

BOOK OF ABSTRACTS



Houwhoek Hotel, Grabouw. Western Cape.

27 November 2023 – 1 December 2023

Hosted by Stellenbosch University



science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA



National
Research
Foundation

WWW.SANAP.AC.ZA

Book of abstracts will be updated.
If you see any incorrect information,
please mail riaolivier@sun.ac.za

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding natural and anthropogenic drivers of change

Title:

Nutrient co-limitation of iron and manganese effects on bacterial communities within the sub-Antarctic

Author(s)

Benjamin Abraham ^[1]

Thulani P Makhalanyane ^[1,2]

Affiliation:

1. University of Pretoria

2. University of Stellenbosch

Abstract:

The role and quantitative contribution of chemoautotrophic microbial (picoplanktonic) communities in ocean systems is largely unknown. Previous studies have shown that iron fertilization results in increased productivity of marine phytoplankton. However, little work has been done to elucidate the effect of iron on deep-sea microbes. While the chemical form of iron in high nutrient low chlorophyll (HNLC) regions such as the Southern Ocean remains unknown, it is well established that molecular speciation affects microbial competition for iron uptake. The importance of iron and manganese for marine ecosystems and its role in the fixation of CO₂ makes the study of this trace metal of great interest. An on-board mesocosm experiment was set up to observe induced changes in iron and manganese concentrations in microbial communities from two distinct depths. Seawater samples (280L in total) collected at two depths (50m and 500m) at station OD2 using GOFlo – trace metal free bottles. 10L samples were incubated in 26 X 10 L acid washed carboys for a total duration of 168 hours. Per depth, 5 mesocosms were treated with 0.5 nM FeCl₃, 5 with 1 nM FeCl₃ with 5 non-iron containing controls for the total experiment. Mesocosms were incubated in the dark at 4°C, with sub-sampling taking place after 1 hour, 36 hours and at the termination point of the experiment. 125 mL of the seawater incubation was collected from each mesocosm in order to measure dissolved iron. Water from each mesocosm was aliquoted for downstream analysis for flow cytometry (preserved in formaldehyde at a final concentration of 2%), single cell genome sequencing (preserved in glycerol Tris-EDTA buffer) and enzyme activity assays. These samples were stored at -20°C for downstream analysis. Remaining water up to a volume of 3 L was filtered via a dual filtration mechanism and vacuum pump through a 0.22 µm Polyethersulfone (PES) filter and the filters stored at -20°C for microbial community analysis at both the DNA and RNA level.

Format:

e-poster

Keywords:

Microbial diversity; Southern Ocean, Picoplankton; Fe/Mn supplementation

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Earth Systems Observations

Title:

Author(s): add rows below if more authors

I. Ansoorge¹,
T. Morris²,
T. Henry¹
J. Hermes^{1,3,4}

Affiliation: add rows below for more affiliations

1. Department of Oceanography, Mare Institute, University of Cape Town, South Africa.
2. Marine Research Unit, South African Weather Service, Cape Town, South Africa.
3. South African Environmental Observation Network - Egagasini Node, Cape Town, South Africa.
4. Institute of Coastal and Marine Research, Nelson Mandela University (NMU), South Africa.

Abstract:

The UN's Decade of Ocean Science calls for programmes that improve scientific knowledge, develop research capacities and transfer marine technological information and expertise across generations. In South Africa, the Department of Science and Innovation's (DSI) has already taken a significant step forward in such training measures. The current DSI Global Change Grand Challenge programme calls for platforms that "attract young researchers and retain them by exciting their interest in aspects of global change, while developing their capacity and professional skills in the relevant fields of investigation". To meet these challenges in the Ocean Sciences head-on, SEAmester – South Africa's Floating University and a joint initiative between Government and Universities was started in 2016. The strength of SEAmester is that South African postgraduate students combine theoretical classroom learning with the application of this knowledge through ship-based, and more importantly, hands-on research through the Agulhas System Climate Array (ASCA) programme. Now into its 8th year and with 241 students from 26 universities all over South Africa having participated in these cruises, this presentation takes a look at how successful this programme has been, the challenges we have faced and more importantly what has become of some of the SEAmester students.

Format:

Oral presentation

Keywords: (add ; between keywords)

Capacity Development, SEAmester, Oceanography

SESSION – OCEAN 1-SEA ICE

MARS Themes:

Earth systems observations

Title:

Winter biogeochemical activity is enhanced by rafting in growing Antarctic sea ice

Author(s): add rows below if more authors

Riesna R. Audh ^[1]

Sarah E. Fawcett ^[1,3]

Siobhan Johnson ^[2]

Tokoloho Rampai ^[2,3]

Marcello Vichi ^[1,3]

Affiliation: add rows below for more affiliations

3. Department of Oceanography, University of Cape Town, Rondebosch, South Africa

4. Department of Chemical Engineering, University of Cape Town, Rondebosch, South Africa

5. Marine and Antarctic Research centre for Innovation and Sustainability, University of Cape Town, Rondebosch, South Africa

Abstract:

The study of Antarctic first-year sea-ice biogeochemistry has been limited by samples mostly being collected in pack ice during summer, with few winter data available. Measurements from the Antarctic marginal ice zone (AMIZ) have proven even more difficult to obtain. The AMIZ is a broad, circumpolar feature of the Southern Ocean found at different latitudes during the year where light and nutrients are high enough to sustain primary production and influence ecosystem functioning. We present the first biogeochemical dataset from growing ice collected in the AMIZ during winter 2019. Measurements of sea-ice physical and biogeochemical properties were used to investigate the winter sea-ice habitat and decipher the conditions under which the ice formed and grew. Model simulations support the hypothesis that nutrient accumulation in advancing sea ice cannot be explained by passive seawater entrainment and thermodynamics alone. Our data confirm that winter sea ice is biogeochemically active by accumulating remineralized nutrients, and further propose that rafting processes enhances the reservoir of concentrated nutrients during sea ice growth. The biogeochemical transition from YI to FYI does not appear to be a linear progression of thickness with habitat space reduction as sea ice consolidates. Instead, FYI bulk biogeochemistry results from multiple cycles of rafting of YI, which conserves the biogeochemical properties of YI in the FYI, ultimately increasing the overall content.

Format:

Poster

Keywords: (add ; between keywords)

Antarctica; Sea Ice; Antarctic Marginal Ice Zone; Biogeochemistry; Numerical Modelling

SESSION: Marine Mammals**MARS Themes:**

Oceans and marine ecosystems under global change

Title:

Entropy-based Detection and Classification of Bryde's Whale Vocalizations: An Approach for Understanding and Conserving an Endangered Species

Author(s): add rows below if more authorsO.P. Babalola ^[1]D.J.J. Versfeld ^[1]**Affiliation:** add rows below for more affiliations

6. Stellenbosch University

Abstract:

Bryde's whales (*Balaenoptera edeni*) are a critically endangered species that inhabits tropical and subtropical waters around the world. Despite their wide distribution, little is known about their population dynamics and behaviour. One of the main challenges in studying these whales is their elusive nature, which makes it difficult to detect and identify them in the wild. In this seminar, we propose an approach for detecting and classifying Bryde's whale vocalizations using entropy-based methods. The proposed method involves using entropy measures to analyse audio recordings of the whales' vocalizations in order to detect and classify different types of calls. This approach is based on the idea that different types of calls will have different levels of entropy, which can be used to distinguish them from one another. Spectral entropy and temporal entropy are the primary measures used for detection and classification, while approximate entropy and sample entropy are also considered. Machine learning techniques such as decision trees, support vector machines, and hidden Markov model are used to improve the classification performance. The proposed method has the potential to provide valuable information on the presence, distribution, and behaviour of these whales, which will contribute to the conservation and management of this critically endangered species.

Format:

Oral Presentation (10 min)

Keywords: (add ; between keywords)

Bryde's whale; acoustics; vocalisations; machine learning; entropy

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding natural and anthropogenic drivers of change

Title:

Elucidating the role of biosynthetic genes in the adaptation of bacterial mixotrophs in the South Atlantic.

Author(s)Runesu Bakasa ^[1]Thulani P Makhwanyane ^[1,2]**Affiliation:**

7. University of Pretoria

8. University of Stellenbosch

Abstract:

Traditionally, marine bacteria have been categorized as either autotrophic or heterotrophic. These two subdivisions hold important roles in the carbon cycling process of marine bacteria. A phenomenon known as mixotrophy was then discovered, where one organism has the genetic ability to support a heterotrophic lifestyle, as well as an autotrophic lifestyle. The energy demands of cell maintenance and division that these organisms have has led them evolve into having small genome sizes, through streamlining, shedding themselves of genes which are not absolutely essential for their survival, be it for metabolism, protection or adaptation. It has been documented that some mixotrophs of the same species possess different adaptation genes on different depths of the ocean, or even at the same ocean depths but under different nutrient availability conditions. These differences in niche adaptations reveal information that lead to a better understanding of mixotrophy in the marine bacteria. Adaptations in marine bacteria are often linked to their production of secondary metabolites. The secondary metabolites are produced by closely associated groups of genes known as biosynthetic gene clusters (BGCs). BGCs often span a length of about 10 000 bases, which is a significant population of the "small genome size" that mixotrophs have. This suggests that the same species of mixotrophs, under different environmental conditions, would have different BGCs that are, in fact, niche adaptations. I intend on formulating ways to identify mixotrophs in the South Atlantic from metagenomics data, by cataloguing the core genes that define a bacterial genome as a mixotroph. I will assess the BGCs they possess. This would be essential to see if the same species of these mixotrophs have the same BGCs and if there are differences in the BGCs observed in these mixotrophs from other marine environment studies.

Format:

e-poster

Keywords:

Southern Ocean; Microbial diversity; Mixotrophy; Biosynthetic genes

SESSION: Data

MARS Themes:

Research Data Management

Title:

Management of Recorded Voyage Data for the SA Agulhas II

Author(s): add rows below if more authors

J P Barnard

N C Taylor

A Bekker

Affiliation: add rows below for more affiliations

9. Stellenbosch University

10. SA Institute of Mechanical Engineering

11. ECSA

Abstract:

The recording and curation of operational data for research and development purposes can present several challenges. The future value of such data often depends upon the proper management thereof. The Sound & Vibration Research Group (SVRG) at Stellenbosch University are involved with recording operational data on the SA Agulhas II during its yearly voyages to and from Antarctica. Various, disparate data structures must be archived in a manner that allows systematic, secure storage, browsing, search and retrieve of historical records. To these effects, the SVRG are developing a research data management (RDM) framework and data model. With the framework, a hierarchical context structure can be defined for the recorded data, as well as relevant attributes of data sources. Solution definitions and meta data are stored in a custom SQL database, developed by the SVRG.

Due to the high-frequency data involved, which are beyond the maximum time resolution capability of conventional process historians, the RDM framework stores raw data files on an enterprise-grade NAS server. Meta data extracted from the raw data are linked to source files and can be searched to select raw data files of interest. The first major milestone is the development of a minimum viable ingress data pipe that will automate the extraction of meta data from raw data files per voyage. Future development milestones include an egress pipeline for search and retrieval of interesting raw data.

Format:

Oral presentation

Keywords: (add ; between keywords)

Metadata;

SESSION: Innovation

MARS Themes:

Innovation

High-level skills

Title:

SA Agulhas II – Flagship for vessel 4.0

Author(s): add rows below if more authors

Bekker, A., Barnard, J.P., De Koker, N., Durandt, P.G., Engelbrecht, M.C., Laas, J., Kruger, K., Melim, M., Matthee, J.J., Nickerson, B.M., Steyn, B.J., Pferdekamper, K.H., Taylor, N.C. & Van Zijl, C.M.

Affiliation: add rows below for more affiliations

Stellenbosch University, Department of Mechanical and Mechatronics Engineering

Abstract:

SA Agulhas II, Africa's only polar vessel, leads maritime digitalization, funded through four SANAP cycles. She is equipped with an advanced "nervous system" of sensors, leading to the most comprehensive operational dataset of such operations in the world. As an ideal incubator for digital twin prototypes, she has impacted ship digitalization.

1. In 2022, a digital twin for propeller load estimation on the Endurance22 aided ice pilots and enjoyed the spotlight from the discovery of Shackleton's wreck. Noteworthy engagements include the €2 million HEALTHPROP project on a propulsion digital twin in icy conditions with researchers from Norway and Germany.

2. SA Agulhas II is an exceptional laboratory for human factors at sea. A slamming discomfort threshold has been established through science on the SCALE voyages. Mariner 4.0, a human cyber-physical system, integrates passenger feedback on motion sickness, enabling real-time estimation of motion-sick scientists—a stride towards Industry 5.0 and human-machine collaboration.

3. With 85% of operations in open water, the vessel's hull design predisposes her to slamming and whipping. Research underscores whipping's dominance in storm-induced fatigue damage, reaching 98% for the stationary ship in following waves. The implications led to South Africa's membership in the International Committee of Ships and Offshore Structures Technical Committee V.7, mandated to report innovative structural monitoring developments through digital twins.

Format:

Oral presentation

Keywords: (add ; between keywords)

SA Agulhas II, Digital twin, Endurance22, Full-scale measurements, Data

SESSION: Data session

MARS Themes:

Education

Title:

Using Unreal Engine 5 to construct a digital Marion Island towards improved science engagement

Author(s): add rows below if more authors

B.E Boyes

Affiliation: add rows below for more affiliations

12. University of the free state

Abstract:

The potential use of three-dimensional (3D) computer graphics game engines such as Unreal Engine 5 (UE5) has not yet been utilised fully in areas which can promote science engagement, education or virtual tourism. Marion Island, located in the south Indian Ocean, is a unique South African territory as it is a volcanic island situated in a sub-Antarctic environment. Within South Africa's geoheritage context, the island hosts a range of geomorphological and geological features found nowhere else in continental South Africa. The value of the island's geoheritage is not yet fully appreciated by the public due to its location and conservation status making it inaccessible to the public at large. This paper aims to utilise UE5 to digitally construct sub-Antarctic Marion Island and explore the viability of using the engine for virtual geo-conservation, education and tourism use. The main focus will be to use UE5 to create a geographically accurate digital island. Digital elevation data and landscape photographs from the island will be used to construct an accurate representation. The digital island will focus on the important geomorphological features of Marion Island such as scoria cones, glacial depositional features and peat lands. The final product will be compared to other current methods such as video and photographic tours used in geo-conservation and tourism.

Format:

Ex. Round table; oral presentation, poster, e-poster, pamphlet etc

Keywords: (add ; between keywords)

Ex. Heritage; Legacy; History

SESSION: Humanities in the South African National Antarctic Programme

MARS Themes:

Human Enterprise

Title:

Over the Horizon: An art project in Antarctica

Author(s): add rows below if more authors

J. Brundrit^[1,2]

Affiliation: add rows below for more affiliations

13. University of Cape Town

14. Antarctic Legacy of South Africa

Abstract:

Speaking from my disciplinary home in Fine Art practice I discuss a body of photographs I made in Antarctica with a lens made of ice, as opposed to a conventional glass lens. These photographs, with others, have been exhibited and published as an artist book (ALSA 2022).

In this presentation I talk about this project, its unusual methodology, the results, meanings and interpretations. I also examine the broader context of Antarctic imagery, including the painted photographs from the 'Heroic Age' that are part of the permanent display aboard the *SA Agulhas II*, and discuss examples of artwork from New Zealand and Argentina made through national Antarctic arts programs.

Format:

Oral presentation; Exhibition

Keywords: (add ; between keywords)

Visual representation; Art

SESSION: Marine Mammals**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Understanding the drivers of Marion Island's elephant seal population

Author(s): add rows below if more authorsC. Murray ^[1]W.C. Oosthuizen ^[1]M.N. Bester ^[2]P.J.N. de Bruyn ^[2]**Affiliation:** add rows below for more affiliations

15. Centre for Statistics in Ecology, Environment and Conservation, Department of Statistical Sciences, University of Cape Town, Cape Town, South Africa

16. Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria

Abstract:

In the middle of the twentieth century, Marion Island's population of southern elephant seals declined rapidly, as did other populations throughout its circumpolar distribution. Fortunately, the trend for Marion Island's population has reversed since then. Using the long-running mark-recapture program on the island, we developed an integrated population model to identify the demographic factors that are responsible for the rebound. Our results indicate that increasing survival of adult female seals and immigration from other Southern Ocean colonies have driven population growth in the last few decades.

Format:

Oral Presentation (5 min)

Keywords: (add ; between keywords)

southern elephant seals; Marion Island; population dynamics; mark-recapture

SESSION: Space Physics

MARS Themes:

Title:

The long-term variation of the geomagnetic field in Antarctica as measured in Hermanus, Maitri and at SANAE-IV since 2007-06-25

Author(s): add rows below if more authors

Cilliers P.J.¹

Seemala G.²

Nel A.¹

Affiliation: add rows below for more affiliations

1. SANSa Space Science, Hermanus

2. Indian Institute of Geomagnetism, Mumbai, India

Abstract:

The long-term variation in the geomagnetic field is of interest for geophysics as well as for space weather studies since the high latitude geomagnetic field reflects both the changing conditions in the Earth's mantle and the variation in the location of the Auroral Oval that determines the most likely locations of the Aurora during geomagnetic storms.

The total geomagnetic field has been measured continuously at the SANAE-IV base employing an Overhauser GSM-19 proton precession magnetometer (GEM Systems, Inc) since the installation of the instrument as part of the expansion of the instrumentation for long-term monitoring of the polar regions during the 4th International Polar Year (IPY 2007-2009). The instrument at SANAE-IV is located at 71.6744°S, 2.83053° and was commissioned on 2007-05-25. The total magnetic field has been sampled at a cadence of 1 s for 16 years, spanning almost two solar cycles.

This paper presents some background on the instruments at SANAE-IV and Maitri, the data recorded during this period, and compares it with two geomagnetic models namely the International Geomagnetic Reference Model (IGRF) and the World Magnetic Model (WMM) at each of the locations.

Format:

Oral presentation

Keywords: (add ; between keywords)

Geomagnetism; Space Physics; Antarctica

SESSION: Ecosystems, Biodiversity and Biodiscovery

MARS Themes:

Understanding scales of biodiversity from molecular to ecosystem

Title:

New trophic paradigms in Antarctic microbiomes

Author(s)

Don Cowan ^[1]

Pedro Lebre ^[1]

Gilda Varliero ^[1]

Lefentse Mashamaite ^[1]

Silindile Maphosa ^[1]

Max Ortiz ^[1]

Surendra Vikram ^[1]

Ian Hogg ^[2]

Affiliation:

17. Centre for Microbial Ecology and Genomics, University of Pretoria

18. School of Science, University of Waikato, Hamilton, New Zealand

Abstract:

In over two decades of research on the microbial ecology of Antarctic desert soils, we have contributed substantially to our understanding of the compositions, complexities and functional potential of Antarctic soil microbiomes. In this presentation, I will summarise some of our most recent metagenomic research on microbial community composition, particularly in the context of microbial aerotrophy.

Cowan DA, Makhanyane TP (2017) Energy from thin air. **Nature** 552: 1-2

Ortiz M, Leung PM, Shelley G, Van Goethem MW, Bay SK, Jordaan K, Vikram S, Hogg ID, Makhanyane TP, Chown SL, Grinter R, Cowan DA, Greening C. (2021) Multiple energy sources and metabolic strategies sustain microbial diversity in Antarctic desert soils. **PNAS USA** 118: e2025322118

Ray A, Zaugg J, Benaud N, Chelliah D, Bay S, Wong HL, Leung PM, Ji M, Terauds A, Montgomery K, Greening C, Cowan DA, Kong WD, Williams T, Hugenholtz P, Ferrari B (2022) Atmospheric chemosynthesis is phylogenetically and geographically widespread and contributes significantly to carbon fixation throughout cold deserts. **ISME J.** 16: 2547-2560

Cowan DA, Ferrari B, McKay C (2022) Out of thin air: Astrobiology and atmospheric chemotrophy. **Astrobiology** 22: 225-232

Format:

10-min oral

Keywords:

Microbial diversity; Trace gas chemotrophy; Aerotrophy; Assimilatory hydrogenase

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Earth Systems

Living Systems

Title:

Killer whale acoustic patterns respond to prey abundance and environmental variability around the Prince Edward Islands, Southern Ocean

Author(s):

Fannie W. Shabangu^[1,2]

Robyn Daniels^[3]

Rowan K. Jordaan^[2]

P.J. Nico de Bruyn^[2]

Marcel A. van den Berg^[4]

Tarron Lamont^[3,4,5,6]

Affiliation:

19. Fisheries Management Branch, Department of Forestry, Fisheries and the Environment

20. Mammal Research Institute, University of Pretoria

21. Department of Oceanography, University of Cape Town

22. Oceans and Coastal Research Branch, Department of Forestry, Fisheries and the Environment

23. Nansen–Tutu Centre for Marine Environmental Research, University of Cape Town

24. Bayworld Centre for Research and Education

Abstract:

Killer whales are apex predators with temporally and spatially varying distributions throughout the world's oceans. Their ecology and behaviour are poorly understood in most regions due to limited research, often because of logistical challenges. Here, we use easily deployable year-round passive acoustic monitoring device to investigate the seasonal acoustic occurrence and diel vocalizing behaviour of killer whales around the remote sub-Antarctic Prince Edward Islands (PEIs), Southern Ocean. Killer whales showed diel vocalizing patterns that varied seasonally in relation to their prey abundance and social activities. Killer whale calls were intermittently detected year-round with a high number of hours containing calls in October through December, and a secondary peak in March through May, which corresponded to the abundance of seal prey. Random forest modelling identified wind speed as an important predictor of the occurrence of killer whale calls whilst sea surface height, chlorophyll-a, and sea surface temperature were moderately important. We provide the first acoustic evidence that killer whale occurrence around PEIs coincide with variability in environmental conditions and prey abundance. Our results provide the first indication of diel vocalizing pattern of killer whales in the Southern Ocean. This knowledge is important for understanding killer whale ecology and adaptation to the changing oceans.

