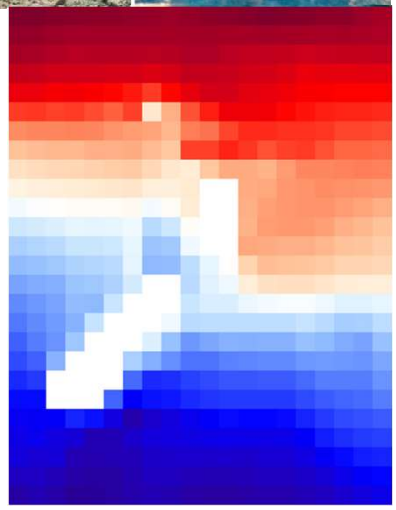
Earth system modelling on the Cray XC50

Jonny Williams, climate scientist, NIWA
Wellington, NZ



NIWA Taihoro Nukurangi | Landcare Research Manaaki Whenua | University of Otago Te Whare Wānanga o Otāgo New Zealand | Antarctica New Zealand | GNS Science Te Pū Ao | Victoria University of Wellington Te Whare Wānanga o Te Ūpoko o Te Ika a Māui | THE DEEP SOUTH | Te Kōmata o Te Tonga | National Science Challenges

The Deep South Challenge

- Objective from Cabinet

To understand the role of the Antartic and Southern Ocean in determining our climate and our future environment.

THE DEEP SOUTH | Te Kōmata o Te Tonga | National SCIENCE Challenges

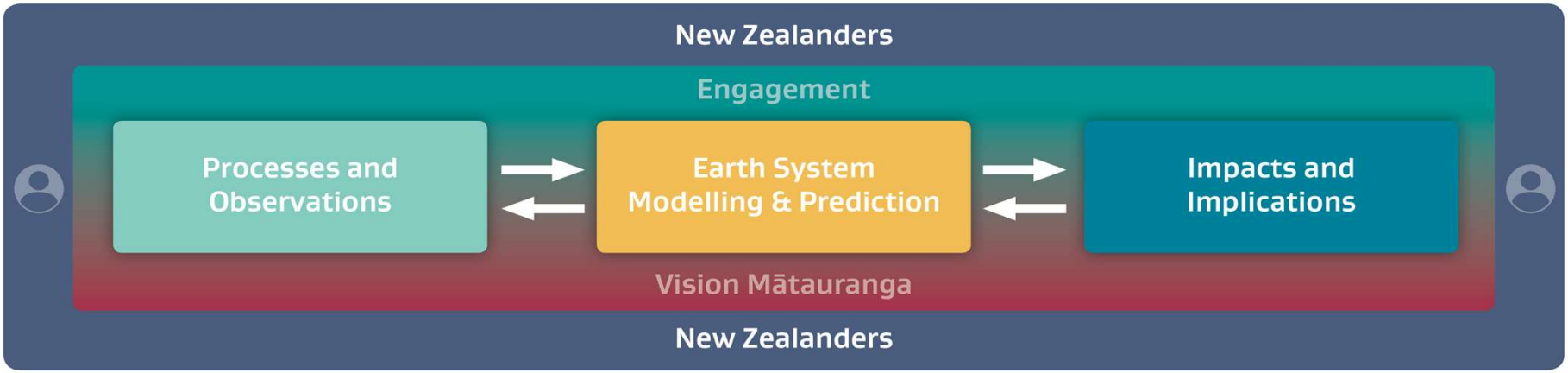
The Deep South Challenge

This Challenge will enable New Zealanders to adapt, manage risk, and thrive in a changing climate.

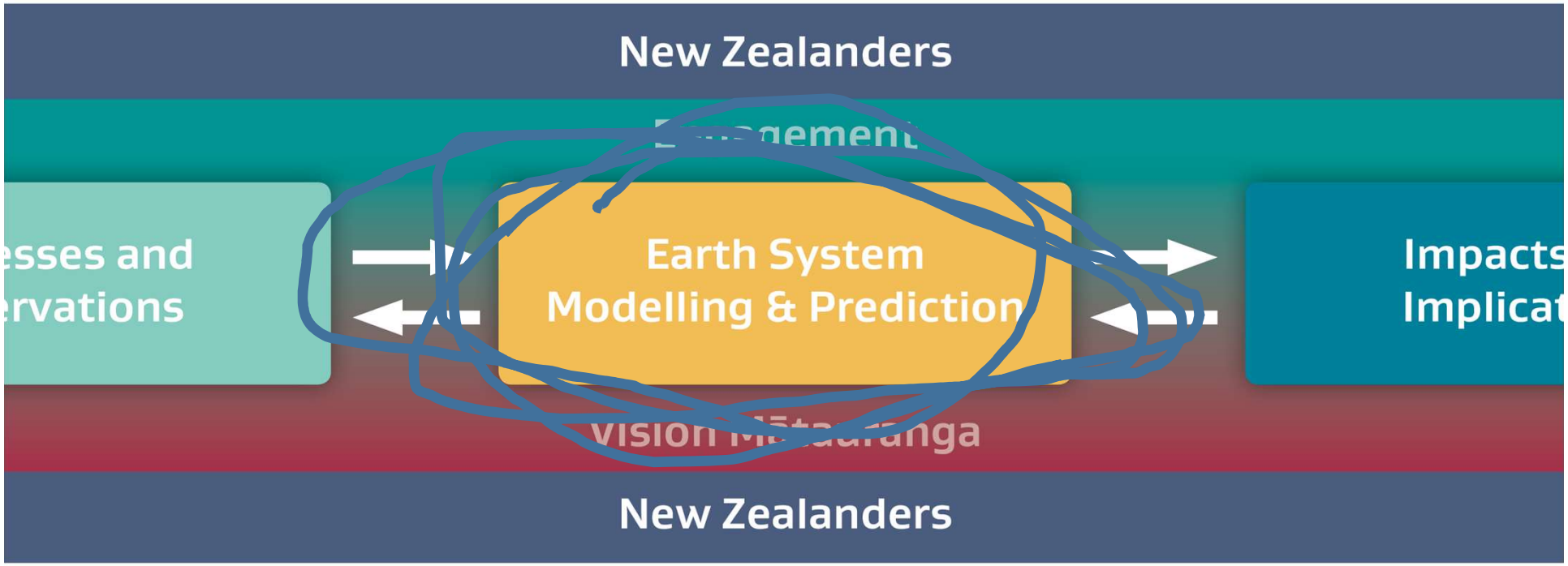
… Working with our communities and industry, we will guide planning and policy to enhance resilience and exploit opportunities. **This will be built on improved predictions of future climate, supported by new understanding of Antarctic and Southern Ocean processes**. The Challenge will focus on the effects of a changing climate on key climate sensitive economic sectors, infrastructure and natural resources.

