

# Can AI help us better characterise tipping points in marine social-ecological systems?

Brigette Wright

Supervised by Prof Gretta Pecl, Dr Jess Melbourne-Thomas,  
Dr Delphi Ward, Dr Steven Rust



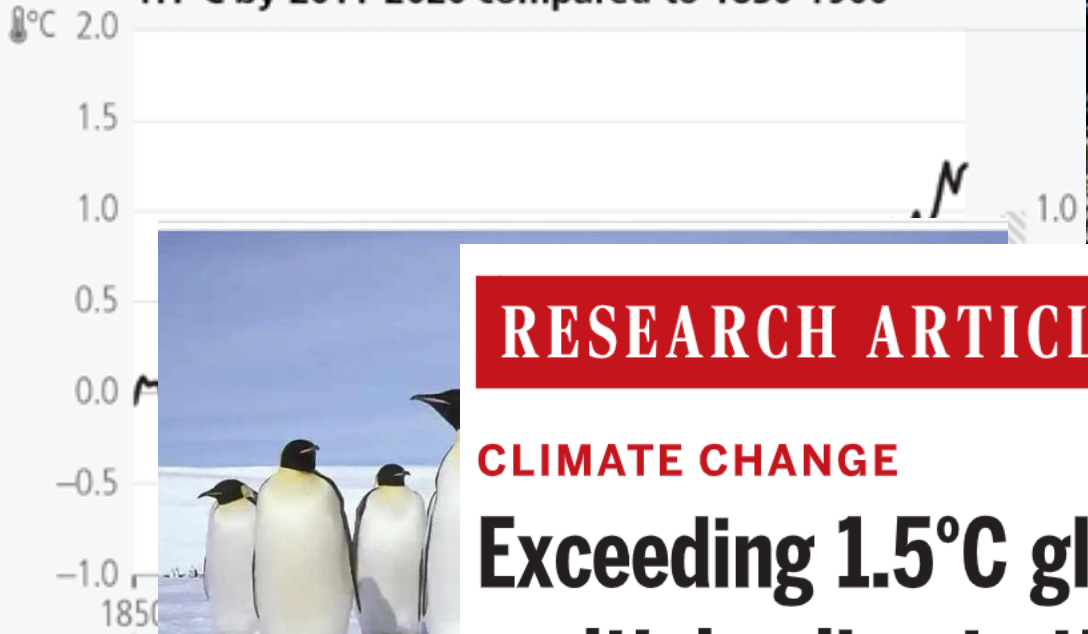
UNIVERSITY of TASMANIA

IMAS

Institute for Marine and Antarctic Studies



Global surface temperature has increased by 1.1°C by 2011-2020 compared to 1850-1900



The Great Barrier Reef's latest bout of bleaching is the fifth in eight summers – the corals now have almost no reprieve



**RESEARCH ARTICLE**

**CLIMATE CHANGE**

**Exceeding 1.5°C global warming could trigger multiple climate tipping points**

The Observer  
 'Simply mind-boggling' record temperature rise in Antarctica raises fears of catastrophe

David I. Armstrong McKay<sup>1,2,3,4\*</sup>, Arie Staal<sup>1,2,5</sup>, Jesse F. Abrams<sup>3</sup>, Ricarda Winkelmann<sup>6,7</sup>, Boris Sakschewski<sup>6</sup>, Sina Loriani<sup>6</sup>, Ingo Fetzer<sup>1,2</sup>, Sarah E. Cornell<sup>1,2</sup>, Johan Rockström<sup>1,6</sup>, Timothy M. Lenton<sup>3\*</sup>

An unprecedented leap of 38.5C in the coldest place on Earth is a harbinger of a disaster for humans and the local ecosystem

...  
 2022 and now  
 the heat  
 as that had  
 n how much  
 e the hottest  
 extreme



'How long before it totally disappears?': Tuvalu's king tides raise bleak question for island...



