

# BEYOND INCREMENTAL THINKING

Transformative approaches for disaster risk reduction

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Australian  
National  
University

# 2022 DISASTERS



# Outline

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The new “normal” – increasing natural hazards with climate change

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The world’s and Australia’s response

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Priorities in a complex and fast changing world

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Transformational approaches at ANU

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Transformation & Innovation at Scale - Build back better Forward Best

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Transition Plan to Zero Disasters



The number of extreme events is increasing worldwide.

Even if we stop carbon emissions today.

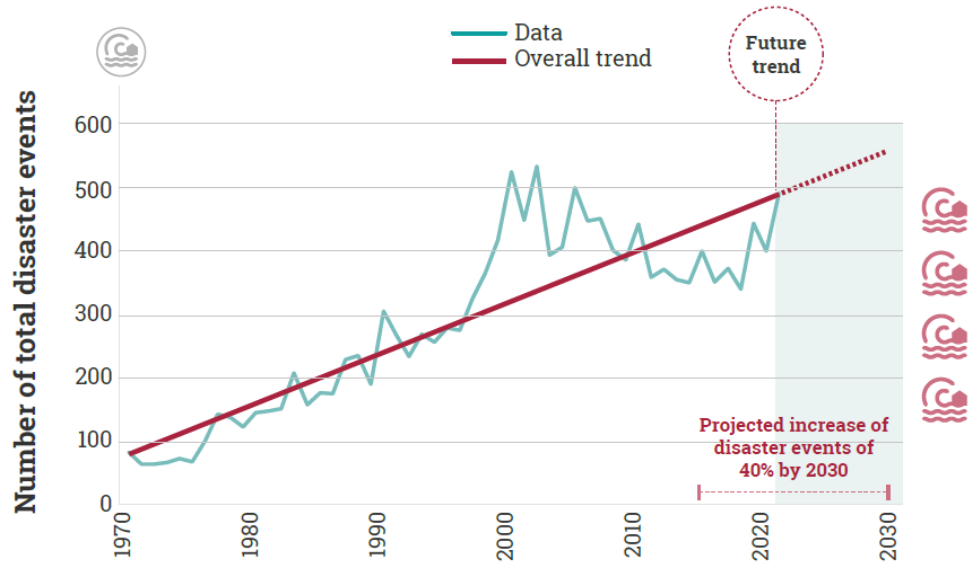
In the US alone:

**1980-2022** - an annual average of 7.7 weather-related events caused at least \$1 billion each in damage to residences, businesses and municipalities.

**2017-2021**, the average was 17.8 such events per year.

NOAA <https://www.ncei.noaa.gov/access/billions/>

**Figure 2.1. Number of disaster events 1970–2020 and projected increase 2021–2030**



Source: UNDRR analysis based on EM-DAT (CRED, 2021)

