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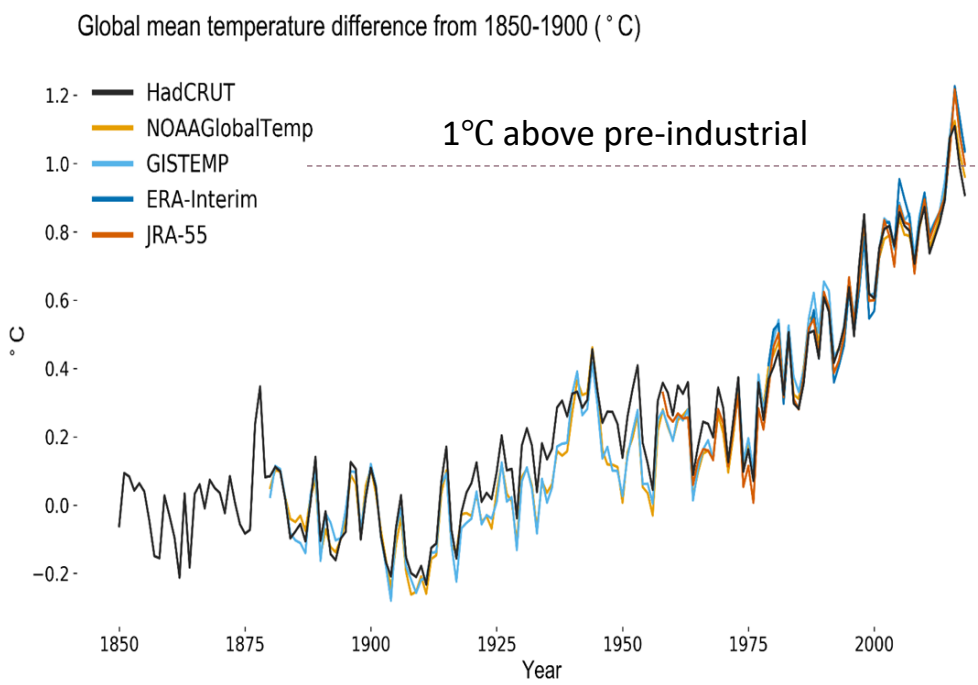
National Environmental Science Programme

Met Office



Managing climate risks to Australia's blue economy

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National Environmental Science Program, CSIRO

Overview -
Examples of significant variations of climate risks

- Tropical cyclone-related risks and El Niño
- Climate change and
  - Sea-level extremes
  - Marine heat waves
  - Ocean waves
  - Tropical cyclone-related risks

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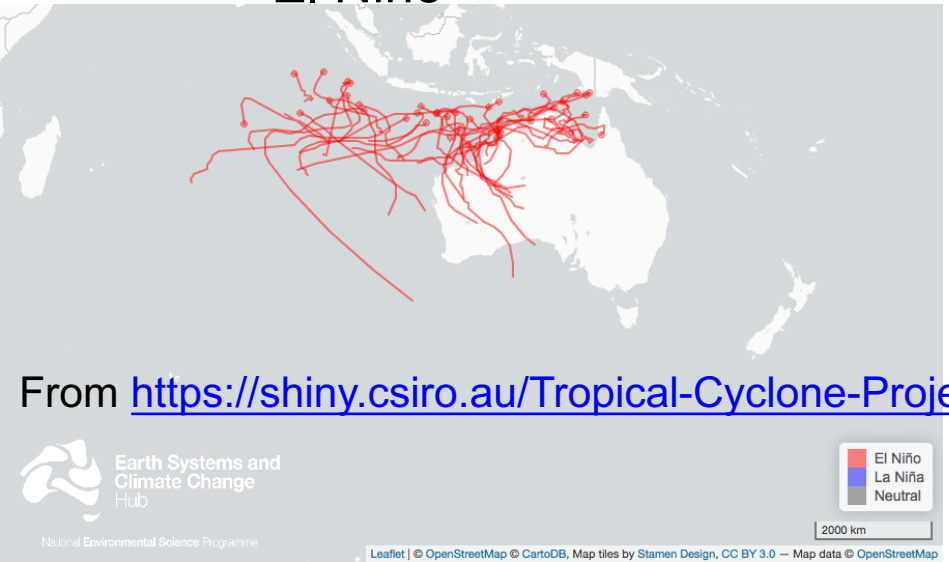
Impacts of El Niño on tropical cyclones in the Australian region

