BYTES

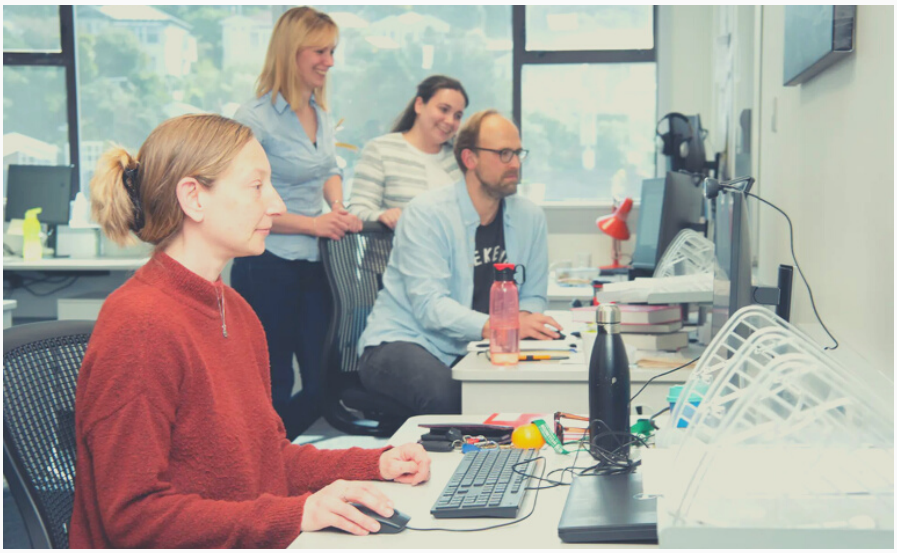
THE NEWSLETTER OF THE NATIONAL MODELLING HUB

An update from the National Modelling Hub in Wellington, a multi-institute partnership supporting the Antarctic Science Platform and NZ Searise programs
August '23 Edition

In a nutshell...

Welcome to the Modelling Hub Newsletter, keeping keeping the NZ Antarctic and climate science communities up-to-date on the Hub. Between creating novel models of the Ross Sea, anticipating storms on Antarctica, and supporting the community via workshops, there's alway something new going on.

Dive into this edition to learn more about the most cutting-edge research in climate, ice, and sea models, as well as what the Hub is doing to support STEM initiatives in New Zealand.

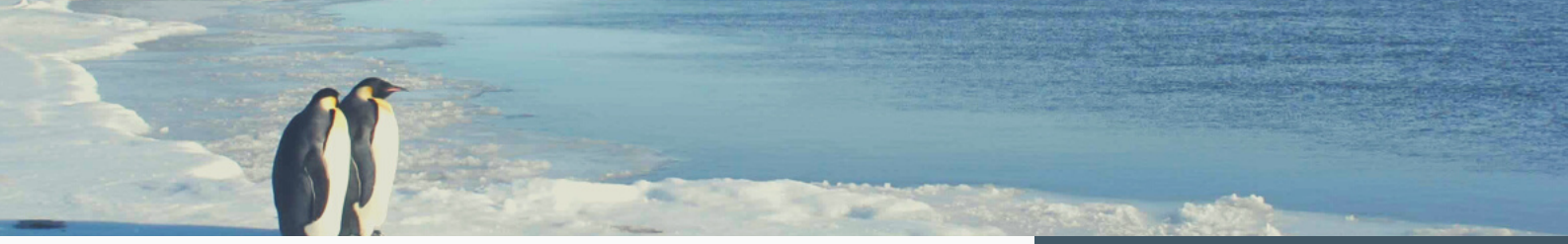


Issue 1

2023 WINTER SCHOOL

Sept 26-27

Details below



Modelling the Ross Sea, Like Never Before

After one and a half years of coding, debugging and recoding, researchers at the Modelling Hub have finally successfully combined ocean, atmosphere and sea ice models under one modelling roof. This accomplishment culminated in their recently accepted paper. Not only is this a landmark in modelling capability, but it allows for even better estimation of what the future holds for the Ross Sea.

The importance of the Ross Sea Ice Shelf can't be overstated. As temperatures rise, the melting of this ice shelf – which, in some scenarios, could occur later this century – will have dramatic implications for sea-level across the globe. That's why researchers at the Modelling Hub spend a good chunk of time working on models which try to predict change in the Ross Sea over the next few decades.