THE DEEP SOUTH | Te Kōmata o Te Tonga | National SCIENCE Challenges

The Deep South Challenge Programmes

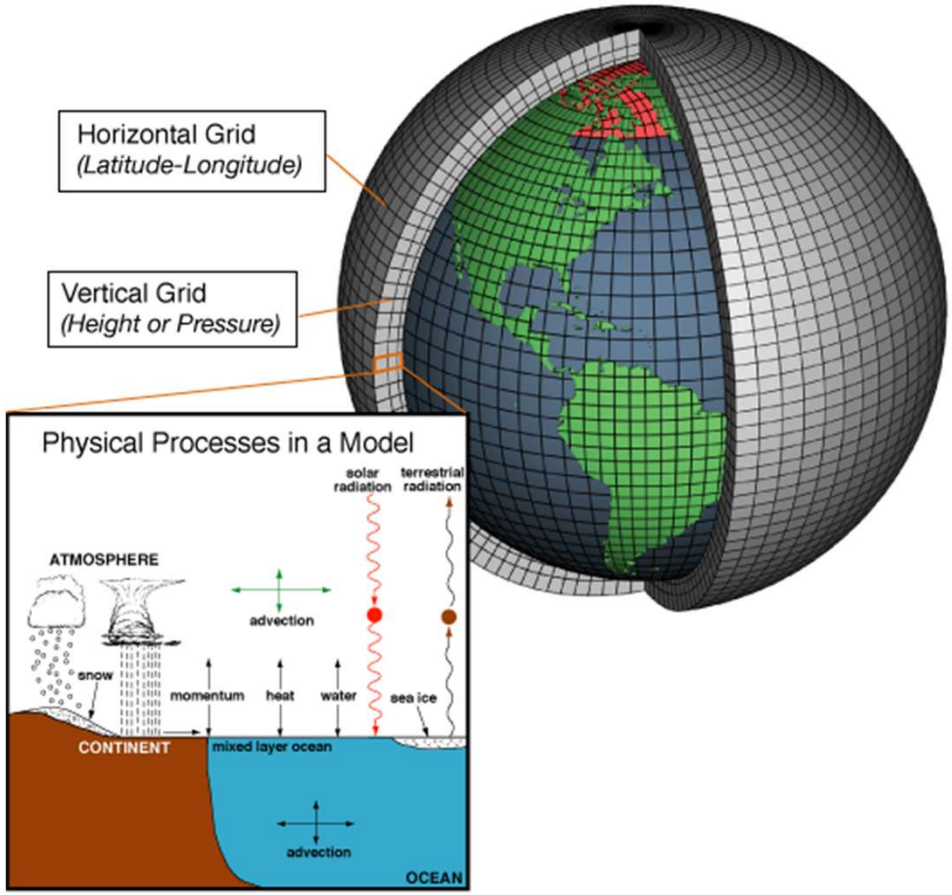


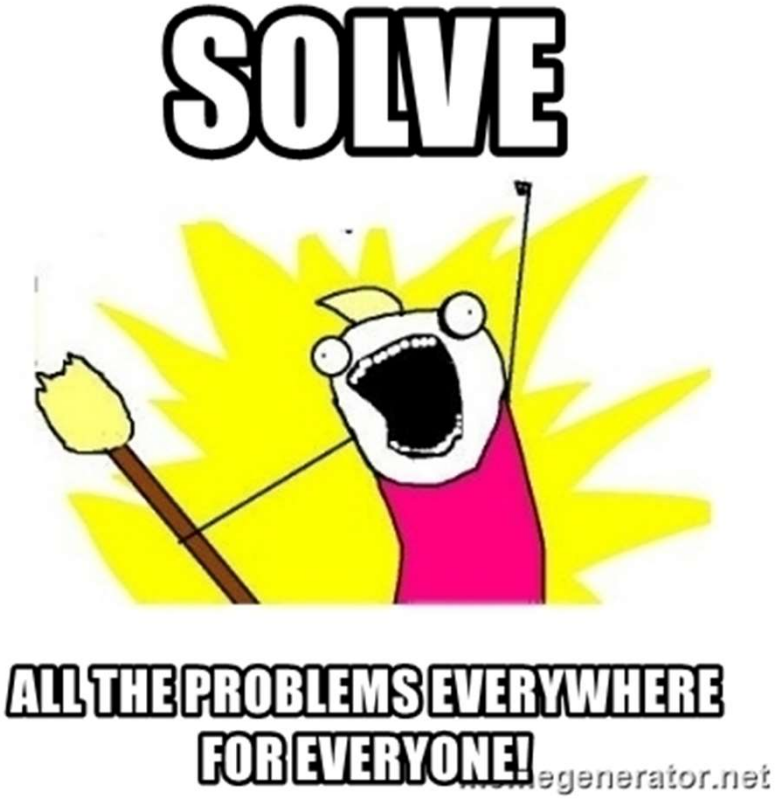
The Deep South Challenge Programmes



THE DEEP SOUTH | Te Kōmata o Te Tonga | National SCIENCE Challenges

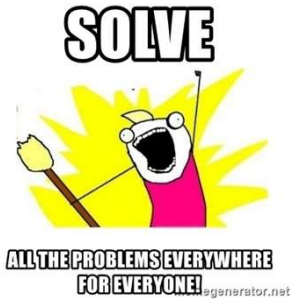
atmospheric models

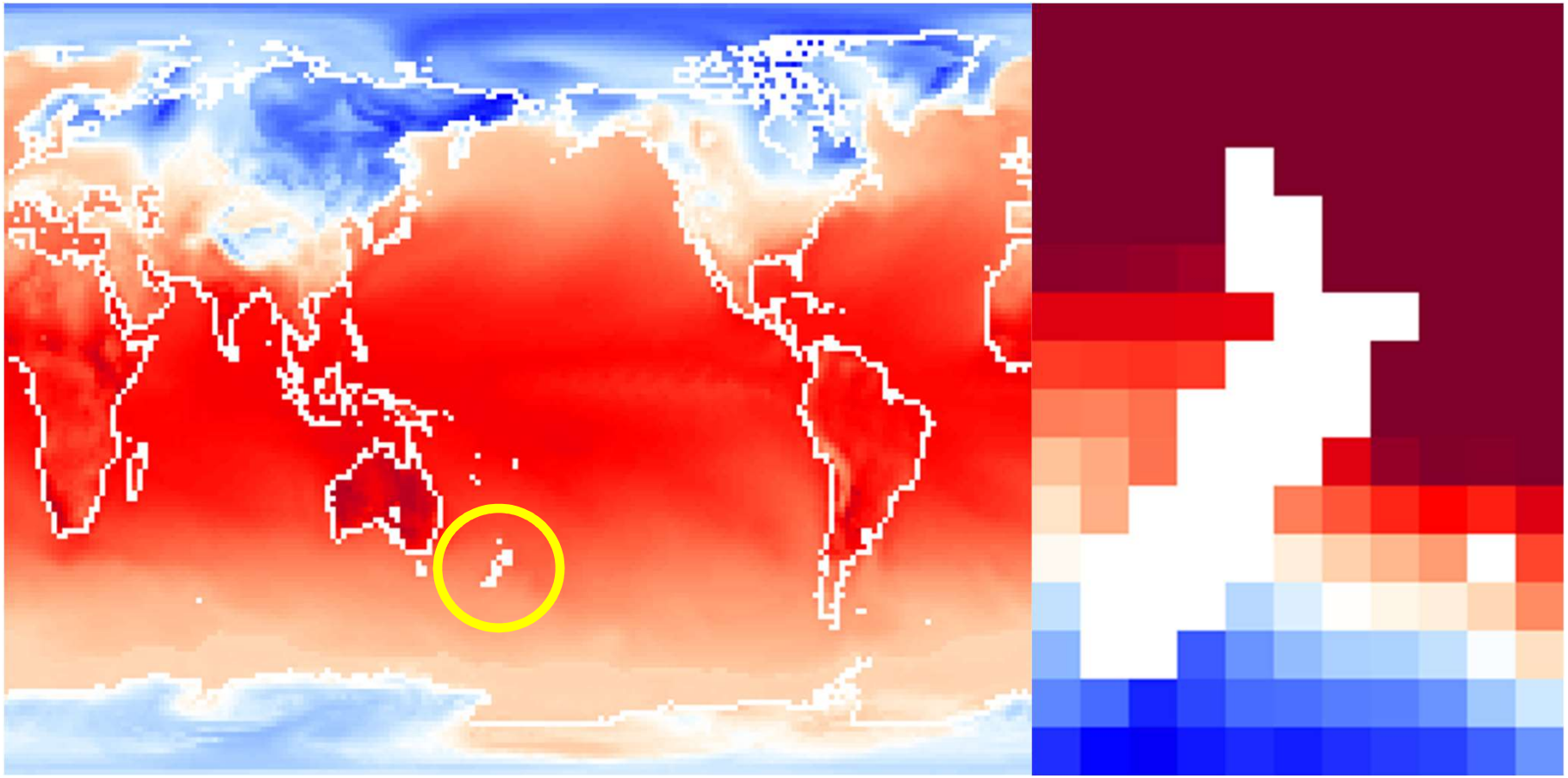




NIWA Taihoro Nukurangi | Landcare Research Manaaki Whenua | University of Otago Te Whare Wānanga o Otāgo New Zealand | Antarctica New Zealand | GNS Science Te Pū Ao | Victoria University of Wellington | The Deep South | Te Kōmata o Te Tonga | National Science Challenges