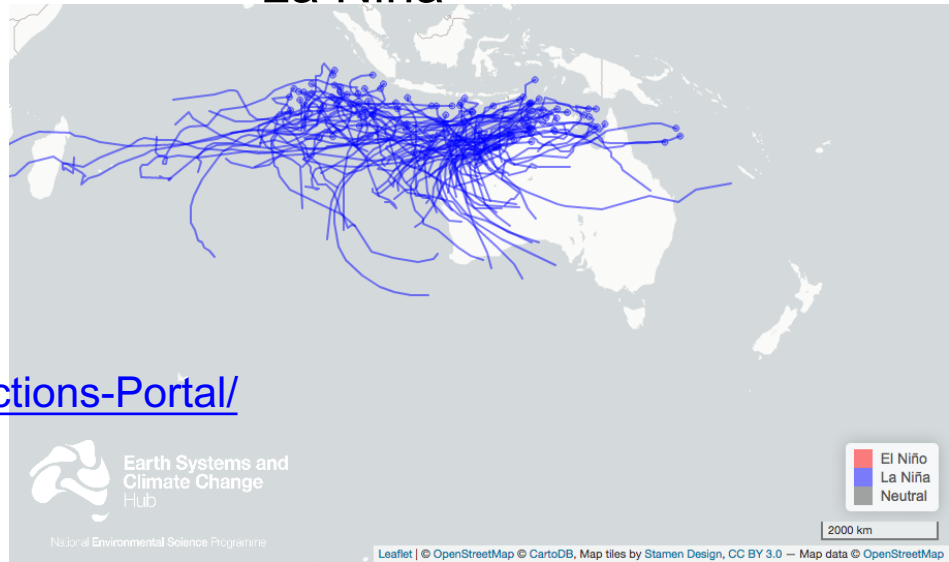
Tropical cyclone-related risks in oceans to the north of Australia are modulated by El Niño.

Observed TC tracks for NW Australian genesis (1981-2010)