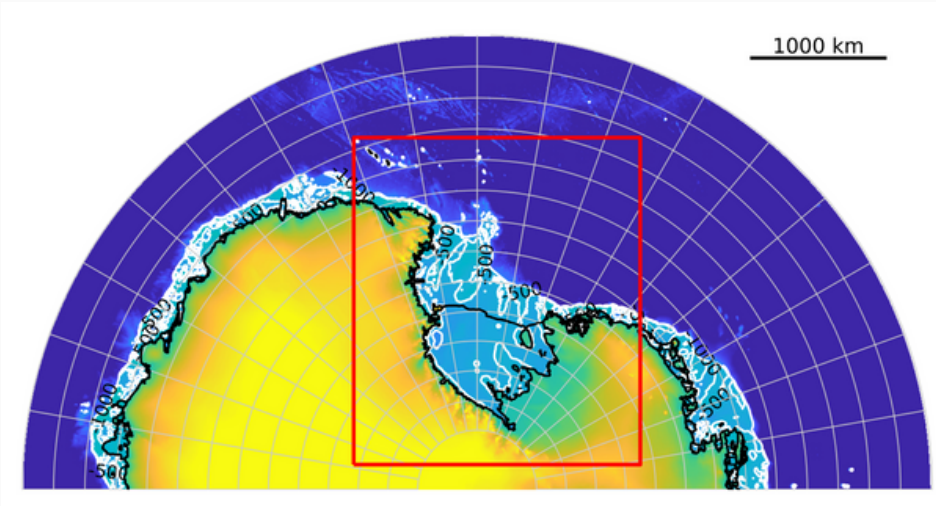


Figure 1 in the pre-print of "Conservation of heat and mass in P-SKRIPS version 1: the coupled atmosphere-ice-ocean model of The Ross Sea". The Ross Sea and surrounding area are highlighted by the red box; the model focuses on this area.

Why study the Ross Sea?

When picturing the Ross Sea, you can't imagine a typical shoreline as you would with, say, the Mediterranean. Besides the freezing climate, the key difference is that the sea continues even where it's not visible, under a massive ice shelf. That's the culprit behind potential worldwide sea level rise, and the reason that researchers focus their models on this region in particular.

If the water begins to warm up in the Ross Sea, the whole ice shelf will begin to melt and more of Antarctica's grounded ice sheet will flow into the sea.

But, modelling is a tricky business.

Different realms (ocean, atmosphere, ice, etc.) are simulated independently to make the problem feasible. That's what makes models like the new P-SKRIPS by Alena Malyarenko and Alex Gossart (with the help of other hub members like Mario Krapp) so valuable. They combine climate and sea ice-ocean models in one, enabling each system to interact with the others, just as they do in real life.

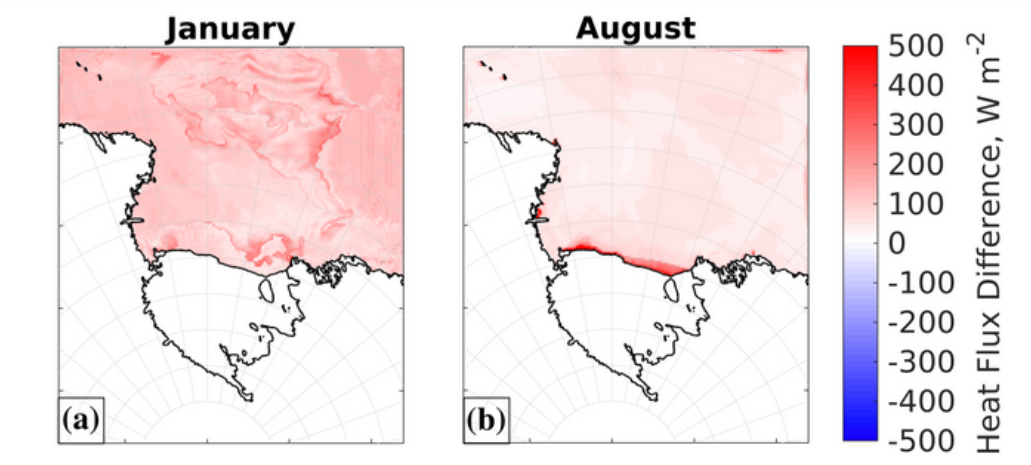


Figure 9 in the pre-print, showing the maximum difference of heat flux exchange for two different experiments (January and August of 2016). The difference reflects the additional heat flux that results from the unique coupling of the models.

Why does computational power matter?

Let's break down the numbers for this model.

If a model estimates every 20 seconds for the next 20 years, that's 30 million time-steps. Even with a supercomputer it takes **months to run**!