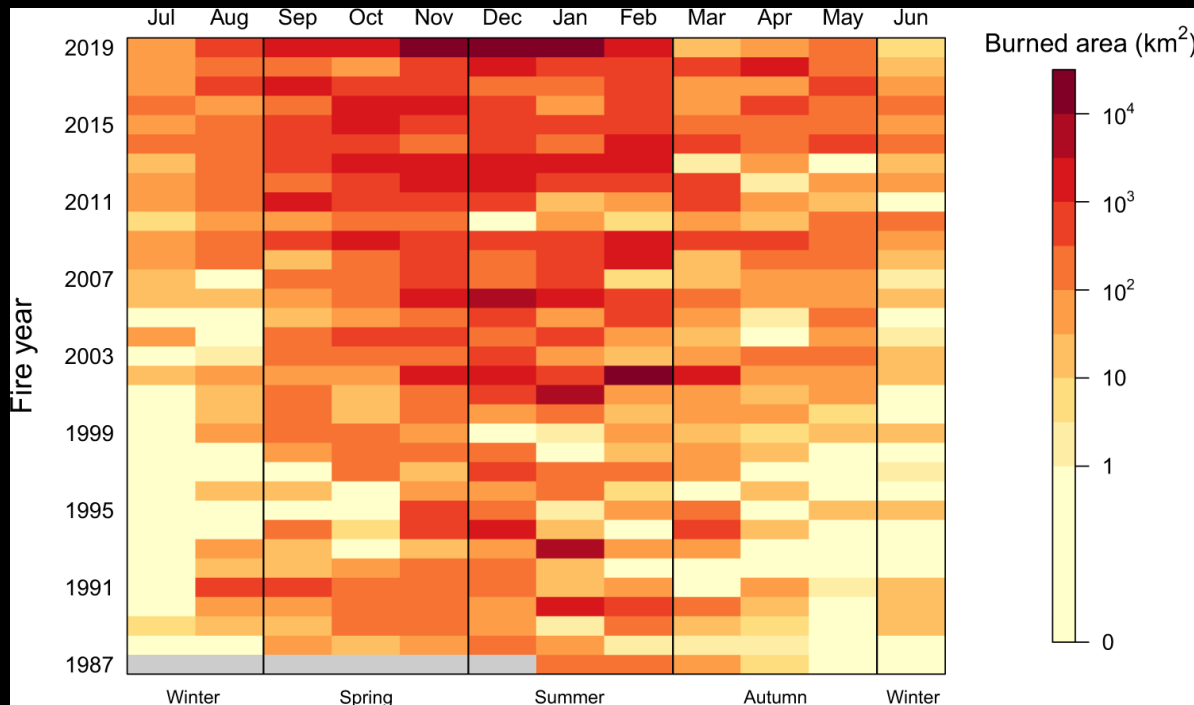


# The Intensity of Extreme Events is Increasing

Multi-decadal increase of forest burned area in Australia is linked to climate change, causing

## Increased:

- dangerous fire weather conditions
- ignitions from dry lightning
- fire-generated thunderstorms,



Monthly burned forest area for fire years (July to June)





# The new normal

## Increasingly frequent severe extreme events

Heatwaves

Droughts

Floods

Bushfires

Tropical cyclones

Sea level rise

Giant hailstorms in South-East Australia

Multi-hazards

Cascading consequences



# The World's Response - Sendai Framework for Disaster Risk Reduction 2015-2030

Substantially reduce global  
disaster mortality by 2030

Reduce disaster risk  
Strengthen resilience

The Sendai Framework outlines seven global targets to be achieved between 2015 and 2030.

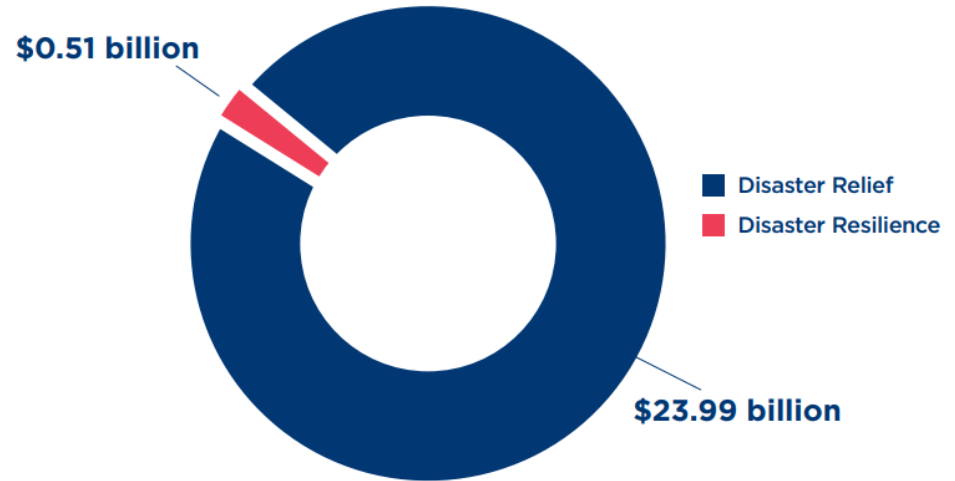


# AUSTRALIA - Spending too little, too late

- Between 2005-2022, the federal government spent \$24.5 billion on disasters
- 98% of this amount was spent on recovery and relief.
- Only 2% was spent on future-proofing and disaster resilience

APRA warns Australia must spend \$3.5bn/year to limit damage from climate-related natural hazards. Responding to bushfires, storms and cyclones after the fact is likely to cost 11 times more (APRA October 2020).

**FIGURE 2** FEDERAL GOVERNMENT EXPENDITURE ON NATURAL DISASTERS, 2005-2022



Source: Australian Government, Final Budget Outcome, 2005 to 2022 (2022 prices)





We are not keeping up  
with climate change

\$20b to upgrade the electricity grid in our transition to Zero Carbon  
Over \$100 billion for AUKUS submarines  
\$200m per year on disaster preparation

What we are doing is  
not working

Invest more for a safer and sustainable future for Australia.

- Build new industries in disaster risk reduction
- Build disaster preparedness into all sectors of the economy

We have a transition plan to Net Zero carbon dioxide emissions.

