ASOF 2021 ABSTRACTS

Author's Name	Title	Affiliation	Email	
Dr Johnathan Kool	New Frontiers in Antarctic mapping – Emerging Technologies	AAD	Johnathan.Kool@awe.gov.au	Many new technologies are emerging that are unlocking new opportunities for mapping the Antarctic, on land, in the air, and below the ocean's surface. Drones, Autonomous Underwater Vehicles (AUVs), saildrones, satellites, and other capabilities all offer new ways of performing research and observing the environment. In this talk we will review some of these technologies, and discuss how they can be used to support Australia's engagement in the Antarctic and Southern Ocean.
Stephanie Mayoh	An introduction to underwater vehicle deployment and positioning on RSV Nuyina	AAD	Stephanie.Mayoh@awe.gov.au	This talk will provide an overview of the HiPAP USBL System fitted to the vessel and projected use cases for ROV and AUV systems. Possible deployment scenarios will be described along with an outline of our commissioning plans. Finally, a recent training opportunity (and possible collaboration) with the NASA Jet Propulsion Laboratory (Orpheus) will be discussed.
Dr Imojen Pearce	Commissioning Program for Science Systems on board RSV Nuyina	AAD	Imojen.Pearce@awe.gov.au	This talk will provide an overview of the HiPAP USBL System fitted to the vessel and projected use cases for ROV and AUV systems. Possible deployment scenarios will be described along with an outline of our commissioning plans. Finally, a recent training opportunity (and possible collaboration) with the NASA Jet Propulsion Laboratory (Orpheus) will be discussed.
Pip Bricher, Petra Ten Hoopen, Benjamin Pfeil and SOOS Data Management Sub-Committee	Weaving together a data system for the Southern Ocean	Utas	data@soos.aq	The Southern Ocean connects the world's ocean basins and it also connects the world's ocean and Antarctic data sharing systems. Researchers and data professionals from more than 60 countries are part of the Southern Ocean Observing System, which aims to integrate data into an interoperable system that both contributes to and relies on international efforts to agree on best practice approaches to all elements of data management. In this presentation, we will outline the vision for a Southern Ocean data system that was created through OceanObs19 and is being refined as part of the UN Decade of Ocean Science for Sustainability. We will discuss the challenges

				inherent in creating a truly international interoperable data ecosystem that serves various scientific disciplines. At the centre of the Southern Ocean data system is SOOSmap (https://www.soosmap.aq/) - a portal for well curated and standardised datasets of key circumpolar interest, which draws on the infrastructure of EMODnet. However, SOOSmap cannot bring together the wide variety of data coming from process studies and other research where standards have not been widely adopted. For those data types, SOOS has a metadata portal and is working with international colleagues to develop federated metadata search based on Schema.org, as an attempt to bridge the seemingly intractable differences in metadata standards across scientific communities. Finally, the SOOS Data Management Sub-Committee helps connect scientists and data centres to find permanent, trustworthy homes for datasets that have not yet been brought into formal data management structures. This multifaceted approach helps weave an interoperable whole out of disparate parts and, with a minimum of centralised funding, depends on the generosity and cooperation of a broad community.
Prof Byeong Ho Kang	New WILR to support the transition to Industry 4.0 : Technology Pool Program	Utas	byeong.kang@utas.edu.au	Industry 4.0 is about the transformation of conventional industrial processes by implementing automation to enhance overall production efficiency. This automation is primarily facilitated by ICT, particularly domains such as AI, IoT, Cloud Computing, BigData and Data sciences work as enabling technologies. In recent years, ICT has been evolving at a higher pace; moreover, the global impact of COVID-19 has acted as a catalyst to rapid evolution. In the industry, in-house ICT team sizes are shrinking as the focus is more towards Off the shelf platforms and re-usability of infrastructures. In-house teams are more focused on the sustainability of the ICT solutions rather than core development. Consequently, a substantial impact on the technology workforce has been noted which has cast its shadow on technology institutes, universities, and research organisations. Traditional internship based programs are getting decommissioned in the favour of modern work-integrated learning. Considering this as a growth opportunity, we at ICT UTAS are taking lead with the development of our Technical Pool Program (TPP). The mission of this program is to bring the university, industry and research organisations together into the Work Integrated Leaning and Research platform that can support the transition to a new technology-based society. We aim to support stakeholders (students, industry, researchers) to meet their success. For students, this program presents