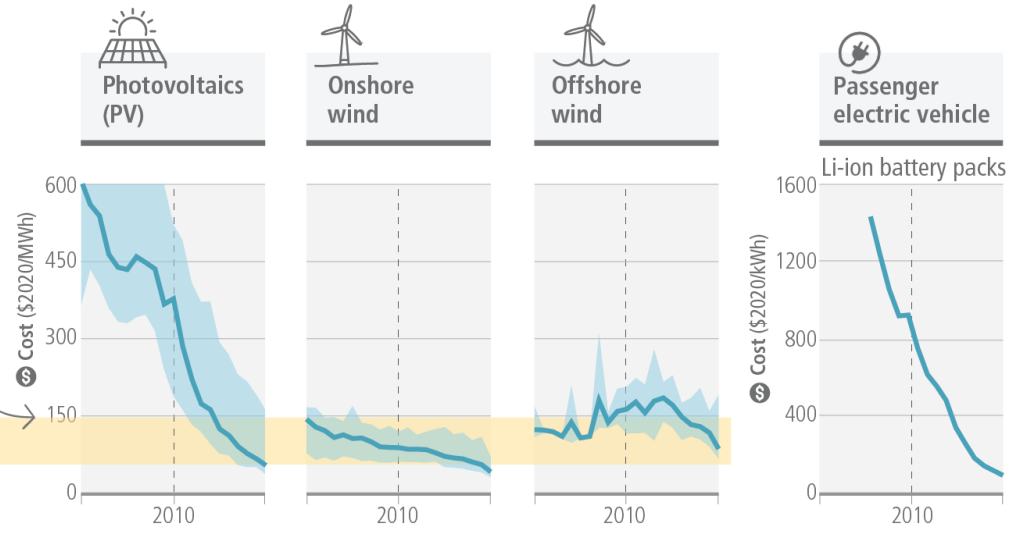
IPCC, 20

From abc.net.au

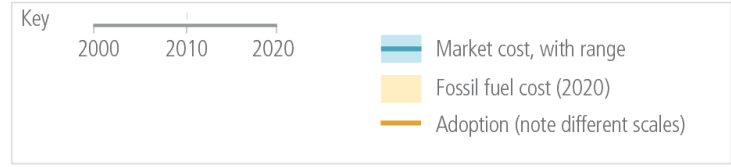
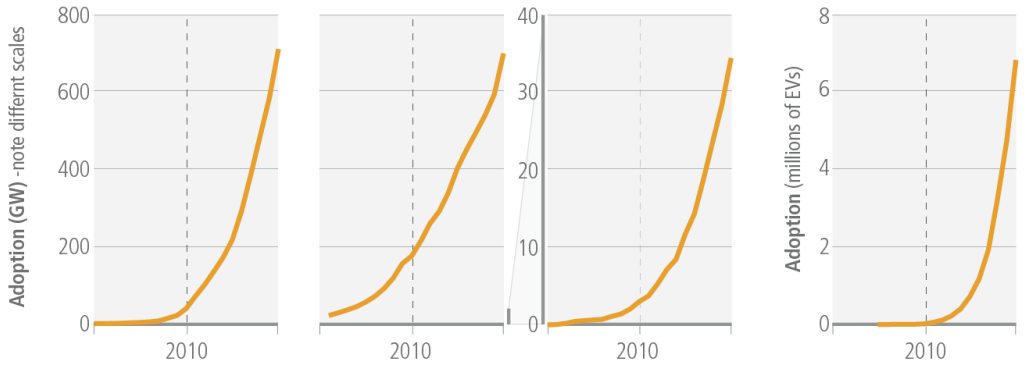
# Renewable electricity generation is increasingly price-competitive and some sectors are electrifying

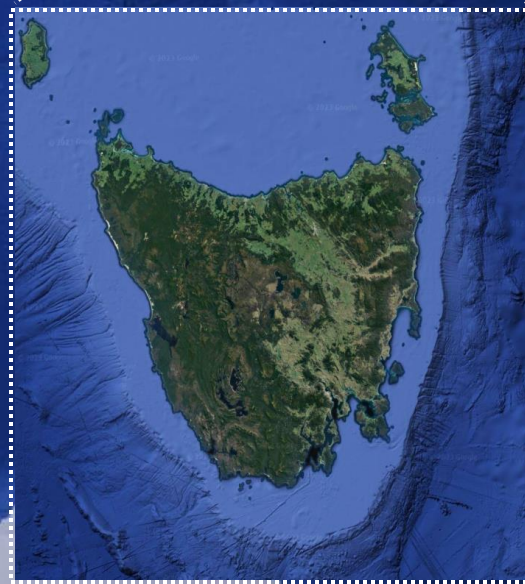


**a) Market Cost**  
 Since AR5, the unit costs of some forms of renewable energy and of batteries for passenger EVs have fallen.  
*below this point, costs can be less than fossil fuels*  
 Fossil fuel cost (2020)



