Global distributed computing used to diagnose changes in New Zealand's extreme weather with global warming.

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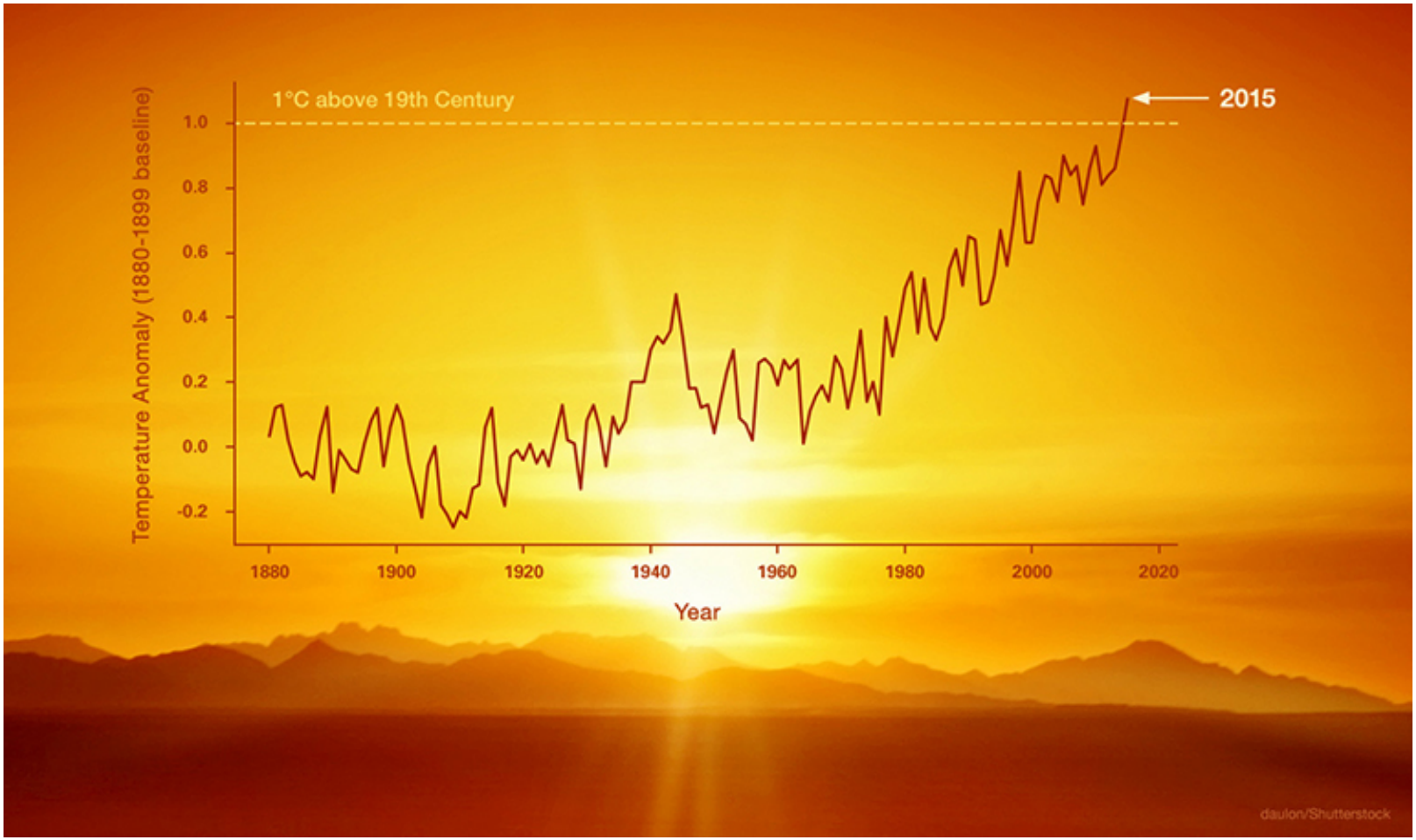
Global mean temperature 1880-2015 (NASA)



Credit: Daulon Shutterstock.com - sunset image,
NASA JPL – data and overlay

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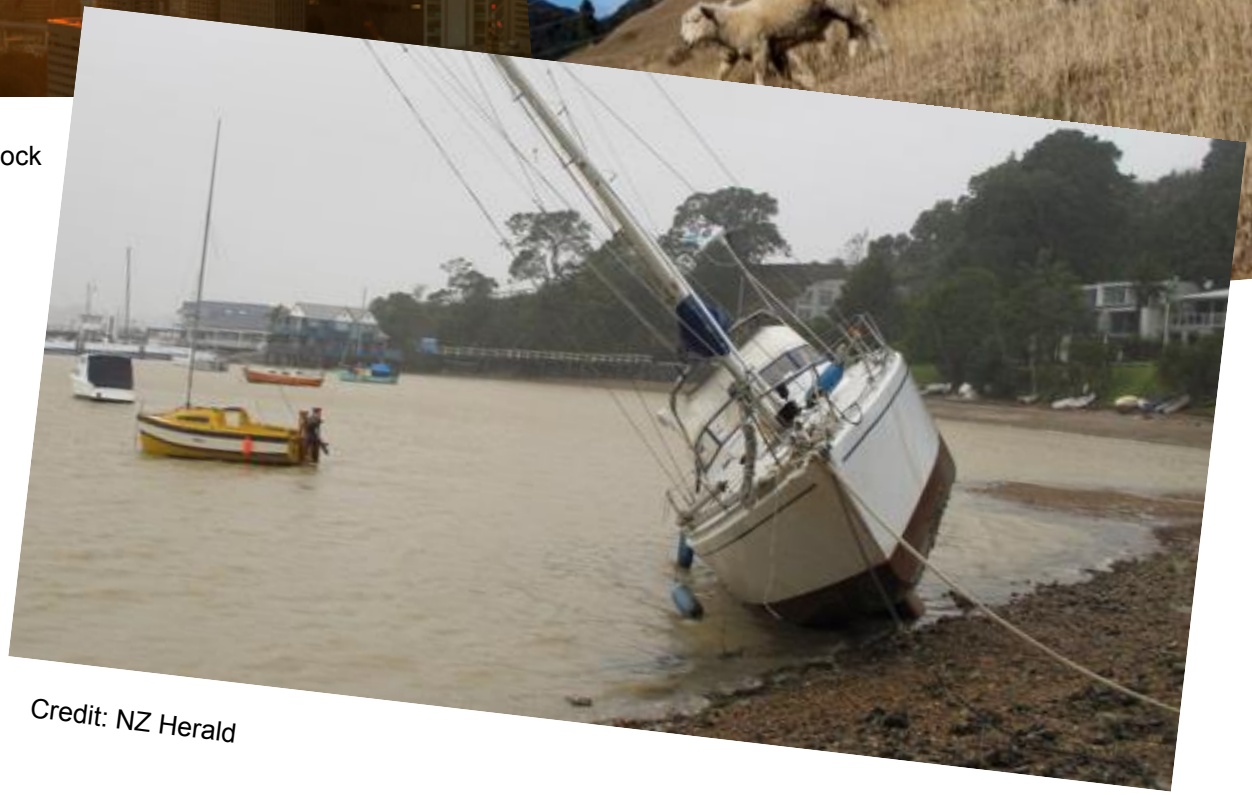
Credit:
Thinkstock

Credit: Mark Mitchell,
NZ Herald



Credit: NZ Herald

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Overview

- A bit about climate*prediction*.net (‘CPDN’) and ‘weather@home’ (‘w@h’)
- A bit about ‘weather@home ANZ’
- Some scientific results – July 2014 extreme rainfall in Northland
- Future directions

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Climate*prediction*.net ('CPDN')

- Global volunteer computing project
- *Harnesses spare processing power of PCs to run state-of-the-art global climate models*
- Based in Oxford (Myles Allen) – runs U.K. Met. Office models (Richard Jones)
- *Running successfully for over 10 years – millions of model years simulated*
- 'Hard core' of order 50,000 participants – approx. 1,000 NZ and 3,000 Australian
- *November 2010 - launched 'weatherathome' – higher resolution regional modelling*
- March 2014 – launched 'weatherathome' for Australia and New Zealand ('w@h ANZ')

