# Spring 2011

VENUS
Victoria Experimental Network Under the Sea

University of Victoria

*The Ocean Online, Real time, Any time*

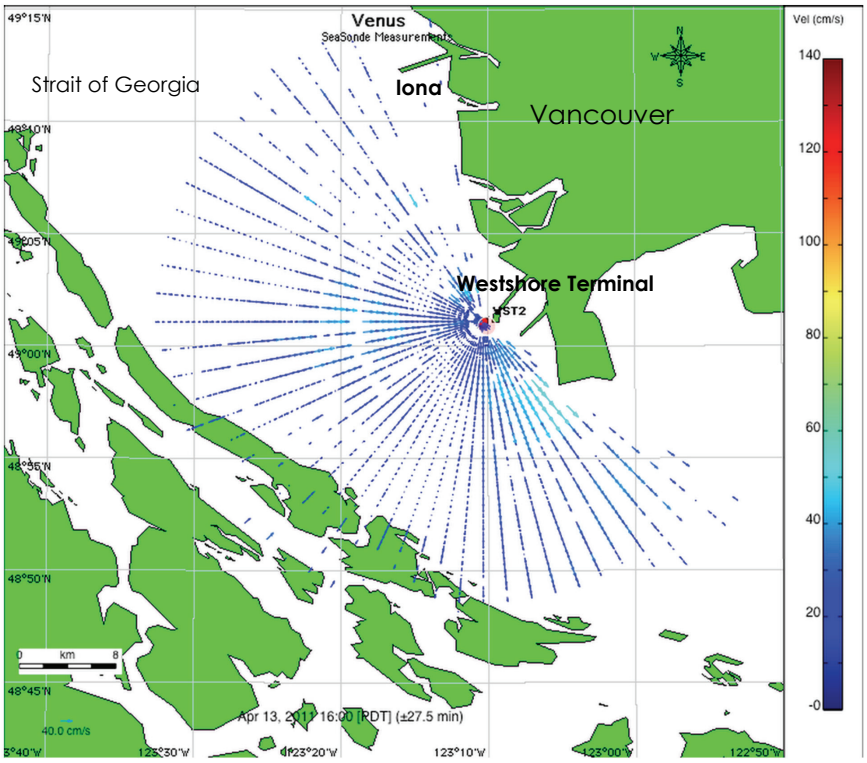
## VENUS - Geospatial Observing Systems

VENUS is making progress on several fronts for the CFI-funded Phase II construction.

Contracts for the instrument interface and the winching system for the buoy profiler in Saanich Inlet have now been awarded. OceanWorks International is responsible for providing VENUS with a highly configurable set of interfaces for up to 14 instruments both at the buoy and on the moving instrument cage. MacArtney A/S are responsible for the winching system, which will manage the safe transit of instruments from the surface to the seabed at 220 depth. The MacArtney solution is based on an existing underwater winch design.

The installation of the first CODAR radar station at Westshore Terminals (Coal Port) is on track for this summer. Several VENUS personnel spent the week of April 11-15 in Vancouver setting up temporary antennas in order to collect sample data. In addition, the antenna pattern measurements were established at the 4 proposed sites by moving a transponder on a 1 km radius around the antenna. The results from this week of testing will help us identify preferred locations for the two stations. Shown in the Figure are the radial velocity estimates from the Westshore Terminal reaching out 25km. When combined with a similar pattern seen from the end of Iona causeway, we will provide extensive coverage of the southern Strait of Georgia.

The three Seakeeper 1000 systems built by YSI/AMJ, along with instruments, have arrived at VENUS. These systems are slated for installation on three BC Ferry vessels over the course of the next 2 years. These systems will




**Radial coverage pattern from the Westshore Terminal, site 2. One of the proposed sites for the CODAR system on VENUS.**

allow VENUS to serve surface properties data from across the Strait in near-real-time. The first vessel to receive a system is the Queen of Alberni, which is scheduled for dry-dock work in the fall of 2011.

