National Environmental Research Program

TROPICAL ECOSYSTEMS hub

Climate change, extreme events and biodiversity in the Wet Tropics

Justin A Welbergen

Centre for Tropical Biodiversity & Climate Change, James Cook University, Townsville, Australia

Email: j.a.welbergen@gmail.com

Web: tiny.cc/welbergen

CENTRE FOR Tropical Biodiversity & Climate Change

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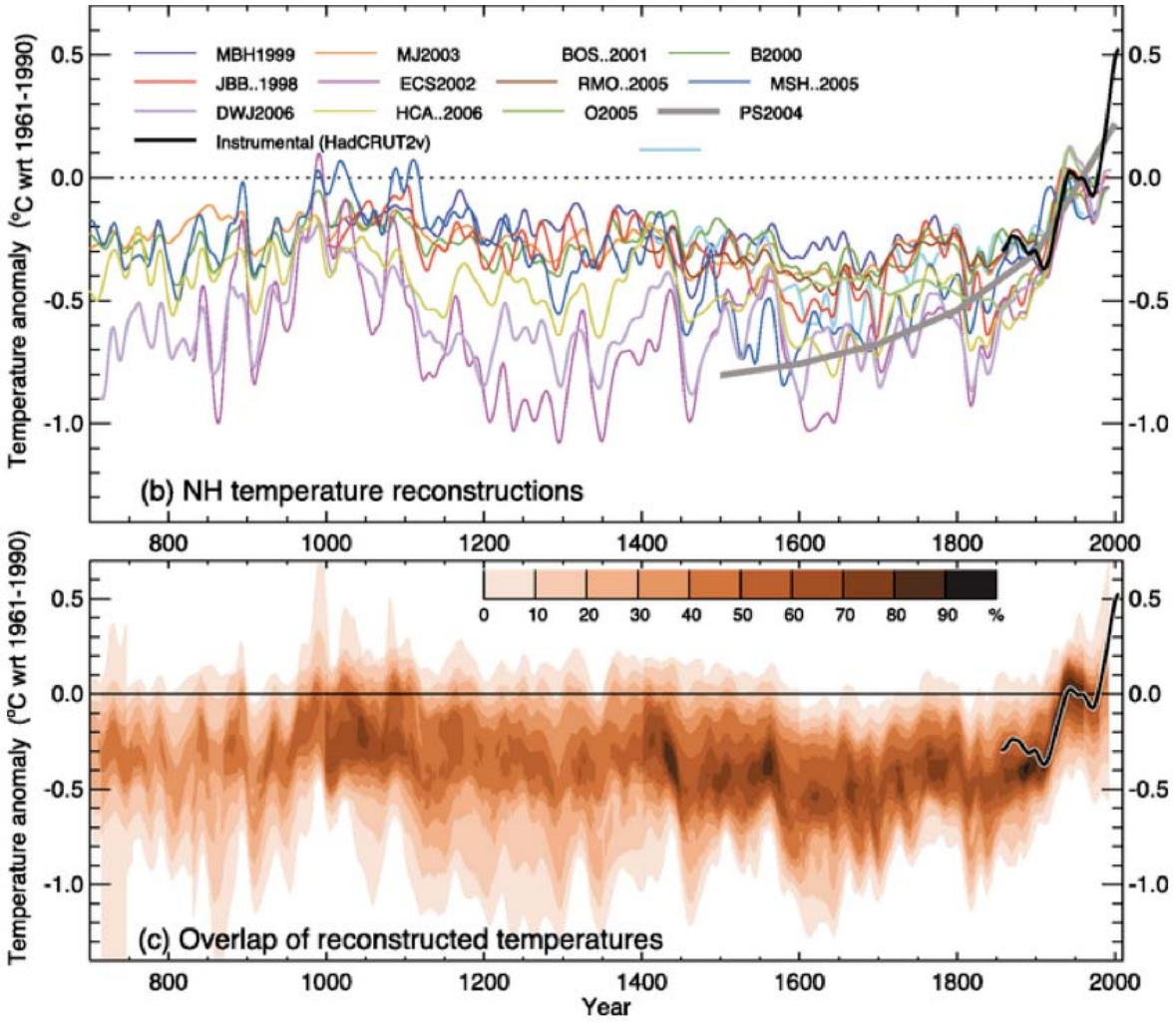
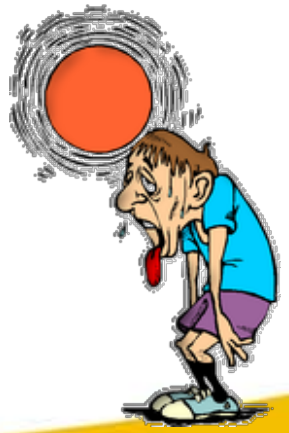
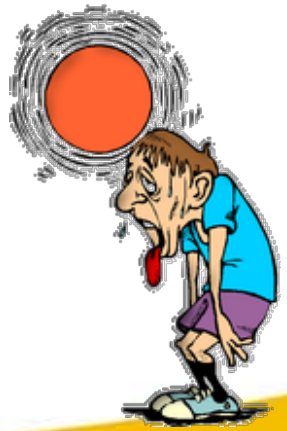
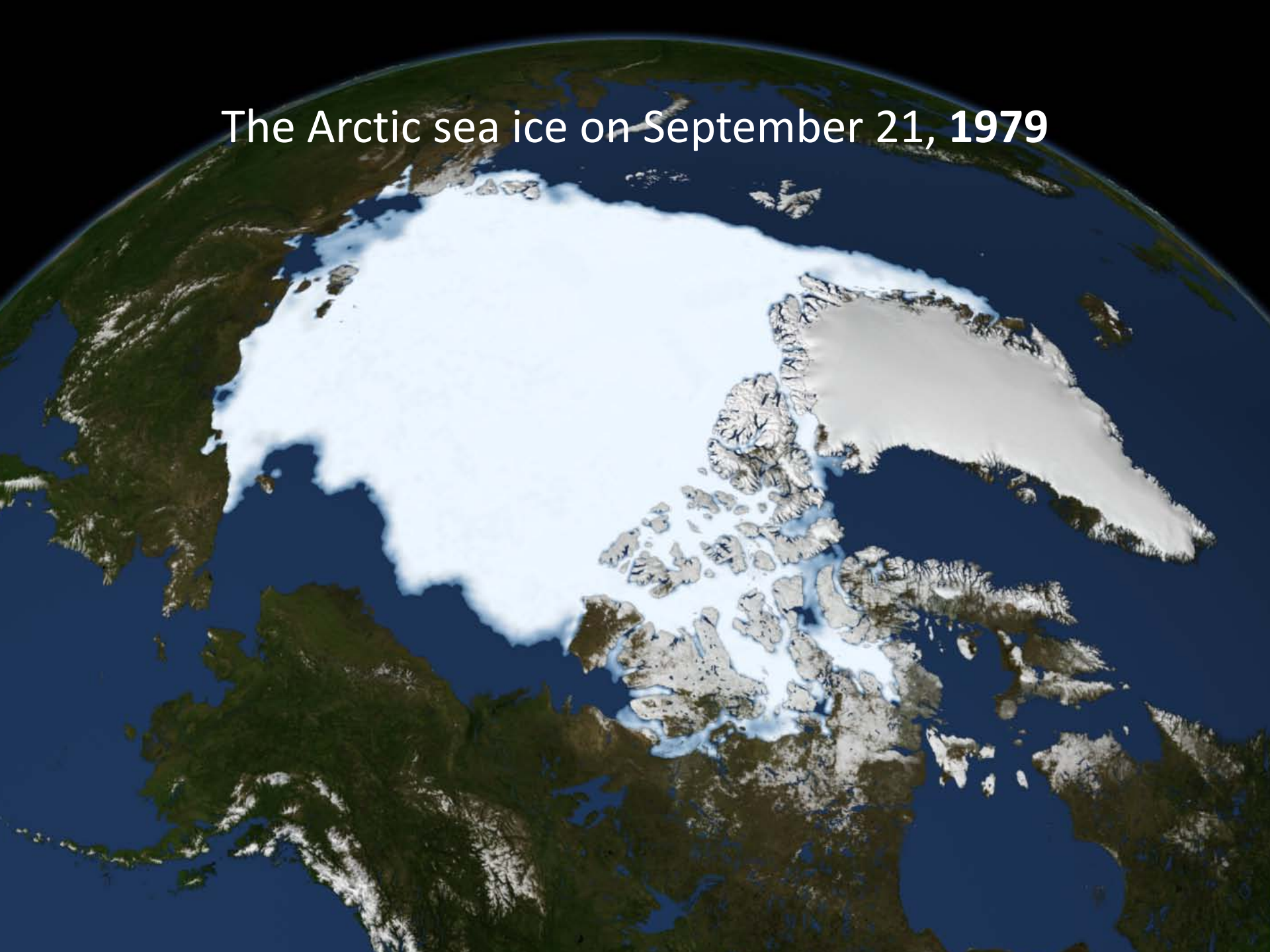