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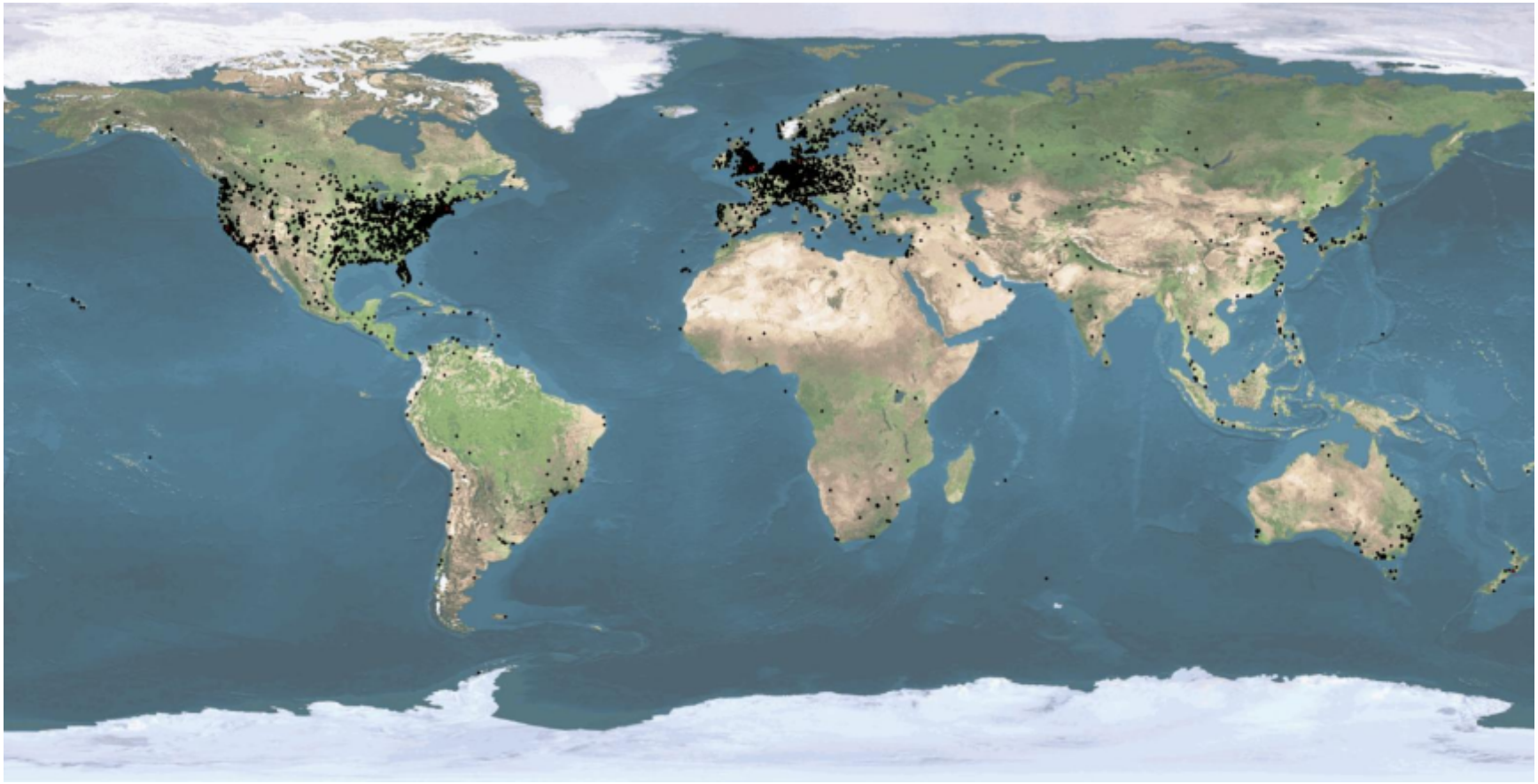
Climate*prediction*.net – a truly global project



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CPDN weather@home 'ANZ'

- Developed under a collaboration among University of Oxford, NIWA Wellington and University of Melbourne.
- Data storage and analysis servers provided and managed by TPAC (Tasmanian Partnership for Advanced Computing).
- 'Mirror' data store provided and managed by HPCF, NIWA, Wellington.
- After release of an experiment to the public, data return at approx. 1Tb per week.
- Total data volume of order 5Tb per experiment typical.

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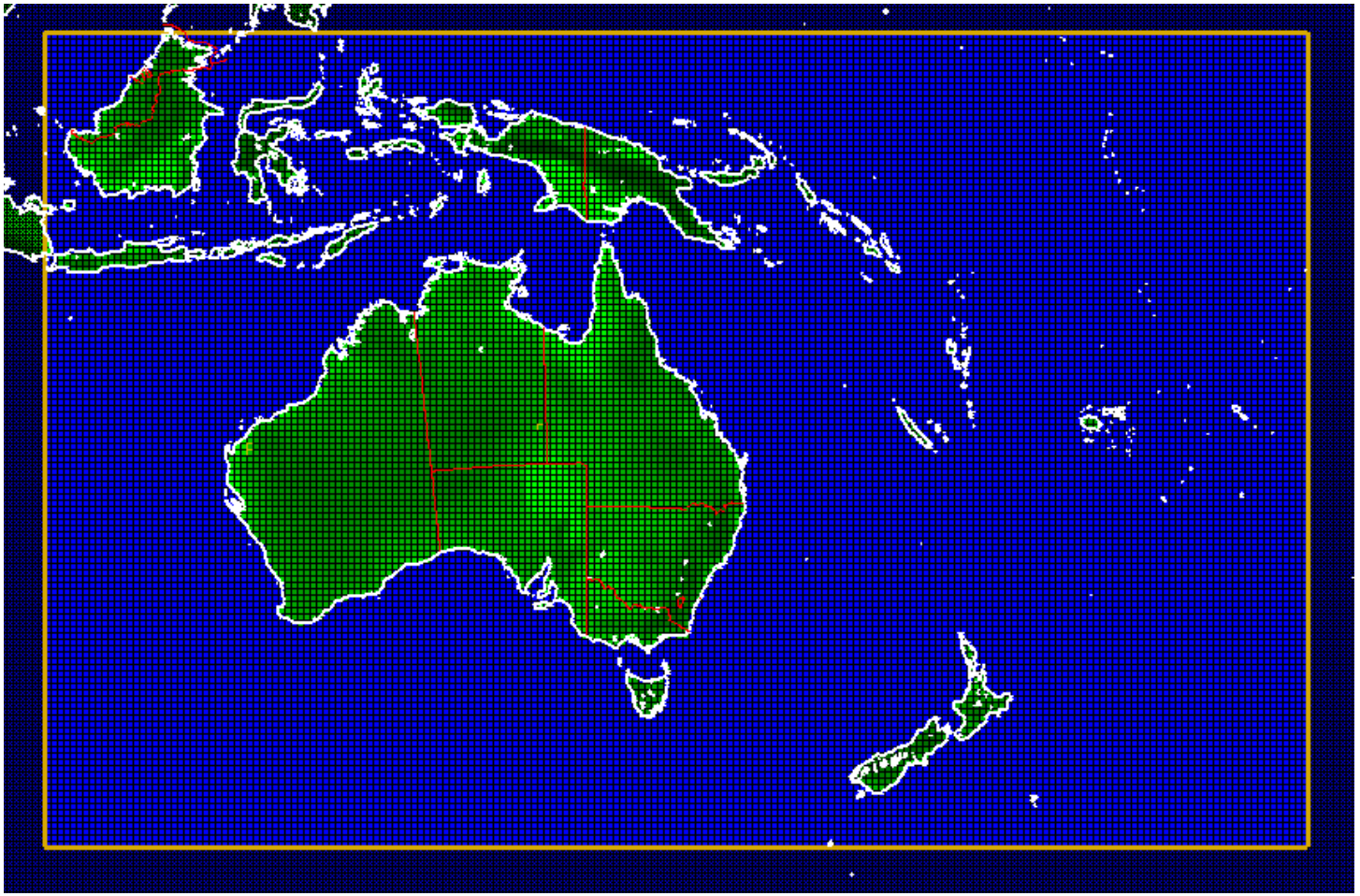
‘weatherathome’ ANZ domain (CORDEX)
50km resolution



