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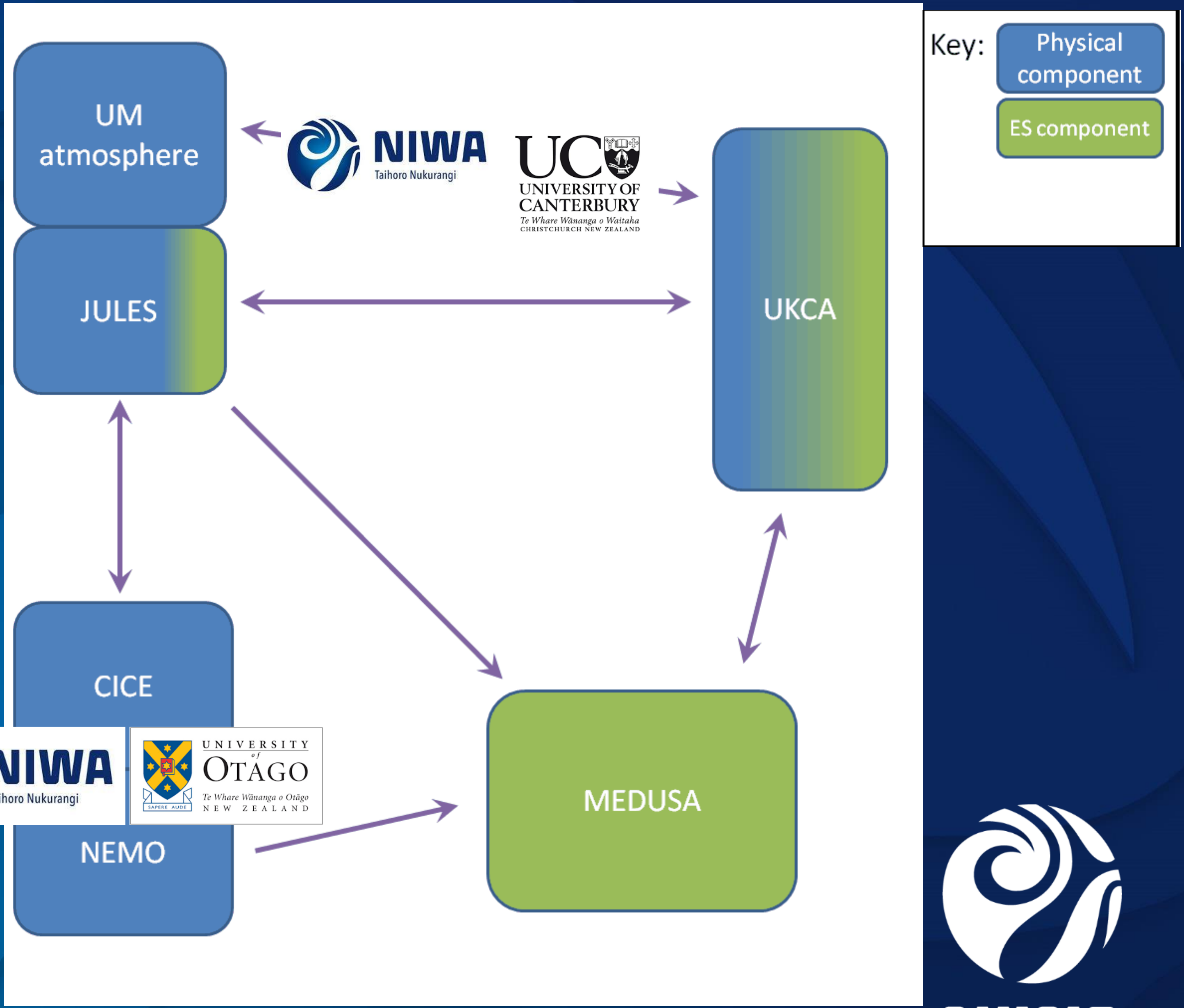
Taihoro Nukurangi

14th February 2020 - Earth system modelling in New Zealand – turning big data in big science

Climate, Freshwater & Ocean Science

UKESM



In this talk I will be concentrating on:

1. Global future climate projection scenario modelling.
2. Aerosol chemistry modelling as part of the next IPCC report.

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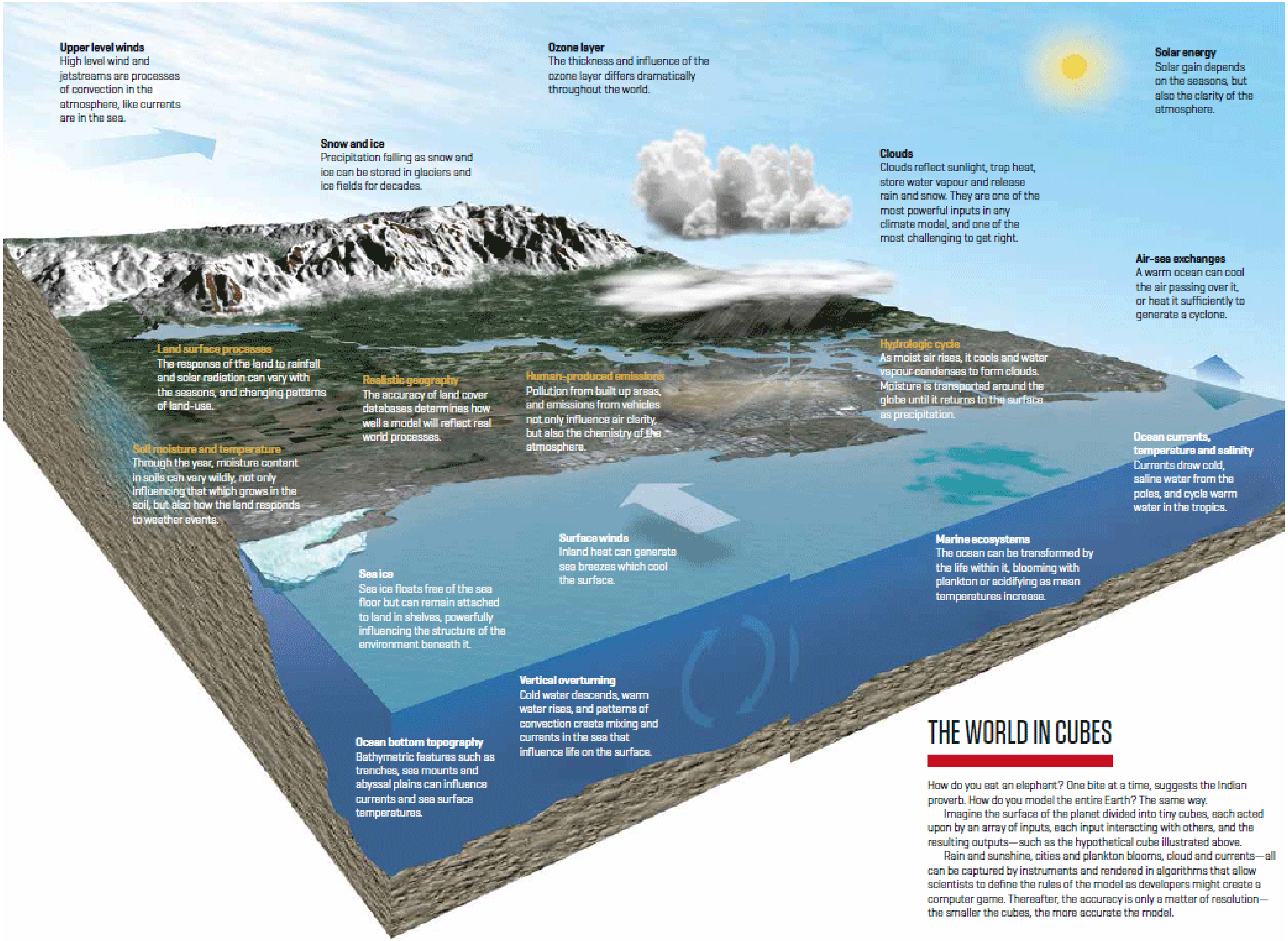

THE WORLD IN CUBES

How do you eat an elephant? One bite at a time, suggests the Indian proverb. How do you model the entire Earth? The same way.

Imagine the surface of the planet divided into tiny cubes, each acted upon by an array of inputs, each input interacting with others, and the resulting outputs—such as the hypothetical cube illustrated above.

Rain and sunshine, cities and plankton blooms, cloud and currents—all can be captured by instruments and rendered in algorithms that allow scientists to define the rules of the model as developers might create a computer game. Thereafter, the accuracy is only a matter of resolution—the smaller the cubes, the more accurate the model.

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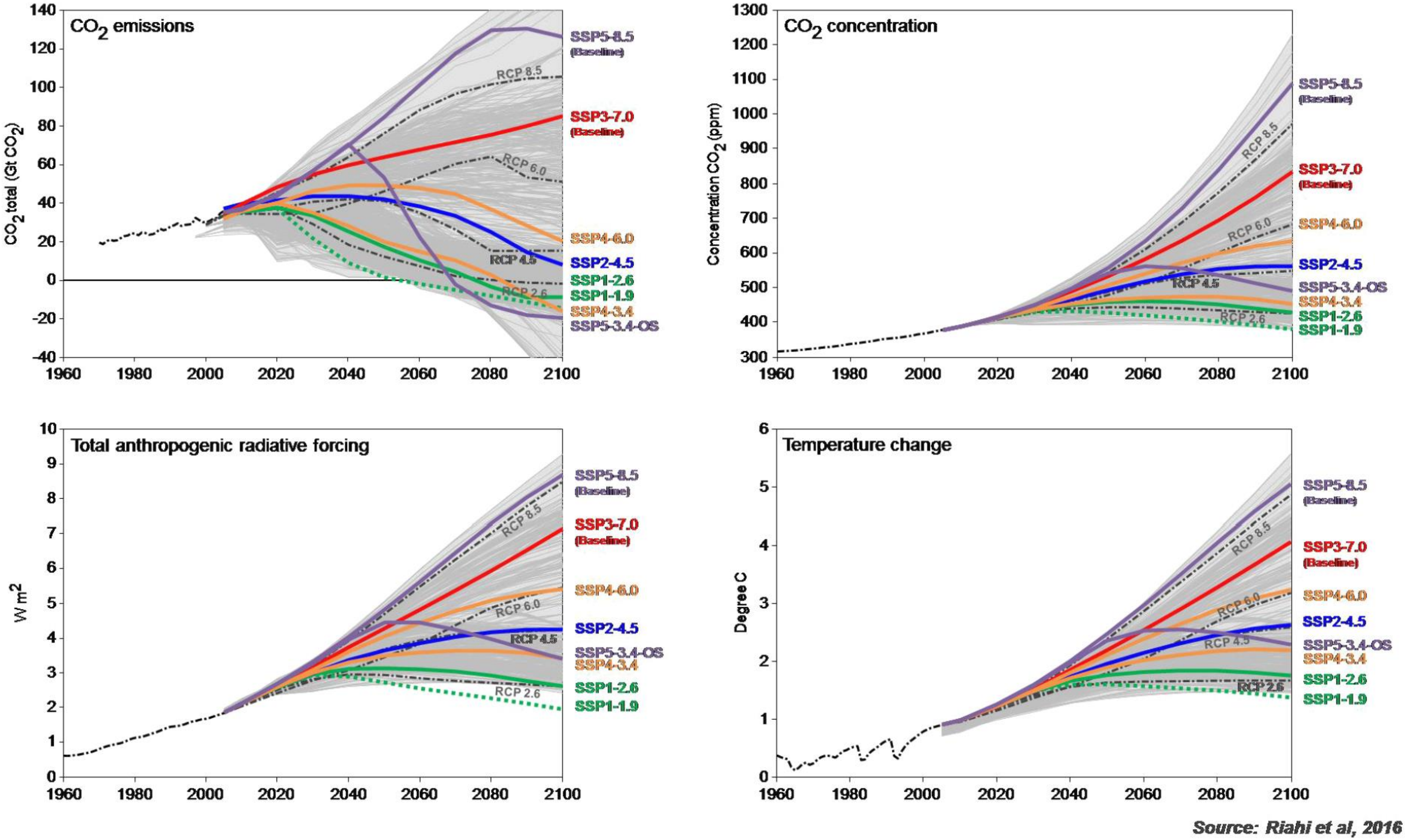

Figure 3. CO_2 emissions **(a)**, concentrations **(b)**, anthropogenic radiative forcing **(c)**, and global mean temperature **(d)** for the 21st century scenarios in the ScenarioMIP design, from Riahi et al. (2016). Concentration, forcing, and temperature outcomes are calculated with a simple climate model (MAGICC version 6.8.01 BETA; Meinshausen et al., 2011a, b). Temperature outcomes include natural forcing in the historical period; projections assume zero volcanic forcing and maintain 11-year solar forcing cycles, consistent with the CMIP5 approach (Meinshausen et al., 2011c). Gray areas represent the range of scenarios in the scenarios database for the IPCC Fifth Assessment Report (Clarke et al., 2014).