El Niño

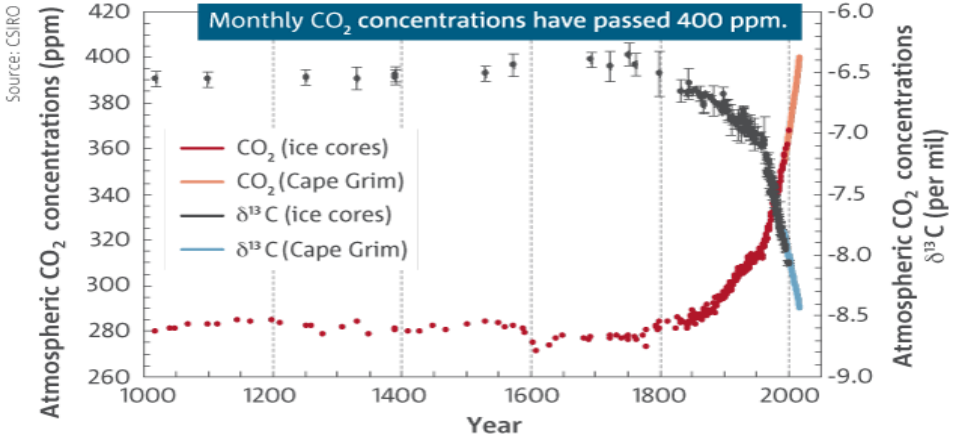


La Niña

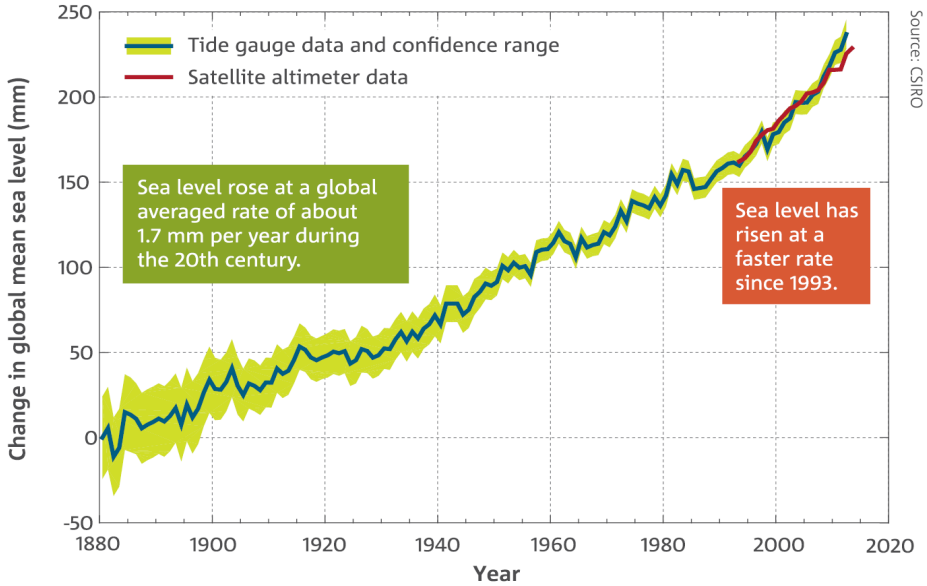


From https://shiny.csiro.au/Tropical-Cyclone-Projections-Portal/