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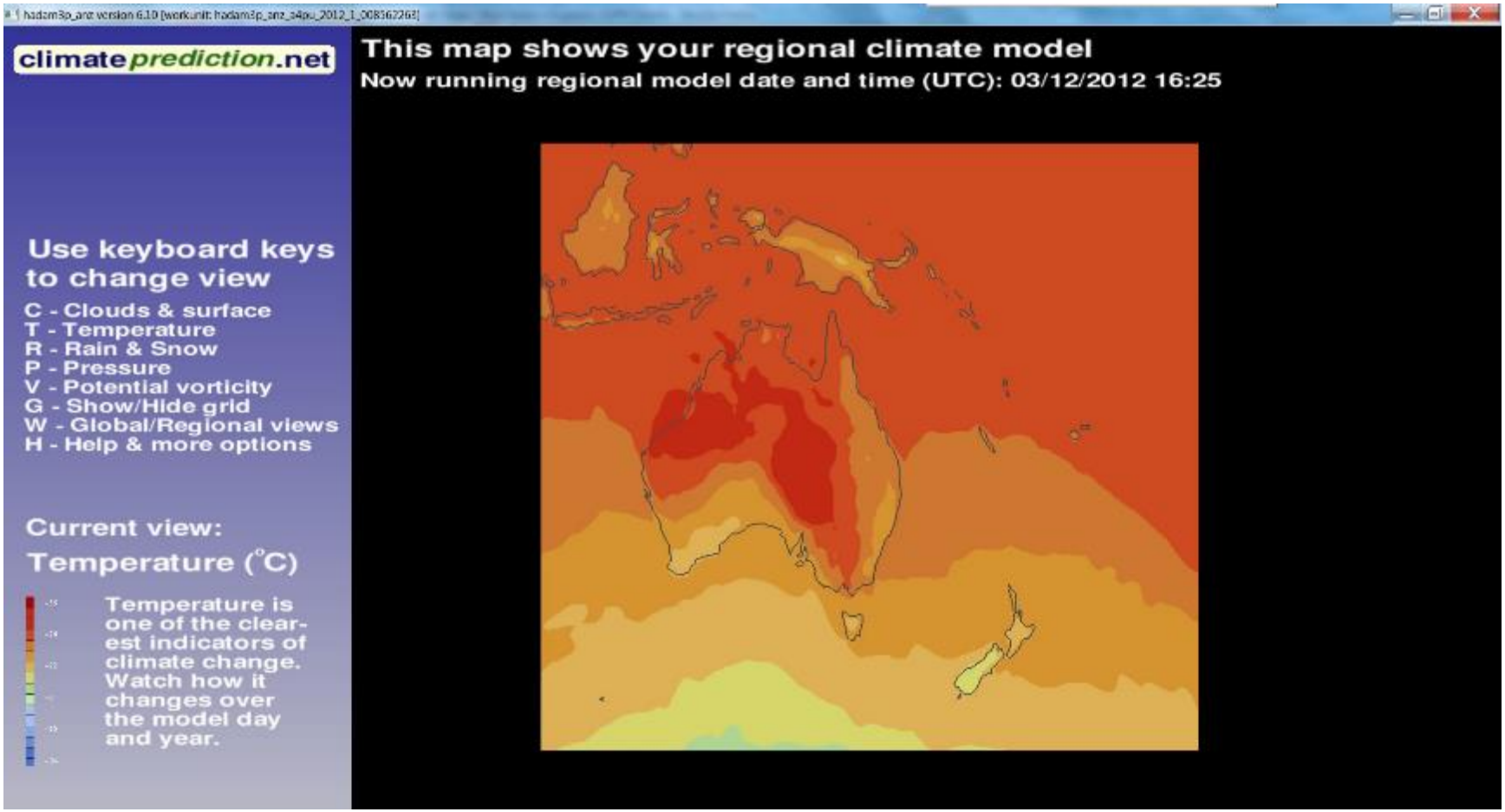
Volunteer participants can see graphics of their own model simulation - temperature, clouds, rainfall, pressure ….



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O.K., some results from a recently published study about Northland …

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July 2014, Northland, New Zealand

Extreme 5-day rainfall (8-12 July) caused severe flooding

– estimated NZ$18.8m in insurance claims.

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Event analysed using w@h ANZ 2014 experiment

Appeared November 2015 in:

'*Explaining Extreme Events of 2014 from a Climate Perspective*',

special supplement to 'Bulletin of the American Meteorological Society'

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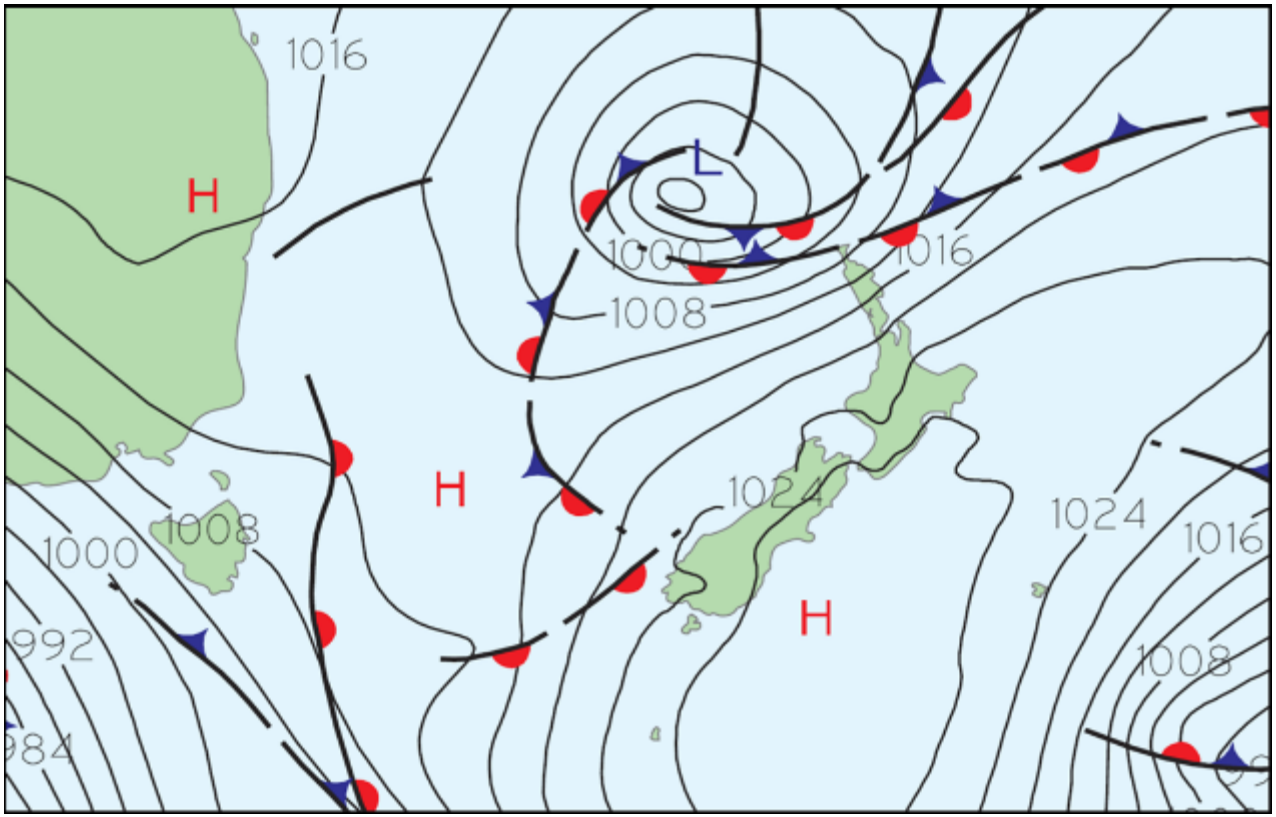
From NZ MetService – 8 July 2014
(midday sfc pressure analysis)



