Solutions Newsletter
January 2018

January 2018 ASL Newsletter. This issue:

Successful Recovery of Marine Arctic Ecosystem Study Mooring Data

ASL Environmental Sciences Inc. (ASL), which is operating an array of four biophysical subsurface moorings for the US Bureau of Ocean Energy Management project Marine Arctic Ecosystem Study (MARES), successfully completed the recovery and redeployment of the MARES mooring array with the assistance of the crew aboard the CCGS Sir Wilfrid Laurier this past October. ASL, a subcontractor to Stantec Consulting Services, Inc., is working with the MARES team to process and analyze the data from 34 of 38 instruments which had been deployed in the Beaufort Sea from 2016–2017 as part of the five-year project.

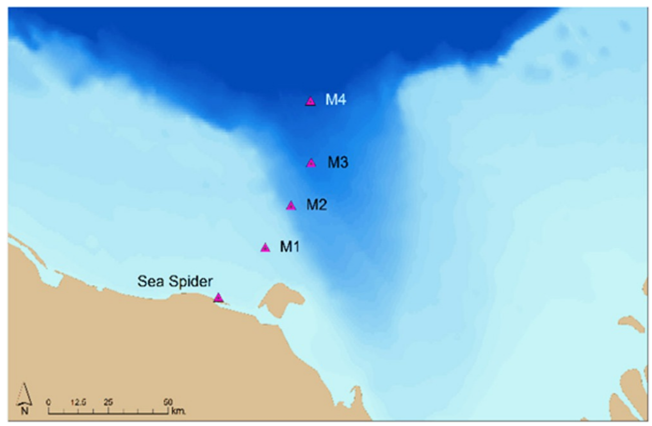

Figure 1. Red triangles indicate locations of the five biophysical subsurface moorings that were recovered.

The mooring array is situated on the western side of the Mackenzie Trough downstream of the mouth of the Mackenzie River and is a critical component in testing one of the project's hypotheses: that changes in physical forcing by wind associated with the diminishing ice cover will alter the intensity and fate of primary producers such as phytoplankton, and secondary production of other marine species, to sustain a healthy food web.

Chief scientist for this leg of the Laurier's Arctic field operations, Dr. Humfrey Melling, led the MARES field team as well as two concurrent science programs aboard the vessel. Stantec's Francis Wiese, MARES technical director, provided oversight and direction for all field operations. Despite the complexity of multiple programs to satisfy, inclement weather, and vessel propulsion issues, the necessary mooring work was completed safely.

All five biophysical subsurface moorings, deployed one year earlier, were recovered, and four replacement moorings were deployed in their place. A suite of physical, biological, and chemical sensors is now providing continuous measurements of the ocean water column and ice environment until the planned recovery in October 2018. Data from the 2016–2017 instruments were downloaded and verified while still aboard the Laurier with high-quality measurement data acquired by 34 of the 38 instruments.

The mooring instruments measure ice draft, ice velocity, ocean currents, salinity, temperature, nitrate, carbon dioxide, turbidity, fluorescence, photosynthetically active radiation, underwater sound, and fish and zooplankton abundance. ASL is providing many of these sensors through our extensive lease pool including the ASL-manufactured Ice Profiler Sonar (IPS) and Acoustic Zooplankton and Fish Profiler (AZFP). The MARES team, including ASL, has now begun the data processing and analysis of the recovered 2016–2017 measurement data. The final fully quality-controlled datasets and derived physical parameters are expected to be complete by summer 2018.

Stantec Consulting Services Inc. (Stantec) leads this project and has assembled a team of collaborators including ASL, the Department of Fisheries and Oceans Canada (DFO), the Woods Hole Oceanographic Institution, the Virginia Institute of Marine Science, the University of Alaska Fairbanks, and the University of Washington. MARES will advance the knowledge of the Arctic marine ecosystem in the region of the Alaskan and Canadian Beaufort Sea Shelf.

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ASL – The First 40 Years 1977–2017

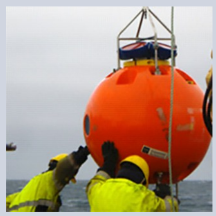
Celebrating 40 Years of Excellence

ASL Environmental Sciences is celebrating 40 years in business. We have come a long way from a small group of oceanographers working out of a hangar at the Institute of Ocean Sciences in Sidney, BC.