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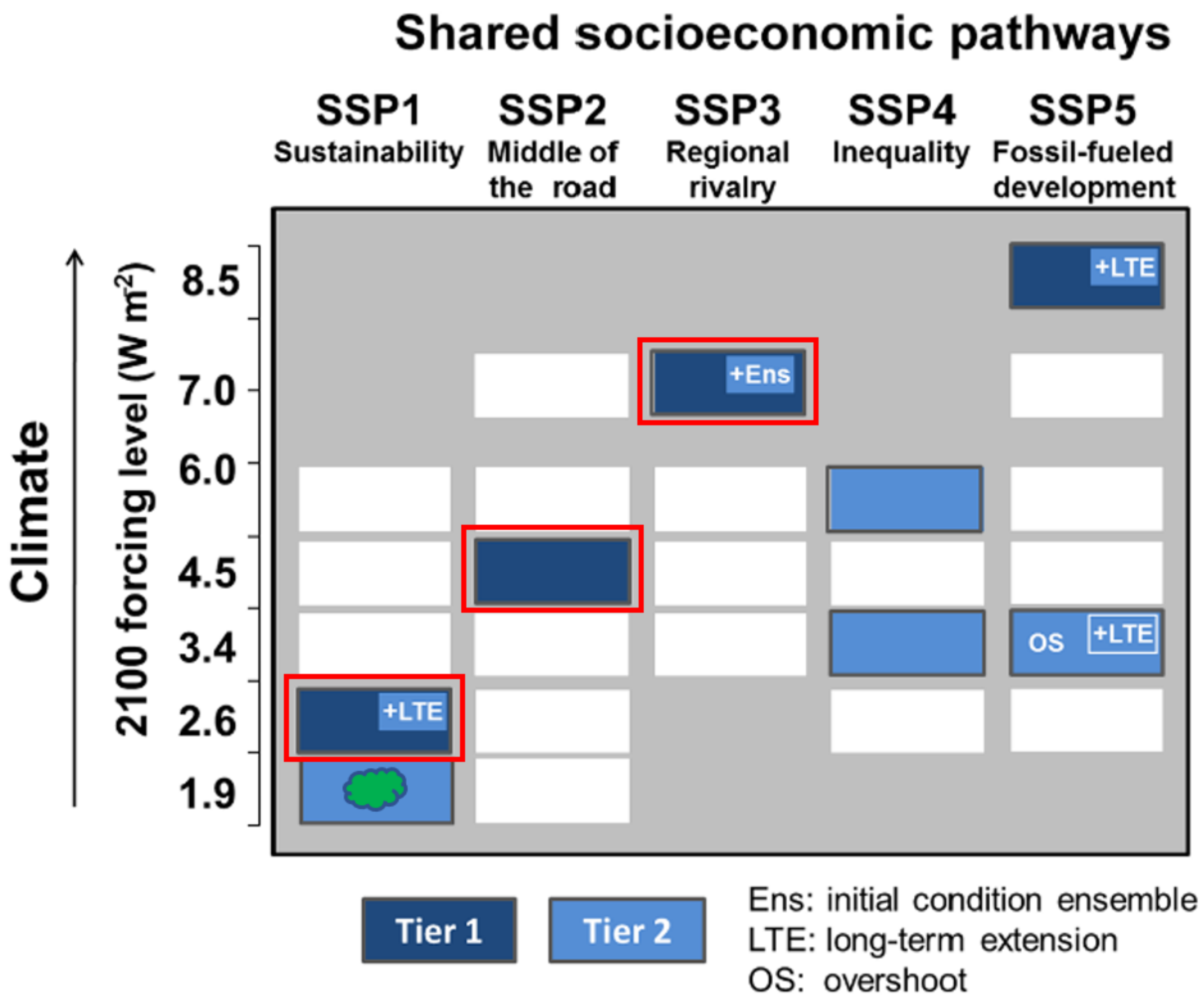
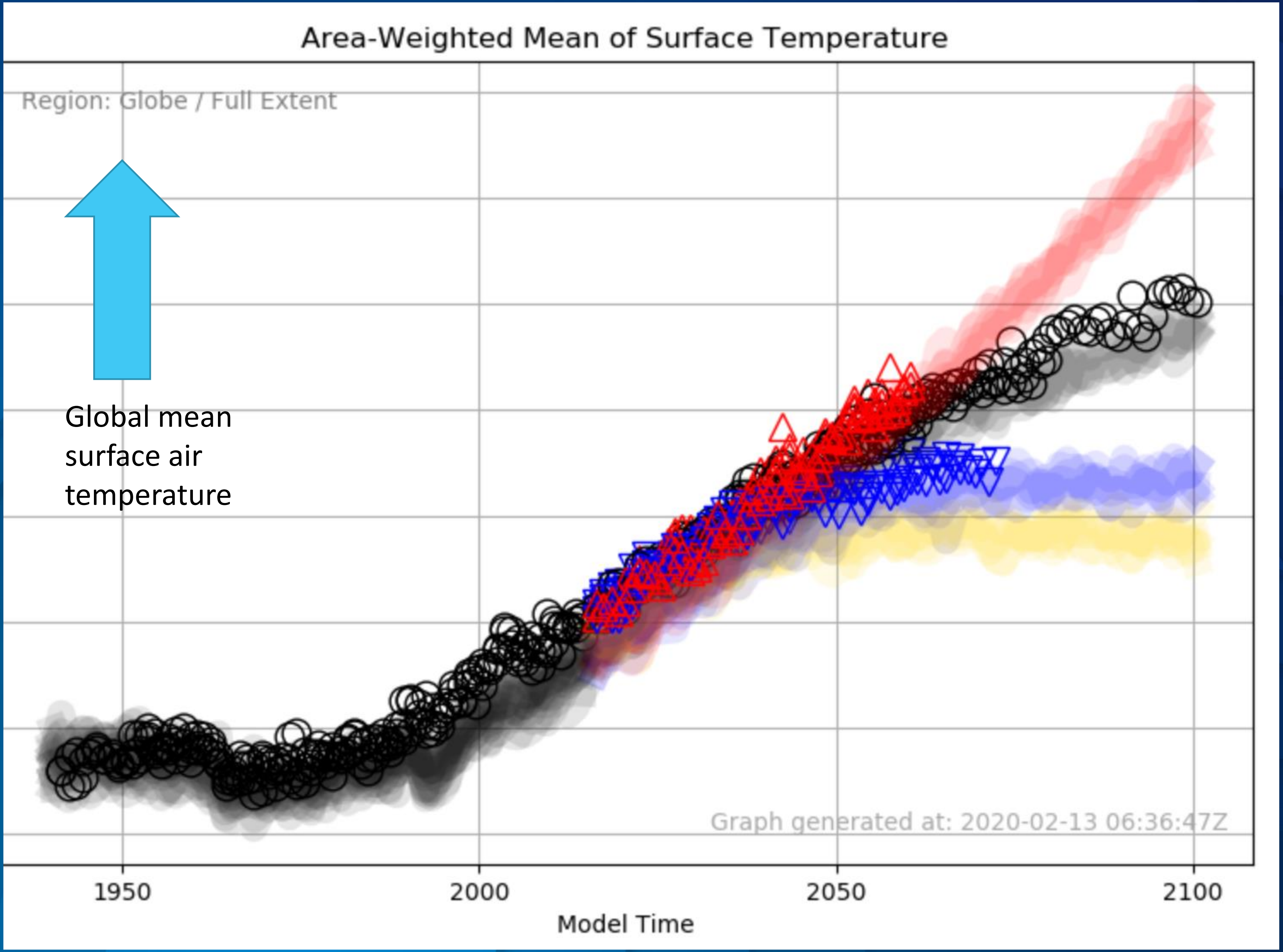


Figure 1: SSP-radiative forcing matrix from O'Neill et al. (2016). The red boxes indicate our recommendations as described in the text. The green cloud indicates a possible fourth scenario, which would depend on further funding.

At the moment we're running three scenarios but we want to do more

$$$$$$$$$$$$$$$$$$$$

Each simulation costs about $30k in NeSI core hours alone.



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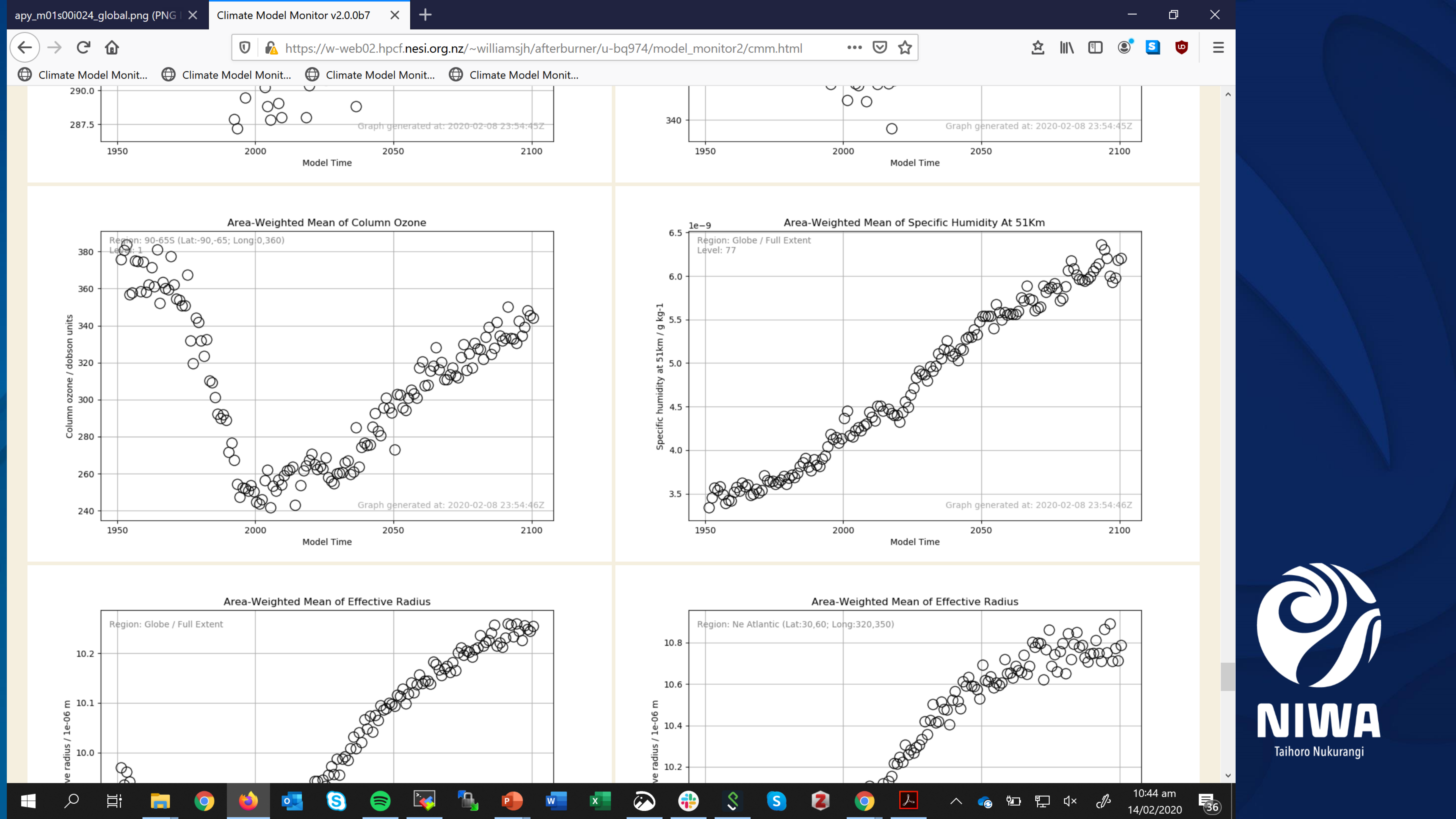

