VENUS

Victoria Experimental Network Under the Sea

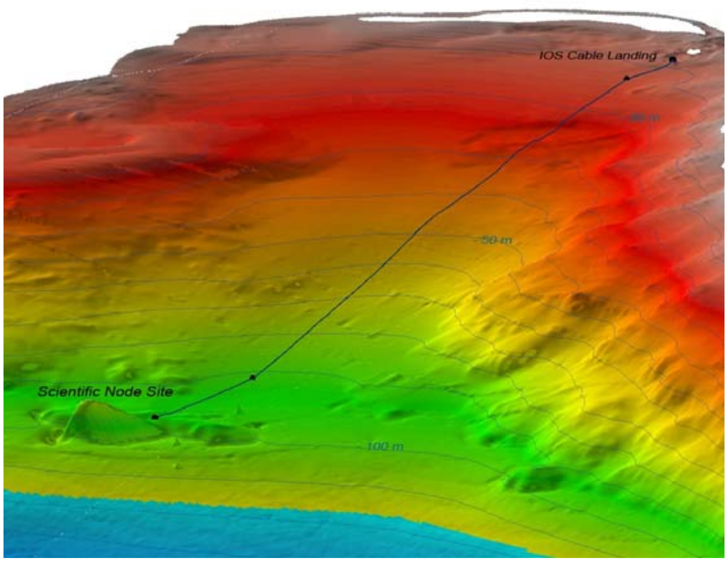
Saanich Inlet

Strait of Georgia

Juan de Fuca Strait

UVic University of Victoria

Fall 2004 Newsletter



Saanich Inlet cable location from Institute of Ocean Science's dock to the Node location.

Project Overview

The Victoria Experimental Network Under the Sea (VENUS) is an ambitious project to conduct coastal oceanography in an innovative and informative way in British Columbia waters.

VENUS will be a network of instruments dedicated to observing oceanographic processes in our marine environment.

Measurements, images, and sound will be delivered to scientists, managers, the public, and a data archive via seafloor fibre-optic cables laid from three landfall sites. These cables will deliver power for instruments, lights, and robots, transmit commands from project scientists, and deliver information back on the health of our oceans. The VENUS Project will install interactive laboratories in Saanich Inlet, Strait of Georgia, and the Juan de Fuca Strait to support new oceanographic experiments for long-term studies of our coastal waters.

Keeping Current

Saanich Inlet Timeline Update

Those of you who have been following the timeline for the Saanich Inlet installation will have noticed that our plan to be in the water by late 2004 has not come to fruition. Several factors contributed to the delay, some of which had been anticipated and others that were a complete surprise. The additional design time has allowed the Project to implement some positive changes to the Saanich Array. This Array will now be deployed with the same node structure and optical/electrical disconnect capabilities as is planned for the Strait of Georgia and Juan De Fuca arrays. This redesign will yield a significantly more capable node in Saanich with enhanced maintainability and flexibility for future growth. We are also responding to a request from NEPTUNE Canada to install a node that will support instrument tests. We have also used the time to re-design the Scientific Instrument Interface Module (SIIM) in order to provide increased flexibility for researchers to add instruments to the VENUS infrastructure.

The contract for the Saanich Inlet Array is now in negotiation and we hope to have a signed contract by Christmas. Our current plan is to deploy the Saanich Array in the spring. Your patience as we work our way through this complex project is appreciated by the Project Team. We are taking the time to "do it right rather than fast" and we are confident that the results will be worth the wait!

Pro-Oceanus Systems GTD Delrin Case

The project has recently purchased a Pro-Oceanus System's Gas Tension Device (GTD) to measure the total dissolved air pressure in Saanich Inlet at 100 metres depth. The total dissolved air pressure is the sum of the partial pressures of all dissolved gases in the water.

One major problem we face with our coastal observatory is the significant corrosion that instruments will inevitably experience over time. In the interest of increasing the longevity of the GTD, we requested from Pro-Oceanus that the unit be housed in a Delrin pressure case instead of its standard aluminium housing. Delrin is a low moisture absorptive polymer and, although it has a lower overall material strength than aluminium, it is sufficiently robust to protect the GTD in Saanich Inlet. Pro-Oceanus generously offered to carry out this work providing the project with an in-kind contribution.

