Tracking Tropical Cyclones Using Historical Records

OVERVIEW

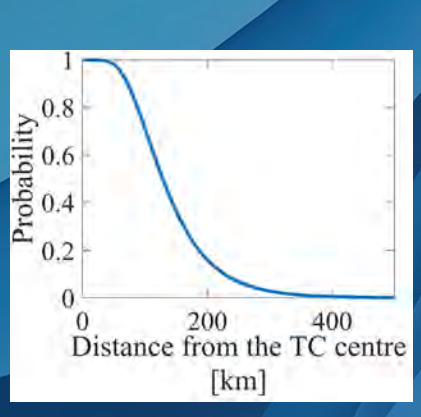
Tropical cyclone forecasting faces maximum uncertainty when a cyclone first forms. At this early point, it is difficult to determine what track the cyclone will take, and when it might make landfall. As a result, most forecasting methods provide predictions only a few days out from landfall.

To address this challenge, QUT is developing a new ‘hindcast’ model that uses historical cyclone data to provide a very early estimate of likely risk from an emerging cyclone.

METHOD

The hindcast model utilises the historical cyclone dataset for post-1960 cyclones (i.e., location, time).

The historical probability of landfall and an estimate of time to landfall for a current cyclone are derived by averaging the tracks of similar past cyclones, weighted by the difference in direction of past and current events.