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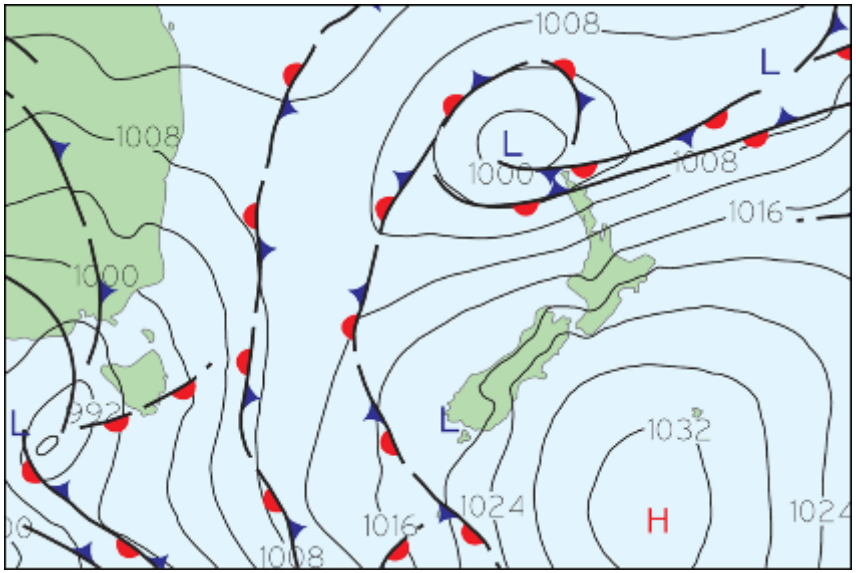
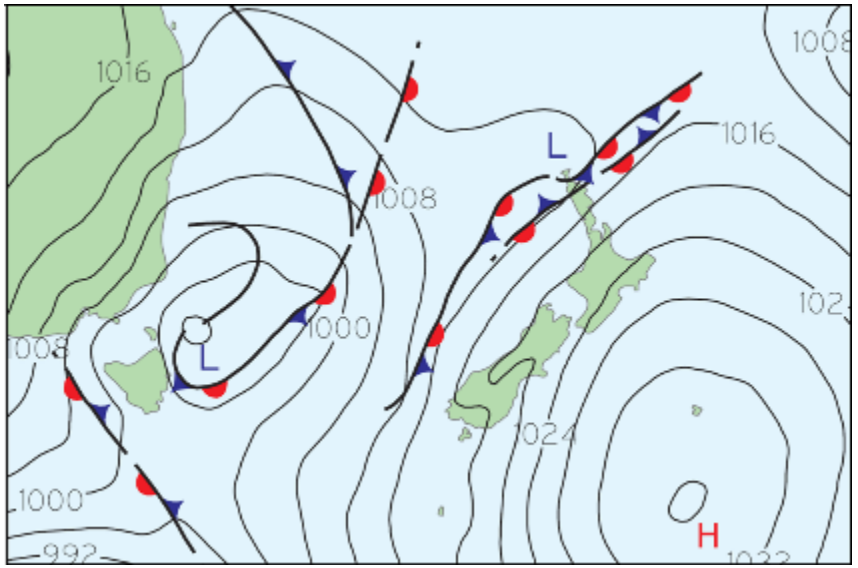
9 Jul, 10 Jul …





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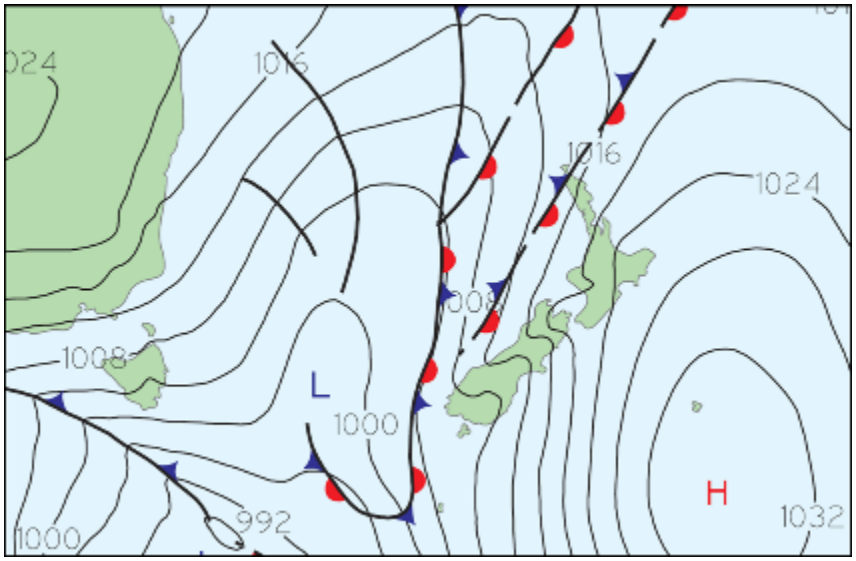
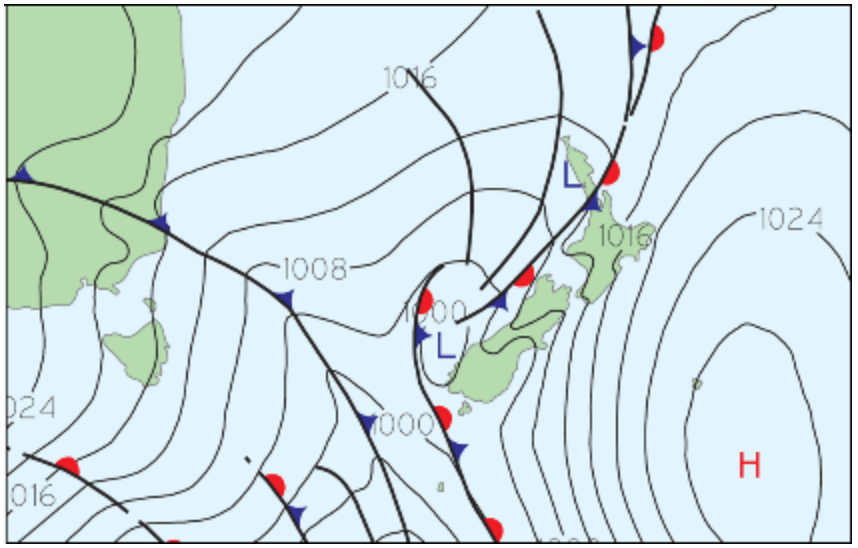
… 11 Jul, 12 Jul