				work-ready skills and work-placement opportunities. For industry, this program not only provides flexible ICT workforce arrangements, but also enables support for sustainability and continuity of on-going ICT projects and their outcomes. This program also extends its services to the research community by reducing the ICT development burden of the research projects; moreover, integrates the ICT innovation to the distinctiveness of the domain research.
A.M. Chiodi, C. Zhang, E. D. Cokelet, Qiong Yang, C. W. Mordy, C. Gentemann, J. Cross, N. Lawrence-Slavas2, C. Meinig, M. Steele, D.E. Harrison, P. Stabeno, H. Tabisola, D. Zhang, E. Burger, K. O'Brien, M. Wang	Exploring the Pacific Arctic Seasonal Ice Zone with Saildrone USVs	Uni of Washington NOAA PMEL	andy.chiodi@noaa.gov	More high-quality, in situ observations of essential marine variables are needed over the seasonal ice zone to better understand Arctic and Antarctic weather, climate, and ecosystems. In summer 2019, a collaboration between US National Oceanographic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA) and University of Washington investigators led to the deployment of five wind-driven and solar-powered uncrewed surface vehicles, with the objective of collecting such observations and providing a subset of them to forecast centers in real time. To better assess the potential for arrays of USVs to provide such observations, these five USVs were sailed into the Chukchi and Beaufort Seas following the 2019 seasonal retreat of sea ice. The vehicles deployed on this mission were developed as part of a cooperative research agreement between Saildrone, Inc. and the NOAA Pacific Marine Environmental Laboratory. The saildrones were equipped to observe the surface oceanic and atmospheric variables required to estimate air-sea fluxes of heat, momentum and carbon dioxide. Some of these variables were made available to weather forecast centers in real time. Our objective here is to highlight the challenges and opportunities for improving remote ice navigation strategies with USVs. We examined the sources of navigational sea-ice distribution information based on post-mission tabulation of the sea-ice conditions encountered by the saildrones. The satellite-based ice-concentration analyses consulted during the mission exhibited large disagreements when the sea ice was retreating fastest (e.g., the 10% concentration contours differed between analyses by up to ~175 km). Attempts to use saildrone observations to detect the ice edge revealed that *in situ* temperature and salinity measurements varied sufficiently in ice bands and open water that it is difficult to use these variables alone as a reliable ice-edge indicator. Devising robust strategies for remote ice zone navigation may depend on developing the capability to recognize sea ice and initiate navigational maneuvers with cameras and processing capability onboard the vehicles. We also used the saildrone observations to evaluate the initial conditions used in several operational numerical weather forecasting systems. Results revealed large biases in near-

				surface temperature and humidity associated with surface warming that was observed by the saildrones but not captured by the models.
Nicholas P Chotiros	Probing elastic properties of sea ice from below with acoustic backscatter	University of Texas	chotiros@ieee.org	The reflection coefficient, as a function of incident angle and frequency, holds many clues to the elastic properties of an elastic material, and particularly arctic ice. Such a measurement could be used to invert for the bulk and shear moduli and the layering within the material. In the case of the underside of arctic sea ice, a small AUV could make such a measurement by using an on-board sound source and a towed line array. The reflection coefficient as a function of frequency and grazing angle is sensitive to the shear speed profile in the ice. However, if power and other constraints make the use of a towed array impractical, then a reduced set of information may be obtained from normal incidence reflection and backscatter measurements, which can be made from one transducer acting as both source and receiver. In particular, the backscattering strength as a function of grazing angle and frequency may be measured by a single transducer. Due to the strong connection between backscattering strength and reflection coefficient, there is a possibility of deducing the shear speed from the backscattering strength as a function of grazing angle. This study explores the acoustic backscattering strength due to the roughness of the water-ice interface and its connection to the shear speed within the ice. [Work supported by the US Office of Naval Research]
Emiliano Cimoli[1,3], Vanessa Lucieer[1], Klaus Meiners[2], Arko Lucieer[3], Zbynek Malenovsky[3], Lars-Chresten Lund-Hansen[4]	Prospects of proximal imaging spectroscopy for sea-ice biophysical research	IMAS-Utas AAD School of Technology, Env & Design-Utas Aarhus University, Denmark	emiliano.cimoli@utas.edu.au leesa.borojevic@utas.edu.au	Sea ice spans over 10% of the world oceans and provides a substrate for key phototrophic organisms. To understand the role of sea-ice algae in the Earth's system, we are required to capture complex biophysical dynamics whereby the variability of small-scale processes can have far-reaching implications at the regional and global scale. Traditional sea-ice sampling methods struggle to capture the high spatio-temporal variability at which sea ice biophysical processes occur (from 1 µm to 10-1000 m). As a result, we lack the mechanistic understanding required to model and predict sea ice primary productivity along with some of its key ecological functions. Hyperspectral imaging (or imaging spectroscopy) offers a turning point in the way we monitor biophysical process in sea-ice at varying spatial and temporal scales. High spatial (mm to cm), and spectral (<3.4 nm) resolution imaging data its being acquired both ex-situ, on vertical and horizontal sea ice cores sections, as well as in-situ, from under-ice remote sensing platforms such as sleds or Remotely Operated Vehicles (ROVs). Combined with the vast array of emerging computational algorithms, its premise is to fundamentally enhance the level of details in the quantification of sea ice productivity, ice algal ecological interactions and biogeochemical model