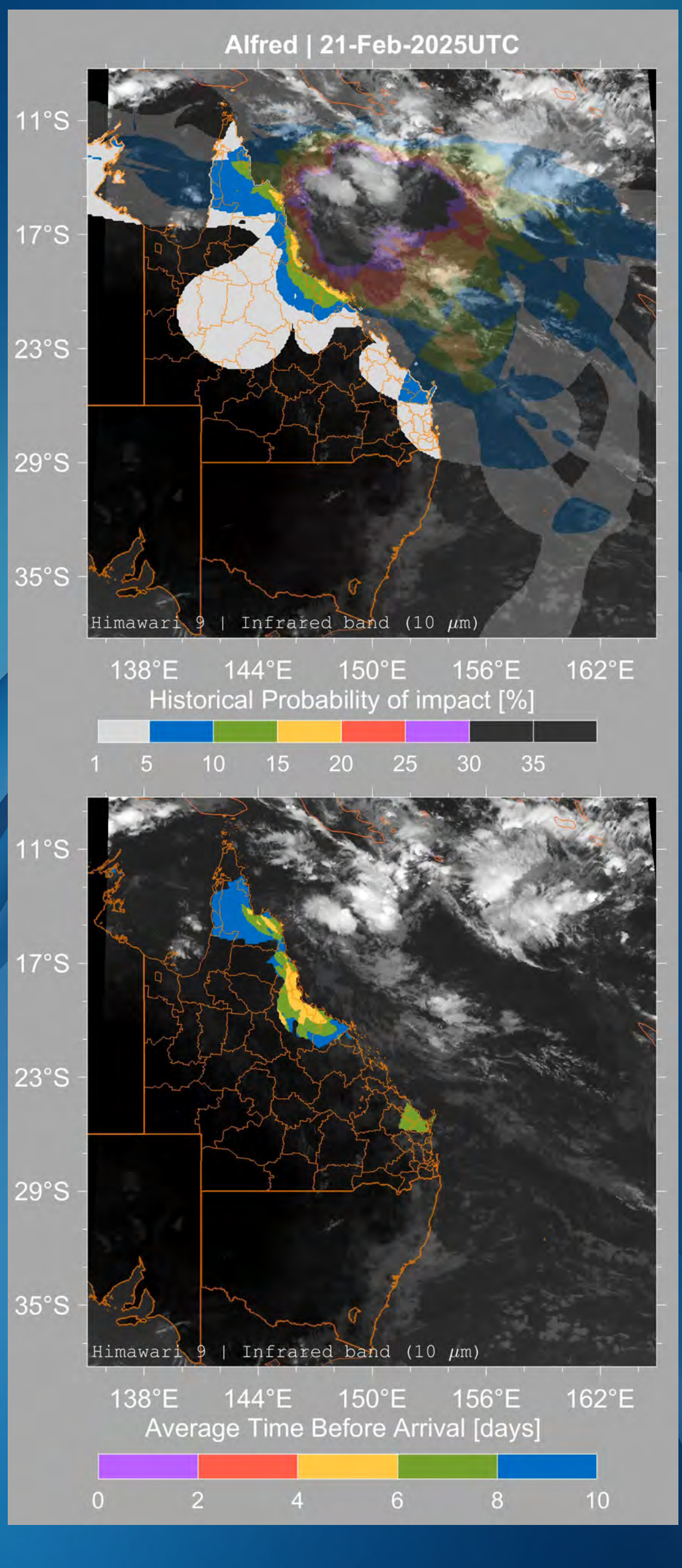


Through this method, the model is able to provide an early risk estimate for every LGA in Queensland, allowing for early steps toward preparedness and complementing existing forecasting approaches.

RESULTS AND NEXT STEPS

The method was initially validated during Tropical Cyclone Alfred in 2025, with the hindcast model showing a high degree of risk to SEQ identified 4-5 days after formation.

QUT will continue to evaluate the performance of the model against future cyclone events. We also aim to develop and trial a simple user interface, and explore paths to incorporate the technology into existing forecasting systems and risk communication.



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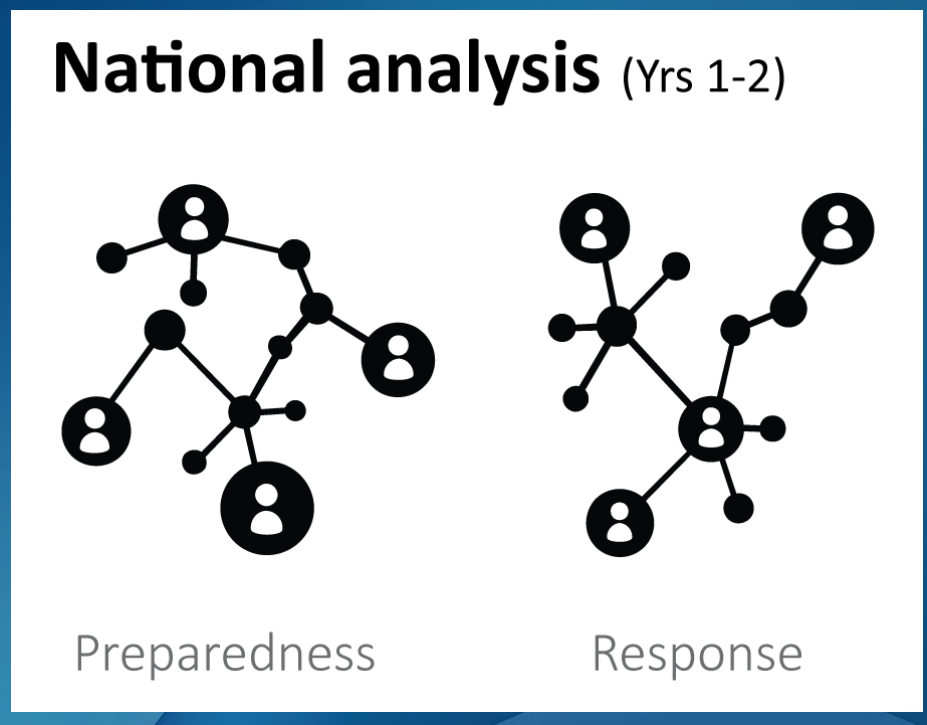
Personal Networks in Compound Hazard Response

OVERVIEW

Communities across Australia are facing more frequent back-to-back disasters—like floods following cyclones—that make recovery harder and increase vulnerability. While infrastructure and warnings matter, people's personal networks—family, friends, neighbours, and community contacts—are often the first line of support. Yet we don't know which types of networks work best for preparing and responding to these complex events. This newly awarded ARC project will fill that gap by studying how different social connections help people get ready and act during consecutive hazards. Starting in early 2026 and running until 2029, we will use surveys and case studies identify what network structures make the biggest difference—and how. The findings will guide practical strategies to strengthen community resilience and improve disaster preparedness programs.



