VENUS

Victoria Experimental Network Under the Sea

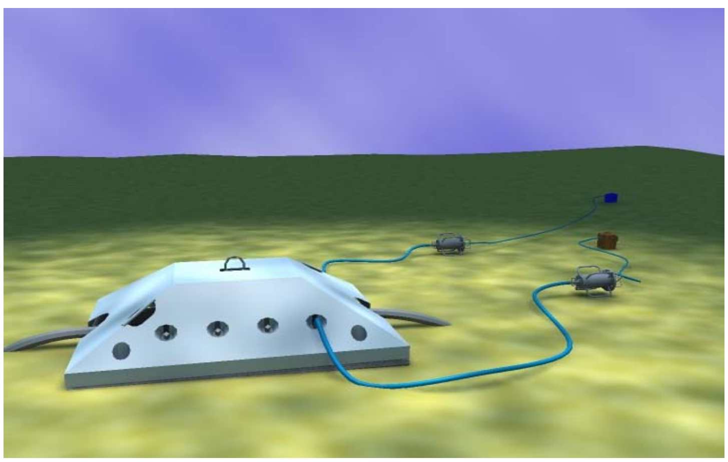
Saanich Inlet

Strait of Georgia

Juan de Fuca Strait

UVic University of Victoria

Winter 2004-2005 Newsletter



VENUS Node Design.

Project Overview

The Victoria Experimental Network Under the Sea (VENUS) is a facility to support coastal oceanography in British Columbia waters. The VENUS network of instruments is dedicated to observing oceanographic processes in our marine environment. The VENUS Data Archive will support data mining and communication among users.

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 state 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

The VENUS Team is now hammering out the last details of the Saanich Inlet Contract. We will be meeting with Global Marine Systems Ltd in early March to finalize the contract and the installation date for the array. We will update you with the latest news as soon as the contract is signed.
This month will also see the delivery of our first order of specialized underwater connectors from Ocean Design Inc. the procurement of the hardware for the Interim DMAS and the initial testing of the digital stills camera system. Slowly but surely, the system is coming together!

Public Outreach & Education

The VENUS and NEPTUNE Projects and the University of Victoria have been offered unparalleled Canadian exposure in the area of Public Outreach. The Canadian Association of Science Centres (CASC), a consortium of over 30 Canadian science centres and planetariums, is collaborating to create a traveling exhibit called the Great Canadian Science Adventure (GCSA). This show will be available in three sizes to science centres and outreach institutions across Canada for five years starting in the summer of 2006. Funding for this project is supported through NRCan and the Canadian Space Agency. VENUS and NEPTUNE plan to participate in one of the seven modules called the “Coast to Coast to Coast to Coast Adventure”. The GCSA exhibit will contain both an overview of VENUS and NEPTUNE as well as showcase some specific studies of science research. Interactive activities will allow the general public to discover ocean science first hand.

The Strait of Georgia Glass Sponge Reefs

by Gitai Yahel (Yahel@UVic.ca)

During a multibeam bathymetric survey in 2001, Kim Conway along with a group of geologists from the Pacific Geosciences Center (PGC), discovered two glass sponge reefs in the Strait of Georgia. The presence of these spectacularly dense populations of giant sponge in the turbid water off the Fraser River pro-delta located just a few km from Vancouver came as a complete surprise. The known glass sponge reefs, discovered in the Hecate Strait in the early 90s, occur in a relatively low sedimentation setting. The Fraser Ridge reef consists of several interconnected mounds that are up to 14 m high and form an ~1km long belt. The reef lies on the crest of a resistant glacial till remnant that rises about 60 m above the pro-delta slope.