				parametrizations. In this work we outline some of the potential applications and research prospects for imaging spectroscopy in relation sea ice biophysical research.
J. Nichols, D. Collyer, A. Woodroffe, E. Jackson, C. Cary	Hauwai 20: An autonomous biosampler for year-round, under-ice measurements in the Antarctic	Cellua Robotics Ltd, Canada University of Waikato, NZ	jnichols@cellula.com	Sea ice is essential in supporting the critical primary production that supports the polar marine food web. The extent and duration of sea ice in the Antarctic is predicted to decline in a warming world, and the primary production needed to support current populations is expected to decline in tandem. A prototype under-ice biosampler, the Hauwai 20, will be deployed at Scott Base (Ross Island, Antarctica) for the 2021/22 season. The sampler has been designed to answer questions about diversity, recruitment, distribution, and abundance of key sentinel organisms to understand how this critical habitat and organisms may respond to a warming world. Year-round sampling below the sea ice will provide a hitherto unavailable and essential data set for environmentalists and oceanographers. As evidence-based policies are developed to address concerns with regard to climate change, a consistent method of data collection is necessary. Climate models focus on a broad approach, as they are required to describe the long-term outlook for the planet. Many of the processes that contribute to these changes happen at very small space and time scales. Furthermore, we have limited knowledge on what happens underneath the sea ice during the winter, spring, and fall periods. To improve future predictions and climate models, a better understanding of how these small processes scale to the large is required. The Hauwai 20 sampler has been designed for year-round deployments below the sea ice. The sampler can take up to 150 discrete samples, each stored in a sealed puck. Each puck contains up to three filters, with user selectable pore sizes from 0.22-1000 µm. A displacement pump pulls a sample through the filters for a user defined volume. At the end of the sample, a preservative is injected into the puck, which is then sealed. The flow path is sterilized once the puck is stored to reduce cross-contamination between samples. To take samples directly under-ice, the sampler is moored on the seafloor and a winch raises and lowers a float containing the sample intake, CTD, altimeter, camera and other sensors. The upwards facing altimeter is used to position the float just under the sea ice for sampling. The sampler incorporates lessons learned from previous designs and has been significantly updated for year-long deployments in the Antarctic. This project has been funded by the University of Waikato and the New Zealand Ministry of Business, Innovation and Employment. The sampler design, pre-deployment testing and science objectives for the first season in the Antarctic will be presented.