Aim 1: Determining Supporting network structures

OUR APPROACH

Our approach combines national-scale social network analysis with qualitative case studies in a mixed-methods design. This is the first project to statistically test which personal network structures enhance preparedness and response to compound hazards across Australia. By integrating advanced modeling with in-depth interviews, we aim to reveal both the patterns and the "how" behind networks that build resilience—moving beyond generic strategies to deliver actionable insights for practitioners and policymakers.

Aim 2: Investigate social mechanisms facilitated by network structures

OUTCOMES

This project will generate evidence-based guidance on how personal networks strengthen disaster preparedness and response to consecutive hazards. By identifying which network structures make the biggest difference—and why—we will enable targeted resilience-building strategies. Outcomes include practical toolkits and guidelines for practitioners and policymakers, informed by national-scale analysis and community case studies, helping Australians reduce vulnerability and improve recovery in an era of escalating extreme weather.

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THE IMPACTS OF PLANNED RELOCATION ON WELLBEING: The case of Grantham, Australia

OVERVIEW

Planned relocation is the strategic and permanent movement of some or all of a community from areas highly exposed to hazards to safer locations, with the intention of keeping community networks intact rather than dispersing households individually. It is increasingly being implemented as climate impacts intensify, with documented cases in more than 78 countries.

Despite its importance, relocation is still approached as a last-resort measure and has often led to unintended impacts on peoples' wellbeing including loss of connection to place, disruption of social cohesion, and inequities in the relocation process. While international frameworks offer guidance, few governments have clear policies that address the social and psychological dimensions of relocation, meaning many processes unfold in an ad hoc and reactive way. This brief draws on the Grantham relocation in Queensland to illustrate how planned relocation can reduce physical risk while still producing complex and uneven wellbeing outcomes.

OUR APPROACH

A qualitative approach was adopted to understand the lived experiences and long-term wellbeing outcomes of the Grantham relocation. Semi-structured interviews were conducted with four key groups: residents who relocated to the new site, residents who remained at the original site, newcomers who arrived after the relocation, and staff involved in managing and implementing the relocation process. Participation was entirely voluntary, and interviews explored personal histories in Grantham, involvement in the relocation, and perceptions of its outcomes and success. In total, sixteen people participated. Human research ethics approval was granted by the Queensland University of Technology.

OUTCOMES

The relocation enhanced physical safety, reducing flood risk and increasing feelings of security. However, psychological wellbeing varied, with some residents continuing to experience trauma and social withdrawal. Community cohesion also shifted, as divisions emerged between those who relocated, stayed, or arrived later, compounded by limited community facilities and services to support reconnection. These diverse outcomes show that reducing physical risk alone is not enough to ensure long-term wellbeing.

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Hybrid ABM-LLM Decision Sandbox for Disaster Resilience

OVERVIEW

During natural disasters, human decision-making plays an important role in determining the outcome of the event. However, studying human behaviour at scale during such events can be challenging.

To address this, we are analysing the behavioural dynamics of natural disasters using a hybrid Agent-based modelling – Artificial Intelligence (ABM-AI) framework.

Our solution integrates survey-based synthetic populations, multilayered social networks, and generative agents to test early warning, resource allocation, and communication policies before costly field trials.

Our sandbox lets policy teams structure the problem, narrow viable options, and analyse system-wide effects quickly.

