



INMARTECH 2018 Symposium

October 16-18, 2018

Woods Hole, MA, USA

Hosted by

Woods Hole Oceanographic Institution

INMARTECH 2018 PROGRAM

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INMARTECH 2018 Symposium

Featured Speaker: Tuesday, October 16, 08:30



Dr. Maurice A. Tivey, Senior Scientist
Department of Geology and Geophysics, Woods
Hole Oceanographic Institution (WHOI)

Presentation: Measuring Earth's Magnetic Field at Sea

Maurice A. Tivey is a Senior Scientist in the Marine Geology Geophysics department of Woods Hole Oceanographic Institution. He is a marine geophysicist with research interests that span all aspects of marine geophysics of the deep ocean with a focus on high-resolution magnetic measurements of the seafloor. Dr. Tivey has published over 90 papers in peer reviewed journals and has more than 160 abstracts and 20 other publications. Dr. Tivey has led and been involved in more than 45 research voyages and made more than 25 dives in deep-sea submersibles including *Alvin*, the French submersible *Nautilie*, and Japan's *Shinkai 6500*.

After earning a Ph.D. in Geological Oceanography from the University of Washington in Seattle in 1988, he joined Woods Hole Oceanographic Institution (WHOI as a Post-Doctoral Scholar). He was appointed onto the scientific staff in 1990 and gained tenure in 1998. From 2004 to 2005, he was the Chief Scientist for Deep Submergence for the National Deep Submergence Facility that operates the ROV *Jason*, HOV *Alvin* and autonomous vehicles *ABE* and *Sentry*. He is a past Chair of the Department of Geology and Geophysics at WHOI and just recently finished a rotation at the National Science Foundation as a Program Director in the Marine Geology and Geophysics Program of the Ocean Sciences Division.

INMARTECH 2018 Symposium

Featured Speakers: Thursday, October 18, 15:50



Jan Witting (left) and Georgie Zelenak (right)
Sea Education Association (SEA)

**Presentation: Science under Sail:
research and undergraduate
education on our global ocean**



Jan Witting is a biological oceanographer with long-running interests in the Sub-Tropical and Equatorial Pacific. As a Professor of Oceanography at the Sea Education Association, he has served as Chief Scientist on more than 20 research cruises in the Central Pacific. His work broadly addresses the linkage between climate variation, circulation, and biological production in the tropical and subtropical oceans, where he studies the effects of changing primary production on the structure of pelagic food webs and the ultimate consequences to Pacific fisheries and the human communities that rely on them.

Georgie Zelenak is the Science Operations Coordinator at Sea Education Association. She manages scientific systems and works closely with science and marine staff to ensure that they have the resources necessary to conduct research within the bigger picture of SEA's shipboard capabilities. Her background is in geophysics and geophysical engineering with a specialty in magneto telluric instrumentation and data collection.



*Jan and students aboard
SSV Robert C. Seamans.
Photo credit:
Tane Sinclair-Taylor*

Presentation Abstract: SEA is a global teaching, learning, and research community dedicated to the exploration, understanding, and stewardship of marine and maritime environments. We operate two ocean-going sailing research vessels on two oceans, collecting scientific data while engaging an undergraduate student population from universities and colleges across the US and abroad. In service of this mission, our purpose-built ships feature NSF-supported lab facilities with broad oceanographic capabilities. From hull-mounted 75kHz ADCPs to 12-bottle Sea-Bird SBE32 sub-compact carousels on Markey winches with 5000m wire capacity, we routinely collect a range of physical, biological, and chemical oceanographic data both for research and educational purposes.

Our science and marine staff work very closely together to overcome unique challenges including deployments from a sailing platform without DPS, assuring underway data quality collected on a vessel with large heel angles, and maintaining a fleet of advanced scientific systems without dedicated technicians or internet connectivity. The commitment, creativity, and talent of our crew allow for the success of our programs in some of the most rarely accessed portions of the world ocean. As an example, our Pacific-based ship, the SSV *Robert C. Seamans*, has generated a pioneering five-year data set of the Phoenix Islands Protected Area during repeated six-week cruises in July-August from 2014 to 2018. This data set has been used for publications, for student projects, and as a basis for the revised research and management plans for this large marine protected area.

This unique combination of undergraduate education and ocean research on Sailing School Vessels led the National Science Board to recognize SEA through its Public Service Award for "...fostering scientific discovery and stewardship of the world's oceans through academically rigorous and challenging programs that include sea voyages and oceanographic research."

INMARTECH 2018 Symposium – *Program at a Glance*

Woods Hole Oceanographic Institution
Sea Crest Beach Hotel
350 Quaker Rd., North Falmouth, MA 02556

Monday, October 15:	RVTEC Meeting
Tues-Thurs, Oct 16-18:	INMARTECH 2018 Symposium
Friday, October 19:	Multi-beam Training and Vendor Tours

Please Note: The RVTEC Meeting will be held on Monday, October 15th from 08:30 to 17:00 at Woods Hole Oceanographic Institution, Redfield Auditorium. The agenda is available separately.

Monday, October 15, 2018 – Sea Crest Hotel

17:00-19:00 **INMARTECH 2018 Check-In** – Participants can pick up their program material in the Sea Crest Hotel, Nauset I & II Room.

Tuesday, October 16, 2018 – Sea Crest Hotel

8:00-8:30 **Coffee** – Sea Crest Hotel, Nauset I & II (*Sponsored by Sonardyne*)

8:30-8:45 **Welcome Remarks** – David Fisichella (WHOI)

8:45-9:15 **Featured Speaker – Maurice Tivey / Woods Hole Oceanographic Institution**

Presentation title: *Measuring Earth’s Magnetic Field at Sea*

9:15-9:45 **Technical Challenges and Solutions** – Participants are invited to present one slide explaining the greatest technical challenge faced this year and how it was resolved.

9:45-9:55 **Session Introductions** – Session leaders will provide brief overviews of plans for the morning and afternoon sessions.

9:55-10:15 **Break**

10:15-12:15 **Technical Breakouts, Skillset Sessions & Trainings** – Sea Crest Hotel

Time	Nauset III	Nauset IV	Nauset V
10:15-12:15	Sensors & Observing Systems <i>Moderator: Brandi Murphy</i>	Acoustics & Camera Systems <i>Moderator: Dan Fornari</i>	Skillset Session: Serial Data 1

12:15-13:30 **Lunch** (*Lunch sponsored by Worldlink Communications*)

13:30-15:00 **Technical Breakouts, Skillset Sessions & Trainings – Sea Crest Hotel**

Time	Nauset III	Nauset IV	Nauset V
13:30-15:00	Sensors & Observing Systems <i>Moderator: Brandi Murphy</i>	Planning for Data Growth: a community discussion	Load Handling Systems & Tension Members <i>Moderator: Marc Willis</i>

15:10-17:00 **Trade Show** – Exhibits will be on display in Nauset I & II.

17:40 **Buses depart** to Woods Hole Oceanographic Institution (WHOI)

18:00-20:30 **INMARTECH Reception and Poster Session** at WHOI, Quissett Campus Clark 507
(Reception sponsored by Kongsberg)

20:30 **Buses return** to Sea Crest Hotel

Wednesday, October 17, 2018 – Sea Crest Hotel & WHOI Tours

8:00-8:30 **Coffee** – Sea Crest Hotel, Nauset I & II *(Sponsored by Markey Machinery)*

8:30-8:45 **Day-2 Welcome, Logistics, and Session Introductions** – David Fisichella (WHOI)

8:45-8:55 **Room Configuration Break**

8:55-12:30 **Technical Breakouts, Skillset Sessions & Trainings – Sea Crest Hotel**

Time	Nauset III	Nauset IV	Nauset V	Racepoint
8:55-10:35	Ship/Shore Communications <i>Moderator: Ken Feldman</i>		Skillset Session: Serial Data 2 – Can you hear me now?	Technical Demonstrations
10:35-10:50	Break			
10:50-12:30	Vehicles & All the Rest <i>Moderator: Lee Ellet</i>	Training: pCO ₂	Skillset Session: Timeservers, and why do we love them: why do we care about time?	Industrial Hardware with Introductory PLC Programming

12:30-13:20 **Lunch** *(Lunch sponsored by Scanmar)*

13:20 **Group Photo**

13:35 **Buses to Woods Hole Oceanographic Institution (WHOI)**

14:00-17:00 **WHOI Ship and Facility Tours**

17:00 **Buses to Sea Crest Hotel**

18:30 **INMARTECH 2018 Dinner** – Sea Crest Hotel Dining Room *(Dinner sponsored by Rapp Marine/Triplex)*

Thursday, October 18, 2018 – Sea Crest Hotel and WHOI Village Campus

- 8:00-8:30 **Coffee** – Sea Crest Hotel, Nauset I & II (*Sponsored by Hawboldt Industries*)
- 8:30-8:50 **Day-3 Welcome, Logistics, and Session Introductions** – David Fisichella (WHOI)
- 8:50-9:00 **Room Configuration Break**
- 9:00-12:10 **Technical Breakouts, Skillset Sessions & Trainings** – Sea Crest Hotel & WHOI Campuses

NOTE: Buses to the WHOI Quissett morning sessions will depart at 8:50AM.

Sea Crest				WHOI Quissett Campus
Time	Nauset III	Nauset IV	Nauset V	Winch Pool
9:00– 10:30	Vessels & Operations <i>Moderator: Scott Ferguson</i>	Skillset Session: Intro to Oscilloscopes	Training: Catching Shipboard ADCP System Problems Early: Visualization and Diagnosis	Skillset Session: Winch Operations
10:30- 10:50	<i>Break</i>			<i>Break</i>
10:50- 12:10	Vessels & Operations <i>Moderator: Scott Ferguson</i>		Training: Catching Shipboard ADCP System Problems Early: Visualization and Diagnosis	Skillset Session: Winch Troubleshooting

12:10 Buses will be available at 12:10 on Quissett campus for transport to WHOI Village for afternoon sessions or for return to Sea Crest Hotel. Those going on to WHOI Village will be provided with box lunches.

12:10-13:20 **Lunch**

13:20-15:30 **Technical Breakouts, Skillset Sessions & Trainings** – Sea Crest Hotel & WHOI Village

Note: Buses will depart Sea Crest Hotel at 13:00 for the WHOI Village and will return before the start of the Featured Speaker.

Sea Crest				WHOI Village Campus	
Time	Nauset III	Nauset IV	Nauset V	Mooring Lab	High Bay
13:20-14:50	Data Management & IT <i>Moderator: Suzanne O'Hara</i>	Skillset Session: Intro to Electronics Design	Training Session: Exploring the mysteries of EK80: A Practical Guide to Simrad Broadband Echosounders	Skillset Session: A Hands on Introduction to Ultra Short BaseLine (USBL) Systems with Sonardyne's Ranger 2 Systems	Skillset Session: Wire Terminations & Wire Testing
14:50-15:30		Skillset Session: Tips for Installing & Support of a Debubbler			

- 15:30-15:50 **Break – Sea Crest Hotel – Nauset I & II**
- 15:50-16:30 **Featured Speaker – Georgie Zelenak and Jan Witting / Sea Education Association**
Presentation title: *Science under Sail: research and undergraduate education on our global ocean*
- 16:30-16:45 **INMARTECH Closing Remarks**
-

Friday, October 19, 2018

- 8:30-15:00 **WHOI Village, Redfield Auditorium**
Training Session: Multibeam – See description on page 35.
- 8:30 **Bus to WHOI Village, Redfield Auditorium**
- 9:00-13:00 **Kongsberg & UNOLS Multibeam Advisory Group (MAC)**
Box lunches will be delivered at noon.
- 13:00-15:00 **“Using Qimera to Diagnose your Multibeam”** – Matthew Wilson/QPS

OR

- 8:30-15:00 **Local Oceanographic Instrumentation & Equipment Vendor Tours**
Tour of oceanographic instrumentation and equipment vendor facilities in the Woods Hole, MA area.
Box lunches will be provided.