Other progress of the Phase II development: the environmental sampler that will process water for genomic assays will arrive at UBC in August; a new HD webcam development is underway and should yield a working system during this summer; an in-house developed digital stills camera system will be deployed in May; a collaboration with the Ocean Technology Laboratory (UVic) should produce an AUV platform for science in late 2011.

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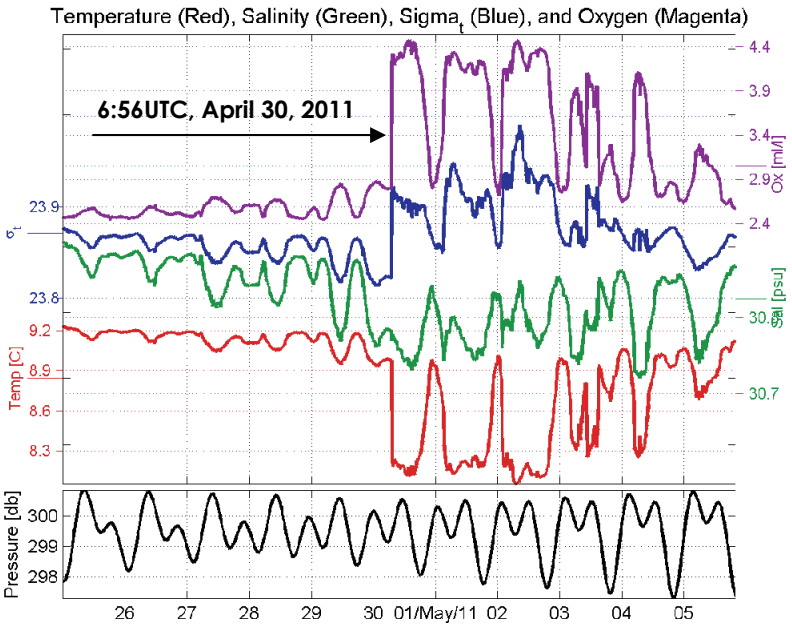
# Gotcha! Deep Water Renewal Event Captured by VENUS in the Strait of Georgia

Richard Dewey (Associate Director, Research)




On April 30, 2011, VENUS captured the deep water renewal event in the Strait of Georgia.

At exactly 6:56UTC, an abrupt hydrographic "front" crossed the VENUS SoG Central site. The temperature (red) dropped 0.6 degree and the oxygen concentration (purple) nearly doubled. The 0.6C temperature drop occurred between two samples taken one minute apart! This cold front was accompanied by a sharp increase in the dissolved oxygen concentration, rising from 2.8 ml/l to 4.4 ml/l. There was, rather surprisingly, little salinity (green) change associated with the arrival of this water mass, although the salinity had started dropping slightly on April 29. A density increase (blue line) at the front is attributed entirely to the colder temperatures. Over the next few days, (May 1-3), there were short excursions into the original warmer/low oxygen water at the end of the large flood, suggesting that the cold front had approached from the north.

By May 5, well into the spring tidal cycle (black), all water properties had returned to near pre-front conditions. In a paper by Diane Masson (*Estuarine, Coastal and Shelf Science* [2002], vol 54, pp 115-126) she identifies two periods when deep water renewals may occur; one in the late summer associated with the incursion of salty dense water, the other in late winter (now!) when cold dense water penetrates the deep regions of the Strait of Georgia.