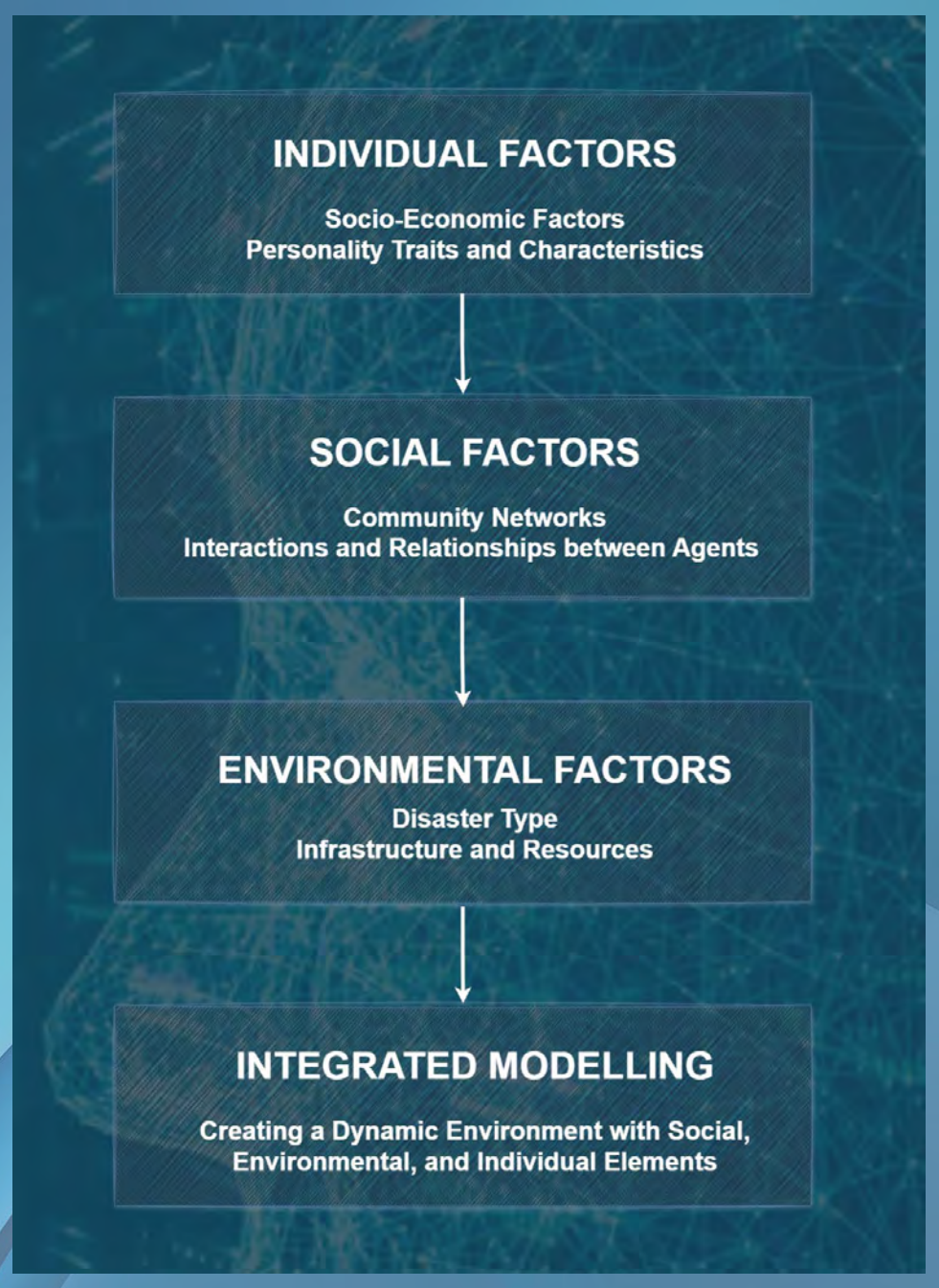

Fig 1: Context Integration Flow

OUR APPROACH

To model and analyse the complexity of human behaviour, we are developing context-aware, AI-driven agents that react to their environment, communicate with each other, and influence each other's decision-making.

Privacy-preserving, synthetic populations are built by mapping variables to 20 thematic profiles. Agents interact through multilayered networks. A hybrid ABM–AI model runs mechanism experiments while comparing bundled interventions before field trials. The architecture enables interoperability with other simulation tools for multifaceted modelling.