Confirmed vendors include:

- EdgeTech - <https://www.edgetech.com>
- McLane Research Laboratories, Inc. - <http://mclanelabs.com/>
- EOM Offshore - <https://www.eomoffshore.com/>
- MITech - Marine Imaging Technologies - <https://marineimagingtech.com/>
- Webb Research - <http://www.teledynemarine.com/webb-research/>

INMARTECH 2018 Symposium – *Technical Session Details with Abstracts and Skillset/Training Session Descriptions*

Woods Hole Oceanographic Institution
Sea Crest Beach Hotel
350 Quaker Rd., North Falmouth, MA 02556
October 16-18, 2018

Technical session presentation listings and skillset/training session descriptions are provided on the following pages. The listing is organized by date, time, and meeting room.

Tuesday, October 16, 2018 – Sea Crest Hotel

Sea Crest Hotel - Nauset III

10:15-12:15 Sensors and Observing Systems (Part 1) Moderator: Brandi Murphy (University of Washington)

- 10:15 **“Hands-Free” CTD Water Sampling** – Keijzer, Edwin (NIOZ)
Abstract: At earlier INMARTECH meetings we have presented the NIOZ Ultra Clean CTD system, in 2006 as a prototype and in 2012 as a working system. An adapted version of the UCC is now the standard CTD system on *Pelagia*, with:
- The NIOZ ‘quick & easy to prepare, hydraulically controlled, easy to clean and fail proof’ butterfly valve sampling bottles.
 - A newly made bottle, adjusted in size and materials to be fitted in standard rosette CTD frames.
 - Self-powering accumulator provides pressure for hydraulic ‘from the inside out’ closing of the butterfly valve, ensuring a 100% leak free bottle and excellent sample quality.
 - Anaerobic sub-sampling made easy by applying N2 over pressure for direct filtering from the bottle.
 - Resetting the system for next the deployment is done in seconds.
 - The bottle submerges with valves closed and opens in the top 30 meters, thereby excluding surface pollution intake.

- 10:35 **Implementation of Automatic Underway Measurement System ("Ferrybox") on Research Vessels** – Crenan, Briec (IFREMER)
Abstract: Ferrybox system was developed some years ago on Ferries lines to collect data at high frequencies. The system improved and showed its reliability and efficiency, increasing at the same time the number of parameter that could be measured. IFREMER installed one of those system onboard one of its high seas research vessels to increase the database with new kind of data. To perform it, several operations were done to check the good functioning of the system (in lab or at sea), this presentation will show it.

- 10:55 **Development of an Autonomous Solar Tracking Measurement Platform for Offshore Use** – Vansteenwegen, Dieter (VLIZ, Belgium)
- Abstract:* Gathering ground truthing data can be a challenging and costly undertaking. Aiming to create new algorithms for remote sensing of SPM and chlorophyll concentration, the Hypermaq project needs offshore irradiance and water and sky radiance measurements. Coinciding these measurements with selected satellite overpasses adds another layer of complexity. An autonomous measurement system enhances temporal data resolution at reduced costs. Measurement cycles are made at regular intervals throughout the day and consist of a number of measurements in relation to the position of the sun. Deployment in varying environments and conditions demands a high degree of customizability. Additional instruments will be added over time, and component choices will depend on availability and requirements. This calls for a modular approach. The setup is built around an embedded controller running the Linux operating system, ensuring compatibility with future hardware. Location and time are gathered from a connected GNSS/GPS receiver, and allow calculation of the sun position. A pan/tilt head then rotates the instruments to correct azimuth and elevation angles, based on user defined offsets. Measurement data is stored in a SQLite database and sent to an on-shore server every day. Power can be provided by a mains supply or batteries. While designed specifically for hyperspectral radiometers, the platform can easily be adapted to suit other measurement purposes. A number of these platforms will form a worldwide hyperspectral validation network.
- 11:15 **Enhancing CTD and Multiparameter Water Column Data Collection with Moving Vessel Profiler** – Walton, James (AML Oceanographic)
- Abstract:* Conducting numerous CTD casts to measure oceanographic properties in the water column is commonplace for researchers at sea. Many research cruises stop at particular locations with the intent of collecting detailed water column data and physical samples. Significantly more data may be collected by taking advantage of systems that enable water column sampling while the vessel is underway, either for observing specific oceanographic factors, or simply transiting between waypoints. One example of an underway profiling solution is a CTD Tow-Yo, where the rosette CTD is reconfigured and deployed using the static winch while the vessel is underway at low speeds. Other vessels may have dedicated equipment such as ROTV or other towed sensor arrays. While these methods generate water column data while underway they have significant drawbacks including labor intensive mobilization and demobilization procedures, active supervision or requirement to pilot the system, loss of valuable ship time during deployment and recovery, and compromise between vessel speed and density of data collected. CTD Tow-Yo requires the vessel to slow to 1-1.5 knots, for example, whereas towed sensor packages can operate at speeds up to 10 knots but are limited to very shallow profiles. Researchers require the capability to collect underway profiles without jeopardizing primary science objectives or increasing demands on personnel. In contrast to other underway systems, Moving Vessel Profiler (MVP) is an automated system that provides near-vertical profiles to hundreds of meters' depth continuously while the vessel is underway at speeds up to 12 knots. MVP is easy to use and may be operated by as few as 1 or 2 people without impacting ship time during deployment and recovery. The high density of near-vertical water column data collected by MVP adds more value to any research cruise than other methods with the associated compromise in vessel speed or mission objectives.

11:35 **Oceanographic Data Facility 36 Position Rosette Improvements for Repeat Hydrography Cruises** – Becker, Susan (Scripps Institution of Oceanography)

Abstract: At Scripps Institution of Oceanography (SIO) Shipboard Technical Support, (STS) Oceanographic Data Facility (ODF) has been using 36 place rosettes on major hydrographic expeditions since 1992. These rosettes provided not only more water samples but also more space to place additional instrumentation such as the Lowered Acoustic Doppler Current Profilers (LADCP) with an external battery pack, transmissometers, fluorometers, altimeters, etc. However, the larger size and weight of these packages had created additional problems during deployment at a higher rate than what is experienced when using smaller rosettes. Problems such as high wire tensions, higher incidents of wire kinking resulting in the need for more cable re-terminations, higher incidents of z-kinks which results in the loss of internal electrical conductors. In 2017 plans were made to build a new 36 place rosette. Improvements that could be made were noted the construction materials, surfaces that could reduce drag, creating open spaces for water to freely flow, and instrumentation support brackets are among the improvements incorporated. The new 36pl rosette was designed at SIO and fabricated in a local shop in the Spring of 2017. It has since been used on a cruise during Summer 2017 and another two-month long cruise in the Spring of 2018. The presentation will cover the approach to these modifications, lessons learned, and outcomes.

11:55 **Seabed Mining: Field Testing of a Nodule Mining Crawler** – Smit, Marck (Royal NIOZ)

Abstract: With the publication by the International Seabed Authority of the first DRAFT regulations for Seabed Mining - the Mining Code - in 2017, the exploitation of polymetallic nodules is one step closer. Local destruction of deep-sea habitats is the most apparent impact of mineral extraction from the seabed. But plumes of fine particles stirred up by mining and spreading out over the surroundings of the mining site may cause further harm to the environment. Identifying problems is part of a scientist's job. But so is proposing solutions. Therefore, NIOZ does not only engage in discussions with fellow scientists, policymakers and NGO's, but also co-operates with industry in an effort to jointly develop an environmentally sustainable mining practice. The Blue Nodules project is a good example of this. In this European project, scientists and technical personnel of NIOZ work together with engineers from the maritime industry in developing deep-sea mining machinery that causes as little disturbance to the surrounding environment as possible. This presentation focuses on the challenges of measuring the plume generated by a nodule mining crawler during a test cruise, using moored sensors, an ROV, video systems, etc.

Sea Crest Hotel - Nauset IV

10:15-12:15

Acoustics & Camera Systems

Moderator: Dan Fornari, Woods Hole Oceanographic Institution

10:15

High-Rate Underwater Acoustic Communication System for Image Transmission with a Manned Submersible SHINKAI6500 – Deguchi, Mitsuyasu (Japan Agency for Marine-Earth Science and Technology, JAMSTEC)

Abstract: Underwater acoustic communication is an essential tool in various fields related to ocean measurement because of the rapid attenuation of electro-magnetic waves in sea water. However, compared with terrestrial radio communication, underwater acoustic communication can encounter difficulties such as a large effect of Doppler shift, a large amplitude and delay of a multipath signal, and the severe limitation of a usable bandwidth. Because of various conditions, including communication range and the motions of platforms, which determine how these difficulties affect the communication performance, it is necessary to design an underwater acoustic communication system that is optimal for each purpose and situation. In Japan Agency for Marine-Earth Science and Technology (JAMSTEC), a manned submersible “SHINKAI 6500” has been under operation for academic research in the deep ocean that can dive to a depth of up to 6500 m. However, only two researchers can occupy this submersible. Therefore, it is very significant that other researchers on a mothership can monitor the situation on the submersible via underwater acoustic communication. Last year, we developed a new high-rate underwater acoustic communication system for the SHINKAI 6500 that can transmit a still image taken by a camera on the submersible, whose size is 320×240 or 480×320, at an interval of 2 to 5 sec. The system is currently being implemented in practice and contributes greatly to real-time monitoring observation in the deep ocean. Regarding the communication device performance, its data rate is approximately 40 kbps, which is the highest data rate of an actual underwater acoustic communication system at a distance of 6500 m. In this presentation, the results of an at-sea experiment using this system are shown. Based on the experimental results, the performance of the 40-kbps system was verified to be robust and stable, and its power consumption was only 20 W. In addition, a data rate of 80 kbps was also achieved at a distance of 6500 m on a trial basis.

10:35

LED Strobes – the Challenges of Getting High Power at a Fast Recharge Rate – Cordell, Jeff (CSIRO Ocean and Atmosphere Australia)

Abstract: CSIRO Australia have been involved in biomass estimations for commercial fisheries for over 20 years. Part of the methodology is to size fish using cameras to create pairs of images which when analyzed can compute fish length and orientation. Previous configurations have used commercial DSLR cameras and Xenon strobes, but these have some limitations. The DSLR’s can’t keep up with the amount of shots taken, as they are towed through a spawning aggregation and lose sync. Discharge strobes have slow recharge times and problems with heat build-up, which limit them to operating at lower power and reduced duty cycles. This limits the cameras depth of field and range. There are some commercial LED strobes on the market but none have the power and duty cycle to capture images of fish at ranges up to 8 meters and a duty cycle of 4 Hz. This presentation will discuss the advantages of using LED strobes how the challenges in the design to meet this specification were overcome.

10:55 **Practical Impacts of Sonardyne CASIUS Calibration on USBL Performance** – Vaughn, Ian
(Woods Hole Oceanographic Institution)

Abstract: On a recent engineering cruise, AUV *Sentry* ran similar multi-beam surveys over the same site in 2300m of water during and after calibration of R/V *Atlantis*'s Sonardyne USBL system. The first survey was conducted with a freshly-installed Ranger USBL header. The second survey used the CASIUS-estimated roll, pitch and heading installation offsets. This offered a unique opportunity to compare the practical effects of calibration on USBL performance. Multi-beam maps from each dive are presented that clearly show the difference between calibrated and uncalibrated USBL systems. Finally, targets are identified in each map to estimate errors that would affect navigation to a specific feature by manned submersible or ROV. These results have implications that may help guide future development of operational doctrines for Sonardyne USBL systems.