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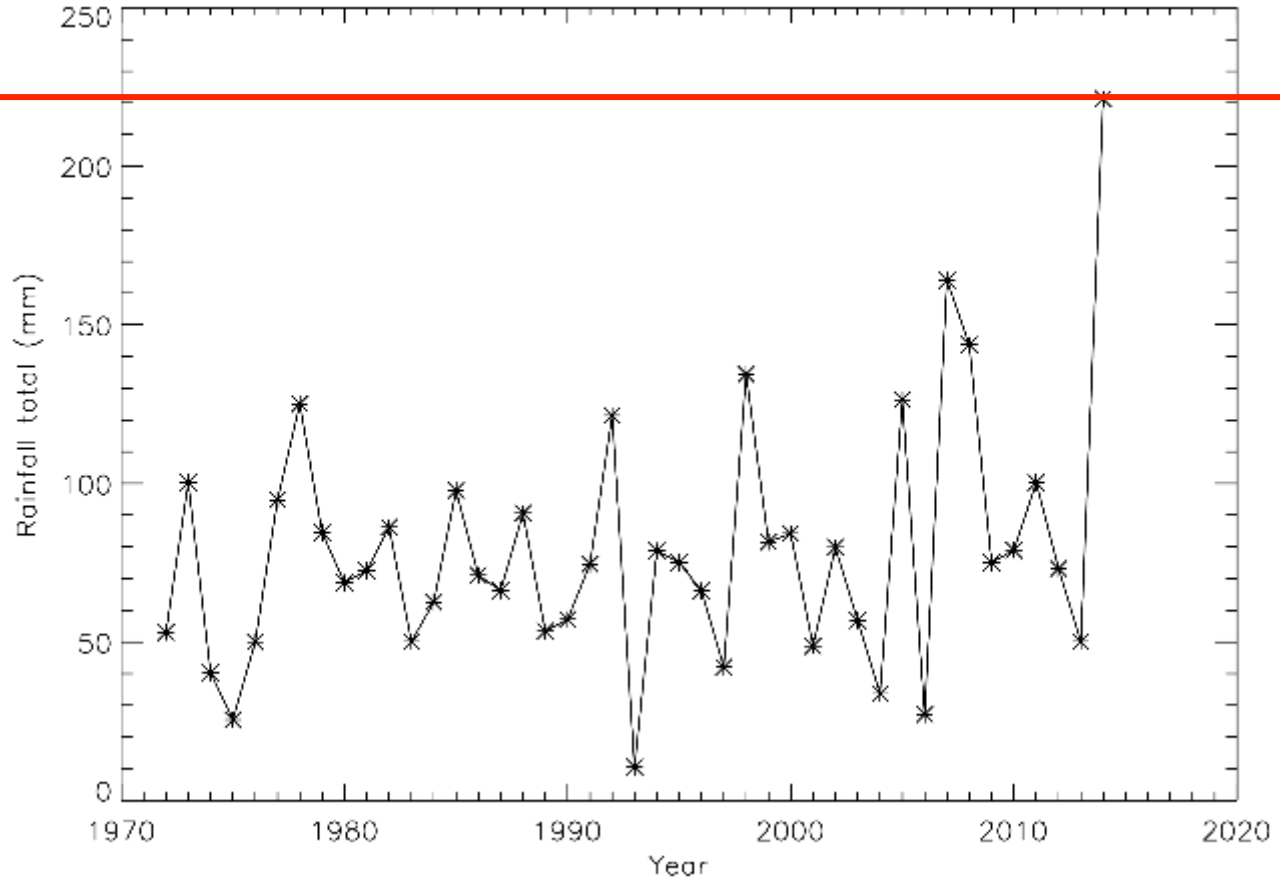
NZ VCSN observations (NIWA)

Max 5-day rainfall total in July, 1972-2014

221mm



Thanks to: Andrew Tait, Abha Sood

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w@h ANZ 2014 experiment

The 2014 that was

Model forced with SSTs (sea surface temperatures), GHGs (greenhouse gases), aerosols, ozone etc. as observed for 2014

'**ALL**'

The 2014 that might have been

Model forcings have anthropogenic contribution removed

10 x model patterns of SST difference (+multi-model mean)

'**NAT**'

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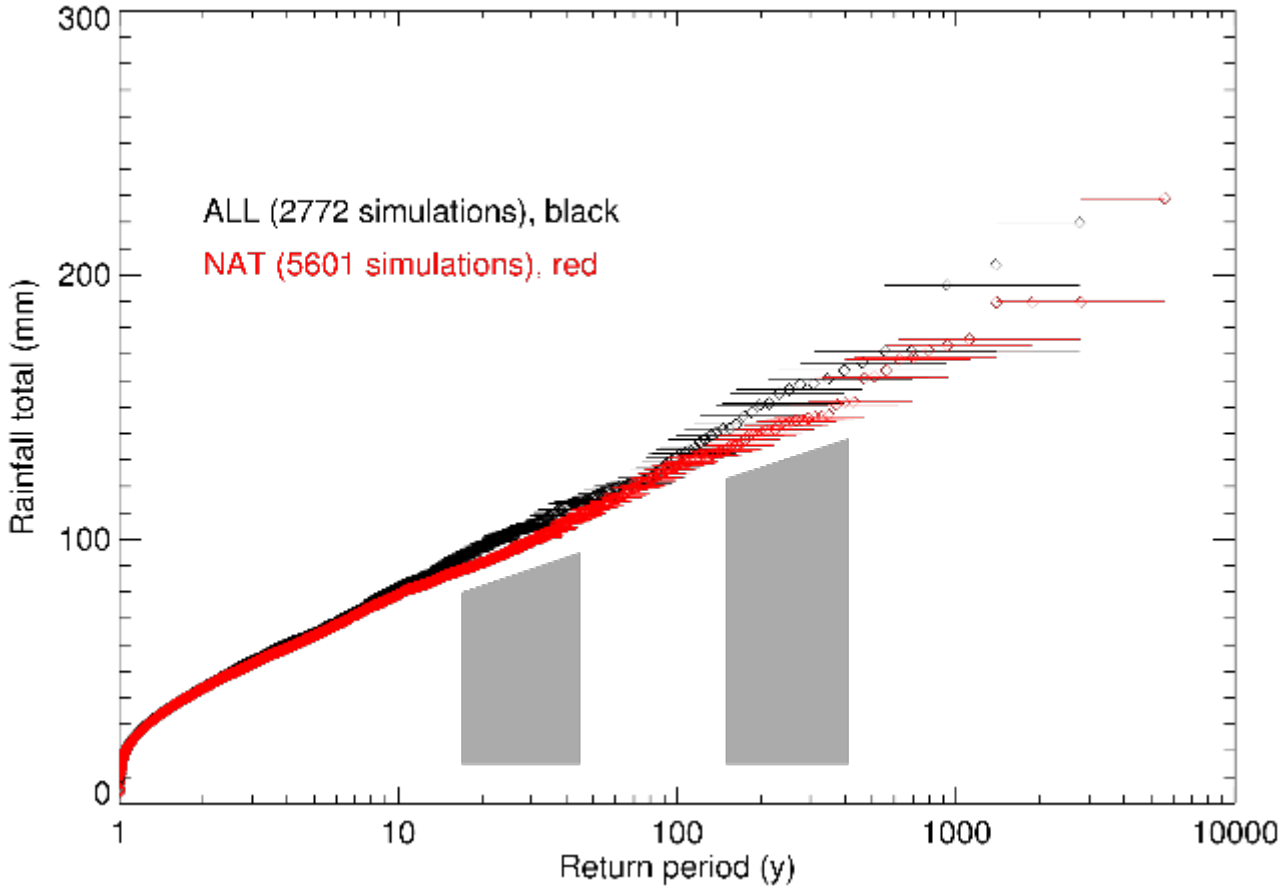
w@h ANZ 2014 model results