Climate Model Monitor v2.0.0b7
https://w-web02.hpcf.nesi.org.nz/~williamsjh/afterburner/u-bq974/model_monitor2/cmm.html
Area-Weighted Mean of Column Ozone
Region: 90-65S (Lat:-90,-65; Long:0,360)
Level: 1
Column ozone / dobson units
Model Time
Graph generated at: 2020-02-08 23:54:46Z
Area-Weighted Mean of Specific Humidity At 51Km
Region: Globe / Full Extent
Level: 77
Specific humidity at 51km / g kg-1
Model Time
Graph generated at: 2020-02-08 23:54:46Z
Area-Weighted Mean of Effective Radius
Region: Globe / Full Extent
Area-Weighted Mean of Effective Radius
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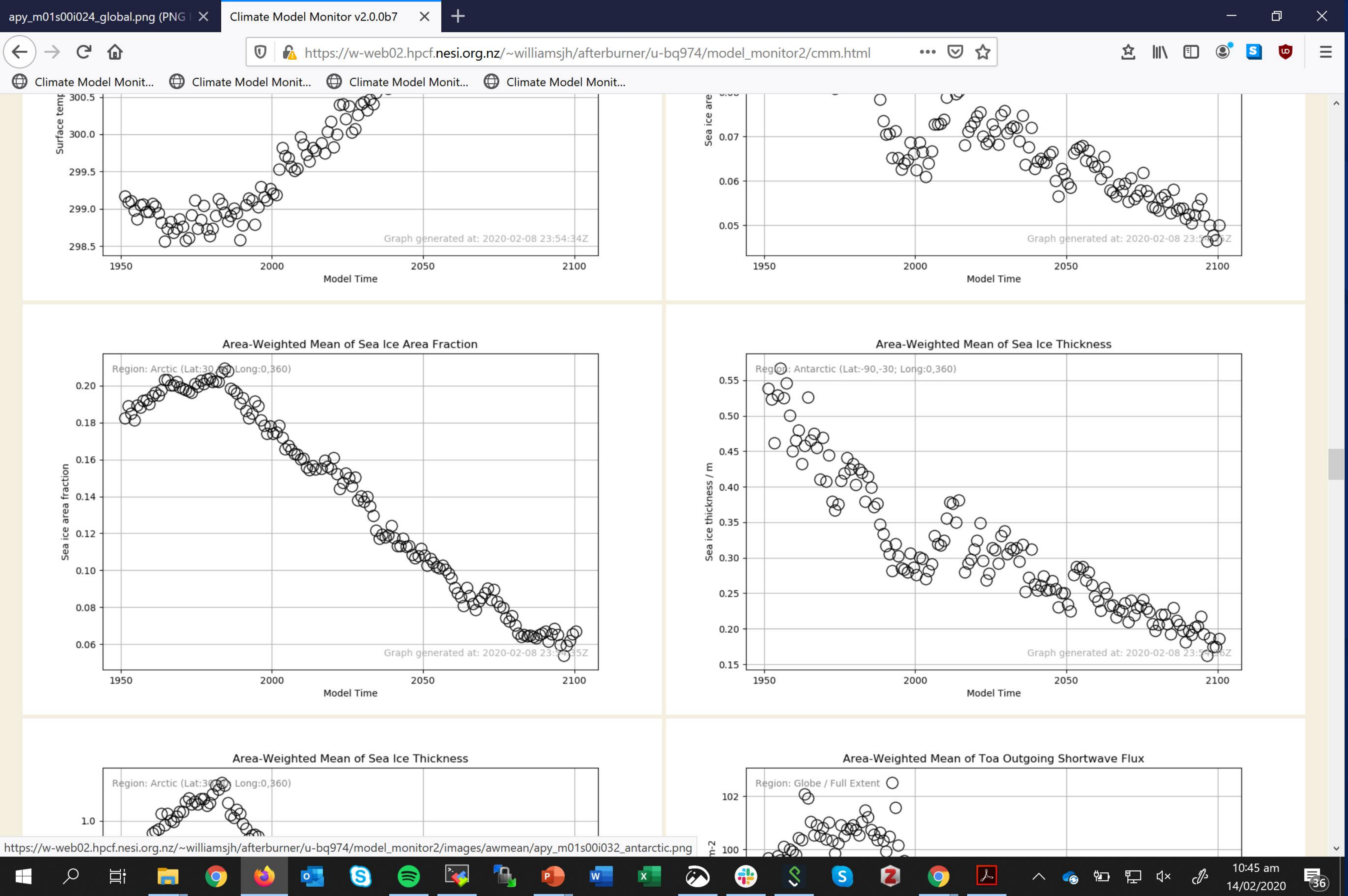

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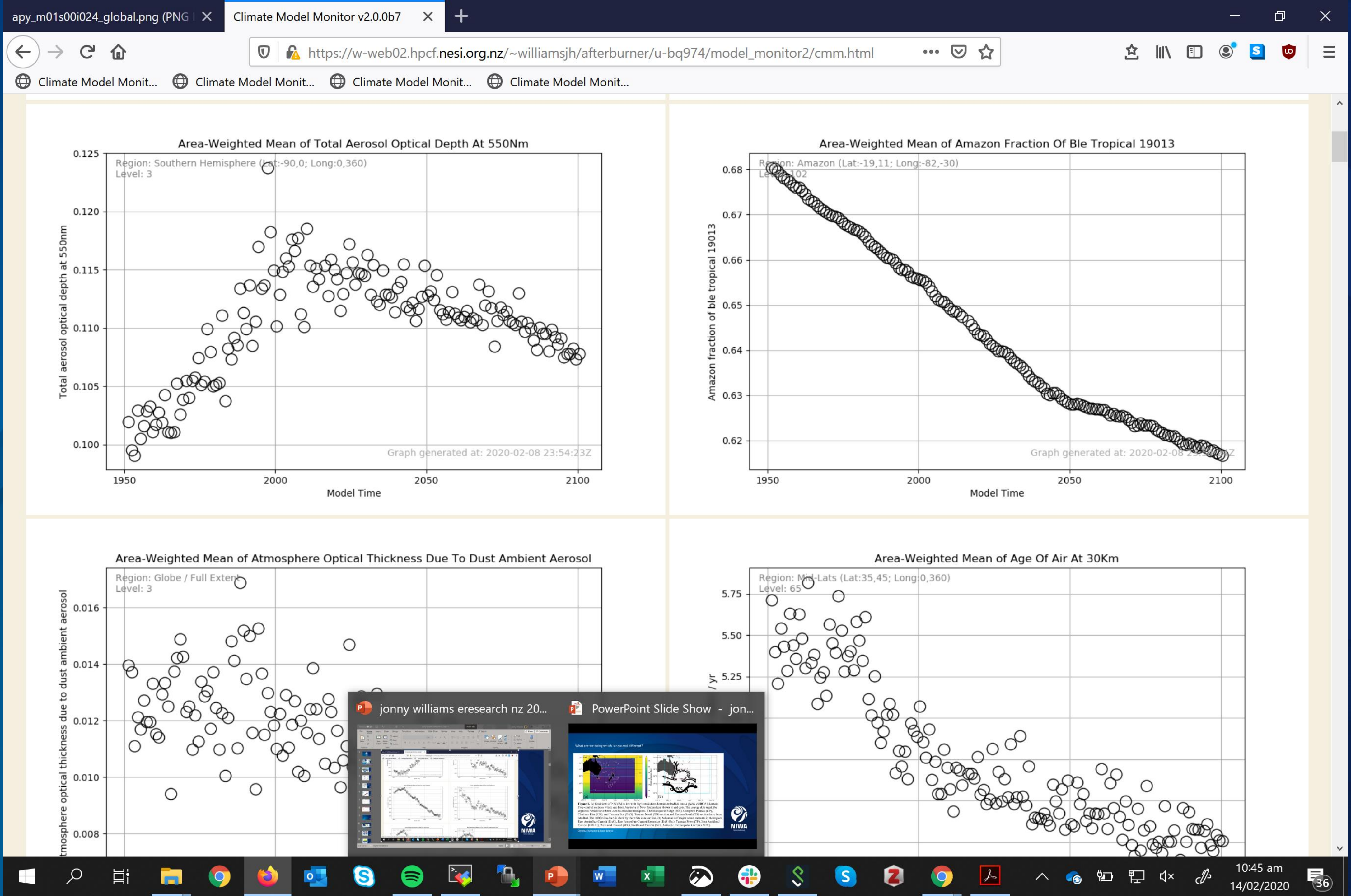

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What are we doing which is new and different?

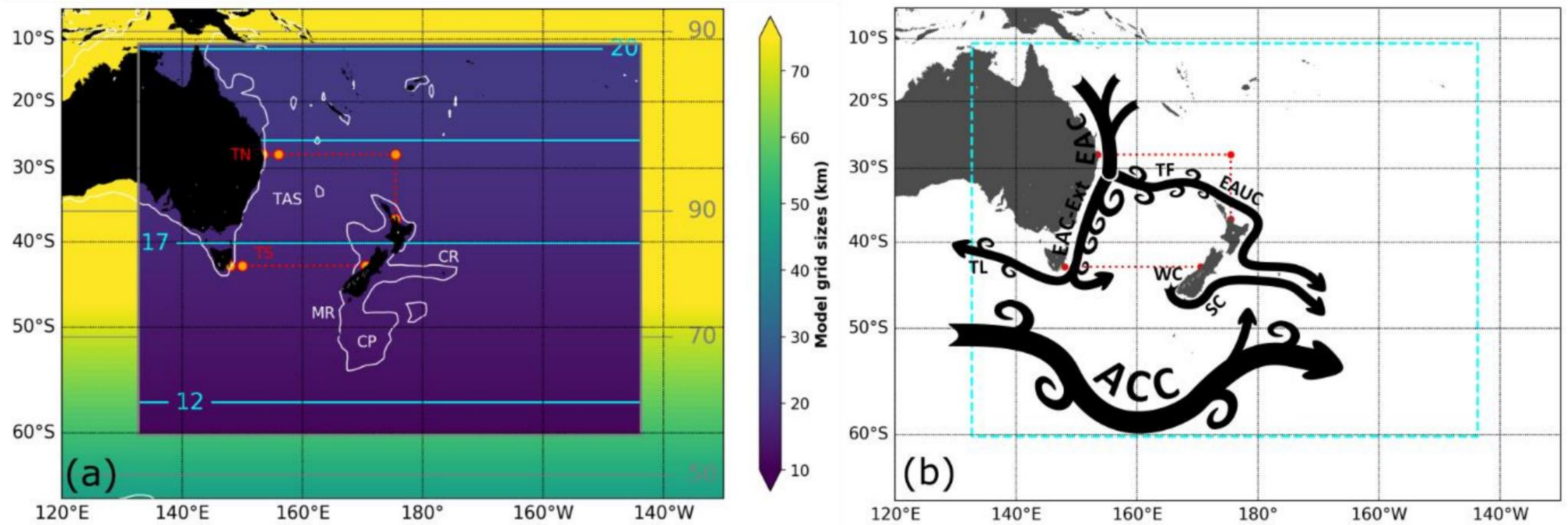


Figure 1. (a) Grid sizes of NZESM in km with high-resolution domain embedded into a global eORCA1 domain. Two control sections which run from Australia to New Zealand are shown in red dots. The orange dots mark the segments which have been used to calculate transports. The Macquarie Ridge (MR), Campbell Plateau (CP), Chatham Rise (CR), and Tasman Sea (TAS), Tasman North (TN) section and Tasman South (TS) section have been labelled. The 1000m iso-bath is show by the white contour line. (b) Schematic of major ocean currents in the region: East Australian Current (EAC), East Australian Current Extension (EAC-Ext), Tasman Front (TF), East Auckland Current (EAUC), Westland Current (WC), Southland Current (SC), Antarctic Circumpolar Current (ACC).