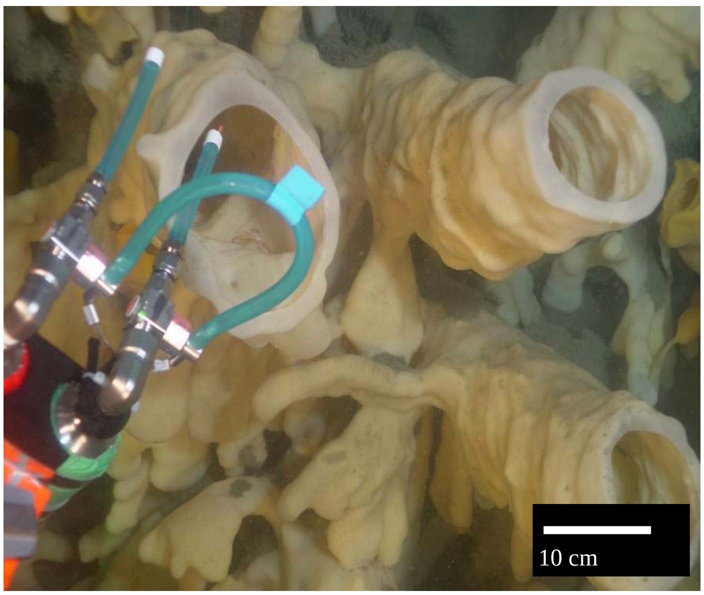


Figure 1. In situ sampling of the water inhaled and exhaled by a glass sponge (*A. vastus*) using ROPOS robotic manipulator and the SIP water sampler

Glass sponges are unique animals. Most of their tissue is made of giant, multinucleated cells called a syncytium. This body organization allows the sponge to transmit electrical signals over its nerveless body perhaps in the style of its metazoan ancestors. The sponge soft tissue forms a thin veneer over a rigid skeleton made of glass spicules that accounts for ~85% of the sponge mass. Interestingly, these "biological glass fibers" are similar to commercial optical fibers. The reef forming glass sponges are large animals reaching over 1.5 m high and a few metres wide. Their glass spicules are fused together so that when the sponge dies, its skeleton remains to form the foundation for the settlement of new sponges. The growth of new generations over the skeletons of their progenitors is the process that creates the glass sponge reef in a similar fashion to the formation of a coral reef.

Like other sponges, glass sponges are probably suspension feeders feeding by pumping large quantities of seawater via a specialized filtration system. Study of the diet composition, pumping activity and metabolism of glass sponge has so far been hampered by their deep, remote and inaccessible habitat. A group of scientists from PGC and the Universities of Alberta, Victoria and Washington, led by Dr. Sally Leys (U. Alberta), are gearing up to conduct the first in situ biological study of glass sponge reefs.

In November 2004, we conducted a preliminary ROPOS (a research ROV) dive to the Fraser Ridge site. During that dive, we deployed settlement arrays and experimental setups to study silica dynamics within the reef system. We successfully tested a novel water sampler that allows us to simultaneously sample the water inhaled and exhaled by the sponge. These water samples can be analyzed to compare changes in the concentration of potential food sources (total and dissolved organic carbon, particulate organic carbon, bacteria, and phytoplankton), skeletal material (SiO_2), waste products (ammonia), respiratory gases and disturbance factors (sediment). Preliminary results suggest that the sponges are efficiently removing the rare and minute bacterial cells (>1 µm) from the thick inorganic "soup" of sediment and diatom frustules suspension. Inorganic particles are somehow passed and "spewed" into the exhaled water.

In the summer of 2005, we will use ROPOS to instrument several sponges with acoustic current meters and a set of optical sensors. These measurements will provide a continuous week long record of sponge pumping, feeding and excretion rates in relation to environmental factors such as tidal currents and sediment load. Coupled with the results of a detailed benthic survey, we can estimate the overall water processing capacity of the reef. A preliminary calculation suggests that the reefs pumping capacity is considerably higher than any known benthic community. Our short term deployments will also serve to explore the feasibility and the instrumentation requirements for establishing a long-term observatory at the reef based on the VENUS infrastructure.

