

CLiC 2026, Conference Abstracts

Below are a compilation of the conference abstracts for the oral and poster presentations made by the Antarctic Sea-Ice Switch (ASIS) research programme team, at the Climate and Cryosphere (CLiC) Open Science Conference (Wellington, NZ, February 2026).

ORAL PRESENTATIONS

1. Sensitivity of climate and ocean circulation to West Antarctic Ice Sheet extent in past interglacials

Authors: Keller, L., Jendersie, S., Golledge, N., Levy, R., Mackenzie, F., Marschalek, J.

Presentation type: oral

Abstract:

Earth system models often have difficulty reproducing the warmth of past interglacials, particularly at the polar regions. CO₂ concentrations and orbital configurations do not by themselves reproduce regional climate for interglacial periods such as Marine Isotope Stage (MIS) 5e, 11, and 31. In particular, simulated sea surface temperatures in the Southern Ocean are often cooler than proxy records would suggest. The extent of the West Antarctic Ice Sheet (WAIS) is a key source of uncertainty.

Here we use an intermediate complexity model, UVic ESCM, to simulate three different climate/orbital forcings (pre-industrial, MIS 31 / 1.07 Ma, mid-Pliocene warm period / 3.2 Ma), each with three different ice sheet configurations: present-day, full WAIS retreat and isostatic rebound, and an intermediate state with substantial WAIS retreat but no or little isostatic rebound. We construct a model ensemble to isolate the impact of each of the WAIS configurations and climate forcings on Southern Ocean sea surface temperatures, sea ice extent and ocean circulation. Model outputs are then used as boundary conditions for high-resolution regional ocean model simulations with ROMS to explore the impact of differences in ice sheet extent on circulation and heat transport on the continental shelf.

Results show nonlinear effects on Southern Ocean surface temperatures and sea ice as well as changes in global meridional overturning circulation (MOC). These experiments offer insight into the sensitivity of global and regional temperatures and ocean circulation to the interactions among atmospheric CO₂ concentration, orbital forcing, and Antarctic ice sheet extent. Our results can be used to help interpret sediment provenance records to determine possible oceanic pathways for sediment transport under different climates and amounts of WAIS retreat.

2. The Roosevelt Island Climate Evolution (RICE) Ice Core: Insights into Antarctic deglaciation climate and ice dynamics

Presentation type: oral

Authors: Bertler, N., Brook, E., Severinghaus, J., and the RICE Science Team

Abstract:

The Roosevelt Island Climate Evolution (RICE) project recovered a 763.4 m deep ice core to bedrock from Roosevelt Island, located at the northern margin of the Ross Ice Shelf. The ice at this site is grounded 210 m below sea level and accumulates locally, while the surrounding Ross Ice Shelf flows around the island's rise. Comparisons between modern RICE stable isotope data and regional meteorological records demonstrate that the RICE core captures temperature variability representative of the Ross Sea Region, the Ross Ice Shelf, and western West Antarctica. Moreover, the record is particularly sensitive to changes in regional sea-ice extent and to low- and mid-latitude climate drivers, including the El Niño–Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), and the Southern Annular Mode (SAM).

We present stable isotope, geochemical, and gas measurements spanning the past 65,000 years, supported by an age model based on synchronization of methane (CH_4) and $\delta^{18}\text{O}_{\text{atm}}$ records with the WAIS Divide ice core. High-resolution CH_4 and $\delta^{15}\text{N}$ data enable precise analysis of interhemispheric climate phasing. Our findings suggest that the Ross Sea region entered Antarctic Cold Reversal (ACR) conditions approximately 125 years before the onset of the Bølling Transition, and ~300 years prior to the WAIS Divide ACR onset. This early transition likely reflects atmospheric changes that reduced snow accumulation and triggered regional isotopic cooling. The total isotopic shift between the Last Glacial Maximum (LGM) and the early Holocene is approximately $\delta\text{D} = 90\text{‰}$, with a 60‰ increase occurring during the ACR-Holocene transition—an enrichment 50–200% greater than observed in other Antarctic ice cores.

LGM-like sea-ice conditions re-emerge during the ACR termination and persist into the early Holocene, coinciding with rapid isotopic warming and atmospheric circulation changes. The Holocene portion of the record is marked by stable temperatures between 11–9.6 ka, followed by cooler conditions until ~6 ka, after which temperatures gradually rise toward present-day values. The RICE data suggest that the Ross Sea might respond early to global climate change drivers.

3. Cultural Values in International Decision Making: Antarctica's Liability Annex

Author: Talwar, S.

Presentation type: oral

Abstract:

A cornerstone of the Antarctic Treaty System is decision-making by consensus, which is an important reason for stability in Antarctic governance. However, the principle can sometimes lead to stalemate, as has been the case for the decades-long discussions on liability limits. Article VI to the Protocol on Environmental Protection to the Antarctic Treaty: Liability Arising from Environmental Emergencies (the 'Liability Annex') was approved in 2005 after 13 years of negotiations. Two decades later, the Liability Annex is not yet in force. It will only become effective when all 28 Contracting Parties who were eligible to make decisions at the time, ratify the document.

As at August 2025, only 19 countries have approved the Liability Annex. This presentation examines both the expressly stated positions of different countries on the appropriate scope and structure of proposed liability limits, as well as the very widely varying values that underscore these positions. The paper concludes with some reflections on the implications of this analysis for the future of decision-making in Antarctica.

POSTER PRESENTATIONS

4. Towards coupling an improved sea ice model to a high-resolution regional atmosphere-ocean model of the Ross Sea region

Authors: Pauling, A., Gossart, A., Malyarenko, A., Keller, L., Bertler, N.