Peter King, Konrad Zürcher, and Isak Bowden-Floyd	Planning for the worse: automating the process of under-ice AUV mission planning	Australian Maritime College-Utas	pdking@utas.edu.au	Deploying an Autonomous Underwater Vehicle (AUV) beneath ice remains a high-risk and challenging task. The physical barrier of ice limits the ability to support vehicles through tracking and communication and limits the availability of navigational aids. In the event of a systematic fault or unexpected situation beneath ice the available courses of action are limited, drastically reducing the likelihood of recovery [1]. To address these challenges the Autonomous Maritime Systems Laboratory (AMSL), over the past five years, have established a methodology for the deployment of large AUVs on long incursion missions beneath ice. This methodology was developed through collaboration with an international panel of experts in the field [2] and has been utilised successfully in two Antarctic deployments of the AUV *nupiri muka*. Codified as a *Risk-averse approach to mission planning*, this methodology stresses the use of a mission template with fixed stages, target locations, and responses to events and detected faults [3]. The underlying ethos are that mission progression is conditional, weighted toward safe return versus mission objectives, and that all missions follow a strict template where only specific locations of targets change. This methodology was deployed in earnest at the Thwaites Glacier in 2020, with six successful deployments of *nupiri muka* beneath the ice, with the longest incursion reaching 30km. To further adhere to the concept of a strict template and to reduce both the planning load on the operators and the likelihood of error, AMSL have developed tools to automate the process of mission generation. These tools are built using open standards and libraries and allow the generation of robust under-ice missions through user interaction on an open GIS platform. Tests of these tools have proven highly valuable, with plans to deploy them on upcoming missions to the Thwaites Glacier. This work will outline the mission planning process employed by AMSL, the template concepts, and introduce the tool set.
Dr Mike Williams on behalf of the SOdecade Task Force	The Southern Ocean UN Decade	Royal Belgium Institute of Natural Sciences, Brussels, Belgium	info@sodecade.org ajanssen@naturalsciences.be Mike.Williams@niwa.co.nz	*Background* In 2017, the United Nations proclaimed a Decade of Ocean Science for Sustainable Development (2021-2030) to reverse the cycle of decline in ocean health, and globally strengthen the international cooperation needed to develop the scientific research and innovative technologies that can connect ocean science with the needs of society. By gathering stakeholders worldwide, the initiative intends to set up a common framework to ensure ocean science can fully support countries in achieving the sustainable management of oceans across the globe.

				The Southern Ocean process Based on the recommendations in the global Ocean Decade implementation plan, the Southern Ocean community engaged in a stakeholder-oriented process to develop the Southern Ocean Action Plan. This Action Plan will provide a framework for Southern Ocean stakeholders to formulate and develop concrete activities that support the Decade vision. Together with outputs from the First Southern Ocean Workshop, the Southern Ocean Task Force collated strategic and scientific priorities from our individual implementation plans, together with those outlined in previous polar and Antarctic initiatives, including the SCAR Horizon Scan (2014), COMNAP Antarctic Roadmap Challenges (2016) and EU-PolarNet (2016). This desk study generated a report of identified strategic and scientific priorities for the Southern Ocean which served as a basis for the Southern Ocean survey, launched in May 2021. This stakeholder-oriented consultation aimed to identify gaps within the report and prioritize Southern Ocean objectives to ensure the wellrepresentation of all groups. Additionally, stakeholders provided input on the activities and contributions that should be developed in the context of the Decade. Working Groups are now being set up for each of the Decade's Societal Outcomes. These meetings will set out to identify the needs of the Southern Ocean community in view of addressing the Southern Ocean priorities identified through the survey. The input from each Working Group will be synthesised into a Draft Southern Ocean Action Plan, which will then be jointly consulted by all stakeholders at the 2nd Southern Ocean Regional Workshop. This workshop will be held online from 20-22 September 2021 and will bring forward a community consensus on how the Southern Ocean community will engage within the Ocean Decade Framework. Following the 2nd Southern Ocean Regional Workshop, the Task Force will review and finalize the Southern Ocean Action Plan.