In the Jurassic period, glass sponge reefs covered substantial parts of the ancient Tethys Sea seafloor forming a 7000 long km

Figure 2 The Fraser Ridge glass sponge reef, ROPOS dive November 2004. The reef is composed mainly of two sponge species, *Aphrocallistes vastus* and *Heterochone calyx* that form densely packed stands.

reef system. This reef system is the largest known biological structures ever built on earth. Thought to be extinct with the dinosaurs, the discovery of extant glass sponge reefs in BC waters has opened up an exciting opportunity to look into the functioning of an ancient benthic community and its interaction with the surrounding ecosystem. The Strait of Georgia reefs include the high turbidity site at Fraser Ridge and the McCall Bank setting which resembles the northern reefs complex. These reefs are located in close vicinity to many of BC's major research facilities. VENUS instruments may be able to reach this site, depending on the final routing of the Strait of Georgia crossing.

Biological Resuspension of Sediment in Saanich Inlet by Ruthy Yahel (Ruthy@UVic.ca)

Sediment resuspension by fish is known to be an important ecological factor in lakes (Scheffer et al., 2003) and coral reefs (Yahel et al., 2002). This resuspension enhances nutrient release from the bottom sediments into the water affecting the rate and magnitude of biological processes. It is hypothesized that similar fish activity may be as important in deeper habitats where they should have a pronounced effect on both the water and bottom geochemistry. So far, data on the resuspension activity of fish below SCUBA depth is lacking.

In a recent video survey of the calm bottom of Patricia Bay, Saanich Inlet (~100 m depth), we discovered an unusually dense population of flatfish (Slender Sole, *Lyopsetta exilis*) on the seafloor (fig. 1). The numerous pits in the sediment suggest that the effect of the flatfish activity on the bottom could be substantial. A one week deployment of a transmissometer 0.5 m above bottom at the study site shows clear and frequent "spikes" of elevated water turbidity for short periods of times. These spikes are most likely sediment "clouds" resuspended by flatfish activity on the bottom.

Testing the acoustic profiler at UVic's McKinnon swimming pool

Photo 1. Flatfish in their pits near the VENUS Saanich Inlet site at 110m depth.

We are now designing a novel experimental array that will allow us to quantify rates of sediment resuspension by these benthic fish. Our setup design includes both acoustic and optical measurements of sediment resuspension as well as video imaging and current measurements. This setup will provide continuous online data via VENUS cables. Periodic sediment and water samples will be collected by remotely operated vehicles starting in June 2005.

To record resuspension events over a larger area, we are intending to use a horizontally mounted acoustic profiler (200 kHz ASL water column profiler). In a trial run, we installed the acoustic profiler 70 cm above the bottom of UVic's McKinnon swimming pool. We detected minute air bubbles released from the pool floor >15 m away from the instrument indicating its ability to track acoustic targets (such as sediment grains) over a large area of the bottom. We are looking forward to deploying the entire experiment on the VENUS node where we hope to learn more about flatfish resuspending sediment in a real-time!

Scheffer M, Portielje R, Zambrano, L. 2003. Fish facilitate wave resuspension of sediments. Limnol Oceanogr 48: 1920-1926
Yahel R, Yahel G, Genin A (2002) Daily cycles of suspended sand at coral reefs: A biological control. Limnol Oceanogr 47:1071-1083

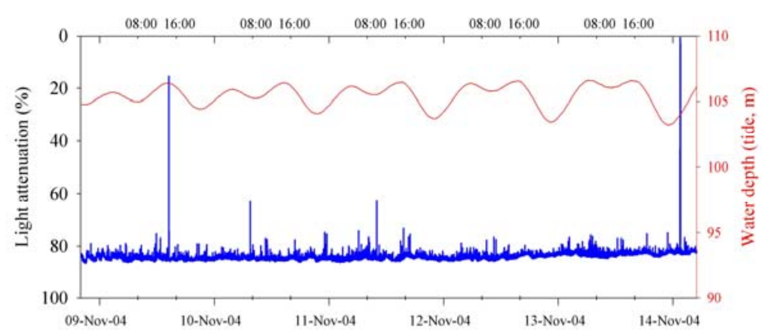


Figure 1. A continuous six day record of light attenuation (a measure of the total amount of suspended particles in the water) measured 0.7 m above the bottom of the Saanich Inlet VENUS site (105m depth). Tide level is overlaid in red.