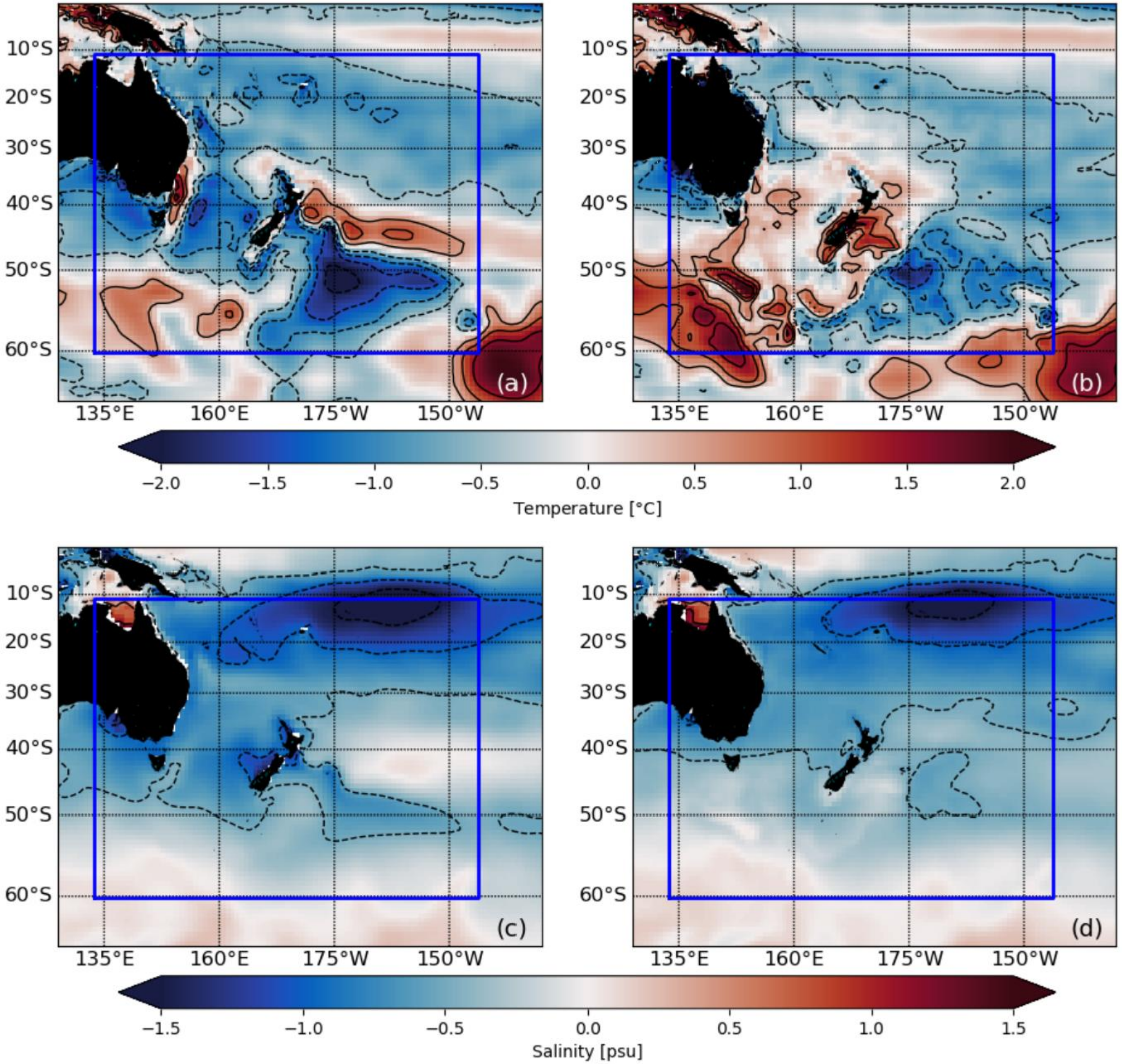
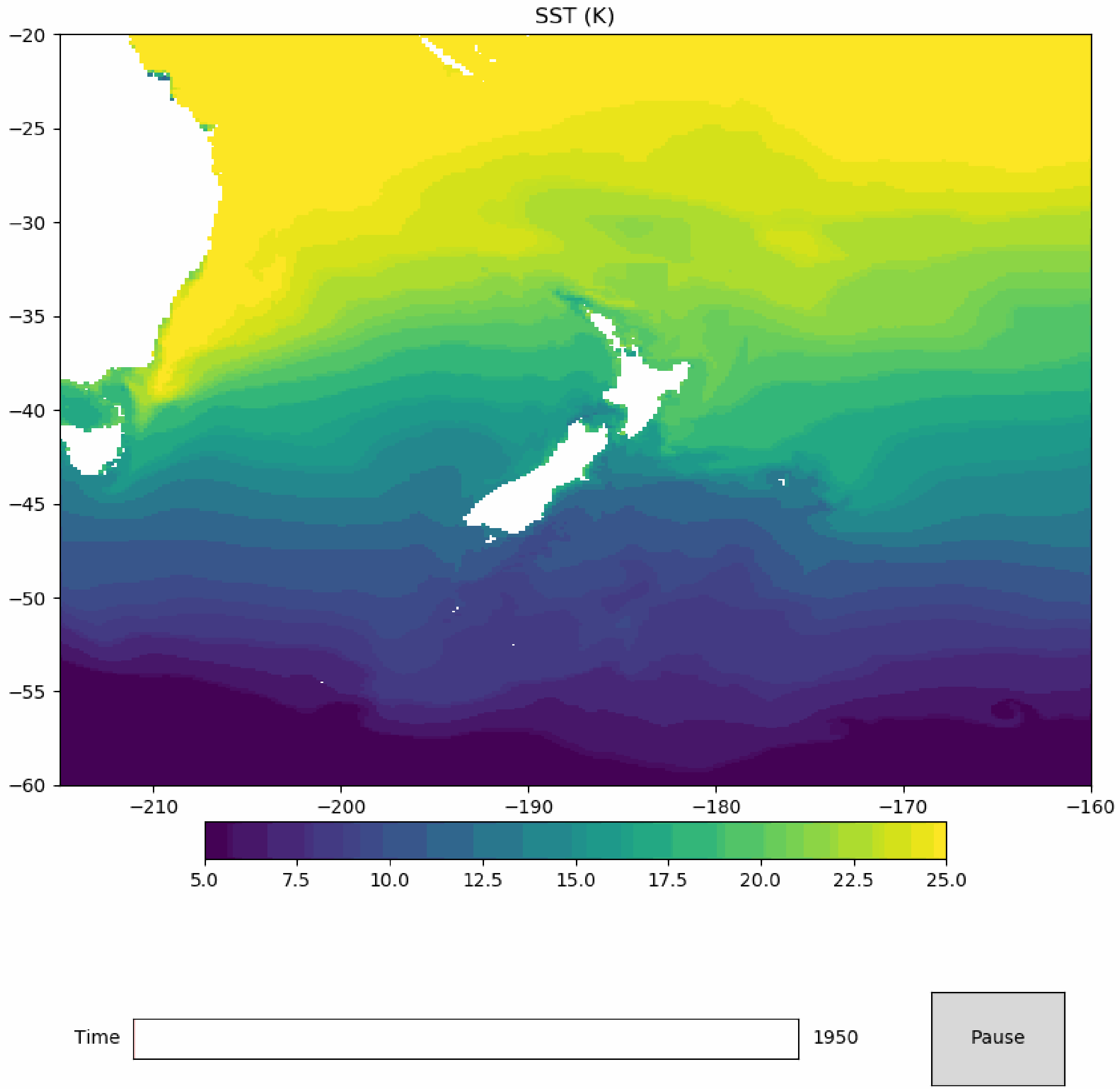


Figure 8: Surface model biases 1995-2014, compared to EN4. (a) SST UKESM, (b) SST NZESM, (c) SSS UKESM and (d) SSS NZESM. The dark-red box marks the region of the high-resolution nest. Contour interval for temperature is 0.5°C and 0.5psu for salinity.


SST (K)
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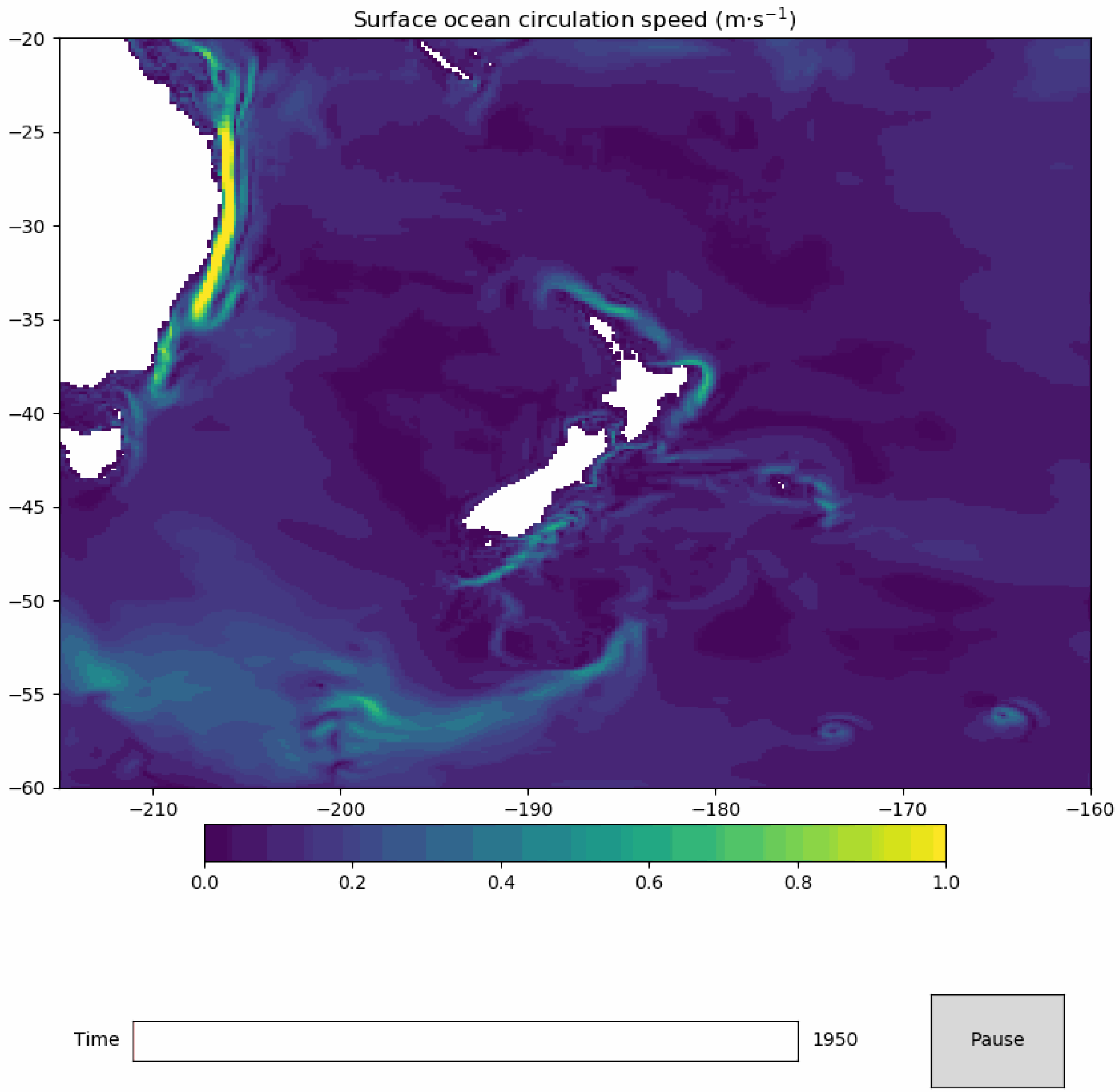

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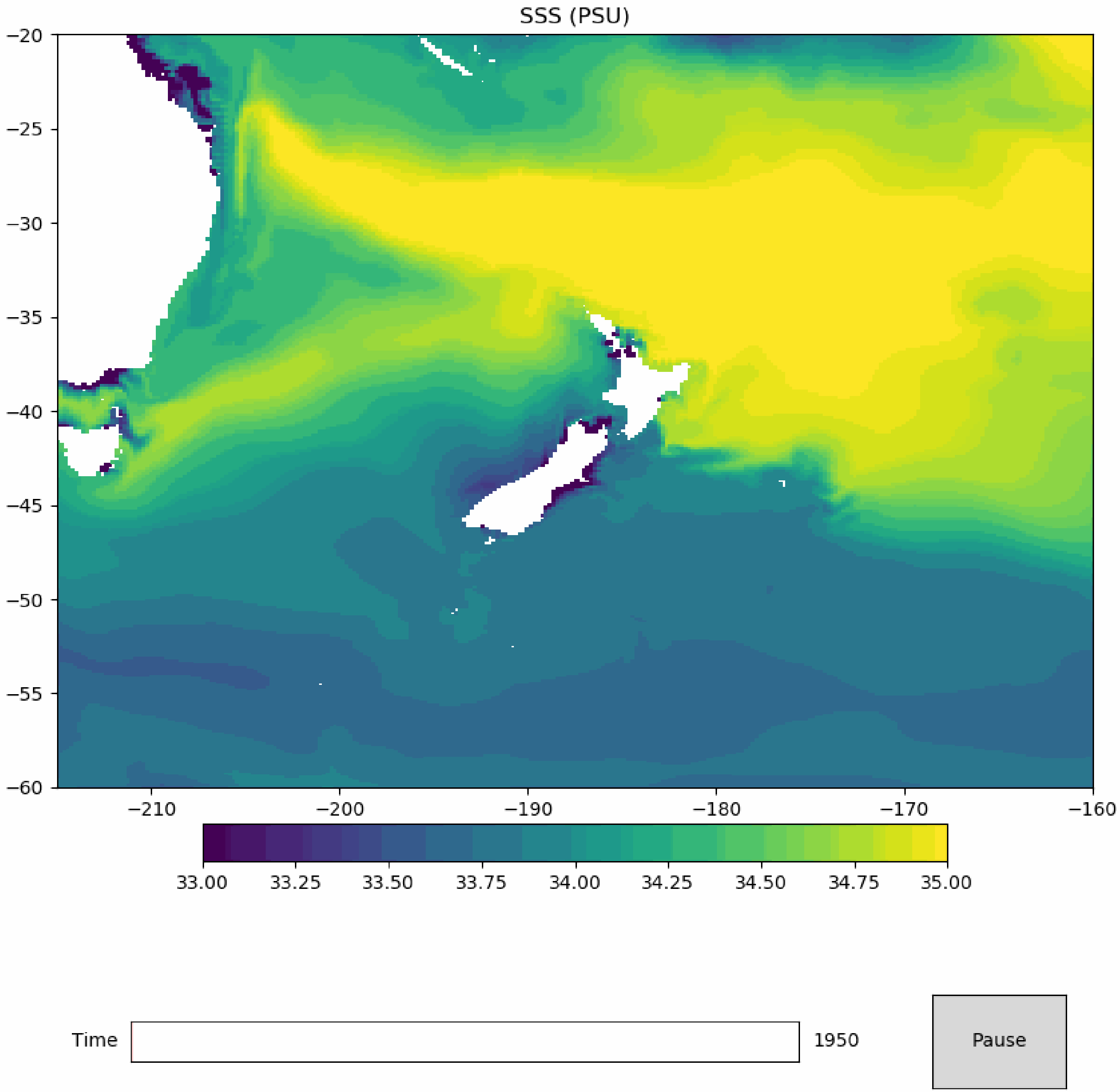
SSS (PSU)
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Time
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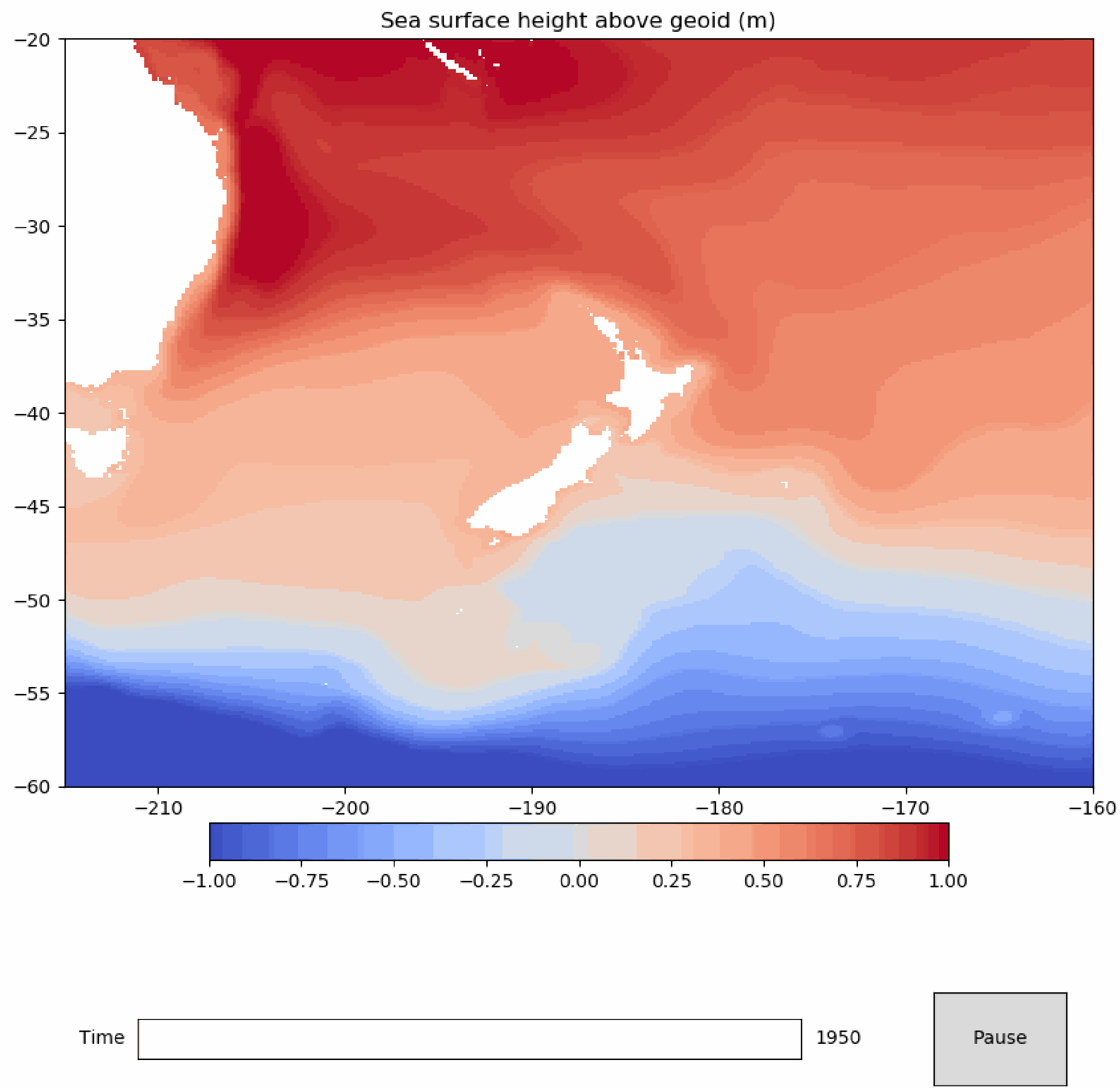