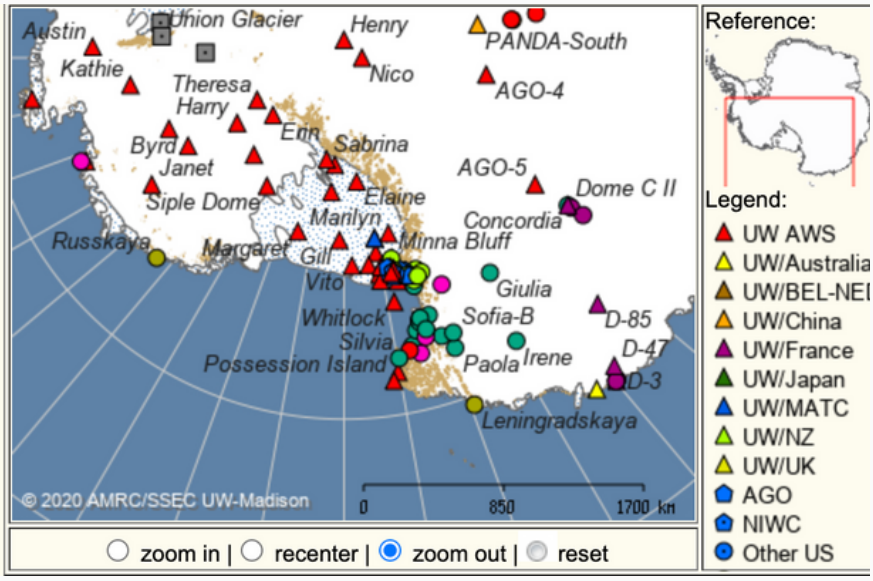
P-SKRIPS's novel contribution is not just the combining of models, but how it's done. Unlike comparable models, P-SKRIP conserves all the heat and mass fluxes transferred between the different models. You can see what a difference this makes in the image overhead by the significant change in heat flux between the two different experiments..

Despite the long road to arrive here, the creation of this model is only the beginning. Alena and Alex are diving into model simulations, and overcoming new hurdles, the most significant of which isn't the science, but resources. Atmospheric modelling requires enormous computational power because it estimates how the atmosphere changes at 20-second intervals. That means running the same simulation for months. So, look out for our next newsletter to see if their experiment is done!

Mesocyclones, and storms in Antarctica

Researchers in Antarctica stay in one of roughly 80 different bases, spread out across the continent. Day-to-day life and research expeditions come with their own set of challenges, like gearing up for -1.8℃ waters or visiting remote mountain ranges. And that's when things are good. These challenges quickly become dire if conditions change and storms roll in. So, understanding why and how these storms occur isn't just a theoretical exercise – the safety of researchers is at stake.

Alex Gossart studies a phenomenon called mesocyclones, which play a key role in the formation of storms in Antarctica. Mesocyclones form when intense winds billowing down from the sides of mountains (katabatic winds) combine with other prevailing winds. The mesocyclones then influence how snow gets distributed, which, in turn, affects moisture in the atmosphere (precipitation) and storm formation.

