ASL Environmental Sciences

Solutions Newsletter

Spring 2015

Ice Studies in Cook Inlet Alaska for LNG Terminal

ASL Environmental Sciences has secured contract for a 3-year metocean-ice study program in Cook Inlet, Alaska for the proposed Alaska LNG Project terminal site. This turnkey metocean program includes program management, a PSO (protected species observer), vessel, HSE lead, data processing and analysis, and engineering inputs.

During the summer and fall of 2014, ASL deployed three Ice Profiler™/ADCP moorings close to Nikiski, Alaska on the Kenai Peninsula. Each mooring consisted of an Ice Profiler, ADCP, CT, and OBS Turbidity sensor and was mounted in ASL's own designed bottom frame or a taut-line mooring. An additional eight ADCP moorings have been deployed through the northern Cook Inlet from June to October 2014. Sediment transport and sand waves are being studied in this highly dynamic area (6 knot currents).

Later in October, the 8 moorings were replaced with four custom-built heavy duty frames each containing an Ice Profiler, ADCP, CT and OBS (see Figure 1). ASL will return to the sites biannually to download data and service the moorings.

ASL trawl resistant LowPro5x7™ IceProfiler™/ADCP mooring

News from around the world:

- Alaska LNG Terminal Ice Studies
- Norwegian Polar Inst. Ice Analysis
- Marine Services in Tanzania
- Mackenzie River NWT Ice Studies
- High Res 3D River Modeling BC
- WERA HF Radar in St Lawrence Estuary
- Remote Sensing as a Tool for Watershed Restoration in BC
- Hazardous Sea Ice Characterization

ASL Continues Ice Draft Data Processing for the Norwegian Polar Institute (NPI)

NPI operates multiple subsurface scientific research moorings located in western Fram Strait across the East Greenland Current. This is the sixth year ASL will be processing the continuous ice draft data acquired from these moorings.

As sea ice is carried southward from the Arctic Ocean into the North Atlantic, it passes through Fram Strait, between Greenland and Svalbard, Norway. This bottleneck creates an opportunity to study the transport of sea ice and water masses between these regions. NPI has been operating a long-term study since 1990 to measure ice and water properties in Fram Strait and compare the results to upstream processes in order to better understand physical relationships between the atmosphere, ocean and Arctic sea ice.

The NPI moorings are complex collections of hardware with some deployed in water depths up to ~2500m. Each mooring is anchored on the seabed and carries various oceanographic instruments situated throughout the water column and topped by an ASL Environmental Sciences *Ice Profiler* at approximately 50m water depth. The moorings also house multiple instruments for the collection of ocean current, ice velocity, salinity, temperature, depth information, and more. For the past two years, ADCPs were included in the moorings. ASL processed ice velocity data acquired with these instruments and combined it with the ice draft results to produce high-resolution two-dimensional continuous ice draft profiles.

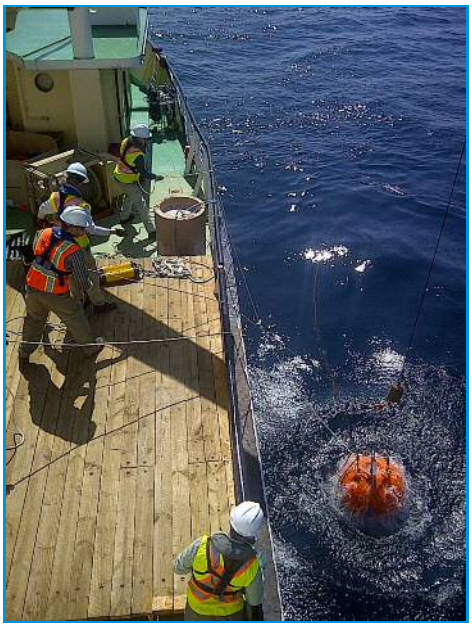
ASL maintains the Ice Profiler Processing Toolbox, a collection of MATLAB tools for the processing and analysis of *Ice Profiler* datasets. ASL also developed new software tools and data processing and analysis methods for the challenges posed by the oceanographic regime in Fram Strait and by the long moorings which were subject to significant motion under high current conditions.