Gas Tension Device (GTD) with Delrin case (approximate length 30cm)

VENUS Infrastructure Update

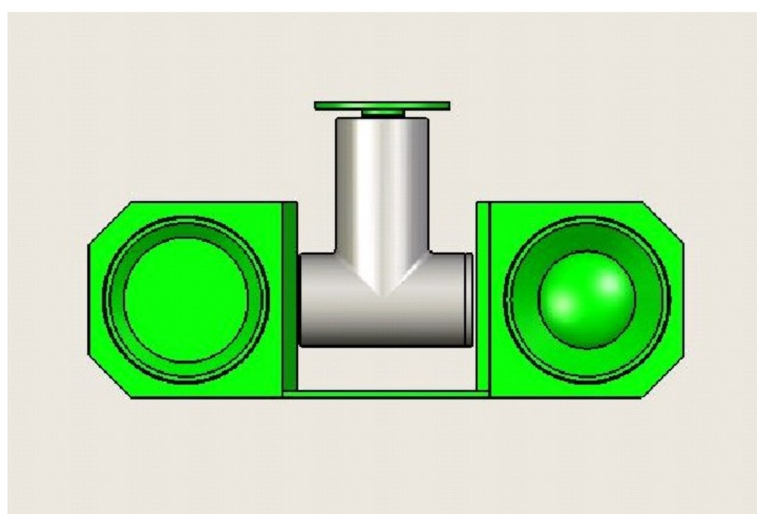
We recently made the decision to design VENUS Nodes that are detachable from the back-bone fibre optic cable. This function will be accomplished using two ODI wet-mate connectors: one for the power conductors and the other for the fibre strands. The Node design will allow a ROV to disconnect it from the cable, and guide it to the surface for recovery. Similarly, the replacement Node will be lowered into position and connected to the observatory. This added flexibility on the Observatory means Nodes requiring maintenance can be readily recovered without the support of a cable ship, thus significantly reducing maintenance costs and observatory downtime.

We are presently exploring the cost and complexity associated with extending our operational range to 200 meters from the Node in Saanich Inlet. A maximum cable length of 100 meters between the Node and instrument packages is dictated by the bandwidth of the observatory however, by including repeater technology, we may be capable of extending instruments an additional 100 meters. This range extension would provide greater flexibility to scientists and would also allow us to recover instrument packages without having to disconnect the cable at the Node.

C-Map Systems Digital Still Camera

Another piece of equipment recently purchased for Saanich Inlet is a versatile digital still camera system. Doug Smith at C-Map Systems has worked with us to develop a camera system that will serve scientists who are interested in observing benthic fauna and sediments. An onboard computer serves as an interface between the top-side user and the subsea camera system. Some features of this system include: an Olympus C8080 Wide Zoom camera (8 Mpixels, f2.4, 5x Optical Zoom), a Sidus SS109 pan & tilt unit, a Photosea 300 Ws flash, and several flood lights (the last for "snapshots" only).

Since the VENUS Observatory has no means for supporting analog video, one technical hurdle we encountered was the need to convert composite video to a digital format. C-Map Systems have added a video server in the camera pressure case that converts composite video to MPEG-2 format so that camera users can have a preview of the picture. With this added feature the still camera system can also be used to view and capture underwater video.