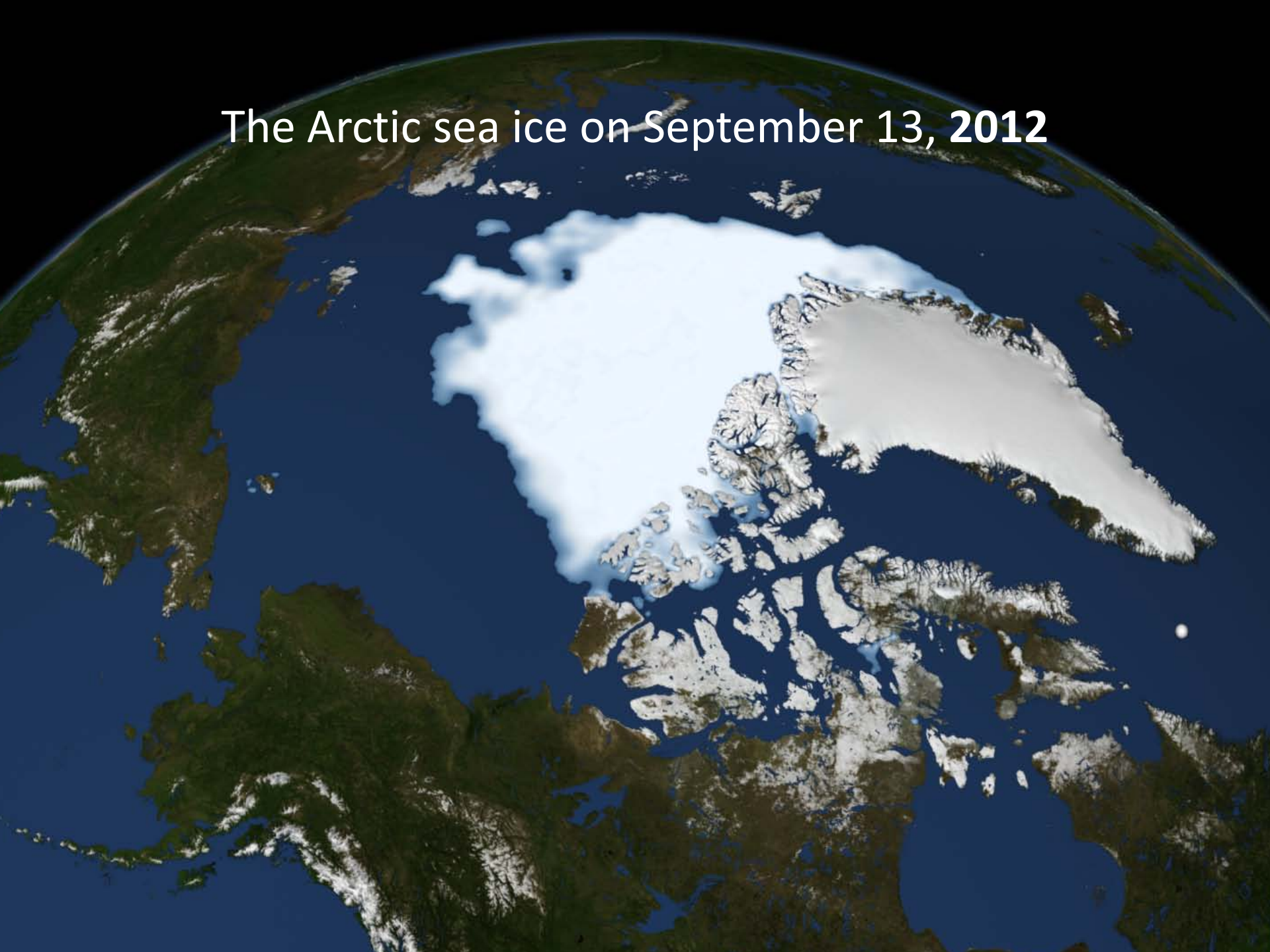


The global average temperature is currently higher than at any time during the last 1,200 years (IPCC Fourth Assessment Report)

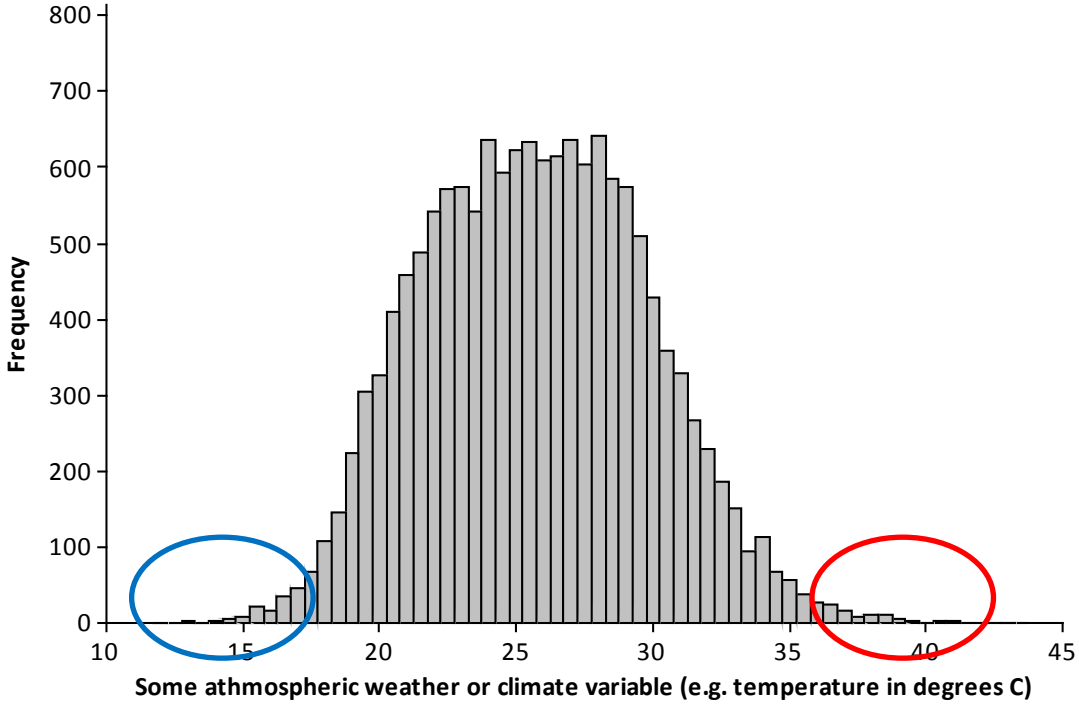
If you are 27 years or younger, you've never experienced a month where the global average temperature was colder than the 20th century average for that month




The Arctic sea ice on September 21, **1979**

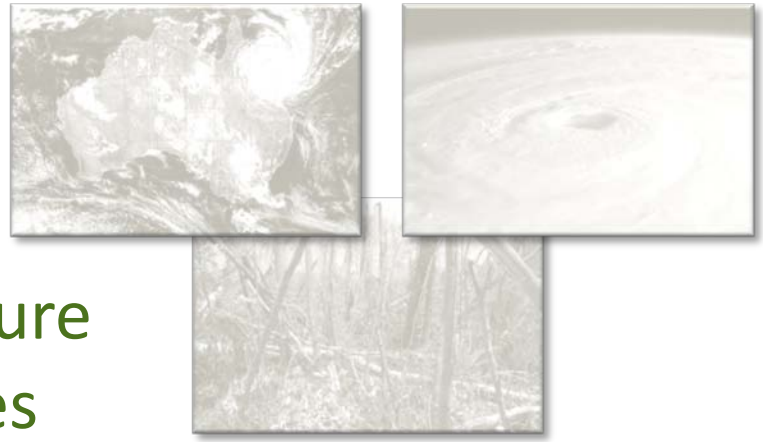

The Arctic sea ice on September 13, **2012**

What are ‘extreme events’?