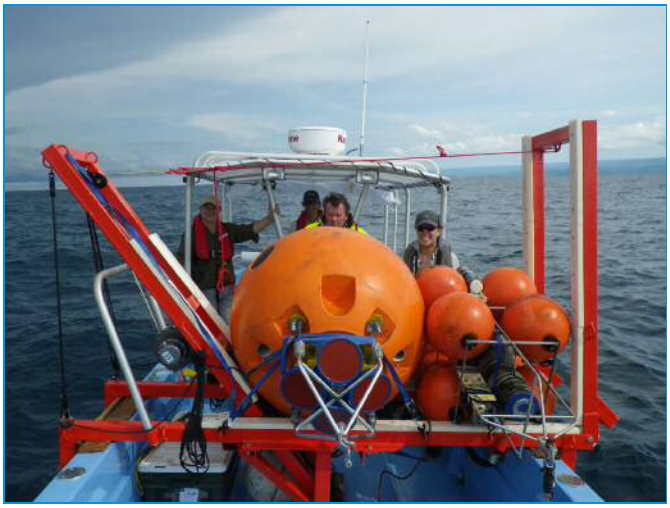
Link to Ice Profiler brochure

Marine Services in Lake Tanganyika, Tanzania

ASL and Golder Associates Ltd. have successfully completed a year-long project for Beach Petroleum Tanzania. The project consisted of collecting baseline data on the physical and biological characteristics of Beach's petroleum exploration area in Lake Tanganyika, Tanzania over 12 months. ASL and Golder provided surface and subsurface moorings which included ADCPs and a range of instruments which measured many meteorological and limnological parameters including wind, waves, currents, water levels and temperatures, near surface water quality including turbidity, conductivity, dissolved oxygen, chlorophyll, and photosynthetically active radiation.

ASL's subsurface moorings were deployed/recovered by helicopter, ship, and small vessel over the 5 trips spanning the 12 month project. (Initial deployment, recovery-service-redeployment, and final recovery).





Mackenzie River Ice Study, Northwest Territories

ASL has been contracted by ATCO Power, developers of independent power generation facilities, to conduct ice studies on the Mackenzie River near Fort Good Hope, Northwest Territories.

This project requires the measurement of Mackenzie River ice draft, ice velocity, and river currents throughout the full water column during the winter ice season and the spring river ice breakup.

Subsurface instrumentation was deployed on the riverbed in January 2015 and will be recovered after the river ice breakup in June 2015. Processing and analysis of the measured data will be completed during the summer of 2015.

The instrumentation housed on the frame includes: an ASL Shallow Water Ice Profiler (SWIP) for measurement of the river ice draft, and an RDI Teledyne Sentinel V20 Acoustic Doppler Current Profiler (ADCP) for measurement of ice velocity and river currents.

ATCO is working with the four Chiefs of the Sahtu to evaluate and ultimately develop a hydrokinetic project to generate electricity within the Sahtu Region.

Understanding of the ice behavior at a potential turbine location is critical. To avoid issues with ice, the hydrokinetic turbine would be mounted on the riverbed. Documenting the clearance between the riverbed and the ice cover throughout the winter, and understanding how the ice moves during spring breakup is essential before installation of a turbine.

Preparation of bore-hole for deployment of ice and current profiling equipment through the Mackenzie River ice cover.

Link to Shallow Water Ice Profiler brochure

ASL Very High Resolution 3D River Modeling in Support of White Sturgeon Habitat Studies

This project was a joint endeavor by ASL and Golder Ltd. Golder collected the field data, ASL developed and ran the models that quantified the physical changes of interest, and then these changes were assessed by Golder biologists to determine effects on sturgeon spawning and early rearing habitat.

The study area is the middle portion of the Columbia River downstream of BC Hydro's Revelstoke Dam and south where White Sturgeon spawning egg deposition and early life stage (larval) rearing occurs.

ASL developed and implemented a high resolution 3D numerical model to study the physical environmental parameters, including river velocities, temperatures, sediment concentrations and the erosion and deposition of river sediments.

The very high resolution ASL-COCIRM-SED model provides near-bottom velocities and sediment properties on horizontal scales as fine as 5 m. The model was calibrated and then extensively validated using six independent verification river velocity data sets obtained from field surveys by Golder in the summer and fall of 2010. The model was then used to simulate detailed river flow and sediment conditions for 58 additional river and temperature discharge conditions from the Revelstoke Dam, the upstream Jordan River discharge and the water levels for the downstream Arrow Lake reservoir.