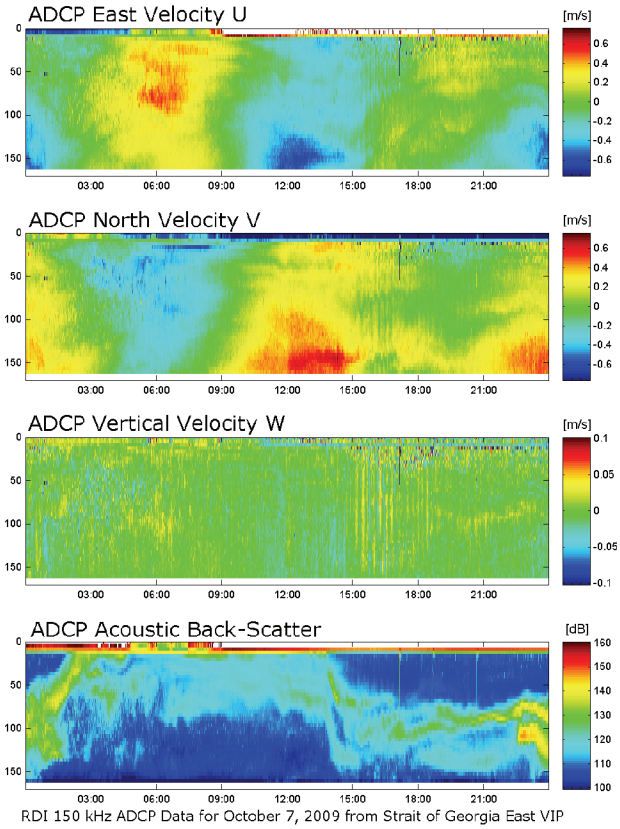
TO SEE LIVE CHANGES IN THE OCEAN FOR YOURSELF, LOG ON TO VENUS **www.venus.uvic.ca.**

## ADCP Data from Strait of Georgia

Richard Dewey

VENUS has been collecting Acoustic Doppler Current Profiler (ADCP) data in the Strait of Georgia since 2008. It is already possible to download this data in RDI binary file format, which can be loaded directly into the RDI WinADCP software or read into Matlab. Shown on the left is an example plot of a day of data (Oct 7, 2009) from the SoG East VIP platform in 170 m of water.

Shown in the four panels, top to bottom are the East-West currents U, the North-South currents V, the Vertical (Up-Down) velocities W, and the Acoustic Backscatter. The tidal currents at this site typically run SSE during the ebb (06:00) and NNW during the flood (12:00). There is a back-ground vertical shear, with stronger ebb currents near the surface and stronger flood currents near the bottom. Internal waves are picked up in the vertical velocities after 15:00, and the back-scatter clearly shows the daily migration of the zooplankton.

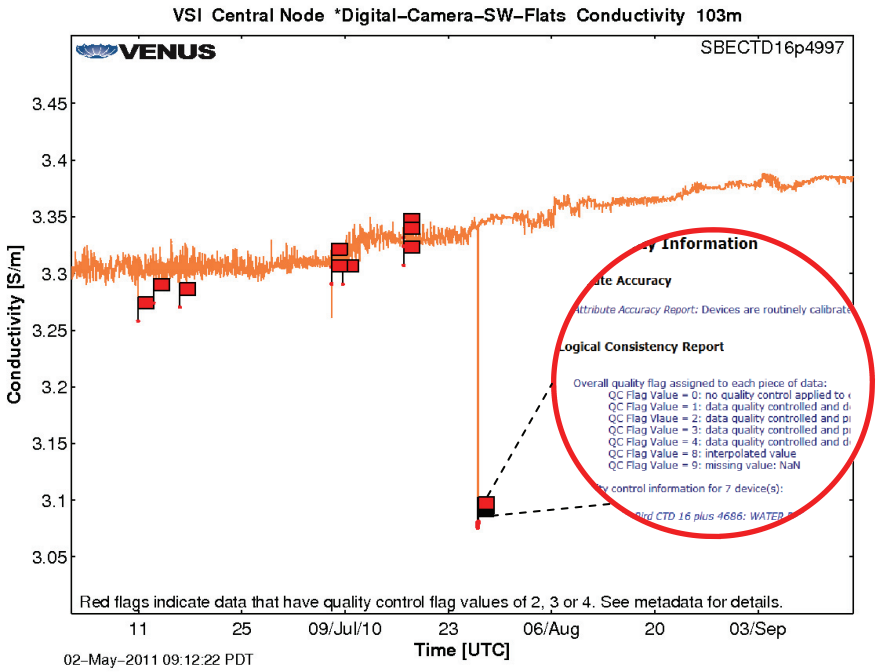



RDI 150 kHz ADCP Data for October 7, 2009 from Strait of Georgia East VIP

# Zooming in on Data Quality

Marlene Jeffries (Observatory Data Specialist)