11:15 **Optimizing Performance of a Long Range Ultra Short Baseline Tracking and Telemetry System** – West, Geraint (Sonardyne International Ltd)

Abstract: While Ultra Short Baseline (USBL) is a well-established methodology for subsea positioning, there has usually been a trade-off between high precision short-range performance and low precision long-range performance based on choice of frequency. Furthermore, the susceptibility of low frequency systems to vessel generated noise can degrade the performance of such low frequency long range systems. As a result, the majority of USBL systems used in ocean science have utilized Medium Frequency (MF 19-34 kHz) operation as a compromise between precision and range, including the Ranger 2 USBL systems produced by Sonardyne International Ltd. These are widely used on a range of research vessels; however, increasing use of Autonomous Underwater Vehicles (AUV) and other subsea platforms have pushed the need for longer range systems with integrated telemetry. In response to this need, Sonardyne have developed a variant of Ranger 2, operating in the Lower Medium Frequency (LMF 14-19 kHz) Band. While this band is subject to a wider variety of noise sources on the vessel, the potential gains in range as a consequence of lower absorption are significant. Indeed, reducing from a centre frequency of 24kHz to 16kHz effectively halves the absorption in the water path. The LMF transceiver head is outwardly identical to the MF transceiver head, with both being capable of positioning precision of up to 0.1% of range. During 2017, Sonardyne undertook two trials of the system: one onboard the Monterey Bay Aquarium Research Institute's (MBARI) vessel, RV *Rachel Carson*; and, secondly one onboard the National Oceanography Centre's (NOC) vessel, RRS *James Cook*. The RV *Rachel Carson* is a former oilfield support vessel acquired in 2011 by MBARI, while the RRS *James Cook* is a modern purpose built multidisciplinary research vessel built to the International Council for the Exploration of the Sea Cooperative Research Report 209 standard (ICES 209). These trials comprised both positioning and telemetry trials at slant ranges increasing to over 11,000 metres and depths of up to 4,500 metres. In addition, a number of baselining trials were undertaken to characterize noise sources on the vessels, under a variety of propulsion configurations and in parallel to other scientific system operation. In particular, the RRS *James Cook* has twin USBL spars, so it was possible to undertake side-by-side comparison between MF and LMF systems in a variety of operational modes. In both cases, consistent slant range positioning was achieved at ranges in excess of 11,000 metres, although modeling results suggest that positioning up to 15,000 metres is possible using a directional beacon, which has a higher (7dB) source level than the beacon used in the

trials. Telemetry trials, using Sonardyne's standard schemes ranging from 200 – 9,000 bps were also undertaken at a variety of slant ranges, with actual achieved data transmission rates in excess of 2,000 bps (at 17mJ per bit) being achieved at a slant range of 7,200 metres during the RRS *James Cook* trial. The achieved data rates were limited by the fact that the setup rejected any sub frame with a block error, meaning that this had to be re-transmitted. Re-requesting individual blocks would overcome this constraint. This paper outlines both trials and discusses the modeled and field data for each and, in particular, the impact of vessel configuration is discussed. Overall, both trials demonstrated the capability to extend USBL performance well beyond ranges achievable using MF, with no loss in precision and the capability to support high rate acoustic communications.

11:35 **Presentation of Kongsberg's EM304 Results Onboard RV *Thalassa* – Crenan, Brieuc (IFREMER)**

Abstract: IFREMER worked close with Kongsberg since many years. Again, a close collaboration between the two companies could permit to install the first EM304, the last MBES designed from Kongsberg. The successor of EM302, the EM304, is the first installed one and this presentation will show you the project step by step from upstream studies in 2016 to Sea Trials in Sept. 2018.

11:55 **High Resolution Deep-Sea Imaging and Camera-Guided Sampling Using EPO-Ocean Imaging Systems and WHOIMISO/SSSG Integrated Camera Systems - Fornari, Daniel (Woods Hole Oceanographic Institution - MISO/SSSG)**

Authors: Daniel J. Fornari – WHOI – MISO/SSSG and Geology & Geophysics Dept., Woods Hole, MA USA; Eli Perrone – EP Oceanographic (EPO) and Ocean Imaging Systems, Pocasset, MA USA

Abstract: Over the past decade significant advances have been made in developing high-resolution (~12-24 MP) digital still color cameras for use with a variety of deep submergence vehicle systems as well as deep-sea sampling and imaging systems, including multicorers and the WHOI-MISO TowCam. A decade-long, and ongoing collaboration between EPO-Ocean Imaging Systems and WHOI-MISO has resulted in the development of a suite of versatile deep-sea digital color camera systems and strobes (200-600 w/s output), that are well-suited for deployment on a variety of submersible platforms and can be integrated into sampling systems. These include a 24MP camera based on a Nikon D3300 module and a 12MP camera based on a GoPro Hero4 module. To date the 12MP and 24MP OIS-EPO cameras have collected hundreds of thousands of images on ~25 cruises that have included DSRV *Alvin*, *Nadir*, and *PiscesV* submersible dives, and ROV *Jason*, *Hercules*, D2, Aegir6000 dives, and the WHOI-MISO TowCam system. Imaging using the EPO-OIS cameras has provided exceptional, high-resolution image data for dive programs spanning nearly half the globe – from the SW Pacific near New Zealand, north to Taiwan and the central and eastern Pacific, and into the north Atlantic. We have also integrated the camera/strobe systems with a variety of WHOI-MISO telemetry and power components to provide imaging capability to multicorers and CTD systems that have been used on multiple cruises spanning the geographic range from the eastern and northern Pacific to the Arctic, west and south of Svalbard and east into the Barents Sea. In 2010, the EPO-OIS cameras and WHOI MISO TowCam system and altitude/depth sensors (<http://www.whoi.edu/miso>) were applied to provide the imaging and data infrastructure required for multicoring using MC-800 multicorers – the standard instrument used by many UNOLS operators. Over the past 8 years we have successfully

deployed the camera-guided multicorer on 8 cruises, from 8 research ships covering study areas from the Chukchi Sea, California borderland, US east coast margin, and in the Norwegian Arctic near Svalbard and into the Barents Sea using the U. Tromsø CAGE UiT multicorer. We will present examples of the imaging capabilities, integration with vehicle systems, and have camera / strobe systems for inspection by meeting attendees.

Sea Crest Hotel - Nauset V

10:15-12:15

Skillset Session: Serial Data 1

Session Leader: Tom Wilson (Stony Brook University)

Learn about asynchronous serial communications: bits, bytes, and frames; parity; baud rates; breaks and checksums; logic level, RS232, RS422, and RS485 communications; hardware and software handshaking; cables, adapters, and tools; surge protection; and sending serial signals over Ethernet, Bluetooth, and fiber. Useful preparation for Serial Data 2 – Can you hear me now? Which will be a serial troubleshooting practicum.

Sea Crest Hotel - Nauset III

13:30-15:10

Sensors & Observing Systems (continued)

Moderator: Brandi Murphy (University of Washington)

13:30

Sensor Calibration Tracking – Felix, Bruce (US Antarctic Program)

Abstract: USAP Marine Calibration Spreadsheet - Over a number of years the USAP has developed a detailed calibration spreadsheet for tracking the various shipboard sensors. Combining input from vendors with shipboard experience, we have defined calibration schedules and best practices. Based on feedback from recent tech exchanges with other ships in the fleet, we thought it would be useful to share what has worked well for us.

13:50

The Temperature-Dependency of Oceanographic Thermometers – Ober, Sven (Royal NIOZ)

Abstract: The temperature-dependency of oceanographic thermometers. It is quite unknown but the SBE3 oceanographic thermometer is slightly pressure dependent. The cause of this pressure-effect is the fragility of the hollow needle with the thermistor. This needle is small and fragile. In order to establish a good thermal contact between the thermistor and the metal of the needle some heat conducting paste is applied. This all makes the thermometer fast ($\tau = 50$ ms). On great depth the needle is compressed somewhat. One would expect that the 'liquid' paste can cope with this small change of dimensions, but it turns out that this is not the case. A portion of the pressure signal is transferred to thermistor and this influences the resistance. This effect varies from thermometer to thermometer, but can be in the order of 0.5 mK / 1000 dbar. This effect has been studied by H. Uchida et al. and he published it in 2007 and 2015. However, he made the assumption that his reference-thermometer, an SBE35, does not show this pressure effect. Our experiments show that that this assumption is too optimistic.

14:10 **Maintain and Expand your Seafloor Observatory by Installing a Sea Floor Resident AUV/ROV system** – Roper, Chris (Saab North America)

Abstract: Increasing use and complexity of ocean observatories has put focus on the costs of maintaining and upgrading these systems. In addition, access to these systems is sometimes limited by adverse weather and ice conditions. Conventional methods for intervention, maintenance and repair (IMR) using surface ships and ROVs are very expensive; furthermore, response and mobilization times can at times be quite slow. To address this Saab Underwater has developed a seafloor resident hovering Hybrid AUV/ROV system to remotely perform IMR reducing the need for a supporting ship. Sabertooth is a 3000-meter depth rated, 30 kWh, hybrid AUV / ROV system designed to remain submerged for extended periods of time in a subsea docking station. Sabertooth can also expand a seafloor observatory by placing seafloor sensors up to 50 KM away from the hub and then visiting these sensors to both recharge them and recover the collected data. Once back at it docking station the Sabertooth can upload the collected sensor data to the observatory network.

Sea Crest Hotel - Nauset IV

13:30-15:10 **Planning for Data Growth: a community discussion**

Session Leaders: Karen Stocks (Scripps Institution of Oceanography/R2R) and Suzanne O’Hara (Lamont-Doherty Earth Observatory/R2R)

The volume of data collected on expeditions is continually increasing. This is due in part to new devices, and in part to the deployment of existing high-data-volume instruments on new platforms (e.g. ROVs, drones) and for new purposes. At the same time, scientists are increasingly expecting near-real-time access to data. This creates challenges for storing data on the vessel, moving it off the vessel, providing access to the data, processing the data, and archiving it long-term. This will be an open discussion of the challenges of growing data volumes, and the potential solutions different groups are evaluating, such as using cloud resources for storage and processing, using new storage media, moving data off the vessel throughout the expedition, and increasing connectivity at ports. We invite the community to bring their experiences to the discussion.

Sea Crest Hotel - Nauset V

13:30-15:10 **Load Handling Systems & Tension Members**

Moderator: Marc Willis (Oregon State University)

13:30 **Multiple Platforms on a Fibre Optic Towed Cable** – Tyndall, Aaron (CSIRO Australia)

Abstract: The RV *Investigator*, owned and operated by CSIRO Australia, deploys a variety of towed body platforms from its multipurpose fibre optic towed cable. These include an undulating CTD, concatenating plankton net sampler and towed and dropped cameras,

with each platform having its own needs and requirements. As such, the method in which the wire is used needs to be adaptable:

- The physical demands on the tow cable for each platform are diverse, from heavy, slow moving and immobile too lightweight, high speed and highly dynamic. These demands have required ongoing adaptation and revised Standard Operating Procedures to ensure safe and efficient use of this crucial vessel based infrastructure;
- Different platform specific communication requirements supported by a single fibre in the cable ranging from single channel Ethernet to multiple communication standards has necessitated the development of various architectures that all operate on the same cable; - Fibre optic faults and losses are a continual challenge which has dictated revised termination procedures, fault identification and rectification.
- Future development continues, to increase the capacity and reliability of the cable, looking at small modifications for short term gains to options of augmented tow cable capability to address fundamental cable constraints.