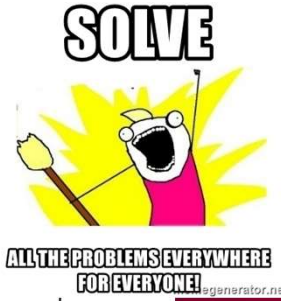
atmospheric models

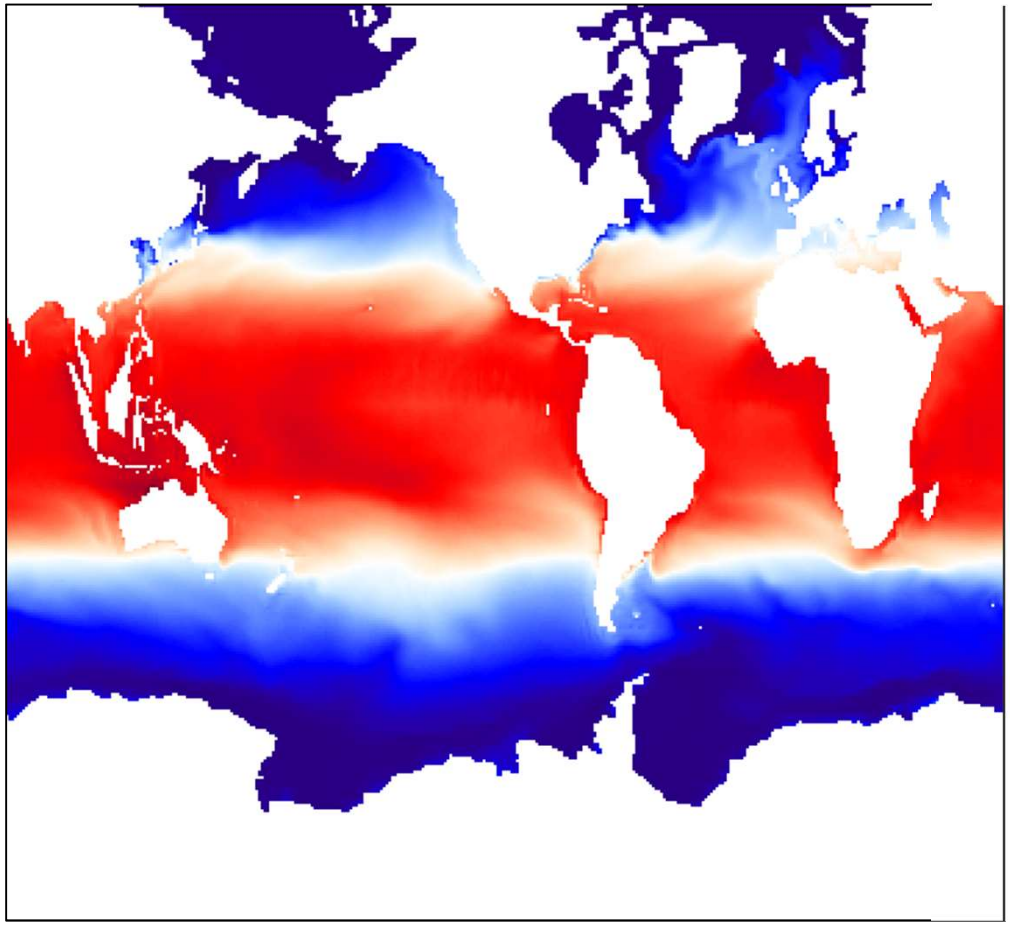


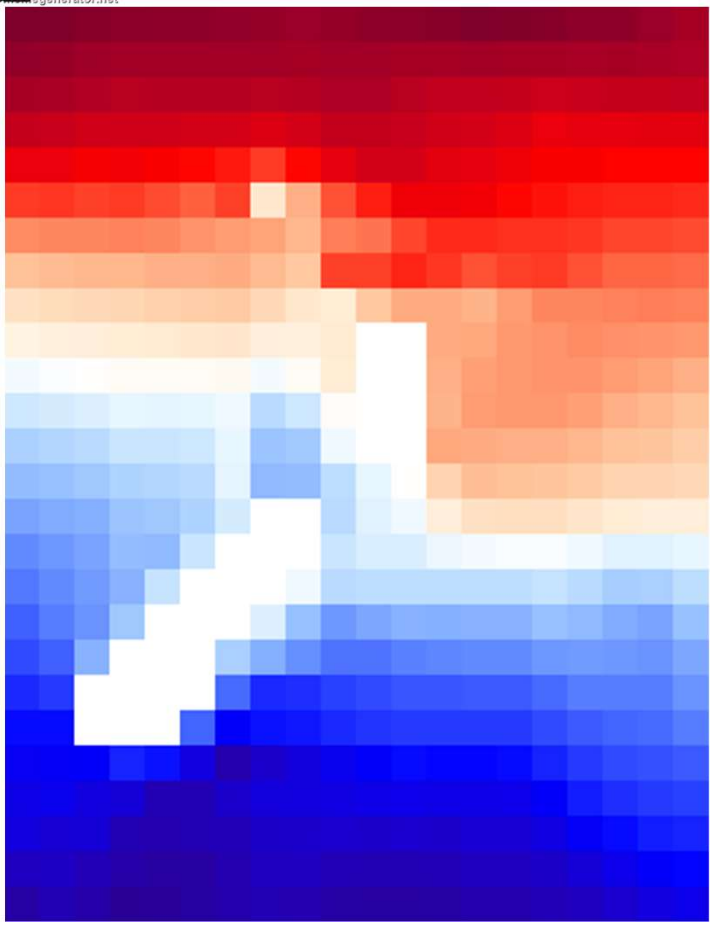


NIWA Taihoro Nukurangi | Landcare Research Manaaki Whenua | University of Otago Te Whare Wānanga o Otāgo New Zealand | Antarctica New Zealand | GNS Science Te Pū Ao | Victoria University of Wellington Te Whare Wānanga o Te Ūpoko o Te Ika a Māui | THE DEEP SOUTH | Te Kōmata o Te Tonga | National Science Challenges