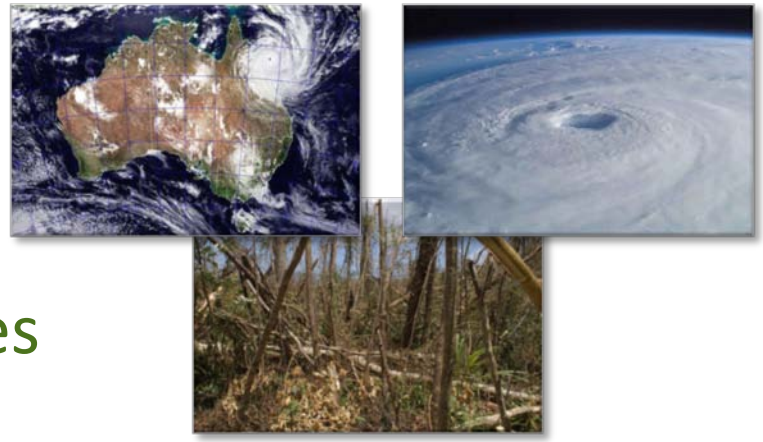
They are values of atmospheric weather and climate variables that are found towards the ends of the normal range

Temperature extremes



Precipitation extremes

Cyclones



There are other events that are sometimes considered ‘extreme events’, including:

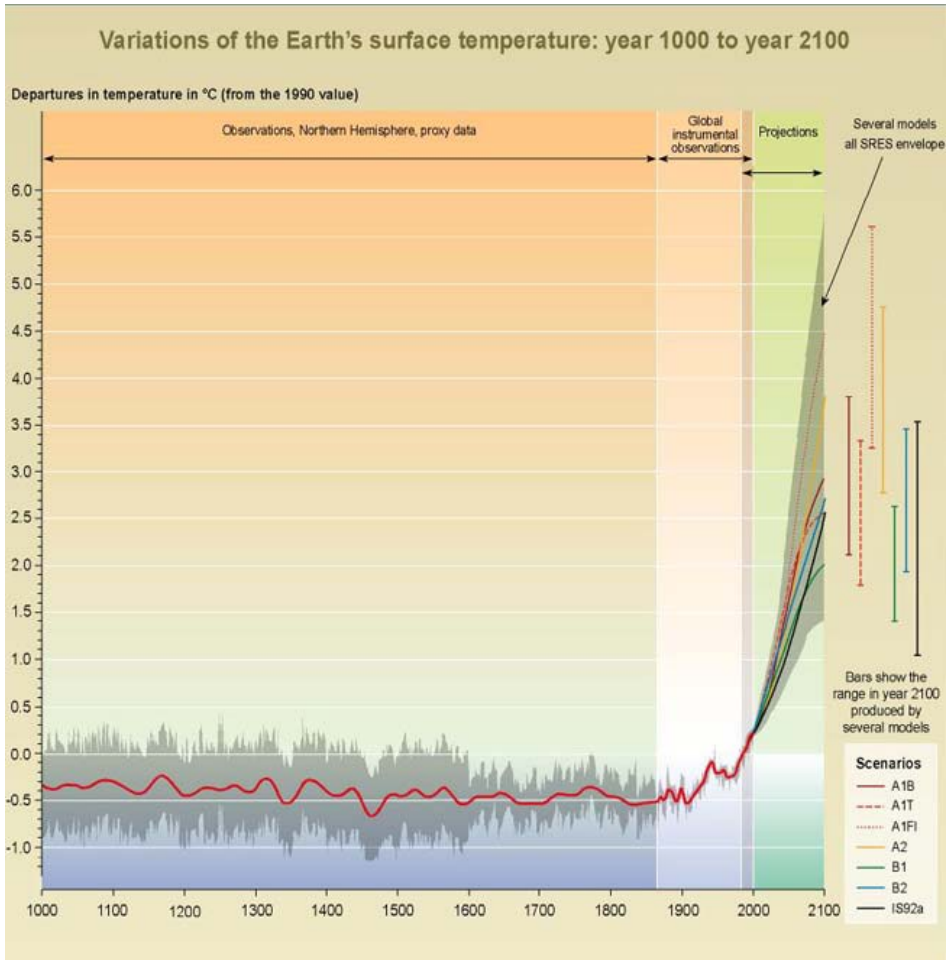
- droughts
- fires
- dust storms
- floods
- landslides
- etc.

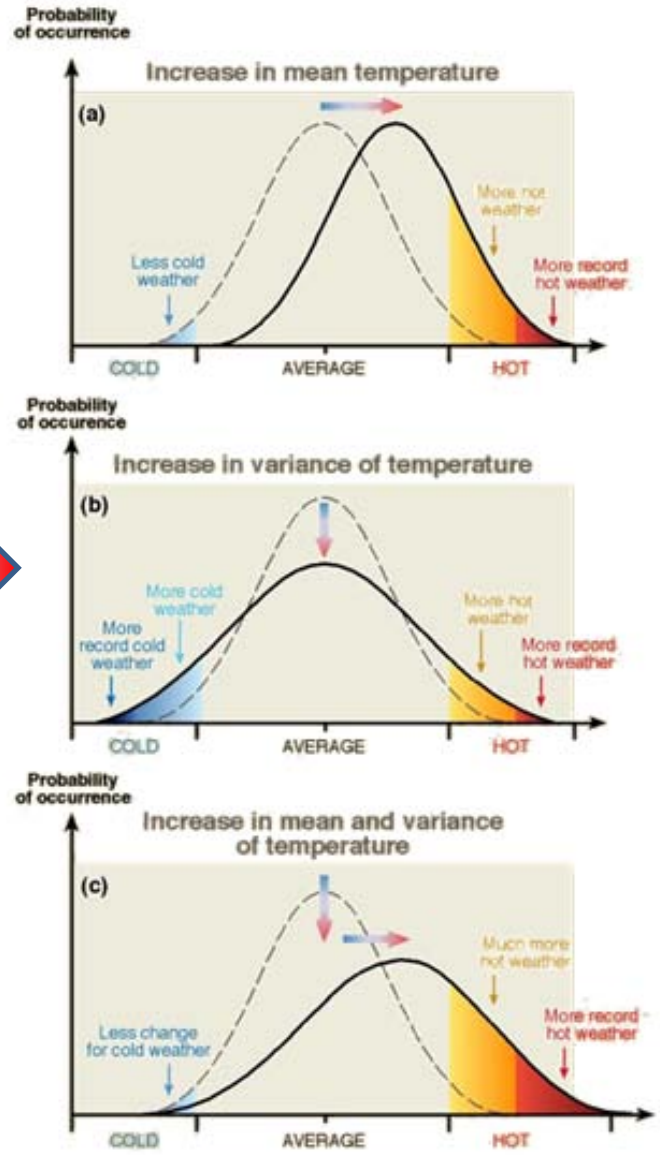
..but these are all in some way or another derived from the atmospheric extremes.