				The development process of the Southern Ocean Action Plan aims to engage a broad community spanning from the scientific research community to the business and industry sector, and governance and management bodies. Through this combined effort, we will identify synergies in priorities over the next decade and identify tangible actions and deliverables to achieve these priorities as a community.
A. Camps[1], J.F. Munoz-Martin[1], J.A. Ruiz-de-Azua[1,2], L. Fernandez[1], A. Perez-Portero[1], D. Llavería[1], C. Herbert[1], M. Pablos[3], A. Gutiérrrez[4], C. António[4], J. Bandeiras[4], J. Andrade[4], D. Cordeiro[4].	FFSCAT – A CubeSat Based Mission for the Polar regions	[1]CommSensLab-UPC, Dept. of Signal Theory and Communications Universitat Politècnica de Catalunya, and Institut d'Estudis Espacials, Barcelona, SPAIN [2]i2Cat, C\ Gran Capità 2-4 Edifici Nexus I, 2ª planta 08034 Barcelona, SPAIN [3]Institut de Ciències del Mar (ICM-CSIC) & Barcelona Expert Center (BEC) on Remote Sensing, Barcelona, Spain; Passeig Marítim de la Barceloneta, Barcelona, SPAIN [4]Deimos Eng., Lisboa, Portugal	camps@tsc.upc.edu	The FSSCat mission was proposed in 2017 by Prof. Camps (UPC) and Prof. Golkar (Skoltech, UPC visiting professor) to the ESA S^3 (Sentinel Small Satellite) Challenge of the 2017 Copernicus Masters competition. It was the winner of the ESA S^3 and overall winner [https://copernicus-masters.com/winner/ffscat-towards-federated-eo-systems], and it was implemented with ESA funding, who also sponsored the launch in the VEGA SSMS PoC (VV 16) on September 3rd, 2020. FFSCat is an innovative mission consisting of two federated 6U Cubesats carrying two scientific payloads: • UPC's Flexible Microwave Payload – 2 (FMPL-2) onboard 3Cat-5/A (identifier 2020-061W) is an innovative dual microwave payload (L-band microwave radiometer and GNSS-Reflectometer) implemented in a software defined radio, • Cosine's HyperScout-2 onboard 3Cat-5/B (identifier 2020-061X) is a hyper-spectral optical payload in the visible, near and thermal infrared, enhanced with PhiSat-1 an Artificial Intelligence experiment for cloud detection. The mission goals are to provide coarse resolution soil moisture, sea ice extent and thickness maps, and to detect water ponds over ice, using microwave radiometry (MWR) and Global Navigation Satellite Systems – Reflectometry (GNSS-R), and enhanced resolution soil moisture maps applying pixel downscaling techniques by combining MWR, GNSS-R and VNIR imagery. L-band MWR can be used to infer sea ice thickness up to ~60 cm. GNSS-R is very sensitive to the surface where the scattering is taking place, being sensitive to the presence of ice, and even its type. The figures below show sample sea ice concentration and thickness over the Arctic and Antarctic oceans derived from FFSCat data. In this presentation we will describe the FSSCat mission, the techniques and products obtained during the first 3 months of operations.

				FSSCat is the first CubeSat-based mission contributing to the EU Copernicus program, and the data acquired follows Copernicus open and free data policy and can be downloaded from: https://catalogue.nextgeoss.eu. FSSCat has shown its potential as a precursor of a scalable constellation of federated small Earth Observation satellites, to cover the gaps in the polar observations in the next years.
Cassie Schwanger, Kendall Sherrin, Stephen Tibben, Andreas Marouchos,	Understanding Nutrient Data – In person intercomparison exercise 2022	CSIRO Hobart, Tas	Cassie.schwanger@csiro.au	Agreement on the analysis, processing, and subsequent delivery of nutrient datasets from different laboratories has been a long-standing issue. The problem of nutrient data comparability has been highlighted by multiple high-profile committees (UNESCO, ICES, IPCC) (Aoyama et al, 2018). In 2007 Bindoff et al noted in the IPCC report that adequate comparability and traceability of measurements of oceanic nutrients had still not been achieved. The SCOR WG#147 was formed with the aim of improving the comparability and traceability of nutrient data in the world's oceans. To follow on and better improve understanding of the disparity in nutrient data, a shipboard inter-comparison exercise will be conducted in collaboration with international laboratories to perform concurrent nutrient analysis in-situ. Direct comparison of these in-situ measurements will help identify key differences in sampling and analytical methods that contribute to disparity in reported results. Targeted experiments will be conducted to focus on isolating variables to further improve the understanding of techniques and protocols. The findings will lead to the formation of recommendations of best practice techniques for ensuring high quality measurements. Standardisation of methodologies across international sea-going agencies is a significant step towards improving the comparability of datasets.
Geunho Lee, Teppei Inoue, Aye Aye More, and Sousuke Hamada	First Step toward Underwater Explorations Using Paddle-based Propulsion Mechanism	Graduate School of Engineering, University of Miyazaki, Japan	geunho@cc.miyazaki-u.ac.jp	The ocean covering over 70% of our planet's surface is the life force of Earth. Since the dawn of history, the ocean has been an essential source of food, transportation, business, activity, and spiritual inspiration. According to surveys, more than 80% of our ocean remains unmapped, unobserved, and unexplored. There still remain much more to be discovered from exploring its deep sea. Toward the contribution to underwater explorations, unmanned underwater robotic systems need a propulsion device for moving around desired areas. The propulsion device generates thrust to have a system move in an assigned direction. According to thrust-generation methods, existing propulsion