Format:

Oral presentation

Keywords:

killer whales; vocalizing behaviour; acoustic occurrence; sub-Antarctic region; prey; oceanographic variables

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Earth System Observation

Title:

Sub-daily Antarctic sea-ice variability estimates using swath-based retrieval methods

Author(s): add rows below if more authors

W. de Jager^[1]

M. Vichi^[1,2]

Affiliation: add rows below for more affiliations

25. Department of Oceanography, University of Cape Town (UCT)

26. Marine and Antarctic Research for Innovation and Sustainability (MARIS)

Abstract:

Satellite-derived sea-ice concentration measurements have traditionally been used to evaluate the impact of climate change on polar regions. However, concentration-based measurements of sea-ice variability do not allow the discrimination of the relative contributions made by thermodynamic and dynamic processes. This prompts the need to use sea-ice drift and type products and develop new methods to quantify changes in sea-ice properties that would indicate trends in the ice characteristics. A component of the sea-ice variability is driven by local weather events, and in some cases is the dominant driver of variability over larger-scale atmospheric features. Previous work by de Jager & Vichi (2022) has suggested that sea-ice vorticity (derived from low resolution sea-ice displacement vectors) may be a useful metric for quantifying dynamical features in Antarctic sea ice; specifically shorter term changes in the ice-interior driven by atmospheric storms. However, this study hypothesised that much of the rotational drift in the underlying sea-ice field was blurred as a result of the relatively large 48-hr temporal resolution of the drift product, therefore highlighting the necessity of measuring sea-ice properties at higher temporal frequencies. This study will therefore assess the usefulness of an overlapping swath-based method of sea-ice displacement retrieval recently made available by the EUMETSAT OSI-SAF. This swath-based method of retrieval allows for analysis of sea-ice variability at sub-daily timescales, which may be more suitable for measuring the effect of weather events on the sea-ice landscape than using daily averages of merged swaths. In situ data of sea-ice conditions were collected on board the SA Agulhas II research vessel in the Atlantic Sector in July, 2022, which will be compared to swath-based satellite estimates. Furthermore, the newly released 24-hr OSI-SAF drift product will also be compared. To complement these drift estimates, a modified swath-based ice-type retrieval method will be presented to add further context to any potential thermodynamic changes affecting the optical properties of the sea-ice surface.

Format:

Poster

Keywords: (add ; between keywords)

Sea ice, remote sensing, Earth observation

SESSION: Marine Mammals**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Considering individual variation when investigating marine predator behaviours during life-history events

Author(s): add rows below if more authorsL. De Kock ^[1]A.D. Lowther ^[2]R.S. Beltran ^[3]M.N. Bester ^[4]W.C. Oosthuizen ^[1]P.J.N. de Bruyn ^[4]**Affiliation:** add rows below for more affiliations

27. Centre for Statistics in Ecology, Environment and Conservation, Department of Statistical Sciences, University of Cape Town, Cape Town, South Africa

28. Norwegian Polar Institute, Research Department, Fram Centre, Tromsø, Norway

29. Department of Ecology and Evolutionary Biology, University of California Santa Cruz, USA

30. Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria

Abstract:

Marine predators undergo life-history events (e.g. breeding or moult), but behaviours can vary widely across individuals of the same species: differing within an individual over time and between individuals of the same population. Furthermore, behaviours can vary due to variations in plasticity, geography and individual personality. However, behavioural studies of life-history events often focus more on understanding 'typical' behavioural patterns than understanding variations in life-history events. We use examples of marine predators in the Southern Ocean to illustrate the importance of taking individual variation into account when studying the behaviour during life-history events. Linear mixed-effects models were fitted to account for repeated individual observations by including individual identity as a random effect. The individual random effect partitions the total variation in behaviours into between- and within individual variation. Considering individual variation improves the understanding of the factors that contribute to varying behaviours. For example, the age and breeding stage of southern elephant seals (*Mirounga leonina*) at Marion Island explained 65% of the between-individual variation in moult arrival date. Furthermore, individual variation can describe patterns of observed and consistent behavioural variation. For example, we have found that during the breeding season of chinstrap penguins (*Pygoscelis antarcticus*), foraging trip behaviours of individuals varied between sites and breeding stages. However, chinstrap penguin diving behaviours were highly repeatable with individuals showing similar dive patterns. Our findings emphasize the inclusion of individual variation in behavioural studies. This approach provides greater insight into the adaptability of marine predators in dynamic environments.

Format:

Oral Presentation (5 min)

Keywords: (add ; between keywords)

southern elephant seals; life-history; individual variation; Marion Island; moult

SESSION: Innovation and development**MARS Themes:**

Innovation and development

Title:

Inversion and Extreme Value Analysis of Ice Loading on Propulsion Shaft of the SA Agulhas II

Author(s): add rows below if more authorsNico de Koker^[1]Anriëtte Bekker^[1]Barend Steyn^[1]**Affiliation:** add rows below for more affiliations

31. Stellenbosch University, Department of Mechanical and Mechatronic Engineering

Abstract:

Probabilistic estimates of ice impact loading on the propulsion systems of vessels designed to operate in polar waters are necessary to assess the adequacy of current design specifications. Over the course of 13 days of operations in sea ice, high frequency inboard shaft line deformation measurements were recorded aboard the SA Agulhas II, and inversion of the dataset performed to determine ice loading on the port-side propeller. The inversion method filters out resonant vibration of the propulsion shaft around its natural frequency and is implemented as a rapid algorithm developed for application to long time series full voyage data as well as real-time monitoring. Extreme value analysis of inferred ice-induced impact loading in active ice navigation was conducted to obtain distribution parameters for 1-second interval ice loading maxima. The resulting annual exceedance probability curves allow the loading specification used in the design of the propulsion systems for the SA Agulhas II to be considered in the context of risk exposure classes.

Format:

Oral presentation

Keywords: (add ; between keywords)

Propulsion system; Health monitoring; Ice impact loading; Extreme value analysis

SESSION: Oceans 3 (Chairs: Sarah Fawcett & Susanne Fietz)

MARS Themes:

Ecosystems, biodiversity and biodiscovery

Title:

Early community development at the Southern Ocean Marginal Ice Zone.

Author(s): add rows below if more authors

Amelia A Deary^[1]

Lumi Haraguchi^[2]

Raquel F Flynn^[1,3]

Jacob Carstensen^[4]

Sarah E Fawcett^[1,5]

Affiliation: add rows below for more affiliations

32. Department of Oceanography, University of Cape Town, Cape Town, South Africa

33. Finnish Environmental Institute (SYKE), Helsinki, Finland

34. Earth Marine and Environmental Sciences Department, University of North Carolina, Chapel Hill, NC, United States

35. Department of Ecoscience, Aarhus University, Denmark

36. Marine and Antarctic Research Center for Innovation and Sustainability (MARiS), University of Cape Town, Cape Town, South Africa

Abstract:

The Southern Ocean's Marginal Ice Zone (MIZ) is a dynamic and heterogeneous ecosystem, where the interplay of biogeochemical and physical processes shapes the development of the early phytoplankton community. At present, the scarcity of biogeochemical and community data for the early productive season leads to uncertainties on important processes occurring throughout the remaining and peak productive season. This study was conducted in the Atlantic Sector of the Southern Ocean MIZ during the winter (July) and spring (October-November) of 2019. Depth-resolved water samples were collected and analysed for nutrient concentrations, and high-resolution community information was determined using pulse-shape recording and imaging flow cytometry (PFCM). Additionally, ¹³C- and ¹⁵N-tracer incubation experiments were conducted at selected stations to determine rates of Net Primary Production and nitrogen uptake. The high variability of the early community is assessed in terms of the high spatial heterogeneity of the MIZ, which is modulated by dynamic ocean-ice-atmosphere processes that govern the availability of essential resources, such as light and nutrients. We elucidate a succession scheme for the early productive season, wherein the community's response to melting sea-ice is characterised based on the developing community structure. Four distinct stages are identified; (1) the *reset community*, is characterised by the co-dominance of nanoflagellates, picoeukaryotes and diatoms, with deep mixed layers that entrain nutrients from depth and incite low light availability, (2) the *early development community*, is characterised by rapidly growing species, such as picoeukaryotes, with low biomass, and a high degree of variability in community composition which is driven by the alleviation of light limitation coincident with possible iron release from melting sea-ice. The later development stages, the (3) "*Booming*" and (4) "*Boomed*" communities are marked by a rapid increase in biomass that is strongly dominated by fast-growing diatoms, with a further significant increase in diatom biomass and the shoaling of the mixed layer distinguishing (4) from (3). Highlighting the mechanisms that shape the biogeochemistry and development of the early community, this study contributes towards an improved understanding of the crucial yet poorly understood Southern Ocean MIZ ecosystem.

Format:

Oral presentation

Keywords: (add ; between keywords)

Marginal Ice Zone; Atlantic Southern Ocean; biogeochemistry; phytoplankton community structure; community development; succession; sea-ice.

SESSION: Ecosystems, Biodiversity and Biodiscovery

MARS Themes:

Understanding scales of biodiversity from molecular to ecosystem

Title:

Bacteria and archaea regulate particulate organic matter export in suspended and sinking marine particle fractions

Author(s)

Choaro Dithugoe ^[1]

Thulani P Makhalanyane ^[1,2]

Affiliation:

37. University of Pretoria

38. University of Stellenbosch

Abstract:

The biological carbon pump (BCP) in the Southern Ocean is driven by phytoplankton productivity and is a significant organic matter sink. However, the role of particle-attached (PA) and free-living (FL) prokaryotes (bacteria and archaea) and their diversity in influencing the efficiency of the BCP is still unclear. To investigate this, we analyzed the metagenomes linked to suspended and sinking marine particles from the Sub-Antarctic Southern Ocean Time Series (SOTS) by deploying a Marine Snow Catcher (MSC), obtaining suspended and sinking particulate material, determining organic carbon and nitrogen flux, and constructing metagenome-assembled genomes (MAGs). The suspended and sinking particle-pools were dominated by bacteria with the potential to degrade organic carbon. Bacterial communities associated with the sinking fraction had more genes related to the degradation of complex organic carbon than those in the suspended fraction. Archaea had the potential to drive nitrogen metabolism via nitrite and ammonia oxidation, altering organic nitrogen concentration. The data revealed several pathways for chemoautotrophy and the secretion of recalcitrant dissolved organic carbon (RDOC) from CO₂, with bacteria and archaea potentially sequestering particulate organic matter (POM) via the production of RDOC. These findings provide insights into the diversity and function of prokaryotes in suspended and sinking particles and their role in organic carbon/nitrogen export in the Southern Ocean.

Format:

10-min oral

Keywords:

Southern ocean; Biological Carbon Pump; Microbial diversity; Marine snow

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Oceans and marine ecosystems under global change

Earth systems observations

Ecosystems, biodiversity and biodiscovery

Title:

Zooplankton variability around the sub-Antarctic Prince Edward Islands and the influence of the environment.

Author(s): add rows below if more authors

SA. du Preez¹

T. Lamont^{1,2,3,4}

JA. Huggett^{1,2}

Affiliation: add rows below for more affiliations

39. Department of Oceanography, University of Cape Town, Cape Town, South Africa.

40. Oceans & Coasts Research, Department of Forestry, Fisheries and the Environment, Cape Town, South Africa

41. Bayworld Centre for Research and Education, Cape Town, South Africa

42. Nansen-Tutu Centre for Marine Environmental Research, Department of Oceanography, University of Cape Town, South Africa

Abstract:

Oceanographic conditions around the sub-Antarctic Prince Edwards Islands (PEIs) are characterized by high mesoscale variability and cross-frontal mixing. Bongo nets (200 μ m) were used to sample the zooplankton community in the upper 200m along routine monitoring transects during the 2018 and 2019 autumn cruises to re-supply the PEI research base. Zooplankton abundance and biovolume were assessed using a ZooScan with ZooProcess software, and images were validated using EcoTaxa. Temperature, salinity, and chlorophyll-*a* were sampled *in situ* in 2018 only, but daily reanalysis and satellite data were used to identify positions of fronts and mesoscale features in both years. In 2018, 2 cyclonic eddies interacted with the PEIs and the southern branch of the sub-Antarctic Front (S-SAF) was located south of the archipelago. In contrast, the S-SAF was closer to the PEI shelf in 2019. Both years showed similar zooplankton abundances (2018: 527.84 ind.m⁻³; 2019: 571.94 ind.m⁻³), but the mean biovolume in 2018 (200.76 mm³.m⁻³) was significantly higher than in 2019 (74.72 mm³.m⁻³), suggesting a higher abundance of larger organisms in 2018. Copepods dominated zooplankton abundance (>90%) in both years, whereas the biovolume was largely made up of Chaetognaths (2018: 44.9%; 2019: 39.2%), Copepods (2018: 33.9%; 2019: 35.7%) and Euphausiids (2018: 14.0%; 2019: 6.3%). Peaks in zooplankton abundance and biovolume corresponded with elevated chlorophyll-*a* (chl-*a*), but only biovolume was significantly correlated with chl-*a*. Our findings revealed the significant influence of mesoscale features like eddies and fronts on the spatial distribution and magnitude of zooplankton abundance and biovolume around the PEIs.

Format:

Oral Presentation

Keywords: (add ; between keywords)

Sub-Antarctic; Prince Edward Islands; Zooplankton

SESSION: Innovation and development

MARS Themes:

Innovation and development

Title:

The Development of a Structural Digital Twin for the SA Agulhas II

Author(s): add rows below if more authors

G. Durandt^[1]

A. Bekker^[1]

Affiliation: add rows below for more affiliations

43. Stellenbosch University, Department of Mechanical and Mechatronic Engineering

Abstract:

In shipping, the evolution of cyber-physical connectivity enables benefits to inform decision-making towards increased vessel safety, enhanced passenger comfort and sustainable operations. The SA Agulhas II (SAAII), a South African polar supply and research vessel, suffers accelerated fatigue as a result of wave slamming which leads to resonant excitation of the structure. Current ship design practice does not account for fatigue related to resonant wave-induced vibration. As ships evolve it has become evident that digital twin solutions are necessary to monitor and model hull loads to enable informed (close to real time) operational and strategic decision-making with respect to the remaining useful life of the structure.

Measurement of the hull response is limited to a finite number of locations. The limited number of data points is not sufficient to estimate the stress distribution of the hull during operation. As such, a virtual sensor is proposed to estimate the global stress distribution of the hull for the low frequency bending and whipping responses. The virtual sensor is built on a physics-based global finite element model (FEM) of the SAAII. This work discusses the virtual measurement architecture and the evolution of the hull structure of the SAAII into a digital asset.

Format:

Oral presentation

Keywords: (add ; between keywords)

Ship vibration, Hull fatigue, Virtual measurement, Digital twin

SESSION: Oceans 3 (Chairs: Sarah Fawcett & Susanne Fietz)

MARS Themes:

Oceans and marine ecosystems under global change

Earth systems observations

Ecosystems, biodiversity and biodiscovery

Title:

Nanoplankton: the dominant vector for carbon export across the Atlantic Southern Ocean in spring

Author(s): add rows below if more authors

R.F. Flynn^[1]

L. Haraguchi^[2]

J. McQuaid^[3]

J.M. Burger^[1]

P. Mutseka Langa^[4]

L. Stirnimann^[1]

S. Samanta^[5]

A.N. Roychoudhury^[5]

S.E. Fawcett^[1] [*presenting author]

Affiliation: add rows below for more affiliations

1. University of Cape Town

2. Finnish Environment Institute

3. Scripps Institution of Oceanography

4. University of Pretoria

5. Stellenbosch University

Abstract:

Across the Southern Ocean, large ($\geq 20 \mu\text{m}$) diatoms are generally assumed to be the primary vector for carbon export, although this assumption derives mainly from summertime observations. Here, we investigated carbon production and export potential during the Atlantic Southern Ocean's spring bloom from size-fractionated measurements of net primary production (NPP), nitrogen (nitrate, ammonium, urea) and iron (labile inorganic iron, organically-complexed iron) uptake, and a high-resolution characterization of phytoplankton community composition. The nanoplankton-sized (2.7-20 μm) diatom, *Chaetoceros* spp., dominated the biomass, NPP, and nitrate uptake across the basin (40-56°S), which we attribute to their low iron requirement, rapid response to increased light, and ability to escape grazing when aggregated into chains. We estimate that the spring *Chaetoceros* bloom accounted for >25% of annual export production across the Atlantic Southern Ocean, a finding consistent with recent observations from other regions highlighting the central role of the phytoplankton "middle class" in carbon export.

Format:

Poster

Keywords: (add ; between keywords)

Carbon export; primary production; iron and nitrogen uptake; phytoplankton community; spring bloom

SESSION: Oceans 3 (Chairs: Sarah Fawcett & Susanne Fietz)

MARS Themes:

Earth Systems Observations

Title:

Observations of Southern Ocean marine aerosols in Simon's Town, False Bay

Author(s): add rows below if more authors

F. J. February^[1]

K. E. Altieri^[2]

A. M. J. Van Eijk^[2]

J. Piazzola^[3]

Affiliation: add rows below for more affiliations

6. Oceanography Department, University of Cape Town, South Africa

7. Netherlands Organisation for Applied Scientific Research (TNO), The Hague, Netherlands

8. Mediterranean Institute of Oceanography (MIO), University of Toulon, France

Abstract:

Marine aerosols are the largest component of natural aerosols which impact climate through radiative forcing and feedback in the climate system. The Intergovernmental Panel on Climate Change (IPCC) considers aerosols as short-lived climate forcers and deems it a necessary part of their mandate to assess the changes of aerosol emissions and abundances in the atmosphere as inputs to climate models. Unfortunately, the large spatial-temporal variability in atmospheric aerosol concentrations and composition causes a significant uncertainty in establishing a reliable value for the forcing effect and hampers our understanding of current and future climate change. The vast and remote Southern Ocean is one of the few places where marine aerosols can be investigated away from large anthropogenic sources. As such, this region offers a unique location for investigating the present-day controls on the sources and formation processes of natural marine aerosols and the preindustrial atmosphere. This study set out to use an extended set of observational aerosol data acquired at the coastal location of Simon's Town in False Bay, South Africa to determine the concentrations, sizes, and types of aerosols. Not only does it contribute to the data scarce region of the Southern Hemisphere, but the unique location also makes it possible to measure pristine marine aerosols from the Southern Ocean. Findings on the concentrations and processes of aerosols can be incorporated into Southern Hemisphere models for evaluating the preindustrial atmosphere and the role of the Southern Ocean in natural climate forcing.

Format:

Oral presentation

Keywords: (add ; between keywords)

Marine aerosols; aerosol concentrations; size distributions

SESSION: Botany

MARS Themes:

Earth systems observations

Title:

An assessment of the status of biological invasions and their management on the Prince Edward Islands

Author(s): add rows below if more authors

Fernández Winzer, L.^{1,2}

Greve, M.³

Le Roux, P.C.³

Faulkner, K.T.¹

Wilson, J.R.^{1,2}

Affiliation: add rows below for more affiliations

9. South African National Biodiversity Institute

10. Stellenbosch University

11. University of Pretoria

Abstract:

The Prince Edward Islands (PEIs) are sub-antarctic islands that have the highest level of protection afforded to any natural area under South African law. Because of this, strict biosecurity measures are in place. However, new introductions of alien taxa still occur. The National Status Report on Biological Invasions in South Africa (2022) - to be launched January 2024 - applied and tested a set of 20 indicators on the PEIs that encompass pathways, species, sites, and interventions. Based on these indicators we discuss the status of biological invasions and their management on the PEIs, highlight gaps and recommend steps to improve management of new detected taxa. A species list of alien taxa on the PEIs has been developed, which uses the Darwin core metadata, and we aim to include this dataset into SAPRI's repository. The pathways along which alien species can be introduced to the PEIs are as contaminants on goods and as stowaways. Out of 93 taxa historically introduced, 44 are currently present on Marion Island, 26 of which are known to be invasive. Prince Edward Island has only eight alien taxa, all invasive. The house mouse is the most harmful alien species on Marion Island, and is feeding on several plant and invertebrate species as well as adult and hatchling seabirds, with impacts on ecosystem functioning. A plan to eradicate the house mouse ('Mouse-Free Marion') has been developed and is due to be implemented in 2025 if sufficient funding is raised.

Format:

oral presentation

Keywords: (add ; between keywords)

invasion impacts; invasion pathways; invasion history

SESSION: Oceans 3 (Chairs: Sarah Fawcett & Susanne Fietz)

MARS Themes:

Earth Systems Observations

Oceans and marine ecosystems under global change

Title:

Micronutrient and pollutant trace elements at the air-sea interface

Author(s): add rows below if more authors

Fietz, Susanne

Affiliation: add rows below for more affiliations

5. Stellenbosch University

Abstract:

Over the past decade, large international efforts demonstrated that interactions with the atmosphere modulate the biogeochemical state of the ocean, and that intrinsically linked ocean dynamics and atmospheric processes should not be considered in isolation. In addition, novel international efforts highlight the need to incorporate environmental and microbial controls in both atmospheric and ocean dynamics. To gain a comprehensive understanding of the complex ocean biogeochemistry and predict future pressures on marine ecosystems, it is crucial to include the atmosphere as a significant external source of nutrients. Dust aerosols can deliver essential micronutrients to marine systems, alleviating nutrient stress for primary producers responsible for CO₂ uptake and forming the base of the food chain. However, the rise in industrial emissions increases the likelihood of potentially toxic elements being deposited through dust aerosols. In the future, the oceans are likely to receive a mixture of new nutrients and toxic elements through dust deposition. The ecosystem's response to this complex mixture of aerosols is multifaceted. Here, we will showcase the team's recent efforts to better understand the intricate dynamics between dust input and the primary producer communities that receive it.

Format:

Oral presentation

Keywords: (add ; between keywords)

SESSION: Marine Mammals**MARS Themes:**

Oceans and marine ecosystems under global change

Title:

Sea ice declines coincide with a period of reduced reproductive success in Southern Ocean top predator

Author(s): add rows below if more authorsM. Germishuizen ^[1]M. Vichi ^[2]E. Vermeulen ^[1]**Affiliation:** add rows below for more affiliations

12. Mammal Research Institute Whale Unit, Department of Zoology and Entomology, University of Pretoria

13. Department of Oceanography, University of Cape Town

Abstract:

Following a steady increase in southern right whale (*Eubalaena australis*, SRW) numbers after the cessation of commercial whaling, South African SRW population dynamics have recently become more erratic. Reproductive rates have slowed together with a decline in maternal body condition and a shift in foraging behaviour. Being migratory capital breeders, these changes are known to be coupled with a decrease in offshore foraging success. This, in turn, is believed to be largely driven by climate forcing, due to its control over parameters such as sea ice and the underlying physics influencing supply mechanisms of key nutrients affecting the development and timing of seasonal phytoplankton blooms. Therefore, this study aimed to perform an in-depth analysis of parameters describing SRW foraging conditions over the period of the observed population-level changes. Four variables were analysed in their Southern Ocean foraging grounds 1) Chlorophyll Index (proxy of total food production), 2) Chlorophyll standard deviation (proxy of food availability), 3) marginal ice zone extent and variability, and 4) sea ice concentration. Trends in these variables reveal significant environmental changes to high-latitude feeding grounds during the period of reduced calving success including declines in winter and spring sea ice and increased primary production. These data suggest ecosystem changes that may be less supportive of Antarctic krill (*Euphausia superba*), their main prey item in this region. Assessing the connection between climate variability and long-term baleen whale population demographics is essential to anticipating the potential future impacts of continued environmental changes on recovering baleen whale populations.

