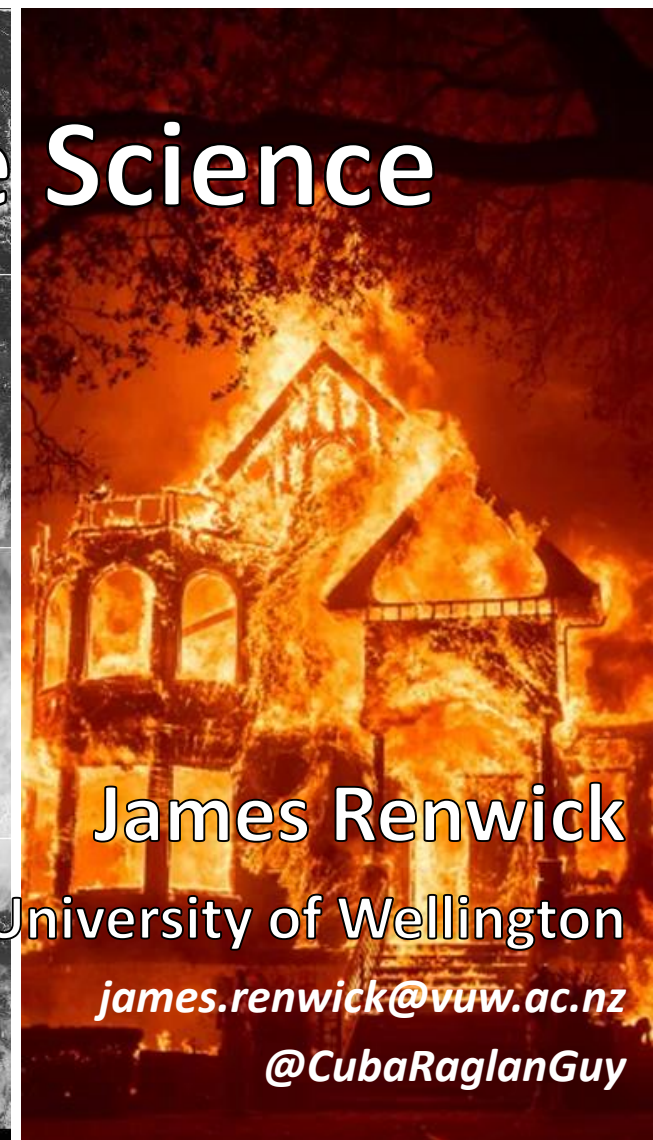
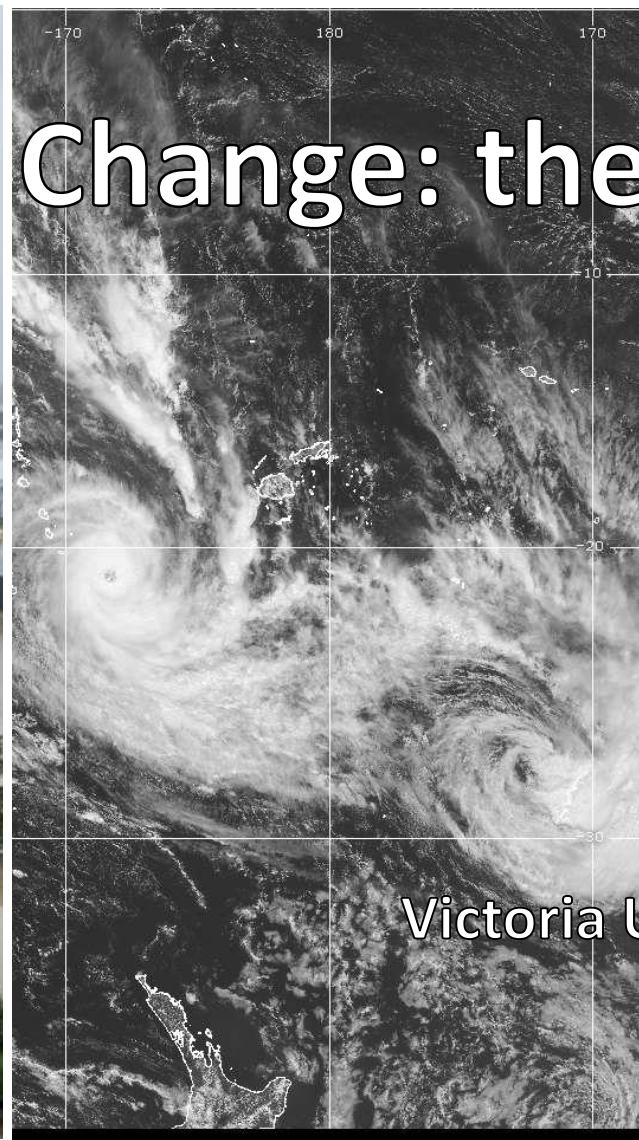


Climate Change: the Science



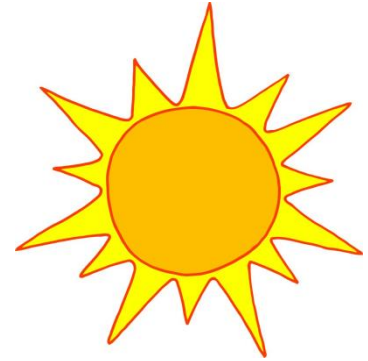
James Renwick
Victoria University of Wellington

james.renwick@vuw.ac.nz

@CubaRaglanGuy

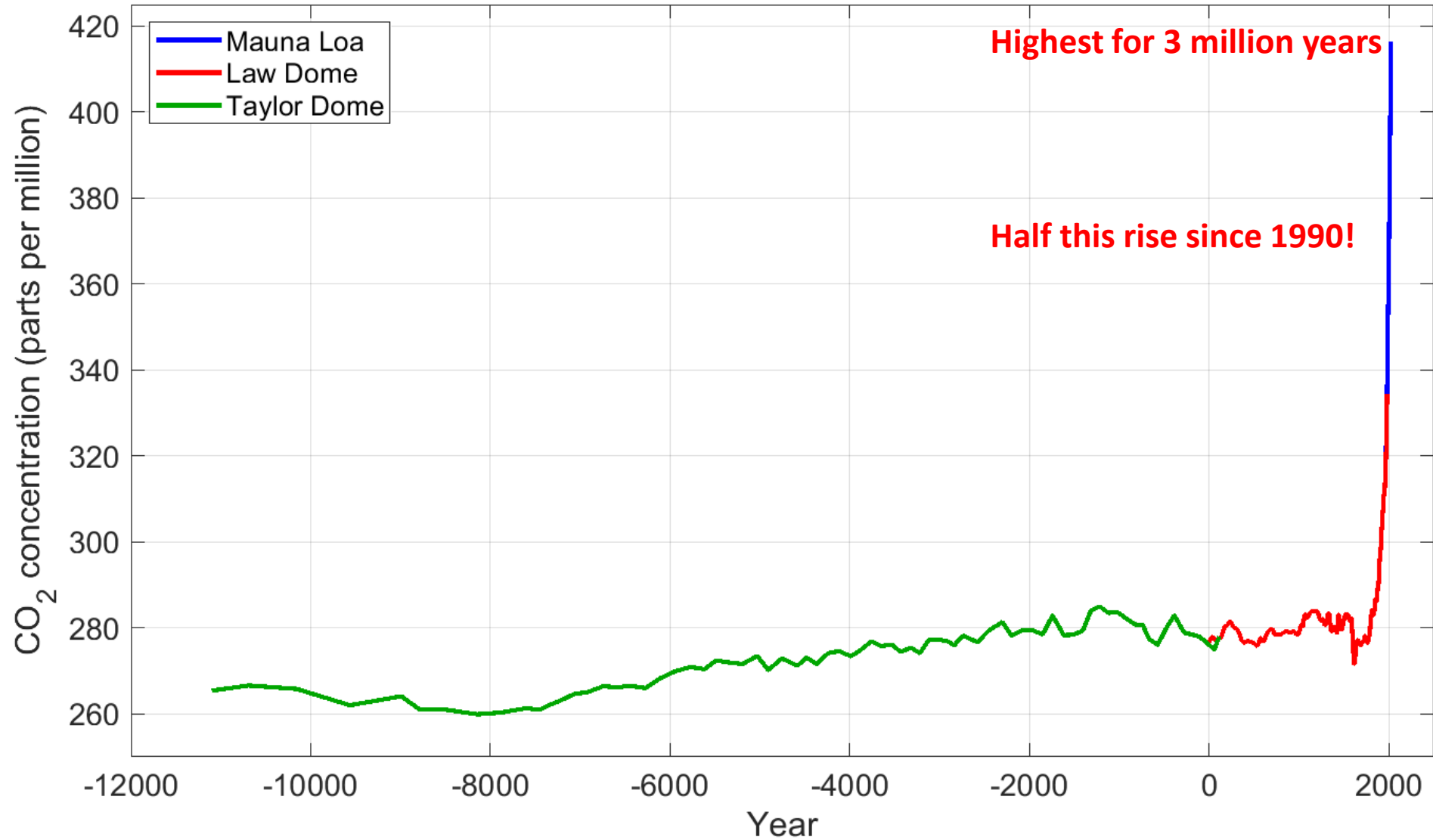
Climate Change 101

- The sun emits (mostly) visible light
 - Absorbed by the earth
- The earth emits heat (infrared) radiation
 - Absorbed (and re-radiated) by the atmosphere
 - By “greenhouse” gases (carbon dioxide, water vapour, etc)
- Change the climate by
 - Changing sunlight
 - Changing greenhouse gas amounts



The problem today

Carbon dioxide concentration





[Credit: NASA]

“Recent changes in the climate are widespread, rapid, and intensifying, and unprecedented in thousands of years.”