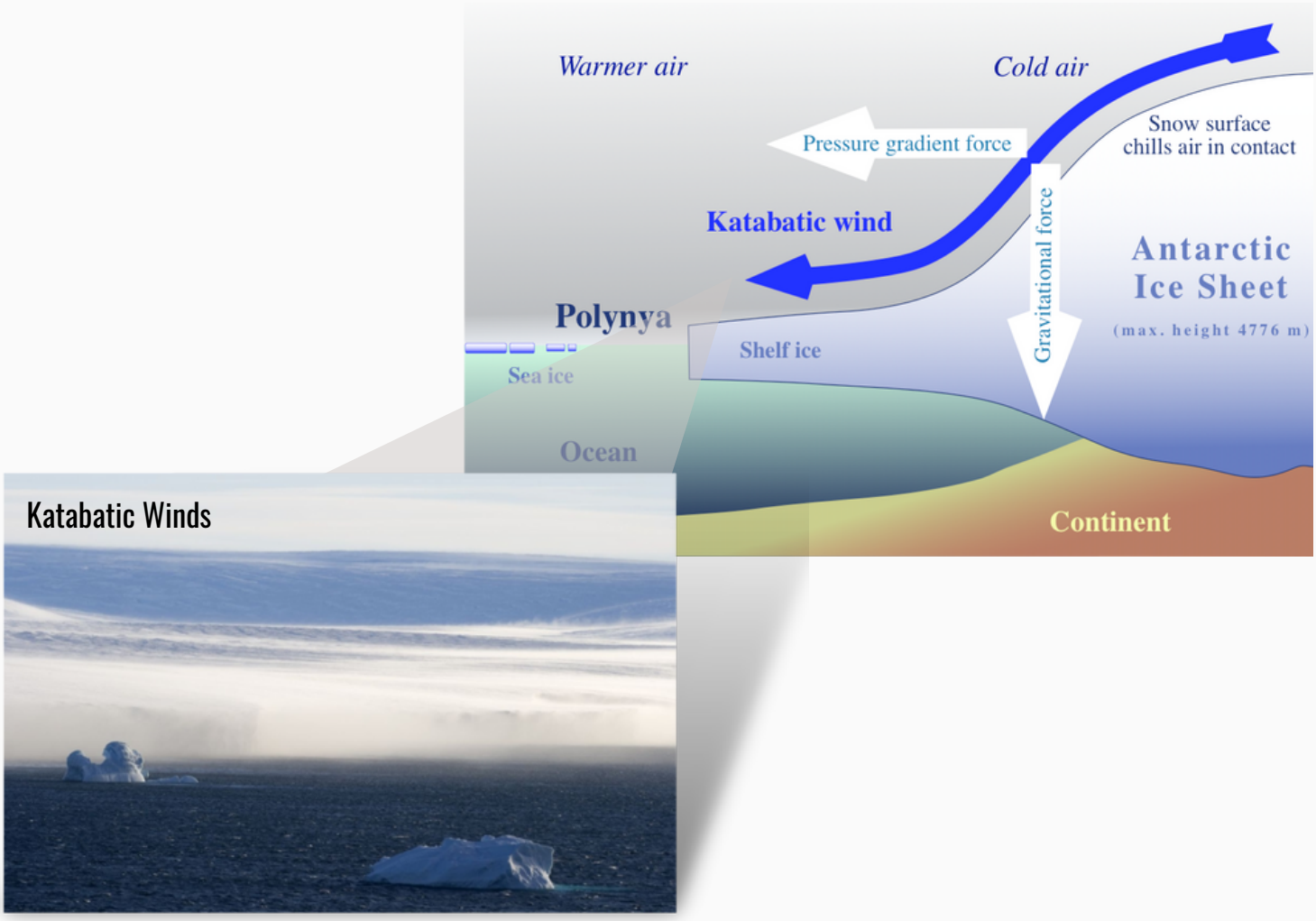


Automatic Weather Stations across Antarctica; Alex's work uses data from those surrounding the Ross Sea, near the centre of the image (from AWS)

Why this research project?

Alex Gossart and her colleagues' work on mesocyclones is just one part of a broader Antarctic Science Platform project: "Project 3 - Projecting Ross Sea Ecosystem Changes in a Warming World".

Ultimately, this research will contribute to understanding the consequences of environmental changes around the Ross Sea, one of the most protected ecosystems in the Southern Ocean.



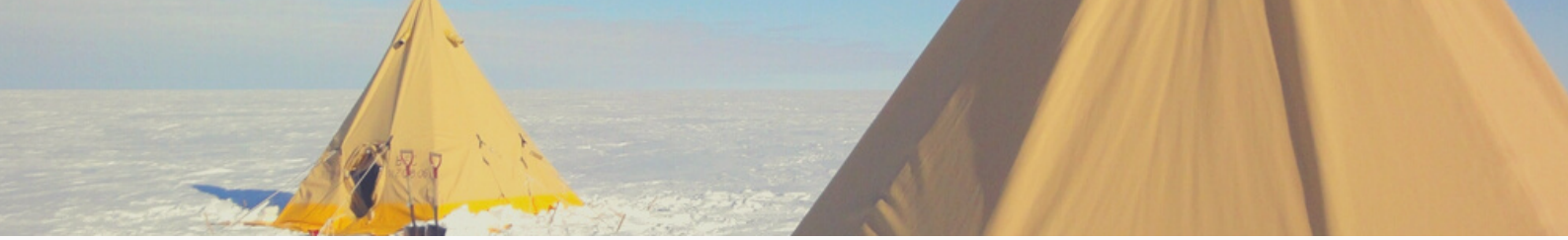
Katabatic winds billow down the sides of mountains and across the ice surface. They interact with other winds to form mesocyclones. Photos by Samuel Blanc and Hannes Grobe.

"That's what I love about modelling, you can just change reality... do things you can't do with observations."