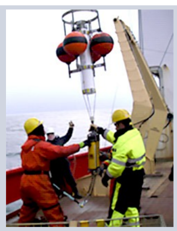
Then | *And Now*

ARCTIC SCIENCES LTD SIDNEY B.C. | ASL Environmental Sciences

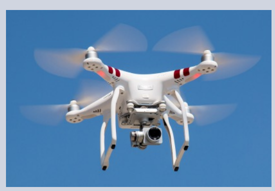
Founded as Arctic Sciences Ltd with a polar bear logo, our early years were spent in the Arctic. Later, to reflect our ability to work anywhere in the world, Arctic Sciences Ltd became ASL Environmental Sciences with a new bear-less logo.



Oceanographic instruments have changed a lot over 40 years, from the Aanderaa RCM4 rotor and vane current meter to the new acoustic Doppler current profilers.

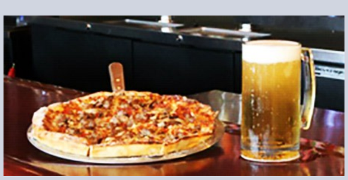


Health and Safety didn't exist then. We tried to work safely and come back with all our fingers and toes. Now full personal protective equipment (PPE) is required and we often have professional HSE reps on board.



Remote sensing still relies heavily on satellites but newer platforms have brought costs more down to earth.

Gone are the days of the PDP 1124 and nine-track tape drives. Numerical model runs are now done in a fraction of the time.



No more pizza and beer for lunch. It's salads and hummus.

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An Oceanographic Study of the Nass River Estuary, BC, Canada

Freshwater discharges and tidal currents dominate the physical oceanography of Nass Bay with the highly stratified waters undergoing large seasonal variability. The fresh water input and large tides (speeds over 1 m/sec) combine to create complex flow patterns.

Landsat satellite imagery below (Figure 1) shows the extent of the plume under ebb (left) and flood (right) tides. The Nass River suspended sediment plume is largest under freshet river flows in late spring and summer and during episodic large rainfall events in fall. Ebb tides allow the plume to extend more than 40 km seaward, while flood tides force the plume back to eastern Nass Bay and the Nass River mouth (read more).

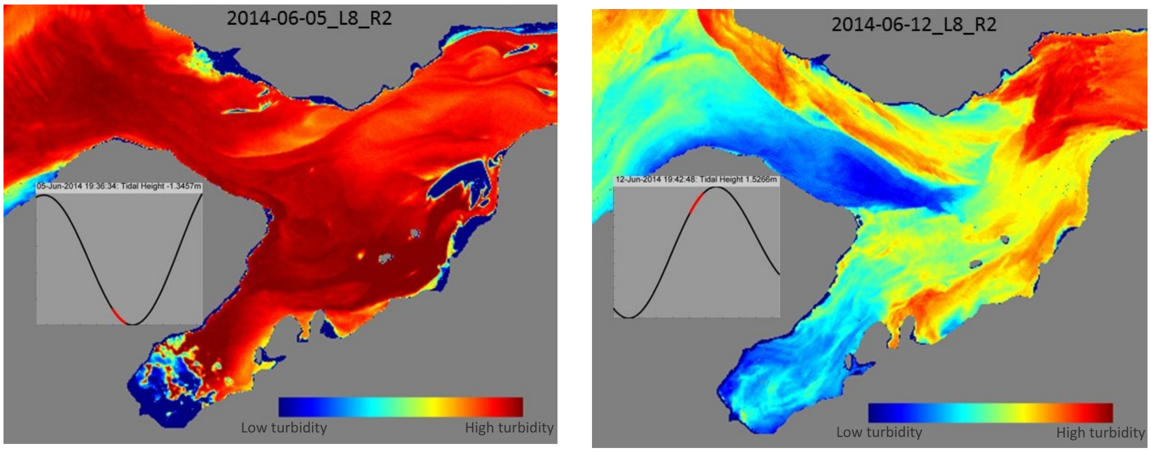

Figure 1. Relative turbidity maps derived from Landsat satellite showing the Nass River plume during freshet in June 2014 at low water following an ebb tide (left panel) and at high water following a flood tide (right panel).

