



BYTES

THE NEWSLETTER OF THE NATIONAL MODELLING HUB



In a nutshell...

In this issue we update you on some exciting new future projections for the Greenland Ice Sheet, as well as development of an ice-sheet enabled NZ Earth system model.

There are reports from the SCAR conference in Chile, and a physical oceanography workshop held in Wellington.

But most exciting of all, we are delighted to share with you Alex's baby girl Zoë!

Enjoy the evolving landscape of climate science, and a wide range of modelling community updates, in each edition of BYTES.

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September 2024

An artificial neural network
for the Greenland Ice Sheet

Expanding the capabilities of
the NZ Earth System Model

Welcome to the
world, Zoë!

SCAR Open Science
Conference, Pucón, Chile

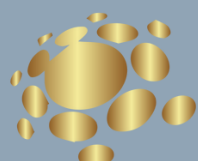
Oceanography workshop,
Wellington

Modelling Hub funding
success

The Hub has an open invitation for researchers to visit, in order to enable both national and international connections and exchanges.

If you're interested in visiting the Hub, please get in touch with us:
<https://www.modellinghub.org>

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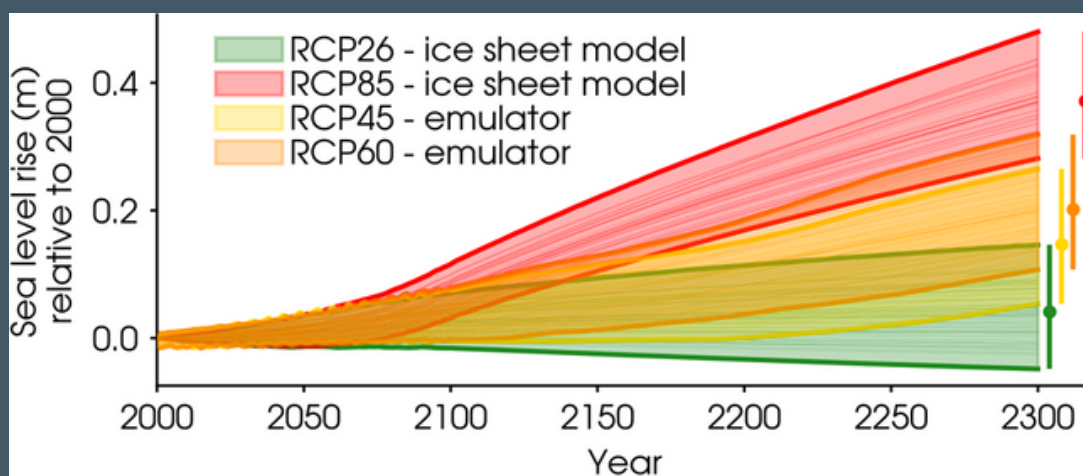




An artificial neural network for the Greenland Ice Sheet

Greenland ice sheet melting is one of the biggest contributors to the global sea level rise. To determine how much and how quickly the sea level rise will change, the scientific community has run numerical Greenland ice-sheet model simulations driven by a few future emission scenarios. However, running these process-based model simulations is time-consuming and expensive, so these simulations only cover part of the range of uncertainties of sea level rise arising from emission scenarios.

To address this, we can use a statistical emulator to learn relationships between the emission scenarios used to drive the ice-sheet model and the sea level rise the model produces. After learning, the emulator can predict the sea level rise from unmodelled scenarios that were not considered in the original ice-sheet model simulations.



The above figure shows an example. The ice sheet model simulates the sea level rise under two future emission scenarios, RCP26 (green) and RCP85 (red), where RCP refers to “Representative Concentration Pathway”, and a higher number indicates more greenhouse gas emissions in the future. Here, we can use the statistical emulator, built with a shallow Artificial Neural Network, to predict the sea level rise of two unmodelled emission scenarios in between, RCP45 (yellow) and RCP60 (orange). Now results reveal the full range of sea level rise under four different emission scenarios. Nevertheless, the sea level rise under these scenarios exhibits substantial overlapping at the year 2300 due to different choices of parameters for the ice sheet models. We will further use the emulator to test other emission scenarios and parameters.



Expanding the capabilities of the NZ Earth System Model

Alanna has now returned to the Hub having spent six weeks in the UK visiting some of the core developers of UK Earth System Model (UKESM), the parent model to the New Zealand Earth System Model (NZESM). Spending time at Reading University, Alanna worked with Robin Smith to troubleshoot some of the remaining bugs in the ice sheet model coupling code. With the help of Robin, Alanna now has a working version of NZESM-ice on the NeSI HPC Maui.

NZESM-ice simulates direct two-way coupling between the atmosphere, ocean and ice sheets, making it an incredible tool for investigating the role of climate-ice sheet feedbacks in driving present and future change over Antarctica and the Southern Ocean.

During her visit, Alanna also spent time with the glaciology team at the University of Bristol where she was able to discuss the latest developments to the ice sheet model BISICLES, the ice sheet component of NZESM-ice. Alanna now begins the next stage of her work in improving the representation of ice-ocean feedbacks within the coupling procedure.

Welcome to the world, Zoë!