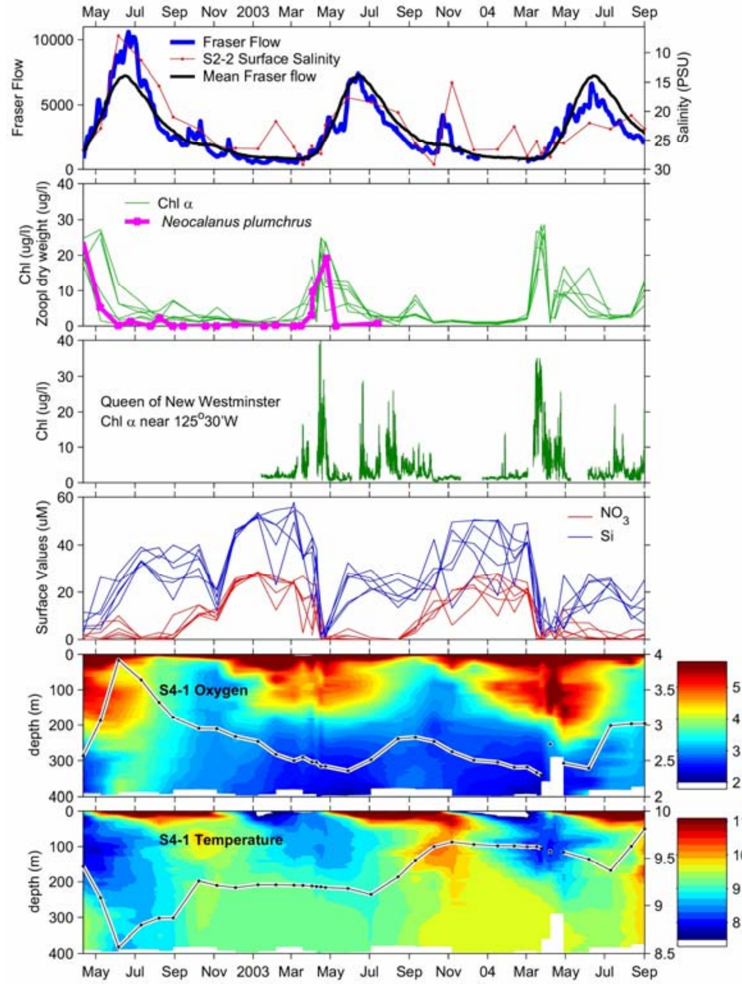
C-Map Camera with Flash on Pan and Tilt assembly

STRATOGEM - Coupled Biology and Physics in the Strait of Georgia

Rich Pawlowicz, Susan Allen, Randall Lee, Kate Collins, Mark Halverson, Olivier Riche, Shannon Harris (UBC), John Dower, Tom Bird, Akash Sastri, Rana El-Sabaawi (UVic)

The Strait of Georgia (SoG) is part of an estuarine system that extends from the mouth of the Fraser River around Vancouver Island to the outer coast. It is a deep basin (400m), separated by channels and sills of about 100m in depth from the Pacific Ocean. The SoG has a well-stratified shallow surface layer dominated by a plume resulting from the freshwater input of the Fraser (and other) rivers. Below this is an intermediate water layer (down to 200m or so), and a deep water layer which is renewed once or twice a year. SoG productivity is apparently limited by available light in the winter and by nutrients in the summer, although the precise mechanisms governing the timing and magnitude of blooms are still only poorly known.

STRATOGEM (www.stratogem.ubc.ca) is an NSERC-funded project attempting to better understand the role of physical mechanisms on planktonic abundance. As part of this work the hovercraft Siyay is used to carry out hydrographic surveys over the southern Strait. The first survey was in April 2002, and the program will continue through to May 2005. Surveys occur roughly monthly, but at weekly intervals during the spring bloom period (37 surveys have been carried out so far). A variety of physical and biological parameters are measured using CTDs, water samples, and net tows. In addition, instruments on several ferries regularly crossing the Strait provide continuous monitoring of the surface waters. Part of this dataset is shown in the figure.



The upper panel shows the flow of the Fraser River at Hope (a proxy for the total fresh-water input), as well as the Fraser's long-term seasonal cycle and the surface salinity at Station S2-2 (central SoG off Fraser river). The Fraser flow was above average in 2002, about average through June in 2003 (and rather lower afterward until the torrential rains of October), and had a substantially below-average peak in 2004. Plume salinity adjusts rapidly to the Fraser flow. Note that the Fraser flow is not a good proxy for the plume in winter when a larger proportion of the runoff comes from smaller local rivers.