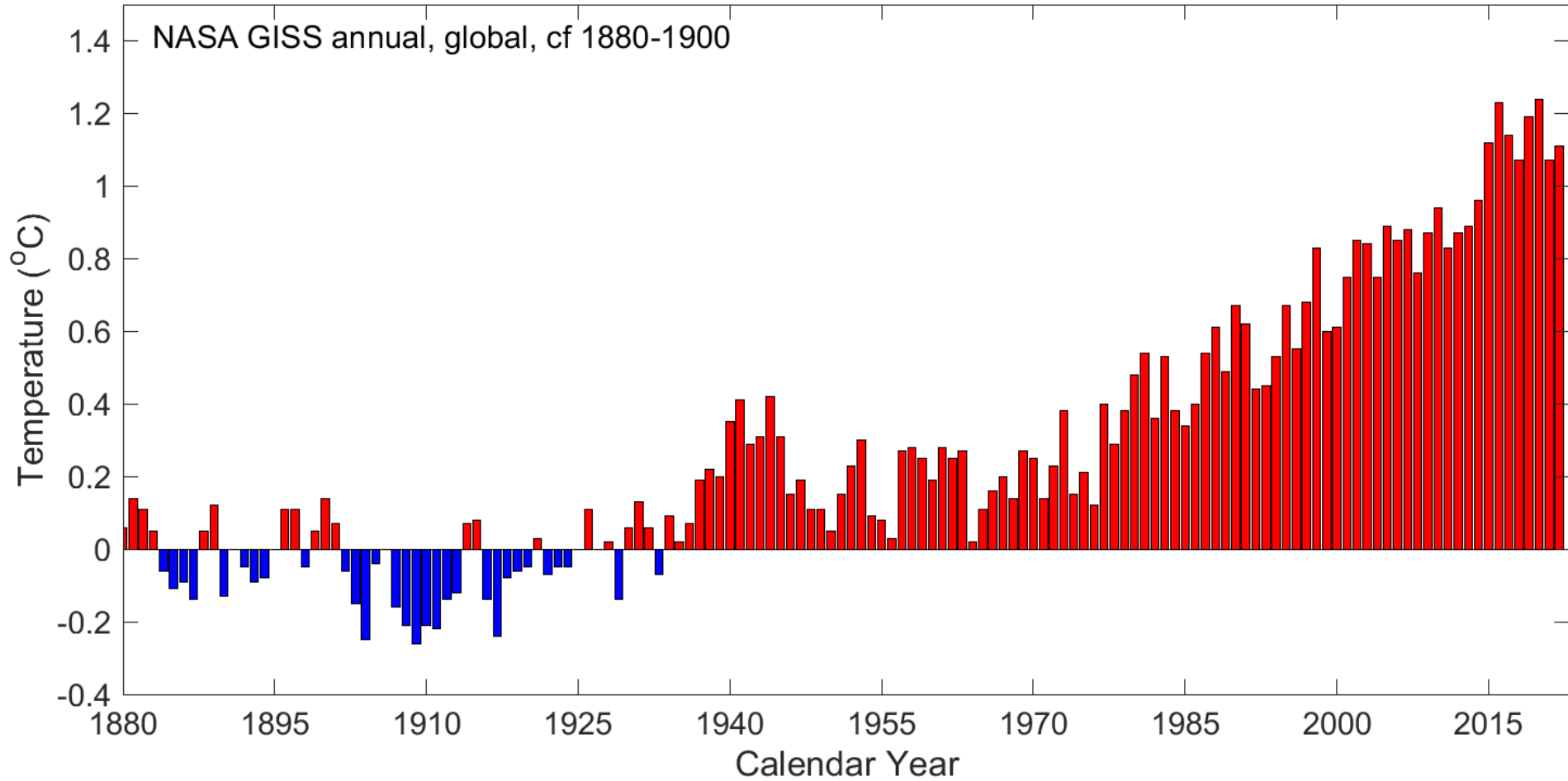
[Credit: Hong Nguyen | [Unsplash](#)]

“ Climate change is already affecting every region on Earth, in multiple ways.

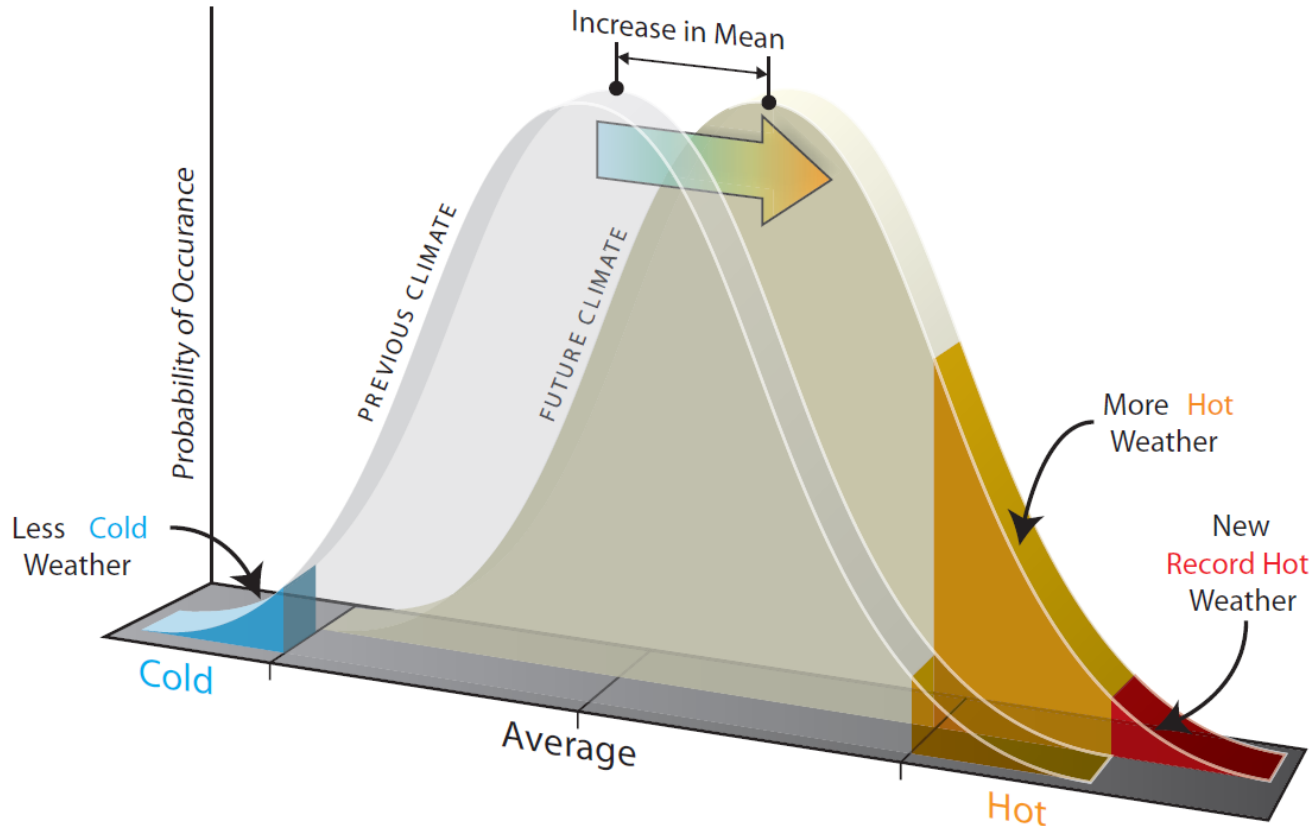
The changes we experience will increase with further warming.