One of the problems facing a real-time oceanographic observatory is the ability to provide a fast and accurate assessment of data quality. VENUS is in the process of implementing measures of real time quality control on incoming scalar data that meet the guidelines of the Quality Assurance of Real Time Oceanographic Data (QARTOD) group. QARTOD is a US organization tasked with identifying issues involved with incoming real-time data from the U.S Integrated Ocean Observing System (IOOS). A large portion of their agenda is to create guidelines for how the quality of real-time data is to be determined and reported to the scientific community. VENUS is striving to adhere to these guidelines to provide trusted data to the scientific community.




**Graphical representation of the QA/QC data on a VENUS data plot.**

In May 2011, VENUS launches the first step towards returning a quality controlled product to the VENUS user. Real time data quality testing at the VENUS includes tests designed to catch instrument failures and major spikes or data dropouts before the data are made available to the user. Tests include instrument manufacturer's limits, climatological values and site ranges determined from the previous years of data. Due to the positioning of some VENUS instrument platforms in highly productive areas, we have also designed dual-sensor tests to catch conductivity cell plugs that cause a sudden drop in conductivity. All of the VENUS primary sensors are subject to the above tests with an overall quality control flag returned with the data requested by the user. Future forms of quality control that VENUS will implement include delayed-mode testing and manual quality control of archived primary sensor data. Manual quality control of archived data by a VENUS data expert will be available by June 2011 while delayed-mode testing is still in development.

# Deep in VENUS Multimedia Data

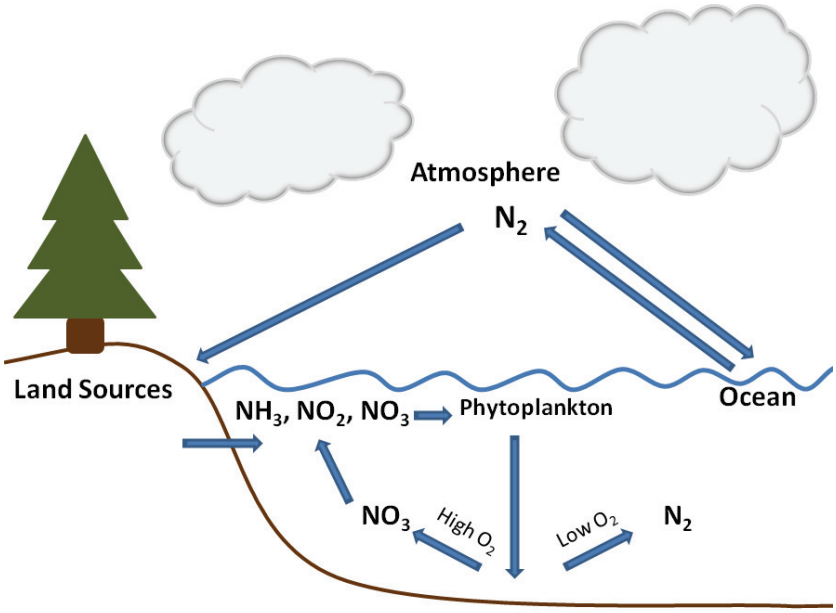
Co-op Student Project with VENUS

VENUS hosted a second year Electrical Engineering Co-op student Kris Dolberg this past term (January – April, 2011) to work on a number of multimedia data projects. The first project Kris worked on was to compile an extensive volume of archived VENUS hydrophone data for one of our principal researchers, Dr. Svein Vagle of the Institute of Ocean Sciences. The VENUS hydrophone arrays are capable of generating high data volumes, with typical data rates of between 6 and 20 MB per minute. At this rate, 3 months of data represent about a Terabyte (TB) of data. Kris wrote web-service scripts to extract raw hydrophone files from the DMAS archive and organize them into structured directories, filling a 2TB drive for Svein to analyze.