We need one for Zero Disasters

Plan for the worst case  
scenarios

Build ~~back better~~ forward best



# Prioritising

Disaster risk depends upon:

- Hazard likelihood, severity and frequency
- Exposure
- Vulnerability to damage.

1. Can we stop the disaster?

2. Can we reduce the intensity of the disaster?

3.a. Can we keep people safe?

3.b. Can we keep infrastructure safe?

3.c. Can we protect agriculture?

3.d. Can we protect the environment?



When a bushfire ignites, every second counts.



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Can we stop the disaster?

## 2019-20 Bushfires In Australia | Impact



17m ha of land incinerated



3b animals killed or displaced



3,000 homes lost

33 deaths



400 excess deaths

> 3,000 hospitalisations



\$20b total damage

CO<sub>2</sub> 830 million tonnes



Ozone layer hole -  
13% drop in levels



# This is not just an Australian phenomenon



Source: <https://www.theguardian.com/media/2022/jul/17/wildfires-worldwide-what-the-front-pages-say>



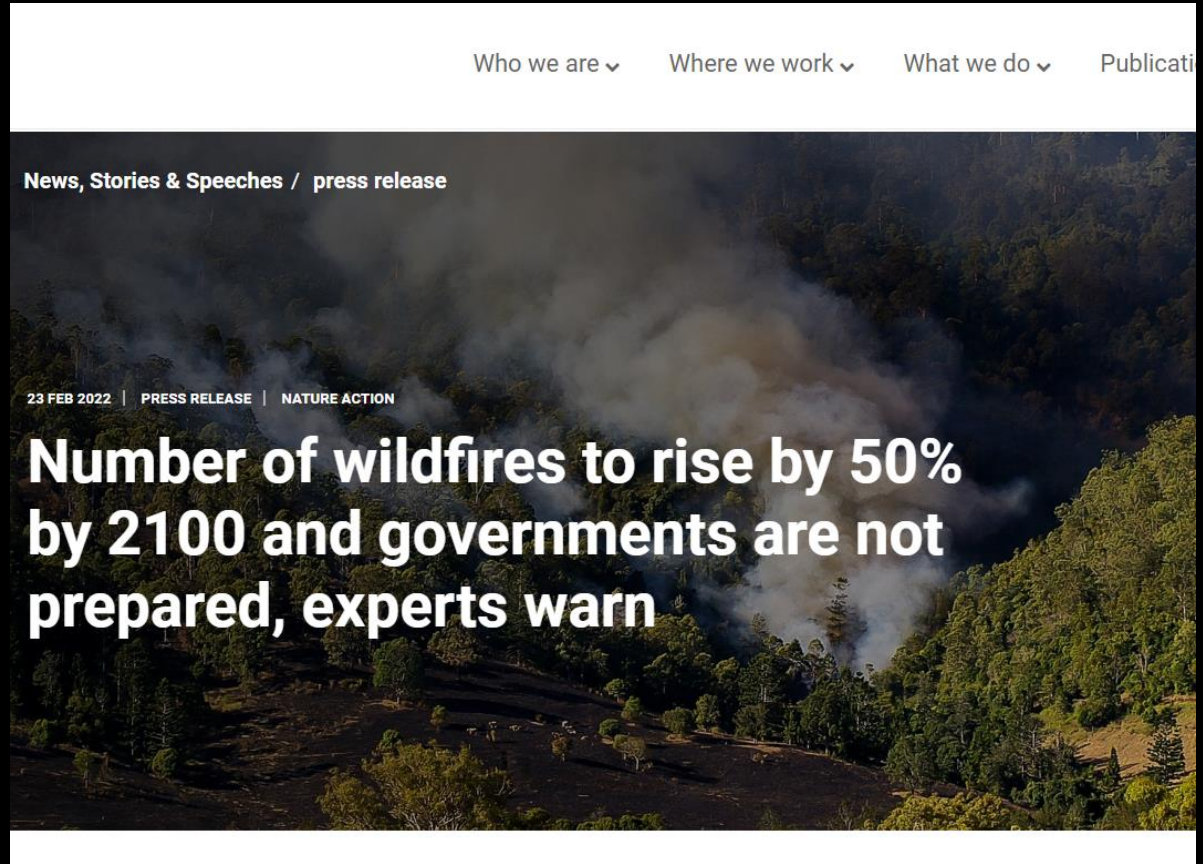
# UNEP raising the alarm

Number of dangerous fire weather days and wildfires on the rise.

A radical change in government spending on wildfires is needed.

Shift investment from reaction and response to prevention and preparedness.