temperature extremes

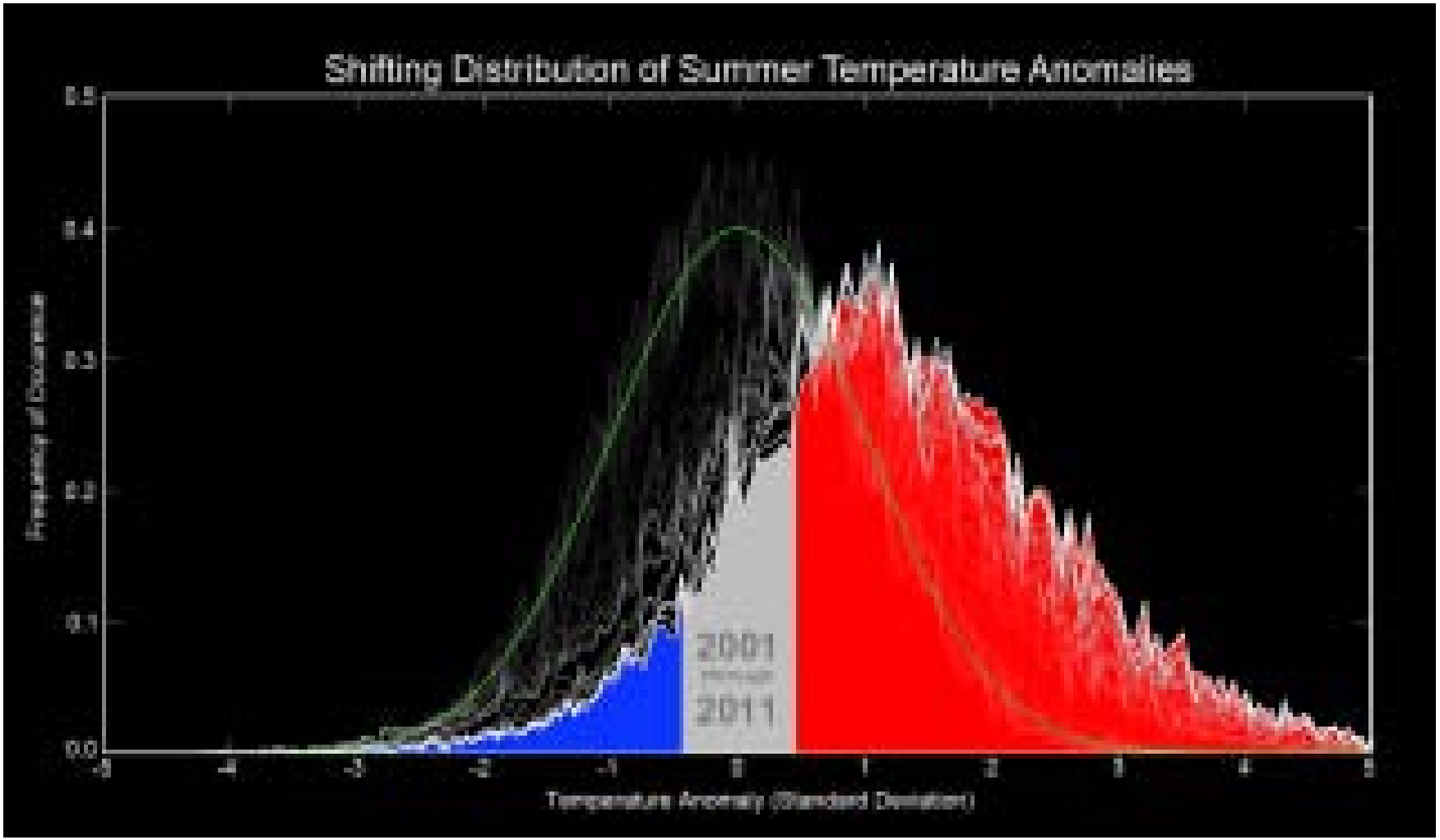
- Among the principal ways in which humans and other organisms strongly experience climate change
- Fundamental expressions of climate change due to their direct link with increased heat content of the atmosphere
- Most data-rich relative to other kinds of extreme events

… through shifts in the mean and the shape of temperature distribution



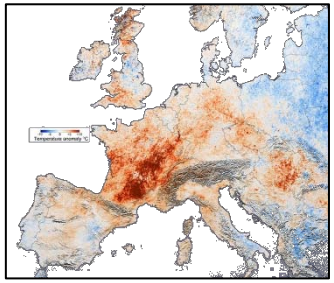


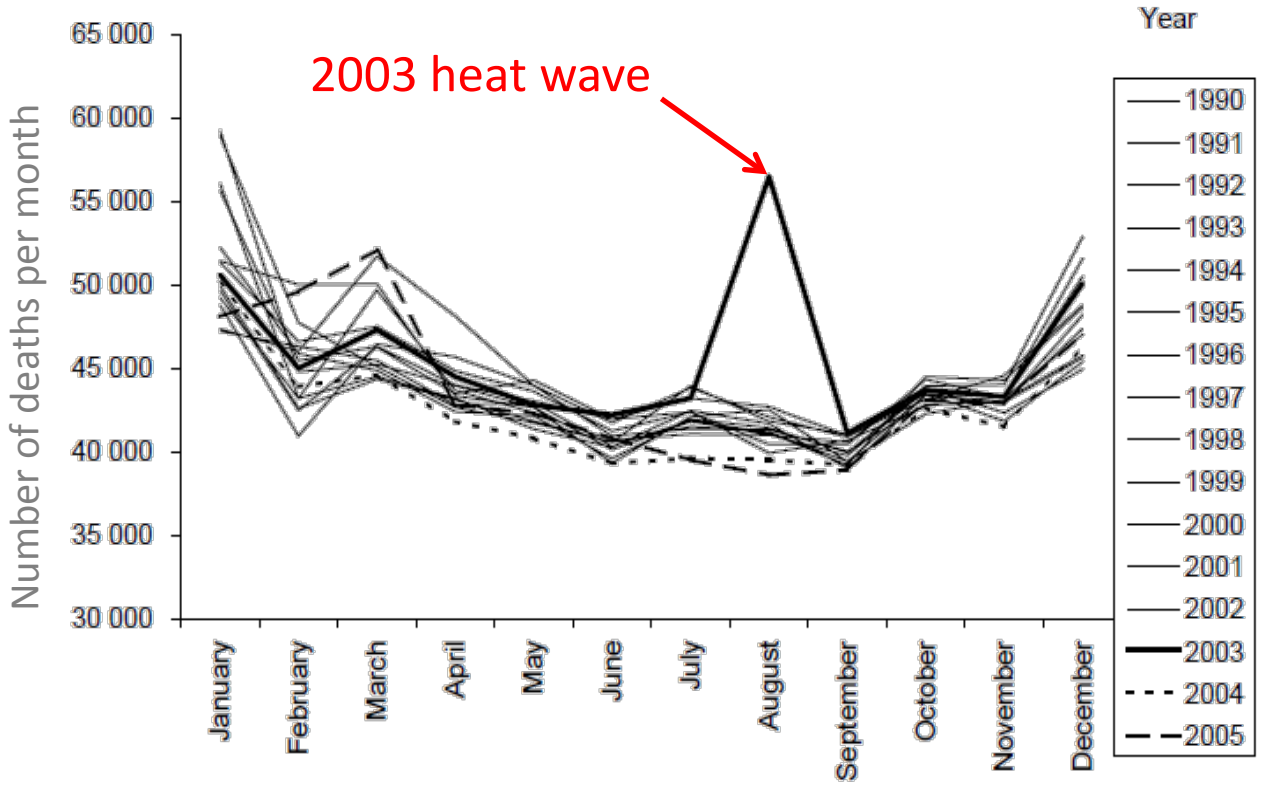
(Animation) Northern Hemisphere temperature anomalies 1950-2011