**b) Market Adoption**  
 Since AR5, the installed capacity of renewable energies has increased multiple times.



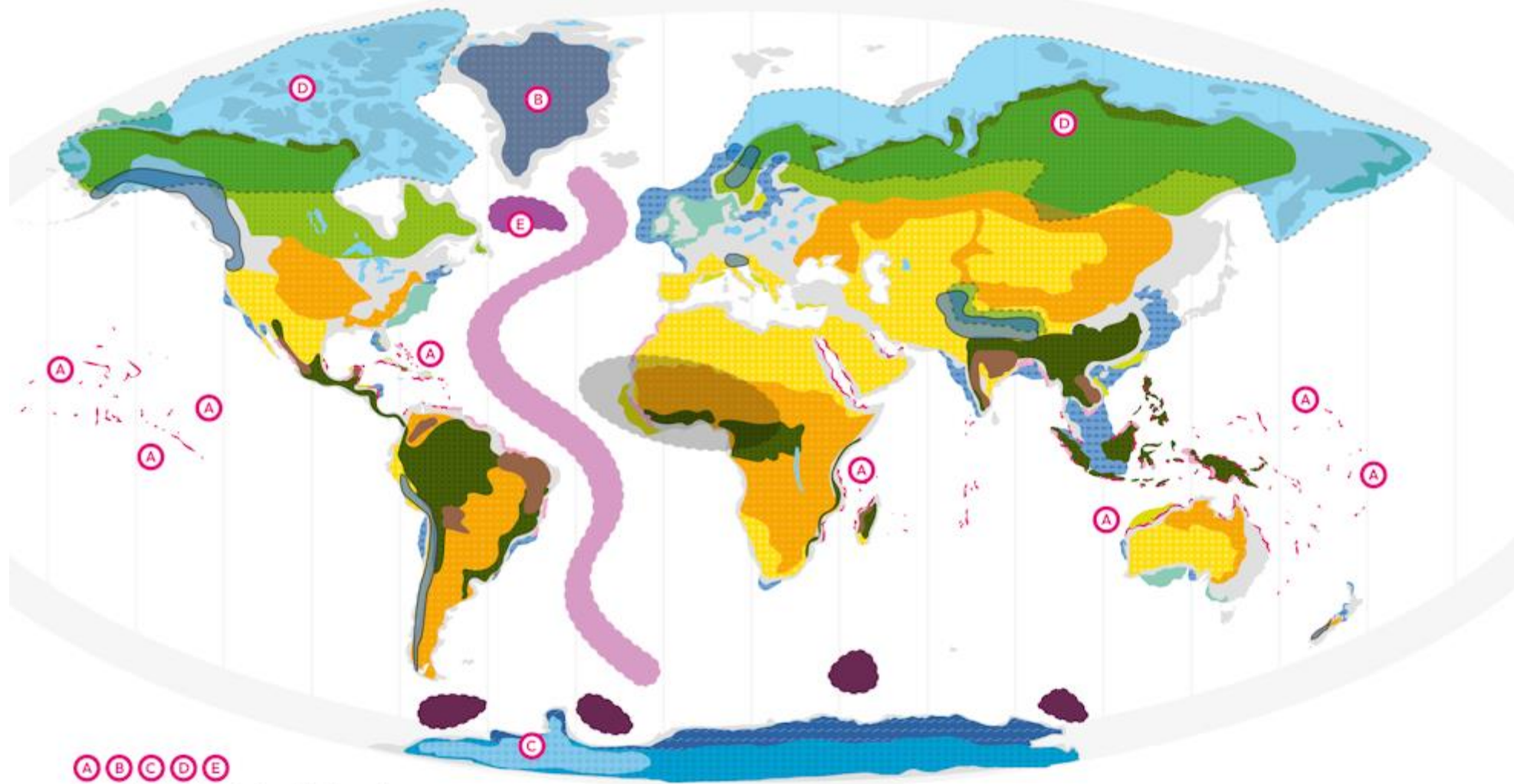


Images: Stefan Andrews, Scott Bennett

Source: Great Southern Reef Foundation



Sources: Stefan Andrews, Scott Ling, John Keane



A B C D E

Closest to tipping - due to global warming

**BIOSPHERE**

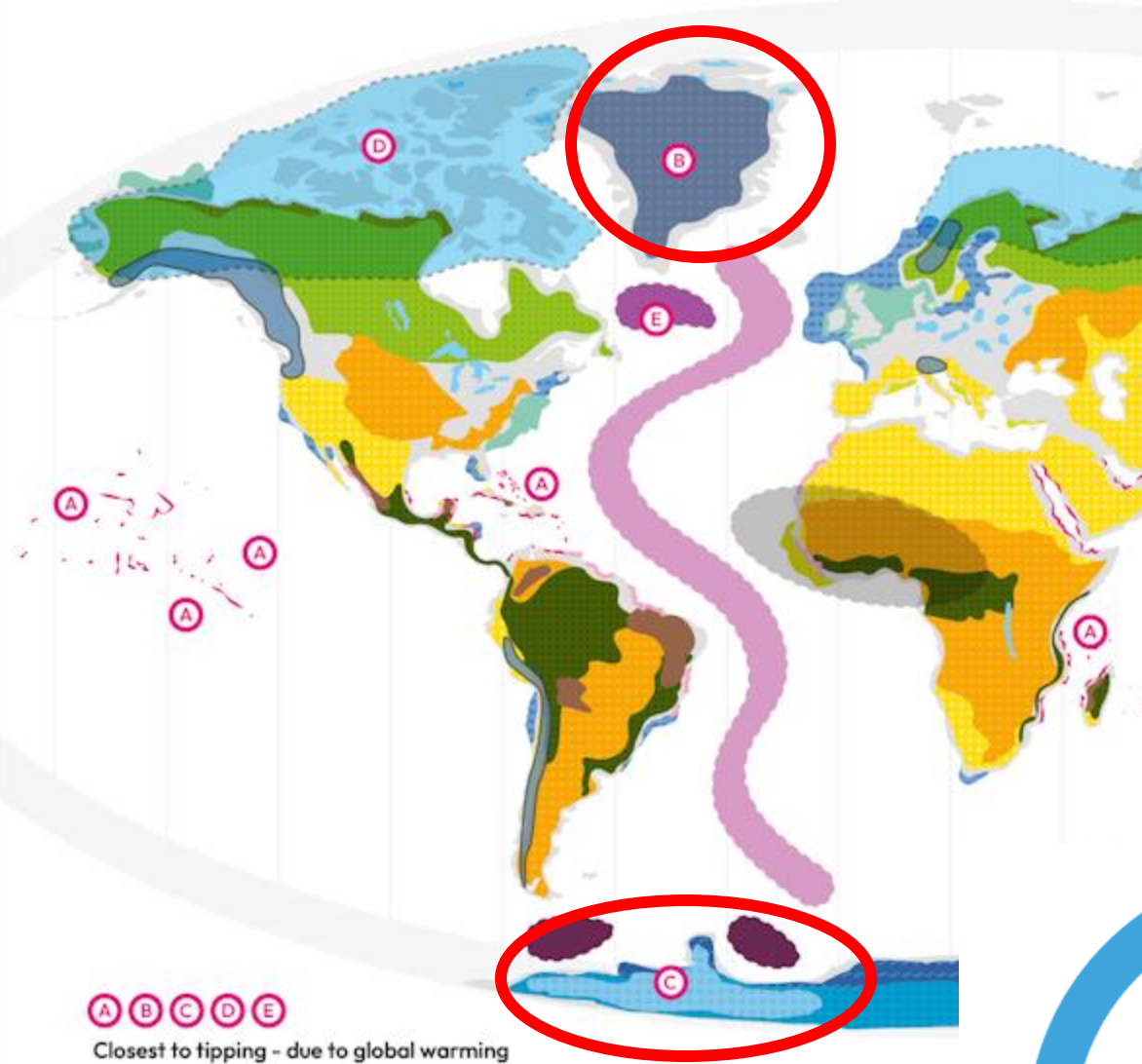
- Tropical dry forest
- Tropical rainforest
- Boreal forest
- Tundra
- Savannas & grasslands