US Naval Research Laboratory to Use an Acoustic Zooplankton Fish Profiler (AZFP) to Conduct Ecosystem Research

The US Naval Research Laboratory has purchased an Acoustic Zooplankton Fish Profiler (AZFP, Figure 1) autonomous echosounder to conduct observations of small zooplankton for ecosystem research. The internally-powered scientific echosounder will store acoustic backscatter data and will be mounted to an apparatus that will move the instrument up and down the water column in order to observe the dynamic behavior of zooplankton. The technology employed by this echosounder uses multiple high frequencies to ensonify the small particle sizes of the zooplankton (Figure 2).

Figure 1. A high-frequency (455, 769, 1200 and 2000 kHz) Acoustic Zooplankton Fish Profiler (AZFP) autonomous echosounder to conduct observations of small zooplankton for ecosystem research.

The Navy will use the instrument to support ongoing research in coupled, ecosystem-circulation modeling, underwater optics and remote sensing.

Disclaimer: The US Navy does not endorse in whole or in part the instruments or manufacturers made mention of or descriptively implied within this story.

Figure 2. An example of zooplankton (Amphipod) to be observed by the AZFP.

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Gary Borstad's Invited Talk: History of Hyperspectral Remote Sensing in Canada

Dr. Gary Borstad, lead scientist and founder of Borstad Associates (a 25-year-old company that merged with ASL Environmental Sciences in 2009) is currently a senior scientist and a director with ASL. Gary recently gave an invited lecture on the early years (1975–1990) of hyperspectral remote sensing in Canada at the Earth Observation (EO) Summit 2017 in Montreal. Gary described those early years as "very exciting times" in which hyperspectral remote sensing and work towards the presently available global remote sensing of ocean chlorophyll was just beginning. His story began with the development of the first linear array spectrometer built for Dr. Jim Gower at DFO's Institute of Ocean Sciences (IOS), which permitted the discovery of solar stimulated fluorescence by phytoplankton chlorophyll by Jim and Bob Neville. Gary then described several international collaborations that he participated in as well as many airborne oceanography projects he conducted with this system in support of fisheries, whale, and seal biology during the early 1980s.

Remote sensing was expanding rapidly at that time, with the launch of several new spaceborne and airborne sensors. With growing international recognition of the importance of fluorescence, DFO began the development of an imaging version of Jim's spectrometer, with the long-term intention of putting it into space. When it was deployed in 1984, the Fluorescence Line Imager (FLI) was the second airborne imaging spectrometer in the world and represented a leap in spectral and spatial capabilities. Early work with the FLI in Canada, the US, and Europe provided the foundation for later hyperspectral instruments, and of the bands selected for several modern satellites including MODIS and MERIS. Unfortunately, ensuing fiscal restraint led to the decision to focus on radar development in Canada. This contributed to the eventual demise of the FLI and a loss of the lead to other later hyperspectral instruments including AVIRIS (operated by NASA).

In a 1987 conversation with Cliff Anger of ITRES Ltd., Gary suggested a smaller version of the FLI would be a commercial success. ITRES went on to develop the Compact Airborne Spectrographic Imager (CASI—Figure 1) with help from Borstad Associates, and together they changed the remote sensing paradigm of using large dedicated aircraft. Borstad obtained the first personal computer-size CASI instrument and flew more than 150 missions in more than 30 countries. ITRES has developed a family of imaging spectrometers and has sold over 100 instruments internationally. Many other companies and university groups now fly imaging spectrometers. Borstad Associates has also flown other hyperspectral instruments. During the 1990s, the Canada Centre for Remote Sensing's Data Acquisition Division (CCRS–DAD) developed an imaging spectrometer for geological applications called the Shortwave Full Spectrum Imager (SFSI), but it too succumbed to government fiscal restraint. After CCRS-DAD closed in 1997, Borstad Associates rebuilt the SFSI-2 and flew it commercially for mineral exploration on three continents for many years. The Borstad team used hyperspectral airborne and spaceborne sensors for aquatic and terrestrial applications that includes coastal mapping, shallow water bathymetry, water quality, fisheries, oceanography, mining exploration, reclamation monitoring, nuclear safeguards, and defense research.

Figure 1. CASI (Compact Airborne Spectrographic Imager) —an instrument that changed the remote sensing paradigm.

This early science and applications development has led to the sensors in use today. Although '*micro*' hyperspectral sensors are becoming available for drones and satellite missions are being planned, airborne hyperspectral sensors still have an important role in research and in time critical applications.