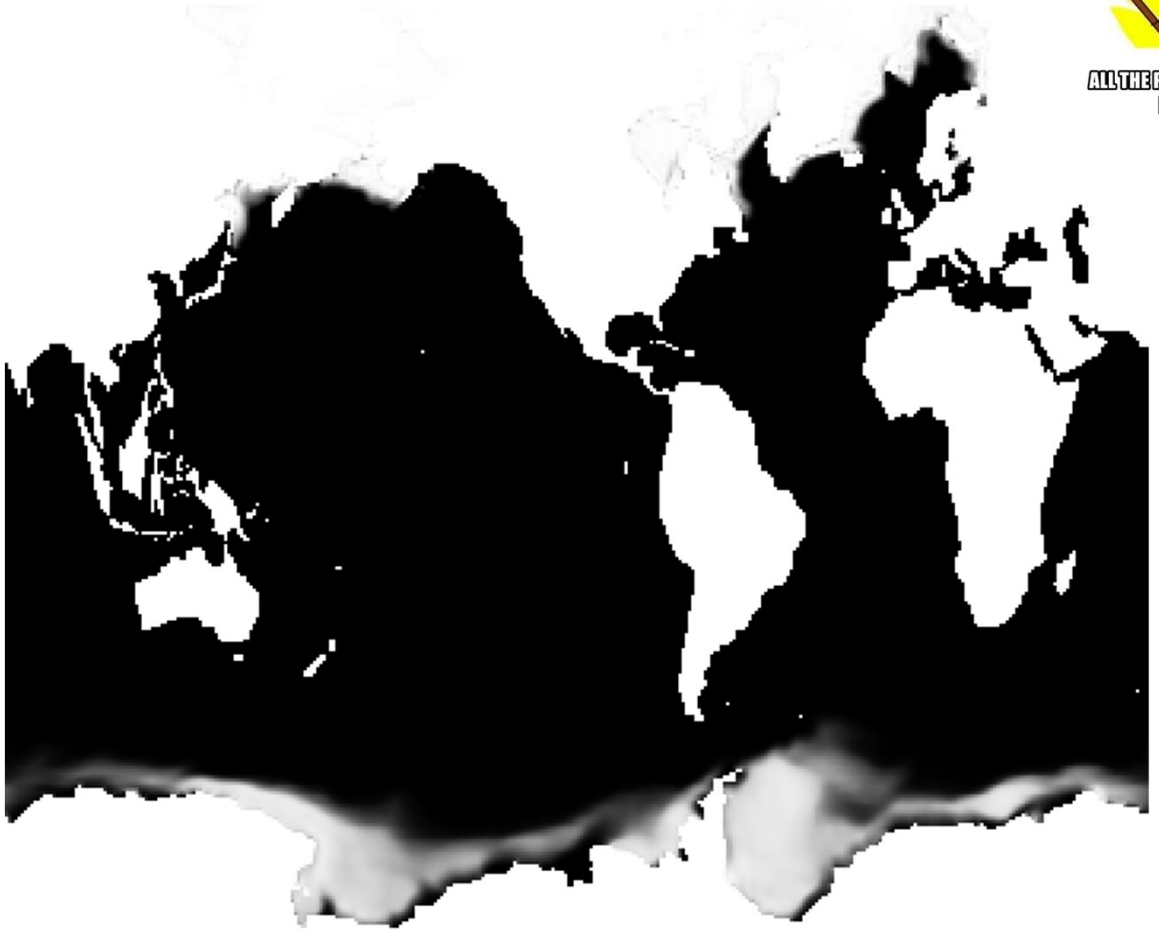
ocean models

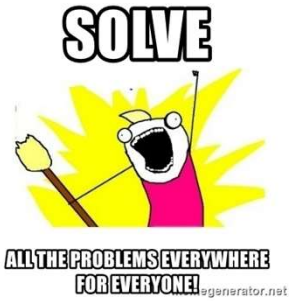




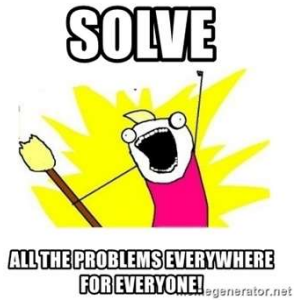


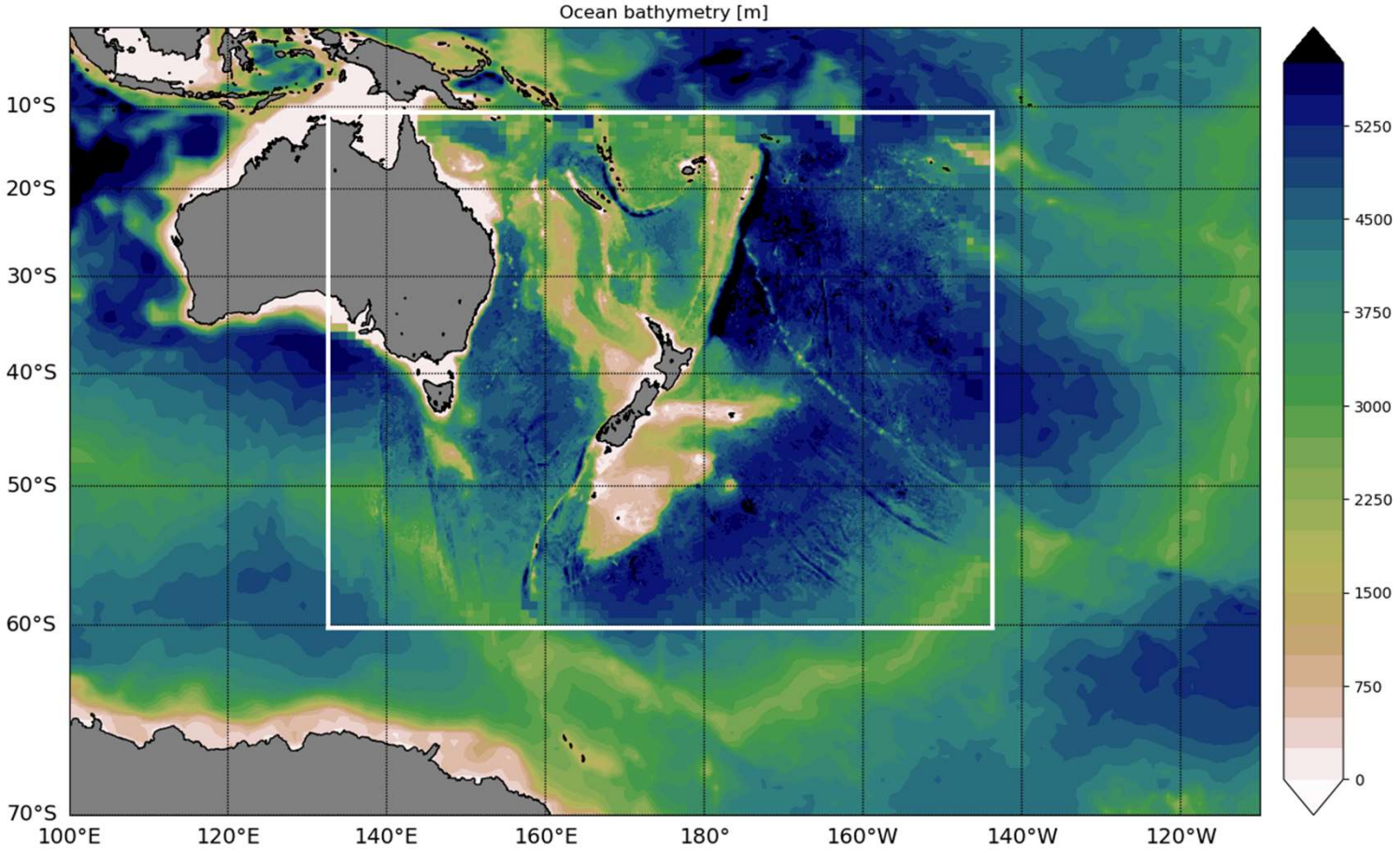
sea ice models



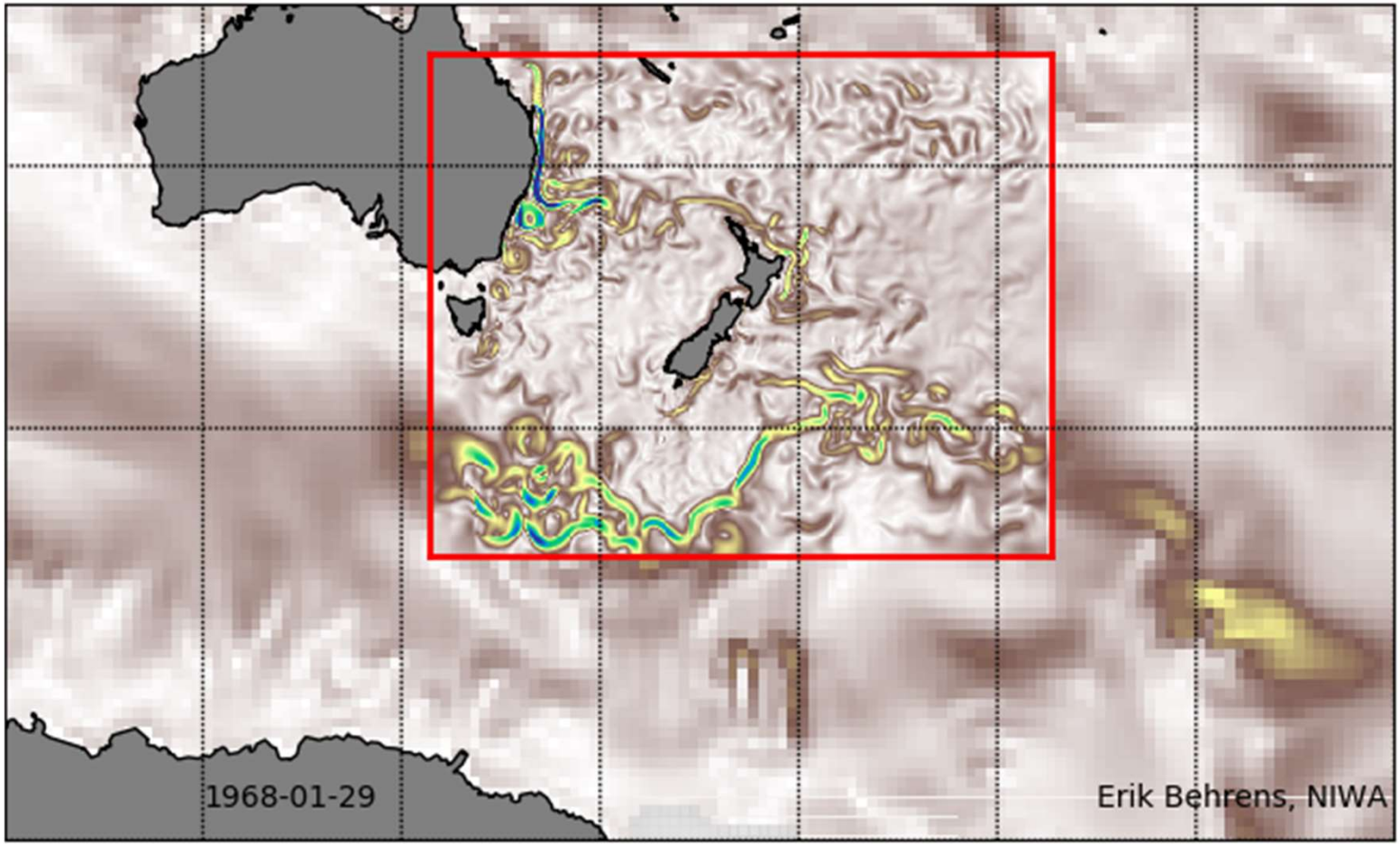


nested ocean models

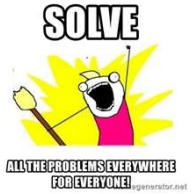




NIWA Taihoro Nukurangi | Landcare Research Manaaki Whenua | University of Otago Te Whare Wānanga o Otāgo New Zealand | Antarctica New Zealand | GNS Science Te Pū Ao | Victoria University of Wellington Te Whare Wānanga o Te Ūpoko o Te Ika a Māui | THE DEEP SOUTH | Te Kōmata o Te Tonga | National Science Challenges