Format:

Oral Presentation (10 min)

Keywords: (add ; between keywords)

Southern right whale; whaling; population dynamics; sea ice; foraging behaviour

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding scales of biodiversity from molecular to ecosystem

Title: Charting the diversity of giant viruses of Antarctic Dry Valley permafrost

Charting the diversity of giant viruses of Antarctic Dry Valley permafrost

Author(s):

Nelisiwe Hadebe^[1]

Thulani P Makhalanyane^[1,2]

Affiliation:

14. University of Pretoria

15. University of Stellenbosch

Abstract:

The discovery of Giant Viruses marked an important turning point in biology due to their enormous configuration and genomes, and the fact that they possess characteristics that are often exclusively found in cellular organisms. However, there have been few studies on the permafrost (permanently frozen) soil of the Antarctic Dry Valley; most of the known variety of giant viruses has been isolated from aquatic ecosystems, other frozen soils and cultivated in the lab with a lack of sufficient knowledge on their functional potential and possible putative hosts. This project aims to better understand the diversity, functional potential, and putative hosts of giant viruses found in this permafrost, as well as how giant viruses could compare to those in different depths of the permafrost and to those found in public repositories. This project also aims to offer novel insights on the giant viruses present in the Antarctic dry valley permafrost. A bioinformatics workflow which serves as a cultivation-independent approach was used to reconstruct giant virus Metagenomic Assembled Genomes from permafrost metagenomic data. The results from many studies demonstrate that the diversity of giant viruses has significantly increased up to this point, and others believe that gene acquisition from hosts and not NCLDV gene reduction from the fourth domain of life, is how they evolved.

Format:

e-poster

Keywords:

Giant viruses; Antarctic; Dry Valley; Permafrost; MAGs

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Oceans and marine ecosystems under global change

Earth systems observations

Ecosystems, biodiversity and biodiscovery

Research Infrastructure and platform

Title:

Oceanographic variability and the GLORYS reanalysis at the Prince Edward Islands

Author(s): add rows below if more authors

I. Halo^[1,3]

B. Soares^[2]

T. Lamont^[1,2,3,4]

C. Russo^[1]

M. van den Berg^[1]

G. Tutt^[1]

Affiliation: add rows below for more affiliations

16. Oceans & Coasts Research, Department of Forestry Fisheries and the Environment, Cape Town, South Africa

17. Department of Oceanography, University of Cape Town, Cape Town, South Africa

18. Nansen-Tutu Centre for Marine Environmental Research, University of Cape Town, Cape Town, South Africa

19. Bayworld Centre for Research and Education, Constantia, Cape Town, South Africa

Abstract:

The Prince Edward Islands (PEI), comprising of Marion and Prince Edward Island, are home to a multitude of species which are supported by a sensitive and complex oceanic environment. Understanding the mechanisms that sustain this rich ecosystem is therefore imperative for both the ecological management of the PEIs, and for the possible prediction of future climate change-driven environmental impacts. The presence of a Taylor column has been suggested as the main driver supporting and maintaining the PEI ecosystem. However, the remote and hostile oceanic environment makes the collection of in situ data challenging. In situ, satellite, reanalysis and modelled bathymetry data, was compared against the GLORYSV12 model output. The model reasonably captured the surface and sub-surface, spatial and temporal variability of temperature and salinity, despite the differences between temperature (biases from -2 to 2 °C) and salinity (biases from -0.4 to 0.4 PSU). GLORYS overestimated the geostrophic currents (up to 0.2 m s⁻¹) and underestimated Sea Surface Height (by up to 0.6 m). While a seasonal bias was observed when comparing GLORYS to single point in situ SST time series data, the datasets had strong positive, statistically significant correlations ($r > 0.80$, $p < 0.001$) and relatively low biases (-0.50 to 0.10 °C). GLORYS therefore showed temperature, salinity and currents to be comparable to observations at a climatological scale, but for specific mesoscale events the model was less successful, as observed in 2013, 2014 and 2015 in situ CTD data when cyclonic and anticyclonic eddies were not accurately simulated by the model. In agreement with in situ observations, a scaling analysis performed using GLORYS output suggested that Taylor columns with a surface expression can indeed form at the PEIs, but more often, they take the form of Taylor cones, which do not have a surface expression.

Format:

Oral presentation

Keywords:

Prince Edward Islands; Taylor column; GLORYS model; in situ and satellite data; Mesoscale events, Scaling analysis

SESSION: Data and frameworks in the support of polar research

MARS Themes:

Human Enterprise

Title:

Consistent mapping and geospatial information representation in the Antarctic and sub-Antarctic: why South Africans should care

Author(s): add rows below if more authors

^{1,2} Christel D Hansen, C.D.

Affiliation: add rows below for more affiliations

1. Department of Geography, Geoinformatics and Meteorology, University of Pretoria
2. SCAGI

Abstract:

The Standing Committee on Antarctic Geographic Information (SCAGI) is responsible for a consistent geographic framework for all activities in Antarctica, and it is in South Africa's interest to make use of and contribute to this framework. The representation of geographic information is crucial for understanding geospatial phenomena. A consistent application and standardization of such even more so. This talk will provide an overview of best practice regarding geospatial data and information representation in Antarctica, as provided in the SCAR International Principles and Procedures for Antarctic Place Names. Further information of national standards relevant to mapping activities of South Africans in the Antarctic and sub-Antarctic, including South African National Standards (SANS, such as SANS 1877:2004, SANS 1878-1:2005, SANS 19162:2016), as well as ISO standards with relevance (e.g., ISO 19162:2015) are discussed. An overview of the South African Gazetteer, and the South African National Names Council Act 118 of 1998 (Republic of South Africa, 1998) is also provided, to ensure South African researchers conform to not only SCAR, but national standards when representing their geospatial information in maps and accessible geospatial layers.

Format:

Oral presentation

Keywords: (add ; between keywords)

Antarctic Place Names; ISO standards; mapping standards; SCAGI South African National Standards

SESSION: Data and frameworks in the support of polar research

MARS Themes:

Human Enterprise

Title:

A geospatial database for the sub-Antarctic Prince Edward Islands

Author(s): add rows below if more authors

¹ Rudolph, E.M., ²Hedding, D.W., ³De Bruyn, N. & ⁴ Nel, W.

Affiliation: add rows below for more affiliations

1. University of the Free State
2. University of South Africa
3. University of Pretoria
4. University of Fort Hare

Abstract:

Research at the sub-Antarctic Prince Edward Islands is increasingly considering geospatial data as an essential component in answering scientific questions. Thus, a need exists for high resolution geospatial data in both multi- and trans-disciplinary research to better analyse fine-scale biotic-abiotic interactions of the islands' landscape and ecosystems within the context of climate change and impacts of invasive species. However, much of the geospatial data that currently exist either have limitations in spatial coverage and/or resolution, are outdated or not readily available. To address these issues, we present an online geospatial database for the Prince Edward Islands (both islands) produced from a high-resolution digital surface model and satellite imagery. This database contains vector files, raster datasets, and maps of topographical and hydrological parameters. It is freely available to download from figshare – an open access data repository. With this database we answer the call to improve data sharing and encourage other sub-Antarctic terrestrial scientists to make use of similar practices.

Format:

Oral presentation

Keywords: (add ; between keywords)

data sharing; geospatial database; Marion Island; open access; Prince Edward Island

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding scales of biodiversity from molecular to ecosystem

Title:**Author(s)**Marike Hillocks ^[1]Thulani P Makhwanyane ^[1,2]**Affiliation:**

20. University of Pretoria

21. University of Stellenbosch

Abstract:

Bacteriophages, as the most dominant biological entity in oceans, are key players in marine ecosystems. These viruses influence ecosystem dynamics by modulating microbial host populations and evolution. Bacteriophages have been shown to harbour phage satellites, a small mobile genetic element. These satellites parasitize bacteriophages for their own propagation and alter bacterial communities due to integration with the host genome and gene transfers. This may be advantageous to microbial communities that harbour these elements. Cargo genes associated with the phage satellites may drive bacterial evolution in deep sea environments. We report on the first study of deep-water samples, their phage satellites, associated cargo genes, and their diversity in the deep Southern Ocean. This study analysed single-amplified genomes (SAGs) from deep ocean samples and identified candidates that may harbour phage satellites, through hallmark genes associated with phage satellites, which were compared to known satellites. We conclude that phage satellites in deep water are diverse and distinct from those found in surface waters, are dominant in Proteobacteria and may be key players in shaping microorganisms of the deep through cargo genes.

Format:

e-poster

Keywords:

Southern Ocean; Microbial diversity; Phage; Cargo genes

SESSION: Space Physics**MARS Themes:****Title:**

Sporadic E layer altitude modulated by the Traveling Ionospheric Disturbances at high latitudes

Author(s): add rows below if more authors

Hiyadutuje, A.^[1]

Kosch, M.J.^[1,2,3]

Habarulema J.B.^[1,4]

Xiangcai Chen^[5]

Stephenson J.A.E.^[2]

Matamba T.M.^[1]

Affiliation: add rows below for more affiliations

1. SANSA Space Science, Hermanus
2. University of KwaZulu-Natal, Durban
3. University of Lancaster, Lancaster, UK
4. Rhodes University, Makhanda
5. Polar Research Institute of China

Abstract:

At Zhongshan (69°S, 76°E) Antarctica we investigate the sporadic E (Es)-layer virtual height modulation caused by the passage of the Medium-Scale Traveling Ionospheric Disturbances (MSTIDs) overhead in the ionospheric F-region. Two events were identified, on 04 October 2011 at 07:00 - 12:00 UT and 29 February 2012 at 00:00 - 04:00 UT during a substorm and minor storm, respectively.

The MSTIDs and Es-layers during both events oscillated at approximately the same periods of ~50.0 to ~20.0 and ~40.0 to ~20.0 minutes, respectively. We show that the MSTIDs polarization electric field (E_p), which is mapped from the F-region along the magnetic field; modulates the Es layers altitude in the E-region via the $E \times B$ drift. The average amplitude modulation of the observed Es-layers in the E-region is found to be $\sim \pm 7.4$ and $\sim \pm 6.3$ km on 04 October 2011 and 29 February 2012, respectively.

Format:

Oral presentation

Keywords: (add ; between keywords)

Ionosphere; Space Physics; Antarctica

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Development of capacity in biodiscovery & biotechnology

Title:

Disentangling the biosynthetic potential of the Southern Ocean microbiome

Author(s)

Nosipho Hlalukana ^[1]

Thulani P Makhalanyane ^[1,2]

Affiliation:

22. University of Pretoria

23. University of Stellenbosch

Abstract:

Microbial natural products play an important role in biotechnology, as evidenced by their roles in various industries. In recent years, the discovery of new natural products has been increased by the availability of large amounts of sequencing data. Sequencing technologies have opened new opportunities to discover the hidden biosynthetic potential of the world's microorganisms, including those from previously uncultured bacteria from extreme environments. Microbial pigments have received significant attention for their uses in industry. They are ubiquitous and are commonly found in high stress environments. Epipelagic sunlit waters in tropical oceans have been identified as having a high diversity of terpenes, which may contain genes that code for production of microbial pigments known as carotenoids. Novel biosynthetic gene clusters have been identified using bioinformatics tools such as antiSMASH. This method uses a rule-based approach to predict biosynthetic gene clusters in genomes. Machine learning methods such as DeepBGC aim to make BGC prediction in microbial genomes more generalisable, thereby increasing the discovery of novel NPs. This machine learning approach predicts biosynthetic gene clusters through pattern recognition in conserved amino acid sequences. Synthetic biology can be used to construct these genes for expression in heterologous hosts. Expression of these gene clusters may lead to discovery of novel natural products for applications in biotechnology.

Format:

5-min oral

Keywords:

Microbial diversity; Southern Ocean; Secondary metabolites; Biosynthetic genes

SESSION: Marine Mammals**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Canine morphometrics as a tool for distinguishing species, sex and age in Southern Ocean fur seals

Author(s): add rows below if more authorsL.E. Pretorius ^[1]M.N. Bester ^[1]M.A. Connan ^[2]G.J.G. Hofmeyr ^[2,3,4]**Affiliation:** add rows below for more affiliations

44. Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria

45. Dept. of Zoology, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa.

46. Port Elizabeth Museum at Bayworld, Port Elizabeth, South Africa

47. Presenter

Abstract:

While museum specimens provide valuable information for scientific research, provenance is critical. Amongst primary information is the species, sex and age of the animal. When this is not available it may be possible to obtain it from preserved remains. The most durable of these are teeth. In this study, we assessed whether the external morphology of canines could be used to distinguish between the closely related, and partially sympatric, Antarctic fur seal *Arctocephalus gazella* and the Subantarctic fur seal *A. tropicalis*. We also tested whether external morphology could distinguish between sex, age class and location of origin. To achieve these eight external measurements were taken from the canines of 340 animals of known species, sex, age class and geographical origin. In addition, external annular ridges were counted and compared to the growth layer groups of sectioned teeth. While measurements distinguished between species, this was clearer in males than in females. In addition, measurements could distinguish between sexes, both within and between species. Furthermore, external annular counts gave a good estimate of age. However, the location of origin could only be characterised in adult male Antarctic fur seals. This study indicates that additional provenance can be obtained from preserved specimens, thus increasing the value of associated material.

Format:

Oral Presentation (5 min)

Keywords: (add ; between keywords)

Antarctic fur seal; Subantarctic fur seal; morphometrics; teeth; tooth growth layer; provenance

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Ecosystems, biodiversity and biodiscovery

Oceans and marine ecosystems under global change

Title:

Towards ecoregionalisation of the eastern subantarctic pelagic zone – mapping zooplankton communities at the Prince Edward Islands

Author(s): add rows below if more authors

J.A. Huggett^[1,2,3]

N.M. Mdluli^[3,4]

S. du Preez^[5]

D. Thibault^[6]

T. Lamont^[1,3,5]

Affiliation: add rows below for more affiliations

24. Oceans and Coasts, Department of Forestry, Fisheries and the Environment

25. Department of Biological Sciences, University of Cape Town

26. Bayworld Centre for Research and Education

27. University of KwaZulu-Natal

28. Department of Oceanography, University of Cape Town

29. Aix-Marseille University, France

Abstract:

Ecoregionalisation is the process of partitioning a large ecosystem into smaller ecoregions using assemblage data, such as relative species abundances. The distribution of plankton, along with that of mesopelagic fish and top predators (birds and mammals), is considered essential for ecoregionalisation of the subantarctic region, which is required to identify priority areas for conservation. We present recent and ongoing efforts to map zooplankton distribution in the subantarctic zone south of the African continent, with most effort in the vicinity of the Prince Edward Islands (PEIs). Large-scale distribution patterns of zooplankton taxa are obtained using a Continuous Plankton Recorder (CPR), which is towed near the surface behind research or commercial vessels. Annual tows between Cape Town and the PEIs during autumn since 2013 by the SA Agulhas II remain to be analysed, but taxonomic data are available for CPR tows from Japanese and German vessels between 1999 and 2009 during summer. Zooplankton net sampling has been conducted in the vicinity of the PEIs for over four decades, also mainly in autumn, and many studies have reported on meso- and macrozooplankton community composition at the archipelago. Annual sampling of zooplankton along standard transects near the PEIs was initiated in 2013, and image analysis is being used to investigate taxonomic and size composition of these communities. Relating patterns in zooplankton distribution to hydrographic conditions including mesoscale features and fronts (abiotic factors) is also an important objective. Future plans include DNA metabarcoding of zooplankton net samples, and comparison of CPR zooplankton data with acoustic data collected en route to the PEIs.

Format:

Either oral presentation or e-poster

Keywords: (add ; between keywords)

Ecoregionalisation; Subantarctic; Zooplankton; Image analysis; Continuous Plankton Recorder

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Earth Systems Observations

Title:

Long term trends in extreme daily temperature and precipitation on sub-Antarctic Marion Island from 1950 to 2020.

Author(s): add rows below if more authors

¹ Z Kabase

¹ W Nel

² DW Hedding

Affiliation: add rows below for more affiliations

1. University of Fort Hare

2. UNISA

3.

Abstract:

The climate of Marion Island has change over the last 70 years with records showing a 2.40C/100 year rise in mean annual air temperature. The maxima and minima temperatures rose by more than 10C and annual rainfall decreased to less than 2000 mm. Extreme climatic events in the Antarctic Peninsula and sub-Antarctic region are predicted to dramatically increase in length, frequency and intensity in the near future. The aim of this research is to determine and assess the trends, patterns and changes of daily extreme climatic parameters of air temperature and precipitation on Marion Island from 1950 to 2020. Daily temperature and precipitation (rainfall) data was obtained from the South African Weather Services to evaluate trends and patterns in the daily extremes. Significant values at the 95th coefficient level were calculated and analysed for each of the 24 extreme indices as developed by the Expert Team on Climate Change Detection Indices using linear regression statistics. Results showed a continuing gradual change in the climate of Marion Island with an observed rise of 1.2 0C ($p < 0.01$) in the annual mean temperatures and daily maximum temperatures. Daily minimum temperatures increased by 0.90C ($p < 0.01$). There was significant increase observed in warm spells ($p < 0.05$), warm nights ($p < 0.01$) and a significant decrease in cold spells ($p < 0.01$), cold nights and frost days. Annual precipitation patterns displays a declining trend, with a significant decrease of 1042.3 mm ($p < 0.01$) in the mean annual rainfall; a significant decrease in heavy precipitation ($p < 0.01$) and an increase of an average of 5 to 7 days in consecutive dry days between 1950 and 2020.

Format:

e-poster

Keywords: (add ; between keywords)

Sub-Antarctic; Marion island; daily climate extremes; temperature; precipitation; long-term change; ETCCDI Indices

SESSION: Space Physics

MARS Themes:

Title:

How blue skies auroral research at SANAE created and saved billions

Author(s): add rows below if more authors

Kosch, M.J. ^[1]

Hough, G. ^[2]

Affiliation: add rows below for more affiliations

1. SANSa Space Science, Hermanus

2. EnviroVision Solutions

Abstract:

Blue skies research into the auroras at SANAE-III in the 1980s gave both authors the skills necessary to develop a world-leading wildfire detection product called ForestWatch®. Rapid detection of wildfire smoke plumes is a similar image processing challenge to studying the auroras. EnviroVision Solutions is a South African company which now employs 100 people, has saved many billions in commercial forests and prevents CO2 emissions worth many billions. It proves that blue skies research has high economic and societal value, but one cannot know in advance what it may be.

Format:

Oral presentation

Keywords: (add ; between keywords)

Research to Operations; Space Physics; Antarctica; Economics

SESSION: Marine Mammals**MARS Themes:**

Oceans and marine ecosystems under global change

Title:

Entropy-based Detection and Classification of Bryde's Whale Vocalizations: An Approach for Understanding and Conserving an Endangered Species

Author(s): add rows below if more authorsO.P. Babalola ^[1]D.J.J. Versfeld ^[1]**Affiliation:** add rows below for more affiliations

48. Stellenbosch University

Abstract:

Bryde's whales (*Balaenoptera edeni*) are a critically endangered species that inhabits tropical and subtropical waters around the world. Despite their wide distribution, little is known about their population dynamics and behaviour. One of the main challenges in studying these whales is their elusive nature, which makes it difficult to detect and identify them in the wild. In this seminar, we propose an approach for detecting and classifying Bryde's whale vocalizations using entropy-based methods. The proposed method involves using entropy measures to analyse audio recordings of the whales' vocalizations in order to detect and classify different types of calls. This approach is based on the idea that different types of calls will have different levels of entropy, which can be used to distinguish them from one another. Spectral entropy and temporal entropy are the primary measures used for detection and classification, while approximate entropy and sample entropy are also considered. Machine learning techniques such as decision trees, support vector machines, and hidden Markov model are used to improve the classification performance. The proposed method has the potential to provide valuable information on the presence, distribution, and behaviour of these whales, which will contribute to the conservation and management of this critically endangered species.

Format:

Oral Presentation (10 min)

Keywords: (add ; between keywords)

Bryde's whale; acoustics; vocalisations; machine learning; entropy

SESSION: Biodiversity / Botany**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Long-term spatially-replicated data show no physical cost to a benefactor species in a facilitative plant–plant interaction

Author(s): add rows below if more authorsM. J. Raath-Krüger^[1]C. Schöb^[2,3]M. A. McGeoch^[4]D. A. Burger^[5, 6]T. Strydom^[7]P. C. le Roux^[7]**Affiliation:** add rows below for more affiliations

49. Department of Zoology, University of Johannesburg

50. Institute of Agricultural Sciences, ETH Zürich

51. Área de Biodiversidad y Conservación, Universidad Rey Juan Carlos

52. Department of Ecology, Environment and Evolution, La Trobe University

53. Department of Statistics, University of Pretoria

54. Cytel Inc.

55. Department of Plant and Soil Sciences, University of Pretoria

Abstract:

Facilitation is an interaction where one species (benefactor) positively impacts another (beneficiary). However, the feedback effects of beneficiaries on their benefactors are typically documented using short-term datasets. We compare the feedback effect of *A. magellanica* on *A. selago* over a 13-year period and using data collected from a single time period. We hypothesized that *A. selago* size and vitality would be negatively affected by *A. magellanica* cover and that the effect of *A. magellanica* on *A. selago* would become more negative with increasing beneficiary cover and abiotic-severity. We also hypothesized that *A. magellanica* cover would increase more on cushion plants with greater dead stem cover. The relationship between *A. magellanica* cover and *A. selago* size and vitality was not significant in the long-term dataset, and did not vary significantly with altitude or aspect; however, data from a single time period did not consistently identify this same lack of correlation. Moreover, *A. selago* dead stem cover was not significantly related to an increase in *A. magellanica* cover over the long term, contrasting with results from short-term datasets. Long-term datasets may be more robust for assessing beneficiary feedback effects than conventional approaches, particularly when benefactors are slow-growing. For the first time using a long-term dataset, we show no physical cost to a benefactor in a facilitative interaction, in contrast to the majority of short-term studies.

Format:

Oral presentation

Keywords: (add ; between keywords)

Competition; Facilitation; Biotic interactions

SESSION: Biodiversity / Botany**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Do anisotropic processes influence fine-scale spatial genetic structure of a keystone sub-Antarctic plant species?