The river velocity and temperatures and sediment processes are of interest since near-bottom velocities influence predation of sturgeon eggs and the sediment distributions influence egg incubation success and early larval survival. The extensive model results were analyzed by Golder to provide quantitative assessments of Revelstoke Dam discharges and Arrow Lake reservoir levels on White Sturgeon spawning habitat and on incubation and early rearing of the sturgeon. These results contribute to answering key management questions related to White Sturgeon habitat issues.

3 Years of Additional Operational Funding in Place for the WERA NorthernRadar™ System on the North Shore of the Lower St. Lawrence Estuary

The shore-based WERA NorthernRadar™ provides reliable data for ocean surface currents and significant wave height and direction over long distances (up to 200 km) with outstanding spatial and temporal resolution.

Two WERA NorthernRadar™ 12-channel systems were acquired through ASL with funding from Canada Economic Development for Quebec Regions. The systems were installed in November 2012 by Dr. Cédric Chavanne of Institut des sciences de la mer (ISMER) at Université du Québec à Rimouski (UQAR) with the assistance of ASL Environmental Sciences, Northern Radar and Helzel Messtechnik. Since then, they have been providing high resolution measurements of currents and waves in an important section of the St. Lawrence Estuary.

Two of the WERA antennas at one of the St. Lawrence sites.

The current data are used to better understand the mesoscale (10-100 km) and submesoscale (1-10 km) processes that occur in the estuary, with the ultimate goal of improving their parametrization in global ocean circulation numerical models used for climate change prediction. This study is funded by the Natural Sciences and Engineering Research Council of Canada (NSERC). Another study funded by the Fonds de recherche du Québec – Nature et technologies (FRQNT) is aimed at quantifying the impact of the presence of sea ice in winter on the availability of current measurements, to prepare for informed planning for eventual future deployments in higher latitudes.

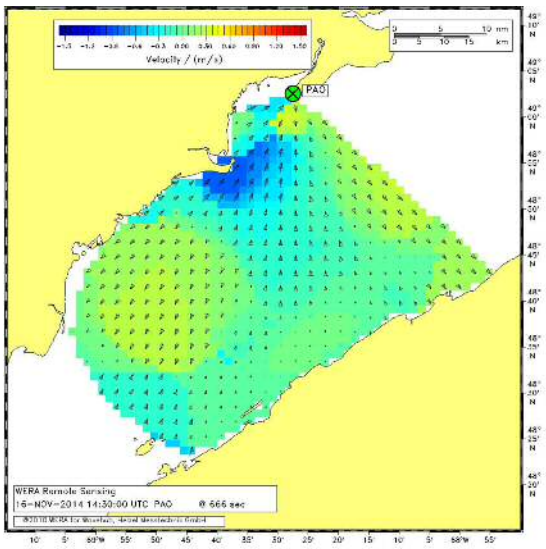


Figure 1 caption: Radial currents on 16 November 2014 at 14:30 UTC from Pointe-aux-Outardes (PAO).

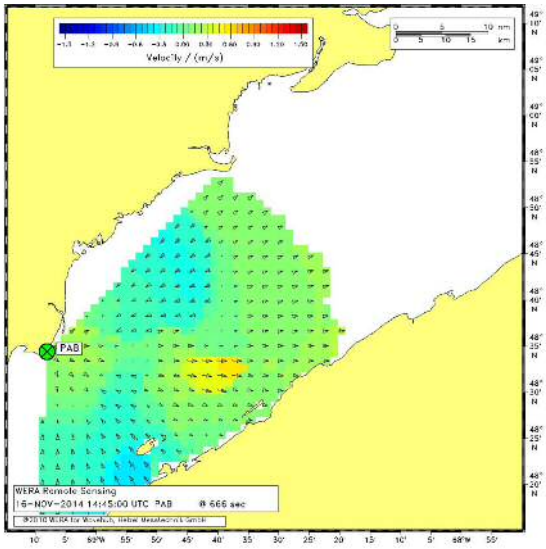


Figure 2 caption: Radial currents on 16 November 2014 at 14:45 UTC from Pointe-à-Boisvert (PAB).

Recently, three years of additional operational funding was obtained from the Marine Environmental Observation Prediction and Response Network (MEOPAR) to ensure that data will keep flowing as part of a surface drift and dispersion monitoring and prediction system led by Dr. Dany Dumont of ISMER-UQAR.