				mechanisms are roughly classified into three types: screw propellers, pectoral fins, and caudal fins. The details on each propulsion will be discussed at our presentation in this forum. In practice, the propulsion device for the explorations have mainly used screw propellers. The screw propeller is to transmit torque generated by rotations into thrust. The main feature of propellers is highly efficient thrust so that they can be largely useful in marine transportations. Propeller fans are capable of controlling pitch motions. However, there exist several limitations of propellers. The main weakness is a cavitation phenomenon, resulting in a great deal of noise, damage to blades, vibrations, and a loss of efficiency. Another problem is the sudden stoppage or breakdown due to the entanglement in nearby algae and garbage caused by the rotation of the blades. To make matters worse, the marine creatures are injured or killed when they come into contact with the blades. In this forum, we introduce a novel robotic swimming mechanism for exploring the ocean bottom. To overcome these limitations above, based on swimming motions generated by abdomen limbs of shrimp, a paddle-typed propulsion mechanism is proposed. Since the shrimp swims by paddling their limbs, this swimming motion does not rotate at high speed and cavitation does not occur. Specifically, the propulsion mechanism allows to employ phase difference between paddling motions by individual paddles, resulting in enhancing more propulsive force. Unlike screw propellers employing lift force, the proposed mechanism uses drag and then moves its platform forward with the drag force as a propulsion. For that reason, the proposed mechanism allows to explore the nearby seabed, not available to other propulsions. Our presentation will detail on the realization of the proposed mechanism. The effectiveness for the mechanism is evaluated through extensive experiments.

Toby Schneider, Supun Randeni, Henrik Schmidt	Fast, Cheap *and* Good: Development of a high performance communications and navigation system for High Latitude AUV deployments using a Virtual Ocean.	USA	toby.e.schneider@gmail.com supun@mit.edu henrik@mit.edu	The engineering cliché says you can have fast, cheap or good: pick two. In our recent work developing and deploying a novel autonomous underwater vehicle (AUV) system in the Beaufort Sea under the sea ice cover, we have found that, with a multi-disciplinary application of simulation tools (collectively referred to as a Virtual Ocean), it is possible to have all three: a rapid development cycle, a compact, inexpensive team with minimal sea-testing expense, and a functional high-performance system at the final deployment. Given the challenge and expense associated with any Arctic or Antarctic deployments, this approach is especially convincing. For this work, we developed a integrated communications and navigation system, where a single synchronised digital communication packet is used to both provide tracking and data to the operator from the 21”-diameter AUV. Deployment of the system was over just a few days at the ICEX20 experiment in March 2020, and development started about a year before (using an existing AUV and the open source MOOS-IvP software framework). With the exception of a single brief open water engineering field test, all development and testing was performed in the Virtual Ocean environment, from subsystem testing through to full mocked-up “virtual experiments” where we attempted to mimic the actual deployment as closely as possible at full scale. The Virtual Ocean consists of five main components: the acoustic communications simulator, the environmental simulator, the vehicle simulator, the topside simulator, and the hardware interface emulators. This talk will briefly discuss all these components, and then focus on the acoustic communications simulator (NETSIM) as an example of the development approach that makes these simulators functional, useful, and quick to develop. To successfully employ this Virtual Ocean approach, we used an iterative process to making the simulators. First, we developed a crude version that captures the basic salient features. Then, we integrate this version with the rest of the system to create a working full system simulation. Finally, we iterate on the design of the simulator, increasing fidelity where possible and where it matters most (e.g. to expose a particular engineering or scientific problem we expect to encounter in the real environment). For example, in the case of NETSIM, we needed to accurately capture the propagation paths in the presence of a new warm water layer (referred to as the Beaufort Lens), which dramatically changes the acoustic communications path in this region of the Beaufort Sea. To do so, we coupled ray-tracing (to drive convolution of the transmitted signals) with hardware-in-the-loop emulation to create a high fidelity model, and also provided a lower fidelity version that could be easily run by the team without need for speciality hardware, but still provided many of the