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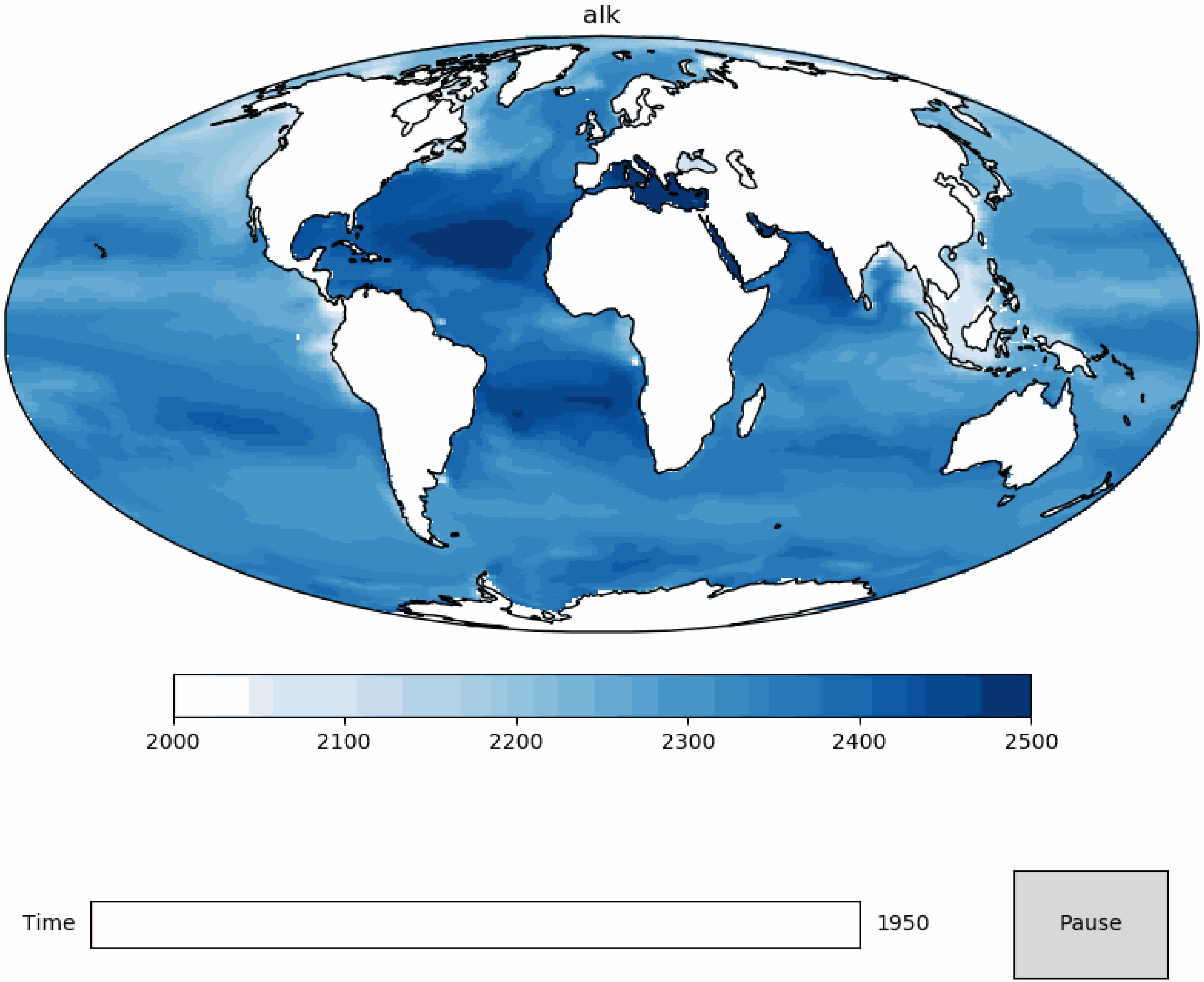

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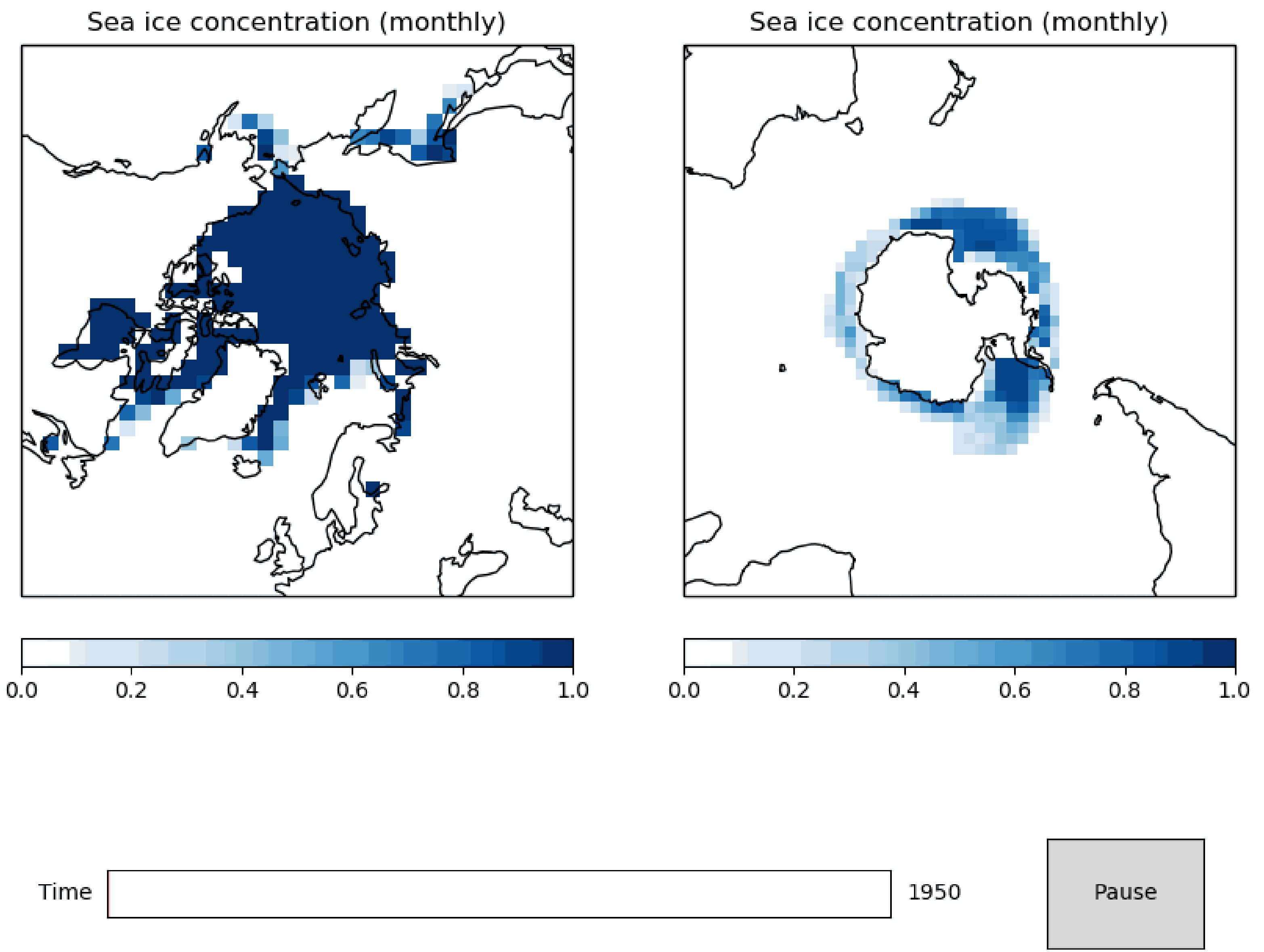

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Geosci. Model Dev., 10, 585–607, 2017
www.geosci-model-dev.net/10/585/2017/
doi:10.5194/gmd-10-585-2017

Geoscientific Model Development
Open Access
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]