Temperature Change

1.5°C



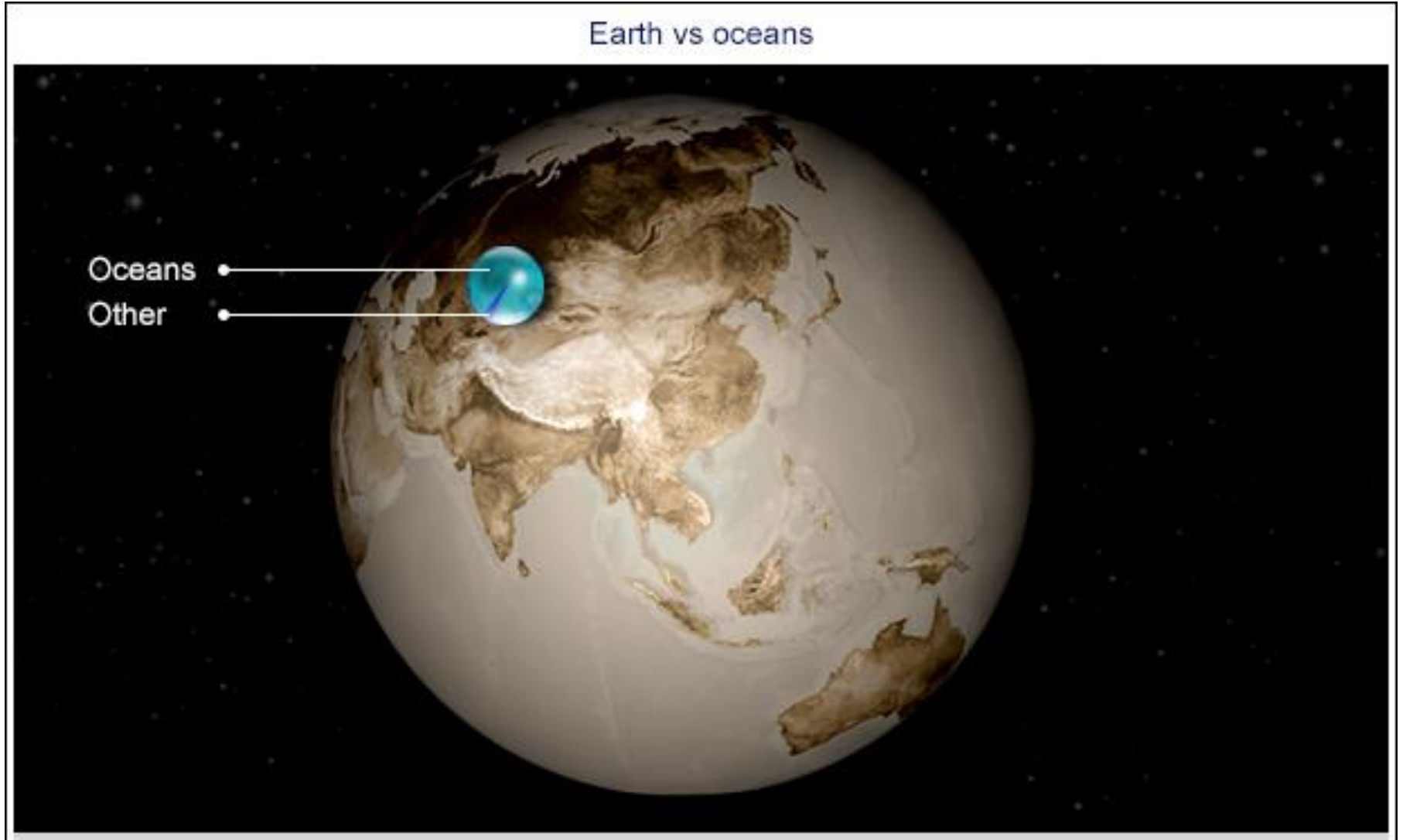
Changes in extremes: temperature



Reisinger (2009)

- Small increase in the average
 - Big increase in risk of extremes
 - Including new, unprecedented extreme values

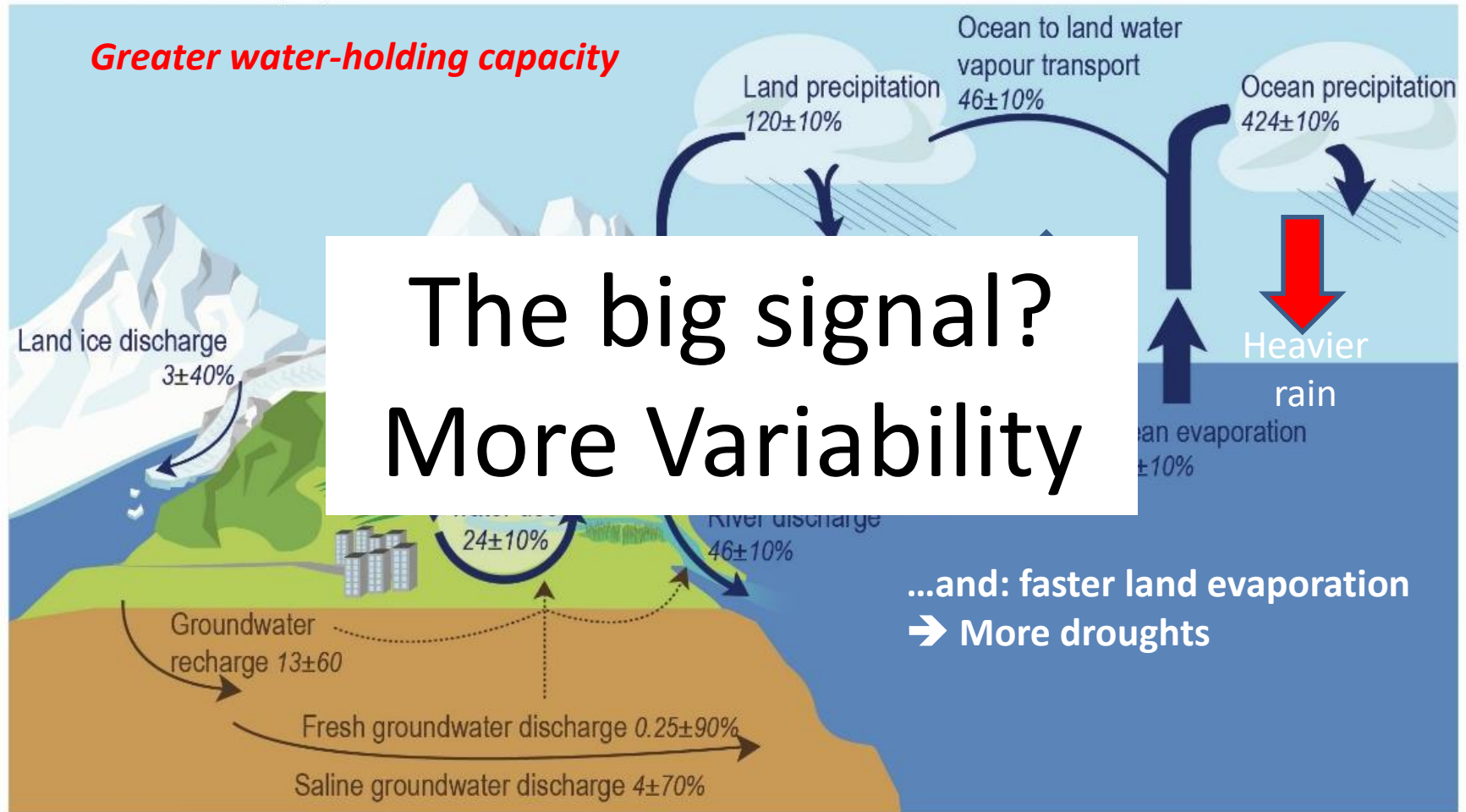
The Earth and its water



Water and Climate Change

(b) Water fluxes

Units in thousands of km³ per year





[Credit: Yoda Adaman | Unsplash]

“ It is indisputable that human activities are causing climate change, making extreme climate events, including heat waves, heavy rainfall, and droughts, more frequent and severe.