				essential performance characteristics (accurate delays, packet loss, and software APIs). We believe this Virtual Ocean-based development model has broad applicability for the development of other multi-domain marine systems, especially those where high performance in extreme environments at a reasonable cost is required.
Stefan Dominicus[,2], Amit Mishra[1,2], Marc de Vos[3], Marcello Vichi[1,4]	AI based ice-charting for Southern Ocean using Sentinel SAR Images	1 Marine and Antarctic Research centre for Innovation and Sustainability (MARIS), University of Cape Town, South Africa 2 Department of Electrical Engineering, University of Cape Town, South Africa, 3 Marine Research Unit, South African Weather Service, Cape Town, South Africa 4 Department of Oceanography, University of Cape Town,Cape Town, South Africa	stefandominicus@gmail.com akmishra@ieee.org amit.mishra@uct.ac.za	Sea ice concentration is an important metric used to characterize polar sea ice behavior. Understanding this behavior and accurately representing it is of critical importance for climate science research, and also has important uses in the context of maritime navigation. Polar sea ice coverage, and the phenomena which drive changes in this coverage, form a critical link in the Earth's climate system. Sea ice is located right at the ocean-atmosphere interface and is thus intricately linked to climate system evolution. Current models used to estimate sea ice concentration (SIC) are derived from passive microwave radar satellite data, but these instruments offer poor spatial resolutions, and are susceptible to interference due to atmospheric variations. Additionally, these models are usually calibrated for Arctic conditions, and evidence from recent in-situ observations in the Southern Ocean suggests that their estimates are significantly biased and are not reliable in the Antarctic marginal ice zone (MIZ). Sea ice behavior is characterized by a number of important variables, of which SIC is one, which are considered essential climate variables by the scientific community.. It is clear that understanding the interplay between these variables is an important requirement for accurately modelling large-scale climate trends. An end-to-end workflow for generating learned concentration estimation models from synthetic aperture radar data, trained on existing passive microwave data, is presented here. A novel objective function was introduced to account for uncertainty in the passive microwave measurements, which can be extended to account for arbitrary sources of error in the training data, and a recent set of in-situ observations was used to evaluate the reliability of the chosen passive microwave concentration estimation model. Google Colaboratory was used as the development platform, and all notebooks, training data, and trained models are available on GitHub. This work and the presentation on this will be an overview of the most interesting aspects of this investigation. A detailed report is also available on GitHub. The development process in this work and the proposed presentation can be broken into three broad sections: 1. data pre-processing, 2. neural network development, and

				3. serving targeted predictions. The full details of each of these sections can be found in the project GitHub repository, but for the purpose of this proposed presentation, the discussion will cover an overview of the data processing pipeline, an explanation of the filtering, batching, and validation processes used, followed by an overview of the machine learning models and custom objective function used for this investigation. Some of the major contributions are then discussed in more detail, justifying their significance in this context. Lastly, some brief conclusions will be presented, as well as recommendations for continued work in this direction.
Francis Chui	RV Investigator's ICT infrastructure and NRUD	CSIRO	Francis.chui@csiro.au	Acquiring and integrating underway data from the multiple sensors and disparate acquisition systems on a research vessel provides a number of challenges. These challenges include the range of observation scales, varied suites of instruments which output data with individual data formats and timestamps. This demonstration presents our near-real-time underway data portal and describes the development of the portal and preparation of the data for publication within the portal.
Chris Berry, Amy Nau	Operational Bioacoustics in the Antarctic	CSIRO	Stuart.Edwards@csiro.au	The RV Investigator recently braved the seas of the Southern Ocean, making its way west to the waters offshore of the Antarctic research station Mawson. A primary scientific objective of the voyage was to estimate krill populations in the region. In order for this to be done bioacoustics methods were employed whereby a suite of echosounders were utilised to locate, track and measure acoustic returns of krill swarms. On board RV Investigator the Geophysical Survey & Mapping team are responsible for the operation of these echosounders. The team will discuss how these sounders are employed in the pursuit of krill and touch on some of the challenges of working in polar waters.
Will Ponsonby	RV Investigator atmospheric capability – the world's first mobile Global Atmosphere Watch (GAW) station	CSIRO	Will.Ponsonby@csiro.au	The atmosphere of the Southern Hemisphere is remarkably cleaner than that of the more anthropogenic influenced Northern Hemisphere, resulting in distinctly different chemical and physical properties. Despite this, only a handful of long-term measurement platforms exist. Australia's recently commissioned new Research Vessel Investigator (RVI) has been designed specifically for atmospheric observations, and provides a unique, world-class