July max 5d rainfall totals in Northland



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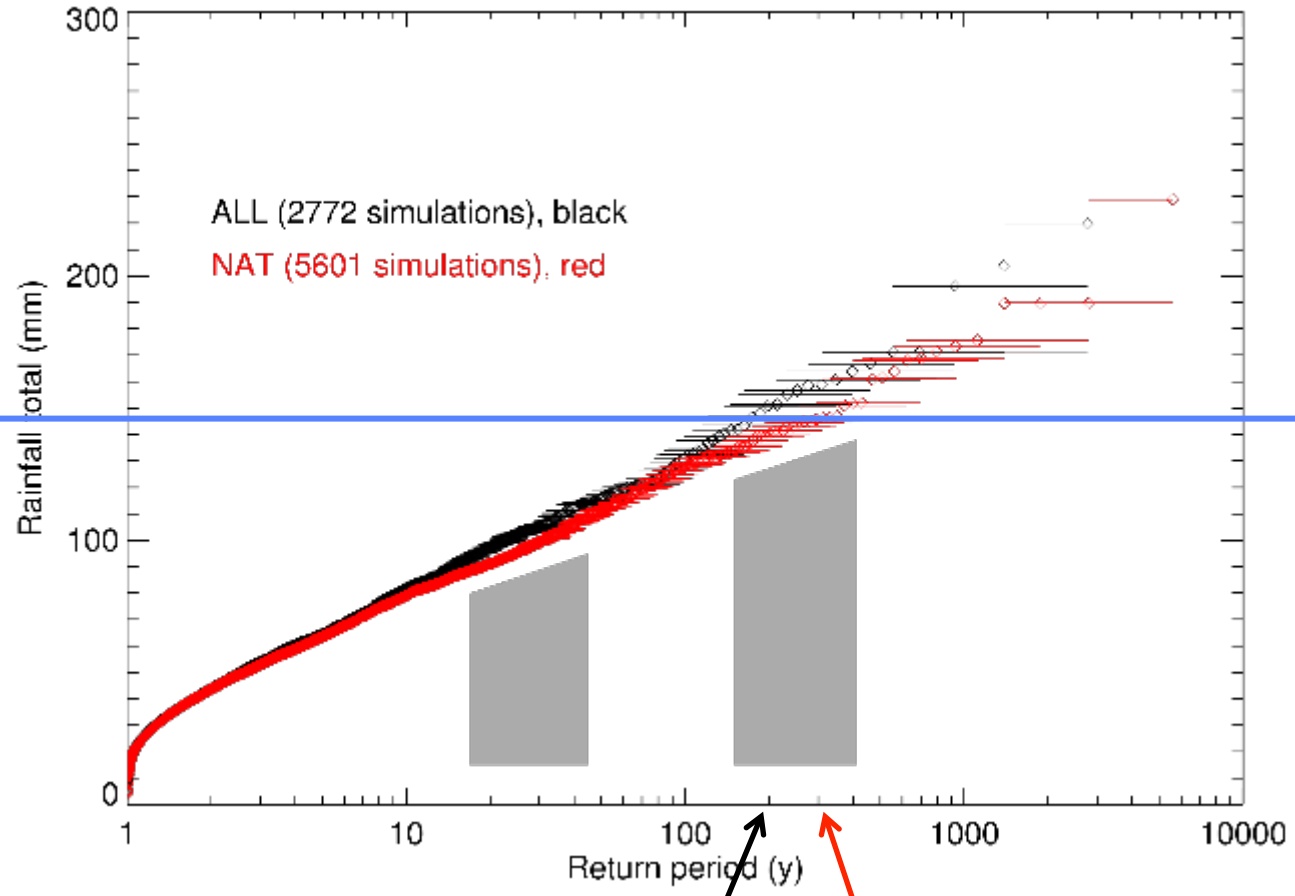
w@h ANZ 2014 model results

July max 5d rainfall totals in Northland



150mm

1 in 200y

1 in 350y

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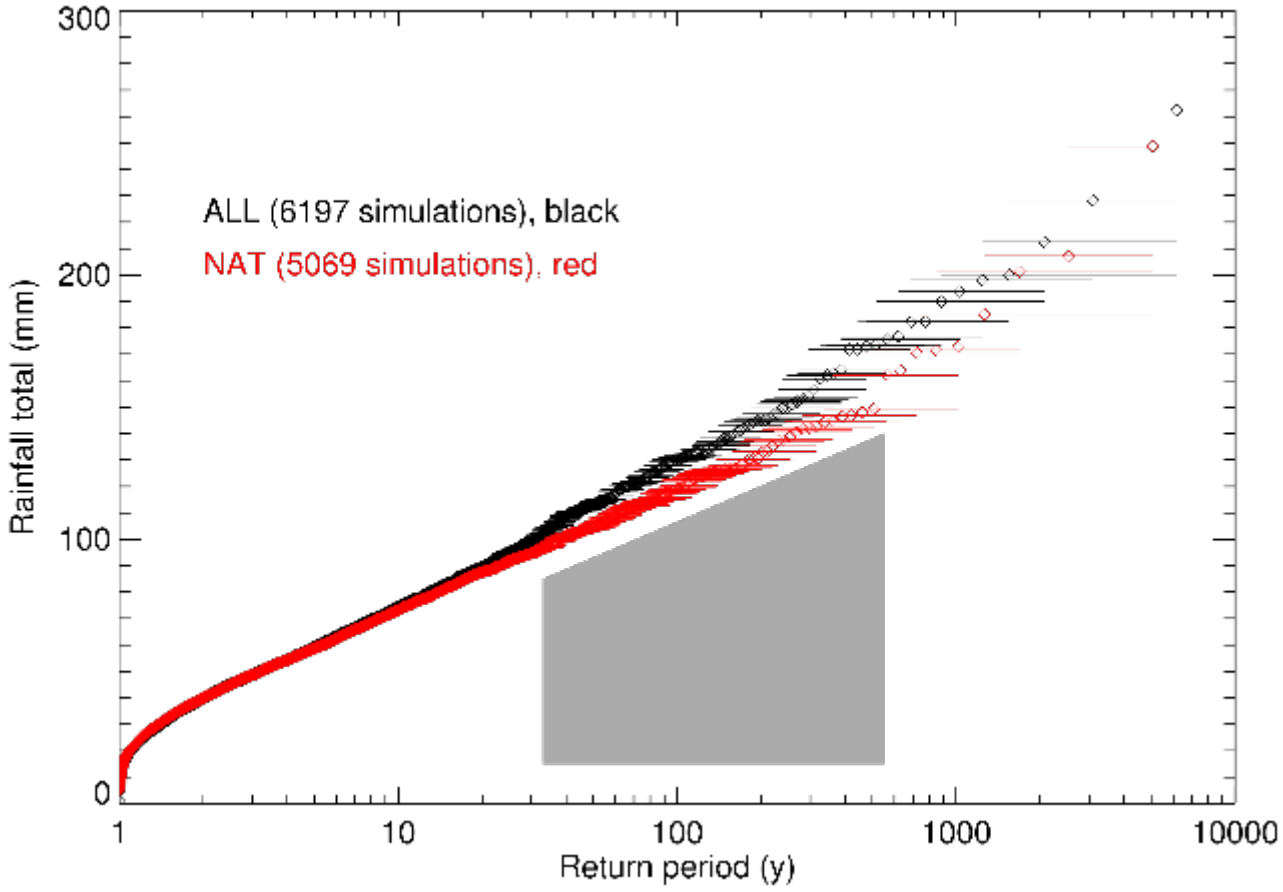
w@h ANZ 2013 model results

July max 5d rainfall totals in Northland



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Computed the **FAR*** (*Fraction of Attributable Risk*) for this event

- At 'best guess' event threshold, FAR was 0.47 – i.e. 47% of the risk of such an event attributable to anthropogenic climate change.

- Estimated the uncertainty in this by computing FAR over all thresholds corresponding to the uncertainty range in the event as given by the GEV distribution – these ranged from about 0.1 to 0.8, with peak (mode) at about 0.27.

* Allen (2003)

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- Results show a *statistically significant anthropogenic influence* on the event over *much, but not all*, of the range of uncertainty in the event's return period as estimated by the GEV fit.

- The risk of such an event has *likely increased due to anthropogenic climate change*, but we suggest *medium confidence in the exact degree* to which this is the case.