Heatwaves & droughts



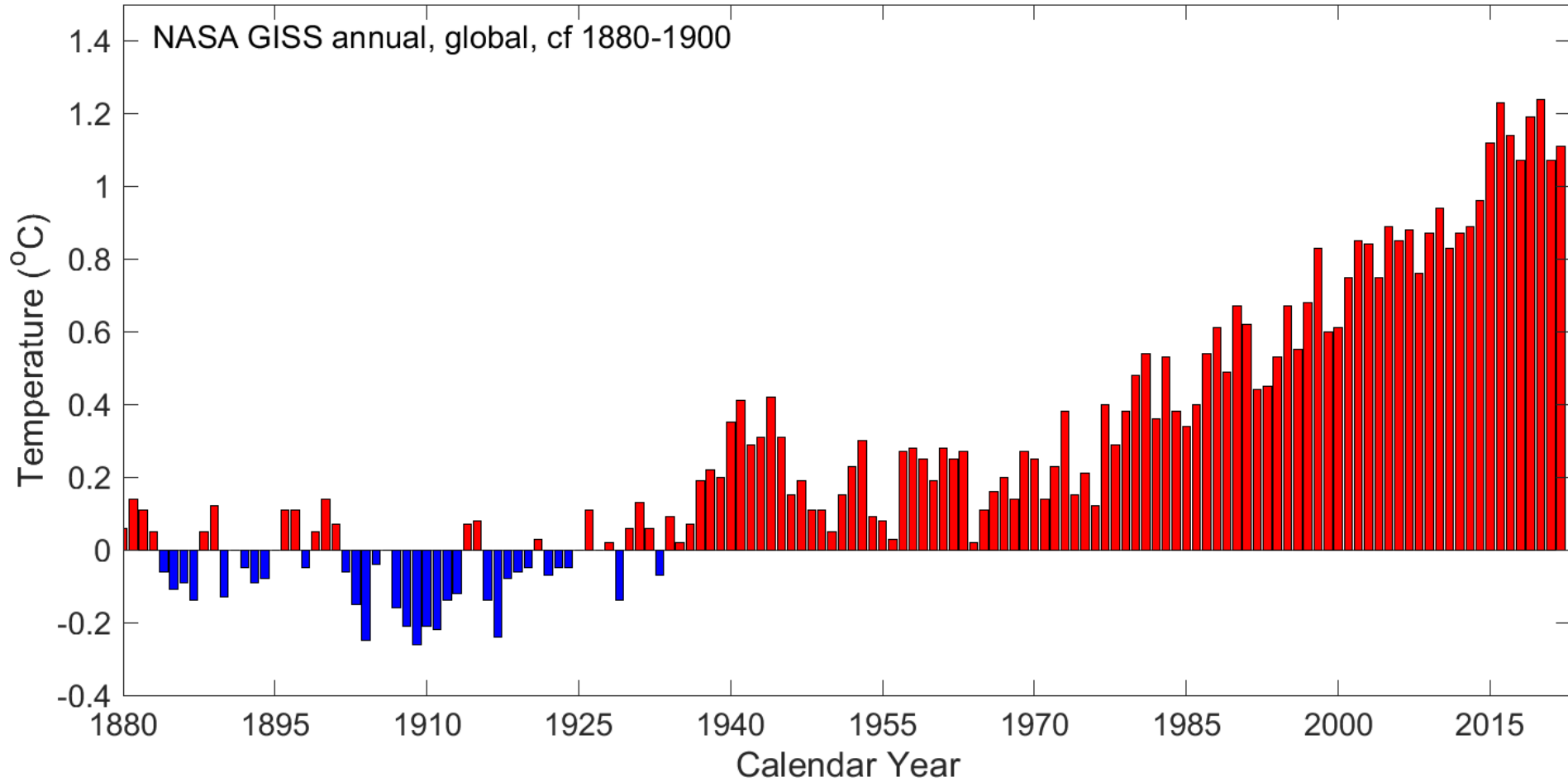
Yangtze River, Wuhan, 19 August

And floods

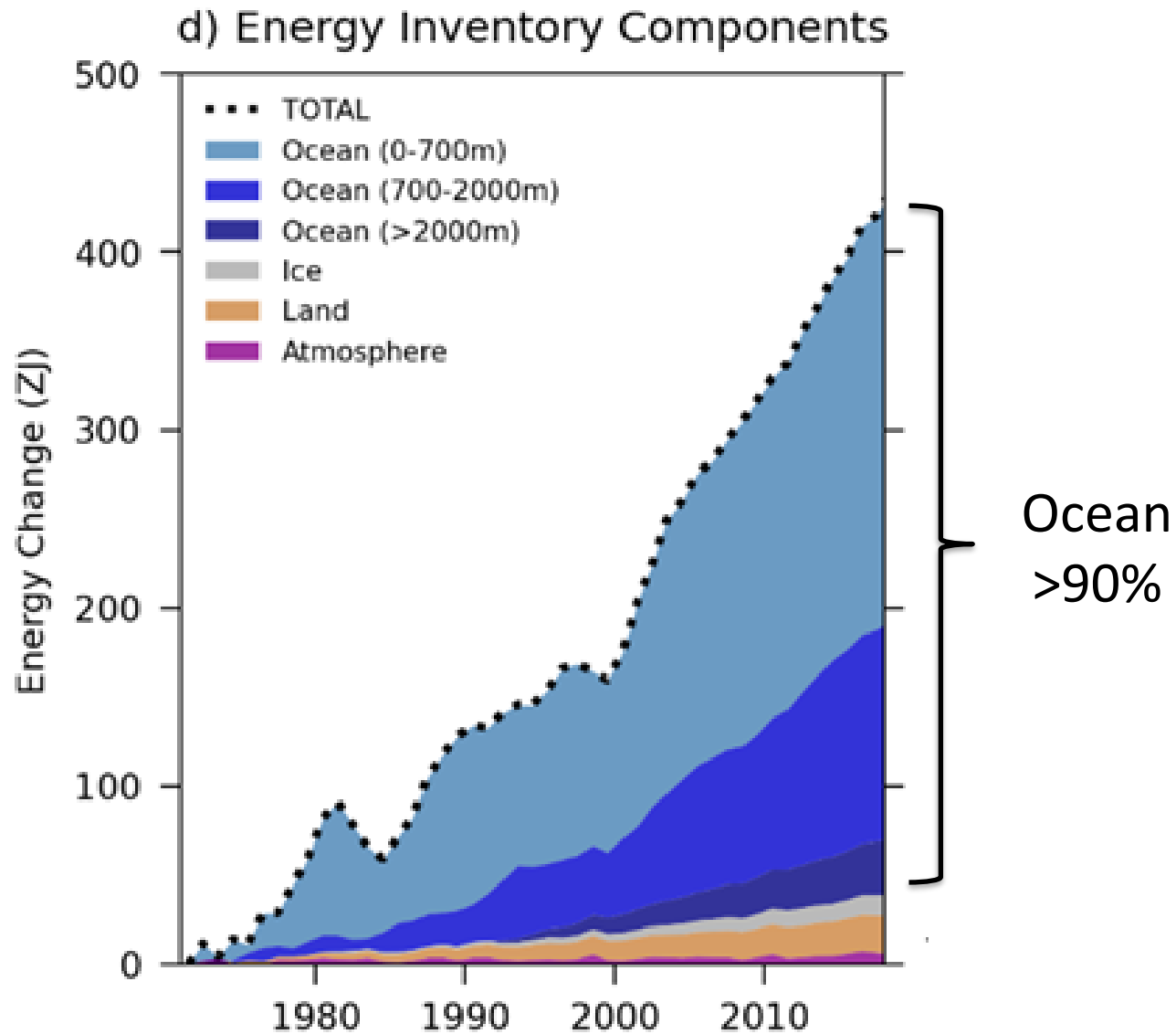


Auckland International Airport, RNZ

Temperature Change

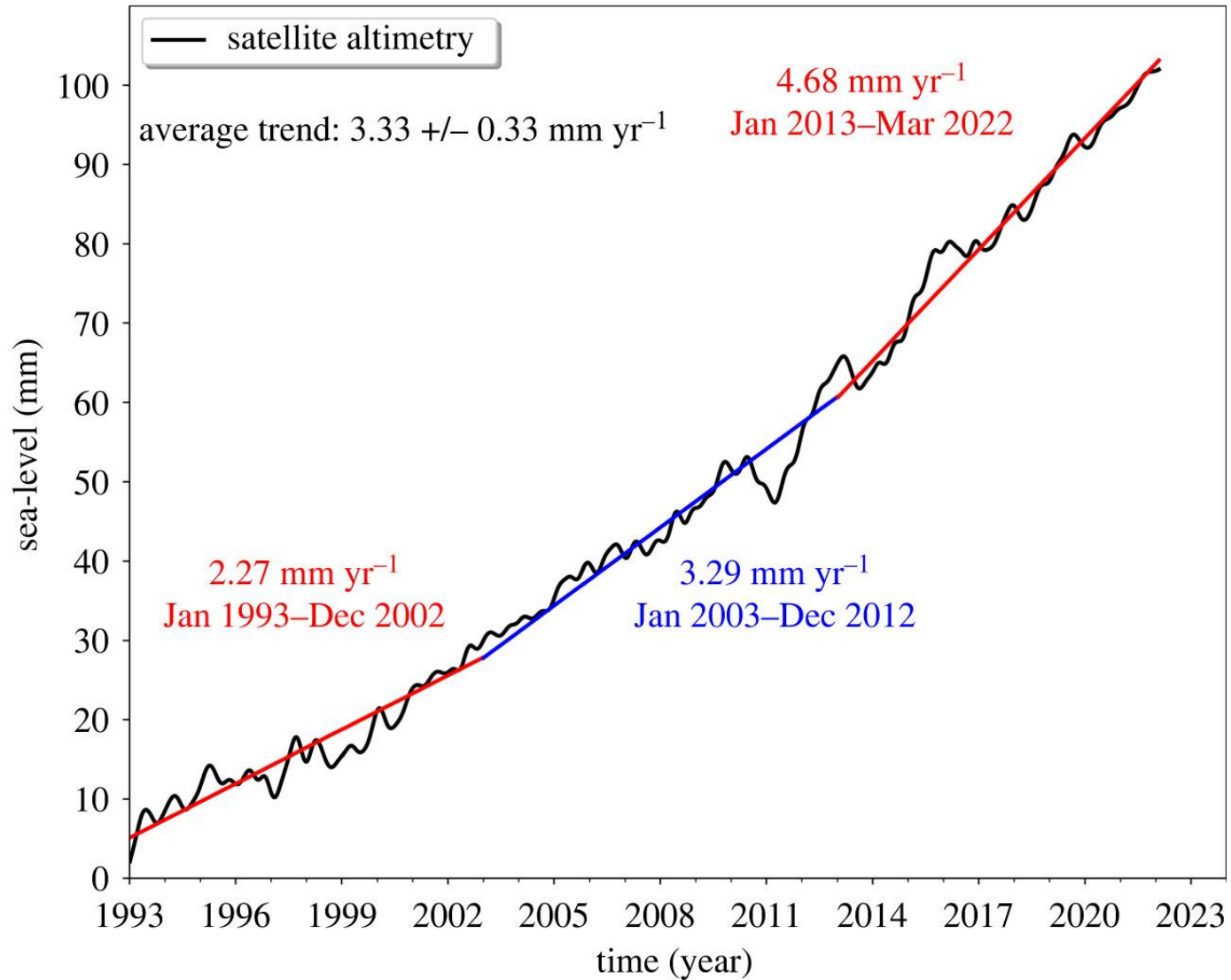


Distribution of heating



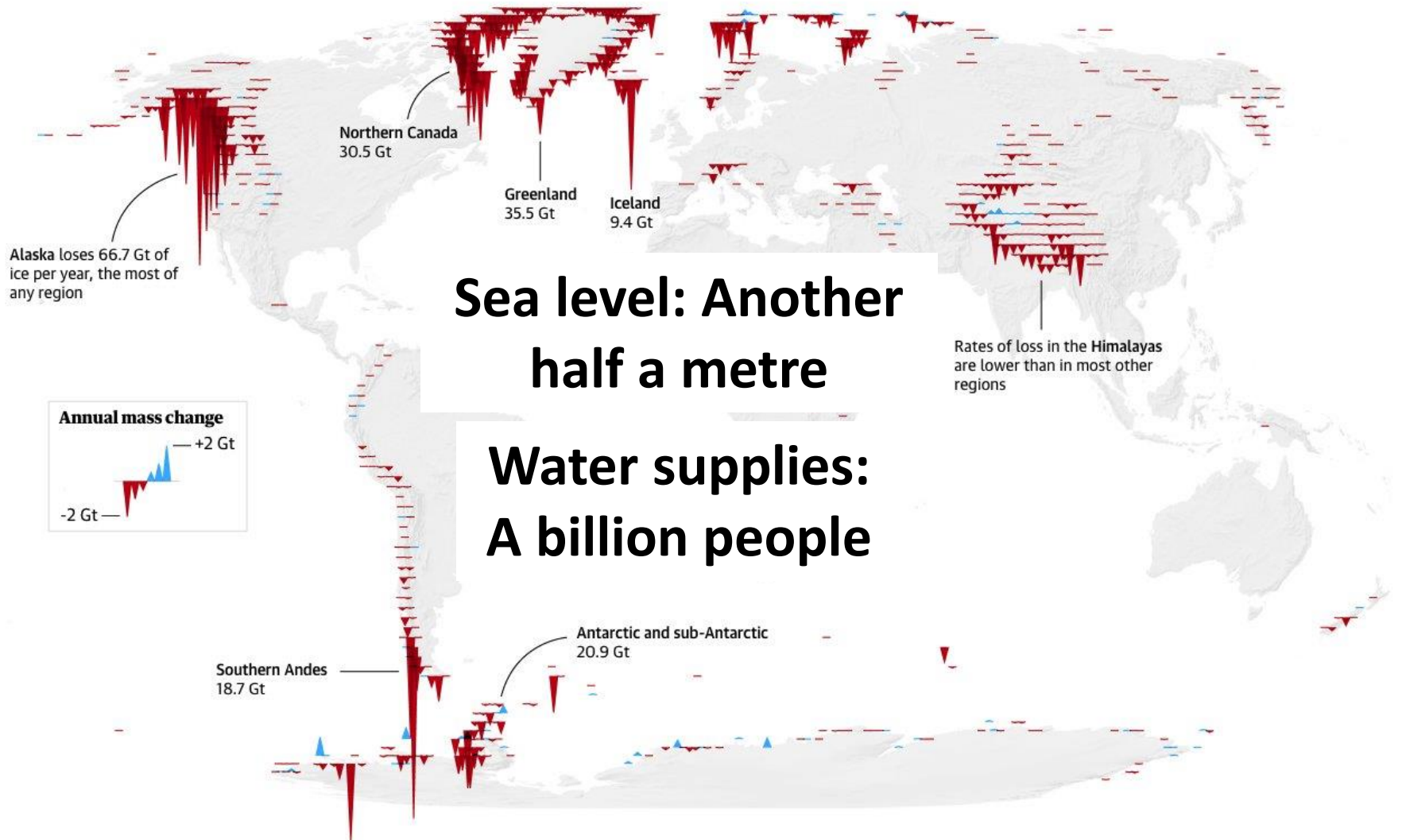
Global sea level

global mean sea-level

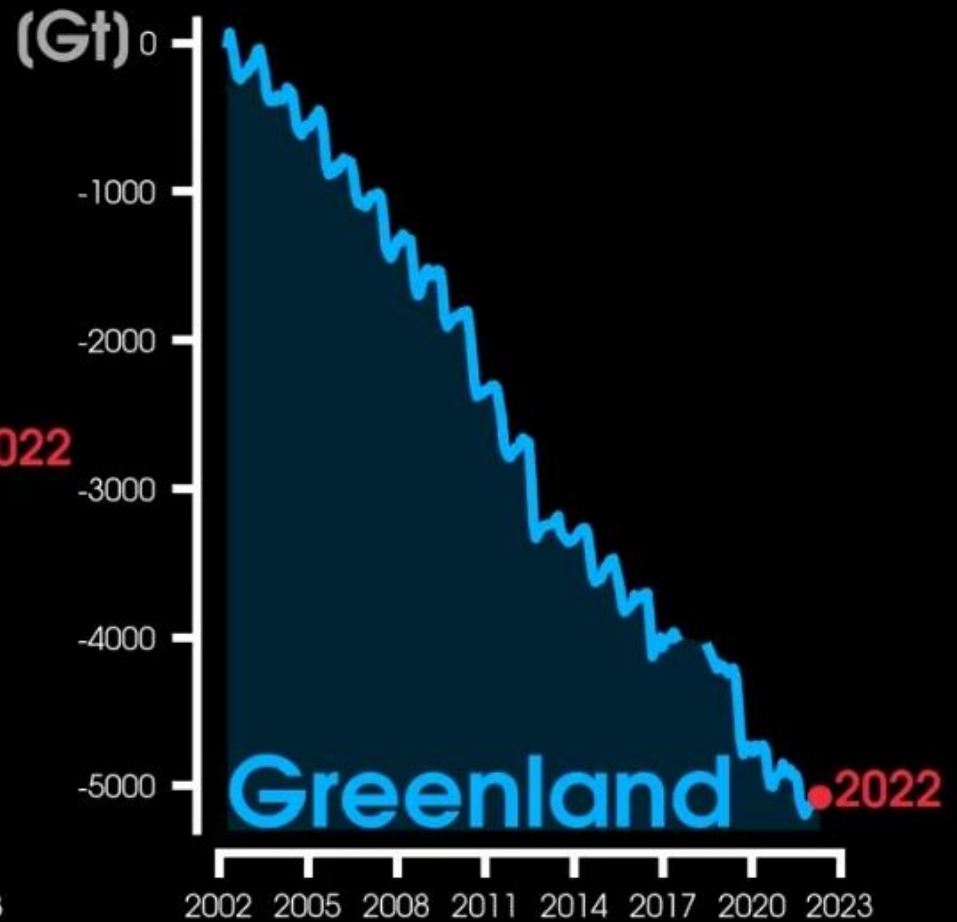