Author(s): add rows below if more authorsM. J. Raath-Krüger^[1,2]A. Emami-Khoyi^[1]P. C. le Roux^[2]D. W. Hedding^[3]J. Schoombie^[4]P. R. Teske^[1]B. Jansen van Vuuren^[1]**Affiliation:** add rows below for more affiliations

56. Department of Zoology, University of Johannesburg

57. Department of Plant and Soil Sciences, University of Pretoria

58. College of Agriculture & Environmental Sciences, UNISA

59. Department of Mechanical and Aeronautical Engineering, University of Pretoria

Abstract:

While the impact of changes in temperature and rainfall on biotic communities have received much attention, there is a relatively poor understanding of how variation in wind speed and direction may impact these communities, particularly through their influence on dispersal and gene flow. Limited seed or pollen dispersal enhances genetic relatedness (spatial genetic structure, SGS) between nearby individuals and populations, with genetic differentiation between populations or pairs of individuals generally increasing as a function of the spatial distance between them. However, this pattern of SGS may not always occur isotropically when spatially asymmetric processes (i.e., wind speed and direction) are important. Consequently, a greater understanding of the anisotropic drivers of spatial patterns of dispersal, particularly at local spatial scales, is needed. We use molecular tools in conjunction with an advanced fluid dynamics model of wind flow to understand the drivers of observed fine-scale genetic patterns and use Marion Island as a model system as the island's landscape is exceptionally heterogeneous and has experienced recent rapid changes in climate. We genotyped 160 *Azorella selago* individuals along transects on Junior's Kop and use this data to assess the efficacy of combining SGS analyses with anisotropic spatial autocorrelation techniques to infer the impact of changing wind flow patterns on local-scale colonisation and up-slope dispersal processes in these plants.

Format:

Oral presentation

Keywords: (add ; between keywords)Wind; genetic structure; *Azorella selago*

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Oceans and marine ecosystems under global change

Earth systems observations

Ecosystems, biodiversity and biodiscovery

Research Infrastructure and platform

Title:

Mesoscale eddies influencing the sub-Antarctic Prince Edward Islands: Origin, pathways, and characteristics

Author(s): add rows below if more authors

T. Lamont^[1,2,3]

M.A. van den Berg^[1]

Affiliation: add rows below for more affiliations

30. Oceans & Coasts Research Branch, Department of Forestry, Fisheries, and the Environment, Cape Town, South Africa

31. Oceanography Department, University of Cape Town, Cape Town, South Africa

32. Bayworld Centre for Research and Education, Constantia, Cape Town, South Africa

Abstract:

The Andrew Bain Fracture Zone (ABFZ) of the Southwest Indian Ridge (SWIR) is known to be a hotspot for the generation of mesoscale eddies in the Southern Ocean. These eddies are known to profoundly impact on heat and salt budgets across frontal zones, and transport physical characteristics and biota of both sub-Antarctic and Antarctic origin across the Antarctic Polar Frontal Zone toward the Prince Edward Islands (PEIs). Interaction of these oceanic features with the PEIs contributes to the maintenance of a rich, biologically diverse ecosystem supporting vast top predator populations. Thus, it is necessary to improve our knowledge of when and how these features interact with the island ecosystem. Satellite altimetry and an eddy detection scheme was used to quantify the number of eddies reaching the PEIs from 1993 to 2018, and investigate their origin, pathways, and characteristics. A total of 395 cyclonic and 377 anticyclonic eddies, with diameters ranging mostly between 60 and 100 km, were observed in the PEI region (44.6-48.6°S; 35-41°E) over the 25-year period, with no clear seasonal variability or long-term trends. The vast majority of eddies were short-lived (< 90 days) and formed within this region, with only 19% anticyclonic and 25% of cyclonic eddies entering the PEI region from further afield. While previous studies described an extensive train of eddies extending from the ABFZ of the SWIR (48.6-52.6°S; 27-33°E) to the PEIs, we found that only 1 anticyclonic and 14 cyclonic eddies born within this hotspot area entered the PEI region over the 25 years. Only 3 of these cyclonic eddies propagated close enough to interact directly with the PEIs. Although less than 10 eddies per year impact the PEIs directly, they remain in contact with the shelf for considerable periods, and can thus be expected to influence oceanographic variability on the shelf for large portions of the year.

Format:

Oral presentation

Keywords: (add ; between keywords)

Prince Edward Islands; Southwest Indian Ridge; mesoscale eddies; satellite altimetry; spatial and temporal variability

SESSION: Humanities in the South African National Antarctic Programme

MARS Themes:

Human Enterprise

Title:

Orienting South: Looking to Antarctica and the Southern Ocean in South African literature

Author(s): add rows below if more authors

C. Lavery^[1,2,3]

Affiliation: add rows below for more affiliations

33. University of Pretoria

34. Antarctica, Africa and the Arts

35. Oceanic Humanities for the Global South

Abstract:

In Peter Wilhelm's *Summer's End*, set two thousand years in the future, the world has entered an ice age and Johannesburg is a city of "ghostly skyscrapers caught in cobwebs of ice". Based on news of a disturbance thousands of kilometers to the South, a father and son set out on a kind of Antarctic expedition to investigate. In Alistair Mackay's *It Doesn't Have to Be This Way*, Cape Town experiences a climate-changed future, both burning and drowning, in which three friends must try to survive in their different ways. One of them plans to escape to a settlement in the melted and newly habitable Antarctica. In these popular fictions by white South African writers, Antarctica is the centre of the future world to which both gaze and journey are oriented. Other literature, including poetry and literary fiction includes marginal references to Antarctica and the Southern Ocean that evoke a South-facing perspective from the continent's southernmost coastlines. If discussions of Antarctic representation are often focused on writers and artists from the Northern Hemisphere, in which Antarctica is often portrayed as faraway and opposite, in some Southern Hemispheric literature—South American literature for instance—the southern continent appears closer and more connected. This paper surveys this small sample of Antarctic representation by South African writers, posing that South Africa's settler society produces a perspective that is somewhere in between.

Format:

Oral presentation

Keywords: (add ; between keywords)

Literature; Fiction; Southern Ocean; Antarctica; South Africa; Global South

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding scales of biodiversity from molecular to ecosystem

Title:

Biogeographical survey of soil microbial communities across Antarctica

Author(s)

Pedro H Lebre ^[1]

Don Cowan ^[1]

Affiliation:

36. University of Pretoria

Abstract:

Antarctica and its unique biodiversity are increasingly at risk from the effects of global climate change and other human influences. A significant recent element now underpinning strategies for Antarctic conservation has been the development of a system of Antarctic Conservation Biogeographic Regions (ACBRs). However, to date no studies analysing patterns in Antarctic bacterial diversity at a continental scale have been conducted using Illumina sequencing data. Our study aims to generate a comprehensive phylogenetic dataset (based on Illumina sequence datasets) of Antarctic bacteria with wide geographical coverage on the continent and sub-Antarctic islands, in order to investigate whether bacterial diversity and distribution is reflected in the current ACBRs. Based on available data, we found that soil bacterial diversity and community composition did not conform well with the present ACBR classification. Although 19% of variability was explained by this classification, the main factor driving soil microbial clustering was the division between the maritime and continental Antarctic regions at the base of the Antarctic Peninsula. Strong divergence in soil microbial community composition was also apparent between the Antarctic/sub-Antarctic islands and Antarctic mainland. Overall, our data indicate that the current bioregional subdivision of the Antarctic continent is too simplistic from a microbial perspective.

Format:

10-min oral

Keywords:

Antarctica; Microbial biodiversity, Biogeography, Antarctic Conservation Biogeographic Regions

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding natural and anthropogenic drivers of change

Title:

Using computational tools to shed light on microbes with the capacity to degrade microplastics in the oceans.

Author(s)Christophe Lefebvre^[1]Thulani P Makhalanyane^[1,2]**Affiliation:**

37. University of Pretoria

38. University of Stellenbosch

Abstract:

The Atlantic Ocean is the second largest ocean, which is split into North Atlantic and South Atlantic Oceans. The South Atlantic Plastic pollution in our oceans is reaching an all-time high. These plastics are broken down into microplastics which cause adverse effects on both marine life and humans. Current methods of microplastic removal are either expensive, ineffective, or toxic to the environment. Extensive research has been done on microbes with the capacity to degrade microplastics and has been catalogued by databases such as the Plastic Biodegradation Database (PlasticDB). Research on the core microbiome of the ocean by the *Tara Oceans* project provides an overview of its microbial distribution. However, the distribution and functional composition of plastic-linked microorganisms in the ocean is still not well understood, particularly in the Southern Ocean. In this study, we analysed microbes from ocean metagenomes collected at various conditions, to discover putative plastic degrading taxa and the proteins that they may employ.

Format:

e-poster

Keywords:

Atlantic Ocean; Microplastics; Biodegradation; Microbial diversity

SESSION: Innovation and development

MARS Themes:

Earth system observations

Innovation and development

Title:

Sea ice research of Finnish Meteorological Institute

Author(s): add rows below if more authors

Mikko Lensu^[1]

Affiliation: add rows below for more affiliations

39. Finnish Meteorological Institute

Abstract:

Finland is the only country that becomes surrounded by sea ice every winter. At the same time icebreakers keep all Finnish ports accessible for tens of thousands of wintertime port calls annually. The need to have a smoothly functioning winter navigation system has created fruitful persistent collaborations between basic ice research, operative marine services and ice-going ship research. The related activities of FMI are shortly summarised, including ice charting, remote sensing, ice forecast modelling and development of new observation methodologies. Special emphasis is on the integration of ship research and ice geophysics, especially the use of ice going ships as platforms for gathering ice data along their transit and the utilisation of ship radar for research purposes. The activities of FMI extend to the Arctic and Antarctic seas, the long-term collaboration around S.A. Agulhas II being one example. The work done on board together with South African and Finnish collaborators is shortly assessed.

Format:

Oral Presentation

Keywords: (add ; between keywords)

Ice research, ice-going ships, remote sensing

SESSION: Space Physics**MARS Themes:****Title:**

Observation of powerful gamma ray burst GRB221009A from Marion Island

Author(s): add rows below if more authorsS.I. Lotz^[1]L. Macotela^[2]M.J. Rycroft^[3]**Affiliation:** add rows below for more affiliations

1. SANSa Space Science, Hermanus

2. Centre for Space, Atmospheric and Oceanic Science, University of Bath, Bath, UK

3. CAESAR Consultancy, Cambridge, UK

Abstract:

Natural and manmade Very low frequency (3-30 kHz) radio signals are routinely used by ionospheric and space scientists to study the magnetosphere, ionosphere and upper atmosphere in the context of space physics, solar activity and meteorology. The relative lack of manmade radio emissions and the high southern latitudes make Marion Island and Antarctica ideal locations to place these instruments. We use these instruments to detect and characterise solar flares, do lightning location, and study magnetospheric dynamics. Less commonly observed are events such as black hole formation or stellar flares.

In this talk we report on the observation of the most powerful gamma-ray burst ever detected (GRB221009A) by the UltraMSK VLF installation at Marion Island in October 2022. The powerful GRB, thought to be from a supernova explosion in the Sagitta galaxy (1.9b years ago), resulted in the in formation of a black hole, and was the highest intensity GRB ever observed (photons carrying up to 18 TeV). This caused increased ionosation of the bottom-side ionosphere, resulting in changes to propagation conditions of manmade VLF signals.

The VLF instruments on Marion Island observed a small phase advance and reduction in amplitude on a number of transmissions from NWC (Australia, 19.80 kHz), DHO (23.40 kHz) and NAA (25.20 kHz). We compare observations at Marion Island with those at other VLF receiver stations and observations made aboard space craft such as Fermi, Wind, and Solar Orbiter.

Format:

Oral presentation

Keywords: (add ; between keywords)

Space physics; Astronomy; Marion Island

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding natural and anthropogenic drivers of change

Title:

Marine microbiome responses to Fe supplementation

Author(s)Mancha Mabaso ^[1]Thulani P Makhwanyane ^[1,2]**Affiliation:**

40. University of Pretoria

41. University of Stellenbosch

Abstract:

Iron (Fe), an essential micronutrient for microorganisms, is known to be low in marine environments, limiting microbial primary productivity. Currently, we lack an understanding of how prokaryotic communities respond to Fe fertilization, especially in high nutrient low chlorophyll regions such as the Southern Ocean (SO). Here, we attempted to elucidate how prokaryotic communities respond to Fe supplementation, particularly in the subsurface. Samples were collected in the SO during Winter and Spring in the mesopelagic and bathypelagic zones. A mesocosm study was conducted where the effects of Fe fertilization at different time points (0 hours, 1 hour, 36 hours and 96 hours) and Fe concentrations (0 nM, 0.5 nM and 1.0 nM) were evaluated. 16S rRNA gene amplicon sequencing and shotgun metagenomics were used to investigate community and genome level differences, with a focus on Fe metabolism. Enzymatic activity, nutrient analysis and flow cytometry were included as part of the analyses. The findings showed patterns of fluctuating enzymatic activity of alkaline phosphatase and β -glucosidase following fertilization and revealed marked community differences between the two seasons and depths. Results suggest that Fe fertilization does not elicit major changes in community structure and composition at higher taxonomic levels. However, significant changes in relative abundance were seen among specific taxa such as *SAR 202 clade* and *Marinimicrobia* at lower taxonomic levels. The results also showed potential for Fe cycling in mesopelagic and bathypelagic zones of the ocean, particularly in the synthesis and exudation of siderophores. This suggests that siderophores may be the prevailing strategy used by microbes for the acquisition of Fe in these SO microbiomes. Taken together, this work adds insight into understanding the response subsurface marine microbes to Fe environmental perturbations and their overall contribution to biogeochemical cycling.

Format:

10-min oral

Keywords:

Southern ocean; Fe; Mesocosm; Microbial diversity; Functional response

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding scales of biodiversity from molecular to ecosystem

Title:

Disentangling the effects of the Agulhas Current on marine viruses

Author(s)Nyasha Mafumo ^[1]Oliver Bezuidt ^[1]Thulani P Makhwanyane ^[1,2]**Affiliation:**

42. University of Pretoria

43. University of Stellenbosch

Abstract:

Microbial communities are essential in the functioning of ocean ecosystems, and they contribute to biogeochemical processes. Viruses play a pivotal role in these communities, as they actively influence the abundance, diversity, and evolution of their cellular hosts. Thanks in part to several large scale marine expeditions (Tara Oceans, Malaspina, Pacific Ocean Virome), we are beginning to understand the distribution and biodiversity of viral communities in most global oceans. However, we still lack comparative insights of viruses in the Agulhas Current and Southern Ocean, both of which are important in mitigating the effects of climate change. Here, we assess the diversity and potential function of viruses in the Agulhas Current and Southern Ocean. Cyanophages and Pelagiphages dominated these regions. A total of 5625 viral Auxiliary Metabolic Genes (AMGs) were annotated from the viral genomes and classified into 206 KEGG orthologous groups. The majority of the AMGs were associated with carbon metabolism and vitamin/co-factor metabolism. Of the energy metabolism AMGs, there were more genes involved in sulfur metabolism compared photosynthesis. These genes included *dsrA*, *dsrC*, and *soxY*, which alleviate bottleneck steps in host mediated sulfur metabolism during infection. Overall, our study suggest that viruses in the Agulhas Current and Southern ocean potentially influence the biogeochemical cycling of carbon and sulfur, through viral lysis and AMG expression. Given that approximately half of ocean microbes are infected by viruses at any given time, findings from this study emphasize the importance of incorporating viral contributions in global biogeochemical cycling models.

Format:

5-min oral

Keywords:

Southern Ocean; Agulhas Current; Viruses; Auxiliary Metabolic Genes

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Development of capacity in biodiscovery & biotechnology

Title:

A reproducible microbiome pipeline for the identification of horizontally acquired mobile genetic elements

Author(s)Sade Magabotha ^[1]Oliver Bezuidt ^[1]Riaan Pierneef ^[1]Thulani P Makhalanyane ^[1,2]**Affiliation:**

60. University of Pretoria

61. University of Stellenbosch

Abstract:

Currently, we lack a clear understanding regarding the extent of intra and inter-community interactions among microbial communities, in part due to their numerical abundances. These interactions may have profound effects, due to the known importance of microbial communities as mediators of biogeochemical cycling. However, a clear mechanistic understanding regarding the role played by horizontal gene transfer and the contributions of mobile genetic elements in the recycling of nutrients in complex microbial assemblages is lacking. We developed BioGeochemical Horizontal Gene Transfer (BioG-HGT), an automated, standalone, and reproducible pipeline, which associates horizontally transferred biogeochemical genes with their mobile genetic elements. Using a metagenomic dataset, with approximately 33 million reads, a macOS Monterey 12.6 system with 8 cores and 8Gb RAM, BioG-HGT was able to analyze the dataset and produce outputs within 14 hours. The resultant tab delimited file provides information on the metagenome assembled bins retrieved from the metagenomic dataset, the position of the mobile genetic elements and the corresponding biogeochemical cycling genes from the same contig. Taken together, BioG-HGT provides an easy-to-use computational tool for understanding the adaptation of microbial communities to environmental disturbances. The pipeline expands the available resources for exploring environmental mobile genetic elements and their role in the dissemination of biogeochemical cycling genes. BioG-HGT is available at https://github.com/Shaedeycool/BioG-HGT_wd.

Format:

e-poster

Keywords:

Microbial diversity; Horizontal Gene Transfer; MAGs; Mobile Genetic Elements

SESSION: Data and frameworks in the support of polar research

MARS Themes:

Human Enterprise

Ecosystems, Biodiversity & Biodiscovery

Title:

Ecoregionalisation of the pelagic zone in the Subantarctic and subtropical Indian Ocean

Author(s): add rows below if more authors

^{1,2}Makhado, A., ^{3,4}Koubbi, P., ^{1,2}Huggett, J.A., ⁵Cotte, C., ⁶Reisinger, R., ^{7&8}Swadling, K., ⁵Azarian, C., ⁹Barnerias, C., ⁵d'Ovidio, F., ¹⁰Goberville, E., ¹⁰Leroy, B., ¹¹Lombard, A.T., ¹²van de Putte, A., and workshop participants

Affiliation: add rows below for more affiliations

1. Oceans and Coasts, Department of Forestry, Fisheries and the Environment, South Africa
2. University of Cape Town, South Africa
3. IFREMER Centre Manche / mer du Nord, France
4. UFR 918 Terre, Environnement et Biodiversité, Sorbonne Université, France
5. LOCEAN IPSL, Sorbonne Université, CNRS, MNHN, France
6. University of Southampton, Southampton, United Kingdom
7. Institute for Marine and Antarctic Studies, Australia
8. Australian Antarctic Partnership Program, Australia
9. Office Français pour la Biodiversité, France
10. Laboratoire de Biologie des Organismes et Ecosystèmes Aquatiques (BOREA) MNHN, CNRS, IRD, SU, UCN, UA, Paris, France
11. Nelson Mandela University, South Africa
12. RRBINS/ULB, Belgium

Abstract:

The Sub-Antarctic islands support important colonies of seabirds and seals. They are of global importance for several species in terms of biomass consumed and conservation status. The high productivity in the vicinity of the islands and the large aggregations of seabirds and seals found there attract a variety of other animals, including several cetaceans, to their vicinity. Recently, the populations of several seabirds that breed on the islands have declined, particularly king penguins on Ile aux Cochons in Crozet (Weimerskirch et al., 2018). Although there is cumulative evidence that declines in albatrosses and petrels have been significantly influenced by fisheries bycatch mortality, while declines in some penguins are likely to be due to reduced prey availability.

The Expert Workshop on Pelagic Spatial Planning for the eastern Sub-Antarctic Region (CCAMLR MPA Planning Areas 4, 5 and 6) took place in Cape Town, South Africa, from 2019. These developed a scientific work programme that will lead to abiotic and biotic pelagic regionalisation using geographic, biological, and oceanographic features. The workshop recognized the significance of understanding the distributions of plankton, mesopelagic fish, and top predators (birds and mammals) to establish an ecoregionalization framework for the Sub-Antarctic region. This framework is essential for identifying priority conservation areas and emphasise the importance of frontal zones such as the Antarctic Polar Front, the Sub-Antarctic Front, and the Subtropical Front.

The workshop developed a detailed plan of scientific work that led to the initial phase of a regional overview of the Indian Sub-Antarctic that can be used in spatial planning for the designation of high seas MPAs in the CCAMLR area.

Format:

Oral presentation

Keywords: (add ; between keywords)

CCAMLR MPA; Expert Workshop on Pelagic Spatial Planning for the eastern Sub-Antarctic Region ; Indian Sub Antarctic;

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding the connectivity between terrestrial, coastal and marine systems

Title:

Understanding the dynamics of microbial communities in the Congo River plume

Author(s):Elizabé Malan^[1]Thulani P Makhalanyane^[1,2]**Affiliation:**

62. University of Pretoria

63. University of Stellenbosch

Abstract:

The Atlantic Ocean is the second largest ocean, which is split into North Atlantic and South Atlantic Oceans. The South Atlantic Ocean boundaries lie north of the equator and south of subtropical convergence. It houses remarkable microbial biodiversity; however, it is understudied. The Congo River flows into the South Atlantic Ocean, which discharges 40 000 m³/s of freshwater, making it the second largest river in the world. The Congo River transports large amounts of suspended matter. It forms a river plume, which is a freshened water mass formed in the sea. This is due to the Congo River discharge mixing with saline seawater. The plume extends 800 km offshore and transports nutrients, carbon, and contaminants. Therefore, it has an important role in global carbon fluxes. Dynamics refers to the changes in abundance of various members in a community, which is the types of organisms present and their relative proportions. External forces, such as temperature, nutrient supply, and physical mixing alter the community. It is important to understand how the microbiome affects the environment since the microbiome is important for maintaining climate and ecosystem stability. Also, they process half of the global biogeochemical flux, such as processing carbon, nitrogen and phosphorus.

Format:

e-poster

Keywords:

Congo River; Discharge; Microbial diversity

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Earth systems observations

Title:

Antarctic sea-ice thickness from IceSat-2 and CryoSat-2 satellites

Author(s): add rows below if more authors

Magata J Mangatane^[1,2]

Marcello Vichi^[1,2]

Affiliation: add rows below for more affiliations

64. University of Cape Town

65. Marine and Antarctic Research Centre for Innovation and Sustainability (MARIS)

Abstract:

Sea-ice thickness (SIT) and sea-ice concentration (SIC) from satellites, are essential climate variables used to characterize the features of the ice-covered ocean and to compare with numerical models. Systematic Antarctic in situ SIT observations are limited and satellite remote sensing is the most promising option to obtain circum-Antarctic SIT distributions. However, these retrievals are less developed in the Antarctic because of a lack of validation data. Here we evaluate three recent methods to determine SIT from laser and radar altimetry (improved one-layer method, improved buoyancy equation, and freeboard differencing method), we propose a reprocessing procedure to estimate uncertainties, and compare the results with field observations. We find that the methods estimate a similar SIT seasonality, but the improved one-layer method and buoyancy equation make a better estimation of the field observations. We show that characterising Antarctic Sea ice with a single mean value misrepresents its variable nature.