Link to WERA NortherRadar

Remote Sensing as a Tool for Watershed Restoration Planning and Management

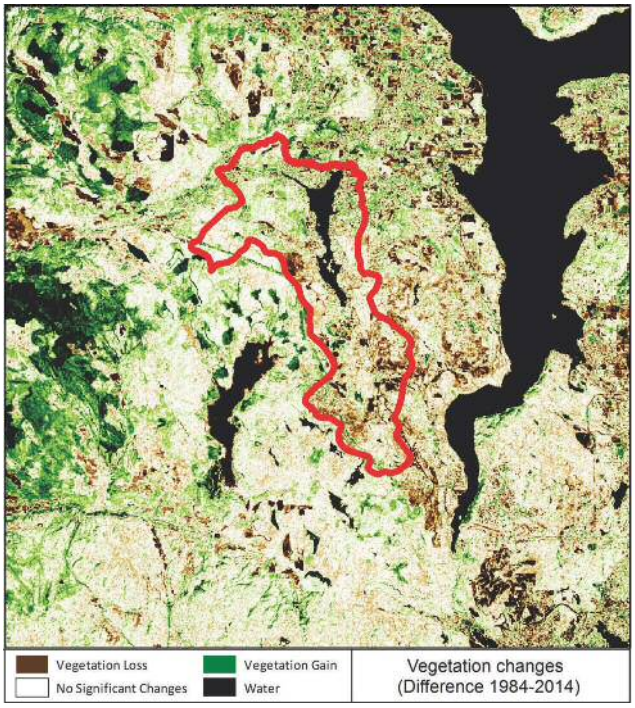
Dr. Bruce Fraser, president of the Shawnigan Basin Society describes the issues in Shawnigan Lake Watershed and recent initiatives as follows:

"Over many years the ecological integrity of the Shawnigan Lake Watershed has been degraded, bringing increased hydrological risk to the public water supply of over 7000 people. The main causes of decline have been extensive clear-cut logging, mining of gravel, and indiscriminate dumping of contaminated soils, subdivision development, lakeshore vegetation removal, motorized recreation and inadequate septic fields. The Shawnigan Basin Society has taken the objective to sponsor the broad collaborative effort that is needed to address the restoration agenda. Key to the watershed restoration project will be improving the ecological integrity of the upland forest, where most of the second growth stands have been logged since the late 1990's. To address the health of the upland forest, the first task was to characterize its current condition."

ASL provided the Shawnigan Basin Society with satellite data and analysis showing the changes in vegetation cover and land use between 1984 and 2014. The change maps highlight the contrast between the Shawnigan Watershed and the Sooke Lake Watershed, where recent conservation efforts have led to forest recovery. These maps will help identify 'priority areas' to focus timely restoration of the Shawnigan watershed. Following the delivery of the maps Dr. Fraser commented:

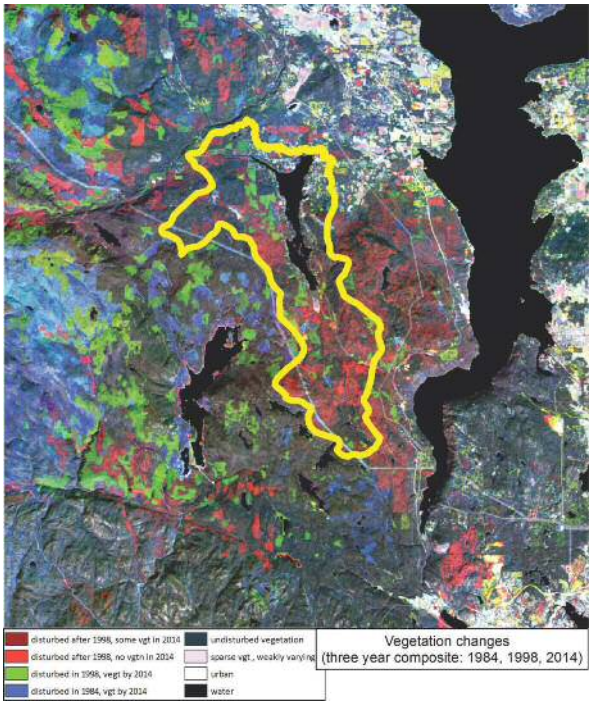
"To this end, we have been greatly aided by a series of LANDSAT images and an assessment of vegetation gains and losses provided by ASL Environmental Sciences Inc., a Victoria firm with a globally developed business in remote sensing. We have already used the maps to illustrate the immensity of the challenge to the Shawnigan public."