- Drylands
- Lakes
- Coral reefs A
- Mangroves
- Fisheries
- Seagrass
- Kelp forest

**CRYOSPHERE**

- Greenland Ice Sheet B
- West Antarctic Ice Sheet C
- Non-marine East Antarctica
- Marine basins East Antarctica
- Permafrost D
- Mountain glaciers

**OCEAN & ATMOSPHERE CIRCULATIONS**

- Atlantic Meridional Overturning Circulation (AMOC)
- Subpolar Gyre (SPG) E
- Southern Ocean Overturning
- West African monsoon



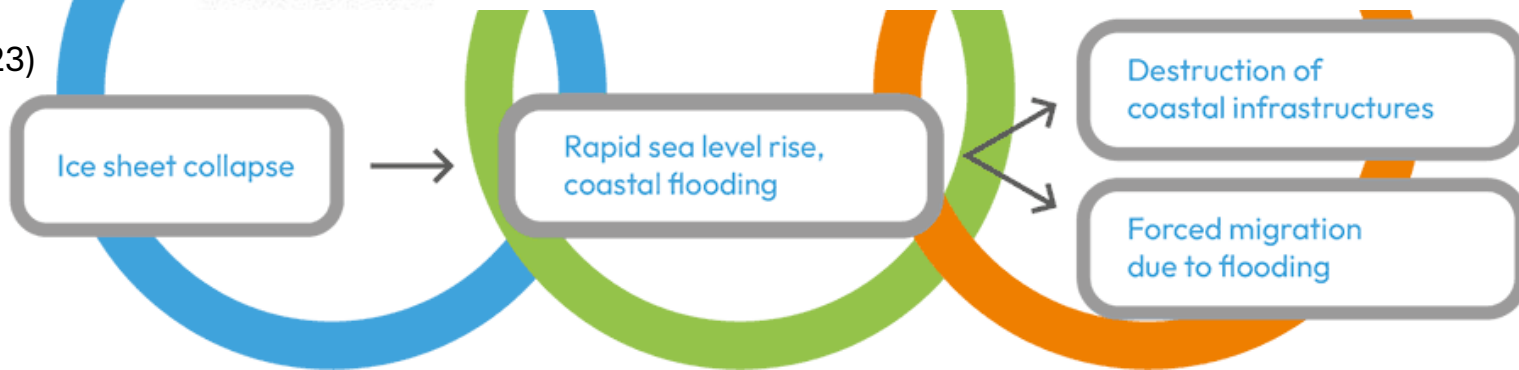
Global Tipping Points Report (2023)