sea surface speed



NIWA Taihoro Nukurangi | Landcare Research Manaaki Whenua | University of Otago Te Whare Wānanga o Otāgo New Zealand | Antarctica New Zealand | GNS Science Te Pū Ao | Victoria University of Wellington Te Whare Wānanga o te Ūpoko o te Ika a Māui | THE DEEP SOUTH | Te Kōmata o Te Tonga | National Science Challenges

enabled complexity

- using the recently decommissioned fitzroy platform, models as complex as these could simply not be run
  - too few processors
  - not enough memory

aerchemmip

- we will be running simulations as part of the aerosol chemistry model intercomparison project
- this will be part of nz's contribution to the next assessment report of the intergovernmental panel on climate change

Geosci. Model Dev., 10, 585–607, 2017
www.geosci-model-dev.net/10/585/2017/
doi:10.5194/gmd-10-585-2017

Geoscientific Model Development
EGU

AerChemMIP: quantifying the effects of chemistry and aerosols in CMIP6

William J. Collins[1], Jean-François Lamarque[2], Michael Schulz[3], Olivier Boucher[4], Veronika Eyring[5], Michaela I. Hegglin[1], Amanda Maycock[6], Gunnar Myhre[7], Michael Prather[8], Drew Shindell[9], and Steven J. Smith[10]

[1]Department of Meteorology, University of Reading, Reading, RG6 6BB, UK
[2]National Center for Atmospheric Research, Boulder, CO, USA
[3]Norwegian Meteorological Institute, Oslo, Norway
[4]Laboratoire de Météorologie Dynamique, IPSL, Université Pierre et Marie Curie/CNRS, Paris, France
[5]Deutsches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany
[6]School of Earth and Environment, University of Leeds, Leeds, UK
[7]CICERO – Center for International Climate and Environmental Research Oslo, Oslo, Norway
[8]University of California, Irvine, CA, USA
[9]Nicholas School of the Environment, Duke University, Durham, NC 27708, USA
[10]Joint Global Change Research Institute, Pacific Northwest National Laboratory, 5825 University Research Court, Suite 3500, College Park, MD 20740, USA

Correspondence to: William J. Collins (w.collins@reading.ac.uk)

Received: 1 June 2016 – Discussion started: 12 July 2016
Revised: 16 December 2016 – Accepted: 4 January 2017 – Published: 9 February 2017

Abstract. The Aerosol Chemistry Model Intercomparison Project (AerChemMIP) is endorsed by the Coupled-Model Intercomparison Project 6 (CMIP6) and is designed to quantify the climate and air quality impacts of aerosols and chemically reactive gases. These are specifically near-term climate forcers (NTCFs: methane, tropospheric ozone and aerosols, and their precursors), nitrous oxide and ozone-depleting halocarbons. The aim of AerChemMIP is to answer four scientific questions.

1. How have anthropogenic emissions contributed to global radiative forcing and affected regional climate over the historical period?
2. How might future policies (on climate, air quality and land use) affect the abundances of NTCFs and their climate impacts?
3. How do uncertainties in historical NTCF emissions affect radiative forcing estimates?
4. How important are climate feedbacks to natural NTCF emissions, atmospheric composition, and radiative effects?

These questions will be addressed through targeted simulations with CMIP6 climate models that include an interactive representation of tropospheric aerosols and atmospheric chemistry. These simulations build on the CMIP6 Diagnostic, Evaluation and Characterization of Klima (DECK) experiments, the CMIP6 historical simulations, and future projections performed elsewhere in CMIP6, allowing the contributions from aerosols and/or chemistry to be quantified. Specific diagnostics are requested as part of the CMIP6 data request to highlight the chemical composition of the atmosphere, to evaluate the performance of the models, and to understand differences in behaviour between them.

1 Introduction

1.1 Motivation for AerChemMIP

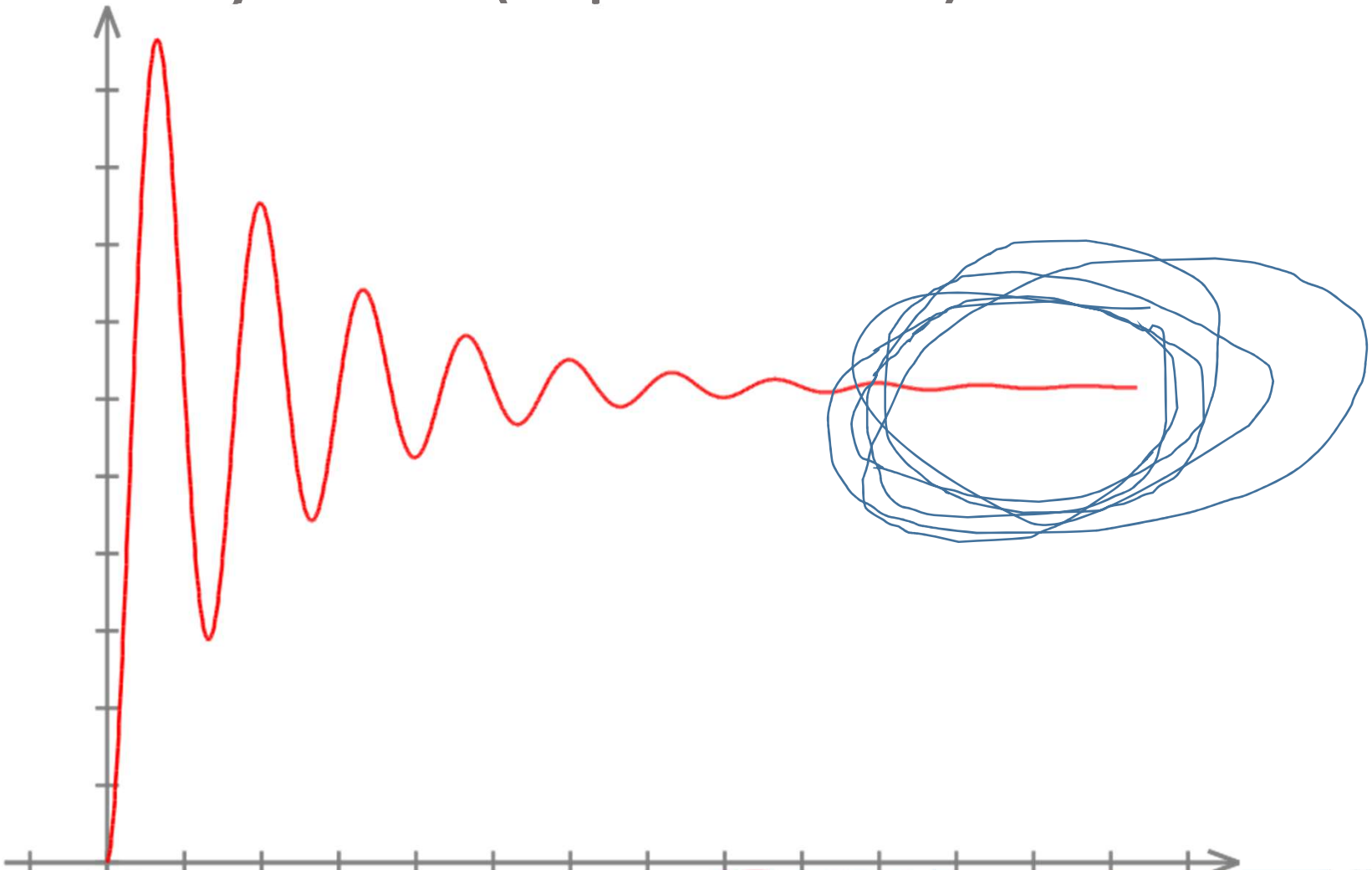
Aerosols and chemically reactive gases in the atmosphere can exert important influences on global and regional air quality and climate. Scientific questions and uncertainties regarding chemistry–climate interactions are relevant to regional-scale climate change (e.g. tropospheric ozone and

