

Theme V: Anthropogenic signatures in Antarctica: The race against pollution and other pressures

Zhiyong Xie, Machiel Lamers, Olaf Krüger, Nicoletta Ademollo, Luisa Patrolecco, Annalisa Di Cicco, Annika Jahnke, Roland Kallenborn, Clara Manno, Catherine K. King, Ilse Van Opzeeland, Karolin Thomisch, Virginia Sciacca, Francesco Filiciotto, Diego Filún, Rita Fabris, Daniela Cajiao, Jasmine R. Lee, Kevin A. Hughes, Heather Lynch, Stephanie Gross, Charlotte Havermans, Marco Grotti, Luca Di Liberto, Simonetta Corsolini, Nicoletta Calace, Tina Kaiser, Susan Bengtson Nash, Bettina Meyer, Dominik Bahlburg, Ralf Ebinghaus, Anette Küster



ANTARCTICA INSYNC



2021
2030 United Nations Decade
of Ocean Science
for Sustainable Development



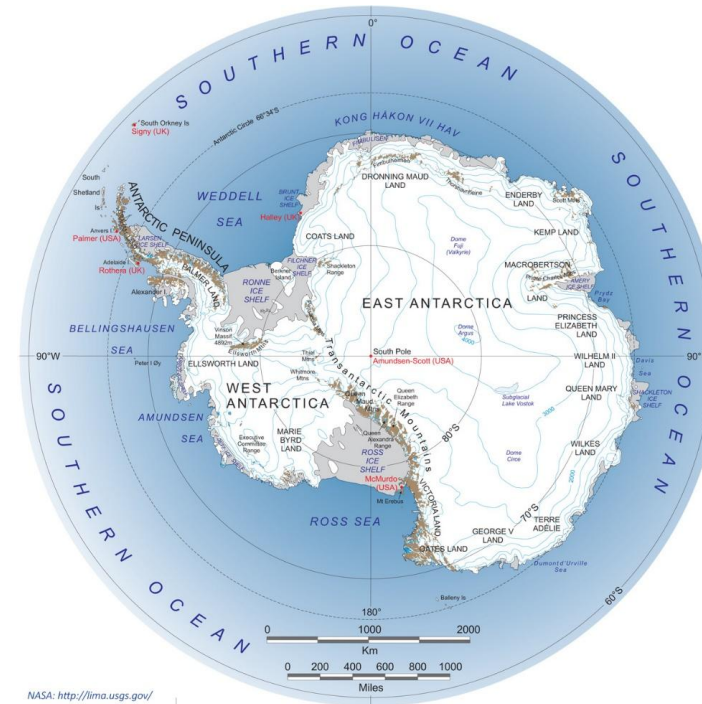
COMNAP
Council of Managers
of National Antarctic Programs





Overview of Core Research Topics

Topic A: Chemical and Plastic Pollution in Antarctica: Sources, Occurrence and Systematic Monitoring



Topic B: Underwater noise pollution in Antarctic waters: understanding the impacts to facilitate sustainable development and conservation management

Topic C: Monitoring Tourism Visitation Impacts, Assessment and Management

Topic D: Biosecurity and Invasive Species Prevention

Topic E: Effects of Marine Pollution on Southern Ocean Phytoplankton and Climate Feedback

New Topic: Assessment and management of ecosystem effect of the krill fishery

Topic F: Encounters at the End of the World – Tracing Antarctic Expedition Legacies

Topic A: Chemical and Plastic Pollution in Antarctica: Sources, Occurrence and Systematic Monitoring



Problem and gap:

- limited systematic monitoring of chemical and plastic pollution
- Insufficient long-term time series, especially for emerging contaminants and nanoplastics
- Limited understanding of contaminant behavior, bioaccumulation, and toxicological effects
- Fragmented research efforts and lack of binding regulatory frameworks

Objectives:

- Developing international Antarctic chemical pollution monitoring networks
- To investigate the sources, pathways, spatial and temporal variations of chemical pollution in the pan-Antarctic, and Identify pollution hotspots and
- To Evaluate the effects of pollutants on Antarctic biota and ecosystems
- Investigate the impacts of climate-driven changes on pollutant transport, mobility, bioavailability, and toxicity

Strategies:

- Coordinate year-round chemical monitoring across Antarctic research bases in various regions
- Create open-access pollution databases and specimen banks
- Apply standardized sampling and analytical methods across environmental matrices
- Use autonomous and innovative monitoring technologies
- Integrate observations and chemical transport models



Topic B: Underwater noise pollution in Antarctic waters: understanding the impacts to facilitate sustainable development and conservation management



Problem and gap:

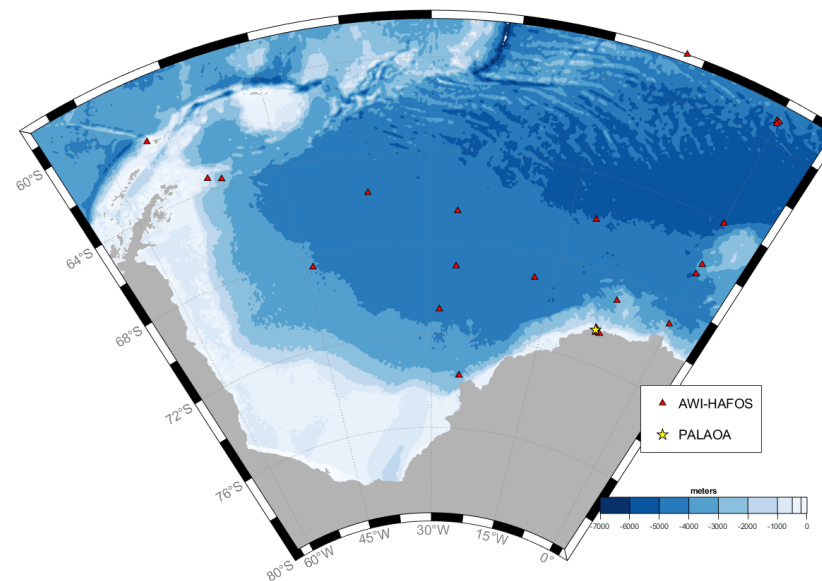
- Insufficient baseline characterization of Antarctic marine soundscapes (ambient levels and spectro-temporal features)
- Lack of coordinated, circum-Antarctic comparisons and mapping of soundscapes
- Limited assessment of long-term and anthropogenic noise trends using historic and current data

Objectives:

- Establish a circum-Antarctic baseline of pristine polar soundscapes
- Compare soundscape composition across Southern Ocean basins
- Improve our understanding for Antarctic soundscapes intercompare over space and time
- Comprehensive evaluation of the impacts of anthropogenic noise on Antarctic soundscapes

Strategies:

- Use existing datasets to evaluate circum-Antarctic marine soundscapes
- Apply soundscape analyses that build on previous pioneering polar acoustic research
- Implement well-documented and standardized analytical methods
- Establish baseline soundscape characteristics for the Antarctic
- Enable pan-Antarctic monitoring of anthropogenic noise budgets and long-term trends



Topic C: Monitoring Tourism Visitation Impacts, Assessment and Management



Problem and gap:

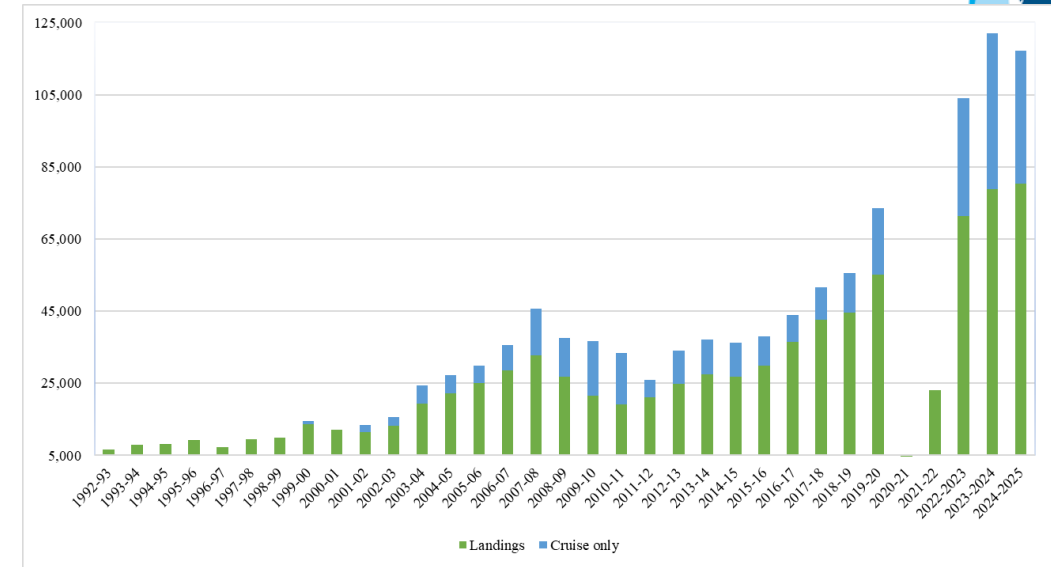
- Growth of Antarctic tourist numbers, including landings at popular sites (see trend figures)
- Concern over potential environmental impacts, and use of new sites
- Lack of a consistent monitoring approach
- Development of a regulatory framework, including new and revision of existing site-specific guidelines

Objectives:

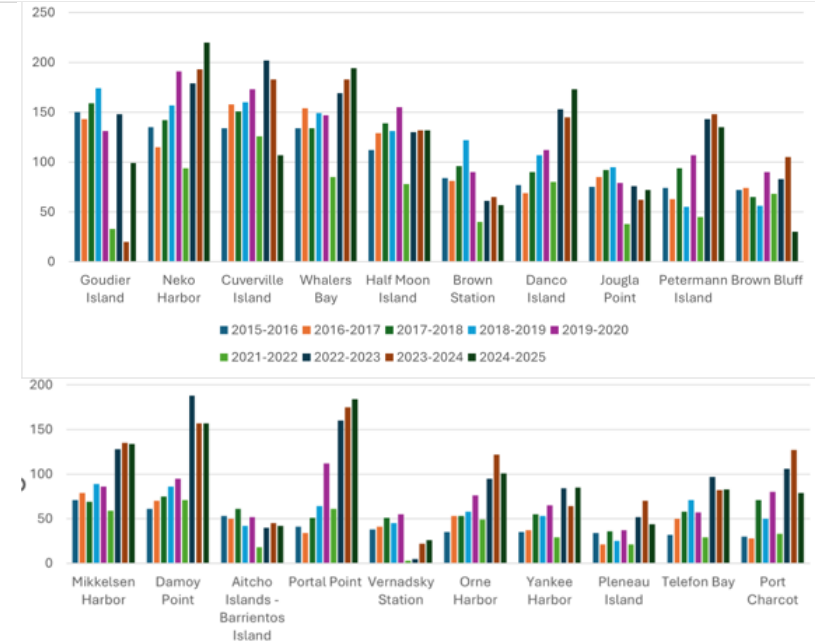
- To establish a monitoring framework for tourism activities and their environmental effects in Antarctica
- Developing an achievable and cost-effective framework for monitoring that can be consistently employed

Strategies:

- Space-for-time substitution approach: case-control pairs
- Collaboration NAPs, IAATO and operators
- Suite of indicators and approaches



Trend figures on:
1) cruise-ship tourists (above) and
2) landings at visitor sites (right), based on IAATO data





Topic D: Biosecurity and Invasive Species Prevention

Problem and gap:

- Limited circumpolar data on AMR and AMR genes in Antarctic
- Poor understanding of regional and seasonal patterns of AMR occurrence
- Knowledge gaps in AMR dissemination pathways, transmission, and reservoirs
- Lack of harmonized international sampling and analytical methods
- Insufficient continuous monitoring of HPAI species, reservoirs, and transmission routes

Objectives:

- Circum-Antarctic AMR surveillance – occurrence of AMR bacteria and AMR genes
- Standardization in sampling and methodology
- Identifying indicator bacteria
- Link AMR to contaminants and microplastic to assess cumulative effects
- Targeted surveillance of wildlife populations

Strategies:

- Coordinate year-round chemical monitoring across Antarctic research bases in various regions
- Conduct year-round circum-Antarctic sampling across pristine and impacted sites to map AMR and eDNA distribution
- Analyze environmental and biota samples using standardized culturing, susceptibility testing, and metagenomics
- Integrate comparable international data to identify eDNA and AMR dissemination pathways and wildlife reservoirs

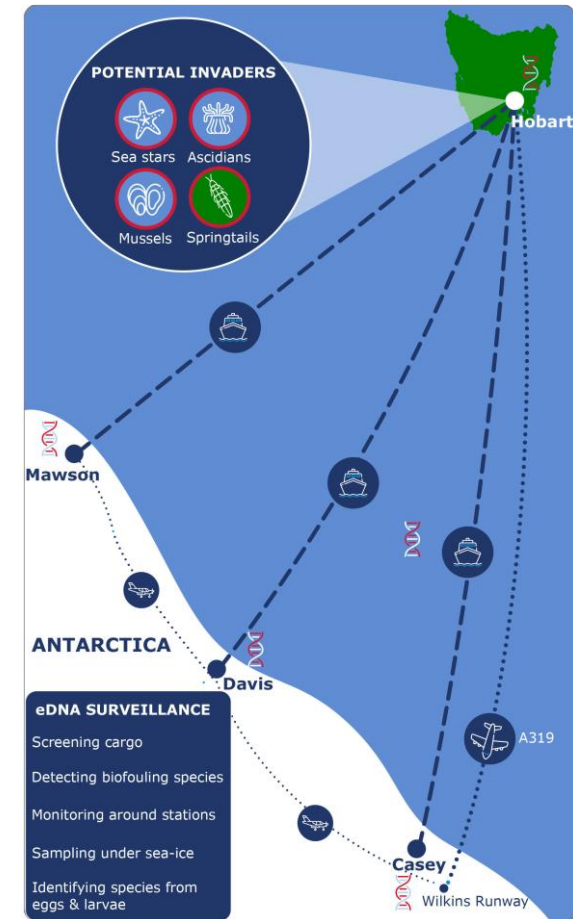
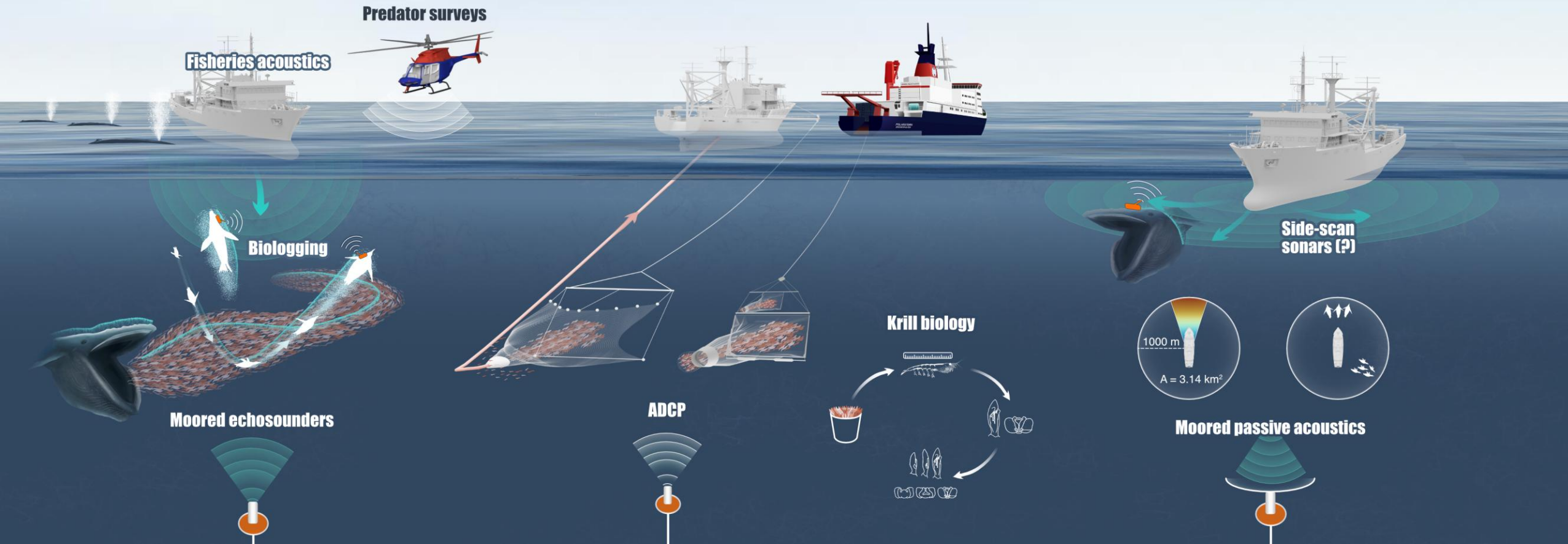