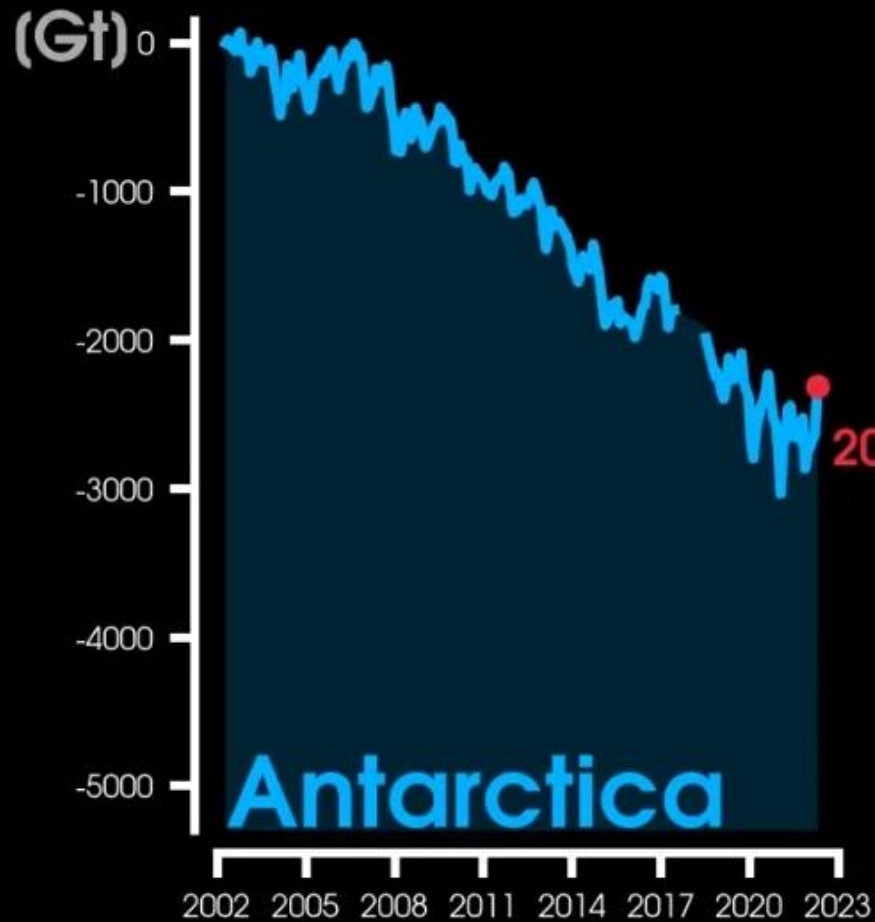


Glacier melt

The world's glaciers are losing 267 gigatonnes of ice per year, driving a fifth of global sea level rise *Hugonnet et al (2021)*



Ice Sheet Melt

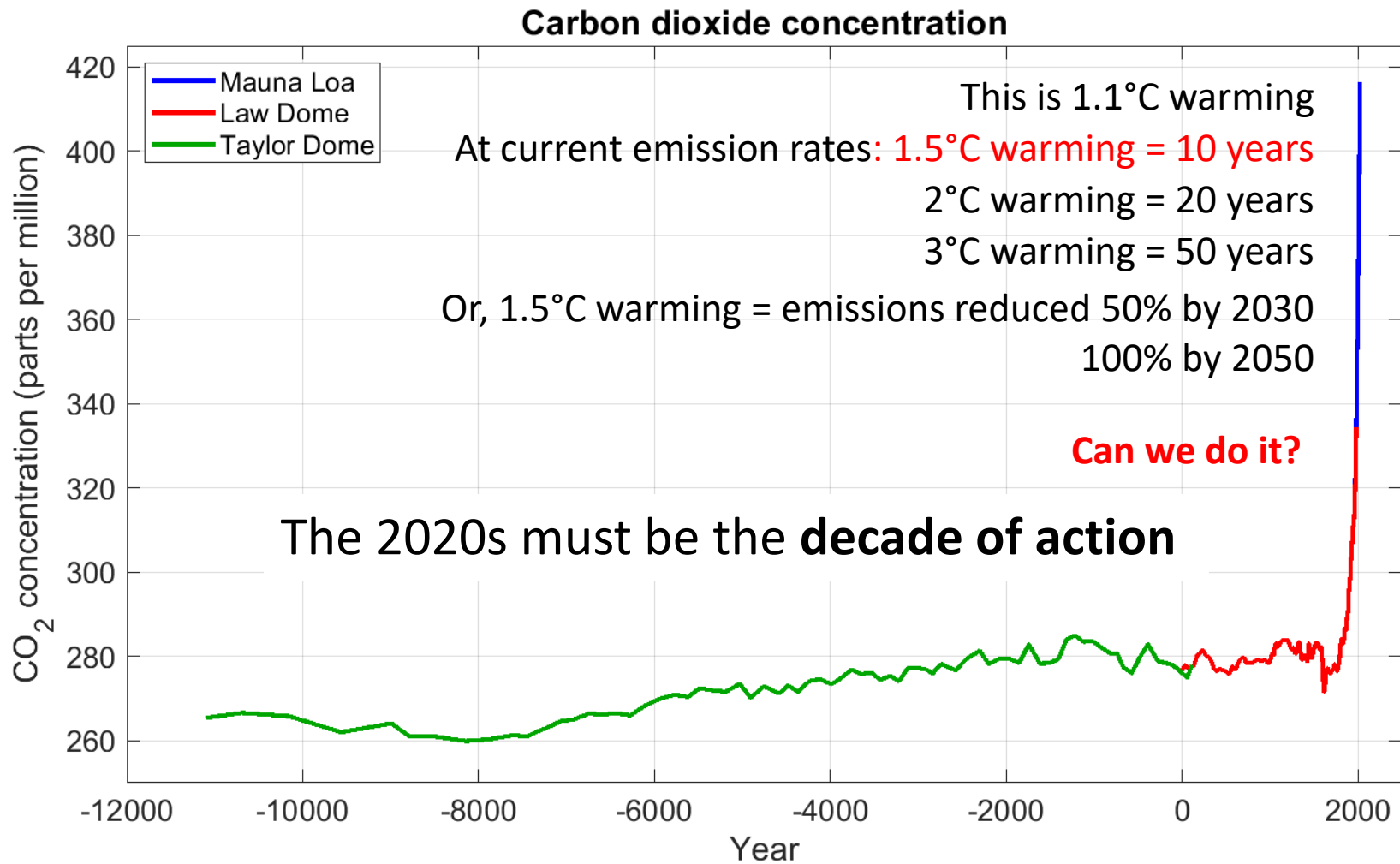


DATA: Gravity Recovery and Climate Experiment (GRACE/GRACE-FO)
SOURCE: <https://climate.nasa.gov/vital-signs/land-ice/> (NASA JPL)
REFERENCE: Wiese et al. (2015, 2019)