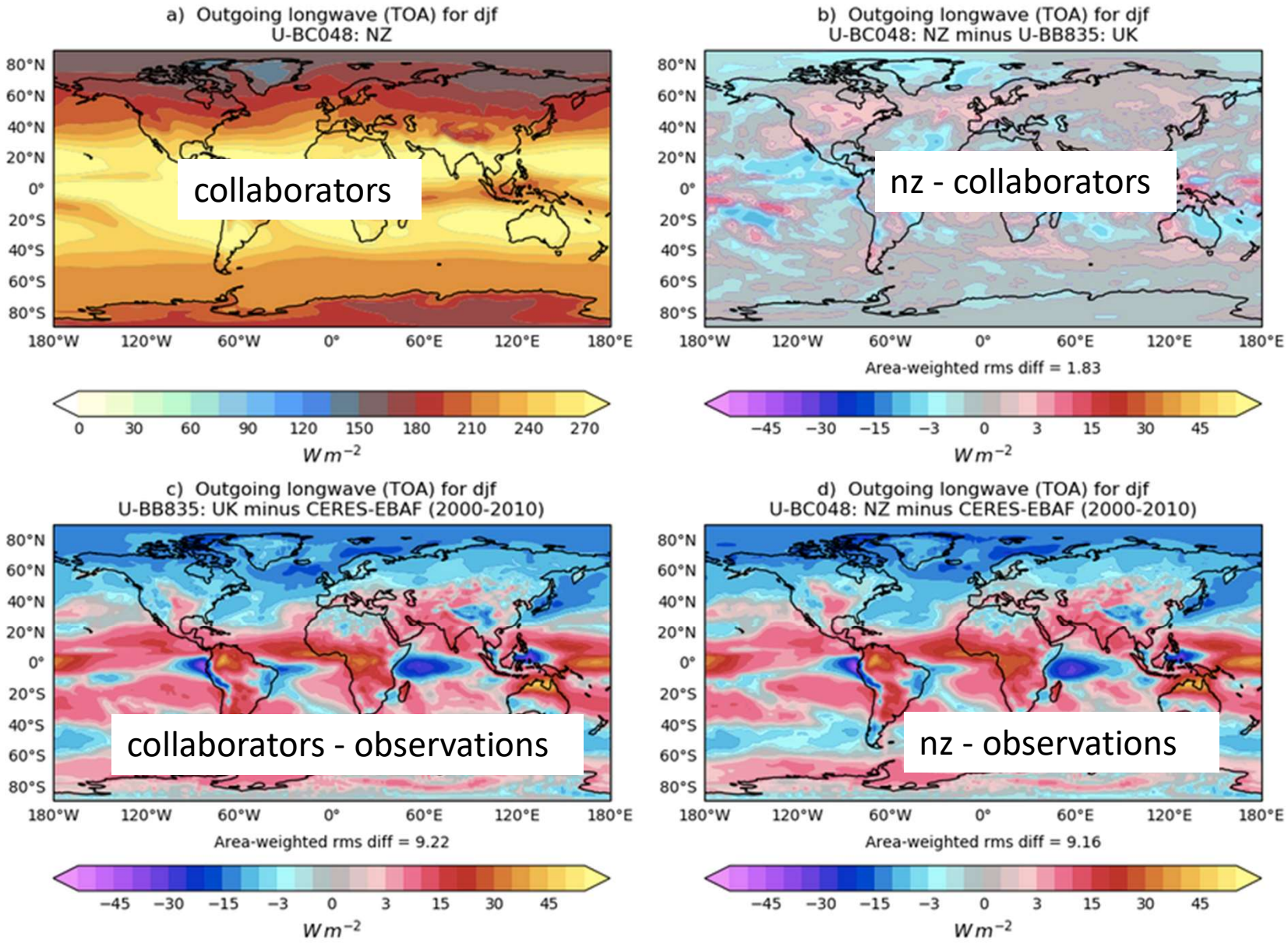
Published by Copernicus Publications on behalf of the European Geosciences Union.

model validation

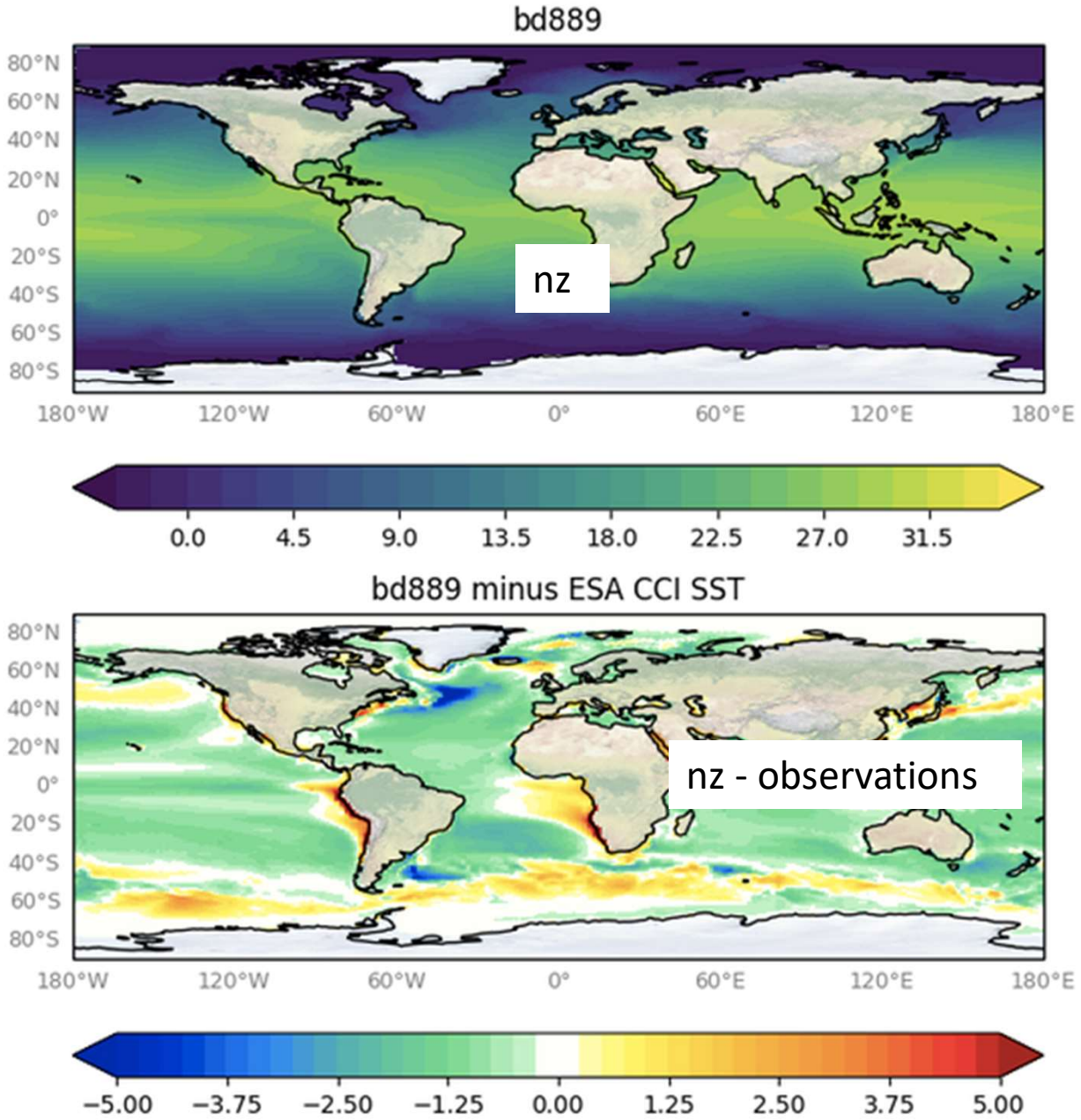
- yes we can run the models, but are they meaningful?