Observed global climate change



SoC, 2016



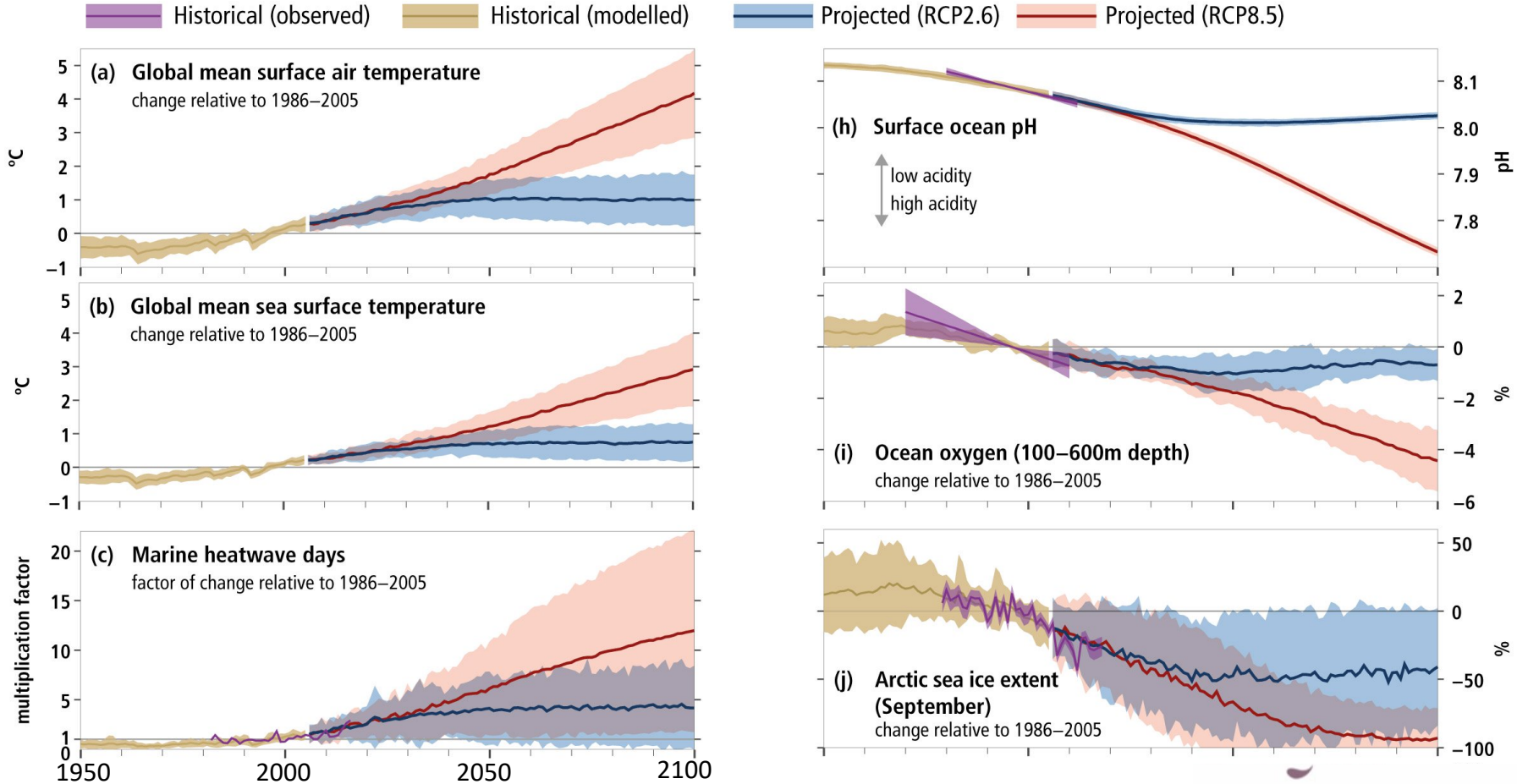
IPCC Special report on the Ocean and Cryosphere in a Changing Climate, 2019