13:50 **Rapp Marine and Triplex - Full Lifecycle Resource for Oceanographic Load Handling Systems** – Kocan, Harsen (Rapp Marine)

Abstract: Rapp Marine and Triplex, now both members of the MacGregor family, provide a fully integrated load handling system solution for oceanographic and fishery research vessels for the full lifecycle of the vessel. This means that Rapp and Triplex are present for support from the beginning conception of a research vessel new build project until that vessel is decommissioned and out of service. Rapp Marine and Triplex provide consultation on the machinery arrangement, wire routing, and other details of the oceanographic handling systems in the initial conceptual design phase of the vessel, provide engineering support throughout the build process of the vessel, and continuous service and maintenance support during the operational lifecycle of the vessel.

14:10 **USCG 46CFR189.35 vs Commercial Standards for Deck Machinery: A Comparison of their Impact on Design and Load Testing** – Einhorn, Michael (Einhorn Engineering, PLLC)

Abstract: For the design and certification of deck machinery the UNOLS community often specifies the USCG Weight Handling Equipment rule (46CFR 189.35). Though referred to at times as the “Gold Standard” for its tough design requirements, the testing requirements in the rule can lead to inadequate proof load testing. This discussion will compare the USCG design standard with commercial specifications from both the design and testing perspectives. For both approaches, the discussion will also review the requirements for load testing not only at commissioning but also throughout the life of the equipment. Understanding proper load testing is key to ensuring long term and safe operations.

14:30 **Community Discussion on Synthetic 0.322 Alternatives for CTD Operations** – Trask, Rick (WHOI)

For many years, the US Academic Fleet has used Rochester 0.322 EM cable for most of the standard over-the-side profiling instrumentation deployments (e.g. CTD/Rosette, MOCNESS, etc.). The steel cable has served the community well and continues to do so. However, there are some advantages to synthetic EM cables. The U.S. National Science Foundation Wire Pool is in the early stages of investigating synthetic cable options. In this

session, we will discuss the current cable, why the US fleet is investigating synthetic cable and the progress we have made in finding a replacement. We hope that this will include a community discussion on the synthetic cables other oceanographic institutions are using and to what success.

Wednesday, October 17, 2018 – Sea Crest Hotel & WHOI Tours

Sea Crest Hotel - Nauset III

8:55-10:35 Ship/Shore Communications

Moderators: Ken Feldman (University of Washington) & Laura Stolp (Woods Hole Oceanographic Institution)

8:55 HiSeasNet Engineering Review and Preview – Walsh, Kevin (Scripps Institution of Oceanography)

Abstract: HiSeasNet is a satellite communications network designed specifically to provide continuous Internet connectivity for oceanographic research ships and platforms within the University-National Oceanographic Laboratory System (UNOLS). The project began in 2002 and is now in the midst of life cycle upgrades that will take advantage of new shipboard antenna systems and High Throughput Satellites. HiSeasNet will preview a technology roadmap focused on the high performance communications capabilities that will support modern ocean science in action.

9:15 LEO + GEO = Innovation Squared – Kemp, Amy (Supplier for High Seas Net)

Abstract: This presentation will provide an update on the planned OneWeb Low Earth Orbit (LEO) constellation and its offerings that will benefit the maritime research community. A brief overview of the OneWeb constellation, a global LEO Ku-band network, that will offer 6 terabits per second of connectivity that is planned to be fully interoperable with the Intelsat network. The partnership of Intelsat and OneWeb will:

- provide synergy of 2 Ku-band global networks on different orbital planes
- enhance innovation and development of Ku-band ground systems on a much larger scale
- further Intelsat's vision to lower the cost and accessibility of satellite-based broadband as one of the initial investors in OneWeb, Intelsat has distribution responsibilities for many vertical market segments including mobility and government.

9:35 VSAT Communications Enabling Survey USV Operations Beyond Line of Sight – Calvin, Jorge (OmniAccess - Senior Account Manager)

Abstract: As the cost of building and operating USV drops and machine intelligence improves, drones could provide powerful means for environmental protection, bathymetry, Sea-bed surveying, mine clearance, AUV Launch and recovery, ROV operations and Ocean science applications. The enthusiasm for USV-based applications is not only driven by improvements in technology but for their formidable operational efficiency improvement potential. One of the key drivers for true autonomy in high seas are satellite communications which need to be reliable, secured, cost optimized and capable of draining big amounts of data ship to shore. Latest advances in satellite technology and novel VSAT service concepts already fulfill all these requirements. For example, an USV can get already high data speeds (+50Mbps shore to ship and +10Mbps ship to shore) using small antennas in a reliable and flexible manner which contributes to the feasibility of remotely operated survey vessels far beyond line of sight. This

presentation will explain the satellite technologies that are currently available and services suitable for USV which are key and ready for the operational success of USVs. Incoming evolutions in VSAT technology contributing to the success of survey USVs will be also detailed.

9:55 **Ship-to-Shore Telepresence Enabled Research and Education** – Coleman, Dwight
(University of Rhode Island Graduate School of Oceanography)

Abstract: The Inner Space Center (ISC) is a one-of-a-kind facility that supports live ocean exploration using telepresence technologies. Located at the University of Rhode Island Graduate School of Oceanography, the ISC is home to a diverse team of ocean scientists, engineers, education professionals, video producers, and media specialists. The team works with cutting-edge technology to facilitate, capture, produce, and promote underwater exploration in real time. The ISC supports the NOAA Ship *Okeanos Explorer* and Exploration Vessel *Nautilus* by providing real-time video streaming to the Internet for science participants and the public to engage with exploration expeditions as they happen. The ISC also supports live expedition-related satellite operations, networking services, voice telecommunications, and data management. The ISC has worked extensively with UNOLS and other ships, often not well-equipped with telepresence technologies, to provide that functionality and enable the telepresence connection for science and outreach. An evolving set of Mobile Telepresence Units have been developed for use on these vessels including the R/V *Endeavor*, R/V *Atlantis*, M/V *Alucia*, R/V *Neil Armstrong* and R/V *Sally Ride*. We often work with HiSeasNet and other satellite service providers to procure and configure the expanded bandwidth required for each project. Recently we have tested telepresence through Inmarsat's Global Xpress network with decent results that are promising for the future. This presentation will provide an overview of our facilities, operations, and achievements for the year. The latest projects include the live production of the third annual World Oceans Day tri-ship connection, live interactive broadcasts and telepresence onboard the One Ocean Expedition's *Akademik Ioffe* from the Northwest Passage, and supporting scientists in the ISC Mission Control during the NASA SUBSEA project in collaboration with the Ocean Exploration Trust and E/V *Nautilus*. The presentation will also focus on the challenges and success related to the employed technologies for each of these specific projects.

10:15 **UNOLS Internet Use Policy (30min)** – Feldman, Ken (University of Washington/SatNAG)

Abstract: Vessels operating on satellite-based Internet connections face continuous challenges providing affordable and usable Internet access for Science and Vessel Operations purposes, as well as general purpose use for all personnel. In order to maintain functional, equitable and fair use of this limited resource it is necessary to manage access to the Internet consistently. The Satellite Network Advisory Group (SatNAG) was tasked with developing a policy and testing it as a proof of concept for UNOLS vessels. SatNAG will lead a community discussion on lessons learned and possible solutions.

Sea Crest Hotel - Nauset V

8:55-10:35

Skillset Session: Serial Data 2 – Can you hear me now?

Session Leader: Toby Martin (University of Hawaii)

Can you hear me now? Talkers with no communication skills:

Is your pet serial device lacking in communication skills? Let us figure out what your unsocial serial devices have to say. Bring your tired, your poorly specified, your one wire connections yearning to be heard to this hands-on serial communications workshop.

Sea Crest Hotel - Racepoint

8:55-10:35

Technical Demonstrations

OpenRVDAS - an Open Source Data Acquisition Architecture – Cohn, David Pablo
(OpenRVDAS)

Abstract: OpenRVDAS is open-source software for research vessel data acquisition. It has been designed as an architecture of simple Lego™-like components that "snap together" to allow easy construction of whatever system is needed to match current vessel requirements. The open source nature of the project supports creation, use and sharing of new modules across the community.

UNOLS Cruise Planning Application – Greubel, Erich (University of Rhode Island)

Abstract: A demonstration and Q&A session for the new UNOLS Cruise Planning Web Application

Using Kayaks for Low-Impact Coastal Research in Antarctica – Race, Julian (MV *Alucia*)

Abstract: Antarctica is an area of interest to researchers because of its pristine environment, yet to explore there typically requires a huge logistical supply chain and lots of equipment (ships, aircraft, small vessels, etc.). Traditional oceanographic research and scientific data collection is conducted from large, expensive oceangoing platforms. These platforms have a large carbon footprint and require a significant amount of resources. By utilizing human-powered craft (kayaks), and a sailing support vessel, coastal data collection can be conducted in a much less impactful and less expensive way as compared to traditional platforms. Several kayaks have been outfitted with a suite of sensors and a small data collection system to demonstrate that high-quality data can be acquired in a low-cost, low-impact way in Antarctica. A team of six will embark on a two-month journey to Antarctica to prove that this non-traditional way of collecting data is feasible and fun.

Sea Crest Hotel - Nauset III**10:50-12:30****Vehicles & all the rest**

Moderator: Lee Ellet (Scripps Institution of Oceanography)

10:50

Technically Enhancing an Aging ROV – Houthoofdt, Robin (VLIZ)

Abstract: The ROV *Genesis*, a Cherokee-type ROV from Forum Energy Technologies (formerly SubAtlantic) has been operational since 2006 at Ghent University (RCMG). In 2012 VLIZ adopted the ROV from Ghent University and we've been improving it ever since. The hydraulic winch was the first to get an overhaul, followed shortly by a new ROV-container with a control room for piloting/navigating the ROV and a mini-workshop. In 2016/2017 we integrated new camera's including a HD-camera and LED-lights. Therefore, the fibers also got upgraded to single-mode for extra bandwidth. These upgrades were all executed by third parties. This year we will also integrate the Teledyne blue view acoustic camera for extra visibility in turbid waters. Recently, we started focusing on in-house electronics developments to create a more versatile and trustworthy system. This includes a power distribution module (PDM) to be able to balance loads to different power supplies and switching on/off all the various devices. A touch screen pilot assist screen that contains most functionality in parallel with the old buttons and switches as well as controlling the newly developed PDM. New experimental upgrade of the hydrolek 5-function manipulator valve pack electronics for a more versatile and reliable communication with possibility of a proportional control system. Future upgrades would include a new telemetry system where we are looking in the direction of the pixhawk4 with ardusub firmware, which would allow us to automate flightpaths much like an AUV.

11:10

Scripps Institution of Oceanography Portable Multichannel Seismic System, Applications, and Recent Activities – Pedrie, Kolby (Scripps Institution of Oceanography)

Abstract: Scripps Institution of Oceanography (SIO), Shipboard Technical Support (STS) provides portable MultiChannel Seismic (MCS) capabilities to US federally funded research programs. Engineers from the STS Shipboard Geophysical Group (SGG) work with researchers closely to provide comprehensive portable MCS support with project planning, environmental compliance, data acquisition and data quality controls. The SGG inventory of portable MCS equipment consists of hydrophone streamers, sound sources, data acquisition systems, protected species mitigation tools and deck equipment. Streamer and source configurations are flexible for the ability to be deployed from various research vessel platforms. Data acquisition can be customized to match scientific objectives. Recent activities for the portable MCS system include an Early Career Scientist training cruise, the evaluation of potential International Ocean Discovery Program (IODP) drilling sites, and contributions to the evaluation of gas hydrates in the Mid-Atlantic Margin. A case study on portable MCS to collect site survey data for potential IODP sites in the Western North Atlantic will be presented.