Format:

Poster

Keywords: (add ; between keywords)

Sea-ice thickness, Earth systems observations, Antarctica

SESSION: Ecosystems, Biodiversity and Biodiscovery

MARS Themes:

Understanding scales of biodiversity from molecular to ecosystem

Title:

Exploring the functional potential of microbial metagenome-assembled genomes (MAGs) from sub-Antarctic islands.

Author(s)

Adeola Rotimi^[1]

Silindile Maphosa^[1]

Pedro Lebre^[1]

Steven Chown^[2]

Don Cowan^[1]

Affiliation:

66. Centre for Microbial Ecology and Genomics, University of Pretoria

67. Monash University, Melbourne, Australia

Abstract:

The majority of islands surrounding the Antarctic continent are poorly characterized in terms of microbial macroecology due to their remote locations, geographical isolation and access difficulties. The 2016/2017 Antarctic Circumnavigation Expedition (ACE) provided unprecedented access to a number of these islands. In the present study we use metagenomic methods to investigate the soil chemoautotrophic communities of samples recovered from 11 circum-Antarctic islands as part of ACE, and to investigate the functional potential of their soil microbial communities. Metagenome-assembled genomes (MAGs) extracted from the circum-Antarctic island soils were screened for marker genes of pathways involved in rare-gas chemotrophy, specifically *coxL*, *NiFe 1h*, and *pmoA*. A total of 21, 45, and 23 MAGs contained sequences for the above genes, respectively.

Format:

5-min oral

Keywords:

Sub-Antarctic Islands; Microbial diversity; MAGs, Aerotrophy

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Oceans and marine eco-systems under global change

Title:

Numerical modelling of sea ice dynamics and thermodynamics in the Antarctic marginal ice zone

Author(s): add rows below if more authors

R. Marquart^[1,2]

M. Vichi^[1,2]

Affiliation: add rows below for more affiliations

68. University of Cape Town (UCT)

69. Marine and Antarctic Research for Innovation and Sustainability (MARIS)

Abstract:

This study aims to enhance and extend the existing small-scale computational sea-ice dynamics model, as developed by Marquart et al. (2021), within the computational fluid dynamics software OpenFOAM. Our objective is to generate improved simulations of sea ice dynamics and thermodynamics, with a particular focus on bridging the gap between small-scale processes and the larger-scale dynamics resolved by current numerical ocean-sea ice models, specifically in the context of the Southern Ocean. With the aim of achieving this objective, we introduce novel parametrizations that consider distinct ice types, such as ice floes and interstitial grease ice, each characterized by unique properties. In addition to this novel approach, we incorporate the thermodynamics model proposed by Tedesco et al. (2009) into our simulations. This integration allows us to comprehensively address the interaction between mechanical properties and thermodynamic processes, particularly in response to the passage of waves. Our research primarily concentrates on the upscaling of mechanical properties and thermodynamics to effectively shape the mean ice type at scales ranging from 5 to 25 kilometres. Coupling between these two models offers a more accurate representation of sea-ice behaviour in the Antarctic marginal ice zone. This novel approach marks a significant contribution to the field of global climate modelling, as it promises to provide for the parametrization of large-scale ocean-ice models.

Format:

5 min oral presentation

Keywords: (add ; between keywords)

Sea-ice; CFD modelling; OpenFOAM; Dynamics; Thermodynamics

SESSION: Ecosystems, Biodiversity and Biodiscovery

MARS Themes:

Understanding scales of biodiversity from molecular to ecosystem

Title:

Microbial diversity in Antarctic Dry Valley soils across an altitudinal gradient

Author(s)

Lefentse Mashamaite ^[1]

Pedro H Lebre ^[1]

Ian Hogg ^[2]

Don Cowan ^[1]

Affiliation:

70. University of Pretoria

71. University of Waikato, Hamilton, New Zealand

Abstract:

The Antarctic McMurdo Dry Valleys are geologically diverse, encompassing a wide variety of soil habitats. These environments are largely dominated by microorganisms, which drive the ecosystem services of the region. While altitude is a well-established driver of eukaryotic biodiversity in these Antarctic ice-free areas (and many non-Antarctic environments), little is known of the relationship between altitude and microbial community structure and functionality in continental Antarctica. The prokaryotic and lower eukaryotic diversity from soil samples across a 684 m altitudinal transect in the lower Taylor Valley, Antarctica was analysed and a phylogenetic characterization of soil microbial communities using short-read sequencing of the 16S rRNA and ITS marker gene amplicons was performed. This phylogenetic analysis showed clear altitudinal trends in soil microbial composition and structure. Cyanobacteria were more prevalent in higher altitude samples, while the highly stress resistant Chloroflexota and Deinococcota were more prevalent in lower altitude samples. We also detected a shift from Basidiomycota to Chytridiomycota with increasing altitude. Several genera associated with trace gas chemotrophy, including *Rubrobacter* and *Ornithinococcus*, were widely distributed across the entire transect, suggesting that trace-gas chemotrophy may be an important trophic strategy for microbial survival in oligotrophic environments. The ratio of trace-gas chemotrophs to photoautotrophs was significantly higher in lower altitude samples. Co-occurrence network analysis of prokaryotic communities showed some significant differences in connectivity within the communities from different altitudinal zones, with cyanobacterial and trace-gas chemotrophy-associated taxa being identified as potential keystone taxa for soil communities at higher altitudes. By contrast, the prokaryotic network at low altitudes was dominated by heterotrophic keystone taxa, thus suggesting a clear trophic distinction between soil prokaryotic communities at different altitudes. Based on these results, we conclude that altitude is an important driver of microbial ecology in Antarctic ice-free soil habitats.

Format:

10-min oral

Keywords:

Microbial diversity; Antarctic Dry Valleys; Soils; Altitudinal gradient; Aerotrophy

SESSION: Space Physics

MARS Themes:

Title:

Analysis of ionospheric storm effects based on GPS and ionosonde data during geomagnetic storms

Author(s): add rows below if more authors

Masango, N^[1]

Habarulema J.B. ^[1,2]

Matamba T.M. ^[1]

Affiliation: add rows below for more affiliations

1. SANSA Space Science, Hermanus

2. Rhodes University, Makhanda

Abstract:

Total Electron Content (TEC) is a key parameter that explains the impact of the ionized atmosphere on the propagation of the radio waves. Major space weather events may contribute to ionospheric delay on the radio signals where additional noise is introduced into measurements of the satellite signal. The quality of the received signals may be severely degraded. This will compromise the accuracy and reliability of the Global Positioning System (GPS) usage. This study focuses on determining the ionospheric storm effects during geomagnetic storm periods. Using GPS TEC and ionosonde TEC over Grahamstown stations. Geomagnetic storm period selection is based on storm-time criteria of $Dst \leq -30$ nT or where $Kp > 4$.

Format:

Oral presentation

Keywords: (add ; between keywords)

Space Physics; Space weather; Global Positioning System

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding natural and anthropogenic drivers of change

Title:

Genomic analysis of Acidobacteria from polar region soils: Delineating the mechanisms leading to diversity and successful adaptation to the polar regions

Author(s)Phillip Mawire^[1]Thulani P Makhalanyane^[1,2]**Affiliation:**

72. University of Pretoria

73. University of Stellenbosch

Abstract:

Polar regions, are harshest habitats on Earth, with temperature, salinity, elevated UV radiation, low nutrient and water content. These regions, dominate Earth's biosphere, supporting sophisticated microbial communities that can persist at low temperatures and are involved in biogeochemical cycles that contribute significantly to nutrient sequestration, including the global C and N cycles, and are also known to be perfect climate change responders. However, the basic mechanisms underlying bacterial cold-adaptation strategies, as well as their ecological significance in polar environments, are unknown. Ubiquity and abundance of acidobacteria in polar soils, as well as their ability to withstand extreme environments, suggest that they serve important functions in polar environment. However, we know less about their ecological functions in these environments. To bridge this gap and gain a comprehensive understanding of global microbial ecological systems in the polar regions, this research will investigate the ecology of acidobacteria in the polar regions. Here we aim to understand the ecophysiology of soil Acidobacteria in polar regions by investigating whether the Acidobacteria pangenome from geographically separated but physically similar environments will have shared genes that reflect general adaptations to the environment, forming globally dispersed functional guilds. And to determine whether adaptation to local conditions, resources, and pressures will result in endemic sets of gene products for adaptation in the polar regions. We will employ both cultivation and non-cultivation methods to determine the ecophysiology of Acidobacteria in cold environments. Low nutrient media and longer cultivation periods will be used in the cultivation methods. We will conduct genome analysis of acidobacteria from polar regions for non-cultivation methods.

Format:

5-min oral

Keywords:

Polar; Acidobacteria, Cold-adaptation; Pangenome

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Earth Systems Observations

Title:

The perceptions of participants on the impact of South Africa's Class Afloat Program (SEAmester) and its links with travel and tourism

Author(s): add rows below if more authors

Mbhalati, T.

Affiliation: add rows below for more affiliations

3. Durban University of Technology

Abstract:

Educational tourism is a type of tourism where people travel with the primary or secondary purpose of learning (Tomasi, Paviotti & Cavicchi, 2020), travel experiences that are planned to meet educational objectives (Coundhary, Srivastavi & Panwar, 2022). It is tourism that is combined with education to improve the leisure and adventurous learning experience, to teach, inform, and promote learning about different cultures, environments, and destinations around the world (Tjitunga, Bama & Makuzva, 2023). Kenfack and Öztüren argue that there has been a growth in the number of nations committed to attracting educational tourists, and certain countries such as Northern Cyprus have been identified as educational tourism destinations. This study aims to investigate the perceptions of participants on the impact of South Africa's Class Afloat Program (SEAmester) and its links with travel and tourism. The study concentrates on individuals who have participated in the program from 2016 to 2023. The study will employ the pragmatic paradigm using a mixed-method approach. Since 2016, 265 graduates have participated in the program, forming the population. A sample of 100 participants will be selected using a convenience sampling technique. An online survey will be administered and data will be analysed using both quantitative and qualitative tools and techniques. The data will be analysed using graphs, charts, and an in-depth assessment of the respondent's responses.

Format:

Oral presentation

Keywords: (add ; between keywords)

Ocean, Capacity Development, Tourism, Seamester

SESSION: Data Management Session (Dr. Anne Treasure)**MARS Themes:****Title:**

Ecosystem modelling to explore ecosystem dynamics at the Prince Edward Islands

Author(s): add rows below if more authorsL. J. McGaughey^[1]E. Pakhomov^[2]V. Christensen^[2]**Affiliation:** add rows below for more affiliations

74. St. Lawrence River Institute of Environmental Sciences, Canada

75. University of British Columbia, Canada

Abstract:

Understanding how ecosystems respond to changing environmental and anthropogenic pressures provides insights that can guide management practices. Ecosystem models that are able to capture population dynamics provide useful tools for understanding past changes and for planning for future scenarios. This study brings together the wealth of data available (1960s – 2010) for the Prince Edward Islands marine ecosystem and consolidates it into a network, mass-balanced model (using Ecopath). The model describes the marine ecosystem at the scale of the Exclusive Economic Zone and, when compared to other subantarctic and Antarctic systems for which there are ecosystem models, the system was most similar to the neighbouring Kerguelen Islands. The contribution of the sources of primary production were assessed through the ecosystem model with open ocean productivity dominating at all but the smallest scale (shelf region), where the macrophyte production was important. An investigation into the ecosystem boundary size was conducted, with all constituents able to satisfy their energetic requirements if considered at the scale of the EEZ. Using the dynamic temporal simulation approach (Ecosim), the model was able to successfully hindcast three past events: the fur seal exploitation, Patagonian toothfish fishery, and the effect of cat predation on small flying birds. In each instance the model performed well for the directly impacted groups. Potential ecosystem effects of climate change were explored through simulations of increasing and decreasing productivity. No single scenario was able to replicate observed patterns and a suite of drivers needs to be considered to reproduce observed patterns. The inclusion of energetic density of prey led to improvements in consumption rate estimates for the static models and should be incorporated into estimates to improve ecosystem model parameterization. This ecosystem model the PEIs can be used as a tool for an ecosystem approach to marine resource management.

Format:

Oral presentation

Keywords: (add ; between keywords)

Ecosystem modelling, population dynamics, marine resource management

SESSION: Innovation and development

MARS Themes:

Innovation and Development

Title:

EXPANDING THE CAPABILITIES OF MARINER 4.0: A HUMAN-CENTRED MONITORING AND RESEARCH TOOL

Author(s): add rows below if more authors

MDA. Melim^[1]

A. Bekker^[1]

K. Kruger^[1]

Affiliation: add rows below for more affiliations

76. Stellenbosch University, Department of Mechanical and Mechatronic Engineering

Abstract:

The maritime industry has witnessed progress in human-centric computing. Among these developments is the human cyber physical system Mariner 4.0, a contribution by Ms. Taylor, a PhD student at Stellenbosch University. Currently implemented on the South African Agulhas ship II, Mariner 4.0 is grounded in a human digital twin framework, digitally mirroring individual seafarers, with a focus on unique states like motion sickness. The primary function of Mariner 4.0 is to monitor and digitize the state of motion sickness in seafarers, creating a service-oriented environment that accurately communicates the individual states of seafarers in real-time.

The content proposed to be communicated at the research session includes enhancing Mariner 4.0 by broadening its capabilities. A central objective of this research is the development of a predictive model for Motion Sickness Incidence. This model harnesses forecasted weather conditions as a primary input to anticipate the ship's motion. By understanding and analyzing the anticipated ship motion, derived from these weather predictions, the model can estimate the likelihood and intensity of motion sickness incidence for individuals aboard. To further this goal, Mariner 4.0 will integrate additional human-centric and environmental metrics. This pro-active approach aims to improve health, safety, and efficiency aboard the South African Agulhas ship II. The data from Mariner 4.0 will be presented in a detailed dashboard, aiding in decision-making, and increasing awareness both on the vessel and ashore. As part of the study, passengers on the South African Agulhas ship II will be equipped with monitoring devices like smartwatches to capture essential human-centric metrics such as heart rate, heart rate variability and body temperature. Participants will also maintain daily diaries and digital questionnaires, detailing their experiences related to various maritime conditions.

Format:

Oral Presentation

Keywords: (add ; between keywords)

Seakeeping; Motion Sickness

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding scales of biodiversity from molecular to ecosystem

Title:

Foregrounding geodiversity in landscape ecology studies: insights from the sub-Antarctic

Author(s)

Daniela Monsanto

David Hedding

Sandra Durand

Shilpha Parbhu

Matthew Adair

Arsalan Emami-Khoyi

Peter Teske

Bettine Jansen van Vuuren

Affiliation:

University of Johannesburg

Abstract:

Biodiversity patterns are shaped by the interplay between geodiversity and organismal characteristics. Superimposing genetic structure onto landscape heterogeneity (i.e., landscape genetics) can help to disentangle these interactions to better understand population dynamics. Previous studies on the sub-Antarctic Prince Edward Islands highlighted the importance of landscape and climatic barriers in shaping spatial genetic patterns, and drew attention to the value of these islands as natural laboratories for studying fundamental concepts in biology. We aim to assess the fine-scale spatial genetic structure of the springtail, *Cryptopygus antarcticus travei*, an endemic to Marion Island, in tandem with high-resolution geology data. Using a species-specific suite of microsatellite markers and a fine-scale sampling design incorporating landscape complexity, we explore genetic patterns overlaid onto high-resolution digital surface models and surface geology data across two one-kilometre sampling transects. Genetic patterns across the landscape closely track landscape resistance data (viewed from the perspective of the study species) in concert with landscape discontinuities and barriers to gene flow identified at a scale of a few meters. These results show that the island's geodiversity plays an important role in shaping biodiversity patterns and intraspecific genetic diversity. This study illustrates that the fine-scale genetic patterns in soil arthropods are markedly more structured than initially anticipated, given the homogeneity of the vegetation complexes at the scale of tens to hundreds of meters. By considering and incorporating fine-scale and high-resolution geodiversity complexity into our study, we were able to explain much of the observed spatial genetic patterns. Our results not only foreground geodiversity as a driver of spatial complexity, but also holds implications for the conservation and management of the sub-Antarctic islands.

Format:

10-min oral

Keywords:

Springtails; Marion Island; Genetic diversity; Spatial patterns

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Innovation and Development

Title:

Investigating the dynamics and exchanges across the ice-ocean interface in artificial sea ice.

Author(s): add rows below if more authors

S. Moos^[1,2]

F. Fripiat^[3]

J. L. Tison^[3]

M. Vichi^[2, 3]

A. de Wit^[5]

T. Rampai^[1,2]

Affiliation: add rows below for more affiliations

77. The Department of Chemical Engineering, The University of Cape Town

78. Marine and Antarctic Research centre for Innovation and Sustainability (MARIS)

79. Université libre de Bruxelles (ULB), Laboratoire de Glaciologie

80. The Department of Oceanography, The University of Cape Town

81. Université libre de Bruxelles (ULB), Nonlinear Physical Chemistry Unit

Abstract:

According to the current studies, there will be a significant decrease in sea ice in both polar regions, which is crucial to the global climate system, since sea ice itself plays a major role in affecting the interaction between the ocean and the atmosphere by insulating the upper portion of the ocean from the polar atmosphere. Investigation of the ice-ocean interaction involves focusing on the internal structures present within the sea ice, such as brine channels, and how these internal structures affect the dynamic processes occurring during sea ice growth.

Dynamic in-situ process analysis on Antarctic Sea Ice is difficult, since currently most available techniques merely provide post-mortem information of the final sea ice sample, without providing further information on the dynamic processes during sea ice growth. Furthermore, certain techniques are only able to provide information on the mushy ice layer, while neglecting additional information on the water below the sea-ice interface, thus not allowing for a complete understanding of the sea ice dynamics. In addition, field experiments pose an additional issue relating to the logistics of measurements, difficulty of isolating external variables and performing high-resolution small-scale investigations over time.

This study focuses on laboratory-based artificial sea ice experiments within a quasi-2D Hele Shaw cell system in a temperature-controlled sub-zero environment to investigate the desalination dynamics at a small scale across the ice-ocean interface. Furthermore, this is supplemented by schlieren and direct optical techniques to visualise and capture both the ice layer and underlying water during ice growth in the Quasi 2D cell,

The obtained images are analysed with Digital Image Processing (DIP) and optical flow algorithms. This approach allows a qualitative and quantitative analysis of the brine expulsion and brine channel velocities during sea ice growth at varying temperatures.

Format:

5 minute Oral presentation

Keywords: (add ; between keywords)

Sea ice; Polar Engineering; Innovation; Digital Image Processing, Computer Vision

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Earth Systems Observations

Title:

Computational Fluid Dynamics Modelling of Pancake Ice on Waves

Author(s): add rows below if more authors

A. Nair^[1,2]

E. Boje^[1]

R. A Verrinder^[1,2]

Affiliation: add rows below for more affiliations

82. Department of Electrical Engineering, University of Cape Town

83. Marine and Antarctic Research centre for Innovation and Sustainability, University of Cape Town

Abstract:

The seasonal evolution of the pancake ice size distribution is not well documented due to the high variability of the MIZ and difficulty in obtaining high resolution in situ data sets. Computational models are used to simulate the small-scale interactions of pancake ice and waves. However, many of these models are limited to two dimensions, and approximate pancake ice as cylindrical. This study presents a computational fluid dynamics model of a single pancake ice floe in a sinusoidal wave field, made with OpenFOAM. Kinematic data for all six degrees of freedom were collected by running simulations of various pancake ice geometries and sizes on waves with different parameters. A validation experiment using a wave flume is set to be conducted at the CSIR in Stellenbosch and Aalto University in Helsinki, to test the fidelity of the model. The simulation data will be compared to visual and inertial data collected with an artificial floe in the wave flume. From the analysis of the simulation data, it was seen that the translational motions of different pancake ice sizes were largely similar and that most of the variation was visible in the rotations. It was noted that, while the surge and heave motions were sinusoidal as expected, the pitch motion displayed two modes. It is hypothesized that there are two main components in these responses: the waves frequency and the natural frequency of the geometry used. It is also hypothesized that the geometry of the pancake ice floe can be approximated from its dynamic behaviour. In future work we hope to develop an algorithm that can approximate the size and geometry of pancake ice using the inertial measurements captured by buoys deployed on them. This will enable us to study the evolution of the size of individual floes.

Format:

5 minute Oral presentation

Keywords: (add ; between keywords)

Computational Fluid Dynamics; Sea Ice Dynamics; Pancake Ice; Marginal Ice Zone

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Earth Systems Observations

Title:

Landscape and climate interactions in the sub-Antarctic: Past, present and future

Author(s): add rows below if more authors

¹W Nel

Affiliation: add rows below for more affiliations

84. University of Fort Hare

Abstract:

In the Southern Hemisphere, sub-Antarctic islands are the only sentinels of land in the vast Southern Ocean. The landscapes of sub-Antarctic islands provide the only terrestrial record of Quaternary glaciations and climate within thousands of kilometres of ocean and even though in the Southern Hemisphere, glacial chronologies provide valuable insights into interactions between glaciation and past climate changes, it is not well constrained on most sub-Antarctic islands. Furthermore, the capacity of the Southern Ocean to absorb anthropogenic CO₂ is limited by an observed increase in the strength of the Southern Hemisphere Westerly Wind (SHW), which modulate both the upwelling and outgassing of CO₂. This means that the ocean may no longer function as such an efficient net sink of CO₂, driving up atmospheric greenhouse gases and accelerating rates of global warming. This presentation aims to provide a progress report on the current research on landscape and climate interactions in the sub-Antarctic by presenting the recent findings of Marion Island's glacial history, geological formation ages and contemporary climate and climate change. The current methodologies employed to reconstruct past changes in the strength and position of the SHW to assess the range of natural variability and evaluate how the SHW have modulated the CO₂ sink in the past and influenced climate in the sub-Antarctic will also be specifically addressed.

Format:

Oral presentation

Keywords: (add ; between keywords)

Sub-Antarctic, climate change, glaciations

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Earth Systems Observations

Title:

Preliminary results of fallout ¹³⁷Caesium techniques on Aeolian land features on sub-Antarctic Marion Island

Author(s): add rows below if more authors

¹ AA Nguna

Affiliation: add rows below for more affiliations

1. University of Fort Hare

2.

3.

Abstract:

The investigation of Aeolian land features (mega ripples & deflation hollows) on Marion Island involves determining the dynamics of each feature and the processes acting upon them. Experiments conducted on the features of two major aeolian study sites on sub-Antarctic Marion Island namely, Mesrug and Santa Rosa have employed the Caesium137 technique for soil erosion assessment. The existing methods for soil erosion assessment can be grouped into two main categories: erosion modelling & prediction methods and erosion measurement methods (Elliot et al., 1991). The quest for techniques for assessing soil erosion to complement existing methods has directed attention to the use of radionuclides, in particular fallout ¹³⁷Caesium as a tracer to obtain estimates of soil erosion and deposition. By artificially labelling soil particles with an appropriate radionuclide, both the extent and source of soil loss can be determined. The ¹³⁷Caesium is by far the most widely used radionuclide in soil erosion and sedimentation studies by virtue of its high affinity for fine particles, its relatively long half-life, its relative ease of measurement and the well – defined temporal pattern of fallout input. Samples were collected at each study site on the trough and crest of each feature at different depths (in situ, 5 cm,10 cm). Analysis of particle size distribution and ¹³⁷Caesium radionuclide fallout will indicate the presence/concentration of the radionuclide and determine whether these features experience considerable amounts of erosion or deposition.