Presentation type: poster

Abstract:

A regional, high-resolution coupled sea ice-ocean-atmosphere model of the Ross Sea has recently been developed with heat and mass flux conservation between the ocean and atmosphere. The Polar Scripps-KAUST Regional Integrated Prediction System (P-SKRIPS) model comprises the Polar Weather and Research Forecasting (PWRf) atmosphere, and the MITgcm ocean and sea ice models. This model has been used to simulate the Ross Sea region under present day conditions. The conservation of heat and mass fluxes has been shown to eliminate the discrepancy of over 900 W m^{-2} found when the fluxes were calculated by the ocean and atmosphere models separately. These

discrepancies were particularly prevalent in the Terra Nova Bay and Ross Sea polynya regions. The current sea ice component of this MITgcm model is relatively simplistic, using a “zero-layer” thermodynamic scheme and viscous-plastic rheology. This means that the sea ice cannot store heat and as such, likely responds unrealistically rapidly to forcing from the ocean and atmosphere. The sea ice model is also unable to simulate a realistic temperature or salinity profile within the ice.

Here, we present first steps to coupling a more sophisticated sea ice component to the existing P-SKRIPS model, with the goal of allowing realistic simulation of both present-day and future scenario Ross Sea conditions. We present the current sea ice performance and limitations of the model, and describe the technical and scientific challenges of the coupling process. Finally, we will outline the proposed present day and future scenarios to be run once the models are coupled.

5. Representation of the Ross Sea Ice in CMIP6 climate projections

Authors: Gossart, A., Malyarenko, A., Keller, L., , Pauling, A., Bertler, N.

Presentation type: poster

Abstract:

Climate models are very useful tools for investigating physical processes and projecting future climate states under various scenarios. Their utility is particularly pronounced in remote and extreme environments like Antarctica, where in-situ observations are sparse and difficult to obtain. Coupled climate models offer the added advantage of capturing interactions and feedbacks across different Earth system components.

In this study, we examine the outputs of all models included in the pan-Antarctic sea ice analysis by Roach et al. (2020), focusing specifically on the Ross Sea region. This area hosts the continent's largest ice shelf, as well as the largest Antarctic Marine Protected Area. We compare sea ice concentration and thickness across models and explore their relationships with near-surface atmospheric and oceanic variables. This analysis aims to assess the range of possible future states of the Ross Sea as represented in current available CMIP6 coupled climate models.

6. Using brittle physics to model Antarctic sea ice variability

Authors: Santana, R., Boutin, B., Horvat, C., Ólason, E., Williams, T., Rampal, T.

Presentation type: poster

Abstract:

Sea ice plays an important role in determining the exchange of heat, salt, and momentum between the atmospheres and oceans. The Next Generation Sea Ice Model (neXtSIM) is a Lagrangian model aimed to study the behaviour of sea ice in response to various environmental factors. For the first time, neXtSIM was applied for the Southern Ocean using both a novel brittle rheology (BBM) and a typical Elastic-Viscous-Plastic (EVP) rheology.

Both runs well-represented the seasonal cycle of sea ice extent but tended to overestimate it by about $2.5 \times 10^6 \text{ km}^2$ (14%) in winter due to a colder ocean forcing. The BBM had larger drift correlation (0.73) in comparison to the EVP run (0.54). This happened because, in the BBM run, sea ice fractures more easily and is more effectively transported by the wind and currents. In contrast, sea ice tends to deform as a highly viscous fluid in the EVP run. Fractured ice in the BBM run also leads to thicker ice due to increased ridging and ice growth which tends to generate a larger Pan-Antarctic sea ice volume.

7. Exploring the Impact of Polar Cyclones on Antarctic Sea Ice with a Brittle Sea Ice Model

Authors: Cheong, G., Santana, R., Horvat, C., Webster, M.

Presentation type: poster

Abstract:

Cyclones are an omnipresent feature of the Antarctic sea ice zone, and play a significant role in driving atmosphere-ice-ocean exchanges. Cyclone-induced winds and waves can dramatically alter the sea ice, with the potential to significantly affect these fluxes and alter the dynamics of the Southern Ocean. Despite the potentially large regional- and global-scale implications for Southern Ocean cyclones on ocean and sea ice circulation, cyclone events are poorly captured in current sea-ice and climate models as the viscous-plastic or elastic-viscous-plastic (EVP) sea ice rheologies used to parameterize sea ice dynamics do not simulate realistic representations of local-scale sea ice deformation. Here we present simulations utilizing a new Antarctic configuration of the next generation sea ice model (neXtSIM-Ant) to evaluate the impact of cyclones on Antarctic sea ice during the winter of 2018. NeXtSIM-Ant uses a Lagrangian mesh and the brittle Bingham-Maxwell (BBM) rheology that simulates more realistic sea ice deformation when evaluated against satellite observations than a standard modified EVP (mEVP) rheology.

Comparing the BBM simulation with an identically-forced mEVP simulation, we evaluate composite cyclone-related impacts across 2018. We find cyclone-induced sea ice dynamics leads to local sea ice losses 5.5 times greater than the mEVP simulation. Integrating across the annual cycle, we estimate a loss of more than 1 million km² of sea ice occurs in response to 48 winter cyclones that is not captured by the mEVP simulation. Our findings highlight the critical role of cyclones in short-term Antarctic sea ice variability, and the capability of the neXtSIM-Ant model to further the understanding of cyclone-driven thermodynamic and dynamic processes that control the wintertime cyclone-sea ice response.