Just as our last issue went out in June, Modelling Hub researcher Alex Gossart gave birth to the beautiful Zoë Lambaerts. Now three months old, Zoë is growing well and learning quickly. We're already hoping to sign her up for the next Winter School!



SCAR Open Science Conference, Pucón, Chile

In August this year over 1200 researchers from around the world converged on the small town of Pucón in Patagonian Chile, for the 11th biannual Open Science Conference of the Scientific Committee on Antarctic Research (SCAR). Four days of science talks were book-ended by side meetings of a wide range of SCAR working groups.

Against the stunning backdrop of Villarrica, one of Chile's most active volcanoes, the week's proceedings unfolded at a relatively relaxed pace, giving attendees plenty of opportunity for networking and collaboration.

The conference opened with a Plenary lecture from Dr. Sally Lau (James Cook University, Australia), who revealed the ways in which DNA analysis can be used to reconstruct the past extent of the Antarctic Ice Sheet. Later in the week Mathieu Casado (IPSL, France) gave a fact-filled and informative overview of the value of ice core proxies for climate change studies, particularly if we want to determine the trend of recent Antarctic changes.

The conference was well-attended by New Zealand researchers across the physical and biological sciences, as well as those interested in science communication, policy issues, and engagement. In between the science there was ample time to explore the cafes and restaurants of Pucón, or head out into the mountains for some snow and scenery.

The next Open Science Conference, in 2026, will be held in Oslo, Norway.



View of Villarrica,
en route to Pucón.



Fourth annual Winter School on numerical modelling and data analysis



Building on the successes of previous years, the Modelling Hub team once again ran their Winter School on numerical modelling and data analysis. For three days in September, participants from across New Zealand learned how to set up and run their own climate simulations, as well as how to view and analyse the outputs.

Many of the attendees had little or no past experience with programming or command-line

tools, but following the introductory sessions of Day 1 they all got up to speed impressively quickly. By the end of the three days, individuals were helping each other out as they worked through a range of exercises, comfortable in the new skills that they had learned.

As with previous years the workshop benefited greatly from the technical and personnel support afforded by New Zealand e-Science Infrastructure (NeSI). Their assistance across the three days was invaluable, and allowed us once again to run all of our tutorials via a web interface to the NeSI cluster.

Huge thanks also to Dao Polsiri and Anna Bowron from the Antarctic Research Centre for all their help behind the scenes, making sure everything ran smoothly, and that we were all well fed throughout!

PETER SIEW



Oceanography workshop, Wellington

In early September, New Zealand's oceanographers gathered at Wellington's Lyall Bay Life Saving Club for their 7th biennial Physical Oceanography Workshop (POW), co organized by Alena Malyarenko (National Modelling Hub) and her colleagues from NIWA Liv Cornillesen and Craig Stevens. The two-day meeting brought together over 60 ocean researchers from all over New Zealand across all career stages. One key aspect of the POW is forging links and facilitating exchange between NZ's numerical ocean modelers and observational oceanographers.

Presentation highlights included a new model-generated wave forecast for Wellington that reduces the error in predicted wave height by 25% (Rafael Santana). The environmental changes and consequences of cyclone Gabriel with extreme rainfalls in Hawkes Bay in early 2023 were reported in a number of presentations, one highlight being the direct observation of submarine groundwater discharge by help of an autonomous glider (Jasmin McInerney).

This year the POW's traditional focus on NZ's coastal ocean, the Tasman Sea and the South Pacific was expanded by a session dedicated to Antarctic ocean research. It showcased a new numerical sea-ice ocean coupled model of Terra Nova Bay in the Ross Sea, developed to reconstruct an 8-year long hydrographic dataset (Liv Cornillesen, Alena Malyarenko). The model promises to shed new light on very important processes that facilitate Antarctic dense water production, the only mechanism by which oxygen is supplied to the global deep ocean ecosystems.



Funding success

Friday the 13th may be unlucky for some, but this September it saw the announcement of successful proposals in the 2024 round of grants from the Ministry of Business, Innovation, and Employment (MBIE). Alex, Alena, Stefan and Liz from the Modelling Hub are part of a \$13.6M 'Endeavour' project awarded to Prof. Nancy Bertler, looking at sea ice and ocean productivity changes in the Ross Sea, whilst Peter Siew and Nick Gollidge will be contributing to a 'Smart Ideas' project led by Dr. Bach Nguyen from Victoria University's Centre for Data Science and Artificial Intelligence.

Congratulations to all – fingers crossed there will be lots of exciting new research to report on in future issues of BYTES!



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HĪKINA WHAKATUTUKI

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



NICK GOLLEDGE

Glaciology, climate change, numerical modelling of Earth systems



PETER SIEW

Artificial Intelligence and machine learning



STEFAN JENDERSIE

Ocean circulation around Antarctica, ice shelves, polar oceanography

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 six active PhD students: Béatrice Désy, Frank MacKenzie, Huiling Zou, Ihanshu Rane, Prasad Shelke and Vincent Charnay.



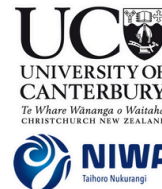
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