ABC News  
@abcnews

King tides are not new in Tuvalu, but February's reached areas that had not been flooded before, forcing some Tuvaluans to question how much time they had left in their home country.



From abc.net.au



# Knowledge gaps



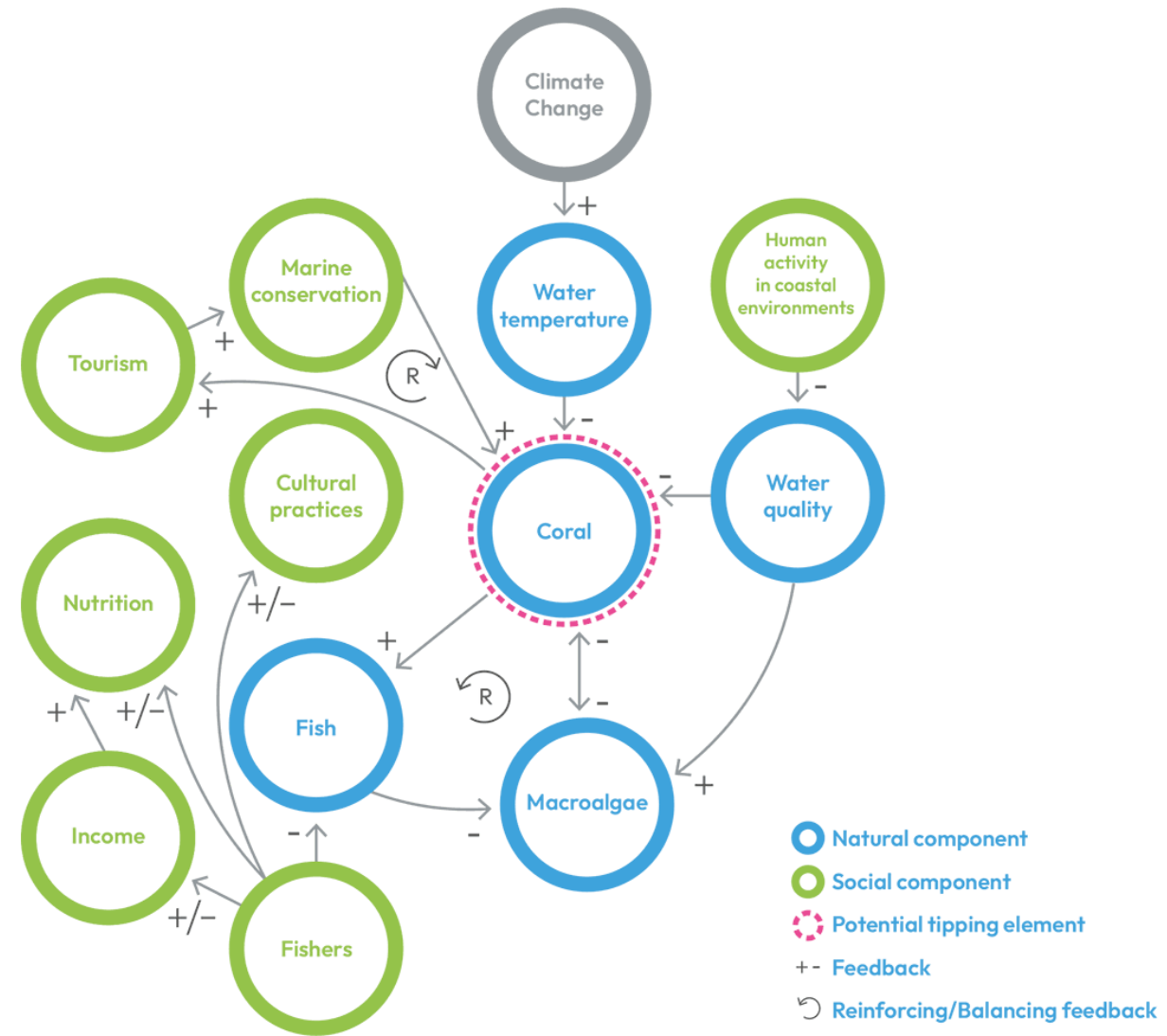
Feedbacks within and between systems, across scales and time



Marine focus



Resilience and adaptation for people at local and regional scales



Tipping cascades in coral reefs and small-scale fisheries. The Global Tipping Points Report, 2023.



