Is the 2023-24 Record Global Heat Warning of Climate Endgame?

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Although we may be entering a new era of 'greenhushing', events such as the devastating LA wildfires and Tropical Cyclone Alfred remind us that climate risk is not going away.

In fact, reports show that previous Northern Hemispheric summer was arguably the hottest for the last 125,000 years, and full year of 2024 exceeding 2023's spectacular warm anomaly as well as Paris Agreement's symbolic +1.5 deg C.

The persistent run of heat that began in May 2023 has prompted increased attention within the climate science community, spurring a hive of research activity around climate extreme event attribution and a search for the cause(s) of the ongoing spree of heat.

A critical question that has emerged centres around whether recent climate observations are warning of accelerated warming beyond model climate model predictions (concerns shared by several leading climate scientists including Prof. James Hansen – American climatologist and adjunct professor at Columbia University), and if so – what are the ensuing global climate policy implications?

To date, evidence of accelerating warming within the climate science community is mixed. Early "candidate explanations" of the sudden spike in temperatures include:

- The 2022 Hunga Tonga eruption
- The El Nino Southern Oscillation (a key weather phenomenon that contributes to natural climate variability — which swung to the "warm" phase in 2023)
- Reduced aerosol cover (which acts as a "blanket" and reflects more radiation) due to a change in international shipping regulations

These are thought to only make up a portion of the observed warming.

Until very recently, less attention has been focused on the dramatic Antarctic Sea ice decline since 2016. It is particularly concerning that the lost sea ice continues to show no sign of refreezing, and if this persists, it would mean that climate models have under-represented at least one key feedback mechanism that would result in higher temperature projections.

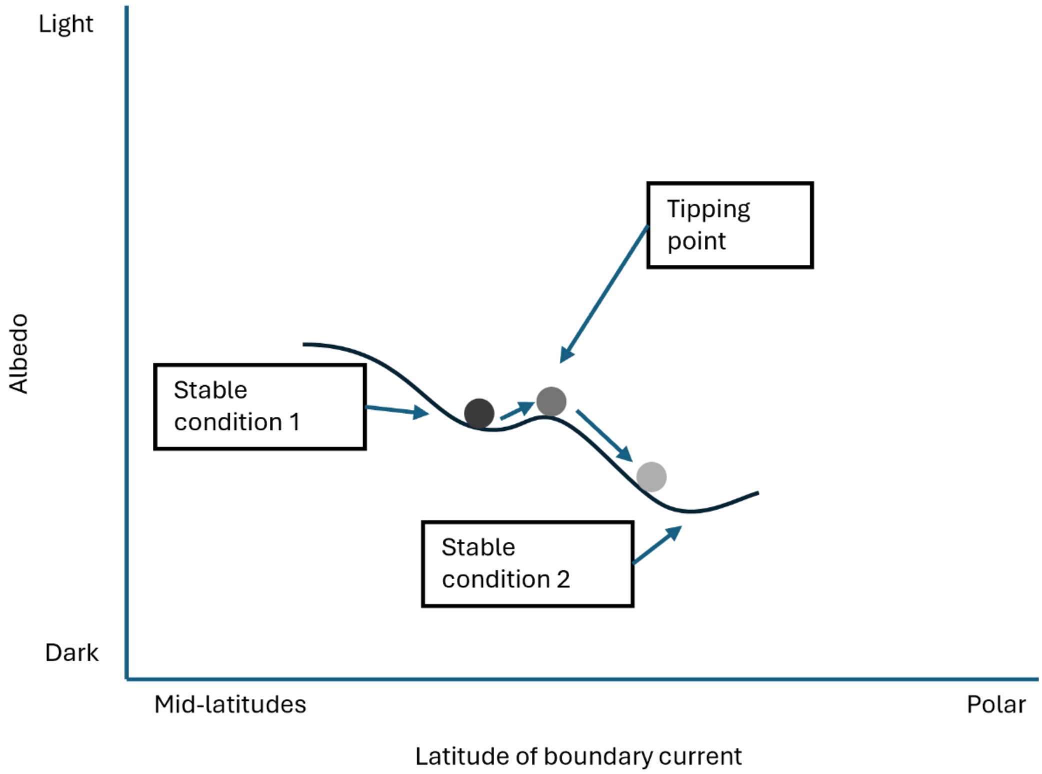
In our view, a key contributor to the jump in global temperatures in 2023 and 2024 may have been setup over multiple years, with gradual heating of oceanic boundary currents located to thewest of major oceans. The three currents of greatest interest are the Algulhas Current, the Eastern Australian Current and the Brazilian Current, with the warming regions of the southern extents (called Retroflections) of these boundary currents gradually extending southwards closer to Antarctica.