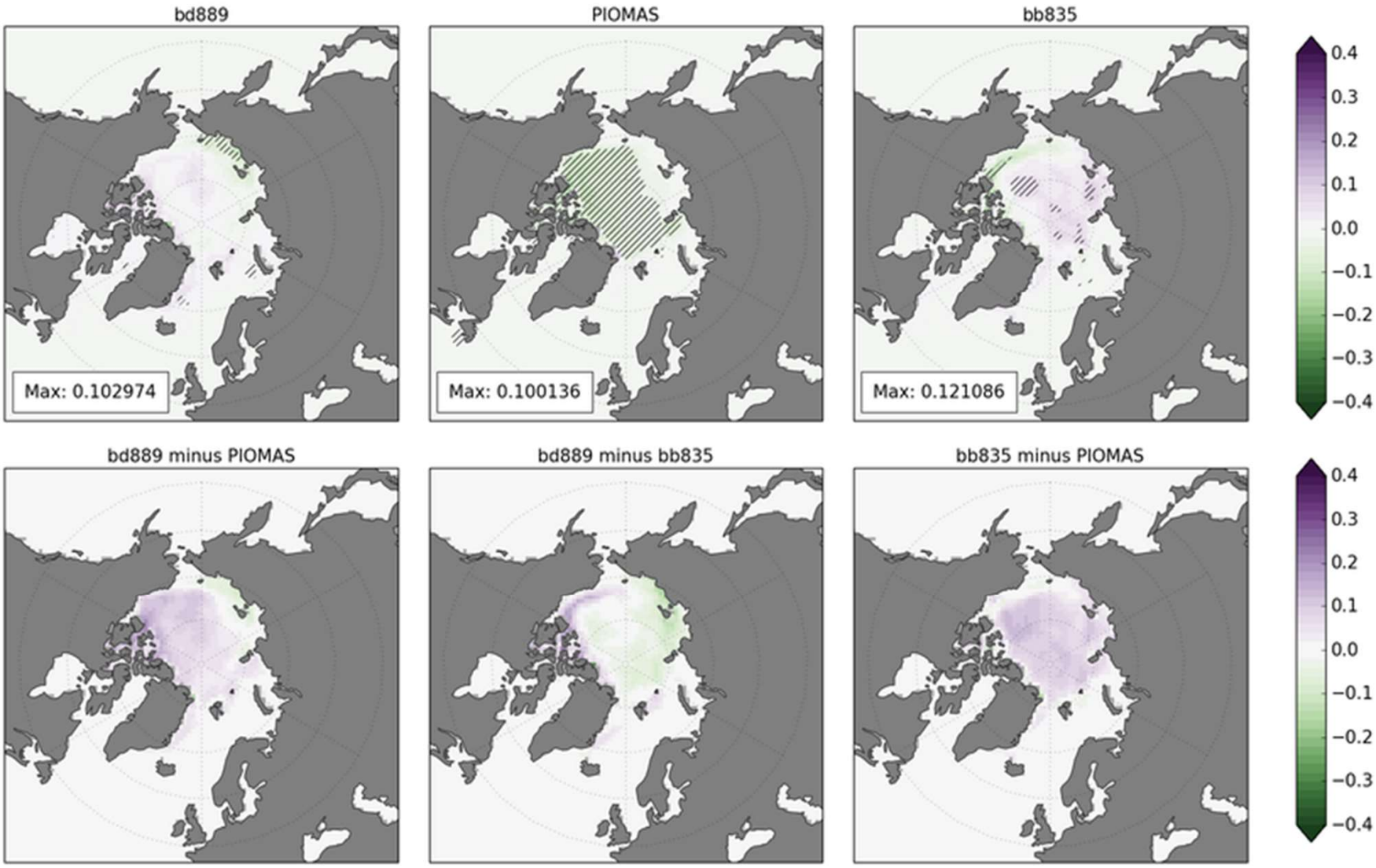
steady state (equilibrium) results





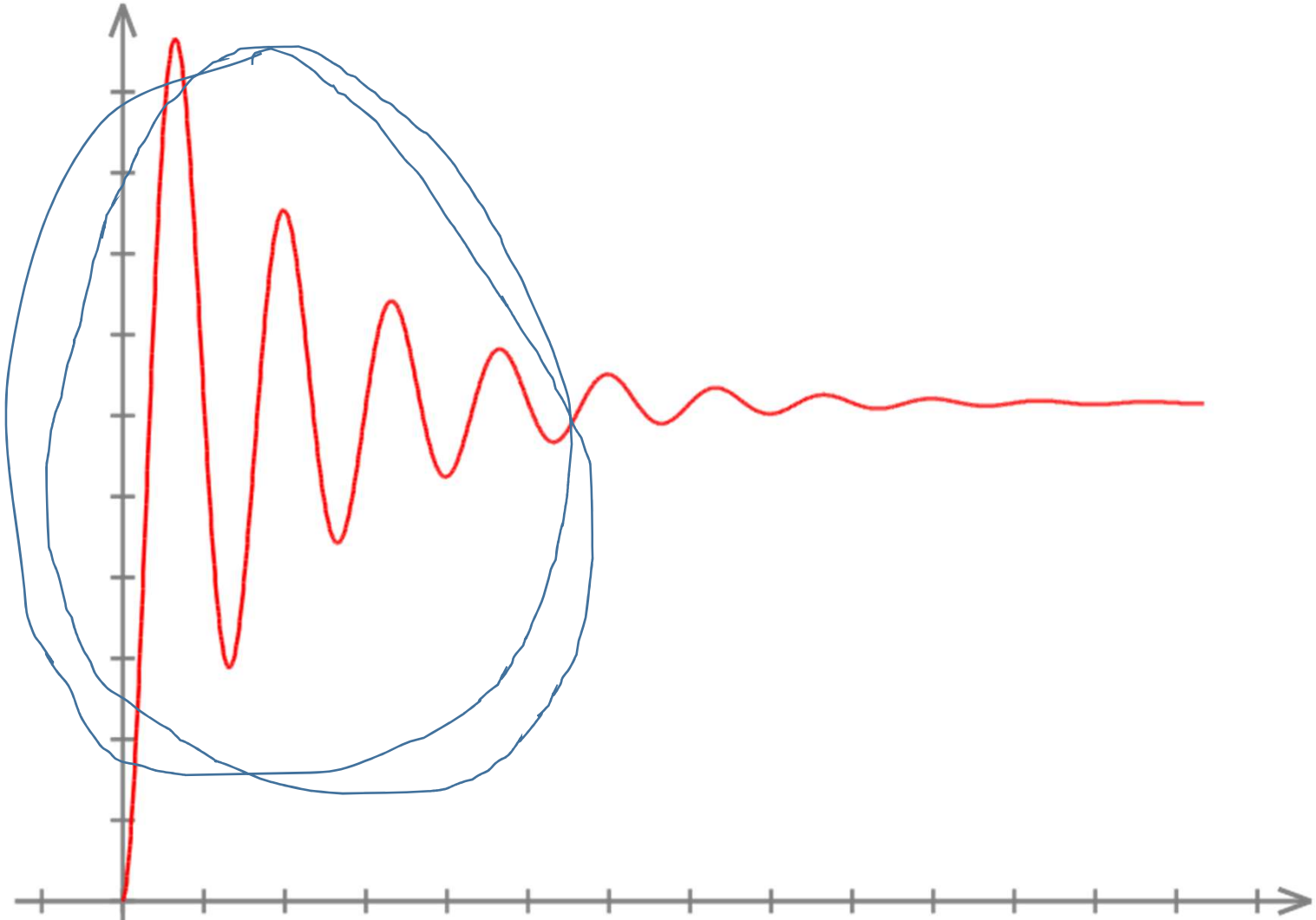
NIWA Taihoro Nukurangi · Landcare Research Manaaki Whenua · University of Otago Te Whare Wānanga o Otāgo New Zealand · Antarctica New Zealand · GNS Science Te Pū Ao · Victoria University of Wellington Te Whare Wānanga o Te Ūpoko o Te Ika a Māui · THE DEEP SOUTH · Te Kōmata o Te Tonga · National Science Challenges


bd889
80°N
60°N
40°N
20°N
0°
20°S
40°S
60°S
80°S
180°W
120°W
60°W
0°
60°E
120°E
180°E
nz
0.0
4.5
9.0
13.5
18.0
22.5
27.0
31.5
bd889 minus ESA CCI SST
nz - observations
−5.00
−3.75
−2.50
−1.25
0.00
1.25
2.50
3.75
5.00