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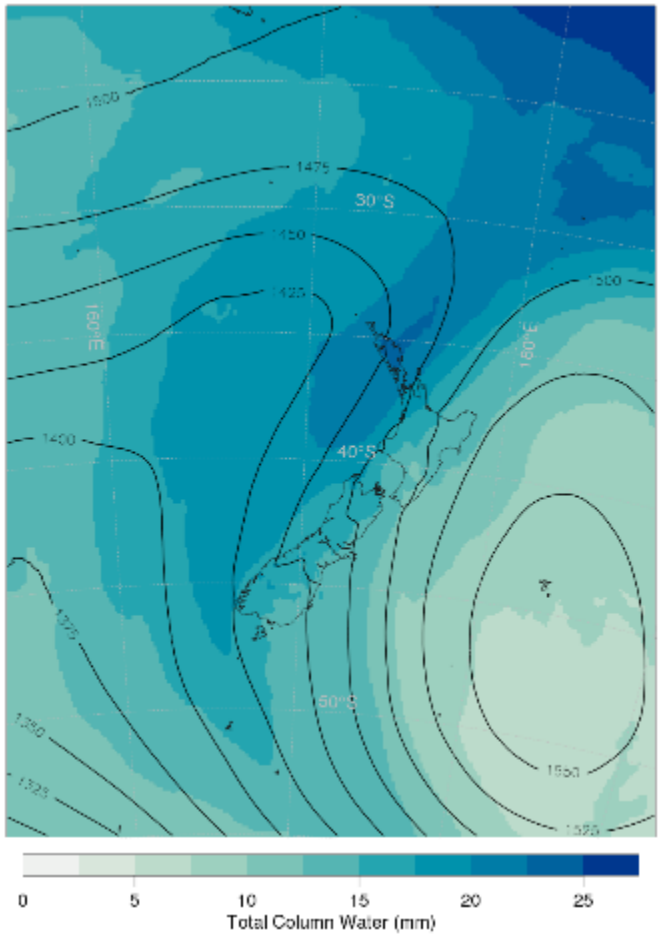
Total column water and 850mb gph

Five-day mean, 8-12 Jul 2014, from NZLAM



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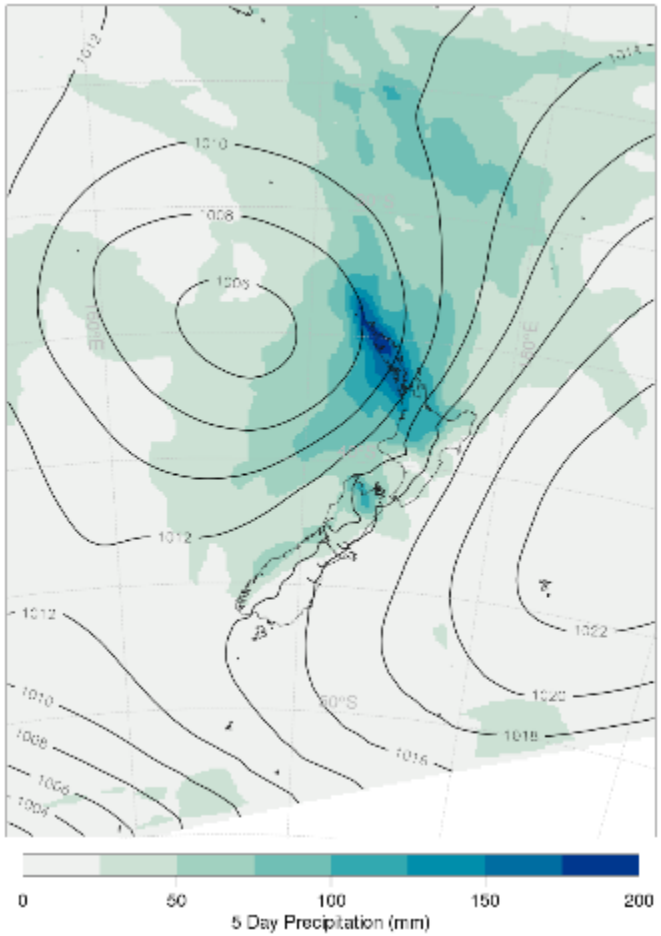
Precipitation total and 850mb gph

w@h 2014 'ALL' model, 7 of 14 wettest, composite of wettest consecutive 5-day period in Jul in each case



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Looking ahead ….
Notable events of 2015 …..
More extreme rainfall ……

- *Kapiti* – May
- *Dunedin* – June
- *Whanganui* – June
- *Gisborne* – September

→ Contribute to 2016 BAMS report

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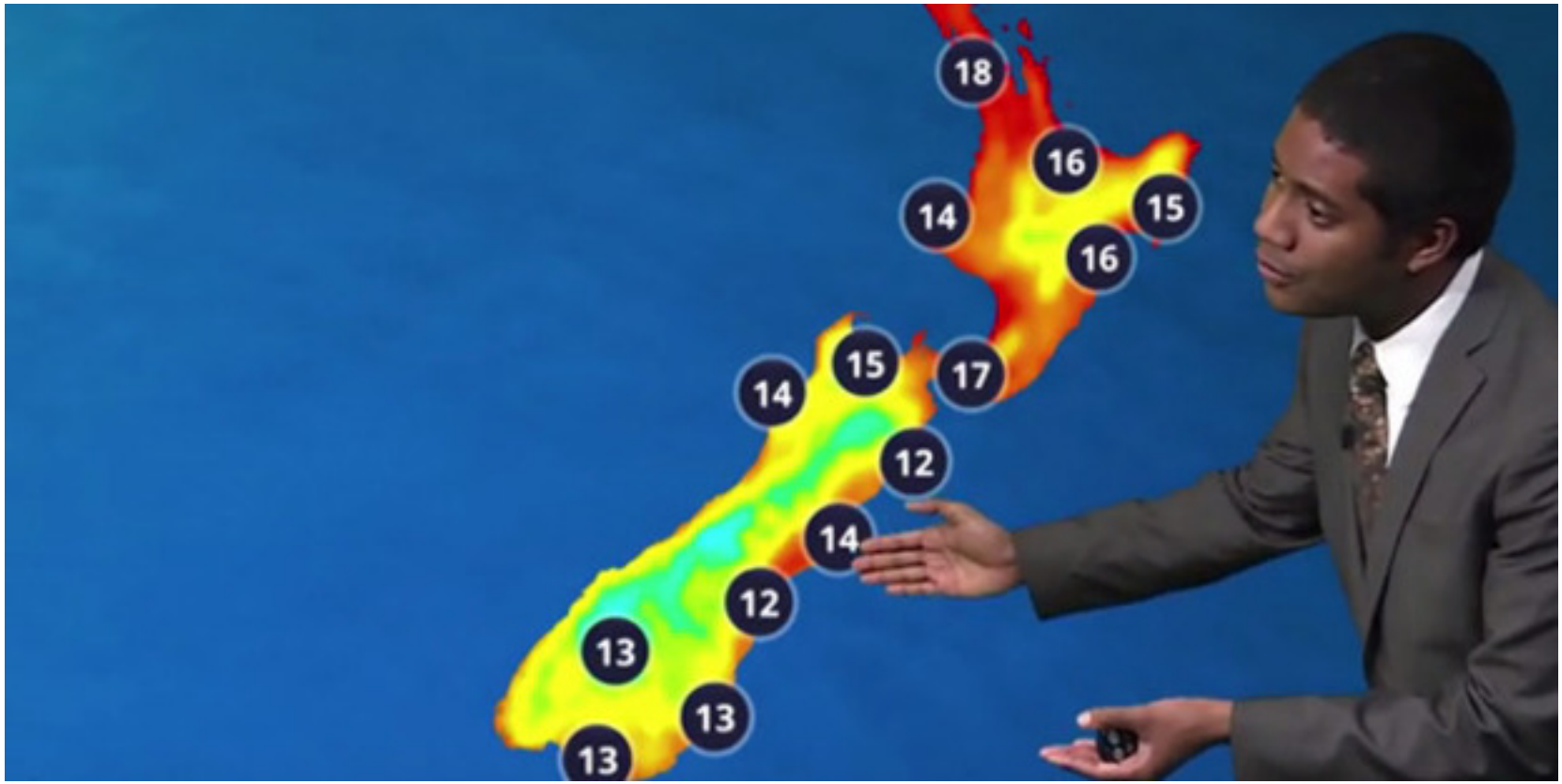
And the forecast for 2050 ….