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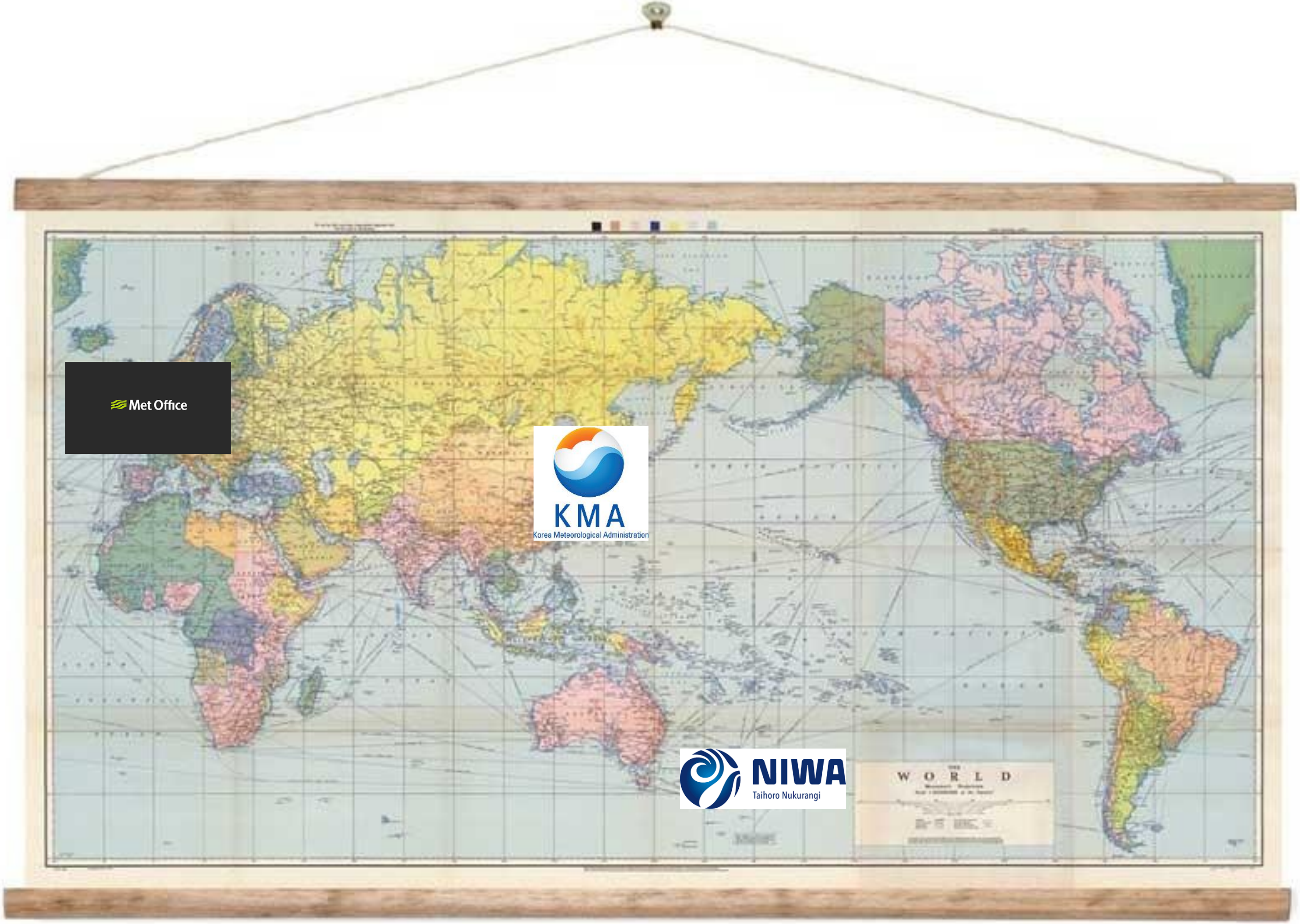
Correspondence to: William J. Collins (w.collins@reading.ac.uk)

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



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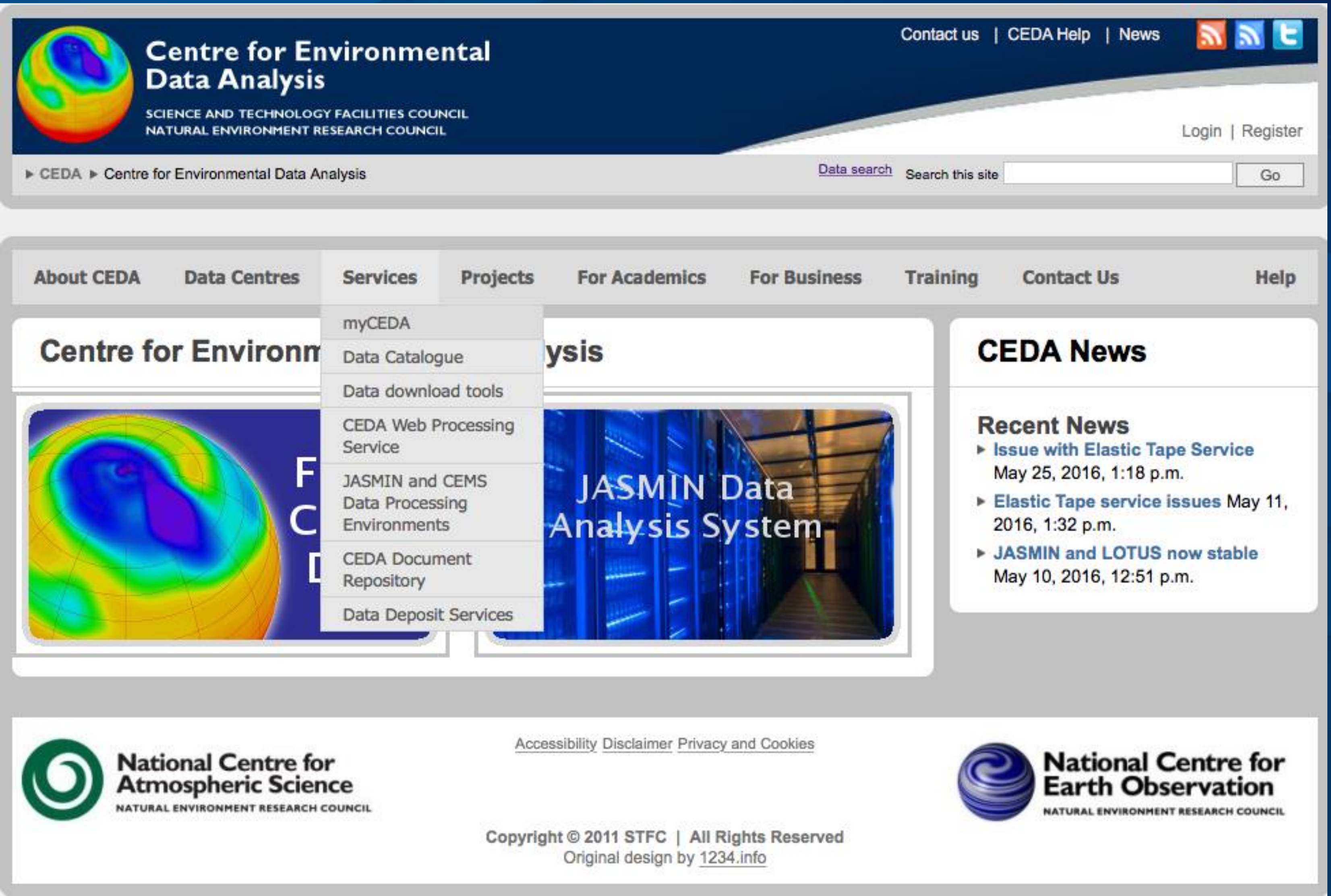
- We need to shift (regularly and reliably) ~10TB to the JASMIN platform.
- Doing this using rsync was simply too slow to be a viable solution.



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NeSI launches national scientific Data Transfer platform

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Level 10, 70 Symonds St,
Auckland, New Zealand
Contact

NeSI's national Data Transfer platform — operated in partnership with Globus, REANNZ and multiple NZ institutions — is now available for users to move data to and from NeSI quickly and easily.

Since 2014, NeSI has partnered with Globus to offer a high-speed option for transferring large and distributed data nationally and internationally. Over that time, NeSI has been working with New Zealand research institutions to facilitate data transfer to and from existing and new Globus Data Transfer Nodes (DTNs).

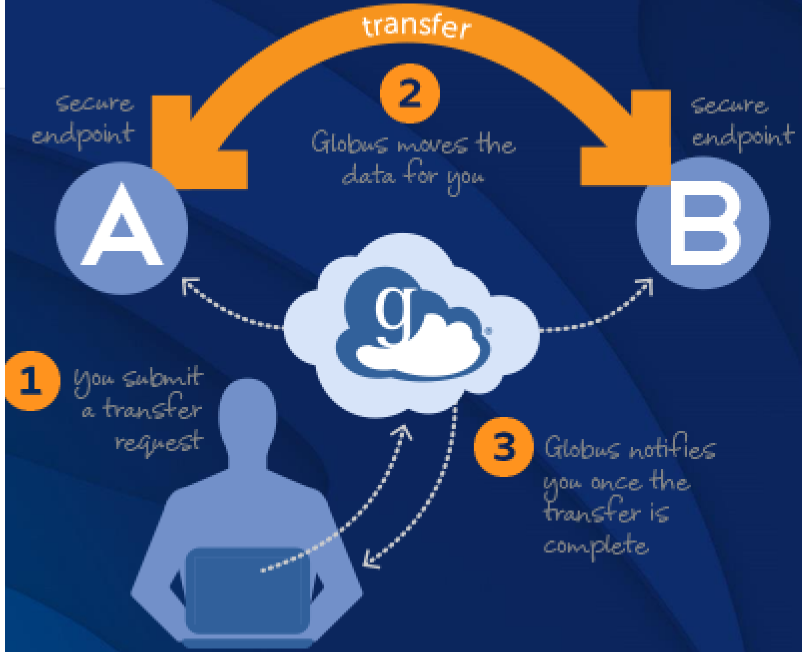
Last year, NeSI reviewed its data transfer offering and has now implemented a new and improved service designed for use with NeSI's national HPC platforms.

NeSI has plumbed Globus DTNs directly into its new infrastructure platform, enabling access to data on both Māui and Mahuika HPC systems hosted at NIWA, as well as at data storage and research facilities at AgResearch, the University of Auckland, and the University of Otago.

These DTNs act as an interface between Globus' worldwide network of other endpoints.

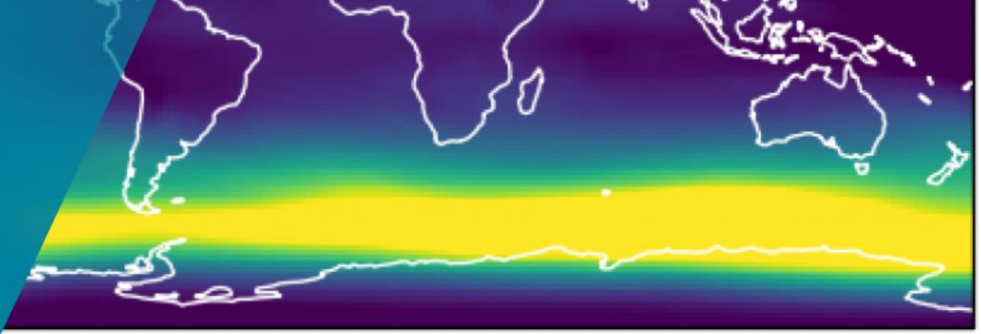
"Bringing this new platform online has truly been a collaborative effort, involving collaborations with international partner Globus, national advanced network provider REANNZ, and several innovative research institutions across the country," says Nick Jones, Director of NeSI.

It didn't take long for the platform's performance to be tested. In May 2018, tens of millions of files and hundreds of terabytes of data were moved over REANNZ's network as the first wave of NeSI users' research data was migrated from the Pan cluster at the University of Auckland to the new Mahuika supercomputer in Wellington, hosted at NIWA. It was a record-setting moment for REANNZ and a testament to the enhanced capabilities and performance of NeSI's new data transfer platform.



Climate modellers transfer 11 terabytes in 24 hours

NIWA climate scientist Dr Jonny Williams sent a massive 11 terabytes of data to research counterparts in the UK.



Caption: Dr Jonny Williams

When NIWA climate scientist Dr Jonny Williams sent a massive 11 terabytes of data to research counterparts in the UK, he didn't give the size of the transfer a second thought. The REANNZ advanced network seamlessly delivered the entire dataset within 24 hours, and without scrambling or dropping data.

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w-clim01

Terminal Sessions View X server Tools Games Settings Macros Help

Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help X server Exit

Quick connect... 2. w-clim01

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jasmin-sci1.ceda.ac.uk|Thu Feb 13|20:58:05|~> mip-dataset-status CMIP6 /gws/nopw/j04/aerchemmip_vol1/data/u-bm459/esgf/CMIP6/AerChemMIP/NIWA/UKESM1-0-LL/histSST-1950HC/r1i1p1f2/day/vas/gn/v20200127/
Publication status for 1 MIP datasets:
Count  Dataset ID                                                        Status
================================================================================================
    1  CMIP6.AerChemMIP.NIWA.UKESM1-0-LL.histSST-1950HC.r1i1p1f2.day.vas.gn.v20200127  completed
================================================================================================
jasmin-sci1.ceda.ac.uk|Thu Feb 13|20:58:22|~>
```