Format:

Oral presentation

Keywords: (add ; between keywords)

radionuclides, ¹³⁷Caesium, sub-Antarctic, Aeolian features.

SESSION: Innovation and development**MARS Themes:**

Innovation and development

Title:

Inverse calculations of ice impacts on propulsion machinery

Author(s): add rows below if more authorsB. M. Nickerson^[1]A. Bekker^[1]**Affiliation:** add rows below for more affiliations

85. Stellenbosch University, Department of Mechanical and Mechatronic Engineering

There is increasing marine traffic in arctic regions, exposing ships and their propellers to harsh operating conditions. What happens if a propeller fails? It is important to monitor propeller loads, as damaged propeller blades mean a ship is stuck in ice. These loads are difficult to measure directly, so inverse models are used to estimate them from response measurements on the propeller shaft. Two inverse models were investigated. The first represents the propeller shaft using discrete lumped parameters. The second uses a finite number of vibration modes to represent the shaft as continuous instead of discrete. Both models have limitations, with the continuous model having the advantage of being significantly more efficient though potentially prone to spurious frequencies in the inverse estimation. Further research is planned to resolve issues in the models.

Format:

Oral presentation

Keywords: (add ; between keywords)

Ship propulsion; Propeller-ice interaction; Inverse model

SESSION: Humanities in the South African National Antarctic Programme

MARS Themes:

Human Enterprise

Title:

Humanities can build bridges between researchers in different fields in Antarctic research. Investigate the option of publishing a human story of the researcher.

Author(s): add rows below if more authors

M. P. Olivier^[1,2]

Affiliation: add rows below for more affiliations

86. Stellenbosch University

87. Antarctic Legacy of South Africa

Abstract:

Can humanities bring together researchers from across the earth and life sciences by bridging their fields, with the common factor that all research is done by a human (person)? The stories of these researchers and scientists need to be told, will Humanities and Social Sciences be able to facilitate the filling of present knowledge gaps surrounding the interactions between these disciplines.

South Africa, as a founding member of the Antarctic Treaty, has a long-term track record of and commitment to undertaking oceanic, terrestrial, and atmospheric research in Antarctica and the Southern Ocean. The Antarctic Legacy of South Africa project (ALSA) commenced in 2009 and is a NRF (National Research Foundation)-funded project that forms part of the South African National Antarctic Programme (SANAP). ALSA's primary role is to digitally archive historical information relating to South Africa's involvement in the Antarctic region. The period of interest extends from the heroic age of Antarctic exploration until the present day. The main aim is to create a legacy for all South Africans including all the scientists in these fields.

One key commitment of the project is to publish books to ensure that South Africa's Antarctic Legacy will not be lost for research. This presentation will show the importance of taking one step closer to preserving the footprints made by many South African researchers and over winterers. The first book is the diary of Brian Huntley, the botanist on the First Biological and Geological Expedition to Marion Island over 1965/66. A story that is correctly compiled can improve knowledge of science and can have an influence on research on field and on governance level.

Format:

E-poster

Keywords: (add ; between keywords)

Heritage; Legacy; History; Research

SESSION: Humanities in the South African National Antarctic Program**MARS Themes:**

Human Enterprise

Title:

Humanities can build bridges between researchers in different fields in Antarctic Research. Investigate the option of publishing a human story of the researcher.

Author(s): add rows below if more authorsM. P. Olivier^[1,2]**Affiliation:** add rows below for more affiliations

88. Stellenbosch University

89. Antarctic Legacy of South Africa

Abstract:

Can humanities bring together researchers from across the earth and life sciences by bridging their fields, with the common factor that all research is done by a human (person)? The stories of these researchers and scientists need to be told, will Humanities and Social Sciences be able to facilitate the filling of present knowledge gaps surrounding the interactions between these disciplines.

South Africa, as a founding member of the Antarctic Treaty, has a long-term track record of and commitment to undertaking oceanic, terrestrial, and atmospheric research in Antarctica and the Southern Ocean. The Antarctic Legacy of South Africa project (ALSA) commenced in 2009 and is a NRF (National Research Foundation)-funded project that forms part of the South African National Antarctic Programme (SANAP). ALSA's primary role is to digitally archive historical information relating to South Africa's involvement in the Antarctic region. The period of interest extends from the heroic age of Antarctic exploration until the present day. The main aim is to create a legacy for all South Africans including all the scientists in these fields.

One key commitment of the project is to publish books to ensure that South Africa's Antarctic Legacy will not be lost for research. This presentation will show the importance of taking one step closer to preserving the footprints made by many South African researchers and over winterers. The first book is the diary of Brian Huntley, the botanist on the First Biological and Geological Expedition to Marion Island over 1965/66.

A story that is correctly compiled can improve knowledge of science and can have an influence on research on field and on governance level.

Format:

E-Poster

Keywords: (add ; between keywords)

Heritage; Legacy; History; Research

SESSION: Marine Mammals**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Marine predators: ecosystem sentinels that help inform Southern Ocean management

Author(s): add rows below if more authorsW.C. Oosthuizen ^[1,2]**Affiliation:** add rows below for more affiliations

90. Centre for Statistics in Ecology, Environment and Conservation, Department of Statistical Sciences, University of Cape Town, Cape Town, South Africa

91. Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria

Abstract:

Studies of animal movement improve our understanding of habitat use, resource availability and predator-prey interactions, that can ultimately help inform conservation and management decisions. In marine ecosystems, tracking is now routine for numerous predator species, many of which face uncertain futures. Abundant tracking data, also from Marion Island, have substantially improved our understanding of marine predator movement and diving behaviour, their responses to environmental change and vulnerability to threats. However, despite advanced tracking technologies, it remains challenging to observe and quantify prey consumption in Southern Ocean marine predators. New methods that improve our ability to quantify predator prey consumption, together with regional estimates of population sizes, will help scale individual functional responses to the population level, to generate spatially resolved measures of predator prey consumption at the population level. This data layer is highly relevant to supporting risk assessment analysis and marine spatial planning particularly in relation to global change, conservation and sustainable resource management.

Format:

Oral

Keywords: (add ; between keywords)

animal movement; habitat use; prey consumption; predator-prey interactions; marine spatial planning

SESSION: Botany GREVE**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Sub-Antarctic plant N uptake in a changing world

Author(s): add rows below if more authorsN. Pallett^[1]B. Ripley^[2]M. Greve^[3]M. Cramer^[1]**Affiliation:** add rows below for more affiliations

92. University of Cape Town

93. Rhodes University

94. University of Pretoria

Abstract:

There is uncertainty around sub-Antarctic Marion Island (MI) plant N acquisition. Plants are assumed to exclusively acquire inorganic N (iN; NH_4^+ and NO_3^-) and not organic N (oN, e.g., amino acids), despite MI soils being replete in the latter. Moreover, warming trends are expected to increase soil N availability, thus stimulating plant growth. We hypothesised that MI grasses acquire oN and that warming indirectly stimulates plant growth through nutrient release. oN and iN uptake was measured using ^{15}N tracers in hydroponics and *in situ*. Plant growth under soil warming was investigated in a full-factorial potted experiment with warming (+3°C above ambient temperature) and NPK fertilisation. MI grasses (*Polypogon magellanicus*, *Poa cookii*, *Agrostis stolonifera*, *Poa annua*) acquired ^{15}N -glycine (oN) more rapidly than $^{15}\text{NO}_3^-$. *In situ*, oN uptake was low at high soil [iN] sites and increased with low soil [iN]. When warmed, soil [iN] increased slightly but only *P. annua* increased biomass. By contrast, all species increased biomass substantially under NPK. The evidence for oN uptake in conjunction with the high soil [oN] of the island suggests that previous literature underestimates total plant-available N. Responsiveness of soil N and plant growth to short-term warming was limited, however nutrient limitations to productivity were clearly important. The sub-Antarctic terrestrial N-cycle requires re-evaluation, accounting for oN acquisition. Long-term warming experiments are needed to elucidate vegetation responses to warming. For MI, we suggest that large nutritional changes due to mammal invasions and consequent decreases in avian-derived nutrients outweigh the effects of short-term climate warming.

Format:

Oral presentation

Keywords: (add ; between keywords)

Graminoid, organic N, inorganic N, Marion Island, N-cycling, soil warming

SESSION: Ecosystems, Biodiversity and Biodiscovery**MARS Themes:**

Understanding natural and anthropogenic drivers of change

Title:

Detecting signals of adaptive selection of an invasive springtail on sub-Antarctic Marion Island

Author(s)

S Parbhu ^[1]

A Emami-Khoyi ^[1]

P Teske ^[1]

C Janion-Scheepers ^[2]

B Jansen van Vuuren ^[1]

Affiliation:

95. University of Johannesburg

96. University of Cape Town

Abstract:

Springtails are important soil dwelling microarthropods with a global distribution. They play a role in nutrient cycling and are commonly used as bioindicators of ecosystem health. On sub-Antarctic Marion Island, there are no vertebrate herbivores, but springtails, invertebrate herbivores, are abundant and therefore fulfil the role of herbivory, which makes them an ecologically important group on the island. Our study organism is the collembolan, *Isotomurus maculatus*, which has a natural distribution that includes Europe and North America, with some individuals present in the Western Cape, South Africa. It was introduced to Marion Island in the late 1970s and is now considered to be an invasive species on the island. Since *I. maculatus* is native to regions that are hot and dry, how did this springtail adapt to a cold and harsh environment such as that on Marion Island? We aim to answer this by identifying possible signals of adaptive selection, by sequencing the transcriptome of *I. maculatus* under different thermal and humidity conditions. We will apply a comparative transcriptomic approach to identify signals from genes and metabolic pathways involved in local adaptation and pinpoint the biochemical mechanisms that facilitate adaptation to Marion Island. The genomic basis of adaptation in invasive species is not well understood, therefore, the implication of this study is far-reaching as it will help to inform the management of invasive species.

Format:

10-min oral

Keywords:

Springtails; Marion Island; Adaptation; Invasive species

SESSION: Seabirds and marine mammals**MARS Themes:**

Oceans and marine ecosystems under global change

Title:

South Atlantic seabirds can be used as bioindicators to monitor small buoyant plastics at sea

Author(s): add rows below if more authorsV Perold ^[1]G Suaria ^[2]M Connan ^[3]B. J. Dilley ^[1]E. A. Weideman ^[1]P. G. Ryan ^[1]**Affiliation:** add rows below for more affiliations

97. FitzPatrick Institute of African Ornithology, DST-NRF Centre of Excellence, University of Cape Town

98. CNR-ISMAR (Institute of Marine Sciences – National Research Council), Italy

99. Marine Apex Predator Research Unit (MAPRU), Nelson Mandela University

Abstract:

Plastic ingested by seabirds is used as a tool to monitor temporal and spatial variation in marine plastic pollution. For seabirds to be a reliable proxy, we need to understand what types of plastics each species ingests, and how these compare with those found in their environment. We use brown skua *Catharacta antarctica* regurgitations, each containing the remains of a single seabird prey, to characterise plastics ingested in four seabird taxa breeding at Inaccessible Island in the South Atlantic Ocean, during 2018. We compare the plastics they ingest to marine plastics collected with a neuston net at 116 sampling stations within the South Atlantic and southwest Indian Ocean region during 2016–2019. Overall, plastic types, colours and polymer types were similar between ingested and marine plastics, but *Fregetta* storm petrels ingested more fibres and white-faced storm petrels more industrial pellets than other taxa. Great shearwaters ingested more flexible packaging items, indicative of their foraging ranges that extend into industrialized coastal areas. Storm petrels were better indicators of the size of plastics floating at sea than larger prions and shearwaters. Given this information, we conclude that as a seabird community, plastics ingested by petrels can be used to assess the composition, and to track long-term changes in floating micro- and mesoplastics in this region.

Format:

Flash presentation

Keywords: (add ; between keywords)

seabirds; plastic ingestion; South Atlantic Ocean; microplastics; bioindicators

SESSION: Ecosystems, Biodiversity and Biodiscovery

MARS Themes:

Title:

Author(s)

Riaan Pierneef ^[1]

Thulani P Makhalanyane ^[1,2]

Affiliation:

100. University of Pretoria

101. University of Stellenbosch

Abstract:

Format:

10-min oral

Keywords:

SESSION: Oceans 3 (Chairs: Sarah Fawcett & Susanne Fietz)

MARS Themes:

Oceans and marine ecosystems under global change

Earth systems observations

Title:

Characterising phytoplankton communities: A Southern Ocean case study of environmental coupling

Author(s): add rows below if more authors

L.B. Quinlan^[1]

S. Fietz^[1]

Affiliation: add rows below for more affiliations

102. Stellenbosch University

Abstract:

The combination of photosynthetic pigments allows one to distinguish specific phytoplankton groups. The analysis of these pigments therefore allows assessment of the phytoplankton community group composition. Global oceans act as carbon sinks, partly due to surface water phytoplankton primary production. However, Southern Ocean data on these communities is sparse and biased toward summer sampling expeditions. This study presents data from winter 2017 (Indian sector) and winter/spring 2019 (Atlantic sector) expeditions aboard the SA Agulhas II. We linked phytoplankton community functional group prevalence with environmental factors. This study aims to better understand how specific phytoplankton groups relate to environmental drivers, and how Southern Ocean hydrography spatially constrains these connections.

Format:

Oral Presentation

Keywords: (add ; between keywords)

Southern Ocean; Phytoplankton; CHEMTAX; Environmental Coupling

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Innovation and Development

Title:

The influence of growth dynamics of sea ice, and the resulting crystal/physical structure, on the mechanical properties of sea ice

Author(s): add rows below if more authors

T. Rampai^[1,2]

Affiliation: add rows below for more affiliations

103.The Department of Chemical Engineering, The University of Cape Town

104.Marine and Antarctic Research centre for Innovation and Sustainability (MARIS)

Abstract:

While the Arctic regions have been the subject of scientific investigations on the material properties of sea ice since the early 20th century, the study of Antarctic Sea ice as a material has received relatively less attention. In the Southern Hemisphere, the knowledge of sea ice properties is mostly related to the surroundings of the Antarctic bases, and therefore temporally connected to the summer period when they attain the largest occupancy with several cruises. A seasonal perspective on Antarctic Sea ice is only available for the western Weddell Sea and the Antarctic Peninsula, due predominantly to the autumn and winter Polarstern cruises in the 80's and early 90's.

Sea ice properties vary drastically with location, due to the dependency on oceanic and meteorological conditions. Thus, sea ice sampling and the determination of its physical and mechanical properties needs to be undertaken over the full season and across the largest spatial region that is practically feasible. In addition, there is great difficulty in assessing the individual variables that contribute to the sea ice dynamics in the field, such as crystal structure, relative porosity volume (brine and air), and biological constituents (EPS), owing to the complexity and short-term variability of the Antarctic Sea ice. Therefore, there is a need to perform year-round experiments in the laboratory to simulate Antarctic conditions and manufacture artificial sea ice. This will allow measurements of the relevant variables in controlled studies and refinement of methodologies that can be used in the field.

Format:

5 minute Oral presentation

Keywords: (add ; between keywords)

Sea ice; Polar Engineering; Innovation; mechanics, mechanical properties

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Earth Systems Observations

Title:

The deglaciation of sub-Antarctic Marion Island

Author(s): add rows below if more authors

¹EM Rudolph

²DW Hedding

³W Nel

Affiliation: add rows below for more affiliations

1. University of the Free State

2. UNISA

3. University of Fort Hare

Abstract:

It is increasingly apparent that local and regional geographic factors strongly influence the timing and extent of glaciation across the Southern Hemisphere. Glacial chronologies of sub-Antarctic Islands can provide valuable insights into the nature of regional climatic variability and the localised response(s) of glacial systems during periods of climatic change. In this talk I will provide an overview of the approaches used to reconstruct Marion Island's past glaciations starting with a (re-)assessment of geological history and geomorphological evolution and then the application of cosmogenic ³⁶Cl exposure age dating. Exposure ages of glacial depositional and erosional features confirm a local Last Glacial Maximum was reached prior to ~40 ka. Ice retreated throughout MIS 2 with minor standstill events between ~33-26 and ~20-17 ka, with limited evidence of ice re-advances during the Antarctic Cold Reversal or Holocene cooling periods. A spatio-temporal reconstruction shows that deglaciation of individual glacier lobes was a-synchronous due to local physiography and topographical factors controlling the island's micro-climate. We compare Marion Island's glacial chronology to other sub-Antarctic islands (e.g. the Kerguelen archipelago, Auckland and Campbell islands, and South Georgia) and continental mountain glaciers (e.g. Patagonia and New Zealand) and a review of evidence for a Southern Hemisphere glacial maximum in late MIS 3. Sea surface temperatures and the position of the Southern Westerly Wind belt are recognized as key controls for ice accumulation / starvation throughout the Quaternary due to their influence on air-temperature and precipitation regimes.

Format:

Oral presentation

Keywords: (add ; between keywords)

Sub-Antarctic, cosmogenic dating, glaciations, ³⁶Cl, MIS2, MIS3

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Ecosystems, biodiversity and biodiscovery

Title:

Acoustic occurrence and behavior of Baleen Whales during winter around Prince Edward Islands

Author(s):

I. Schäfer ^[1]

F. W. Shabangu ^[2, 3]

T. Lamont ^[1, 2]

Affiliation:

1. Department of Oceanography, University of Cape Town
2. Department of Forestry, Fisheries and Environment
3. Mammal Research Institute Whale Unit, University of Pretoria

Abstract:

Acoustic occurrences and diel call patterns of Baleen Whales around Prince Edward Islands (PEI) are described using acoustic recordings. Acoustic data were recorded from a hydrophone deployed on an oceanographic mooring located between the subantarctic Marion and Prince Edward Islands in the Southern Ocean. Acoustic occurrences (i.e. presences) of baleen whales were identified through visual and audio analyses of spectrograms of recorded data. Environmental parameters including sea surface temperature (SST), which is possibly associated with acoustic occurrences, was investigated for correlation. During the study period of winter 2022, eight different types of baleen whale calls were detected, with Fin whale calls having the highest occurrence. Correlations performed between the various calls' acoustic occurrences and SST, deemed Madagascar Pygmy Whale calls, Humpback Whale songs, Sei Whale upsweep calls and Antarctic Blue Whale Z-calls to be statistically significant. This study improves our knowledge about the diel call patterns and acoustic occurrence of baleen whale species around PEI. Such knowledge could be essential for the conservation and management of the species.

Format:

Oral presentation

Keywords:

Baleen whales ; Bioacoustics ; Prince Edward Islands ; SST ; Southern Ocean

SESSION: Data and frameworks in the support of polar research**MARS Themes:**

Oceans and Marine Ecosystems under Global Change

Title:Non-breeding distribution and moulting activity of Blue Petrels (*Halobaena caerulea*) breeding on sub-Antarctic Marion Island**Author(s):** add rows below if more authors¹Schoombie, S., ²Connan, C., ³Cleeland, J., ⁴Thompson, M., ²Ryan, P.G.**Affiliation:** add rows below for more affiliations

1. Centre for Statistics in Ecology, the Environment (SEEC), University of Cape Town
2. Fitzpatrick Institute of African Ornithology, University of Cape Town
3. Institute for Marine and Antarctic Studies (IMAS), University of Tasmania
4. Cornell Lab of Ornithology

Abstract:

Burrow-nesting seabirds are among the most numerous seabirds in the Southern Ocean. Because of their cryptic habits and small size, they are much less studied than their counterparts nesting above ground. At Marion Island, the Blue Petrel (*Halobaena caerulea*) is the second most abundant procellariiform species, with the combined breeding population at the Prince Edward Islands (PEI) being the third largest globally, after Diego Ramirez and Kerguelen. Little is known about their non-breeding distribution and particularly where they moult. We fitted 21 adult Blue Petrels with geolocator tags, measuring light intensity and water contact, to estimate their at-sea and moulting distributions. The birds moved to higher latitudes (60–70° S) southwest of PEI directly after breeding (January/February), where they moulted their flight feathers prior to the austral winter. After returning to the PEI in April/May, most birds remained close to the PEI during winter (June-August). The at-sea distribution and preferred moulting areas of Marion Island Blue Petrels are similar to birds breeding at Kerguelen and South Georgia, suggesting that birds from the three largest colonies in the South Atlantic and southwest Indian Ocean all moult in the same region. This has important conservation consequences, as birds are less mobile when moulting, and protection of such areas in the high seas are crucial.

Format:

Oral presentation

Keywords: (add ; between keywords)

at sea distributions; Blue Petrel; geolocating; moulting distributions; Prince Edward Islands

SESSION: General (Summer Survey participants)**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Innovation and development

Title:

Studies of wind, plants and seabirds on Marion Island

Author(s): add rows below if more authorsJ. Schoombie ^[1]M. Momberg ^[2]L. Smith ^[1]K. Craig ^[1]P. C. le Roux ^[2]**Affiliation:** add rows below for more affiliations

105. Department of Mechanical and Aeronautical Engineering, University of Pretoria

106. Department of Plant and Soil Sciences, University of Pretoria

Abstract:

Recognizing the pivotal role of shifting westerlies in shaping regional climate patterns and ecological processes, a comprehensive effort commenced in 2018 to improve our understanding of spatial and temporal variation in Marion Island's wind patterns. The first component of the project used Computational Fluid Dynamics (CFD) simulations to estimate wind flow patterns around the island under different prevailing wind conditions. Empirical wind speed and direction data were then collected using 34 anemometers from 17 locations on the island. These data not only provided valuable insights into wind variation within the island but also validated the CFD simulations.

The CFD simulation results comprised 16 wind directions and the best agreement was obtained for westerlies and south-westerlies, which occurred most frequently based on wind measurements (Goddard et al. 2022). Overall, the simulations proved to be sufficiently accurate and revealed marked fine-scale spatial variations in wind patterns. The resulting estimates of wind conditions across Marion Island under different wind directions proved instrumental in understanding the impact of wind on the island's ecology.

From the measured data and CFD simulations we have demonstrated the link between fine-scale variation in wind patterns on Marion Island and, for example, the distribution of Wandering Albatross nesting sites (Momberg et al. 2023), the distribution of vegetation types (Momberg 2022), plant community characteristics (Momberg et al. 2021a) and plant species occurrence patterns (Momberg et al. 2021b). We have also been able to link local wind patterns to fatal crash-landings of Grey-headed Albatross adults in Santa Rosa Valley (Schoombie et al., in press).