Source: UNEP website; IPCC AR6 WGII





To prepare  
better for  
catastrophic  
bushfires, we  
need to turn  
our thinking  
upside down

Research has been dedicated to understanding how large fires get larger and how we can stop them from damaging important infrastructure

Large fires start small in remote areas and we usually do not see them until they have grown too big to extinguish.

What if we invested our efforts into finding them and putting them out when they are tiny?

# Change the way we fight bushfires.

Remote lightning ignitions cause 80-90% of the area burned

After ignition, time is limited before fire is too large

Inability to control large fires a key factor in 2019-20

Current methods cannot beat catastrophic bushfires.

Detect and extinguish ignitions before they spread and become hazardous.

Faster is better.





# Vision | Detect and extinguish a small bushfire before it can spread



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# Can we stop cyclones?

- Annual global damage US\$26 billion
- Hurricane Ian: property damage estimates range- \$42 billion to \$258 billion
- Mortality rate 10,000 lives per year
- Climate change increasing cyclone intensity.

Photo: NASA

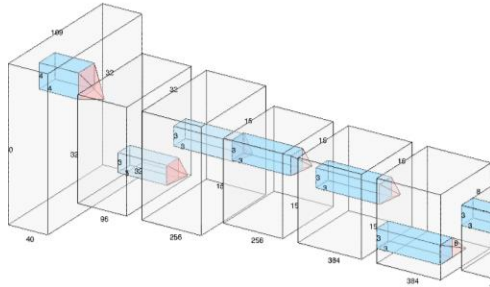
## Possible Interventions

- cloud seeding,
- pipes to inject cool water into cyclone hotspots,
- injecting particles into the upper atmosphere,
- atmospheric aerosol injections

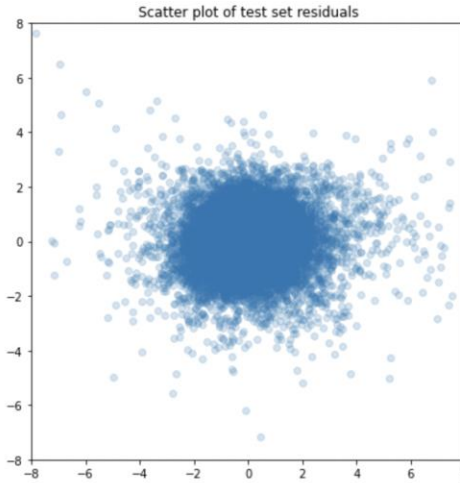
Ecological side effects and Governance issues.



## Students research to understand cyclone formation and trajectory



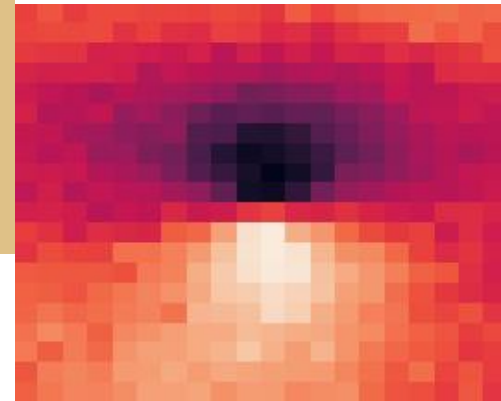
Explore traditional deep learning techniques for cyclone prediction



Characterize the uncertainties of trained models

ANU students:  
Jack Miller and Oliver Balfour

Discover novel learning algorithms and architectures which are informed by the physics of the system



Miller et al. 2022 submitted



# Can we stop flood damage?

A robust ecological system can cope with a variety of extreme floods.

Nature-based solutions contribute to a robust system.

Slow down flood flows and give rivers room to flood safely:

- reconnect rivers to floodplain wetlands;
- relocate or raise infrastructure (eg houses);
- change land use on floodplains;
- reinstate ancient paleo-river channels
- *enhance* riparian buffer strips

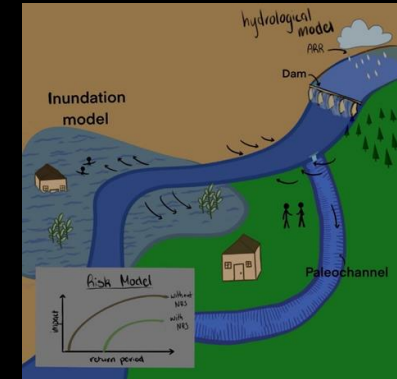


Photo: Shutterstock



## Partnering with local communities in regional Australia to increase resilience to flood risk.

- Developing an **evidence base and guidelines** for impact of Nature Based Solutions on flood risk
- Maximise impact
  - Novel simulations
  - Value co-benefits
  - Institutional and social factors
- Develop effective **financial incentives**



[HTTPS://WWW.EDX.ORG/COURSE/NATURE-BASED-SOLUTIONS-FOR-DISASTER-AND-CLIMATE-RESILIENCE](https://www.edx.org/course/nature-based-solutions-for-disaster-and-climate-resilience)





# Earthquake – earlier warning to protect people and infrastructure



We can't stop earthquakes.

