researcher's personal computer from heavy data processing loads.

The Oceans 2.0 project environment will ultimately provide:

- easy access and control of many types of sensors and instruments
- custom data and metadata searches
- ability to prepare on-line custom data processing scripts (in Matlab, R, or SigmaPlot) that can be revised and run on NEPTUNE Canada computers through the web
- ability to plot, customize, save and share all types of data products
- facilities for document sharing and collaborative manuscript authoring
- project wikis, resource links, references, etc.

The demonstration sparked a discussion with scientists on helpful features like communication tools and metadata access. A number of researchers were enthusiastic about using this project environment to develop data processing and visualization algorithms prior to instrument deployment. Once an initial version of this environment is released, features will be added and refined continuously.

Feedback is welcome and will help determine development priorities. Several scientists have agreed to work with NEPTUNE Canada staff as we move forward with further prototyping and development. If you are interested in getting involved, please let us know.

For science presentations and more go to: http://neptune.uvic.ca/news/calendar/workshop-agenda.dot

Over lunch on day three a visualization of NEPTUNE Canada's footprint on the recently released **"Google Ocean"** was shown. We've used it to visualize Barkley Canyon and link seafloor locations with ROPOS video gathered during an installation planning survey in 2007. We've also used it to create a quick air and underwater tour of our facilities and nodes. The KML data files for both of these visualizations are available for you to download and explore at: http://neptune.uvic.ca/news/index.dot?id=12631

In the future, NEPTUNE Canada hopes to offer more data and imagery for desktop deep-sea exploration via Google Ocean.

Doug Schillinger engages in Oceans 2.0 discussion

NEPTUNE Canada

Transforming Ocean Science

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