NASA/Goddard Space Flight Center GISS and Scientific Visualization Studio

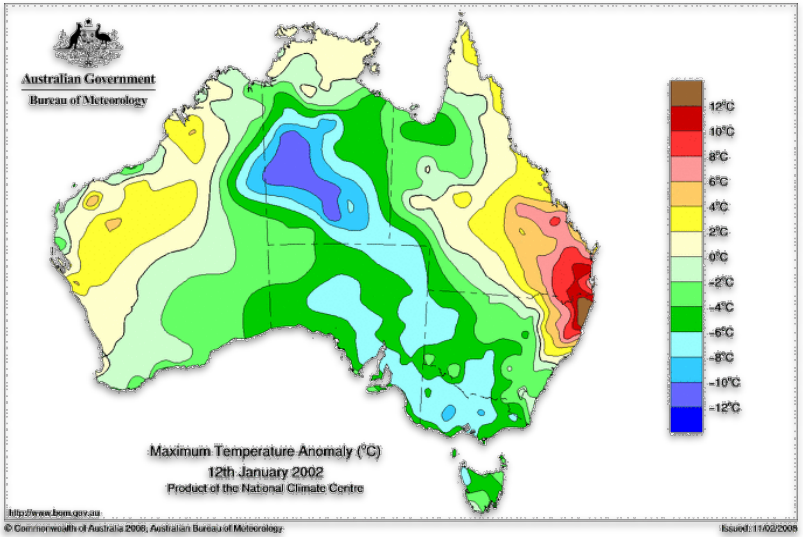
Extreme summer temperatures can cause significant mortality amongst humans





(from Beaumel et al 2005)

Extreme summer temperatures can cause mass die-offs in biodiversity



PROCEEDINGS OF THE ROYAL SOCIETY B

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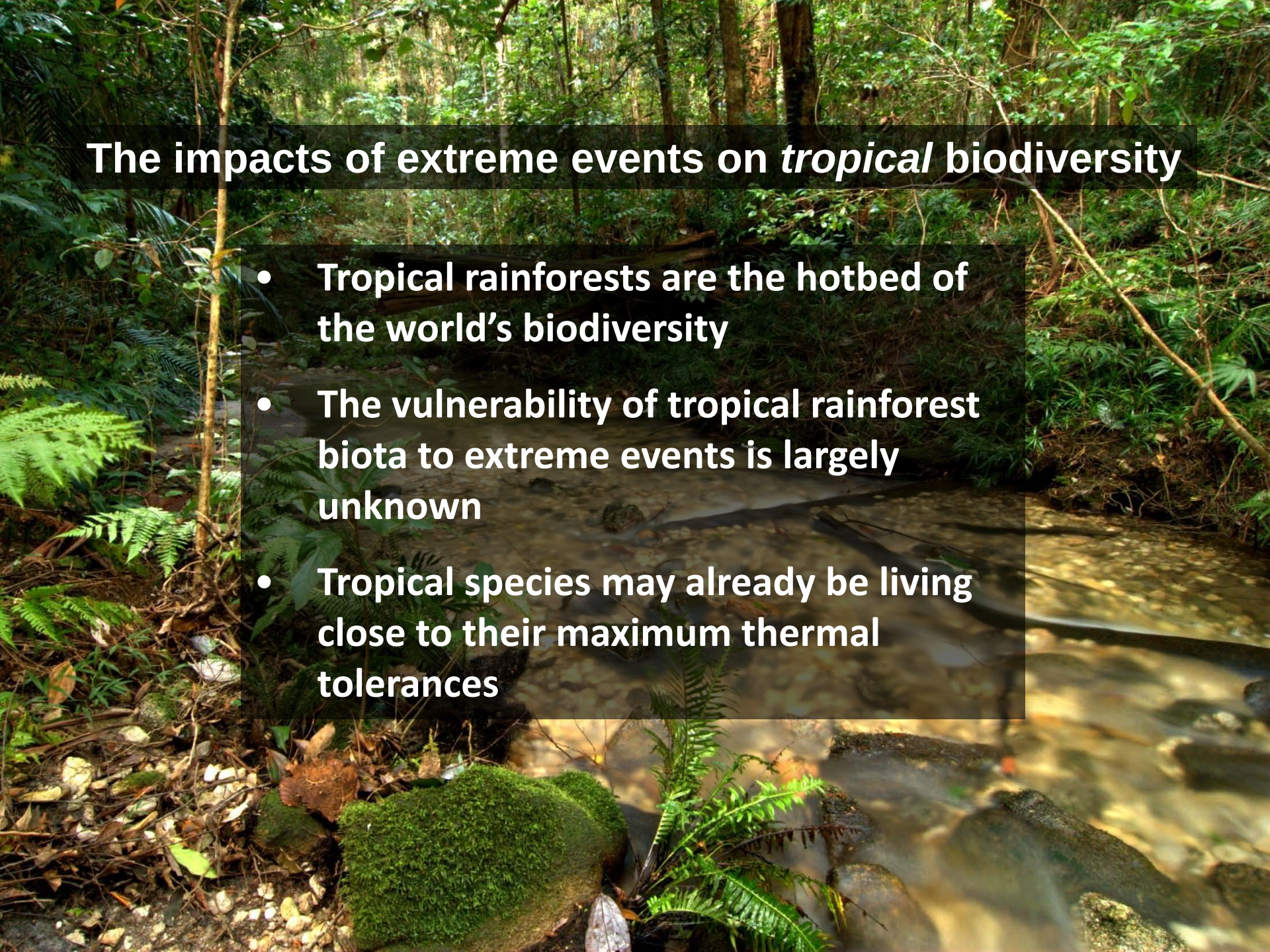
Climate change and the effects of temperature extremes on Australian flying-foxes

Justin A. Welbergen[1,*], Stefan M. Klose[2,3], Nicola Markus[4] and Peggy Eby[5]

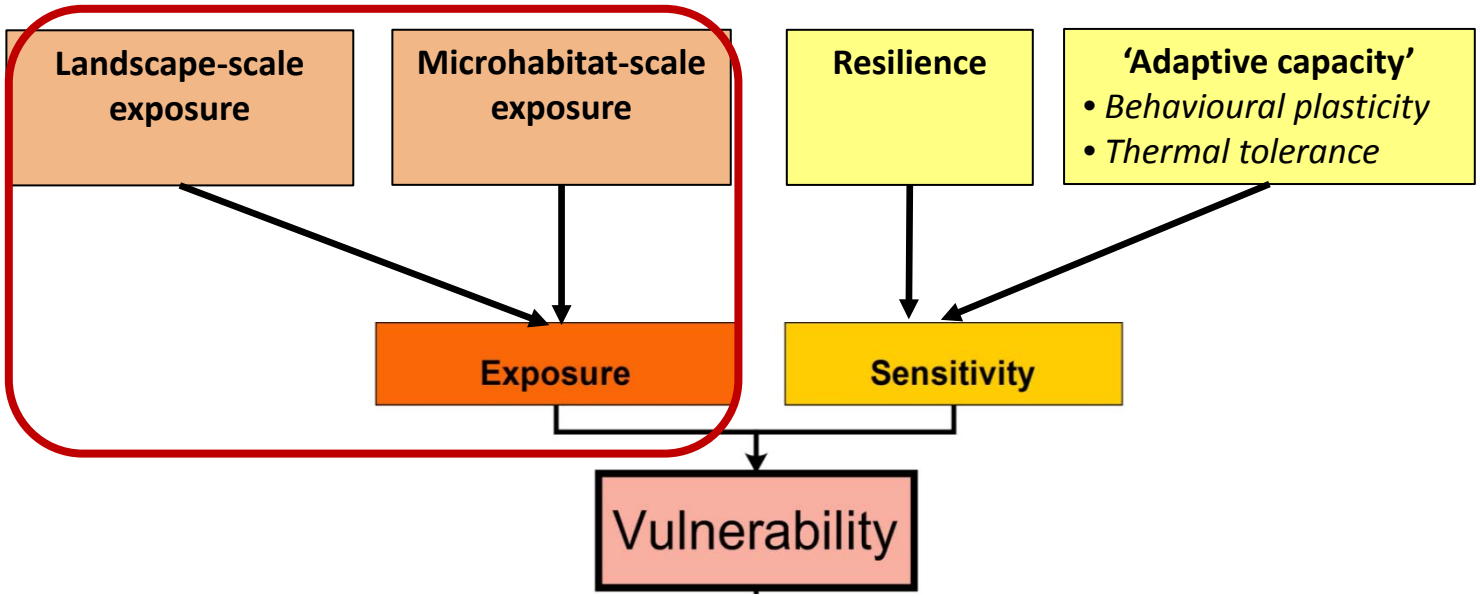
[1]*Department of Zoology, University of Cambridge, Cambridge CB2 3EJ, UK*
[2]*Institute of Experimental Ecology, University of Ulm, 89069 Ulm, Germany*
[3]*School of Integrative Biology, University of Queensland, Brisbane, Queensland 4072, Australia*
[4]*WWF Australia, Ultimo, New South Wales 2007, Australia*
[5]*Department of Ecosystem Management, University of New England, Armidale, New South Wales 2351, Australia*