11:30

Evaluation of Accurate Heading Devices for use with Shipboard ADCP Systems – Hummon, Julia (University of Hawaii)

Abstract: Shipboard ADCPs (Acoustic Doppler Current Profilers) provide ocean currents after the application of position and heading. An accurate heading device is a crucial

component of a good ADCP data system: a 1-degree error in heading results in a 0.1m/s error in cross-track ocean velocity, about 50% of typical open ocean velocities. Therefore, good ocean currents require headings of 0.1deg accuracy. Most research ships have multiple heading devices; some have multiple accurate heading devices. Mechanical gyro compasses are reliable but not sufficiently accurate, and gps compasses can be highly accurate but are not always reliable, or even accurate. We compare the heading data collected on ships with multiple accurate heading devices to assess the accuracy of these devices, and give us confidence (or not) in the quality of these devices. Usually "the more you spend, the more accurate your heading" but there are some surprises and some disappointments. This talk will discuss these comparisons and (to a limited extent) the technology behind these measurements.

11:50

Routine Near-Surface Current and Shallow-Water Bathymetry Mapping Capabilities for Research Vessels with Science Marine X-Band Radars – Lund, Bjoern (University of Miami)

Abstract: Several research vessels in the UNOLS fleet are equipped with science marine X-band radars (MRs). R/Vs *Neil Armstrong*, *Sally Ride*, *Sikuliaq*, and *Roger Revelle* feature wave monitoring systems (WaMoS) that connect to either the navigational or a dedicated MR. WaMoS is an operational system that acquires and analyzes sequences of radar sea clutter images to yield directional surface wave spectra. It also provides access to the raw radar data (i.e., the radar backscatter intensity as a function of range for each microwave pulse transmitted and received by the rotating radar antenna) through a proprietary binary format. We have recently provided R/V *Neil Armstrong* with software tools that (1) utilize the raw radar data collected by WaMoS or similar systems to generate NetCDF files of ship motion corrected single scan radar images in Cartesian coordinates and (2) provide temporally averaged images of the sea surface roughness in KMZ or PNG formats. The NetCDF files are significantly smaller in size than the WaMoS raw radar data files (175 vs. 500 GB per day), easier to read (NetCDF is a self-describing, machine-independent, open format for scientific data with freely distributed data access libraries in many languages), and eliminate the hurdles of ship motion correction and geo-referencing. The temporal averaging of the MR backscatter intensity measurements reduces the otherwise dominant signal from the longer waves, enhancing the signals associated with current or density fronts, internal waves, sea ice, etc. The NetCDF files can be analyzed further to obtain maps of the near-surface currents and the shallow-water bathymetry, among other oceanographic products. In this presentation, we show examples of radar-derived near-surface current and bathymetric maps (at ~ 500 m resolution and up to a maximum range of ~ 4 km) from several recent research cruises. We also present the first comprehensive validation of shipboard MR near-surface current maps using measurements from ~ 1,000 biodegradable GPS-tracked CARTHE drifters as reference. The validation indicates that the MR current speeds and directions have an accuracy better than 4 cm/s and 12°, respectively. This technique holds great promise as it allows research vessels to map the horizontal flow structure, complementing the vertical profiles measured by ADCP, and furthermore yields the bathymetry of shallow water areas that are otherwise difficult to survey. Our present efforts on R/V *Neil Armstrong* and other research vessels have the goal of making MR data more accessible to the broader scientific community. In the future, we aim to provide science party and ship crew with reliable and accurate oceanographic products, including near-surface current and bathymetric maps, in near-real time.

Sea Crest Hotel - Nauset IV

10:50-12:30

Training: pCO₂

Session Leader: Aleck Wang (WHOI) and Susan Becker (Scripps Institution of Oceanography)

The air-sea interface is a boundary of great interest to atmospheric and oceanographic scientists, as heat, gas, and other material exchange occur in great extent that may affect Earth's climate and elemental cycling. Carbon dioxide (CO₂) is the primary greenhouse gas that largely determines Earth's climate. The increase of CO₂ in the atmosphere due to anthropogenic activities has caused global climate change for the last one and a half centuries. Measurements of partial pressure of CO₂ (pCO₂) at surface water is a primary mean to determine the fluxes of CO₂ between the ocean and the atmosphere.

This session will provide an overview of the methodology and the instrument commonly used for shipboard underway pCO₂ measurements today. The presentation will provide the basic knowledge of how pCO₂ sensing technology works before you get into the more practical aspects geared toward technical folks including the 'hows' and 'whys' of supporting the system and ensuring good data collection.

In the research vessel community, pCO₂ systems are finding their way onto an increasing number of ships. Part II of this session will be an immersive show and tell featuring the pCO₂ installation on Scripps Institution of Oceanography's R/V *Sally Ride*.

Sea Crest Hotel - Nauset V

10:50-12:30

Skillset Session: Timeservers, and why do we love them: why do we care about time?

Session Leader: Toby Martin (University of Hawaii)

Timeservers, and why we love them: Why do we care about time?

- Time via location (or location via time)
- order of events
- synchronization within a platform
- synchronization between platforms
- How do we know what time it is, Network Time Protocol (NTP)?
- Synchronizing daemons: NTP, systemd-timesyncd, chrony,
- Synchronizing on windows: tardis
- How often to synchronize?
- Jumping versus slewing?

Who watches the watchers? Monitoring the timeserver.

ntpq: GPS, flywheeling, init; delay, offset, jitter

Sea Crest Hotel - Racepoint

10:50-12:30

Skillset Session: Industrial hardware with introductory PLC programming

Session Leader: Josh Eaton (Woods Hole Oceanographic Institution)

Do you want to move your projects beyond the Arduino? In this session we will discuss the basics of industrial hardware and explore the ways it goes together. We will focus on industrial electronics and when to choose it. From here we will learn the basics of PLC programming. The programming will be hands on with a free suite of tools.

<https://support.automationdirect.com/products/domore.html>

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Thursday, October 18, 2018 – Sea Crest Hotel & WHOI

Thursday Morning, October 18, 2018 – Sea Crest Hotel

Sea Crest Hotel - Nauset III

9:00-10:30

Vessels & Operations

Moderator: Scott Ferguson (University of Hawaii)

9:00

Underway IFREMER Projects – R/V *Thalassa* Refit, Seismic Renewal and Polar Pod Project – Nokin, Marc (IFREMER)

Abstract: This paper reviews main projects currently underway at IFREMER. The modernization of RV *Thalassa* started in 2016 and will end by this year. The main objective was to open the ship to geosciences cruises. In particular, a new panoply of acoustic equipment was integrated on a specifically design fairing. A second important project is the complete renewal of the seismic equipment. The new system includes a 2D high penetration 6000m long streamer equipment and a 2D/3D high resolution equipment. This project was conducted between 2014 and 2018. Finally, the POLAR POD project, initiated by Dr. Jean-Louis Etienne, is currently underway. The objective is to build a new oceanographic platform inspired by the FLIP that will undertake a world tour through the Southern Ocean following the Antarctic Circumpolar Current.

9:20

Managing the UNOLS Marine Technician Pool – Chapman, Piers (Texas A&M University)

Abstract: Shipboard systems onboard Academic Research Vessels continue to grow in complexity. The Marine Technician of today must have skills in computer networking, satellite communications, electronics, general marine/deck practices and a proficiency in a multitude of instrumentation. Recent right-sizing of the fleet, led to concerns of the loss of experienced technicians which would in turn affect the training of new technicians. In 2015, the National Science Foundation issued an RFP for a Cooperative Agreement that provided for the establishment of a pool of technicians who could be used as temporary support for research cruises and associated shore-side work. The aim was to improve staffing flexibility, ensure that hard-earned knowledge was not lost but spread among new, younger technicians, and simplify the process of hiring and managing personnel. Texas A&M was awarded the initial contract for the Cooperative Agreement, which began in early 2016. In the two and a half years since the agreement was signed, the pool has grown from the initial two technicians to more than a dozen with over 90 cruises supported on 16 different vessels. A big reason why the tech pool is successful is due to the care in matching the technicians' skillsets with those required for the cruise. Some technicians have worked repeatedly on a particular vessel and developed a rapport with the vessel or project making them more a part of the operations rather than fill-in help. Teething troubles regarding items such as setting up contracts at relatively short notice, arranging insurance, and arranging for payment of salaries and expenses have been overcome. The pool is operating efficiently and has become an integral resource to the US Academic Research Fleet.

9:40 **Feasibility of the Zero/V: A Zero-Emission, Hydrogen Fuel Cell Coastal Research Vessel –**
Appelgate, Bruce (Scripps Institution of Oceanography)

Abstract: Scripps Institution of Oceanography is exploring options to replace its aging research vessel *Robert Gordon Sproul*, which conducts scientific, educational, and technology development missions offshore California. As part of this effort, we conducted a comprehensive study to determine the technical, regulatory, and economic feasibility of a coastal research vessel powered solely by zero-emission hydrogen fuel cells, and assess the environmental benefits for such a vessel. Our results indicate that it is feasible from technical, regulatory, and economic perspectives to design, build and operate a coastal research vessel powered solely by hydrogen fuel cells, using existing and commercially-available technology and services. The conceptual vessel (Zero-V) would offer dramatic environmental benefits, have low airborne and underwater noise signatures, and could be conveniently refueled by LH2 truck trailers at likely ports of call.

10:00 **R/V Sally Ride Ship Improvements –** Hirsch, Matthew (Scripps Institution of Oceanography)

Abstract: R/V *Sally Ride* is the newest Ocean class research vessel in the UNOLS fleet. It is owned by the US Navy and operated by Scripps Institution of Oceanography (SIO). After the first full year of operations Shipboard Technical Support (STS) technicians and engineers reviewed the feedback received from users of the vessel. That feedback was incorporated into planned improvements to the vessel and science network, laboratory spaces, instrumentation display layout, and instrumentation support spaces during a maintenance period. The presentation will cover the approach to these modifications, lessons learned, and outcomes.

Sea Crest Hotel- Nauset IV

9:00-10:30 Skillset Session: Intro to oscilloscopes 101

Session Leader: Lane Abrams (Woods Hole Oceanographic Institution)

At its most basic, an oscilloscope can be described as a test instrument that can display a variety of signals in graphical form over time. Through various demos, this session will give an introduction to this useful troubleshooting tool. The session will explain how, why, and when to use the dials and switches of a typical oscilloscope. Further, practical application demos for the oceanographic technician will be explored in this session, including RS232, timing and noise applications.

Sea Crest Hotel - Nauset V

9:00-10:30 Training: Catching shipboard ADCP system problems early – visualization and diagnosis

Session Leader: Julia Hummon (University of Hawaii)

This half-day tutorial will introduce shipboard ADCP acquisition systems and describe common problems. For example, a layer of bubbles may block sound from the transducer; electrical noise may get in through the transducer cable; heading or position feeds may fail; or the acquisition software may be mis-configured. We will demonstrate the use of free (open source) software tools to assess and visualize the data, identify problems, and provide solutions.