The temporal dynamics of wind phenomena, such as turbulence at a landform scale, remain an area of interest that requires further exploration. The project aims to expand its efforts through the deployment of additional sensors on Marion Island, conducting more refined CFD simulations, and identifying the mechanistic links between wind conditions and ecological patterns.

Format:

Oral presentation

Keywords: (add ; between keywords)

Wind; Simulation studies

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Ocean

Title:

Life near the sea ice edge: Listening for whales off the Maud Rise, Antarctica

Author(s): add rows below if more authors

Fannie W. Shabangu^{1,2}

Christopher T. Tessaglia-Hymes³

Leon Jacobs⁴

Marcel van den Bergh⁴

Gavin Louw⁴

Tarron Lamont⁴

Holger Klinck^{3,5}

Affiliation: add rows below for more affiliations

107. Fisheries Management Branch, Department of Forestry, Fisheries and the Environment, Foreshore, Cape Town, South Africa

108. Mammal Research Institute Whale Unit, University of Pretoria, Private Bag X20, Hatfield, Pretoria 0028, South Africa

109. K. Lisa Yang Center for Conservation Bioacoustics, Cornell University, Ithaca, New York, USA

110. Oceans and Coastal Research Branch, Department of Forestry, Fisheries and the Environment, Foreshore, Cape Town, South Africa

111. Department of Fisheries, Wildlife, and Conservation Sciences, Marine Mammal Institute, Oregon State University, Newport, Oregon, USA

Abstract:

Localities around the sea ice edge provide suitable summer feeding environments for migratory marine mammals; however, such areas are understudied because those locations are remote and dominated by harsh, icy conditions. We deployed a Rockhopper acoustic recorder that sampled at 250 kHz off the Maud Rise, Southern Ocean, near the sea ice edge from January 2022 to January 2023 at a water depth of 1200 m. The acoustic instrument was duty cycled to sample for the first half of every hour of each day; however, the instrument only worked for the first 30 days (mid-January through mid-February) of yearlong deployment due to technical constraints. Antarctic blue whale Z-calls, fin whale 20 Hz pulses, blue whale D-calls, sperm whale clicks, humpback whale songs, ice cracking sounds, and seismic signals were detected from the monthlong recordings. Most of these whale calls were previously detected around this location, except for sperm whale clicks that were not detected previously, and Antarctic blue whale Z-calls were the most commonly detected calls whereas sperm whale clicks were the least detected. No pinniped calls were detected from these recordings. The acoustic presence of these whales around this seamount near the sea ice edge in summer suggests that these animals could have been foraging around this biological productive area. In conclusion, these results provide further evidence that the Maud Rise is an important summer feeding habitat for various marine mammals.

Format:

e-poster

Keywords: (add ; between keywords)

Sea ice; Antarctic seamount; acoustic occurrence; soundscape; anthropogenic activities

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Ocean

Title:

Rhyiming in the cold: Fish calls between two sub-Antarctic Islands, Southern Ocean

Author(s): add rows below if more authors

Fannie W. Shabangu^{1,2}

Stephen Lamberth^{1,6}

Shyam Madhusudhana³

Charles von den Meden⁴

Grant van der Heever^{1,4}

Ofer Gon⁵

Hannah Raven^{4,6}

Affiliation: add rows below for more affiliations

112. Fisheries Management Branch, Department of Forestry, Fisheries and the Environment, Foreshore, Cape Town, South Africa

113. Mammal Research Institute Whale Unit, University of Pretoria, Private Bag X20, Hatfield, Pretoria 0028, South Africa

114. Centre for Marine Science and Technology, Curtin University, Bentley, WA, Australia

115. South African Environmental Observation Network (SAEON) Egagasini Node, Cape Town, South Africa

116. South African Instituted for Aquatic Biodiversity, Grahamstown, South Africa

117. Institute for Coastal and Marine Research, Nelson Mandela University, Gqeberha, Port Elizabeth 6031, South Africa

Abstract:

Acoustic ecology of fish in the Southern Ocean is poorly understood due to lack of research around those remote areas. The objective of this study was to investigate the seasonal occurrence, establish diel vocalizing pattern of fish, and identify the sources of the fish calls detected halfway between Marion Island and the Prince Edward Island in the Southern Ocean. To collect our acoustic data, we used a SoundTrap ST500 autonomous recorder deployed at a water depth of 162 m on an oceanographic mooring from mid-2021 to early 2023. Fish calls were initially detected using visual and aural review on a subset data, and then a deep learning techniques were used to count calls from the whole dataset. Ski-Monkey III towed camera footage from dives deployed near the recording site were reviewed to identify the potential source of the recorded fish calls. In turn, calls were broadly categorised into stridulation or drumming and fish families in the study area, with or without swim-bladders and drumming muscles, were identified from the available literature. Fish vocalized more at night and their year-round presence responded to variability in environmental conditions such as wind speed, sea surface temperature, chlorophyll-a, and sea surface height. Two types of fish calls were found from our acoustic data set, and *Lepidonothus larseni* and *Lepidonothus squamiformes* were the commonly found fish species from camera footage. However, these species were discounted as the likely sources of the recorded loud calls given their small size. This study provides the first evidence of the seasonal occurrence and diel behaviour of soniferous fish in the Southern Ocean.

Format:

e-poster

Keywords: (add ; between keywords)

Fish acoustics; sub-Antarctic region; acoustic repertoire; camera footage; deep learning

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Capacity Development

Title:

The Antarctic Youth Coalition (AYC), a core objective of the Antarctic Cities and the Global Commons project.

Author(s): add rows below if more authors

Silima, R.

Affiliation: add rows below for more affiliations

4. Antarctic Legacy of South Africa
5. Antarctic Youth Coalition
6. SEAMesters

Abstract:

Ongoing youth-based programmes providing education-based expeditions to Antarctica have been developed by non-state actors, universities and national Antarctic programs since the early 2000's. Despite the successes and impact of these youth based educational programs, and despite the emergence and growth in recent decades of youth-led issues-based movements worldwide, there have been scarce opportunities for young people to have a voice in national and global networks for action on Antarctica. In February 2020, five young leaders representing each of the world-known Antarctic 'gateway' cities travelled to the northern tip of the Antarctic Peninsula to fulfil a dream: see Antarctica and find a common pathway for transmitting a sense of care and responsibility for this polar region onto their home communities. This endeavour is known as the Antarctic Cities Youth Expedition (ACYE), a global first youth forum that took place in Antarctica to address Antarctica's future challenges through the lens of young people. The ACYE members developed in situ the basis of collaborative work to progress the idea of Antarctic custodianship beyond the boundaries of the polar region's governance. The ACYE led to the formation of the Antarctic Youth Coalition (AYC), a core objective of the Antarctic Cities and the Global Commons project, an interdisciplinary, multimodal and international research project led from Western Sydney University (Australia). The Antarctic youth coalition (AYC) is a membership-based organisation for people living in the Antarctic gateway cities of Cape Town (South Africa), Christchurch (New Zealand), Hobart (South Africa), Punta Arenas (Chile) and Ushuaia (Argentina). Our vision is for cities to come together and embrace the principles of Antarctica for the protection of our shared futures. This coalition is not exclusive to the gateway cities but for anyone who has the passion, drive to take the baton of Antarctic custodianship. This plays hand in hand with our mission, which is to build a network of young custodians across the gateway cities, advocating for Antarctica's future, by promoting sustainable communities and connecting urban identities to Antarctica. We thus challenge our cities into practicing sustainability, using the model of Antarctic governance for instance, cooperation, diplomacy, science and best of all collaboration between countries to meet a sustainable end.

Format:

Oral presentation

Keywords: (add ; between keywords)

Antarctica, Gateway Cities, Legacy, Tourism, Governance, Capacity Development

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Earth Systems Observations

Title:

Towards determining the formation ages of the lithologies on sub-Antarctic Marion Island

Author(s): add rows below if more authors

¹SS Sinuka

Affiliation: add rows below for more affiliations

1. University of Fort Hare

2.

3.

Abstract:

Key to identifying the volcanic landscape dynamics on Marion Island is understanding the geochronology of the volcanic activity. Little is known about the ages of the older Pleistocene grey lavas, younger Holocene black lavas or red scoria cones that make up the surface lithology of sub-Antarctic Marion Island. The aim of this study is to determine the formation ages of the three deposits using Uranium Series Dating and clarify limits on accumulation of organic matter for peat development and maximum ages of ecological succession. Rock samples (0.5kg) were collected from various locations around the Island, analysed using Scanning Electron Microscope, underwent heavy mineral separation and X-ray Fluorescence analysis. Age determination was done via an Inductively Coupled-Plasma Mass Spectrometer (IC-PMS), and equilibria/ disequilibria calculations to determine age formation. The mineral composition identified in the samples are consistent with those of Verwoerd (1971) and McDougall et al., (2001) with exception of Chromium Oxide and Vanadium Oxide. The red scoria cones had the highest Loss of Ignition measured, due to possible large organic containment. The grey lava deposits were the only samples to contain the mineral ilmenite in them, which explains the highest values for Iron oxide & Titanium oxide minerals and their distinct colour characterisation. The study is on-going and the age results will provide precise ages of the lava flows found on the surface of Marion Island.

Format:

Oral presentation

Keywords: (add ; between keywords)

Sub-Antarctic, geology, formation ages, Uranium Series Dating

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Oceans and marine ecosystems under global change

Earth systems observations

Ecosystems, biodiversity and biodiscovery

Title:

From Physics to Top Predators at islands and seamounts in the Southern Ocean

Author(s): add rows below if more authors

A. K. Sneddon^[1]

T. Lamont^[1,2,3]

C.J.C. Reason^[1]

C.S. Russo^[2]

Affiliation: add rows below for more affiliations

1. Oceanography Department, University of Cape Town, Cape Town, South Africa

2. Oceans & Coasts Research Branch, Department of Forestry, Fisheries, and the Environment, Cape Town, South Africa

3. Bayworld Centre for Research and Education, Constantia, Cape Town, South Africa

Abstract:

Marine heatwaves (MHW) are extreme oceanic warm water events. They have been shown to have major negative impacts on marine ecosystems, for example, causing mass coral bleaching, loss of kelp forests and declines in surface chlorophyll-*a* levels as a result of increased stratification. These negative impacts of MHW have potential implications for the economies and livelihoods of the countries dependent on the ocean. MHW have been observed to be increasing in both frequency and intensity throughout the global oceans as a result of anthropogenic climate change. As a result, it is imperative to understand the characteristics of MHW for better adaptation and mitigation of the effects of these extreme events. While many studies have been conducted in the global oceans, MHW characteristics in the oceans around southern Africa have yet to be studied in depth. This study compared the characteristics of MHW in the South Atlantic and South Indian Ocean basins in order to better understand how they may change in the future. It was found that, on average, MHW lasted longer in the South Atlantic (~30 days) than in the South Indian Ocean (~25 days). MHW were also found to have a higher frequency and mean intensity in the region of current systems such as the Agulhas Retroflexion region (3.5 MHW per year and 4.5°C, respectively) and the Brazil-Malvinas Confluence (3.5 MHW per year and 3.5°C, respectively) than in the Atlantic and Indian Ocean basin interiors (1 to 2.5 MHW per year and 0.5 °C to 1.5°C, and 1 to 2.5 MHW per year and 0.5. °C to 2 °C, respectively). When a smaller region in the Agulhas Retroflexion was investigated, the longest and most intense MHW lasted 87 days and had a maximum intensity of 4.6°C above the threshold. The second- and third-longest MHW, lasting 71 days and 70 days respectively, occurred within 15 days of each other.

Format:

Oral presentation

Keywords: (add ; between keywords)

Marine heatwaves; heatwaves.

SESSION: Humanities in the South African National Antarctic Programme

MARS Themes:

Human Enterprise

Title:

Proposed project: Digitisation and preservation of Marion Island's hut books

Author(s): add rows below if more authors

M.H. Stander¹

E.M. Rudolph¹

A.M. Treasure²

C. Lavery³

R. Olivier⁴

M. Rossouw⁵

Affiliation: add rows below for more affiliations

¹Department of Geography, University of the Free State

²South African Polar Research Infrastructure, Stellenbosch University

³Department of English, University of Pretoria

⁴Department of Botany & Zoology, Stellenbosch University

⁵Art History and Image Studies, University of the Free State

Abstract:

Marion Island holds a unique cultural legacy through its field hut books, which chronicle daily life since the early 1990s. Despite their potential significance to South Africa's cultural heritage, these hardcopy records face the imminent threat of deterioration. This project, spanning geography, data management, image studies, archiving, and literature across three institutions, aims to digitise and systematically document Marion Island's hut books. The interdisciplinary collaboration will develop skills, fostering innovative methodologies and technologies while contributing to the Antarctic and Southern Ocean Strategy's capacity-building goals. The project balances the ethical challenges of digitisation with the imperative to preserve the unique narratives contained in the hut books. The digitised content promises rich insights into the social dynamics, environmental conditions, and personal experiences of Marion Island's inhabitants, benefitting both natural and social sciences. The methodology involves navigating the harsh conditions of remote field huts, necessitating an innovative approach to ensure high-quality digitisation, metadata management, and secure archiving. The project underscores the need for ethical considerations in digitising personal accounts, proposing strategies to protect privacy while allowing future access. The potential impact on public awareness and education is highlighted, aligning with strategic objectives in marine and Antarctic research initiatives. The preservation of these records is seen as a crucial step toward safeguarding South Africa's heritage, adhering to national legislation emphasising the cultural significance of historical documentation. The proposed project's dual objectives include digitising the hut books and exploring ethical archiving practices, paving the way for future research opportunities. This project, if approved, aim to collect, digitise, and store the hut book entries. Additionally, we aim to propose ways, either by embargo or other privatisation clauses, in which the content of the hut books might be accessed in the future by researchers whilst ensuring ethical practices, protection of privacy and the conservation of historical heritage. This abstract emphasises the collaborative nature of the project and encourages valuable inputs from the public, acknowledging the potential enrichment of the research through diverse perspectives and insights.

Format:

E-poster

Keywords: (add ; between keywords)

Cultural heritage; Marion Island; Field hut books; Digitisation

SESSION: Innovation and development

MARS Themes:

Innovation

Title:

A Longitudinal Study of the Open-Water Performance of an Ice-Class Vessel

Author(s): add rows below if more authors

B.J. Steyn, A. Bekker

Affiliation: add rows below for more affiliations

Department of Mechanical and Mechatronic Engineering, Stellenbosch University

Abstract:

Periodic ice navigation impacts the performance of a ship. The effects of fouling on ship performance have been extensively researched and have partly motivated standards such as ISO 19030 to be developed to help manage this detrimental phenomenon. However, not much literature or data is available on how ship performance is affected by periodic ice navigation. The propulsive performance of a research and supply vessel operating in the southern hemisphere from a full-scale measurement repository of key voyages spanning ten years to reveal the short- and long-term consequences of ice navigation. To achieve this, a deterministic ship performance model is constructed from standard methods to account for adverse non-reference in-service conditions and isolate performance loss due to hull and propeller degradation. A data conditioning procedure is developed to refine the dataset, and performance indicators are employed to quantify the performance results insightfully. The findings of the performance investigation shed light on key issues, such as the aptness of dry-docking intervals and the effectiveness of hull coatings in resisting fouling and ice abrasion. This study not only quantifies open-water performance before and after ice navigation but also examines performance intermittently during ice navigation, specifically during operations in polynyas, to determine the extent of fouling loss per distance due to ice scouring.

Format:

Oral presentation

Keywords: (add ; between keywords)

Modelling; Performance; SA Agulhas II; Ice; Open water; Biofouling; Anti-fouling Coating damage

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Innovation and Development

Title:

Investigating brine and air inclusions in sea ice from the Antarctic marginal ice zone

Author(s): add rows below if more authors

H. Swait^{1,2}

T. Rampai^{1,2}

Affiliation: add rows below for more affiliations

118. University of Cape Town Department of Chemical Engineering

119. Marine and Antarctic Research for Innovation and Sustainability (MARiS)

Abstract:

Sea ice plays a critical role in the global climate systems. The high albedo of sea ice reduces incoming solar radiation aiding in regulating temperatures. Sea ice is composed of a multiphase matrix of ice, liquid brine inclusions and air inclusions. These inclusions and their morphology impact other factors of the ice such as the mechanical and optical properties. The size and distribution of these inclusions are influenced by the physical properties of the ice such as temperature, salinity and ice texture. Brine inclusions are greatly influenced by fluctuations in temperature and, as such would be influenced by storage temperatures as sea ice samples are typically stored at lower than *in situ* temperatures (~-20°C). When these samples are to be tested, they have to be heated up to testing temperatures (~-10°C) to comply with the standard testing conditions. However, studies on the impacts of these low storage temperatures and heating on the porosity and morphology of inclusions are sparse and testing protocols and methodologies often lacking in accuracy. This project investigates the impacts of low storage temperatures and different heating methods on the distribution and the morphology of these inclusions to understanding the properties as close to *in situ* as possible.

Format:

5 min oral

Keywords: (add ; between keywords)

Sea ice, brine inclusions, air inclusions,

SESSION: Innovation and development

MARS Themes:

Innovation and development

Title:

The berth of Mariner 4.0: A human-centered monitoring and research tool

Author(s): add rows below if more authors

N. C. Taylor^[1]

A. Bekker^[1]

K. Kruger^[1]

Affiliation: add rows below for more affiliations

120. Stellenbosch University, Department of Mechanical and Mechatronic Engineering

Abstract:

The SA Agulhas II is South Africa's polar research vessel equipped with advanced monitoring systems to aid operations. The ship and status of much onboard equipment can be tracked in near real-time from a plethora of dashboards on board. Yet, the well-being of scientists unaccustomed to ship motion remains a mystery until word of mouth conveys the news of motion sickness incidences during a research voyage. Mariner 4.0 is an information and communications technology platform developed for human-centered health monitoring to provide insight into motion sickness responses on seafaring vessels.

The content proposed to be communicated at the research session includes introducing the Mariner 4.0 concept, a practical description of the platform, and the results from the berth of Mariner 4.0 on a winter research expedition. A feat in shipping will be showcased: the motion sickness status of 15 participants was monitored in near real-time over the course of the voyage. Novel motion sickness criteria were determined by Mariner 4.0 on Winter Cruise using data captured from the participants and a full-scale ship motion measurement system. The Mariner 4.0 platform served as a tailored research tool for advancing the study of motion sickness that humans experience on ships.

Format:

Oral presentation

Keywords: (add ; between keywords)

Human-centered systems; Motion sickness; Human factors

SESSION: Antarctic and sub-Antarctic earth science

MARS Themes:

Capacity Development

Title:

The SOCCO Trajectory - A brief synopsis of our origin, emergence and strategic direction

Author(s): add rows below if more authors

Sandy J. Thomalla^{1,2},
Pedro Monteiro³,
Nicolette Chang,
Sarah-Anne Nicholson¹,
Thomas J. Ryan-Keogh¹,
Precious Mongwe¹,
Siyabulela Hamnca¹,
Thulwaneng Mashifane¹

Affiliation: add rows below for more affiliations

1. Southern Ocean Carbon-Climate Observatory, CSIR, Cape Town, South Africa
2. Marine and Antarctic Research Centre for Innovation and Sustainability, University of Cape Town, Cape Town,
3. South Africa School of Climate Studies, Stellenbosch University, Cape Town, South Africa

Abstract:

This presentation aims to share the journey from humble beginnings to a leading research capability that addresses the role of the Southern Ocean in 21st century regional and global climate. As a small group, a niche approach was needed to address this grand challenge, which led to the formulation of an underpinning hypothesis that fine-scale ocean dynamics are key to understanding climate sensitivity through their impacts on the variability and trends of carbon fluxes in the Southern Ocean. An emergent aim was to understand and constrain the seasonal cycle as the mode of variability that links ecosystems to climate. This approach required the use of observational and modelling platforms that could resolve the relevant scales and involved pioneering Southern Ocean robotics experiments, remote sensing and high-resolution modelling. It has been a journey fraught with difficulties and the occasional disappointment but ultimately eclipsed by moments of realisation of achieving innovative and pertinent science. Overall, SOCCO continues to make a growing contribution to our understanding of the role that fine-scale dynamics play in shaping the phasing and magnitudes of the seasonal cycle and its inter-annual variability. This presentation will showcase our Phase IV Integrated Science and Innovation strategy: Taking ocean climate science to society.

Format:

Oral presentation

Keywords: (add ; between keywords)

Capacity Development, Oceanography, Research

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Oceans and marine ecosystems under global change

Earth systems observations

Ecosystems, biodiversity and biodiscovery

Research Infrastructure and platform

Title:

Inter-annual and longer-term variability and trends of surface hydrography around the sub-Antarctic Prince Edward Islands.

Author(s): add rows below if more authors

T. Toolsee^[1,2]

T. Lamont^[1,2,3,4]

Affiliation: add rows below for more affiliations

121. Marine Research Institute and Department of Oceanography, University of Cape Town, Cape Town, South Africa

122. Department of Environment, Forestry and Fisheries (DEFF), Cape Town, South Africa

123. Nansen–Tutu Centre for Marine Environmental Research, University of Cape Town, Cape Town, South Africa

124. Bayworld Centre for Research and Education, Cape Town, South Africa

Abstract:

The Prince Edward Islands (PEIs) are ideal for the study of sub-Antarctic ecosystem responses to climate variability. Their remoteness makes collection of in situ observations challenging, resulting in a severe lack of data. We used satellite and reanalysis data to determine interannual, decadal and long-term trends of Sea Surface Temperature (SST), wind forcing and surface circulation at the PEIs. We also investigated the impact of climate modes, such as El-Niño Southern Oscillation (ENSO), Southern Annular Mode (SAM), and Semi-Annual Oscillation (SAO). All long-term trends were statistically insignificant, or substantially weaker than the intra- and interannual changes. SST showed strong interannual and decadal-scale variability at periods of 0.8, 2.8 and 7.5 years, while geostrophic current speed variations were strongest at 1.2 and 3.9 years, and wind speed variations were greatest at periods <1 year. There were no statistically significant relationships between SST, wind, and geostrophic current speed with any of the climate modes, but the Antarctic Circumpolar Wave (ACW), an ENSO teleconnection, could be influencing SST variability. Observed SST, wind and circulation trends around the PEIs, and the influence of climate modes, differed somewhat to patterns observed across the greater Southern Ocean. This was likely due to the frequent mesoscale variability, such as eddies and frontal movement, around the PEIs, which makes it unique within the Southern Ocean.