- It is *virtually certain* that the global ocean has warmed unabated since 1970 and has taken up more than 90% of the excess heat in the climate system.
- Marine heatwaves have very likely doubled in frequency since 1982 and are increasing in intensity.
- Global mean sea level is rising, with acceleration in recent decades due to increasing rates of ice loss from the Greenland and Antarctic ice sheets, as well as continued glacier mass loss and ocean thermal expansion.
- Increases in tropical cyclone winds and rainfall, and increases in extreme waves, combined with relative sea level rise, exacerbate extreme sea level events and coastal hazards.

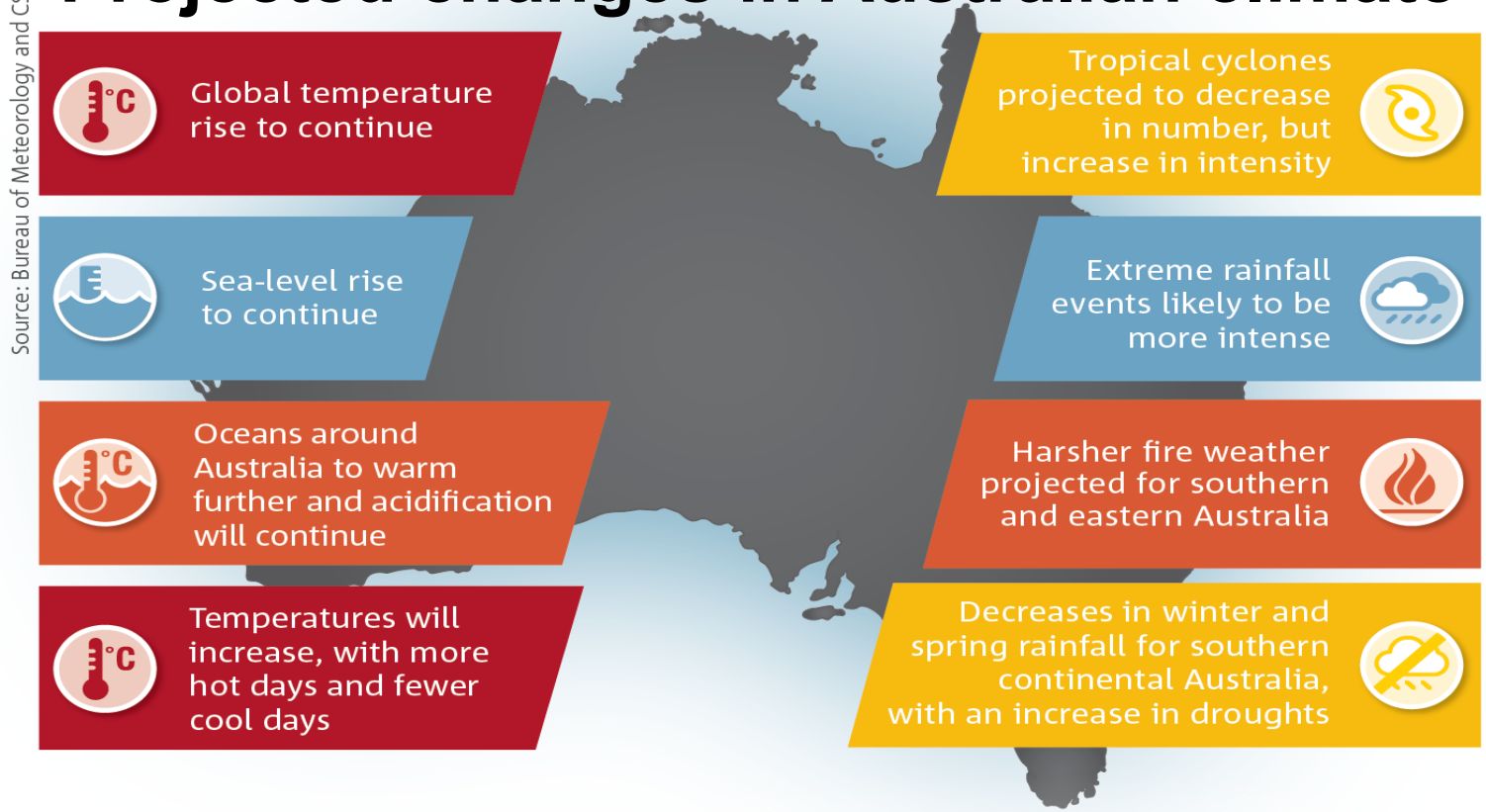
Past and future changes in the ocean and cryosphere

From IPCC SROCC 2019, Fig SPM.1

Historical changes (observed and modelled) and projections under RCP2.6 and RCP8.5 for key indicators



Projected changes in Australian climate



SoC, 2016, 2018

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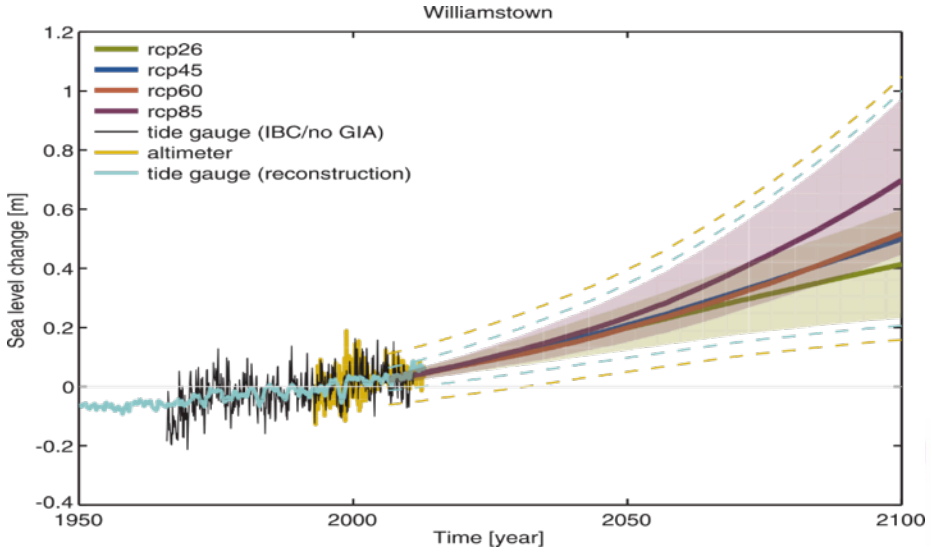
Sea-level rise and flood frequency