Saanich Inlet Instrument Configuration

Over the past year, VENUS has acquired a number of instruments for deployment on the Saanich Inlet array. Some of these instruments were purchased by the project and several are on loan from scientists and manufacturers. An initial instrument configuration for Saanich is proposed in Figure 1. The cables extending away from the Node to the various instrument platforms will be approximately 85 meters in length. This distance is dictated by Fast Ethernet bandwidth specifications (100 Mbps).

In this proposal, a common instrument platform will be deployed in a flat region to the north of the Node. A SIIM (Science Instrument Interface Module), which is our principal interface for instruments, will be co-located with a variety of sensors on this platform. The SIIM plugs directly into the far end of the extension cable from the Node. The SIIM located on the common instrument platform, and the instruments it supports, are shown in the upper white box in Figure 2. Occupying a serial port on the SIIM is a Seabird 16plus CTD. The 16plus has additional capacity to support analog and serial devices and is providing connectivity for an Aanderaa Oxygen Optode (Model 4175), a SeaTech Transmissometer (loaned to the project by John Dower, UVic), and a Pro-Oceanus Systems Gas Tension Device (GTD-Pro). These devices will be sampled at the same interval as the CTD (i.e. 2 samples per minute).

In addition to the Seabird 16plus, two other conductivity and temperature instruments will be located on the platform courtesy of several generous instrument manufacturers. Both Alec Electronics Co. (Japan) and Falmouth Scientific Inc. (USA) have offered to lend the Project instruments to sample alongside the Seabird Instrument. The Alec Compact-CT sensor has an integrated bio-wiper that cleans the conductivity cell on a 10 second interval, and the FSI NXIC is an Ethernet-ready instrument providing Conductivity, Temperature and an additional pressure measurement. Also housed on the common instrument platform is an RDI 300 kHz ADCP for measuring currents in the water column (loaned by Richard Dewey and Chris Garrett), and a 200 kHz Zooplankton Acoustic Profiler (ZAP) made by ASL Environmental in Sidney, BC.

The second SIIM in Saanich Inlet is located on a tripod that supports a digital still camera system (C-Map Systems) to support benthic research and outreach. We anticipate moving the camera to capture different environments and serve research upon request. A detailed description of the camera system can be found in the VENUS Fall 2004 Newsletter. Co-located with the camera is an additional 200 kHz ZAP, that will be used to study re-suspension events (see previous article). Two SIIM ports are available on this tripod for additional sensors.

The third SIIM in Saanich Inlet will reside on a smaller platform in a yet to be determined location. Presently, its purpose is to support a small array of acoustic fish receivers made by VEMCO / AMIRIX in Halifax. The receivers detect signals (69 / 81 kHz) from transponders surgically implanted in salmon and other fish. The array in Saanich will consist of three receivers, spanning over a kilometer along the bottom. The purpose of this partial array is to test a newer version of the receiver (VR3) for eventual deployment on full coverage arrays across the Straits of Georgia and Juan de Fuca. These receivers will join an already well established network of arrays along the west coast (David Welch http://www.postcoml.org/project/). Several free ports are available at this SIIM for additional instruments.

Finally, the fourth instrument package in Saanich Inlet is a hydrophone array designed and built by researchers and technicians at the Institute of Ocean Sciences. The system is designed for directionality using three hydrophones sampled at 44.1 kHz each. The overall sampling rate of the system will be 200 kHz. The system will also allow users to reconfigure a single hydrophone to sample at 200 kHz, or two hydrophones at 100 kHz each. Each hydrophone is mounted on the end of a long pipe that folds out when the platform hub encounters the bottom, thereby establishing the correct geometry. Several these hydrophone arrays will be deployed on VENUS.