NIWA Taihoro Nukurangi · Landcare Research Manaaki Whenua · University of Otago Te Whare Wānanga o Otāgo New Zealand · Antarctica New Zealand · GNS Science Te Pū Ao · Victoria University of Wellington Te Whare Wānanga o Te Ūpoko o Te Ika a Māui · THE DEEP SOUTH · Te Kōmata o Te Tonga · National Science Challenges

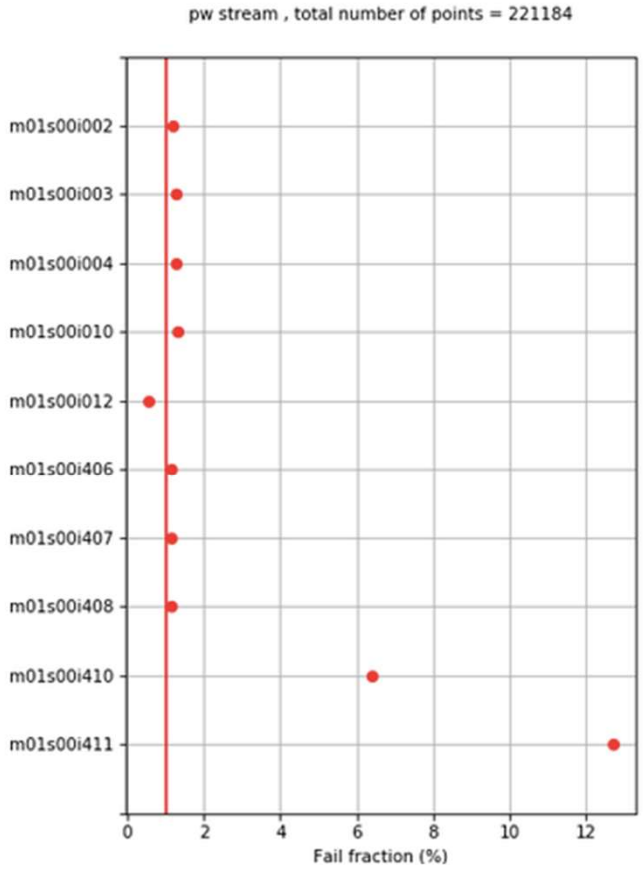
transient results

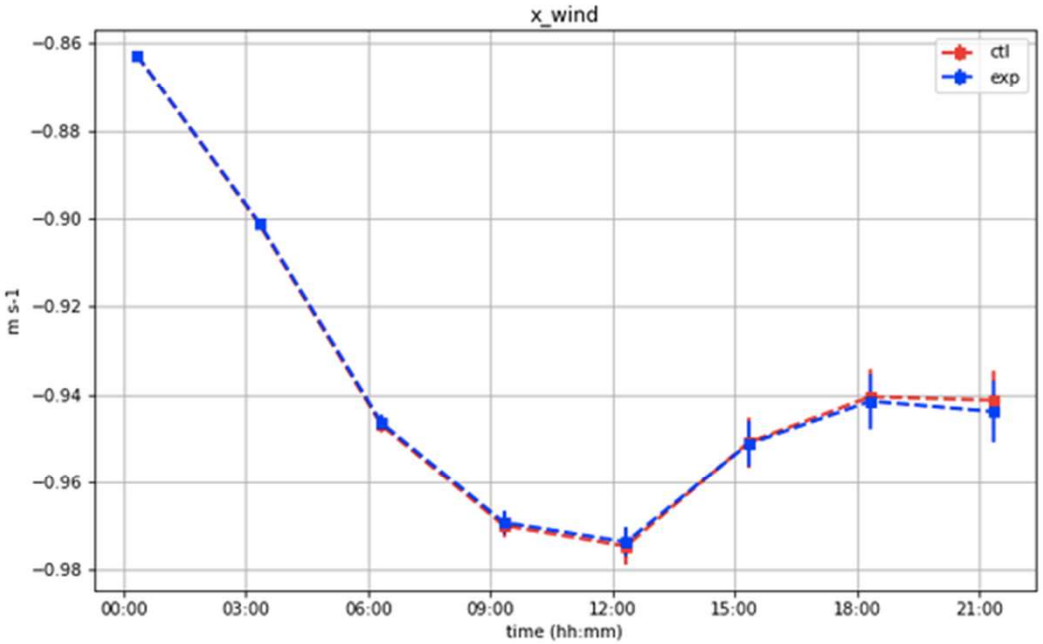


PReVIOuS: u-bc810 vs u-bd138

pw | Global | model_level_number_00 | m01s00i002 series

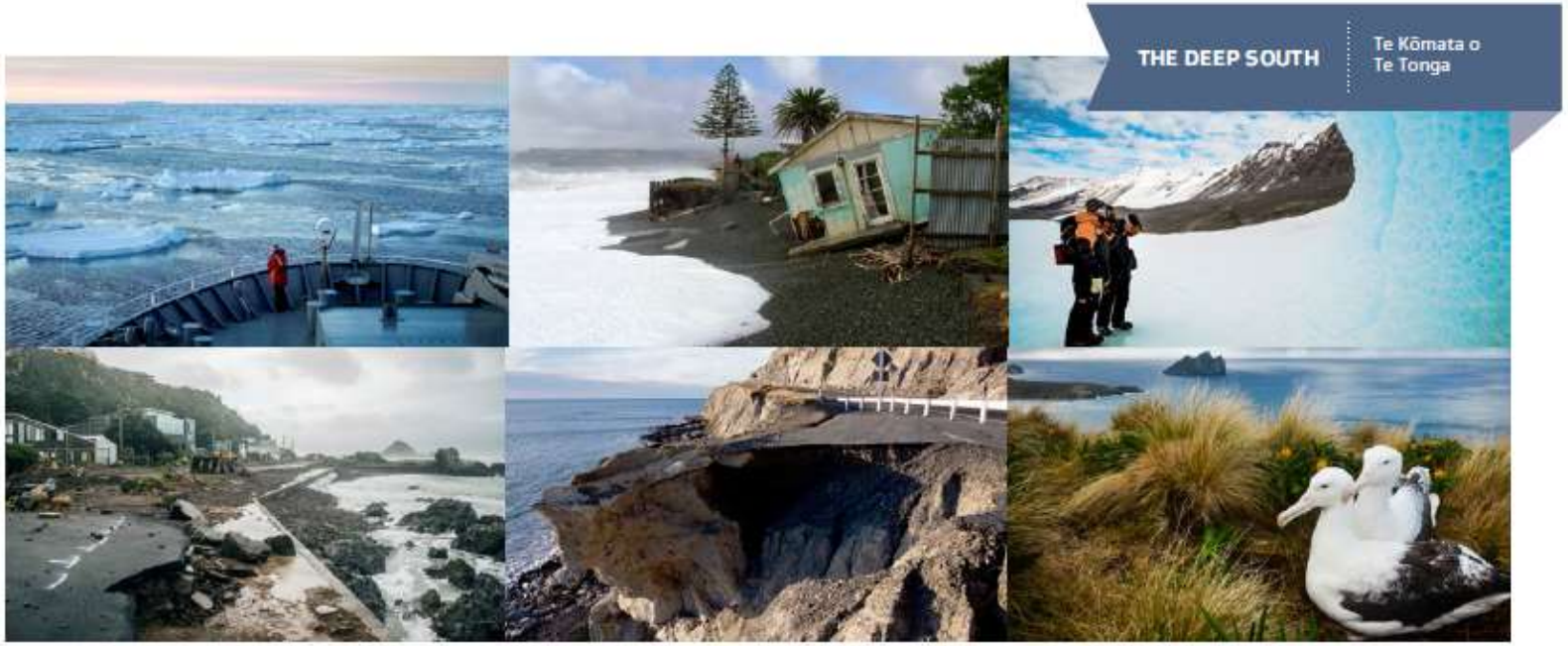
Step back | Step forward





summary

- in the earth system modelling space, we are making good use of nz's newly available compute resource!
- we are also heavily involved with earth system model validation, also using the new nesi platforms
- our results are in agreement with our international collaborators; an essential first step in porting meteorological models to new platforms
- we will be running simulations as part of the next intergovernmental panel on climate change assessment report



NeSI
New Zealand eScience Infrastructure

Thank you

@jonnyhtw

Met Office

NIWA Taihoro Nukurangi | Landcare Research Manaaki Whenua | University of Otago Te Whare Wānanga o Otāgo New Zealand | Antarctica New Zealand | GNS Science Te Pū Ao | Victoria University of Wellington | THE DEEP SOUTH Te Kōmata o Te Tonga | National Science Challenges