The impacts of extreme events on *tropical* biodiversity

- Tropical rainforests are the hotbed of the world's biodiversity
- The vulnerability of tropical rainforest biota to extreme events is largely unknown
- Tropical species may already be living close to their maximum thermal tolerances

Assessing vulnerability of biodiversity to extreme events

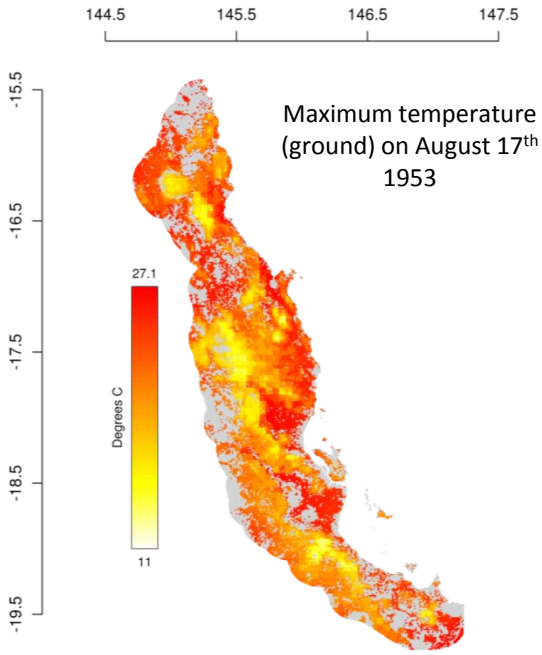


- Outputs year 1: Accurate high-resolution maps of the ***exposure*** to temperature extremes as experienced by organisms in-situ

Based on Williams, S.E., Shoo, L.P., Isaac, J.L., Hoffmann, A.A.& Langham, G. (2008). *PLoS Biol*, 6, 2621-6.

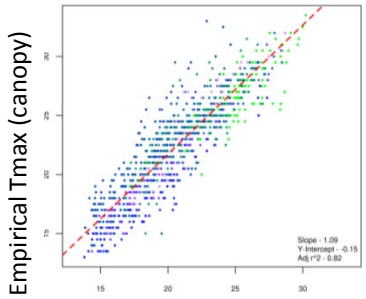
Estimates of exposure

Downscaled estimates of historical daily maximum and minimum temperature...



Maximum temperature (ground) on August 17th 1953

closely predict hourly temperatures in key microhabitats...



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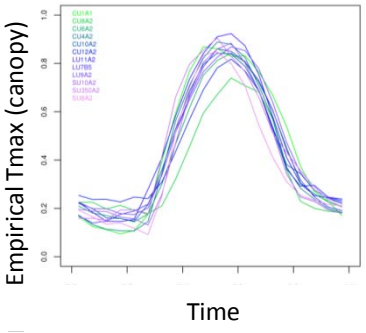
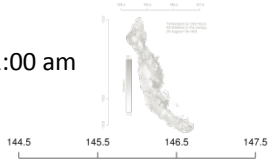
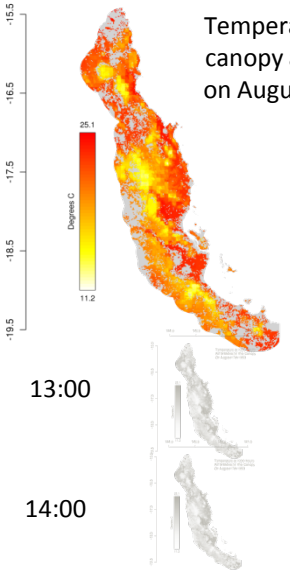


enabling hourly estimates of historical temperature in key microhabitats.

11:00 am





Temperature in the canopy at 12:00 pm on August 17th 1953

13:00

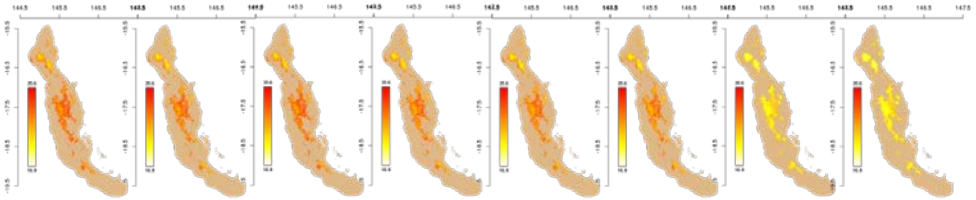
14:00

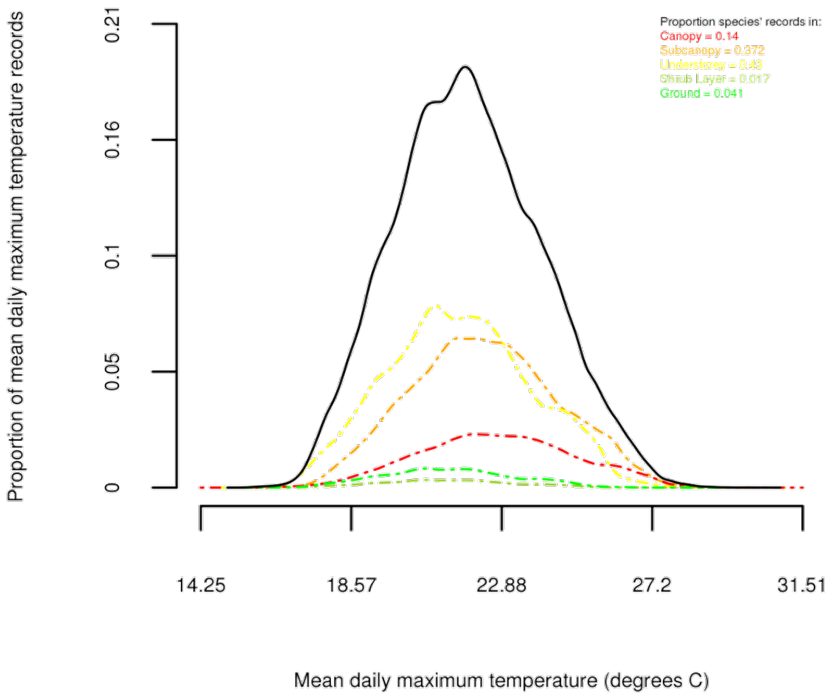
etc.