				platform for atmospheric measurements in the Southern Hemisphere. The vessel has been equipped with a range of permanent instrumentation allowing for the measurement of a broad range of atmospheric properties. Modelled after the Cape Grim GAW station, the RVI-GAW station includes measurements of greenhouse gases, tropospheric ozone, radon, a range of microphysical and optical aerosol properties, as well as a research grade weather radar. The high quality nature of these measurements was recognised in 2018, with its registration as the world's first mobile GAW station. In addition, the platform is equipped with a range of facilities that provide guest users a facility suitable for intensive measurement campaigns with specific scientific questions in mind.
Jamie Nicholas Jacobson*1,2, Robyn A. Verrinder*1,2, Jarryd Son1,2, Marc de Vos3, Amit Mishra1,2, Marcello Vichi1,4	SHARC BUOY: Expanding in situ sensing in the Southern Ocean Marginal Ice Zone through the development and deployment of low-cost ice-tethered instrumentation	1 Marine and Antarctic Research centre for Innovation and Sustainability (MARIS), University of Cape Town, Rondebosch, Cape Town, South Africa, 7700 2 Department of Electrical Engineering, University of Cape Town, Rondebosch, Cape Town, South Africa, 7700 3 Marine Research Unit, South African Weather Service, Cape Town, South Africa, 7700 4 Department of Oceanography, University of Cape Town, Rondebosch, Cape Town, South Africa, 7700	jcbjam007@myuct.ac.za robyn.verrinder@uct.ac.za	Antarctic sea ice plays a pivotal role in regulating heat and energy exchange between oceanic and atmospheric systems, which drives global climate. The Antarctic Marginal Ice Zone (MIZ) is the largest in the world ocean, since it borders the circumpolar ice extent in the Southern Ocean. Current understanding of MIZ dynamics is poor with temporal and spatial gaps in critical seasonal datasets due to the challenges of deploying in situ instruments in very thin and variable sea ice. This lack of in situ environmental and wave data drove the development of the University of Cape Town's first generation of in situ ice-tethered measurement platform. In this proposed presentation, the design of an affordable ice-tethered instrument is presented as a platform to increase in situ temporal and spatial data collection for this region. The buoy was required to be low-cost and manufactured in the African continent, to survive Antarctic climate conditions in a mixed environment, and to contain a global positioning system, temperature sensor, digital barometer and inertial measurement unit to provide waves-in-ice measurement capability. The design was optimised for cost and development time with the device's development cycle coinciding with the expected departure dates of winter and spring expeditions in 2019. Two versions of the buoy were developed with the first device completed in 2019 containing basic sensing features (GNSS, temperature), with a redesign in 2020 featuring upgraded sensing capabilities (GNSS, temperature, atmospheric pressure, inertial data), mechanical robustness, electronic modularity and increased onboard memory capacity.

				Two devices (v1) were deployed during the winter cruise in July 2019 on pancake ice floes in the Antarctic MIZ (56°59'59.70"S; 0°0'36.96"E and 57°17'11.28"S; 0°1'18.30"E) to test their performance in remote conditions. However, due to mechanical and power failures, the devices stopped communicating shortly after deployment. A third device was placed on the deck of SA Aghulas II during the expedition and successfully survived for one week in winter conditions while continuously transmitting GPS and ambient temperature data. Two devices (v2) were deployed during summer 2021. One node was tested on the Antarctic continent at the SANAE IV base for survivability, where it was deployed for 2 days before retrieval, successfully transmitting its data packets to a remote server. A further node was deployed from the RV Polarstern on pack ice in the Weddell Sea, where it lasted 5 days and successfully transmitted data until the battery capacity depleted. From these initial investigations, a number of key design improvements were identified for further development, specifically power supply and bandwidth constraints. These preliminary experiments demonstrate a successful design and implementation of a low-cost, expendable, ice-tethered autonomous sensing device that is capable of positional and local temperature/pressure measurement in the harsh and dynamic Antarctic MIZ.