GRAPHIC: Zachary Labe (@ZLabe)

Exchange rate: 360Gt ice = 1mm SLR

Where to from here?





[Credit: Peter John Maridable | Unsplash]

“ Unless there are immediate, rapid, and large-scale reductions in greenhouse gas emissions, limiting warming to 1.5°C will be beyond reach.

What is at stake?

- Everything
- “The climate system” is what gives us
 - Every mouthful of food
 - Every sip of water
 - All of our livelihoods and our lives
- We are collectively pulling the rug out from beneath ourselves...



[Credit: [Shari Gearheard](#) | NSIDC]

“There’s no going back from some changes in the climate system. However, some changes could be slowed and others could be stopped by limiting warming.”

Sea Level Rise

Human activities affect all the major climate system components, with some responding over decades and others over centuries

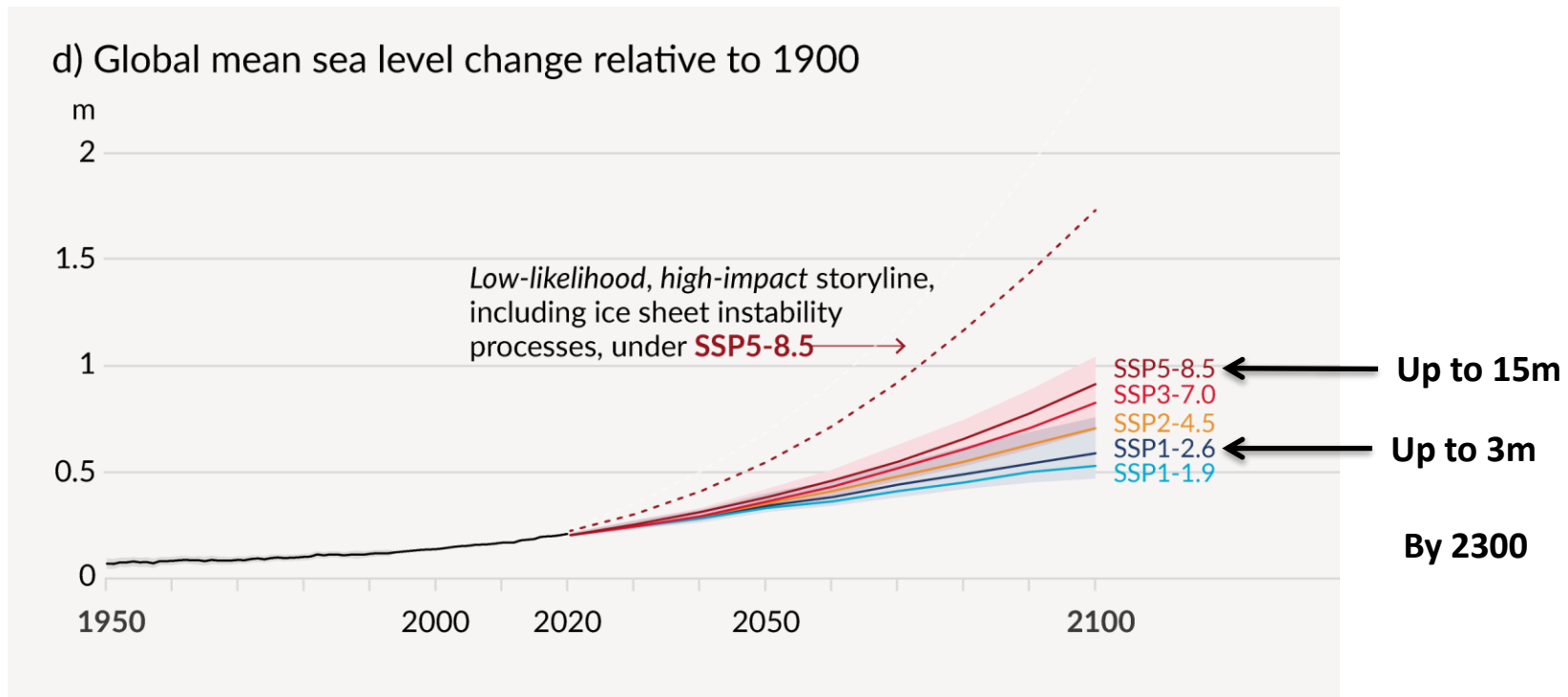
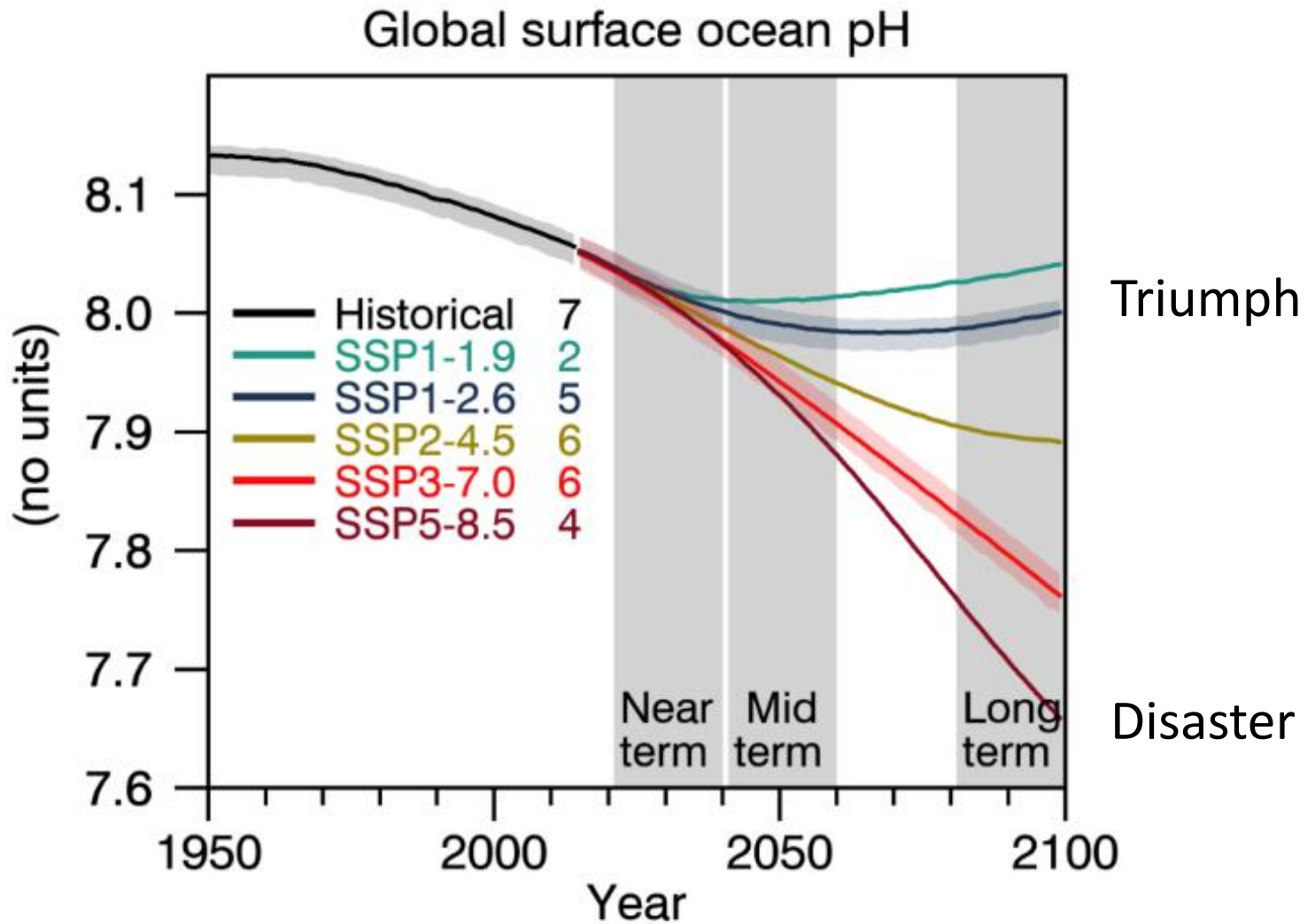


