BYTES

THE NEWSLETTER OF THE NATIONAL MODELLING HUB

In a nutshell...

Kia ora koutou, and welcome to the first 2024 issue of BYTES!

In this issue we report on the hugely important collaboration between the Antarctic Science Platform (ASP) and New Zealand e-Science Infracture (NeSI), a relationship that has grown and grown since the inception of the ASP in 2018.

And as always, we update you on the recent research, conferences, and visitors that the Hub have been involved with, and share news of a major award for one of our team.

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

As we go to press we are saddened to learn of the passing of our friend and colleague Prof. Craig Cary. Our thoughts go out to his family.

Issue 4
March 2024

Supercomputing to supercharge our research

Welcoming our New Intern

Capital Complexity

Major award for Modelling Hub co-leader

Publication Highlights

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

NATIONAL MODELLING HUB

Supercomputing to supercharge our research

When the Antarctic Science Platform was established in 2018, it was recognised straight away that the demand for high-performance computing (HPC) would be significant. This is because many of the numerical models that ASP researchers depend on use parallel processing to accelerate the vast number of calculations needed for any given simulation. These kinds of models are too complex to run on a typical desktop PC, and that's where our relationship with the New Zealand eScience Infrastructure (NeSI) team comes in.

NeSI maintain and run HPC facilities that researchers can access remotely whenever they need to. NeSI support a wide range of large research programmes across NZ, and in 2020 a Memorandum of Understanding (MOU) was signed by NeSI and ASP, signalling a desire to work together to enhance New Zealand's Antarctic research. Having successfully operated for its initial three years, the MOU was renewed in December 2023 by NeSI Director Nick Jones and ASP Director Nancy Bertler.

In 2023 there were nine different ASP projects running on NeSI resources, utilising a total of 1.7 million core hours and an average of over 100 TB of data storage. All up, these numbers translate into over $100,000 of hardware support, and the numbers are growing

Georgina Rae and Nick Jones from NeSI (top) join Nancy Bertler and Nick Golledge from the ASP (bottom) in commemorating the signing of the renewed MoU between the two organisations

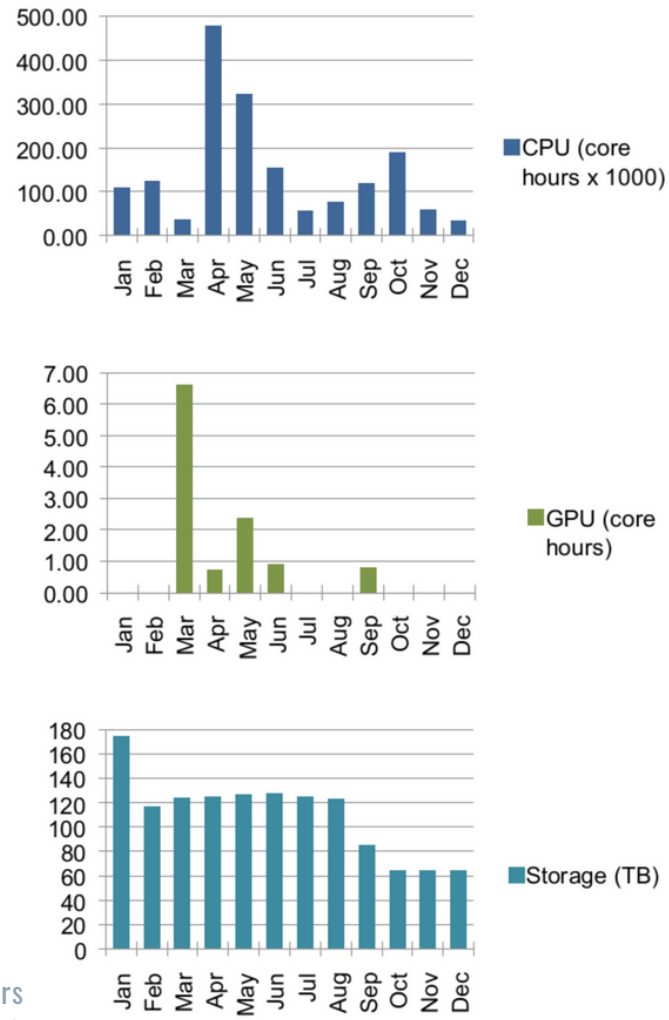
Parallel Processing

A method of computation in which individual calculations are carried out simultaneously on multiple processors. This contrasts with a typical PC where calculations are usually done one at a time. By using hundreds or even thousands of parallel processes, numerical models running on supercomputers can complete simulations in a few weeks that would otherwise take many years to run. Nesi operate two machines, Maui, with 18,000 cores, and Mahuika, with 16,000 cores. Currently the fastest supercomputer in the world is the Frontier computer in the USA, with more than 600,000 CPU cores and a staggering 8,300,000 GPU cores.

steadily each year. So the new MOU is an important recognition of ongoing NeSI support, but it isn't just the hardware that ASP researchers benefit from.

Through NeSI's Consultancy service, researchers have had access to dedicated experts who have helped build and optimize code, often undertaking complex debugging tasks when several models need to be coupled. NeSI staff have also contributed to the last two ASP Winter Schools, running sessions, assisting the participants, and creating a complete virtual environment on NeSI machines where all the course content could be hosted.