```
Relative URL: ^/b/k/3/7/5/cdds
Repository Root: https://code.metoffice.gov.uk/svn/roses-u
Repository UUID: 7d42c781-efc1-4492-b88e-e6facad7bc31
Revision: 142371
Node Kind: directory
Schedule: normal
Last Changed Author: jonnywilliams
Last Changed Rev: 140301
Last Changed Date: 2019-12-01 23:16:00 +0000 (Sun, 01 Dec 2019)

jasmin-sci1.ceda.ac.uk|Wed Feb 12|01:21:
jasmin-sci1.ceda.ac.uk|Wed Feb 12|01:21:03|u-bk375>
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```
  2 #27 histSST-piN20   u-bk375
  3 #43 piClim-N20      u-bi883
  4 #44 piClim-HC       u-bi639
  5 #47 piClim-SO2      u-bj009
  6 #48 piClim-OC       u-bi976
~
niwa-aerchemmip-runs                         3,1          Bot
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w-clim01.maui.niwa.co.nz|Thu Feb 13|20:57:23|L242>
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[jasmin] 0:ssh*                                   "williamsjh@jasmin-sci1" 20:58 13-Feb-20
```

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9:58 am 14/02/2020

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Welcome, **Jonny**. | My Profile | Log out

WCRP CMIP6
World Climate Research Programme

You are at the ***ESGF@DOE/LLNL*** *node*

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WARNING: Not all models include a variant "r1i1p1f1", and across models, identical values of variant_label do not imply identical variants! To learn which forcing datasets were used in each variant, please check modeling group publications and documentation provided through ES-DOC.

CMIP6 project data downloads are unrestricted. Please use the -s option to wget scripts to bypass the login prompt.

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Data Node: esgf-data3.ceda.ac.uk
Version: 20200127
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JAMES | Journal of Advances in Modeling Earth Systems

Research Article | Open Access

Implementation of UK Earth system models for CMIP6

Alistair A. Sellar, Jeremy Walton, Colin G. Jones, Richard Wood, Nathan Luke Abraham, Miroslaw Andrejczuk, Martin B. Andrews, Timothy Andrews, Alex T. Archibald, Lee de Mora, Harold Dyson, Mark Elkington, Rich Ellis, Piotr Florek, Peter Good, Laila Gohar, Stephen Haddad, Steven C. Hardiman, Emma Hogan, Alan Iwi, Chris D. Jones, Ben Johnson, Douglas I. Kelley, Jamie Kettleborough, Jeff R. Knight, Marcus O. Köhler, Till Kuhlbrodt, Spencer Liddicoat, Irina Linova-Pavlova, Matthew S. Mizielinski, Olaf Morgenstern, Jane Mulcahy, Erica Neininger, Fiona M. O'Connor, Ruth Petrie, Jeff Ridley, Jean-Christophe Rioual, Malcolm Roberts, Eddy Robertson, Steve Rumbold, Jon Seddon, Harry Shepherd, Sungbo Shim, Ag Stephens, Joao C. Teixeira, Yongming Tang, Jonny Williams, Andy Wiltshire

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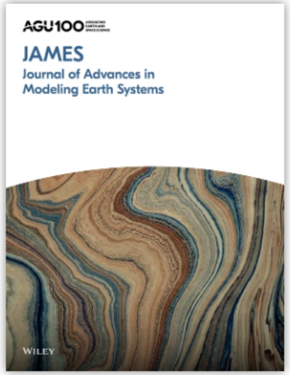
First published:07 February 2020 | https://doi.org/10.1029/2019MS001946



Accepted Articles

Accepted, unedited articles published online and citable. The final edited and typeset version of record will appear in the future.

e2019MS001946

Computing the Climate: Building a Model World

Frontiers for Young Minds

2020-01-22 | journal-article

DOI: 10.3389/frym.2019.00161

Part of ISSN: 2296-6846

Source: Jonny Williams ★ Preferred source

The sensitivity of Southern Ocean aerosols and cloud microphysics to sea spray and sulfate aerosol production in the HadGEM3-GA7.1 chemistry–climate model

Atmospheric Chemistry and Physics

2019-12-17 | journal-article

DOI: 10.5194/acp-19-15447-2019

Source: Crossref ★ Preferred source

Improved simulation of clouds over the Southern Ocean in a General Circulation Model

2019-11-11 | other

DOI: 10.5194/acp-2019-884

Source: Crossref ★ Preferred source

Supplementary material to "Improved simulation of clouds over the Southern Ocean in a General Circulation Model"