Format:

Oral Presentation

Keywords: (

Sub-Antarctic Islands; satellite and reanalysis data; climate change; climate modes

SESSION: Botany**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:The first record of fungal endophytes associated with the sub-Antarctic cushion plant, *Azorella selago* (Apiaceae)**Author(s):** add rows below if more authorsJ. Tsamba^[1,2]B. Slippers^[2]M.A. Harris^[1,2]M. Kemler^[3]P.C. le Roux^[1]M. Greve^[1]**Affiliation:** add rows below for more affiliations

125. Department of Plant and Soil Sciences, University of Pretoria

126. Forestry and Agricultural Biotechnology Institute, University of Pretoria

127. Universität Hamburg

Abstract:

Sub-Antarctic Marion Island serves as a classical system for understanding the ecological impacts on biodiversity, owing to its simplicity, low species diversity, and the pronounced influence of climate and invasive species. Despite island-wide studies with complete inventories of major taxa carried out, there is scarce information regarding fungal endophytes there. Thus, our study sought to record fungal endophytes associated with the keystone cushion plant, *Azorella selago*, on the island using the next generation sequencing approach. In addition, we tested the contribution of abiotic and biotic in predicting composition and richness of those endophyte communities. Only 33 of the 1283 operational taxonomic units (OTUs) detected were dominant. Environmental variables did not explain endophyte community composition. However, they explained endophyte richness, with high solar radiation reducing endophyte richness of the dominant species, while elevation and high solar radiation reduced endophyte richness for all species. Furthermore, higher *A. selago* cover and higher plant species richness increased endophyte richness. The positive correlation of plant and endophyte richness suggests shared, possibly generalist endophyte taxa amongst vascular plants on the island. While many endophytes associated with *A. selago* are locally rare, rare taxa can confer benefits to their host and enhance the overall functioning of the ecosystem. Further, when conditions change through external forces such as climate change, these rare species may be a valuable reserve that helps the host's resilience to the disruptive events. This study is an important baseline report on sub-Antarctic endophyte communities and paves the way for future research in this field on the island.

Format:

Presentation

Keywords: (add ; between keywords)fungal endophytes; next generation sequencing; *Azorella selago*; Marion Island; plant-microorganism interactions; phyllosphere; cushion plant

SESSION: From Physics to Top Predators at islands and seamounts in the Southern Ocean

MARS Themes:

Oceans and marine ecosystems under global change

Earth systems observations

Ecosystems, biodiversity and biodiscovery

Research Infrastructure and platform

Title:

Influence of eddies and fronts on the shelf seas of the sub-Antarctic Prince Edward Islands

Author(s): add rows below if more authors

M.A. van den Berg^[1]

T. Lamont^[1,2,3]

I.J. Ansorge^[2]

Affiliation: add rows below for more affiliations

128. Oceans & Coasts Research Branch, Department of Forestry, Fisheries, and the Environment, Cape Town, South Africa

129. Oceanography Department, University of Cape Town, Cape Town, South Africa

130. Bayworld Centre for Research and Education, Constantia, Cape Town, South Africa

Abstract:

Within the Southern Ocean, ecosystems such as the Prince Edward Islands (PEIs) sustain rich environments with large populations of top predators. Thus, there is a crucial need to enhance our understanding of drivers of oceanographic variability and impacts on biological communities in such regions. Daily-averaged bottom temperatures and water-column current speeds from two moorings at the PEIs showed warming/cooling events of 0.5-2 °C, concomitant with changes in current speed and direction. These variations were associated with advection of waters into the shelf region from passing anticyclonic/cyclonic eddies, some of which influenced shelf circulation for >30 days at a time. The impact of frontal movement was quantified by increased current speeds throughout the water column when the southern branch of the sub-Antarctic Front (S-SAF), or the northern branch of the Antarctic Polar Front was close to the islands. When the S-SAF was north of the PEIs, bottom temperatures were lower due to stronger influx of Antarctic surface and intermediate waters. In contrast, when the S-SAF was south of the PEIs, bottom temperatures were elevated due to the occurrence of larger proportions of warmer, more saline surface and intermediate sub-Antarctic and even Subtropical waters. During 2014-2017, generally lower temperatures reflected more frequent northward movements of the S-SAF, but the more elevated temperatures since 2018 indicated a more southerly position of the S-SAF, which has also been observed in satellite altimetry. Predominance of westerly flow in the southern portion of inter-island region suggests the existence of a Taylor column, at times enhanced or dissipated by the juxtaposition of some eddies. Due to its coarse spatial resolution, satellite altimetry fails to capture this westerly flow, demonstrating the critical need to sustain and enhance in situ observations in the region.

Format:

Oral presentation

Keywords: (add ; between keywords)

Prince Edward Islands; sub-Antarctic Front; Antarctic Polar Front; mesoscale eddies; satellite altimetry; moorings

SESSION: Botany

MARS Themes:

Ecosystems, biodiversity and biodiscovery

Title:

Long-term vegetation change (1965-2020) in response to rapid warming and drying in a sub-Antarctic tundra: evidence from repeat photography

Author(s): add rows below if more authors

S. van der Merwe^[1,2]

M. Greve^[3]

M.T. Hoffman^[1]

A.L.S. Skowno^[1,2]

M.D. Cramer^[1]

Affiliation: add rows below for more affiliations

131. University of Cape Town

132. South African National Biodiversity Institute

133. University of Pretoria

Abstract:

At high latitudes, anthropogenic climate change and invasive species particularly threaten biodiversity, often with antagonistic effects. Climate change not only impacts all native plant species directly by driving distribution and abundance of species, but indirectly through the influence on community dynamics and habitat suitability to invasive species. A key obstacle to quantifying vegetation change in the sub-Antarctic is the scarcity of cloud-free satellite imagery in a region with near-permanent cloud cover and lack of historical plot data. Vegetation change on Marion Island was thus analysed with repeat photography between 1965 and 2020. The climate trends and invasive plant species cover changes were also studied over the same period. Total vegetation cover was significantly higher in 2020 than in 1965 in all habitats, other than in the coastal saltspray habitat, indicating an increase in overall biomass on the island. The more responsive “generalist” plant species, specifically the grass *Polypogon magellanicus* and fern *Austroblechnum penna-marina* have expanded across the island, whilst the more “specialised” plant species have not significantly changed in cover, with the exception of the mire graminoids which have decreased. MI has thus undergone significant vegetation change across most habitats in the last five decades, accompanied by aridification, an increase in mean air temperature, change in wind direction and wind speed. The three most widespread invasive plant species have also expanded their ranges, especially in biotic areas, and invasive mice have rapidly increased in abundance. The two key interactive drivers of vegetation change on MI are thus climate change and invasive species.

Format:

E-poster

Keywords: (add ; between keywords)

Vegetation change; climate change; invasive species; repeat photography

SESSION: Humanities in the South African National Antarctic Programme

MARS Themes:

Human Enterprise

Title:

Render | Remnant: Tracing the entangled histories of African and Antarctic whaling

Author(s): add rows below if more authors

A. van Eeden-Wharton ^[1,2,3]

Affiliation: add rows below for more affiliations

134.University of Pretoria

135.Antarctica, Africa and the Arts

136.Oceanic Humanities for the Global South

Abstract:

Taking a non-traditional form, this presentation draws on an ongoing body of site-responsive creative practice and archival research in which I trace transoceanic modern whaling histories spanning the South Atlantic, Indian and Southern oceans – from the waters along the coasts of Gabon, Angola, Namibia, South Africa, Mozambique and Madagascar to the sub-Antarctic and Antarctic whaling grounds. Mapping the former sites of twentieth-century shore-based whaling stations and the routes of pelagic factory ships and catchers, I explore the role of African seaports as gateways to the southern high latitude regions and the sprawling networks of capital, control and coerced labour that enabled the industrial-scale slaughter of cetaceans.

Montage sequences will combine examples of images and sounds, recorded at the crumbling remains of South African stations that operated seasonal Antarctic whaling fleets and became military training bases after the closure of the factories, alongside extracts from archival materials. Introducing not only histories of exploitation and violence that connect seemingly disparate places and times, but also questions of survivability and afterlives as new multispecies communities find refuge in the ruins.

Format:

Oral presentation

Keywords: (add ; between keywords)

Ex. Whaling; Southern Africa; Antarctic; Transoceanic; Art; Archival

SESSION: Biodiversity / Botany**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Examining the potential for entomophilous pollination on sub-Antarctic Marion Island

Author(s): add rows below if more authorsE. van Ginkel ^[1]P. C. le Roux ^[1]**Affiliation:** add rows below for more affiliations

137. Department of Plant and Soil Sciences, University of Pretoria

Abstract:

Pollination interactions have received attention worldwide, but to a lesser extent in the sub-Antarctic, mainly due to the assumption that sub-Antarctic plants employ anemophily or self-pollination. This region is unique in terms of climate and geographic isolation, providing a novel environment to study plant-invertebrate interactions. The objective of this study was to document the richness and abundance of invertebrate species visiting flowering species; aiming to determine (1) the potential for invertebrate-mediated pollination, and (2) the relationship between invertebrate activity on flowers and climatic conditions. Consequently, this study was conducted at Marion Island over two flowering seasons. Weather data was collected and invertebrate richness and abundance were recorded through 10-minute observations of focal plant species. The interaction network shows 28 invertebrate taxa interacting with 11 plant species. However, when invertebrates were examined, pollen was only detected on 21 of the taxa. This interaction network had a high level of generalization, with multiple invertebrate species interacting with multiple plant species. The abundance and richness of invertebrates on flowering species were predominantly determined by plant identity, with abiotic factors, such as aspect, altitude and time of day, contributing weakly. Therefore, this sub-Antarctic plant-invertebrate network may be predicted to be fairly robust to direct climatic changes.

Format:

Recorded presentation

Keywords: (add ; between keywords)

Wind; Plant-insect interactions

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Innovation and Development

Title:

Investigation of the Interactions Between Sea Ice Algae From the Marginal Ice Zone of Antarctica and Artificial Sea Ice

Author(s): add rows below if more authors

J. van Niekerk^{1,3}

E. Roche^{2,3}

T. Rampai^{1,3}

Affiliation: add rows below for more affiliations

138. Department of Chemical Engineering, University of Cape Town

139. Department of Biological Science, University of Cape Town

140. Marine and Antarctic research for Innovation and Sustainability (MARiS)

Abstract:

Algae and sea ice are vital components of Earth's regulatory mechanisms. Understanding the intricate interplay between these two elements is essential for predicting ecological shifts and the impacts these shifts have on larger climate systems. Algae, a diverse group of photosynthetic microorganisms, constitute as the building block of the aquatic food web and play a pivotal role in the planet's carbon cycle. They absorb atmospheric carbon through photosynthesis, generating a significant portion of Earth's oxygen supply. However, the growth and survival of algae are sensitive to environmental factors like temperature, salinity, irradiance, and nutrient availability.

Extracellular polymeric substances (EPS) secreted by algae are crucial for their survival, forming protective layers and aiding in adhesion and nutrient retention. Temperature and salinity variations can significantly affect algae populations, with some species demonstrating greater adaptability than others. Irradiance, another vital factor, governs the growth and survival of sea ice algae, which rely on light for photosynthesis. Light availability in the polar regions varies seasonally and with ice structure, impacting algae communities differently throughout the year. Nutrient availability, including nitrogen, phosphorous, and trace metals, further shapes algae growth, ultimately supporting higher trophic levels.

This research aims to investigate the complex relationship between algae and sea ice using artificial sea ice experiments.

Format:

Poster

Keywords: (add ; between keywords)

Algae, Sea ice, EPS

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Southern Ocean

Title:

Wind- and wave-driven free-drift dynamics in Antarctic Sea ice.

Author(s): add rows below if more authors

Ashleigh Womack (1)

A. Alberello (2)

M. de Vos (3)

A. Toffoli (4)

Marcello Vichi (presenter) (1,5)

Affiliation: add rows below for more affiliations

141. University of Cape Town

142. University of East Anglia, UK

143. SA Weather Service

144. The Melbourne University

145. Marine and Antarctic Research centre for Innovation and Sustainability

Abstract:

Two ensembles of buoys, deployed in the marginal ice zone (MIZ) of the north-eastern Weddell Sea region of the Southern Ocean, are analysed to characterise the dynamics driving sea ice drift and deformation during the winter-growth and the spring-retreat seasons of 2019. The results show that although the two buoy arrays were deployed within the same region of ice-covered ocean, their trajectory patterns were vastly different. This indicates a varied response of sea ice in each season to the local winds and currents. Analyses of the winter data showed that the Antarctic Circumpolar Current modulated the drift near the sea ice edge. This led to a highly energetic and mobile ice cover, characterised by free-drift conditions. The resulting drift and deformation were primarily driven by large-scale atmospheric forcing, with negligible contributions due to the wind-forced inertial response. For this highly advective coupled ice-ocean system, ice drift and deformation linearly depended on atmospheric forcing. We also highlight the limits of commercial floating ice velocity profilers in this regime since they may bias the estimates of sea ice drift and the ice type detection. On the other hand, the spring drift was governed by the inertial response as increased air temperatures caused the ice cover to melt and break up, promoting a counterintuitively less wind-driven ice-ocean system that was more dominated by inertial oscillations. In fact, the deformation spectra indicate a strong de-coupling to large-scale atmospheric forcing. Further analyses, extended to include the deformation datasets from different regions around Antarctica, indicate that, for similar spatial scales, the magnitude of deformation vary between seasons, regions and the proximity to the sea ice edge and the coastline. This implies the need to develop rheology descriptions that are aware of the ice types in the different regions and seasons to better represent sea ice dynamics in the MIZ.

Format:

Poster

Keywords: (add ; between keywords)

Antarctic; sea ice; drift; autonomous devices

SESSION: Innovation and development

MARS Themes:

Innovation and development

Oceans and marine ecosystems under global change

Title:

The classification of multi-impact events by the application of inverse methods and machine learning

Author(s):

C. C. van der Spuy^[1]

A. Bekker^[1]

Affiliation: add rows below for more affiliations

146. Stellenbosch University, Department of Mechanical and Mechatronic Engineering

Abstract:

As maritime transportation in ice-covered seas is projected to rise in coming decades, the demand for efficient and safe shipping in Arctic regions has become increasingly crucial. During the navigation of Polar regions, ice impacts on ship propellers pose a significant threat to propulsion mechanisms as these impacts may cause extreme loads on machinery which can result in fatigue and the failure of critical components. As such, progressive research is aimed at identifying and classifying the ice-loads experienced by propellers to improve upon current design regulations. In the case of ships featuring elongated propeller shafts, measuring the ice-loads directly at the propeller blades becomes challenging due to destructive ice impacts on sensors. Consequently, alternative methods are employed where indirect measurements are taken along the inboard section of the propulsion shaft, and inverse models are utilized to estimate the loads on the propeller blades. Furthermore, advancements in signal processing and machine learning now offer a promising avenue for tackling this issue more effectively. This project explores the development of an automated system for identifying and classifying multi-impact propeller loads by utilizing machine learning techniques. These techniques are developed and validated against current inverse models to assess their accuracy and real-life applicability. The application of advanced measurement techniques and machine learning methodologies holds significant promise for enhancing our understanding of propeller-ice interactions, enabling more precise design regulations and the efficient monitoring of propulsion systems in ice-covered maritime environments.

Format:

Oral presentation

Keywords: (add ; between keywords)

Propeller; Inverse mathematical methods; Machine learning; Impact classification

SESSION: Biodiversity / Botany**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

Examining the potential for entomophilous pollination on sub-Antarctic Marion Island

Author(s): add rows below if more authorsE. van Ginkel ^[1]P. C. le Roux ^[1]**Affiliation:** add rows below for more affiliations

147. Department of Plant and Soil Sciences, University of Pretoria

Abstract:

Pollination interactions have received attention worldwide, but to a lesser extent in the sub-Antarctic, mainly due to the assumption that sub-Antarctic plants employ anemophily or self-pollination. This region is unique in terms of climate and geographic isolation, providing a novel environment to study plant-invertebrate interactions. The objective of this study was to document the richness and abundance of invertebrate species visiting flowering species; aiming to determine (1) the potential for invertebrate-mediated pollination, and (2) the relationship between invertebrate activity on flowers and climatic conditions. Consequently, this study was conducted at Marion Island over two flowering seasons. Weather data was collected and invertebrate richness and abundance were recorded through 10-minute observations of focal plant species. The interaction network shows 28 invertebrate taxa interacting with 11 plant species. However, when invertebrates were examined, pollen was only detected on 21 of the taxa. This interaction network had a high level of generalization, with multiple invertebrate species interacting with multiple plant species. The abundance and richness of invertebrates on flowering species were predominantly determined by plant identity, with abiotic factors, such as aspect, altitude and time of day, contributing weakly. Therefore, this sub-Antarctic plant-invertebrate network may be predicted to be fairly robust to direct climatic changes.

Format:

Recorded presentation

Keywords: (add ; between keywords)

Wind; Plant-insect interactions

SESSION: Marine Mammals**MARS Themes:**

Ecosystems, biodiversity and biodiscovery

Title:

The conveyor belt of Ross seals in the Lazarev Sea and their behaviour

Author(s): add rows below if more authorsM. Wege ^[1]H. Bornemann ^[2]M.N. Bester ^[1]T. McIntyre ^[3]**Affiliation:** add rows below for more affiliations

148.Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria

149.Alfred Wegener Institute for Polar and Marine Research, Germany

150.University of South Africa

Abstract:

Ross seals (*Ommatophoca rossii*) are the least studied Antarctic seal, there are only a handful of publications on them and few Antarctic scientists have ever seen one. Ross seals also behave unlike any of the other pack-ice seals and travel away from the Antarctic continent to forage in the open ocean most of the year. When they haul out on the pack-ice, they prefer dense, consolidated ice, adding to the difficulties of finding and studying them. They are the only species listed as “Specially Protected Species” in the Antarctic Treaty System, mainly due to the lack of data about their abundance and biology. Over the last few years we have been collecting a steady stream of movement, diving, behavioural, diet and other data on this data deficient species. We are starting to tease out basic components of their ecology and physiology to understand how this species interacts with its environment. This talk will be an overview of the strides that we have made to date, the gaps and future perspectives on Ross seal research.

Format:

Oral Presentation (10 min)

Keywords: (add ; between keywords)

diving behaviour; sea ice; foraging behaviour; seal; diet

SESSION: OCEAN 1-SEA ICE

MARS Themes:

Innovation and development

Title:

Discussion on the Premise of, and Challenges in, the Development of a Ship-Based Radar System for the in-situ Measurement of Sea Ice Thickness

Author(s): add rows below if more authors

D. White^[1,2]

S.Paine^[1]

R.A. Verrinder^[2]

Affiliation: add rows below for more affiliations

1. Radar and Remote Sensing Group, University of Cape Town

2. Marine and Antarctic Research Centre for Innovation and Sustainability, University of Cape Town

Abstract:

Current Global Climate have indicated a large bias towards sea ice coverage, particularly towards sea ice in the Southern Ocean and its marginal ice zone (MIZ). Present methods for estimating sea ice coverage and thickness predominant utilise data from remote sensing technologies in the form of laser and radar altimeters as well as passive microwave radiometers which are then combined with previously derived models of sea ice parameters. While the data from these methods are highly valuable, it is worth noting that these models and methods have been predominantly developed for and tested on Arctic sea ice which has different parameters compared to Antarctic sea ice. As such, there is a clear and substantial need for *in-situ* measurements to complement and calibrate such remote sensing data. Our research group(s) are thus proposing and investigating the development of a radar-based sea ice thickness sensor to be mounted on the S.A. Agulhas II to perform such measurements.

In this presentation, I will provide context on current methods for ice thickness estimation and the implications of applying such methods in the southern hemisphere. The extension of this is the illustration of the value that could be gained from our proposed sensor in calibrating these estimations. I will then conclude by presenting our proposed sensor and explaining the anticipated challenges and proposed solutions facing its design.

Format:

Poster

Keywords: (add ; between keywords)

Sea Ice; Radar; Ship-Based Radar; Wideband Radar; Southern Ocean;

SESSION: Oceans 3 (Chairs: Sarah Fawcett & Susanne Fietz)

MARS Themes:

Oceans and marine ecosystems under global change

Title:

Impact of metals in aerosols and dust on marine phytoplankton: South Africa

Author(s): add rows below if more authors

E. Wium^[1]

S. Fietz^[1]

Affiliation: add rows below for more affiliations

151. Stellenbosch University

Abstract:

Aerosol and dust deposition in the oceans may act as sources of metal nutrients for marine phytoplankton or of metal pollutants. These metals can either have a positive or negative effect on phytoplankton depending on e.g. the concentration ranges and bioavailable forms in which these metals exist within dust, and the phytoplankton community under investigation. This presentation will focus on the concentration ranges for possible metal pollutants (Cu, Cd, Zn, Mn, Pb, Fe) in the world's oceans, in aerosols and dust, and how these concentration ranges relate to the potential threshold levels of toxicity for different phytoplankton species. This will then be put into context for waters near and around southern Africa, where phytoplankton communities may be somewhat resilient to high metal concentrations from frequent exposure to possible pollutants. To broaden the scope of this study, an additional future investigation is planned for aerosols and dust in the South Atlantic and South Indian sectors of the Southern Ocean to examine the effect on phytoplankton that may be less frequently exposed to high metal pollutant concentrations. The outcomes from these investigations will aid in answering the question of whether aerosols and dust are, or can become, detrimental to marine phytoplankton in waters near and around southern Africa and the Southern Ocean.

Format:

Oral Presentation

Keywords: (add ; between keywords)

Trace metals, aerosols, dust, phytoplankton, toxicity, South Africa

SESSION: Innovation and development**MARS Themes:**

Earth systems observations

Innovation and development

Title:

Ice Load measurement and ice condition monitoring onboard S.A. Agulhas II

Author(s): add rows below if more authors

Yaxuan Zhu

Jukka Tuhkuri

Affiliation: add rows below for more affiliations

152. Aalto University, Finland

Abstract:

The global warming is changing the Antarctic sea ice. For ship navigation, ice floe fields, which are relatively mild ice conditions, might become more common. The ice floe fields in the marginal ice zone constantly interact with and attenuate waves. The ice floe fields further inside the ice pack are less affected by the waves. In order to understand the mechanics of ice loads on ships in different ice floe fields, field measurements were conducted onboard S.A. Agulhas II during the SANAE 2022/2023 relief voyage. The ice loads on the ship hull were measured and linked with simultaneous ice conditions recorded with cameras and observed visually. Most data is from calm ice floe fields. The highest ice load recorded during this voyage occurred at a very low ice concentration and with a ship velocity of 11 knots. Severe ice loads were recorded also at high ice concentration. These have been related to force chains within the floe field.

Format:

Oral presentation

Keywords: (add; between keywords)

Ice load; ship; field measurement; Antarctica