Welbergen et al unpublished

Estimates of exposure

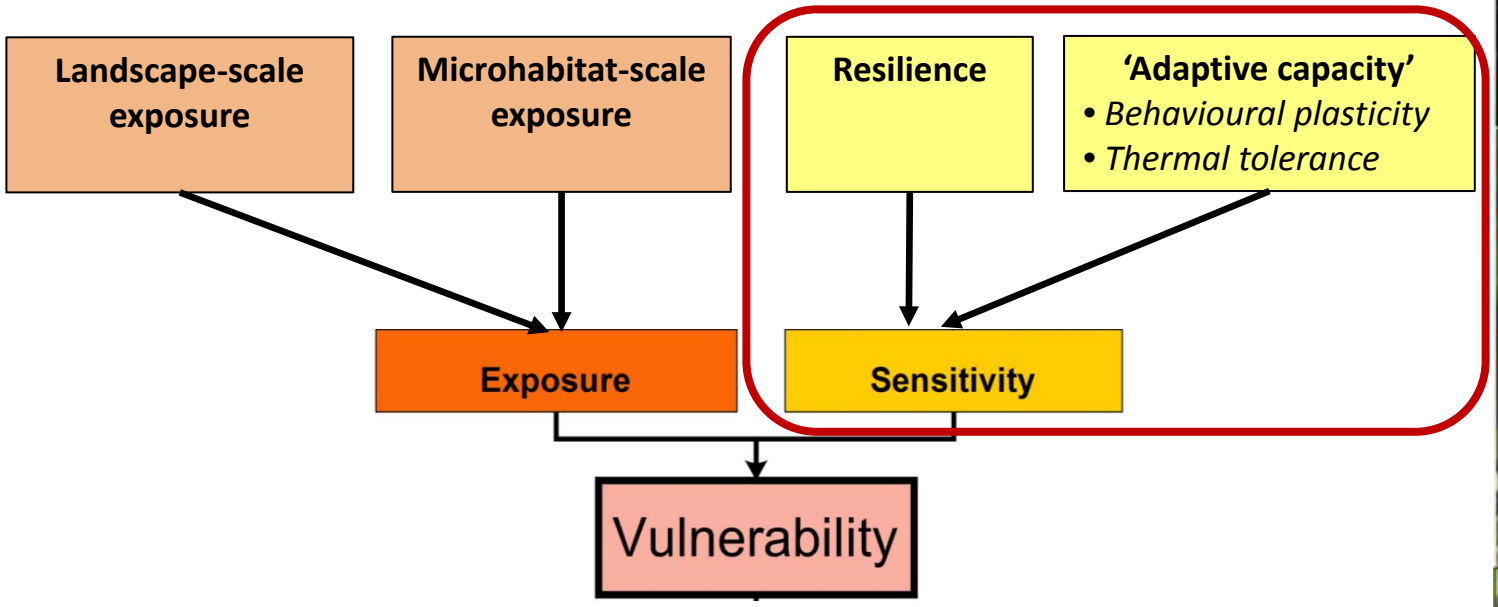
We can estimate the exposure of any species with a know distribution and microhabitat use





Welbergen et al unpublished

Assessing vulnerability of biodiversity to extreme events



- Outputs year 2: Accurate estimates of the ***sensitivity*** of organisms to temperature extremes

Estimates of "*Resilience*"

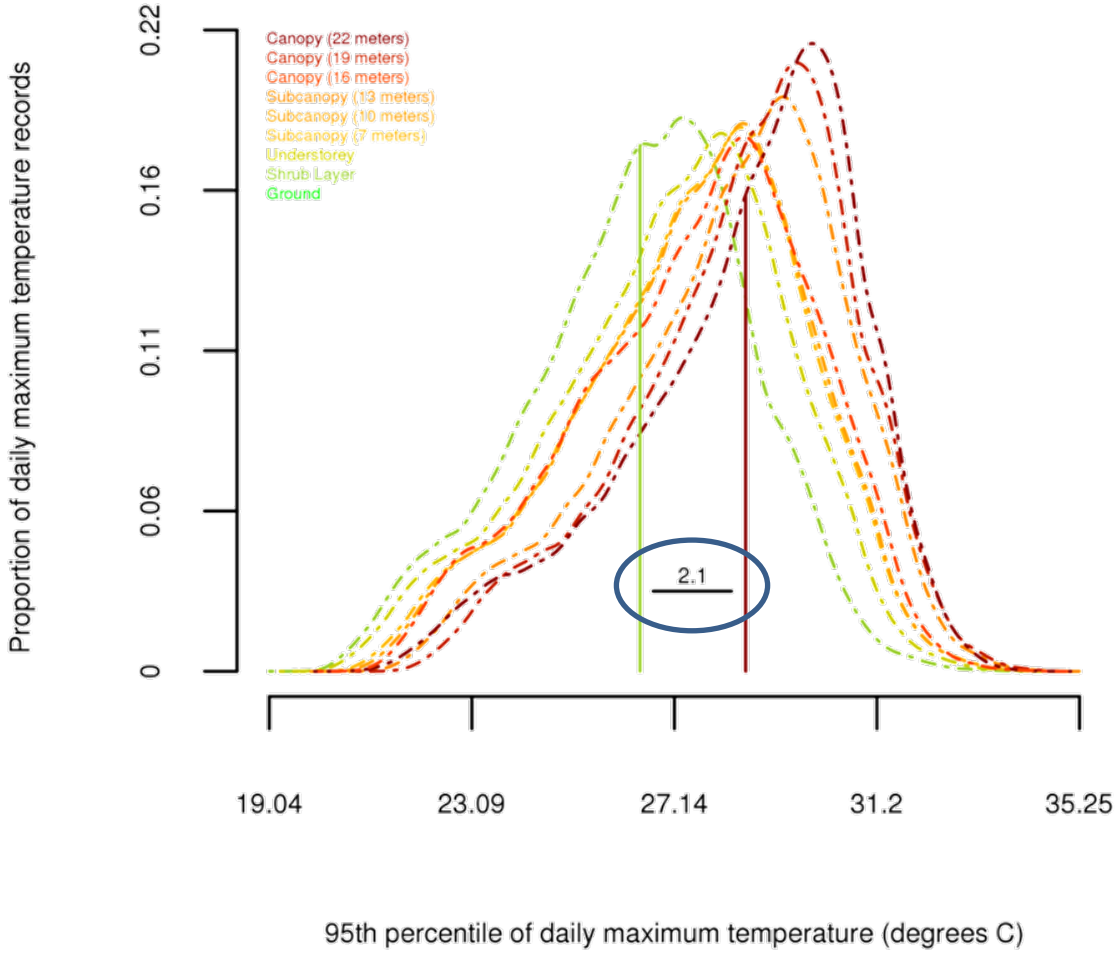
= The ability of species to recover from environmental disturbances

Rank	Resilience index	Binomial species' name	Common name	IUCN Status
1	0.000	*Techmarscincus jigurru*	Bartle Frere cool-skink	NL
2	0.001	*Eulamprus frerei*	Bartle Frere barsided skink	NL
3	0.009	*Cophixalus neglectus*	Tangerine nursery-frog	EN B1ab(v)+2ab(v)
4	0.087	*Hemibelideus lemuroides*	Lemuroid ringtail possum	LR NT
5	0.091	*Cophixalus monticola*	Mountain top nursery-frog	EN B1ab(v)+2ab(v)
6	0.100	*Cophixalus hosmeri*	Pipping nursery-frog	VU D2
7	0.103	*Lampropholis robertsi*	Grey-bellied sunskink	NL
8	0.104	*Trichosurus vulpecula johnstonii*	Coppery brushtail possum	LR LC
9	0.105	*Taudactylus rheophilus*	Northern tinkerfrog	CR A2ac; B2ab(v)
10	0.109	*Antechinus godmani*	Atherton antechinus	LR NT
11	0.111	*Saproscincus czechurai*	Saproscincus czechurai	NL
12	0.112	*Sminthopsis leucopus*	White-footed dunnart	DD
13	0.116	*Glaphyromorphus mjobergi*	Atherton Tableland mulch-skink	NL
14	0.120	*Pseudochirulus herbertensis*	Herbert river ringtail possum	LR NT
15	0.123	*Acanthiza katherina*	Mountain thornbill	LC
16	0.123	*Uromys hadrourus*	Masked white-tailed rat	LR NT
17	0.125	*Prionodura newtoniana*	Golden bowerbird	LC
18	0.128	*Ptilonorhynchus violaceus*	Satin bowerbird	LC
19	0.128	*Dasyurus maculatus*	Spotted-tailed quoll	VU C1+2a
20	0.130	*Sericornis keri*	Atherton scrubwren	LC