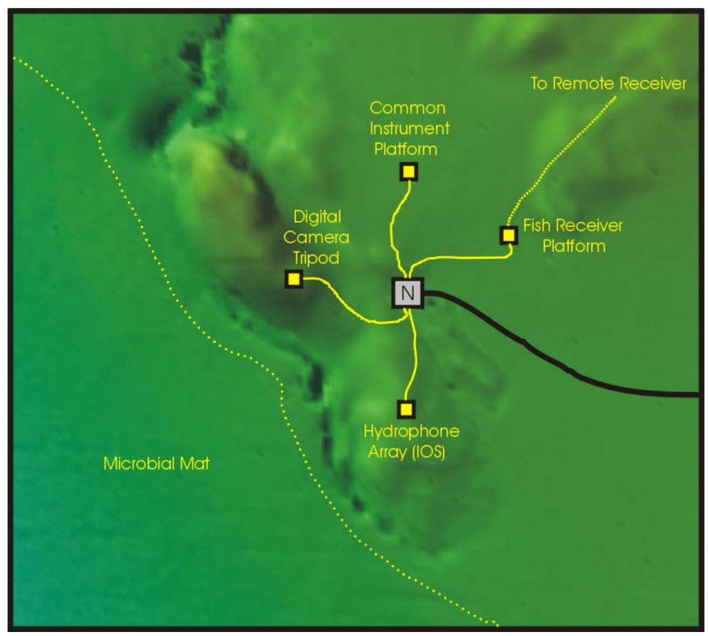


Figure 1: One possible configuration of instruments and platforms in Saanich Inlet. Suggestions for alternative locations are solicited.

Requests to Users:

1. Please let us know if you have preferences for instrument location.

2. We have ports available for more instruments: contact us to find out how to connect.

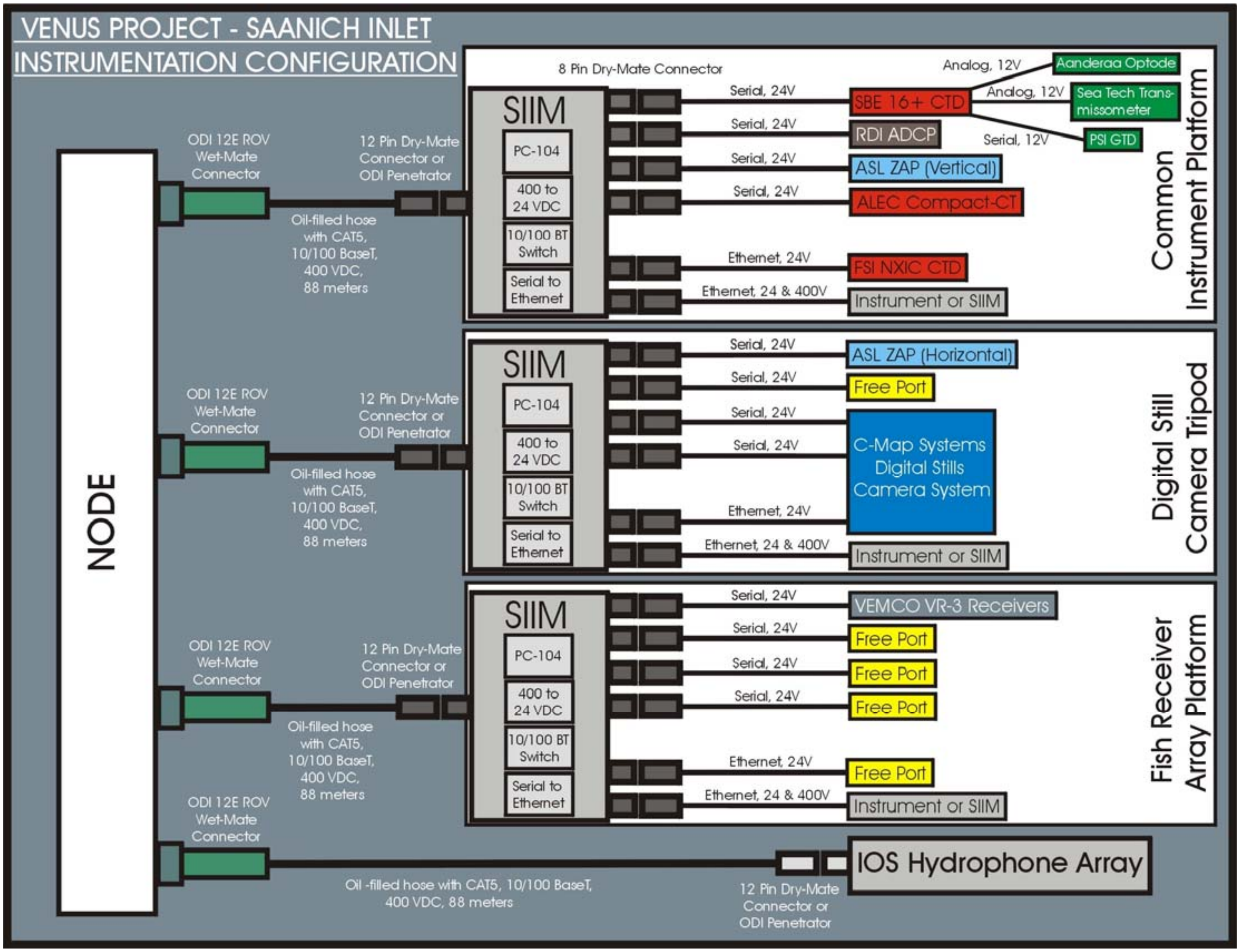


Figure 2: Proposed VENUS Project Saanich Inlet Instrumentation Configuration

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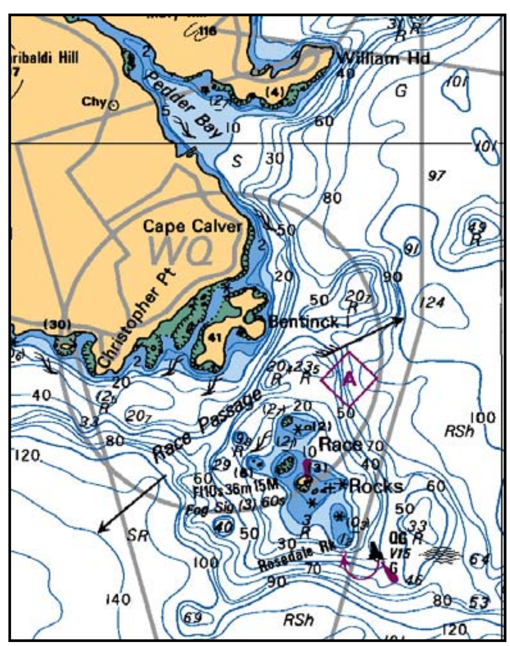
Juan de Fuca Strait Update



The VENUS Project will continue to assess the extent of our commitments and capabilities in Juan de Fuca Strait. Discussions with Global Marine and DND have focused on potential land-fall sites west of Race Rocks at Christopher Point. (see Chart). Landing at Christopher Point would avoid laying the cable out of Pedder Bay and through the Race Passage. This would create a safer route around the high risk Race Rocks area.

Interim Data Management and Archiving System (IDMAS)

Work is progressing on the VENUS interim Data Management and Archiving System (IDMAS). Building on the NEPTUNE Canada DMAS prototype system, the IDMAS is composed of off-the-shelf software and hardware components. The IDMAS will allow the data to be collected from the VENUS arrays while helping NEPTUNE Canada to better understand the requirements of a full-fledged DMAS.

This collaborative approach between the two projects is a win-win for both groups. VENUS will benefit from a cost-effective interim solution that will grow with its needs and improve with time, whereas NEPTUNE Canada has the opportunity to further refine the DMAS requirements by examining the IDMAS in a real, operational environment. When the NEPTUNE Canada DMAS is in full operation, the data flow from VENUS will be redirected to it and the existing VENUS archive transferred.

The next three months will see the various components of this interim system being put in place. The system will be a hierarchy consisting of a data centre that will receive data from daughter shore stations. The connection between the data centre and the shore stations will likely be done through leased Internet services from commercial providers.