- Impacts of sea-level rise are felt strongly during extreme events
- Sea levels have risen by ~ 0.1 m since 1970
- Projected sea-level rise for RCP 8.5 relative to 1986-2005

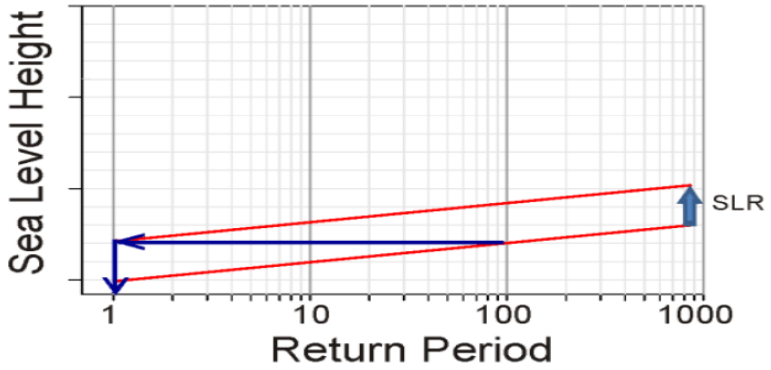
  2050 : 0.24 [0.15-0.32] m

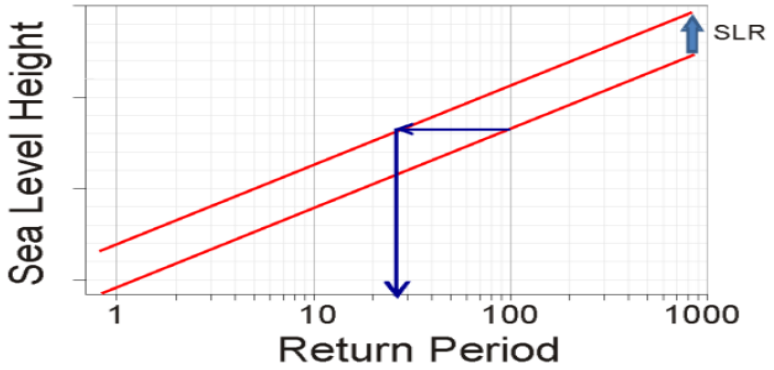
  2100 : 0.44 [0.44-0.96] m



Data sources: McInnes et al, 2015

Frequency of inundation will increase with sea-level rise





- Change in frequency depends on the characteristics of extreme events at a given location
- For Williamstown, a 0.5 m sea-level rise is expected to increase the frequency of exceedances by a factor of ~ 130 times
- i.e. a 1-in-100 year event will occur more than once per year under a 0.5 m sea-level rise