ALEX GOSSART

Working alongside researchers at the University of Canterbury (Marwan Katurji and Peyman Zawar-Reza), Alex runs experiments on katabatic winds to determine how environmental factors affect the formation of mesocyclones. From these model runs, she found that the winds and resulting mesocyclones depend mainly on the topography. For example, temperature and sea ice matter much less than the height of the mountain.

Just by using data collected from remote instruments positioned across the Ross Sea, the team can infer what environmental conditions influence these events.



Girls* on Ice

Led by Antarctic Research Centre glaciologist Dr. Lauren Vargo, Modelling Hub researchers Alanna Alevropoulos-Borrill and Alex Gossart, together with others in the ARC and ARC collaborators, recently created a local chapter of "Inspiring Girls Expeditions: Girls* On Ice Aotearoa", a program to empower high school girls through scientific and outdoor exploration.

The top of Mount Ruapehu and the various glaciers surrounding it; the area where The Girls on Ice expedition will travel in January 2024. (Photo from Te Ara)*

The team is in the midst of securing funding to support their 10-day expedition to the Mount Ruapehu in January 2024. Participating students will get novel exposure to alpine environments and experience in understanding their surroundings scientifically. Students will learn about atmospheric processes, glaciology, geomorphology and ecology of the area and develop their own research projects within these disciplines. Especially unique to this outreach initiative is the additional emphasis of connecting students to the environment through art projects that the participants will complete.

Alanna and Alex were recently awarded a grant to cover the accomodation costs of the students. This is just one of many funding requests the team will work on in the coming months to ensure the trip is a success.

Applications are now open on their site, and due by September 1st.

2022 Winter School

Modelling Hub's 2023 Winter School

The ASP Modelling and Future Projections Working Group is now able to confirm dates for the 2023 Winter School on numerical modelling, data analysis, and computational techniques for Earth and climate sciences.

This two-day fully-catered workshop will be held in Wellington and will run **Tuesday 26th to Wednesday 27th September** with an optional introductory day on Monday, the 25th, for attendees who are completely new to this kind of work or just want a refresher on basic command-line computing.

The workshop is open to all ASP researchers. We hope it will be particularly useful for postgraduate students wanting to learn essential computational research skills, as well as for staff wishing to update their expertise or diversify their skill-sets.

To learn more, see their page on Eventbrite, or check out last year's Winter School here.

RSVP on Eventbrite

2023 WINTER SCHOOL

SEPT 26 - 27

NUMERICAL MODELLING

DATA ANALYSIS

COMPUTATIONAL TECHNIQUES

EARTH AND CLIMATE SCIENCES

NATIONAL MODELLING HUB

RESEARCH TEAM

ALENA MALYARENKO

Ice Shelf cavities, Ross ice sheet, The Terra Nova Bay Polynya

ALANNA ALEVROPOULOS-BORRILL

Ice sheet modelling, Ice-ocean interaction

ALEX GOSSART

Surface mass balance processes, Ross Sea, Terra Novay Bay

DAN LOWRY

Ice sheet dynamics, Ice shelf-ocean interactions, surface mass balance

LIZ KELLER

Carbon cycle dynamics, changes in Antarctica on global climate

MARIO KRAPP

Statistical modelling, dynamical systems, complexity

STEFAN JENDERSIE

Ocean circulation around Antarctica, ice shelves, polar oceanography

NICK GOLLEDGE

Glaciology, climate change, numerical modelling of Earth systems

ABOUT THE HUB

The National Modelling Hub was set up as a partnership between NIWA, VUW and GNS, funded by the Antarctic Science Platform (ASP). Now, the Hub incorporates researchers from VUW, GNS Science and University of Canterbury, all of whom are funded through a range of research programmes. The work of the Hub is coordinated by Nick Golledge and Liz Keller, Co-Chairs of the ASP Modelling and Future Projections Working Group.

The Hub has eight active PhD students: Béatrice Désy, Frank MacKenzie, Huiling Zou, Ihanshu Rane, Nikhil Hale, Prasad Shelke, Vincent Charnay, and Yaowen Zheng.

VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA | Te Puna Pātiotio Antarctic Research Centre | GNS SCIENCE TE PŪ AO | NZ SEA RISE TE TAI PARI O AOTEAROA | Antarctic Science Platform | MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT HĪKINA WHAKATUTUKI | UC UNIVERSITY OF CANTERBURY Te Whare Wānanga o Waitaha CHRISTCHURCH NEW ZEALAND | NIWA Taihoro Nukurangi

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