Sea Crest Hotel - Nauset III

10:50-12:10 Vessels & Operations (continued)

Moderator: Scott Ferguson (University of Hawaii)

- 10:50 **The Making of R/V ‘Kronprins Haakon’** – Bremnes, Jan (IMR)
Abstract: The icebreaker ‘RV *Kronprins Hakon*’ is just delivered to Institute of Marine Research. The vessel will be the first Norwegian Icebreaker built for Polar research. The vessel will have a PC 3 class icebreaker: Year-round operation in ice-covered waters. The vessel will be equipped to handle many scientific tasks, covering operation from fishery reaches to geology reaches and many more. To cope with its operational tasks a large instrumentation is necessary. In this session we will present an overview of the vessel and look at the instrumentation that will be available onboard, such as hydro acoustic instrumentation, scientific winches and laboratories. Furthermore, we will highlight how the vessel has performed during the first month of testing.
- 11:10 **Greening the UNOLS Fleet** – Corliss, Bruce (URI Graduate School of Oceanography)
Abstract: The University-National Oceanographic Laboratory System (UNOLS) initiated an effort to promote environmental sustainability of U.S. research vessels and port facilities in 2010 and subsequently carried out four “Green Ships and Ports” workshops at Duke University, University of Rhode Island and Oregon State University. These workshops brought together UNOLS ship operators, federal agencies, and private sector experts to discuss how to make existing and future vessels more sustainable and to identify best practices promoting environmental sustainability that can be used in the operation of the U.S. fleet. Important topics in these workshops included ship design, propulsion and fuel, energy monitoring and conservation, noise pollution, compliance, emerging technologies, port sustainability and certification. A review of findings from the workshop will be given, as well as examples of environmental sustainability of new ships entering the UNOLS fleet.
- 11:30 **CTD deployments - Operational Challenges** – Palmer, Rod (CSIRO Oceans and Atmosphere Australia)
Abstract: The RV *Investigator* is Australia’s only blue water research vessel owned and operated by CSIRO Australia and managed by the Marine National Facility and ASP Shipping. *Investigator* is a 93.9 metre purpose-built research vessel, capable of traveling 10,000 nautical miles in a single voyage, carrying up to 40 scientists and support staff, from the equator to the Antarctic ice-edge. One of the key capabilities of RV *Investigator* is to deliver world class oceanographic research, specifically through the use of a CTD system, comprising winches, wire and cable handling (Rapp-Hydema and Triplex), deployment frames, water sampling carousels, CTD (SBE9) from Seabird Inc. and multiple auxiliary instruments whose data streams are integrated into the vessel data acquisition system. Having such complex systems seamlessly integrating during deployments to deliver the highest quality data has provided many challenges. After 5 years of operation the journey continues. This presentation highlights these challenges and describes the step improvements that have been undertaken to strive for highest quality performance.

Issues to be discussed include:

- 24 Vs 36 bottle carousel deployments – weight and drag issues
- Rochester 8mm wire limits – Wire characteristics and behavior
- Carousel rotation – during deep deployments
- Cold climate operations – Water freezing in instruments
- Ship-board cable Earthing and EMI issues – data spiking
- Cable termination - mechanical and electrical
- Constant tension winch deployment mode
- AHRS monitoring of CTD payload for abnormal operation
- Active Heave Compensation – control system lag.

11:50

Conceptualizing an International Marine Technical Enhancement Exchange (IMTEE)

Program – Roth, Ethan (University of Alaska, Fairbanks)

Abstract: This session seeks broad community interaction with the goal of improving R/V science capability and expanding operational knowledge. This information may be used to help guide science mission requirements for the next US global class vessel. As a community forum, or impromptu survey of sorts, we will develop a list of ships and operators/technical personnel that are interested in the IMTEE concept. Participants will provide input on how best to conduct a program that makes effective use of time for both the "visiting technical ambassador" and the host institution. We are looking for a path to move forward that could eventually justify an actual technician exchange program beyond borders while leveraging the next generation of R/Vs.

Sea Crest Hotel - Nauset V

10:50-12:10

Training: Catching shipboard ADCP system problems early – visualization and diagnosis (continued)

Session Leader: Julia Hummon (University of Hawaii)

This half-day tutorial will introduce shipboard ADCP acquisition systems and describe common problems. For example, a layer of bubbles may block sound from the transducer; electrical noise may get in through the transducer cable; heading or position feeds may fail; or the acquisition software may be mis-configured. We will demonstrate the use of free (open source) software tools to assess and visualize the data, identify problems, and provide solutions.

Thursday morning, October 18, 2018 – WHOI Quissett Campus

WHOI Quissett Campus - Winch Pool

9:00-10:30

Skillset Session: Winch operations

Session Leader: Joshua Eaton (WHOI)

In this session we will discuss the basics of winches. We will focus on operating an electric direct drive winch and an introduction to its features. We will give you a hands-on experience with a winch and all of its operating modes, including: Speed Mode, Constant Torque, Active Heave Compensation, AHC Live Joystick, Auto-Render, and Render/Recover. Further we will discuss different types of winches and their typical uses.

WHOI Quissett Campus - Winch Pool

10:50-12:10

Skillset Session: Winch troubleshooting

Session Leader: Joshua Eaton (WHOI)

Often times winches are only an afterthought to science operations. They aren't given a second thought until something goes wrong. Join us for an in depth discussion on the way winches work and how to diagnose a problem. We will cover both electronic and hydraulic winches. Feel free to share problems you have experienced.

Thursday afternoon, October 18, 2018 – Sea Crest Hotel

Sea Crest Hotel - Nauset III

13:20-15:30

Data Management & IT

Moderator: Suzanne O'Hara (Rolling Deck to Repository - R2R)

13:20

Deployment of High Availability Computing Clusters on Research Vessels – Meyer, Jon
(University of California, San Diego/SIO)

Abstract: Cyberinfrastructure -- resources that make a modern ship's computing resources work (e.g. mail servers, DNS, DHCP, NAS, Directory Servers) -- are disruptive when they are not stable. In order to achieve maximum stability, we need high availability for such resources: we need a compute environment deployed with design requirements such as: no single point of failure, recovery strategy, vendor support and life-cycle maintenance plan that decouples our installation from our hardware. Here, we discuss the successful deployment of such clusters aboard R/V Sally Ride and R/V Roger Revelle, best practices we've adopted from the datacenter world as well as future goals.

- 13:40 **KVM over LAN for Oceanographic Data Acquisition Systems** – Yang, Daniel (University of California San Diego/SIO)
Abstract: These days, Keyboard, Video and Mouse (KVM) can be presented in multiple places on a ship's Local Area Network (LAN) easily and flexibly. With that flexibility comes heavier reliance on that LAN, which brings along engineering requirements for performance (10Gbps backbone, multicast) and high availability (Link Aggregation Control Protocol - LACP) in order to work stably and at scale. We discuss our experience in deploying such a system aboard R/V *Sally Ride*.
- 14:00 **RCRV Data-Presence: A Near Real-time Update** – Nahorniak, Jasmine (Oregon State University)
Authors: Chris Romsos, Jasmine Nahorniak, Katie Watkins-Brandt, Sean Marty, Demian Bailey, Clare Reimers College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
Abstract: Two regional-class research vessels (RCRVs) are currently under construction to support ongoing national and international oceanographic research. One of the many advanced features of these vessels is a data interface specifically designed to simplify the monitoring and maintenance of underway sensors and their data from shore and at sea. Coined “datapresence”, this system provides interactive displays of and access to near real-time data from the full suite of navigational, meteorological, and oceanographic sensors that are permanently housed on the vessel. The interface has been designed to support a range of use cases such as cruise planning, sensor status monitoring, data access, and outreach activities. Features include navigational charts, time series plots, a one-page status screen, customizable alerts, and an integrated event log. Hooks in the system also allow additional sensors brought on-board by science-party members to be temporarily added to the data interface as needed. Targeted end-users include the science party, marine technicians, vessel operators, shore-based technical support, educators, and students. The interactive nature of the interface has already been found to draw in students and pique their curiosity during outreach activities. This system has been tested on a number of research vessels, and is currently permanently installed on the R/V *Pacific Storm*. The data are continuously trickled in near real-time from ship to shore via satellite; the delay is only a few seconds. A server on shore houses the same content (data and web interface) as the server on the vessel, allowing seamless participation in the science being conducted at sea from shore. Development of the system is ongoing, and many more features are planned. Input from the community is continuously sought and is critical to the success of this system. We will present the current status of the interface and solicit suggestions from the INMARTECH participants for feature additions and further improvement.
- 14:20 **Rolling Deck to Repository (R2R): Current Status and New Developments** - O'Hara, Suzanne (Rolling Deck to Repository (R2R))
Authors: O'Hara, S, B. Arko, P. Clark, C. Chandler, J. Elya, V. Ferrini, K. McLain, C. Olson, C.Sellers, S. Smith, K. Stocks, L. Stolp, S. Carbotte
Abstract: The Rolling Deck to Repository (R2R) program provides fleet-wide management of routinely acquired environmental sensor data from the US academic research fleet, to ensure preservation of, and access to, our national oceanographic research assets. R2R routinely catalogs and deposits data in long-term public archives, including the NOAA

National Centers for Environmental Information (NCEI). Data from each cruise are submitted directly to R2R by the vessel operator. In addition, R2R provides a set of services, including: - publishing an online, searchable and browsable master cruise catalog, supported by cruise and dataset DOIs

- organizing, archiving, and disseminating original underway data and documents;
- assessing data quality on select data types;
- creating select post-field data products; and
- supporting at-sea event logging.

New developments, including documenting time sources for devices, and ongoing challenges, such as growing data volumes, will be discussed.

14:40 **Supporting Research on-board CSIRO's RV *Investigator* – A Data Perspective – Van Grass, Steven (CSIRO)**

Abstract: The research vessel *Investigator* is owned and operated by CSIRO on behalf of Australia's Marine National Facility. It provides a blue-water research platform for Australian scientists and their international collaborators to utilize in the region centered around Australia and ranging from the equator to the ice-edge of Antarctica. With a vast array of fixed instrumentation, sounders, deployable packages and capacity for additional voyage-specific installations, ensuring the collection of high quality data poses many challenges. This presentation aims to outline the technical support provided on-board the *Investigator*, with particular focus on how data is collected, quality controlled, aggregated, visualized and disseminated during scientific voyages. There will also be discussion of our experiences in supporting the ICT needs of such a versatile platform, and specifically how virtualization technologies provide a responsive backbone.

15:00 **UHDAS: Shipboard ADCP Data Acquisition, Processing, Monitoring, and Stewardship – Hummon, Julia (University of Hawaii)**

Abstract: Acoustic Doppler current profilers, (eg. RDI ADCPs) mounted in a ship's hull, can be used to determine ocean currents. Data quality can be improved by appropriate selection of ancillary data (position and heading), good settings (for the ADCP and for the ancillary feeds), and processing (single-ping editing before averaging, calibration, editing after averaging). An automated shipboard ADCP data acquisition and processing system written at the University of Hawaii ("UHDAS"), has been in operation on an increasing number of U.S. research ships since 2003; at present over 35 research ships have UHDAS installed, as well as a few volunteer observing ships (software runs autonomously). UHDAS acquires the ADCP and ancillary data, runs automated processing at sea, provides data and figures to scientists at sea, and sends a daily email back to land so the health of system can be monitored and appropriate recommendations made to the shipboard technicians. The UHDAS processing component is provided as Mercurial repositories or as a completely configured Virtual Computer. It is documented, with examples, and runs natively on Linux or Mac (or via the Virtual Computer, runs on Linux, Mac or Windows). Data acquired using UHDAS or VmDAS (Windows acquisition program that comes with RDI ADCPs) can be processed using the UHDAS processing component, providing powerful single-ping editing algorithms as well as access to diagnostic and visualization tools that are available with this software suite.

Sea Crest Hotel - Nauset IV

13:20-14:50

Skillset Session: Intro to electronics design

Session Leader: Tom Wilson (Stony Brook University)

Electronic troubleshooting is like code debugging: work down from the total system to locate the specific subsystem that is malfunctioning. Electronic design is like code writing: build simple, robust, testable subsystems, then combine them to achieve a large and complex result. This session will discuss starter kits and projects, good reference books, sources for parts and tools, the wonderful world of surplus vendors, schematics, building “one off” projects, and designing PC board.