Today, the ASL team provides hyperspectral expertise as part of a broad offering of remote sensing science and technology in the visible, short wave, thermal infrared, and microwave (radar) spectral ranges. We provide R&D services and operational solutions that include data acquisition, processing, and analysis for the government and industry sectors.

WERA Radar Detects Tsunami-Like Event Sixty Kilometres Offshore More than Twenty Minutes Before It Arrived on Shore

Installation of Ocean Networks Canada's (ONC) WERA® high frequency oceanographic radar near Tofino on the west coast of Vancouver Island (Figure 1) was completed on March 27, 2015 by ASL Environmental Sciences Inc. of Victoria, British Columbia; Northern Radar Inc. of St. John's, Newfoundland; and Helzel Messtechnik GmbH of Germany. The primary goals of the radar, which provides oceanographic data and tsunami monitoring in near real-time under all-weather conditions, are to detect tsunamis generated off the west coast of Vancouver Island and, in the future, provide valuable warning time to decision makers and for those in harm's way.

On October 14, 2016 at 05:45 UTC the ocean radar system sent out a tsunami alert after it detected and identified the distinctive signatures of a changing surface velocity (Figure 2) potentially associated with a tsunami. There was, however, no seismic activity at that time to trigger an earthquake-generated tsunami. Although there was no tectonic activity, the system did record a meteotsunami, having an unusual wave propagation current that coincided with the passage of an atmospheric cold front.

The tsunami pattern during the October 14 event was first detected 60 km offshore as the currents were approaching the coast (Figure 3). The total observation time of the event was about 1.5 hours (read full story).

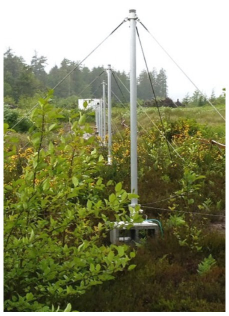

Figure 1. Receiver antenna elements near Tofino, British Columbia.

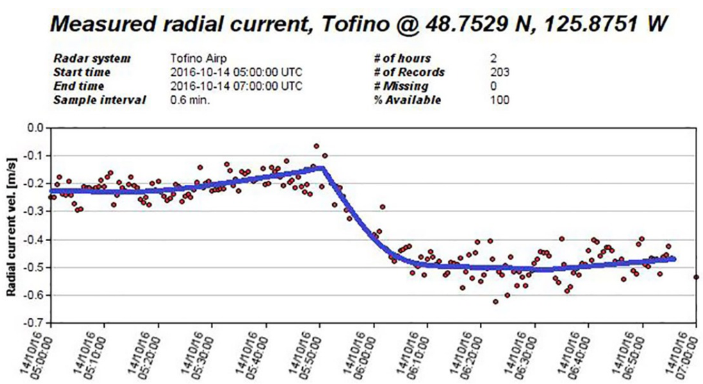

Figure 2. Measured radial surface current velocity on 14 October 2016. Negative currents are directed inward toward the sensor array.

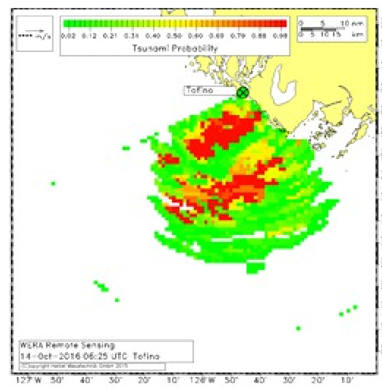

Figure 3. Tsunami alert maps showing the event on 14 October 2016.

International Conferences

Recently Attended

- Oceans 17, Sept 18–21, Anchorage, Alaska
- Teledyne Marine Technology Workshop Oct 15–18, San Diego, California
- Asian Fisheries Acoustics Society, Nov 13–15, Guangzhou, China
- International Arctic Change Conference Dec 11–15, 2017 Quebec City, Quebec

Upcoming

- Alaska Marine Sciences Symposium (AMSS) Jan 23–26, 2018 Anchorage, Alaska
- Ocean Sciences Meeting (ASLO 2018) Feb 11–16, 2018 Portland, Oregon
- Society for Ecological Restoration – Western Canada (SER-WC), February 13-17, 2018 Burnaby, BC
- Oceanology International (OI 2018) March 13–15, 2018 London, UK

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