We **can** protect people and some infrastructure.

High precision gravitational waves technologies can potentially detect:

- earthquakes many tens of seconds
- tsunamis tens of minutes

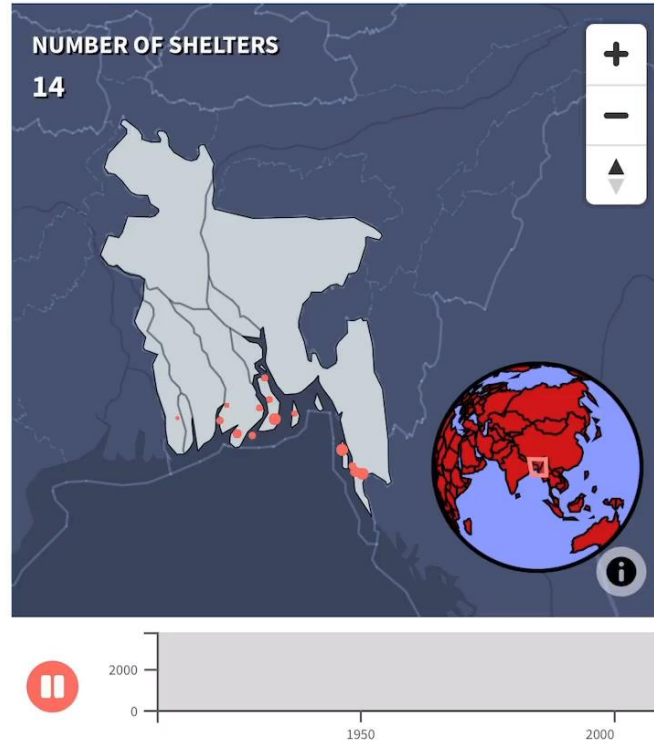
earlier than current Earthquake and Tsunami Early Warning systems.

Bram Slagmolen and Phil Cummins



# Cyclone shelters – Transformation at Scale

## Cyclone shelters in Bangladesh



[HTTPS://WWW.THENEWHUMANITARIAN.ORG/INVESTIGATION/2021/12/2/HOW-BANGLADESH-IS-BEATING-THE-ODDS-ON-CLIMATE-DISASTER-DEATHS](https://www.thenewhumanitarian.org/investigation/2021/12/2/how-bangladesh-is-beating-the-odds-on-climate-disaster-deaths)



# Build Forward Best – Why not Floating houses en masse?

## Mekong

<https://www.buoyantfoundation.org/vietnam-amphibiation-in-the-mekong-river-delta>



## Sweden





TYPICAL EXISTING  
'SHOTGUN' HOUSE

HOUSE ELEVATED  
TO 12 FT

HOUSE ON BUOYANT  
FOUNDATION



## The Buoyant Foundation Project

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[HTTPS://WWW.YOUTUBE.COM/WATCH?V=79S9JUQZUY](https://www.youtube.com/watch?v=79S9JUQZUY)



# We need change

Keep pace with climate change

Recognise the scale of the threat

We can't afford not to invest

Account for multi hazards and their flow on impacts

Weigh up priorities, including co-benefits

Transformational change needed at scale

Innovation needed at scale

All while we are recovering from multiple disasters



## Research to stop asteroids

NASA's Double Asteroid Redirection Test (DART) - spacecraft collided with asteroid Dimorphos on 26 September.

The asteroid was successfully diverted.



[HTTPS://WWW.TWEAKTOWN.COM/NEWS/88729/SPACECRAFT-DETECTIVE-WILL-INVESTIGATE-NASAS-CRASH-SITE-ON-ASTEROID/INDEX.HTML](https://www.tweaktown.com/news/88729/spacecraft-detective-will-investigate-nasas-crash-site-on-asteroid/index.html)



# Zero Disaster Transition Plan

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Expect the Worst

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Build ~~back~~~~better~~ Forward Best

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Innovation at scale

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Transformation at scale

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Prioritise at scale