# Literature review



Aim 1: Review global ecological systems and characterise the tipping points in marine systems

*Your Own Personal Superhero*




# AI TO THE RESCUE

TITUS BLAIR - ROBERT JAMES

tipping points in marine social-ecological systems. Develop a conceptual framework to identify tipping points in

SES TP search 1 19.9.23

 TITLE-ABS-KEY (( "tipping point\*" OR "regime shift\*" OR "phase transition\*" OR "bifurcation\*" ) AND ( "marine" OR "ocean" OR "aquatic" OR "coastal" OR "cultural\*" ))

regime shift\*" OR "phase transition\*" OR "bifurcation\*" ) AND ( "marine" OR "ocean" OR "aquatic" OR "coastal" OR "cultural\*" )

3,312 results

# Screening with ChatGPT



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## **Spatio-temporal Variability in the Tipping Points of a Coastal Defense**

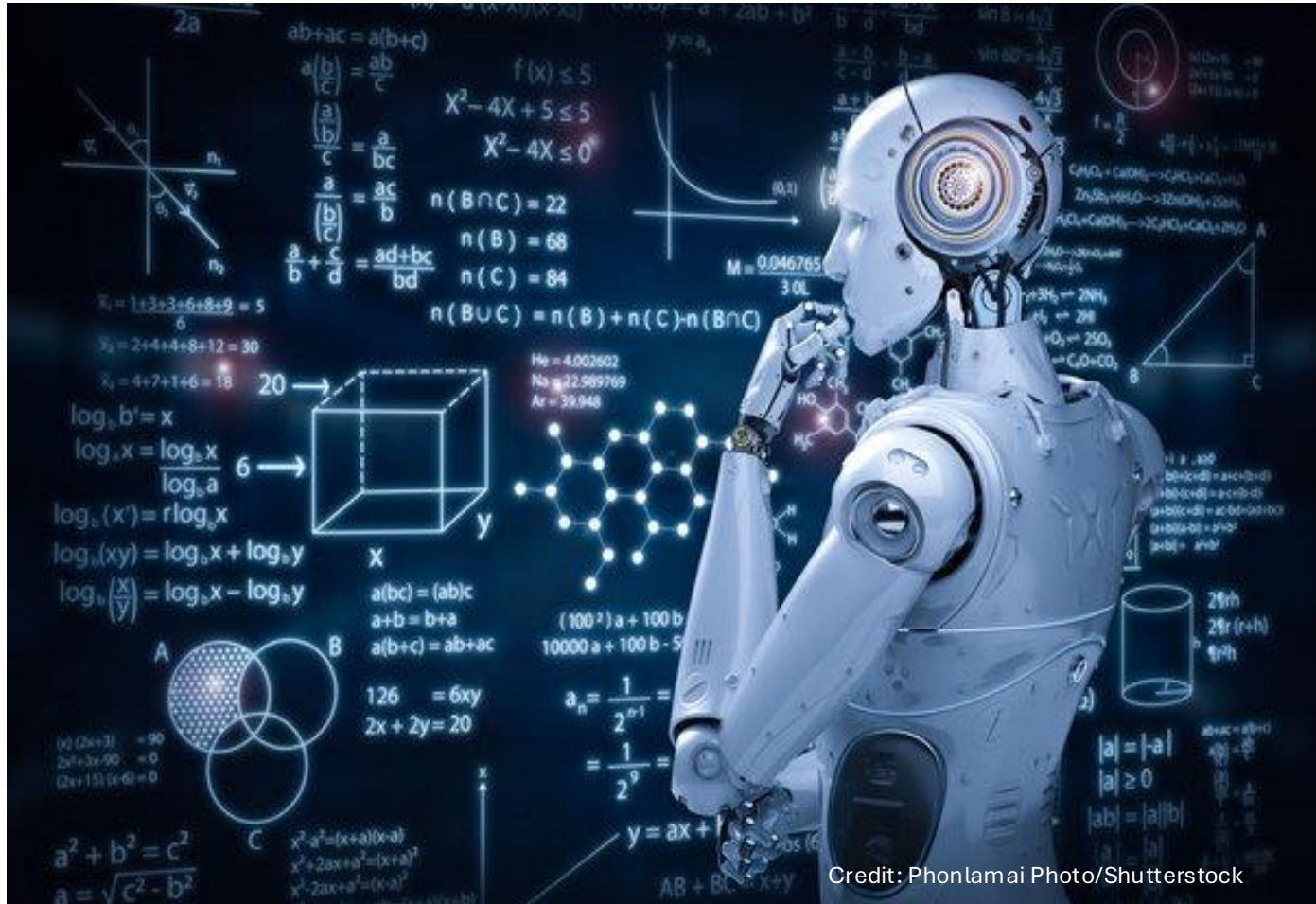
Authors: Brown, Jennifer M., Prime, Thomas, Phelps, Jack J.C., Barkwith, Andrew, Hurst, Martin D., et al.