The second Kris worked on was to collect and organize photos and videos from our Webcam, presently deployed in the Strait of Georgia (SoG) at the Central Node site. Kris established a regular schedule when he would log onto the Webcam and collect a series of images and videos. The video signals were streamed through a "Live Video" link on the VENUS website. Kris also wrote a Matlab program to produce an HTML catalogue of the image/video files for users to browse, linked with a plot showing the phase of the tide when the images were collected. The final multimedia project Kris worked on was to develop some Python code to utilize web-service links as a means of loading hydrophone MP3 files directly from the data archive into the **www.venus.Orchive.net** audio analysis tool being developed by Steve Ness and Dr. George Tzanetakis of UVic's Computing Science Department. These were all challenging projects. We'd like to thank Kris for his help and wish him the very best as he moves on in his Co-op education.

# Method Assessment for Qualification of Nitrogen Variability in Saanich Inlet

Courtney Dean (Research Assistant, SEOS, UVic)




Decomposition of phytoplankton debris by **Bacteria**

**Simplified diagram of the global nitrogen cycle, detailing nitrogen pathways based on oxygen conditions. While bacterially-mediated nitrogen transformations are concentrated in the sediments, these processes also occur in the water column.**

***Diagram created by Courtney Dean (the Dr. Juniper Lab, UVic).***

Acknowledgements:

I would like to thank Dr. Kim Juniper (*Department of Biology, SEOS, UVic*), Dr. Richard Dewey (*Associate Director, Research, VENUS*), Dr. Roberta Hamme (*SEOS, UVic*), and Dr. Jody Klymak (*SEOS, UVic*).

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Nitrogen, an essential element for all life forms, is bio-available in the marine environment as ammonia ($NH_3$), nitrite ($NO_2^-$) and nitrate ($NO_3^-$). These nitrogen salts primarily enter the marine system through runoff from land and are then taken up and transformed by phytoplankton, that form the base of the food chain. The decomposition of plankton debris in seafloor sediments releases dissolved nitrogen salts back into the water column when oxygen is abundant, but during oxygen depletion, the nitrogen is lost from the ecosystem as nitrogen gas (Figure). Since oxygen depletion events are becoming more common, and the productivity of marine ecosystems is usually limited by nitrogen salts, it is important to understand how oxygen levels can drive nitrogen availability, particularly in the more productive coastal ecosystems that are influenced by nitrogen inputs from anthropogenic sources.

To study the influence of oxygen levels on the movement of nitrate in and out of bottom sediments, we used a nitrate sensor deployed just above the sea-floor at 99 m on the VENUS observatory in Saanich Inlet, which goes through a cycle of oxygen depletion each year. Nitrate, oxygen, temperature, salinity, density and pressure data were obtained from the VENUS data archive for October 2008 to January 2009. The results suggested that the physical movement of the water masses in and out of Saanich Inlet created a complex environment, where variations in nitrate concentration were not just caused by biological processes, but were also strongly influenced by the physical mixing of water masses. As a result, the effects of physical mixing and biological processes on concentrations of dissolved nitrate could not be separated in the data set.

Our results contributed to a new proposal to deploy the nitrate sensor on a water column vertical profiler that will be part of the VENUS Phase II expansion, expected to be in operation in the summer of 2012. By measuring nitrate concentrations throughout the water column, together with other indicators of water mass intrusions into the inlet, we should be better able to separate local production and consumption of nitrate from external inputs.