As the ASP looks ahead to Tranche 2 of the programme, it seems clear that whatever our compute needs might be for that next phase, NeSI will be on hand to help us make it happen.



ASP usage of NeSI resources during 2023. CPU core hours (top), GPU core hours (middle), and data storage (bottom).

New intern at the Antarctic Research Centre

In February this year, Timothée Lebrat joined Modelling Hub co-leader Nick Golledge to work on an ice-sheet modelling project. Timothée will first use the Parallel Ice Sheet Model (PISM) to explore Antarctic Ice Sheet response to changes in climate. Then he will run the same simulations using the Instructed Glacier Model (IGM), a state-of-the-art model that uses GPU processing and embedded deep learning to speed up ice flow calculations. Timothée previously worked with Guillaume Jouvet, the developer of IGM, in Switzerland so already has some experience with this model. His project will hopefully reveal the strengths and weaknesses of the two models, and if all goes well, provide interesting new insights into Antarctic Ice Sheet dynamics in a warmer world.

"After studying for five years in a French city where wind is legendary, I wanted to discover the reality of wind at the antipodes. And I'm not disappointed."

Complex Systems

Complexity science has risen in popularity considerably over recent years, in part because of the evermore connected lives we lead. Complex systems can be thought of as those that are composed of many parts, all of which influence the others to the extent that unique behaviours arise in the population as a whole. The COVID-19 epidemic suddenly brought complexity science tools like network theory into the public domain, enabling connections between millions of individuals to be analysed and modelled in a quantitative way, which ultimately allowed critical policy decisions to be made.

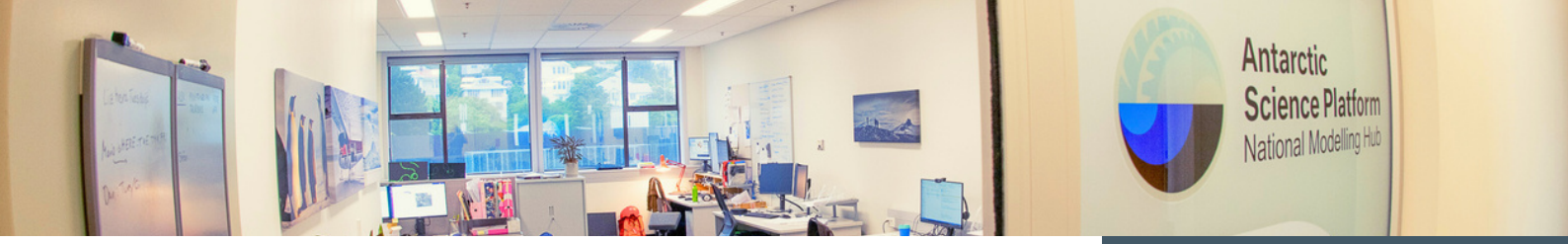
Capital Complexity

Last month also saw the second Capital City Complex Systems Symposium take place at the Tiakiwai Conference Centre in Wellington on February 13-14th.

Organised by Te Pūnaha Matatini Centre of Research Excellence the conference attracted around 100 attendees from New Zealand and overseas, with presentations spanning disciplines such as network science, data ethics, ecology, climate modelling, epidemiology and many more.

Modelling Hub Ph.D researcher Béatrice Désy was one of those on the organising committee: "I was blown away by the quality of the talks, and perhaps even more so by their interconnectedness, with so many references to previous talks and questions. Seeing speakers and attendees from such a diverse range of disciplines and backgrounds coalesce in unexpected ways was quite amazing".

Complex Systems Symposium photos by Mark Coote and Te Pūnaha Matatini.



Major award for Modelling Hub co-leader

The annual awards ceremony of the Royal Society of New Zealand was held at the end of November last year, at Government House in Wellington. One of the 2023 awards recipients was co-leader of the Modelling Hub, Prof. Nick Golledge.

Nick won the Hutton Medal for "cutting-edge contributions to modelling of the Antarctic Ice Sheet, and research on climate change, including his role as a Lead Author for the most recent Assessment Report from the Intergovernmental Panel on Climate Change (IPCC)". The award recognised the new capability in ice sheet modelling that Nick brought to New Zealand over a decade ago, and his ongoing commitment to building and maintaining modelling expertise ever since.

The award was presented by the 22nd Governor-General of New Zealand, Her Excellency The Right Honourable Dame Cindy Kiro.

Nick's research has received international recognition and media coverage, and has informed government policies.

The 2023 Hutton Medal awarded to Prof. Nick Golledge

Publication highlights

Modelling Hub climate modeller Alex Gossart was among 29 contributors to a paper published in February in Nature Reviews Earth and Environment. Entitled, "Short- and long-term variability of the Antarctic and Greenland ice sheets", the paper investigates whether the long-term evolution of ice sheets is substantially influenced by short-term fluctuations or extreme events. This kind of study is especially timely in the light of events such as the Antarctic heatwave recorded in March 2022.

In December last year, a paper was published in Science led by a team of Australian geneticists and co-authored by the Modelling Hub's Nick Golledge. The paper used octopus DNA to show that during the Last Interglaciation, around 125,000 years ago, seaways connected the Ross and Weddell seas, implying a collapse of West Antarctica under a climate similar to today's.

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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.

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