The next panel shows the peak Chlorophyll concentrations at 6 stations along the SoG from the Swartz Bay ferry track north past Halibut Bank. Spring blooms from 3 years are visible (mostly composed of plankton larger than 20 um), roughly coinciding with the appearance of Neocalanus Plumchrus in the upper 100m. Detailed analysis suggests that the bloom slightly precedes the freshet, the turbid waters of which act to limit growth. During the summer a variety of smaller blooms appear, with plankton in a range of sizes. Winter biomass is low, and mostly dominated by plankton smaller than 2 \um. Although our hydrographic surveys apparently catch the broad-brush details of biological activity they are actually too far apart in time to adequately determine details of the biological evolution. Spatial and temporal variability on time scales down to fractions of a day is being captured by the ferry monitoring program. The next panel shows surface Chla fluorescence from this dataset. The spring bloom is actually composed of a rapid series of peaks and valleys as dominating species succeed each other, and wind bursts and other effects sometimes delay and at other times accelerates growth. Note also the presence of some rather large blooms in the summer 2003 which were missed by the hovercraft surveys.

Surface nitrates and silicic acid are shown in the next panel for 6 stations. N and Si is plentiful in the winter (surface values are similar to deep values), but are almost completely used up in the spring bloom. Through the rest of the summer N levels are low, mainly appearing within the Fraser plume (which is composed of a mixture of nutrient-rich deeper water with turbid fresh water). In the fall levels rise again as production ceases. Phosphates follow a very similar pattern to nitrates, but Si is slightly different. Although driven almost to depletion in the spring bloom, Si levels rapidly rise to intermediate values over the summer. This probably reflects a compositional change in the dominant phytoplankton from diatoms to flagellates.

Dissolved Oxygen and Temperature from station S4-1 off Nanaimo (a traditional time-series station) are shown in a time-depth format in the last two panels. DO levels shallower than 10m tend to be near saturation except during the spring bloom when observations have found values as high as 150% of saturation. Intermediate waters are oxygenated in the spring (Jan - May) of each year as cold water flows in from the Haro Strait/Boundary pass region. Intermediate waters warm up through the rest of the summer and then cool as water continues to enter, but the inflow amounts are apparently not enough to reverse the overall decay of DO levels. In the deep water (see also black lines which give values at 370m) renewal is more infrequent, occurring in May 2002, Aug/Sept 2003 and both April and June 2004. Renewals in the first part of the year are accompanied by temperature decreases, and in the latter part of the year with increases. Note that annual and interannual variability in the deep water are of the same magnitude.

This detailed view of the evolution of the SoG shows that a variety of processes are at work in Strait, and that large year-to-year changes in physical and biological evolution can be expected. By next spring the STRATOGEM field program will be completed, and our focus will shift to a more quantitative analysis of the workings of this system.

VENUS/NEPTUNE DMAS Desktop Study

On October 18, 2004, Barrodale Computing Services Ltd. (BCS www.barrodale.com)) delivered the final report for their examination study on the needs and requirements of the Data Management and Archive System (DMAS) to be built for the cabled observatories VENUS and NEPTUNE. The study was conducted and presented in three phases representing: I) Data and Instruments, II) Existing Archives and III) Framework and Issues for the VENUS and NEPTUNE DMAS. The 233 page document and accompanying resources represent an exhaustive investigation of the various components and issues to be considered during the development of the DMAS architecture In Phase I, a dozen representative instruments were investigated with respect to their communications and data handling requirements on a cabled ocean observatory. Consideration was given to sampling rates, configuration options, data transfer modes, embedded metadata, raw and formatted data structures, and transmission protocols. In Phase II, a wide range of existing archives were examined to provide guidance with respect to common practices, lessons learned, facilities required, modes of access, and details on data collection, storage, and distribution. A summary of the key technologies utilized by the oceanographic, meteorological, and seismographic archive providers was also included. In Phase III, BCS provided a review of possible archive architectural options for the DMAS; including general, traditional, and object-relational database systems. An abridged version of the report is posted on the VENUS and NEPTUNE web sites.

ORION Meets VENUS

At the end of October, VENUS was introduced to the ORION Executive Steering Committee. The Ocean Research Interactive Observatory Networks (ORION) is a US program office established this year by the National Science Foundation. Its mandate is to coordinate the science, technology, education and outreach of emerging network of science-driven ocean observatories. We expect NEPTUNE to become one of the three cornerstones of this program. As VENUS is comparatively advanced on observatory design and implementation, there was considerable interest in keeping close ties that allows ORION to observe our progress. VENUS is glad of the “exposure”; see http://www.orionprogram.org for more information and their fall newsletter that has an article on VENUS.

“Look, more mud bottom.”
VENUS staff at sea with the ROPOS crew

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