Link to Remote Sensing technical papers



This image shows the difference in vegetation index (NDVI) 1984 – 2014. Higher NDVI values in 2014 are shown in green, lower in brown; lighter colours indicate areas with small NDVI differences between the 2 years, NDVI = Normalized Difference Vegetation Index.

Outlined areas are Shawnigan Lake Watershed



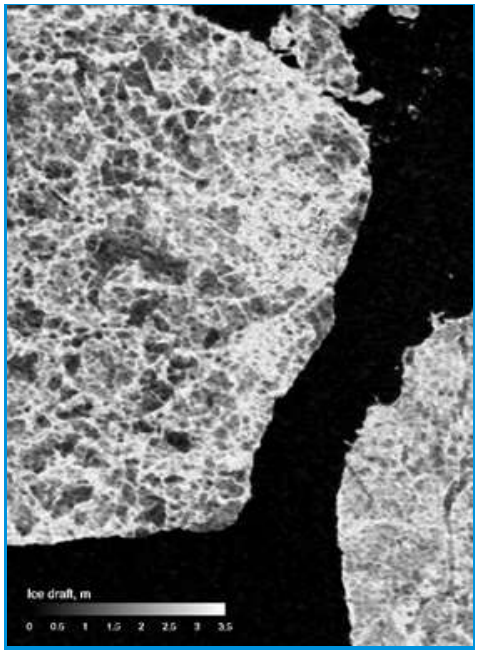
This image shows the dynamics of revegetation.

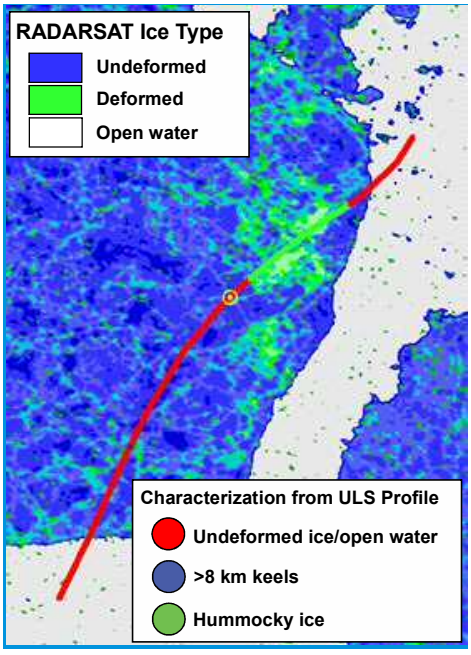
Hazardous Sea Ice Characterization using RADARSAT and Upward Looking Sonar

ASL has successfully completed a research study funded by the Canadian Space Agency that combined the technologies of RADARSAT-2 quad polarized satellite imagery and ASL's upward-looking sonar, the Ice Profiler™, to provide a new, three-dimensional view of sea ice. Using Ice Profiler data sets we showed that a number of satellite data products correlate very well with ice draft. This enabled the production of a first-time map representation of sea ice draft (on the left) derived from satellite data. Other satellite products were used to generate maps of deformed and undeformed ice (on the right) that were validated against ice characterization from the Ice Profiler. Products such as these are of interest to the Canadian Ice Service, and the Ice Engineering Group of the National Research Council, both of whom participated in the project as Canadian Government end-users. Other government research institutions and the offshore oil and gas industry who contributed Ice Profiler datasets to this study are also potential end-users.

Another exciting finding from this project was that the compact polarimetry beam modes planned for the upcoming RADARSAT Constellation Mission (RCM) show good promise for performing as well as the quad-polarized beam modes from RADARSAT-2. With more operational coverage of Arctic areas with RCM, this bodes well for future satellite monitoring of hazardous sea ice.

Selected results from this project will be presented at the International Conference on Port and Ocean Engineering under Arctic Conditions (POAC) in Trondheim, Norway, 14-18 June 2015. For more information please contact Dr. Kaan Ersahin (e-mail: kersahin@aslenv.com)





ATC 2015 Copenhagen (March 25-29)

**Alison Scoon, Oceanographer;
Birgit Hansen, Marketing for Helzel Messtechnik,
ASL's partner for the WERA NorthernRadar;
and David Fissel, Board Chair ASL.**

Upcoming Conferences

Cdn Symp Remote Sensing NL	Jun 8-11
POAC 2015 Norway	Jun 14-18
ISOPE 2015 Hawaii	Jun 21-26
Oceans 2015 DC	Oct 19-22

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