Sea Crest Hotel - Nauset IV

14:50-15:30

Skillset Session: Tips for installing and support of a debubbler

Session Leader: Alex Sneddon (Stony Brook University)

The SoMAS Vortex Debubbler: 1987 - 2018. The SoMAS vortex debubbler is designed to remove nuisance air bubbles from an input seawater stream before sending the water to bubble-sensitive instruments such as salinometers and fluorometers. The talk will cover history, use of the debubbler aboard various ships, and a live demonstration of adjustment and operation.

Nauset V

13:20-15:30

Training Session: Exploring the mysteries of EK80: a practical guide to Simrad broadband echosounders

Session Leader: Andone Lavery (WHOI) and Michael Jeck (NOAA Fisheries)

Anyone who has used the Simrad/Kongsberg EK80 software knows there is a dizzying array of settings available to the user. Do you want a continuous wave (CW) ping or would a frequency modulated (FM) signal better serve your purpose? What are you looking for with gain adjustments, power settings, ping intervals? Would a slow or fast ramping be the best way to visualize your target data? Before even starting to collect good data there is the whole calibration question and procedure. This session aims to help do just what the title describes - explore the EK80 mysteries of which there are many. Learn what is meant by a broadband echosounder, split-beam transducer, a tungsten-carbide sphere, among many other things. Through a combination hands on and overview approach, allow us to elucidate the finer points of collecting quality EK80 data for scientists sailing aboard your vessels.

Thursday afternoon, October 18, 2018 – WHOI Village Campus

WHOI Village - WHOI Pier

13:20-15:30 *Skillset Session: A hands on introduction to Ultra Short BaseLine (USBL) systems with Sonardyne's Ranger 2 system*

Session Leader: Geraint West and Chris Hammersley (Sonardyne International Ltd)

The session will cover principles of USBL operation and optimization, including functionality for autonomous and remote vehicle operations and will supported with live in-water demonstrations. There will be plenty of opportunity for discussion and Q&A.

Mooring Lab

13:20-15:30 *Skillset Session: Wire terminations and wire testing*

Session Leader: Matt Durham (Scripps Institution of Oceanography) and Rick Trask (WHOI)

This session will explore various termination types for wire ropes and cables. Beginning with a short presentation providing an overview of different wire rope and cable types that are standard or commonly used aboard UNOLS research vessel, the session will then transition into a more open form "show and tell" where there will be examples of the terminations and descriptions of their installation and the pros and cons associated with each. Further, the session will go into the UNOLS Wire Pool wire test procedures and pull test a few different wires and terminations to breaking. The strength of various terminations applied to the same types of wire and cable can be compared.

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Friday, October 19, 2018 – WHOI Village – Redfield Auditorium

9:00-15:00 **Training Session: Multibeam**

9:00-13:00 **Kongsberg & UNOLS Multibeam Advisory Group (MAC)**

Session Leaders: Mark Amend (Kongsberg Underwater Technology, Inc.,
Tony Dahlheim (Kongsberg), Vicki Ferrini (LDEO), Paul Johnson (UNH),
Giuseppe Masetti (UNH)

Topics to be covered:

1. So your ship has a multibeam on its hull and electronics scattered about... this is how it came to be (Kongsberg)
2. These are the components to that system, this is what they do (Kongsberg)
3. Here is how to operate and maintain your multibeam (Kongsberg)
4. Open Q&A with a Kongsberg field engineer (Kongsberg)
5. Sound speed management and environmental variability estimation for ocean mapping (MAC)
6. Data evaluation / QC / Performance testing (MAC)
7. Data processing for field deliverables (MAC)
8. File management-archive-distribution (MAC)
9. What is next? (Kongsberg & MAC)

8:30-15:00 **Using Qimera to Diagnose your Multibeam**

Session Leader: Matthew Wilson/QPS

How Qimera can be used to diagnose the health of the ship multibeam system, as well as how to use some of the other Qimera tools that may be helpful to the techs.

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INMARTECH 2018 Symposium Posters

Tuesday, October 16th, 2018

Time: 18:00-20:30

Woods Hole Oceanographic Institution
Quissett Campus, Clark 507

Diao, Xinyuan (Institute of Oceanology, Chinese Academy of Sciences) - **The Usage of the ROV system for the Deep Sea Research in the West Pacific Ocean**

Abstract: In the recent years, the deep sea investigation was conducted by the IOCAS (Institute of Oceanology, Chinese Academy of Sciences) in the West Pacific Ocean. The ROV system "Faxian" was used to take sediment and marine organism samples. Many tools and equipment were invented by the engineer to improve the ability to acquire the samples. This helps the scientist make a great progress of the research about environment of the seafloor the also the biological community.

Fairbarn, Kenneth (UNH/CCOM) - **Unmanned Surface Vehicle (USV) Deployment and Retrieval Methods**

Abstract: Unmanned Surface Vehicles (USVs) are increasingly used in scientific operations across sectors including academia, government, military and public use. Due to the diversity of USV models and platforms available for deployment, streamlined methods are needed for safe and effective operations. We have been working to develop effective methods for the deployment and retrieval of a modified ASV Global C-Worker 4 from shore and on ships of opportunity including an oceanographic vessel with a knuckle boom crane and a hydrographic survey vessel with a survey launch and boom crane. Knuckle boom cranes designed for ROV work were the most effective platform identified and we have developed standardized protocols for their use. Boom cranes were found to be effective in sea states up to 1 meter, but safety of operations becomes a concern in higher sea states. Staging of tag and lift point extension lines has improved efficiency of recovery. We have tested various devices used for deployment/retrieval and found the brailer release to be the most effective, although a custom remote-controlled release would be ideal. Moving forward, we see three reasonable options for adapting existing research vessels for USV operations: 1) adapting existing survey launch davits to be used with USVs, 2) installing a knuckle boom crane, or 3) designing a reticulating A-Frame. An ideal platform must be developed that can provide safe and effective deployment and retrieval for a broad range of USV models that can be built in to future research vessel to accommodate USV operation.

Forest, Alexandre (Amundsen Science) - **The Canadian Research Icebreaker CCGS Amundsen and its Pool of Scientific Equipment**

Abstract: The CCGS Amundsen is Canada's only dedicated research icebreaker. The ship is a 98-metre long icebreaker of the Canadian Coast Guard retrofitted for science in 2003. The platform is accessible to Canadian academics and their partners from governments, the private sector and other countries. The Amundsen's pool of specialized equipment includes 65 scientific systems and 22 onboard and portable laboratories that can accommodate the

needs of physical, chemical, and biological oceanographers, paleoceanographers, geologists, atmospheric researchers, remote-sensing specialists and medical scientists studying Inuit health. The equipment is maintained, developed and operated with the support of a skilled team of ocean instrumentation professionals. Since 2003, the vessel has spent over 2,000 research days at sea and accommodated over 1,500 researchers, technicians, students, professionals and media from over 20 different countries, travelling over 230,000 nautical miles or over 10 times the circumference of the earth. For more information, please visit <http://www.amundsen.ulaval.ca/>

Gruebel, Erich (University of Rhode Island) – **UNOLS Cruise Planning Application**

Abstract: A demonstration and Q&A session for the new UNOLS Cruise Planning Web Application

Heater, Allison (Woods Hole Oceanographic Institution) – **Search for the *San Juan***

Abstract: On 15-November-2017, the Argentine submarine ARA *San Juan* made its last successful communication. On 17-November-2017, she and her crew of 44 servicemen were announced missing, and the search for the submarine became a global effort. At the time of the announcement, the R/V *Atlantis* was en route to Montevideo, Uruguay where the next mooring cruise was to commence. Within days, the *Atlantis* received its orders to join the search and rescue mission off the coast of Argentina. The *Atlantis* immediately diverted and headed toward her first assigned search area. Meanwhile, those onboard, scrambled to prepare for the new mission. The main scientific tool available on the *Atlantis* was a Kongsberg 1 x 1 em122 multi-beam echo sounder. Since this echo sounder is normally utilized as a bottom mapping system in relatively deep water, resolving large geologic features, this application presented some substantial obstacles (the *San Juan* dimensions were approximately 66 meters long and 8 meters wide when in an undamaged state). Lacking the possibility of using the *Alvin* submersible or the *Alvin* Observation Vehicle, the crew worked to find alternative methods of capturing underwater video. The CTD rosette frame was stripped of its instrumentation and lighting and cameras were added, resulting in a makeshift tethered vehicle the *Alvin* members aptly dubbed “McGyver”. Finally, during a port stop in Mar del Plata, Argentina from 16-21 December 2017, a Navy ROV, *CURV*, was added to the mix of tools. Although, by the conclusion of our voyage, on 28 Dec 2017, the whereabouts of the *San Juan* remained a mystery, new insight into the crew’s ability to stretch the limits of the R/V *Atlantis’* equipment was gained. Coming together to build vehicles of opportunity, sit unexpected and long multi-beam watches, and investigate the thresholds of the multi-beam system in search of the best possible resolution are the sorts of things UNOLS ships’ crew do best.

Laird, Robert (Woods Hole Oceanographic Institution) - **Euler, TSS, Tait-Bryan? Do you know what your Motion Sensor is saying?**

Abstract: Your motion sensor outputs roll and pitch with a particular frame of reference. But there is more than one frame of reference available, and even though they are mathematically related in a defined way, they are not identical. We will be looking at the pitfalls of getting this wrong, and will also take some side trips about general survey requirements and how a manufacturer can make your life miserable by messing up a firmware upgrade in a motion sensor.

Matthews, Nick (Bermuda Institute of Ocean Sciences) - **Underway Data Logging, Wire Reports & Event logging Integrated Solutions for Automation**

Abstract: The R/V *Atlantic Explorer* has implemented a simplified system of logging cruise events and underway data which has allowed us to automate wire reports. For underway data, the emphasis was put on the use of commercially-available data logging and viewing products. Currently, the ship is logging all meteorological and sea-surface data on Campbell Scientific DataLoggers. Data from any hull-mounted acoustic instruments have not been implemented yet. The underway data was then made available on the ship's network for use by a custom-made program that logs science events during a cruise. This event logger is web-based, collects a snapshot of all underway data and has a foolproof user interface that is easy enough for bridge officers to use. They merely click three buttons on an iPad and the rest of the data is automatically collected. Lastly, the event times from the event logger are synced with underway data and LCI-90i data to produce automated wire reports for submission to the wire pool and for general monitoring of the life of a wire. This overhaul has improved the quality, consistency and the reliability of our data logging while also making the ship tech's experience more efficient.

Quinn, William (NIWA) - **Installation of Geotechnical Survey Systems on Small Vessels**

Abstract: The National Institute of Water and Atmospheric Research (NIWA) which is based in New Zealand, has operated various marine geotechnical survey systems from its small survey craft (< 14m). This poster will show several of the approaches NIWA has undertaken to mount and deploy survey equipment (multi-beam systems, sub-bottom profilers, USBL transponders) from these vessels).