Source: Journal of Coastal Research, 75(sp1) : 1042-1046

Published By: Coastal Education and Research Foundation

URL: <https://doi.org/10.2112/SI75-209.1>

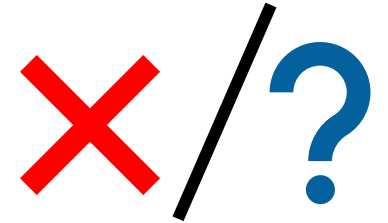
# Did it work?



CBFM



Marine SE  
TP literature  
review



Marine SE TP  
case studies

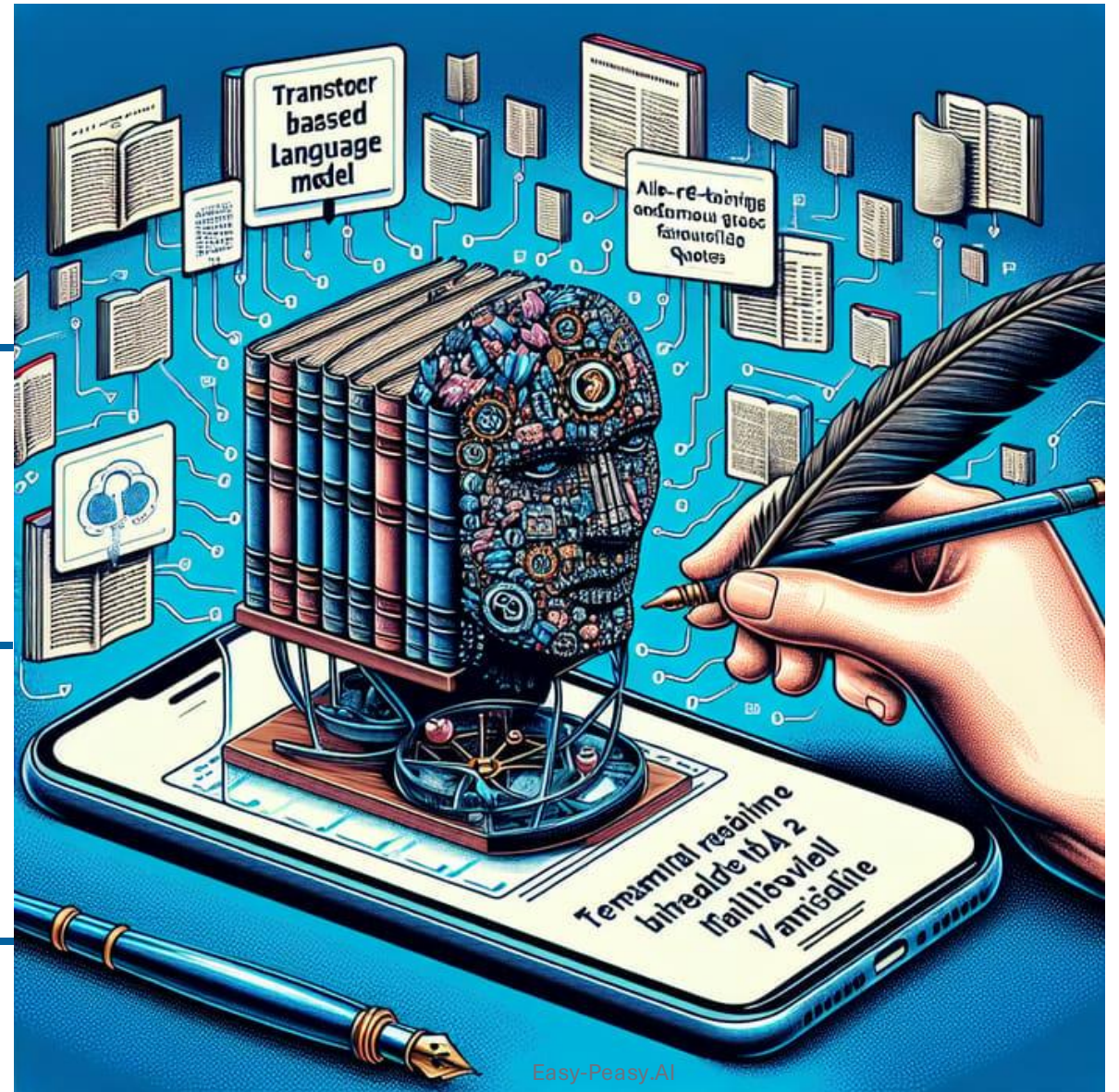


# LLMs and SESs

**Bias?**

**Justice?**

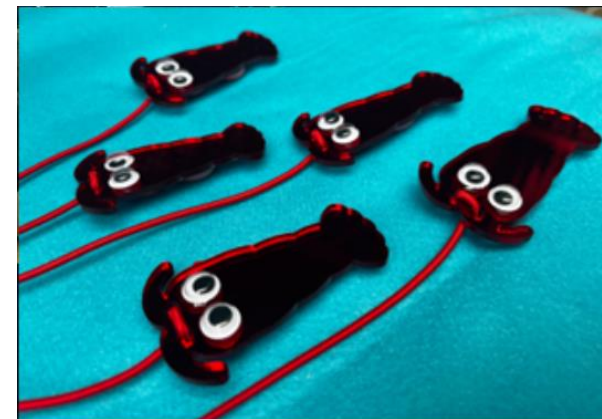
**Quality?**



# What now?



# The Best Kelp Secrets





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# Thank you



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Spillias, S., Tuohy, P., Andreotta, M. *et al.