Welbergen et al, unpublished

Estimates of *"Behavioural plasticity"*

= The ability of species to seek out cooler microhabitats



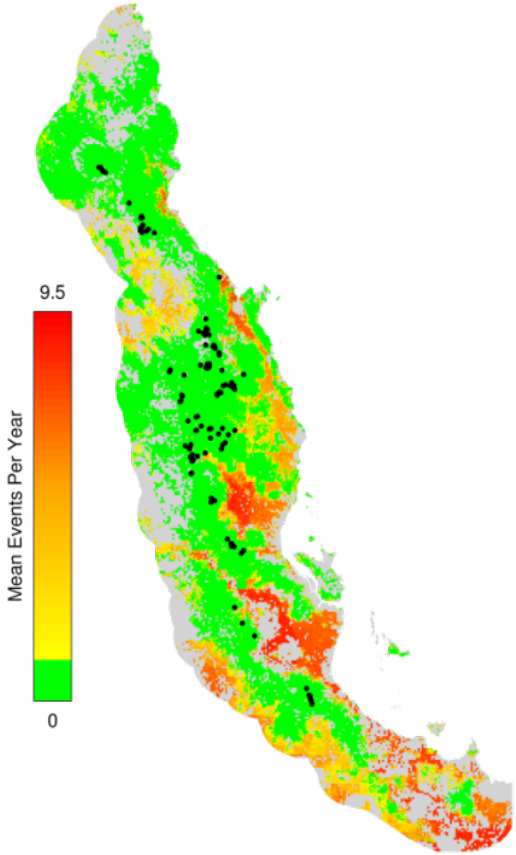
Welbergen et al, unpublished

Estimates of "*Thermal tolerance*"

= The ability of species to withstand certain temperatures

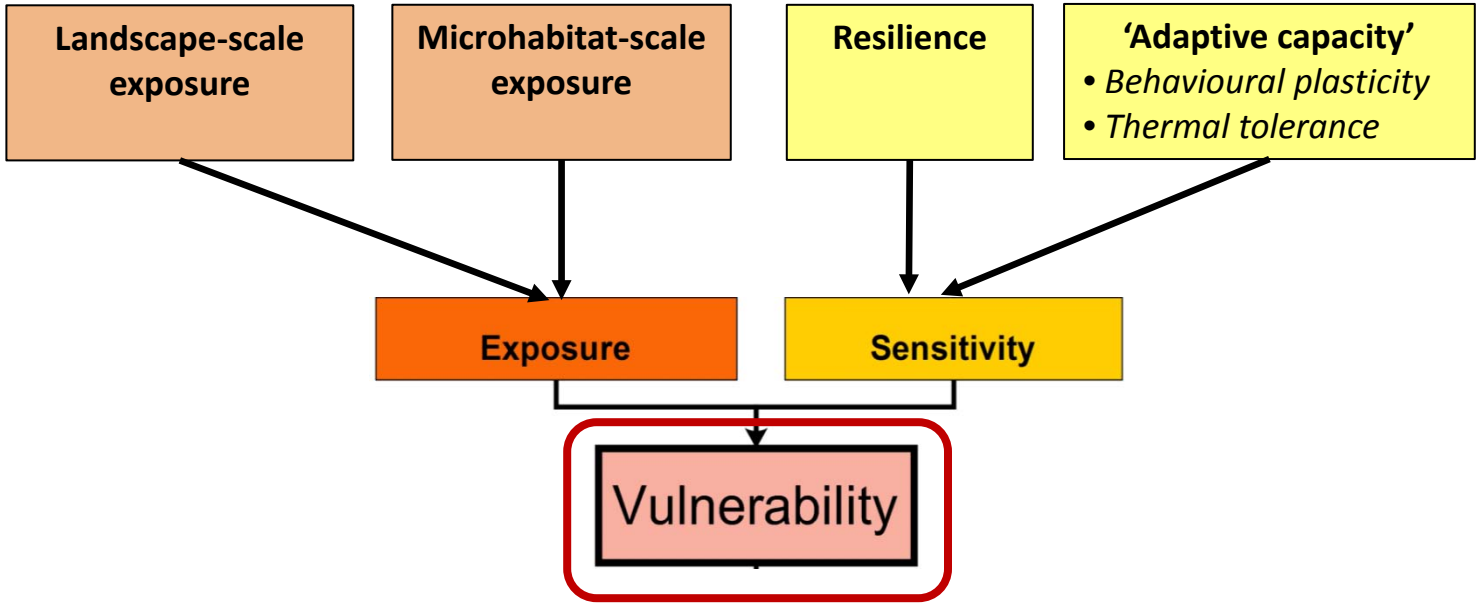
Example : Green ringtail possums will not survive when the ambient temperature exceeds > 30 ^{o}C for more than 5 h per day for more than 4 consecutive days (Krockenberger et al 2012).

The species is only present where this temperature regime <u>does not</u> occur.



Welbergen et al, unpublished

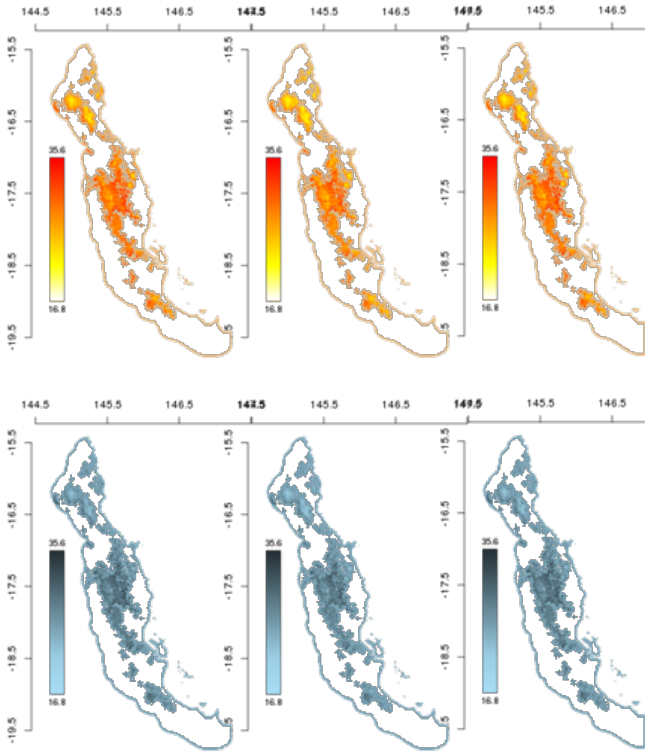
Vulnerability



Our final aim is to conduct vulnerability assessments and produce:

Vulnerability: *expected outputs*

- Maps of the areas where biodiversity is currently most vulnerable to temperature extremes (‘thermal hotspots’)
- Maps of the areas where biodiversity is least vulnerable to temperature extremes in the future (‘thermal refugia’)
- List of species particularly at risk from extreme events






THANK YOU

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CONTACT

Name:	Justin Welbergen
Organisation:	James Cook University, Townsville
Phone:	(07) 4781 4479
Email:	Justin.Welbergen@jcu.edu.au

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