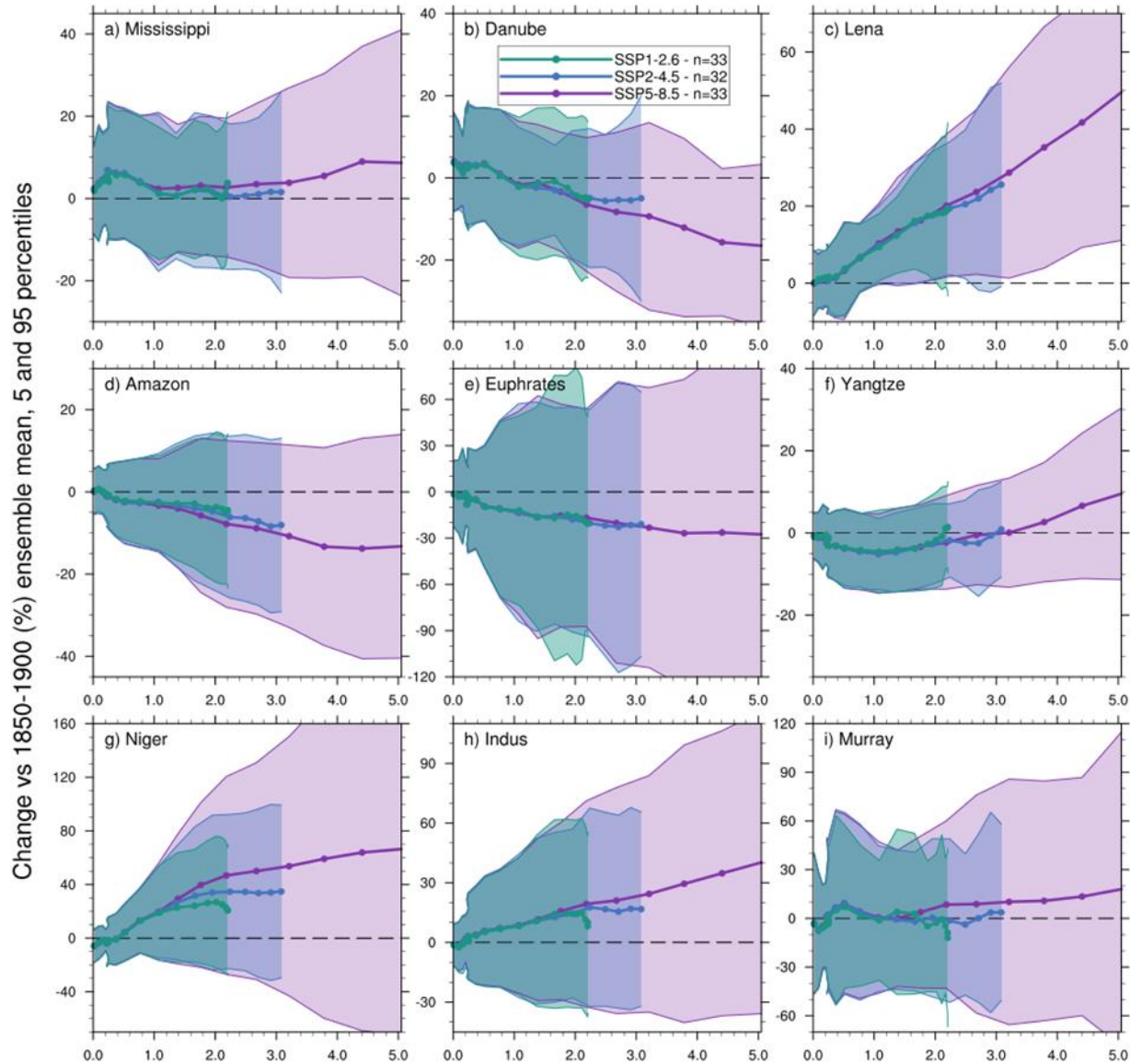
Figure SPM.8

Ocean Acidification



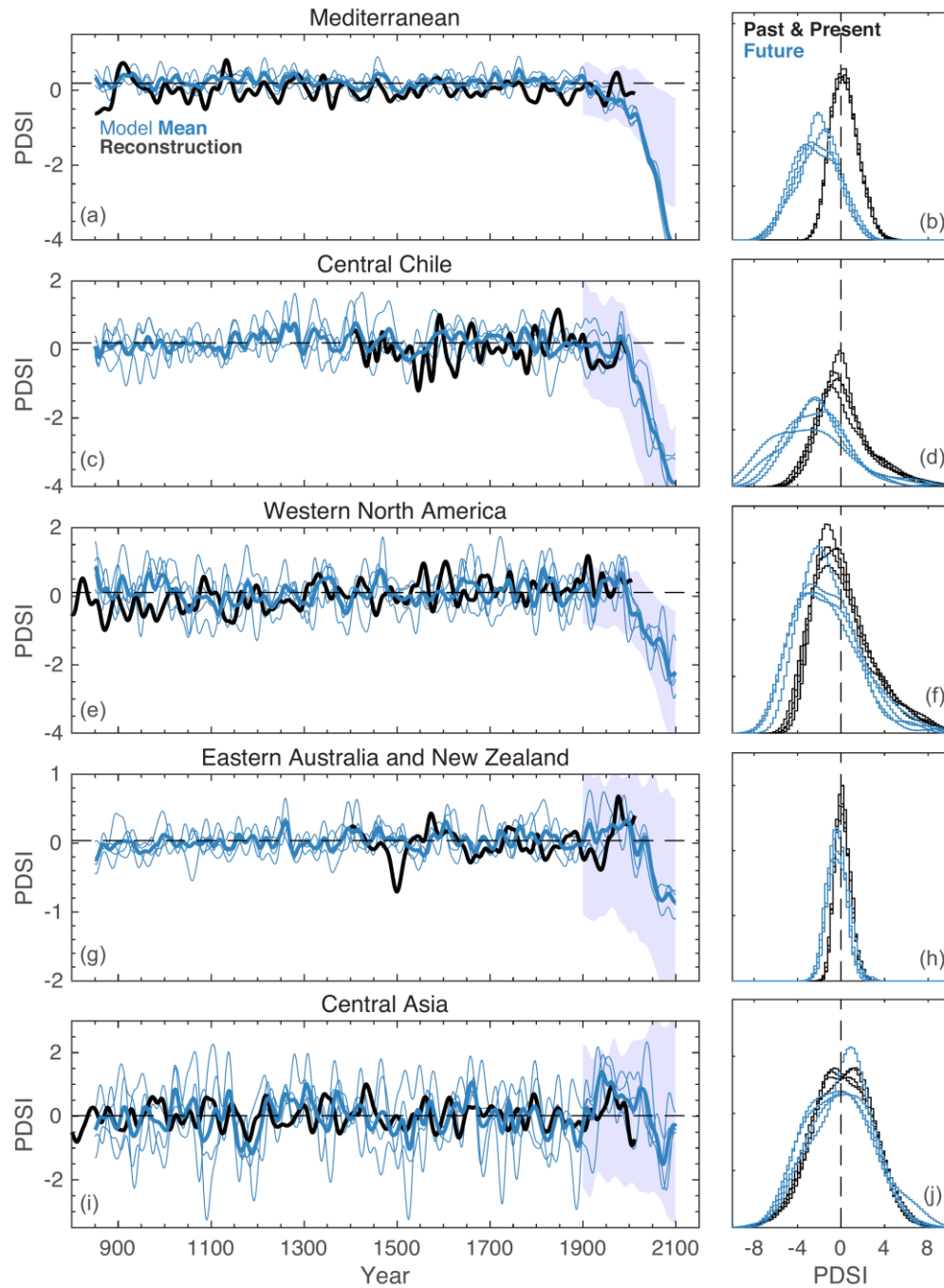
River flow and warming

Rate of change in basin-scale runoff mean



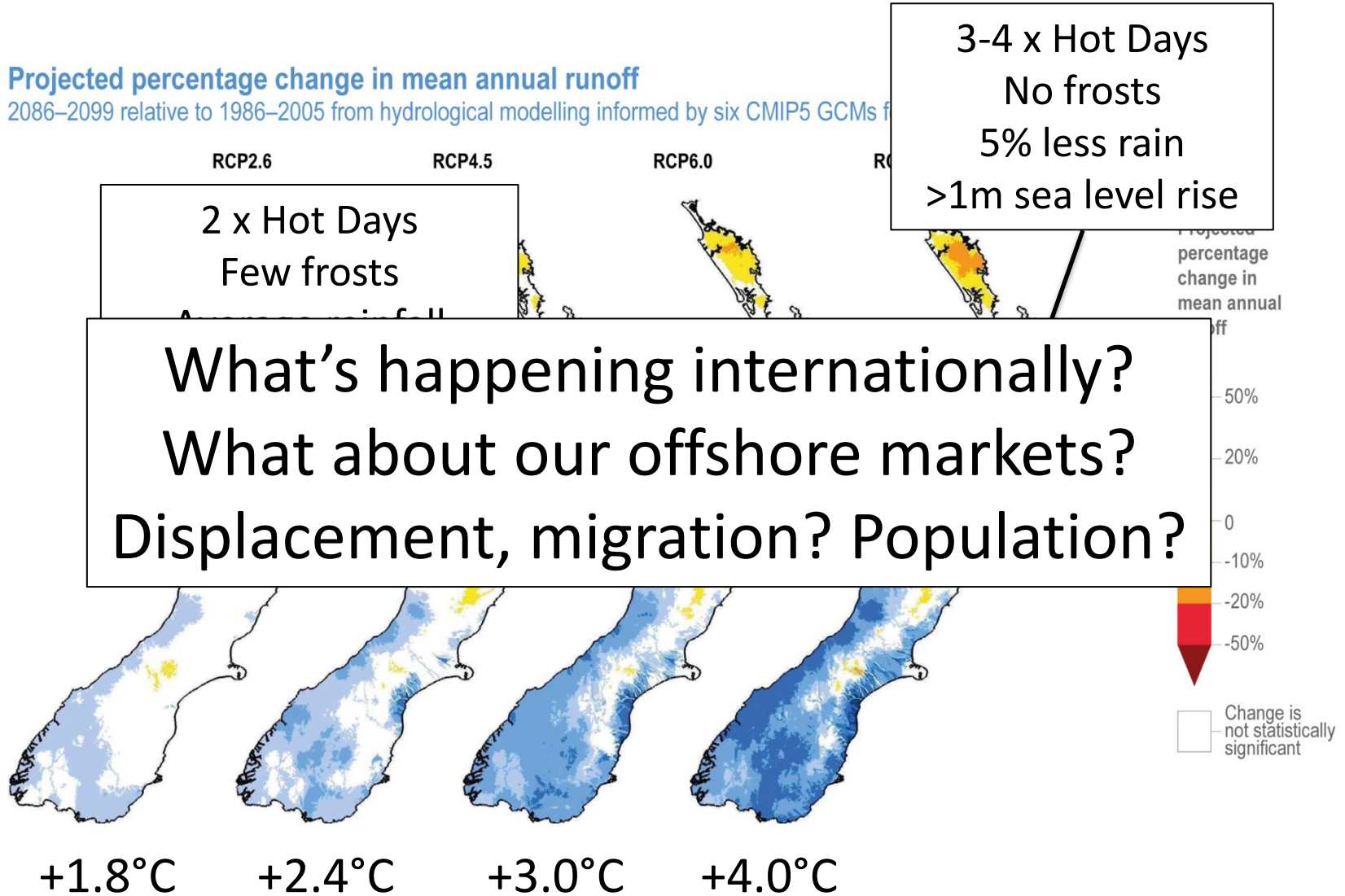
Warming above 1850-1900, from 1901 to 2100