* Human-AI Collaboration to Identify Literature for Evidence Synthesis, 05 July 2023, PREPRINT (Version 1) available at Research Square [<https://doi.org/10.21203/rs.3.rs-3099291/v1>]

Urzedo, D., Sworna, Z.T., Hoskins, A.J. *et al.* AI chatbots contribute to global conservation injustices. *Humanit Soc Sci Commun* **11**, 204 (2024).  
<https://doi.org/10.1057/s41599-024-02720-3>

Sworna, Z.T., Urzedo, D., Hoskins, A.J. *et al.* The ethical implications of Chatbot developments for conservation expertise. *AI Ethics* (2024).  
<https://doi.org/10.1007/s43681-024-00460-3>



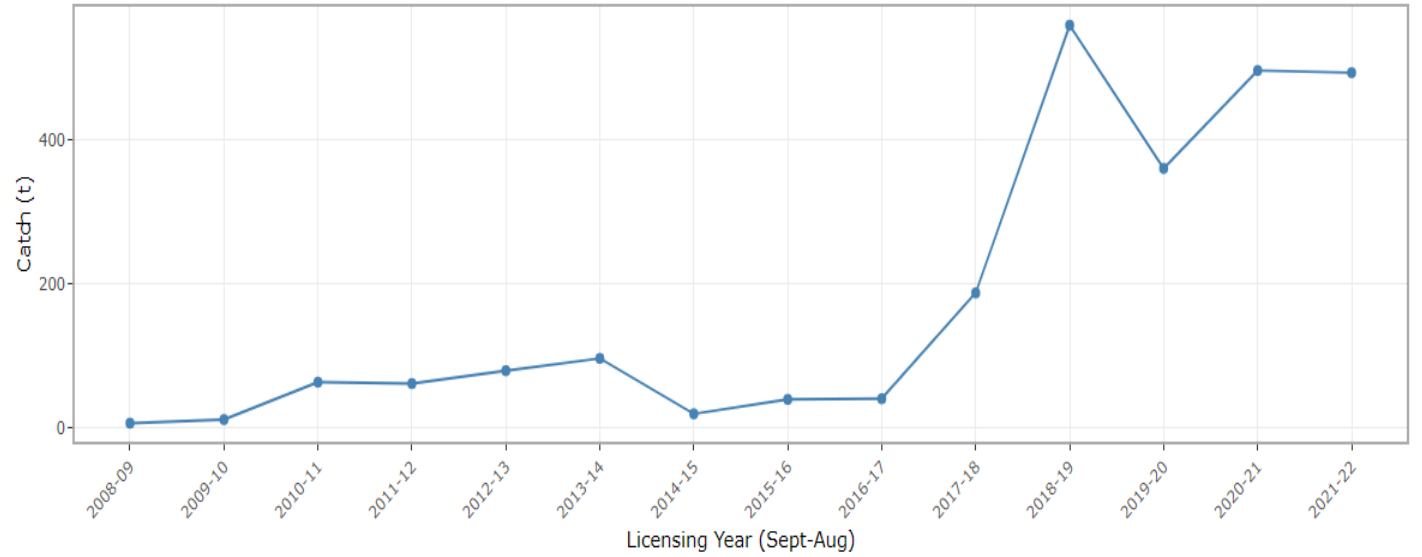
Source: Great Southern Reef



Source: Great Southern Reef



Source: True South Seafood



Source: Institute for Marine and Antarctic Studies