Data source: IPCC AR5, Chapter 13, Figure 13.25; IPCC SROCC

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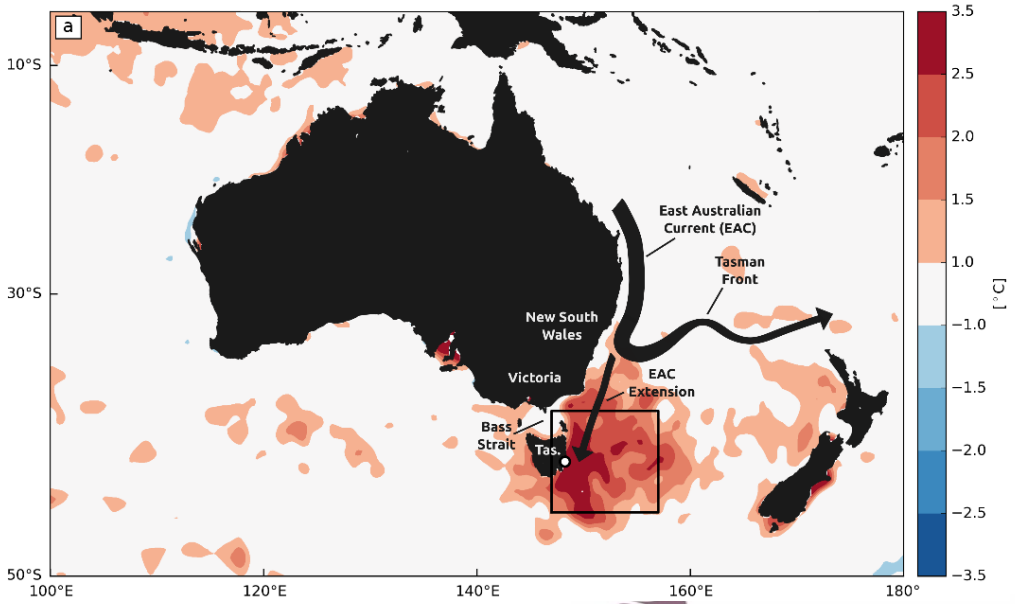
Marine heatwaves have increased significantly over the past century

From 1925 to 2016,

- global marine heatwave frequency increased by 34%,
- the duration of the heatwaves increased by 17%,
- globally, annual marine heatwave days increased by 54%
- Future changes show continued increases, depending on global mean warming

The 2015/16 Tasman Sea marine heatwave



From http://nespclimate.com.au/marine-heatwaves-changes-causes-and-impacts/

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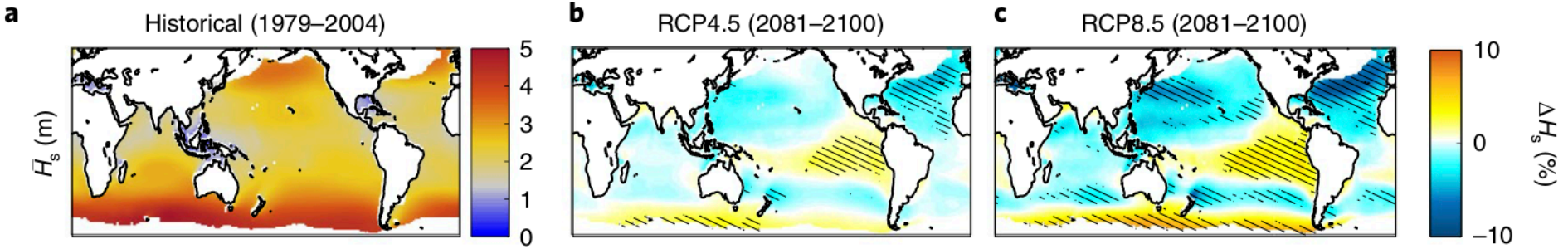
Projected changes in ocean wave climate



Simulated multi-model annual-mean significant wave height for the present day (1979–2004) and projected changes for 2081–2100 under RCP4.5 and RCP8.5.

Hatching shows regions with model agreement on projected changes.
Based on synthesis from Coordinated Ocean Wave Climate Project (COWCLIP) using CMIP5 model wind projections and wave modelling
Uncertainties mainly due to differences in climate model projections of wind changes.

From J Morim, M Hemer et al., *Nature Clim Change*, 9, 711-718, 2019

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Projected impacts on tropical cyclones in Australian region