Figure shows How environmental DNA can contribute to biosecurity surveillance in the Australian Antarctic Program. It indicates some of the potential invaders, their Australian source populations (Tasmania/Derwent estuary), pathways (shipping and flights), some of the locations where eDNA can be sampled (cargo, ships, stations, under sea-ice), and some benefits of incorporating an eDNA-based approach (e.g., sampling under sea-ice, and identifying species from eggs and larvae) (Clarke et al., 2024)

New Topic: Assessment and Management of ecosystem effects of the krill fishery

Objectives:

- Quantification of spatiotemporal overlap between the krill fishery and krill predators, and functional responses to fishery-induced changes in krill availability
- Behavioural interactions between fishing vessels and predators, with focus on foraging behaviour, movement and energetic costs
- Establishment of coordinated, standardised, multi-platform monitoring protocols that integrate predator tagging, krill surveys, and fisheries observations
- Quantification of krill biomass distribution and variability (flux) at local and regional scales
- Development of management advice for CCAMLR



Topic E: Effects of Marine Pollution on Southern Ocean Phytoplankton and Climate Feedback



Problem and gap:

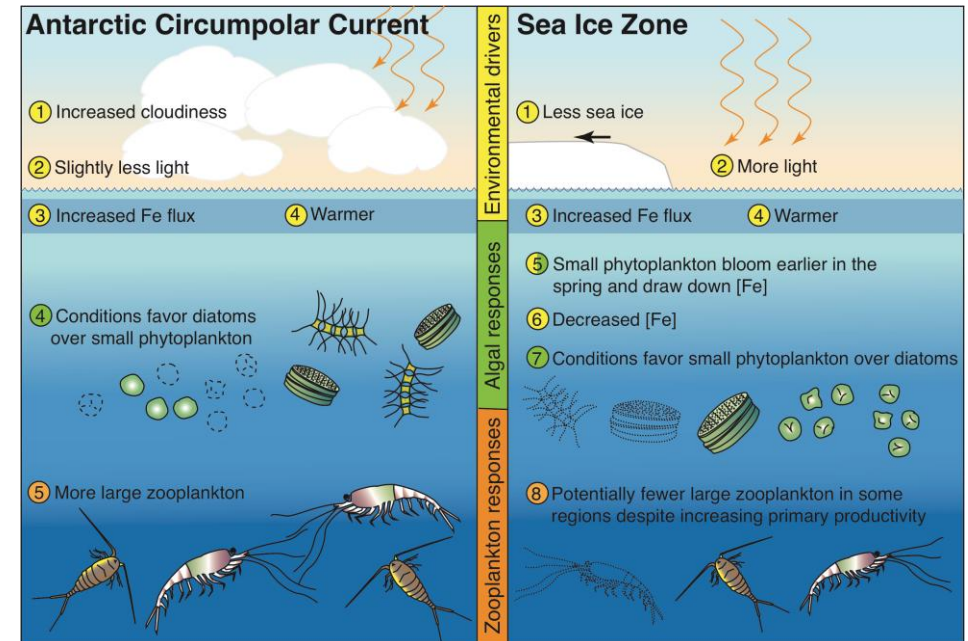
- Limited understanding of how pollutants accumulate in phytoplankton and lower trophic levels
- Poor understanding of species- and size-specific phytoplankton responses to marine pollution
- Unclear links between phytoplankton community shifts, biogeochemical cycles, and ecosystem functioning
- Incomplete understanding of the role of phytoplankton and microbes in marine aerosol formation and climate feedbacks
- Insufficient knowledge of combined effects of pollution and climate change on Southern Ocean phytoplankton dynamics