A tipping point may have arisen when these warm waters moved close enough to allow the meridional (north-south) transport of heat from atmospheric low-pressure systems that gain their energy from these warm waters, transporting heat from tropical and mid-latitudes to the polar regions over multiple months.

In other words, our view is that this was largely an atmospherically driven reduction in sea ice extent (think of a hairdryer effect over an ice cube). Worryingly, the lost sea ice (roughly equivalent to a third of the size of the Australian continent) then leads to a decrease in albedo[1] and imposes a new 'steady state' of increased warmth around the Antarctic (see figure below).

[1] Ability of surfaces to reflect sunlight (higher albedo means higher reflection ability)

Illustration of regime change due to shift in boundary current



Illustrative only: Warming pushes the latitude of boundary current poleward to a critical point (where the boundary current interacts directly with the edge of the ice sheet), and albedo decreases dramatically following ice melt. This sustains the position of the boundary current due to the higher absorption of solar energy into open water compared with ice.

If there is a chance that warming is indeed accelerating, what then does this mean for global climate policy?

Climate policy often involves weighing up nearer term costs of decarbonisation against future losses in the absence of mitigation, known as the "social cost of carbon". The ultimate social cost of carbon is a highly uncertain estimate (ranging from $32 to $1000 per tonne CO2)[2] that is highly sensitive to warming scenarios, as well as assumptions

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[2] Rennert et al., The Social Cost of Carbon, Advances in Long Term Probabilitistic Projections of Population, GDP, Emissions and Discount Rates, Brookings Papers on

of discount rates which is contentious as it reflects how much we value intergenerational equity.

For example, a small change in global average temperature can result in disproportionate increase in heat waves as well as risks associated with a range of other climate perils – an upwards revision in estimates, or how climate projections should be interpreted in the context of climate policy could could send reverberations across firms who have relied on scenario analysis for disclosure and other purposes , including the financial industry where regulators and international consortiums such as the Network for Greening Financial Services (NGFS) have been championing the early adoption of climate scenario analysis amongst entities to assess financial climate risk.

If economic and society impact resulting from climate change is found to be under appreciated, this may trigger a need to overhaul physical risk assessments or climate stress tests undertaken to date.This may include incorporating socioeconomic impacts from emerging evidence of tipping points such as the Atlantic Meridional Overturning Circulation (AMOC) collapse, or stress testing of ecological and societal resilience under extreme temperatures above hazardous Wet Bulb Globe Temperatures (WBGT).

Concluding, it is difficult to craft a positive narrative from the current persistent record heat, particularly at a time when we ought to be studying the climate more closely than ever before and scientific agencies responsible for monitoring climate health are being systematically dismantled in the US.

As such, it is imperative that other nations step up funding for advanced climate institutions such as the ECMWF (Europe), JMA, CSIRO and others to pick up the mantle and double down on efforts to improve climate projections. For actuaries or other practitioners in this space, it is important to be aware of limitations of existing scenario analysis methodologies, the high degree of uncertainty associated with results to date and hence the degree of reliance placed upon them.

About the Authors

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Bruce is a senior meteorologist and climatologist with 47 years of experience. He has been involved in climate change research with IAG, Woodside Energy, Rio Tinto, and the Meat & Livestock Association of Australia. Bruce has co-authored five books and has numerous peer-reviewed scientific publications. He was also team meteorologist for the successful Australian and Japanese sailing teams at the London, Rio and Tokyo Olympics respectively. Bruce holds a PhD in Atmospheric Science from UNSW.

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