Credit: Chester Lampkin, NZ Herald

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- Run ‘w@h ANZ’ with forcings appropriate to order of two or three decades from now
- Forecast range of possible extreme weather behaviour in this near-term future decade
- Provide useful information for planning for adaptation to climate change
- This work supported by the *Deep South National Science Challenge*

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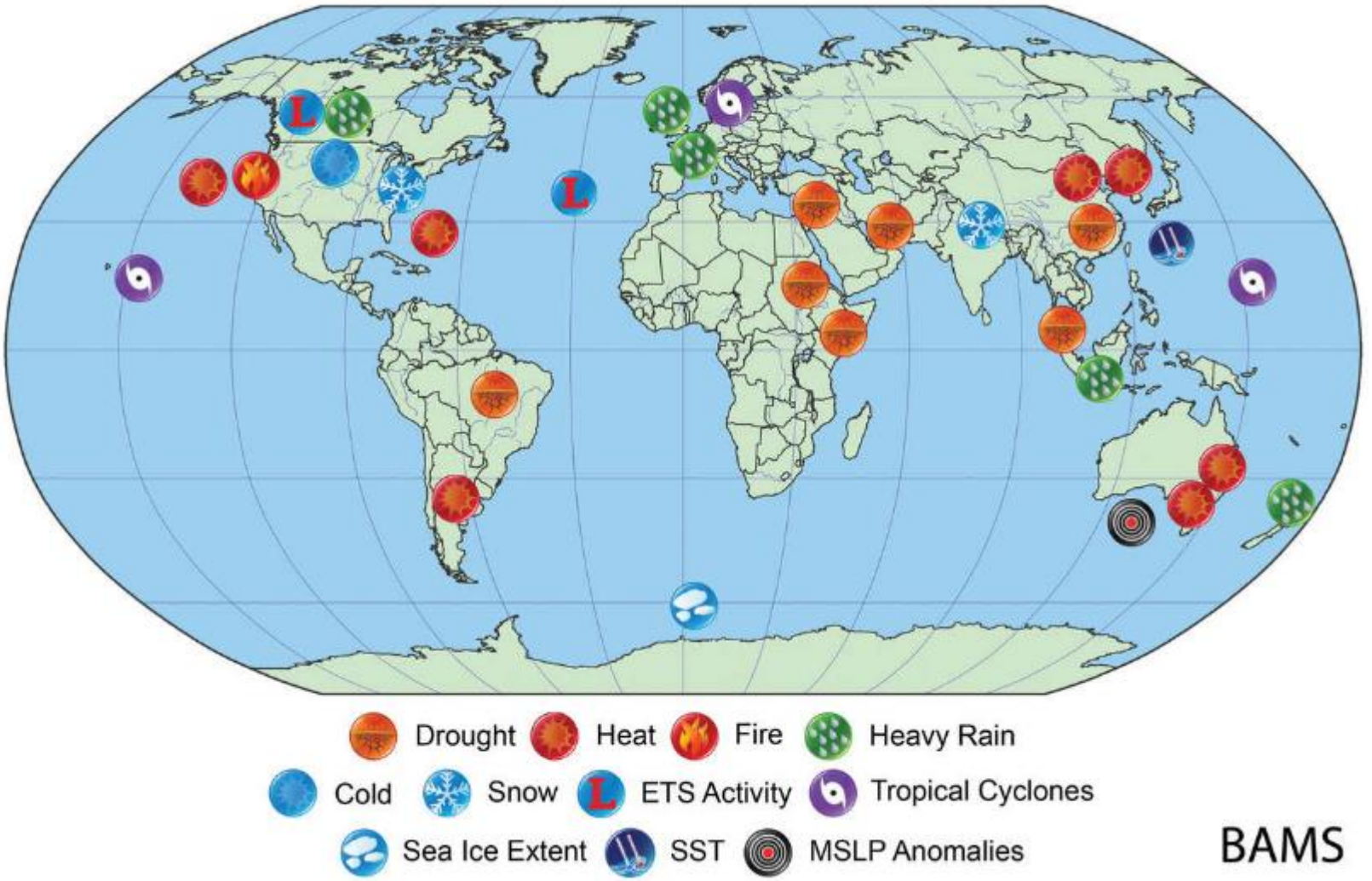
Some 2014 weather extremes around the globe (BAMS)



BAMS

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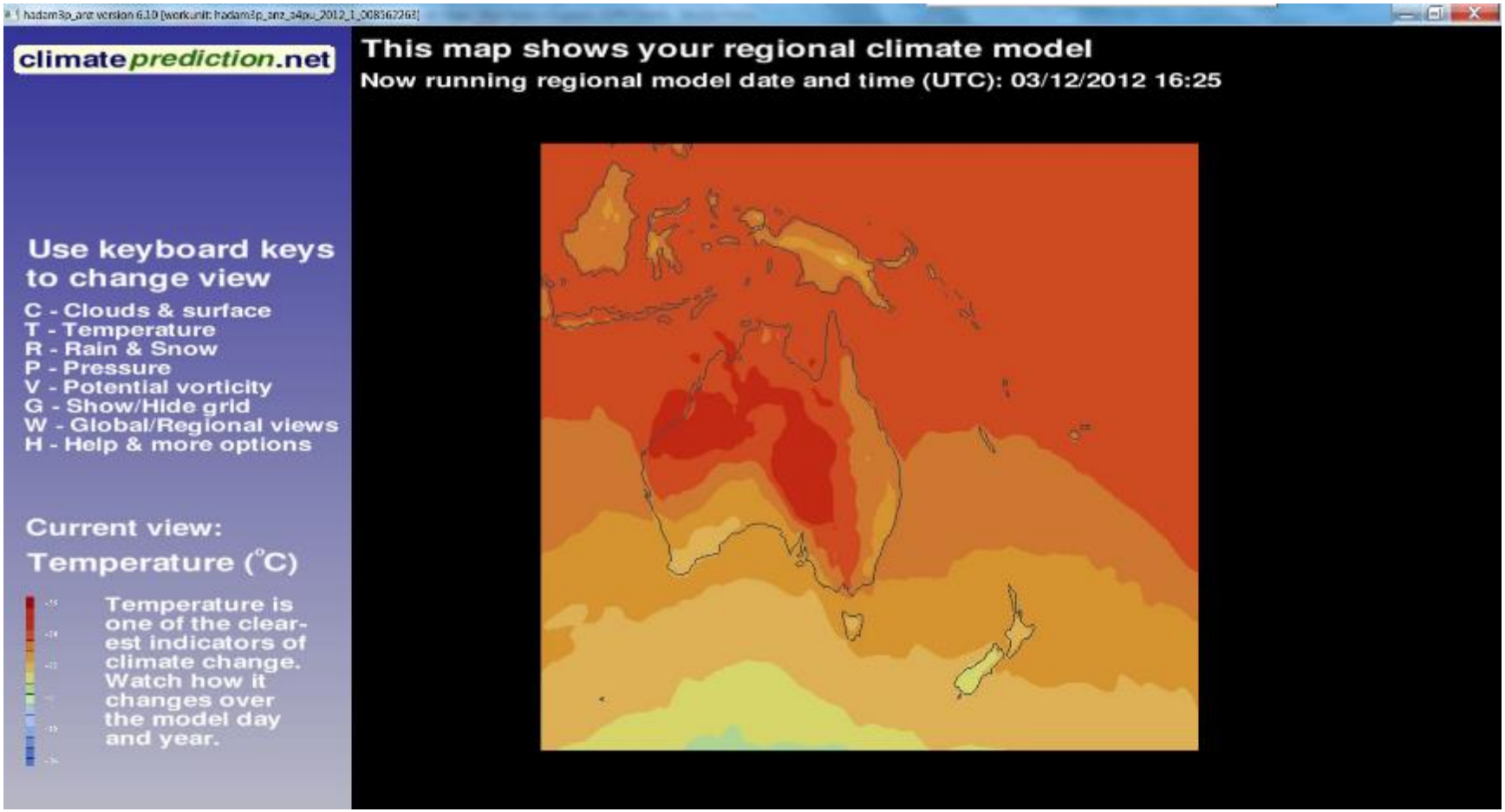
Interested in joining?

weatherathome.net



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