Objectives:

- To understand how pollutants affect phytoplankton community composition and productivity
- To understand the role of phytoplankton and its composition and dynamics on climate feedback processes

Strategies:

- Collect in-situ, airborne, and satellite data using ships, aircraft, and fixed stations
- Implement long-term, harmonized, and internationally coordinated monitoring
- Conduct targeted measurement campaigns across multiple observing platforms



Schematic of hypothesized changes to Southern Ocean ecosystem in the Antarctic Circumpolar Current region and the Sea Ice Zone) (Krumhardt et al., 2022)

Topic F: Encounters at the End of the World – Tracing Antarctic Expedition Legacies: Cultural Signatures and Evolving Narratives

Research gaps:

- Incomplete documenting tangible and intangible expedition legacies
- Limited analysis of evolving “men–ocean” myths across media
- Few comparisons between historic and modern expeditions
- Weak strategies for communicating expedition stories
- Limited critique of heroism and conquest narratives

Objectives:

- Document and analyze the cultural, social, and historical signatures of historic Antarctic expeditions
- Examine the evolution of expedition narratives and myths across literature, art, media, and tourism
- Assess how contemporary expeditions relate to and reinterpret these historical legacies
- Explore strategies for public engagement with diverse audiences based on these insights

Strategies:

- Combine fieldwork at heritage sites and on expedition vessels with real-time observation of contemporary practices
- Collect perception data through surveys, interviews, and analysis of cultural products
- Integrate field observations with archival and media research for a holistic analysis of expedition legacies



“Blasting and sawing work to free the Gauss on 5 February 1903” (Photograph, reference: Dry1126, Emil Philipp, 5 February 1903, Photos of the Gauss Expedition, IfL Online Catalogue)



“Equipment in the vicinity of the research vessel *Gauss*” (Photograph, reference: Dry1551, German South Polar Expedition (1st: 1901–1903: Antarctica), c. 1902, Photos of the Gauss Expedition, IfL Online Catalogue)



Outreaching Activities



12th SCAR Open Science Conference will be held in Oslo, Norway, from 10-14 August 2026

<https://scar.org/events/osc/oslo-2026>

Parallel Session:

➤ **S43: Chemical Contamination in Antarctica: From Global Transport to Local Remediation**

Convenors: Catherine King, Zhiyong Xie, Anette Küster, Simonetta Corsolini, Susan Bengtson Nash, Roland Kallenborn

The abstract submission deadline is **28 February 2026 at 23:59 UTC**

Satellite event:

➤ **Antarctica InSync Theme V: Anthropogenic Signatures in Antarctica – The Race Against Pollution and Other Pressures**

Convenors: Zhiyong Xie, Anette Küster, Roland Kallenborn, Ralf Ebinghaus

➤ Theme 5 Workshop will be organized



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Thank you, and welcome to join us!