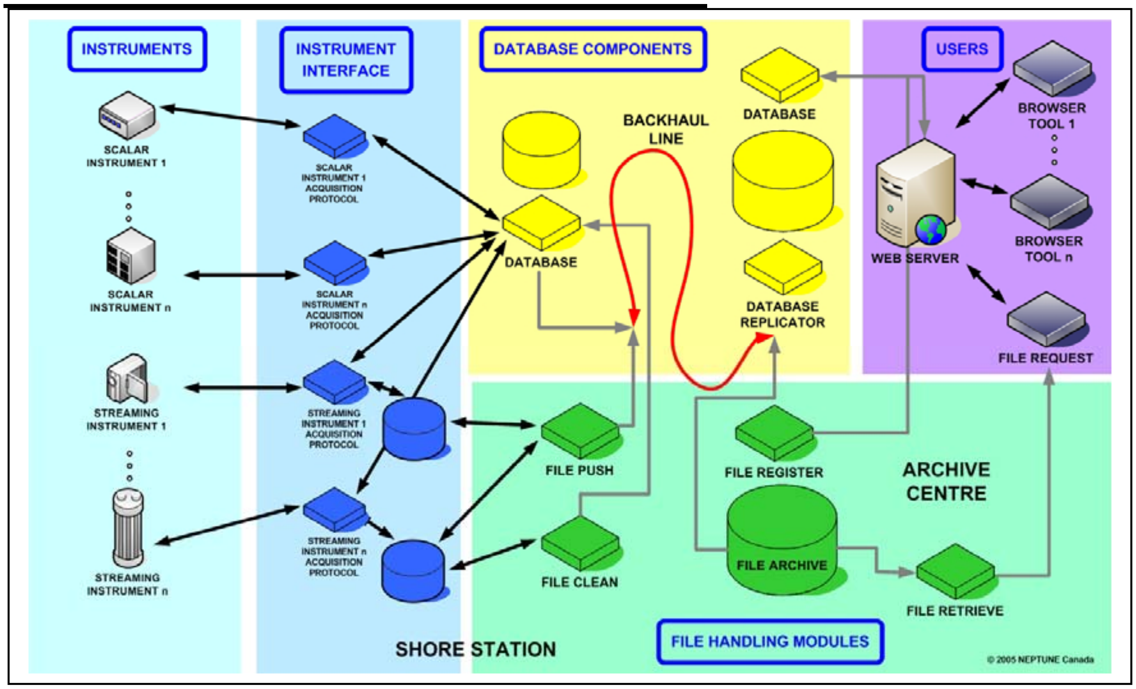
The shore stations will include:

- A database management system to buffer scalar data, metadata and files
- Software and hardware systems to support the interaction with the instruments (data acquisition and instrument control)
- A system, constantly monitoring incoming data, that will detect events and trigger actions

The data centre will host the main database system as well as file storage. It will also host the primary data access point for external users. The current system has been assembled in such a way that only limited software development, initially in the area of instrument data acquisition and control, will be required. The remainder of the software will be procured commercially or found in the public domain.

The initial capabilities of IDMAS will concentrate on data acquisition. Instrument commanding, sophisticated data access mechanisms as well as underwater network resource monitoring will be phased in gradually. Figure 1 depicts the proposed initial structure of the VENUS Interim DMAS.

For more information about the prototype, please read a recent posting on DMAS:
http://www.neptunecanada.ca/PDF/DMAS/2005NEPTUNECanadaLetter3DMASrev.pdf



venus@uvic.ca
www.venus.uvic.ca

VENUS Team:
Verena Tunnicliffe, Project Director (250) 472-5365
Adrian Round, Project Manager (250) 472-5364
Richard Dewey, Science Coordinator (250) 472-4009
Paul Macoun, Instrument Engineer (250) 472-5369
Debbie Smith, Project Coordinator & Outreach (250) 472-5366
Ruthy Yahel, PDF (250) 472-5367