2019-11-11 | other

DOI: 10.5194/acp-2019-884-supplement

Source: Crossref ★ Preferred source

The sensitivity of Southern Ocean aerosols and cloud microphysics to sea spray and sulfate aerosol production in the HadGEM3-GA7.1 chemistry-climate model

2019-08-15 | other

DOI: 10.5194/acp-2019-629

Source: Crossref ★ Preferred source

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CORE CONCEPT Published: January 22, 2020

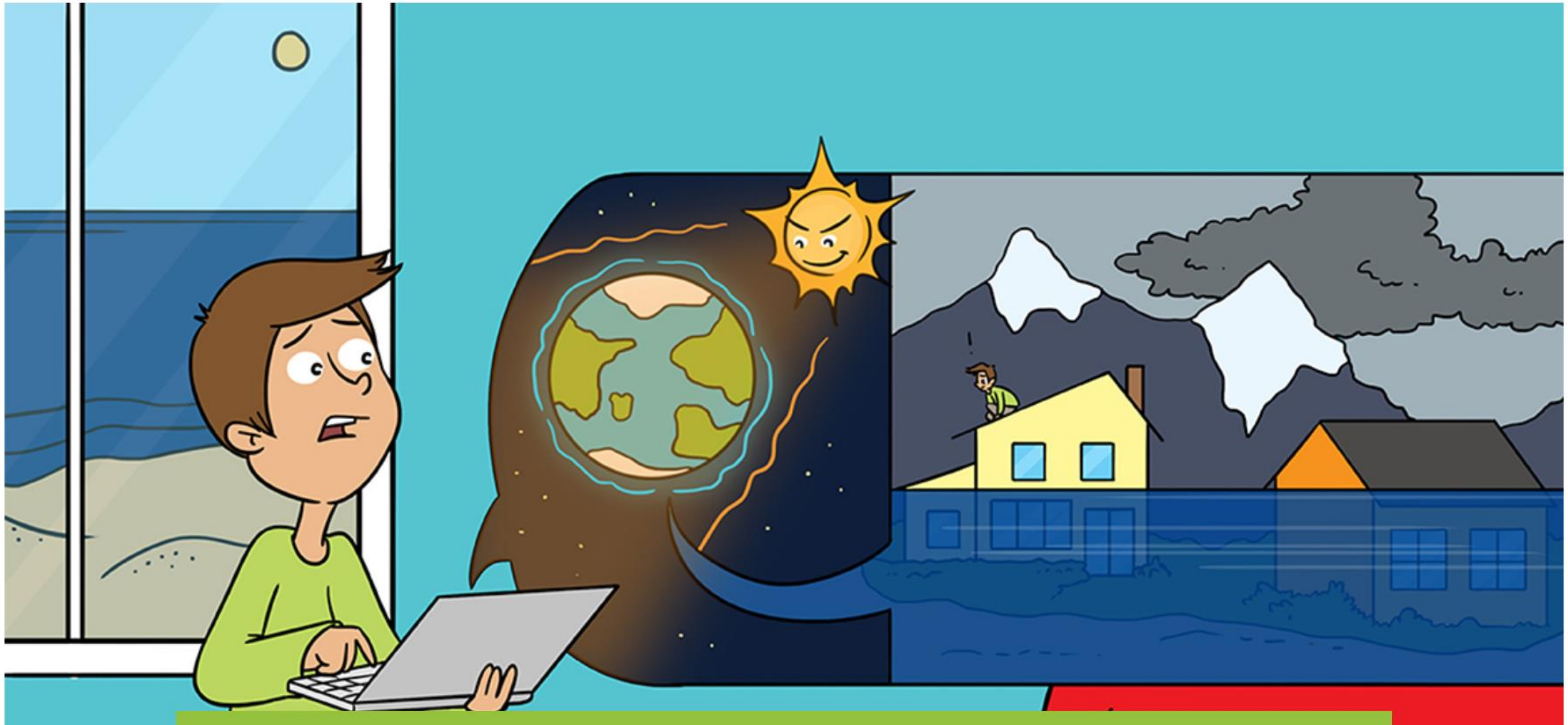
Computing the Climate: Building a Model World

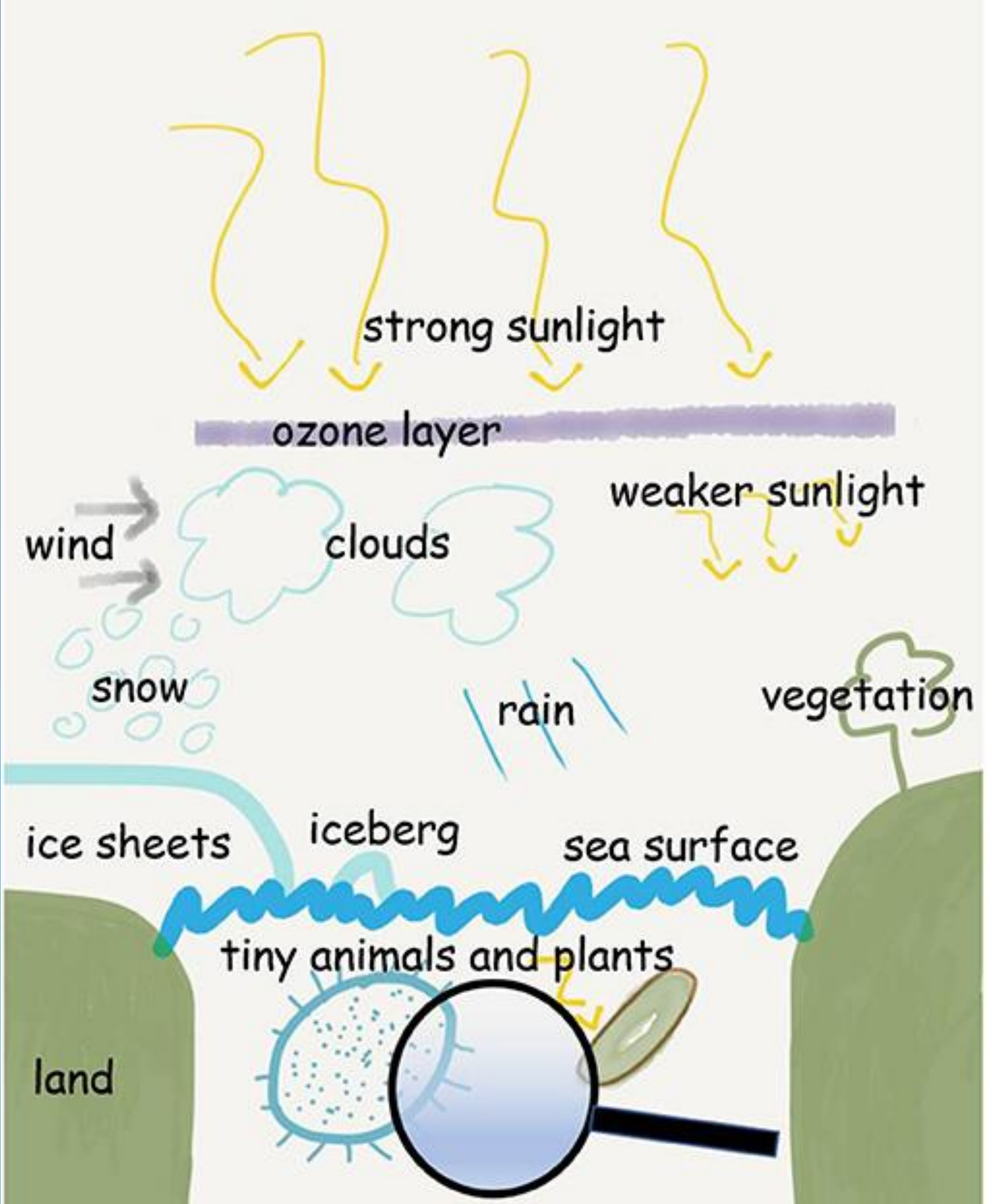
Authors

Jonny Williams

Young Reviewers

Nicolas Omer





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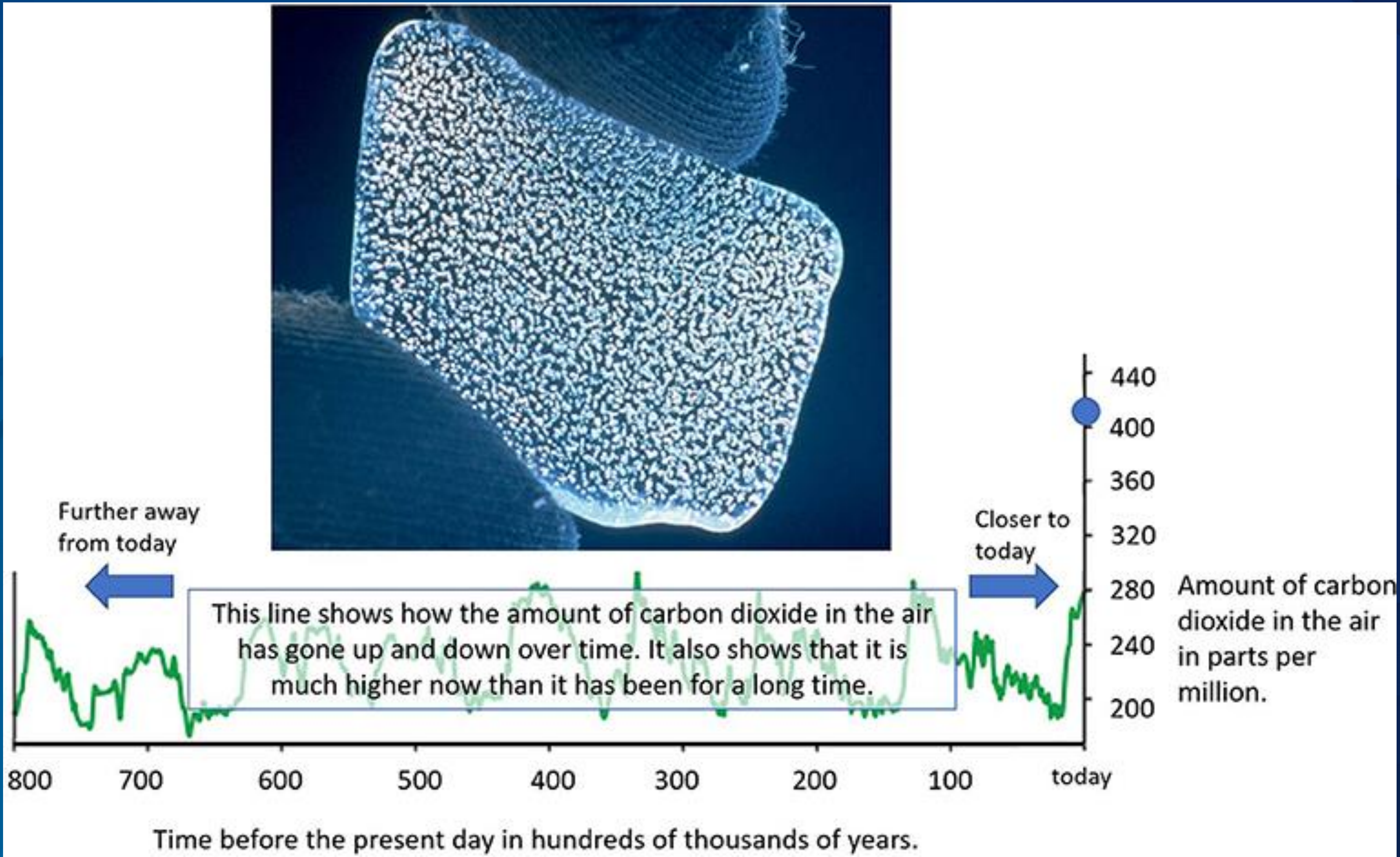

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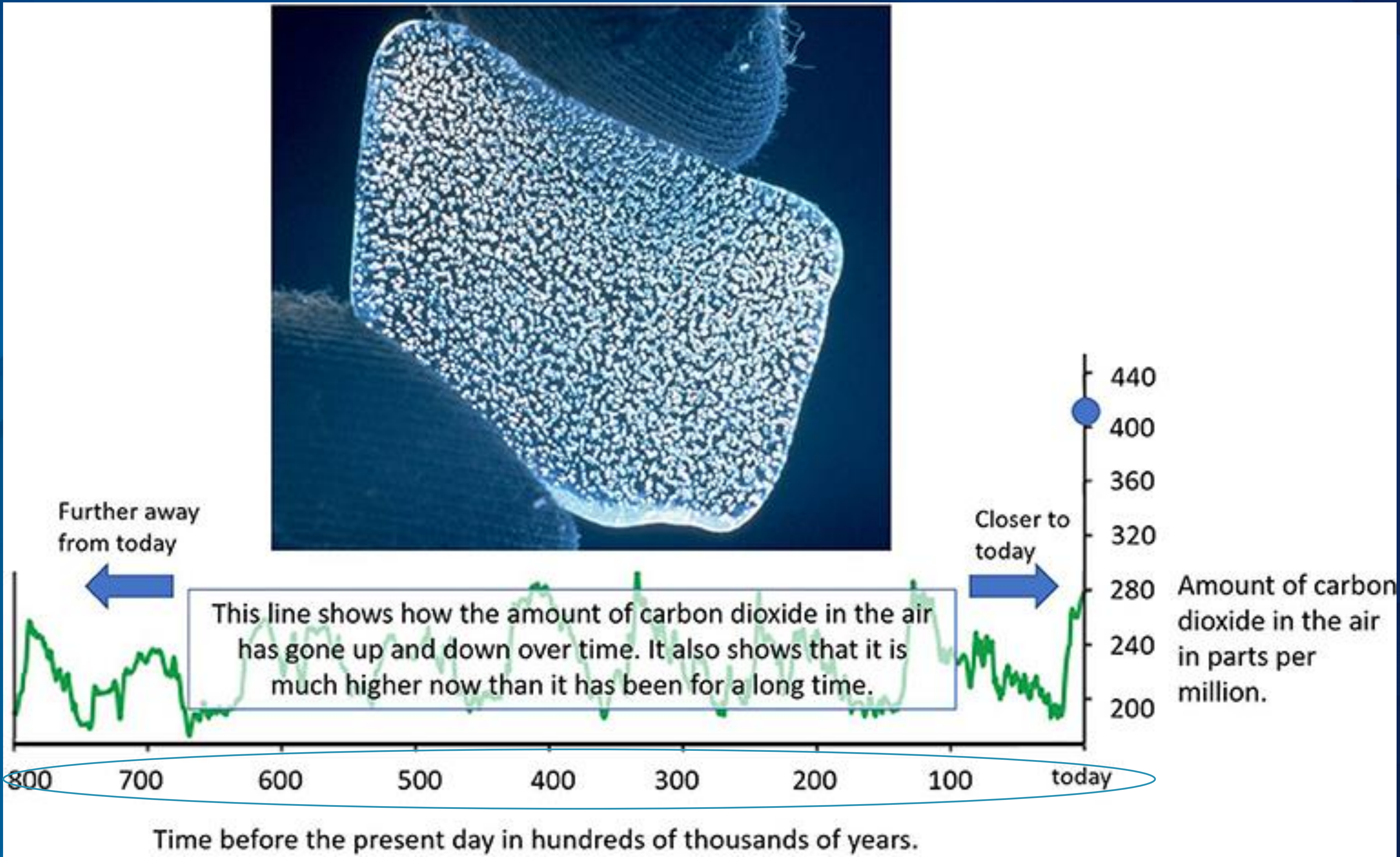

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YOU CAN HELP!

By using the power of the Internet, we can build a special type of computer together. Many people's computers are often switched on but not doing very much. What this means is that the spare computer power can be used to do some calculations about future climate change.

If you have a computer that you can use, then you can be a climate scientist too. If you want to get involved, then you can go to www.climateprediction.net. Here, you can sign up to run a model of the atmosphere on your own computer!

www.climateprediction.net is just one example of what is called a citizen science project. Citizen scientists are people who give some of their time to help answer a science question. What is great about these projects is that a lot can be achieved using teamwork! There are lots of these projects out there and you can start getting involved today.

climate*prediction*.net

the world's largest climate modelling experiment for the 21st century

Search

In this section:

weather@home

Weather@home is a group of regional climate modelling experiments within climate*prediction*.net

Follow live results from the weather@home 2015 Western US Drought experiment

Thanks to your support of climate*prediction*.net we are able to design experiments that answer questions we otherwise could not answer without large climate model ensembles. However, most extreme weather events take place on a much smaller scale that the global models can't show. For this we need the weather@home project!

Weather@home allows us to run regional climate models to answer the question: how does climate change affect our weather.

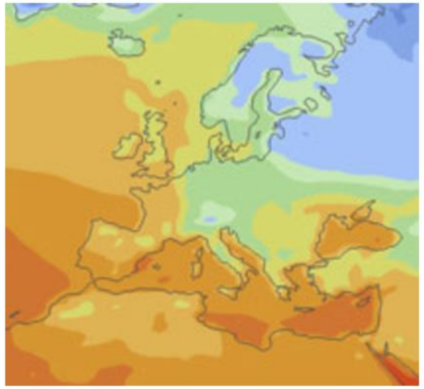
Weather@home helps us, and scientists all over the world, to answer this question. It is a family of regional climate models for a growing number of regions around the world. With weather@home we can investigate how the odds of extreme weather events change due to man-made climate change and natural climate variability.

With weather@home you can run the model simulating the weather in your native part of the world. Weather@home also makes climate*prediction*.net a truly international project, as participants and the scientists who analyse the data come from all over the world. The fact that local scientists are collecting and analysing the data is important as it means that any results from the project are underpinned by local knowledge, making them even more relevant to people's daily lives.

Related links:

weather@home is supported by **the Guardian**

Developed with financial assistance from **Microsoft Research**



Translate

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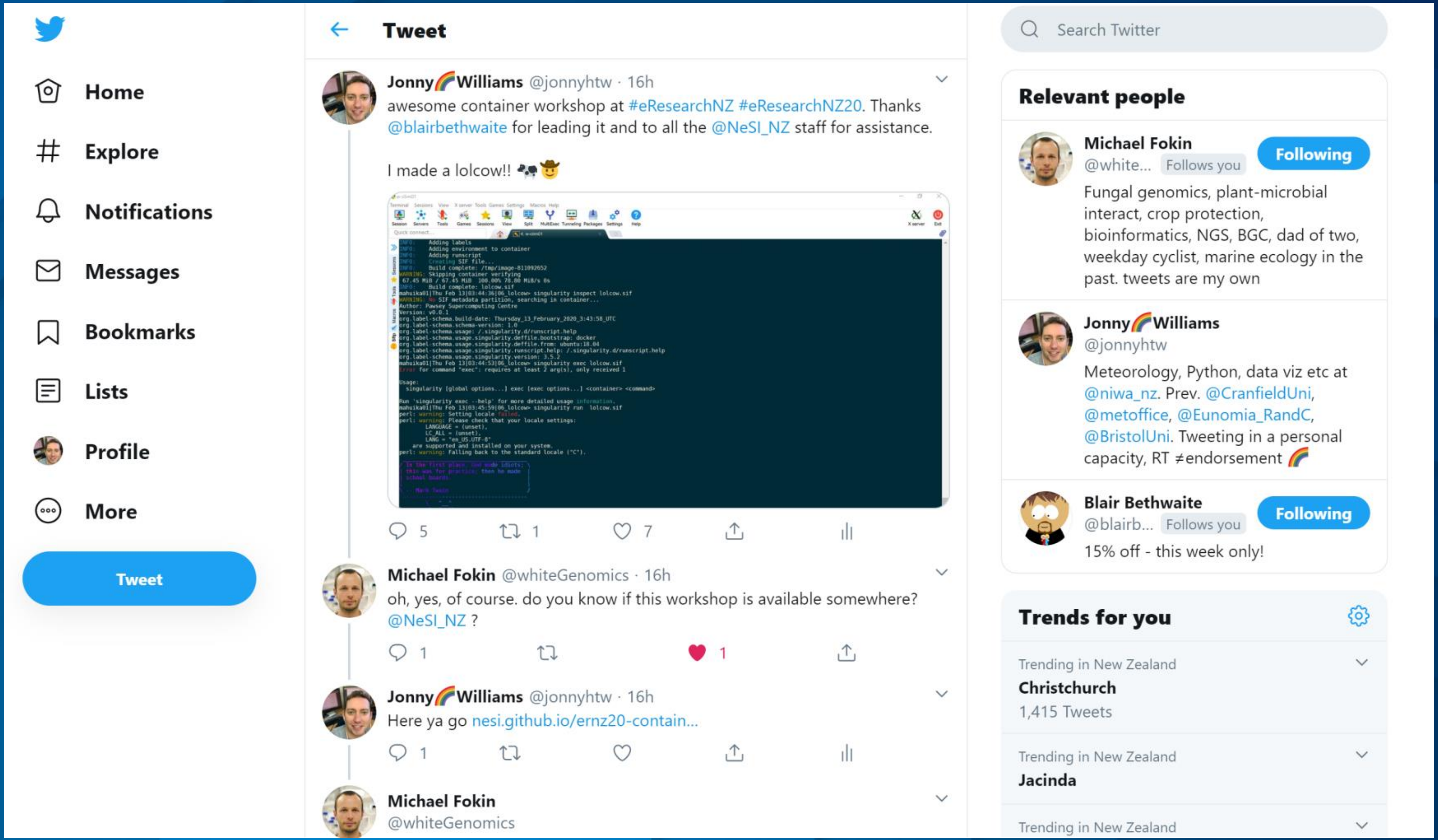
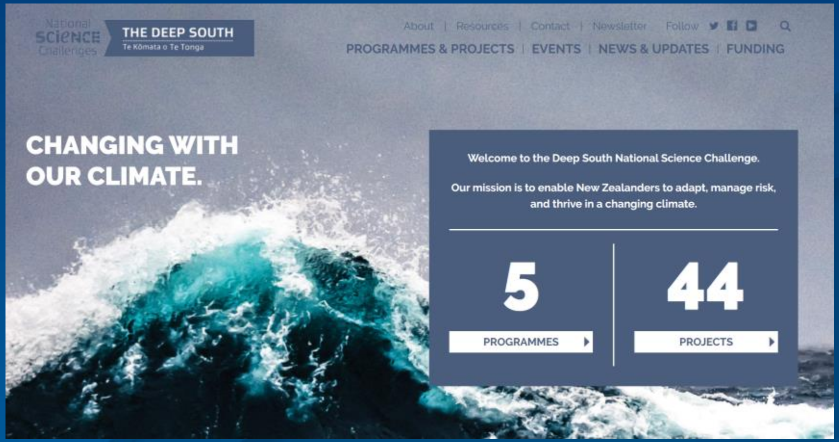
Coming soon, CONTAINERS!



NIWA
Taihoro Nukurangi



Thanks for listening, I'd be very happy to take questions if you have any.

@jonnyhtw