Mega-drought




Locally

Projected percentage change in mean annual runoff
2086–2099 relative to 1986–2005 from hydrological modelling informed by six CMIP5 GCMs for



Locally...

An aerial photograph showing a two-lane asphalt road built on a steep, eroded cliffside. The ocean is visible to the left, with waves crashing against the base of the cliff. The cliff face is dark and shows signs of significant erosion, with some debris and exposed roots. The road has white dashed lines and a green grassy shoulder on the right side.

30cm more, next 40 years
[had 20cm in last 100 years]
Between 50-150cm by 2100
Depends on overall warming

Actions: Adaptation

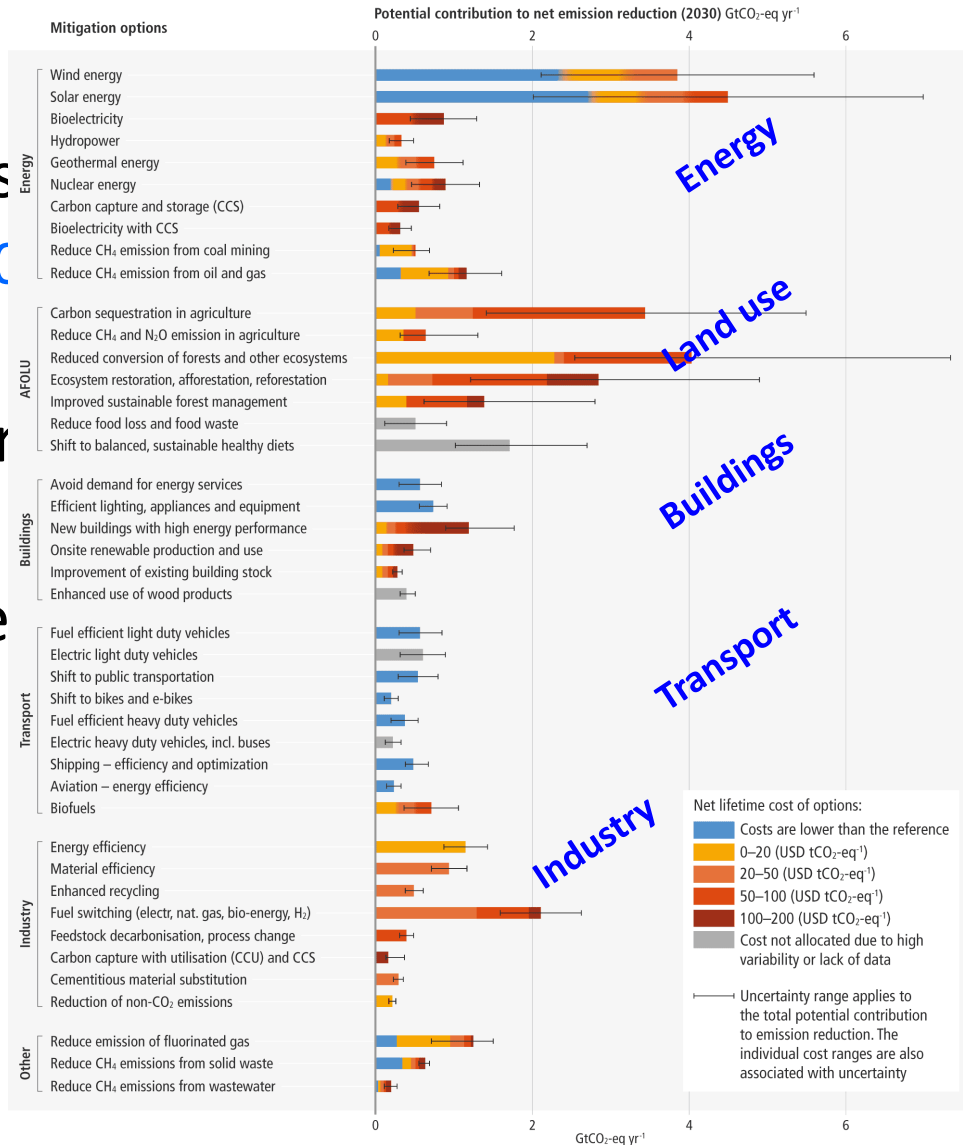
- Retreat from the coast
 - Easy to say, difficult and costly to do → start early
- Retreat from flood plains
 - Improve drainage, don't build bigger stop banks
 - Protective measures may be sensible, sometimes
- Change land use to suit the climate
 - No pip or stone fruit?
 - Hotter-climate grapes?
- Help communities become more resilient
 - A sense of “community”

Mitigation – reducing emissions

Many options available now in all sectors are estimated to offer substantial potential to reduce net emissions by 2030. Relative potentials and costs will vary across countries and in the longer term compared to 2030.

Latest IPCC

- Emissions – For a 5C
- We are driving
- There are



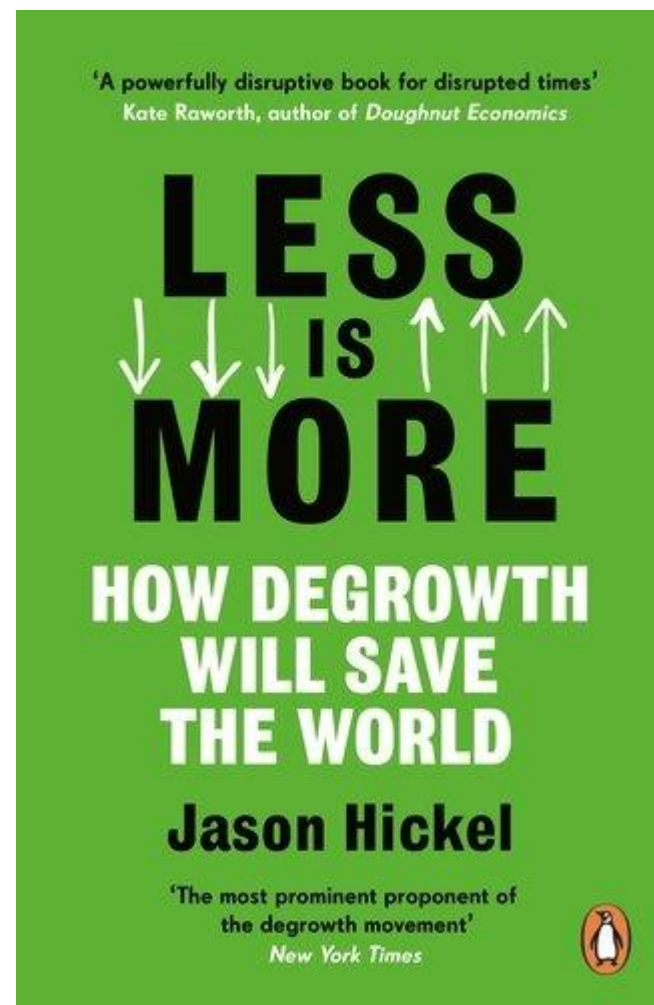
C
e power
missions...

Personal action & agency



How did we get here?

- Growth
 - Especially economic growth
- And how we stop it
 - Economic
 - Also resource use, population land use...
- The answer? Degrowth...?



Summary

Climate Science 101

©KA_Nicholas

1. It's Warming¹
2. It's US²
3. We're Sure³
4. It's Bad⁴
5. We Can Fix It⁵

1. IPCC AR5 WG1, "Warning of the climate system is unequivocal."
2. "Extraordinarily likely (95%) human influence has been the dominant cause of observed warming since mid 20th c." IPCC WGR4, 2013.
3. 97% to 10 scientists concurred (Oreskes et al., 2004); c. 37. Anthropogenic climate change is a threat to human development and well-being (IPCC WGR4, 2007).
4. Widespread impacts on water, food, ecosystems (IPCC WGR4, 2007).
5. See KimNicholas.com/we-can-fix-it-world-safe.html

You are warmly invited to the launch of

UNDER THE WEATHER

By James Renwick

6pm | Tuesday 13th June

Unity Books Wellington
57 Willis Street

RSVP by Wednesday 7 June to
publicity@harpercollins.co.nz



Books will be for sale on the night



 HarperCollins *Publishers New Zealand*

- <https://www.facebook.com/events/895450811507410>
- Search “Under the Weather” on FB, should be in list of events