Rolph, Jeremy (COAPS-FSU) - **Best Practices for Automated Meteorological and Thermosalinograph Observations**

Abstract: Most research vessels are equipped to provide underway observations of navigational (position, course, heading, and speed), meteorological (air temperature, humidity, wind, surface pressure, radiation, rainfall), and near-surface oceanographic (surface sea temperature and salinity) parameters. Using automated instrumentation and computerized data acquisition systems, these measurements are typically made at high-temporal frequency (sampling interval ≤ 1 minute). For nearly two decades, the authors have been collecting and quality-evaluating these underway measurements within projects that include the World Ocean Circulation Experiment, Shipboard Automated Meteorological and Oceanographic System Initiative, and the Rolling Deck to Repository. From this experience, the authors will describe best practices for making meteorological and surface oceanographic measurements using the types of automated sensors common to research vessels. Best practices include those associated with deployment of instruments on a vessel, data processing and reduction methods, and documentation of sensors and the data in a manner that meets the needs of the downstream data user. The authors will provide recommendations for siting various meteorological and oceanographic sensors to achieve maximum data quality. This topic will also address vessel design parameters that can maximize sensor exposures to the environment when new vessels are built. We will also address techniques to orient wind sensors and how to take advantage of translators and/or DAS to adjust wind sensor angles to achieve a bow-referenced relative wind. Data processing techniques will include proper calculation of true winds, adjusting observations to standard heights, averaging methodology, etc. We will address metadata requirements including, but not limited to, sensor location, calibration, units, averaging, precision, processing level, etc.

For ocean sensors, we will provide best practices for siting different sea temperature and salinity sensors and note the critical metadata needed to support a range of applications.

Stolp, Laura (Woods Hole Oceanographic Institution/SatNAG) - **Bandwidth Limiting Tools**

Abstract: Satellite bandwidth is a finite resource and technicians aboard research vessels are constantly trying to manage bandwidth with tools that allow or deny applications, limit amount of bandwidth per device and/or user, yet they can still spend large amounts of time tracking down errant applications. A bandwidth limiting application can be used as a stand-alone method to reduce bandwidth consumption for a particular device. There are a number of bandwidth limiting tools and we have delved into several and tested them on different systems, and will be presenting our results as part of our poster presentation.

T'Jampens, Michiel (Flanders Marine Institute) - **Adding an event-based scheduling interface to a Research Vessel's data acquisition system**

Abstract: VLIZ runs an in-house developed DA system on board the RV *Simon Stevin* to provide continuous real-time weather, navigation and water quality parameters during campaigns. When in 2015 the ICOS project started, a much stricter and thorough calibration and verification process of a real-time pCO₂ gas analyzer was demanded. At an early phase, this could be implemented in hardware. But due to increasing complexity it was opted to implement it in the DA system. Given that this process involves controlling multiple devices while gathering data from sensors and doing calculations on it. This meant implementing a script-able scheduling interface. This interface needed to allow –among other things- to send a specific string to a chosen device at a certain time if a real-time value was within preset parameters... and maybe report about it in an email. In short, the DA system needed to evolve from simple 'gather-data-and-make-sure-it's-stored' to a system that can actively interact with devices.

Yokota, Makito (Marine Applied Technology Section) - **Air-sea flux observation by Wave Glider SV3**

Authors: Makito Yokota, Iwao Ueki, Tatsuya Fukuda, Yasuhisa Ishihara, Marine Works Japan LTD., Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Abstract: JAMSTEC is conducting air-sea flux observation in the western Pacific and eastern Indian Ocean by TRITON (Triangle trans-ocean buoy network) and m-TRITON moorings. The mooring observation has the advantage to acquire detailed direct measurement record at a fixed point compared with satellite observation. However, it takes relatively high cost to keep many sites and it cannot cover wider area without the large number of moorings. Therefore, JAMSTEC is developing an air-sea flux observation system based on Wave Glider (Liquid Robotics, Inc.) that can reduce operation cost and can observe wider area. Three types of meteorological sensor units; the Weather Station (Airmar Technology Corp.), Weather Transmitter (Vaisala), and JAMMET (JAMSTEC), are installed on Wave Glider and those can measure air temperature, relative humidity, barometric pressure, longwave radiation, shortwave radiation, wind and rain fall amount. Underwater sensors for temperature, conductivity, pressure and ocean current profiler within 120 m depth are also installed. The poster presentation will describe specification of Wave Glider for air-sea flux observation, result of comparison with m-TRITON buoy, and actual procedures of deployment and recovery by small boat.

List of Presenters (in Alphabetical Order) and their Presentation Titles

Name	Presentation Title	Session
Appelgate, Bruce	Feasibility of the Zero/V: A zero-emission, hydrogen fuel cell coastal research vessel	Vessels & Operations
Becker, Susan	Oceanographic Data Facility 36 Position Rosette Improvements for Repeat Hydrography Cruises	Sensors and Observing Systems
Bremnes, Jan	The Making of RV <i>'Kronprins Haakon'</i>	Vessels & Operations
Calvin, Jorge	VSAT communications enabling survey USV operations beyond line of sight	Ship/Shore Communications
Chapman, Piers	Managing the UNOLS Marine Technician Pool	Vessels & Operations
Cohn, David Pablo	OpenRVDAS - an Open Source Data Acquisition Architecture	Technical Demonstration
Coleman, Dwight	Ship-to-Shore Telepresence-Enabled Research and Education	Ship/Shore Communications
Corliss, Bruce	Greening the UNOLS Fleet	Vessels & Operations
Crodeff, Jeff	LED Strobes – the challenges of getting high power at a fast recharge rate	Acoustics & Camera Systems
Crenan, Brieuc	Implementation of automatic underway measurement system "Ferrybox" on Research Vessels	Sensors and Observing Systems
Crenan, Brieuc	Presentation of Kongsberg's EM304 results onboard RV <i>Thalassa</i>	Acoustics & Camera Systems
Deguchi, Mitsuyasu	High-rate underwater acoustic communication system for image transmission with a manned submersible <i>SHINKAI6500</i>	Acoustics & Camera Systems
Einhorn, Micheal	USCG 46CFR189.35 vs Commercial Standards for deck Samachinery: A comparison of their impact on design and load testing	Load Handling Systems and Tension Members
Felix, Bruce	Sensor Calibration Tracking	Sensors and Observing Systems
Feldman, Ken	UNOLS Internet Use Policy (40min)	Ship/Shore Communication
Fornari, Daniel	High Resolution Deep-Sea Imaging and Camera-Guided Sampling Using EPO-Ocean Imaging Systems and WHOI-MISO/SSSG Integrated Camera Systems	Acoustics & Camera Systems
Gruebel, Erich	UNOLS Cruise Planning Application	Technical Demonstration
Hirsch, Matthew	RV <i>Sally Ride</i> Ship Improvements	Vessels & Operations
Houthoofd, Robin	Technically enhancing an aging roV	Vehicles and all the rest
Hummon, Julia	Evaluation of Accurate Heading Devices for use with Shipboard ADCP Systems	Vehicles and all the rest
Hummon, Julia	UHDAS: Shipboard ADCP Data Acquisition, Processing, Monitoring, and Stewardship	Data Management & Vessel IT
Keijzer, Edwin	"Hands-Free" CTD Water Sampling	Sensors and Observing Systems
Kemp, Amy	LEO + GEO = Innovation Squared	Ship/Shore Communications
Kocan, Harson	Rapp Marine and Triplex - Full Lifecycle Resource for Oceanographic Load Handling Systems	Load Handling Systems and Tension Members
Lund, Bjoern	Routine near-surface current and shallow-water bathymetry mapping capabilities for research vessels with science marine X-band radars	Vehicles and all the rest
Meyer, Jon	Deployment of High Availability Computing Clusters on Research Vessels	Data Management & Vessel IT

Nahorniak, Jasmine	RCRV Datapresence: A Near Real-time Update	Data Management & Vessel IT
Nokin, Marc	Underway Ifremer projects – RV <i>Thalassa</i> refit, seismic renewal and Polar Pod project	Vessels & Operations
O’Hara, Suzanne	Rolling Deck to Repository (R2R): current status and new developments	Data Management & Vessel IT
Ober, Sven	The temperature-dependency of oceanographic thermometers	Sensors and Observing Systems
Palmer, Rod	CTD deployments - Operational Challenges	Vessels & Operations
Pedrie, Kolby	Scripps Institution of Oceanography Portable Multichannel Seismic System, Applications, and Recent Activities	Vehicles and all the rest
Race, Julian	Using Kayaks for Low-Impact Coastal Research in Antarctica	Technical Demonstrations
Roper, Chris	Maintain and Expand your Seafloor Observatory by Installing a Sea Floor Resident AUV / ROV system	Sensors and Observing Systems
Roth, Ethan	Conceptualizing an International Marine Technical Enhancement Exchange (IMTEE) Program	Vessels & Operations
Smit, Marck	Seabed mining: field testing of a nodule mining crawler	Sensors and Observing Systems
Trask, Rick	Community Discussion on synthetic 0.322 alternatives	Load Handling Systems and Tension Members
Tyndall, Aaron	Multiple platforms on a fibre optic towed cable	Load Handling Systems and Tension Members
Van Graas, Steven	Supporting research on-board CSIRO’s RV <i>Investigator</i> – A data perspective	Data Management & Vessel IT
Vansteenwegen, Dieter	Development of an autonomous solar tracking measurement platform for offshore use	Sensors and Observing Systems
Vaughn, Ian	Practical Impacts of Sonardyne CASIUS Calibration on USBL Performance	Acoustics & Camera Systems
Walsh, Kevin	HiSeasNet Engineering Review and Preview	Ship/Shore Communication
Walton, James	Enhancing CTD And Multiparameter Water Column Data Collection With Moving Vessel Profiler	Sensors and Observing Systems
West, Geraint	Optimising performance of a long range Ultra Short Baseline tracking and telemetry system	Acoustics & Camera Systems
Yang, Daniel	KVM over LAN for Oceanographic Data Acquisition Systems	Data Management & Vessel IT

INMARTECH 2018 Symposium
Mini Tradeshow Vendor List
Sea Crest Hotel, Nauset I and II

Vendors

Rapp Marine/Triplex
Kongsberg
WorldLink
Scanmar AS
Sonardyne International Ltd.
Markey Machinery
Hawboldt Industries
Teledyne
McLane Research Labs
MacArtney Inc.
Hydroid
Edgetech
AML Oceanographic
Saab Seaye
Remote Measurements & Research Co. LLC/The Eppley Laboratory, Inc.
Applanix

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INMARTECH 2018 Symposium Attendee List

Last	First	Affiliation
Abrams	Lane	Woods Hole Oceanographic Institution
Agnich	Jason	University of Minnesota, Duluth
Alberts	Jon	UNOLS
Alesandrini	Stian	Schmidt Ocean Institute
Amend	Mark	Kongsberg Underwater Technology, Inc.
Appelgate	Bruce	Scripps Institution of Oceanography
Bahr	Frank	Woods Hole Oceanographic Institution
Baldwin	Wayne	U.S. Geological Survey
Becker	Susan	Scripps Institution of Oceanography
Beem	Kristin	Oregon State University
Benway	Eric	Woods Hole Oceanographic Institution
Besson	Karen	UNOLS
Bierbaum	Joshua	LUMCON
Bjork	Barry	Antarctic Support Contract
Boom	Lorendz	Royal Netherlands Institute for Sea Research (NIOZ)
Bremnes	Jan	IMR
Broda	Jim	Woods Hole Oceanographic Institution
Brodet	Steve	Hydroid, Inc.
Brown	Bob	Hydroid, Inc.
Burbank	Tim	Ocean Exploration Trust
Butler	Lynne	University of Rhode Island
Caldwell	Craig	Hydroid, Inc.
Callahan	Barbara	UNOLS Wire Pool
Calvin	Jorge	OmniAccess
Campbell	Errol	Schmidt Ocean Institute
Cano	Marco	Cortland
Carlin	Croy	University of Washington
Carter	Jennifer	Woods Hole Oceanographic Institution
Chapman	Piers	Texas A&M University
Chen	Ruoting	Xiamen University
Chuhran	Chris	Antarctic Support Contract - Leidos
Clark	Dru	Scripps / R2R
Clark	Pam	Woods Hole Oceanographic Institution
Cohn	David Pablo	N/A
Colburn	Ted	JMS
Coleman	Dwight	Inner Space Center
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