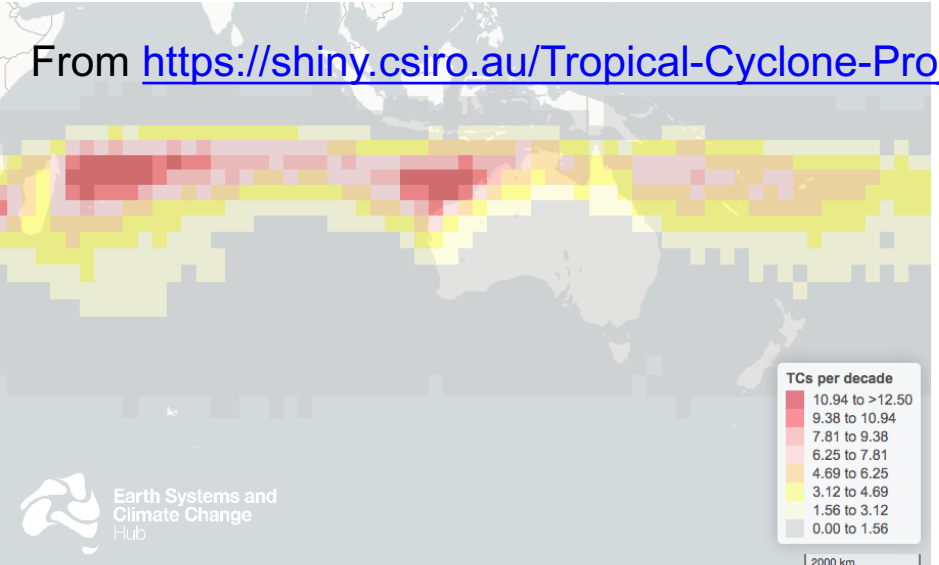
Tropical cyclone-related risks in oceans to the north of Australia are projected to significantly change due to climate change

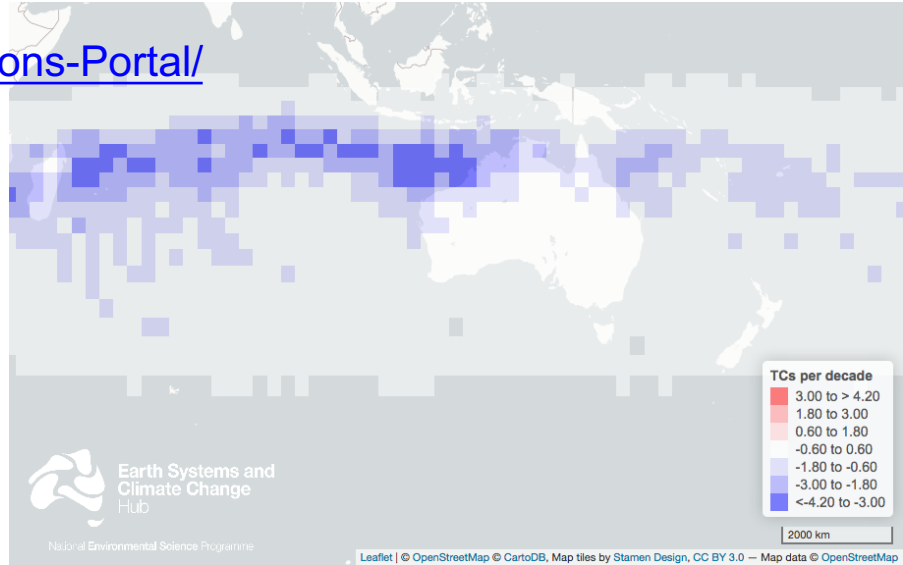
Simulated TC track density for selected multi-model synthesis

Baseline (1970-2000)

Change future (2070-2100) - baseline

From https://shiny.csiro.au/Tropical-Cyclone-Projections-Portal/





Summary

- Climate change has already led to significant changes in climate risks and will continue to do so for the next 30-100 years or more
- Most confident projected changes affecting the blue economy are:
  -increases in marine heat waves,
  -increases in sea level extremes and coastal flooding,
  -increases in temperature extremes at ports,
  -increases in ocean acidity;
  less certainty in some other extremes (waves, tropical cyclones)

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The Earth Systems and Climate Change Hub is funded by the Australian Government's National Environmental Science Program, with co-investment from the following partner agencies

CSIRO

Australian Government Bureau of Meteorology

Australian National University

MONASH University

THE UNIVERSITY OF MELBOURNE

UNSW SYDNEY

UNIVERSITY of TASMANIA

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