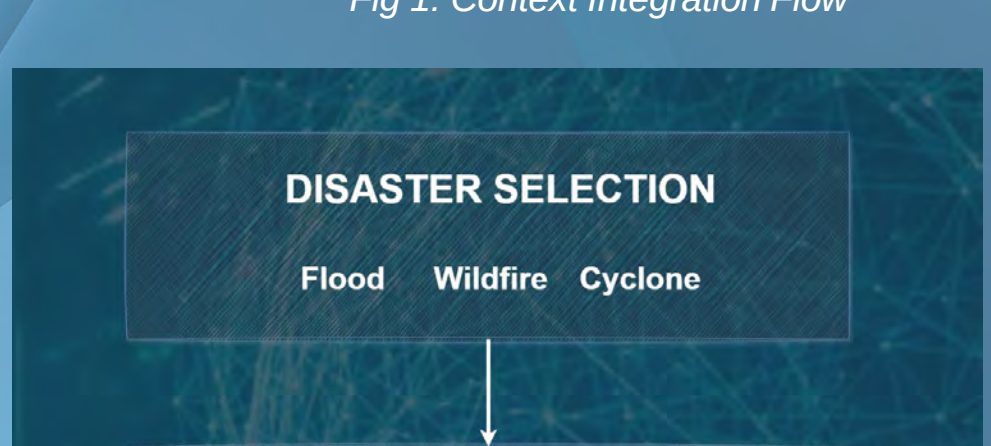

Fig 2: Simulation Execution Flow

WHAT IT ENABLES

The system models 'what-if' scenarios at population scale, identifies vulnerable cohorts, and enables researchers to study different communication and intervention channels.

It enables the evaluation of outcomes in a complex and semi-autonomous environment with feasibility and ethical compliance in mind.

The system's flexible architecture also supports testing diverse behavioural topics such as crime.

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QUT

BITA
ARC Training Centre for Behavioural Insights for Technology Adoption

Natural Disasters and Fraud

OVERVIEW

The physical impact of disasters is evident, and efforts are largely concentrated into the recovery of property and services. However, research indicates fraud flourishes in the aftermath of a natural disaster as offenders exploit vulnerabilities of those affected.

Natural disasters present many unique opportunities for offenders. Evidence suggests that price gouging and charitable fraud are common, as well as contractor fraud and schemes whereby individuals defraud the government and other organisations such as insurers.

Disasters wreak havoc on the physical and emotional wellbeing of individuals. Social disruption, unreliable communications, and weakened social networks weakened increase vulnerability. Additionally, the needs of individuals and communities may override processes in place to properly assess individuals, contracts and other opportunities.

OUR APPROACH

To date, research focuses heavily on a limited set of fraud types, the motivations of perpetrators and the heightened vulnerability of victims during these periods.

There is a pressing need to extend the conceptualisation of fraud and to consider the wider spectrum of fraudulent approaches, including investment fraud, romance fraud, recruitment fraud and business email compromise fraud, as well as other phishing approaches and identity-related crime types.

OUTCOMES

It stands to reason that the impact of a natural disaster could influence aspects of one's life that extend beyond immediate needs of property repair and insurance claims. Instead, the disruption afforded by a crisis event may alter the potential vectors of vulnerability of an individual and make them open and susceptible to other types of fraudulent approaches that they may have ignored before the natural disaster.

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Building gender-sensitive disaster resilience

OVERVIEW

Natural disasters intensify the structural drivers of gender-based violence (GBV). Rural and regional women, particularly those with disabilities and older women, are disproportionately impacted, including an increased risk of homelessness.

This community-engaged research project works with the Bundaberg Domestic and Family Violence Community Working Group. We are seeking to understand how regional communities can best respond to GBV across the disaster continuum:

- disaster planning and preparedness
- immediate response
- long term response, recovery and reconstruction.

The project focuses on Bundaberg's flood-prone communities where:

- there is limited disaster resilience infrastructure
- areas need strengthened cross-sectoral coordination
- the geographic isolation of rural areas compounds gender inequality during disasters.

This research project is supported by the Resilient CARE program, a Country to Coast Queensland and Australian Business Volunteers partnership, with received funding from the Australian Government.

RESILIENT CARE | Community-led Action for Resilient Health Eco-Systems

OUR APPROACH

A participatory approach is being taken in research, integrating a comprehensive evidence synthesis, including a gender analysis of local disaster plans, with community power mapping through interviews with diverse stakeholders and people with lived experience.

Co-design workshops enable collaborative development of prevention-focused responses, followed by partnership building for sustainable implementation. This approach combines best-practice evidence with place-specific power analysis and prioritises community ownership. This will facilitate community-driven responses to addressing the structural drivers of GBV that intensify during disasters.

OUTCOMES

This project will produce a community-owned 5-year action plan addressing the structural drivers of GBV across the disaster continuum, with a specific focus on women with disabilities and older women.

The research will enhance stakeholder understanding of how gender inequality intersects with disaster vulnerability. It will support the strengthening of cross-sectoral coordination between disaster management and GBV services, and establish place-based, prevention-focused partnerships.

Project team

Dr Christina Malatzky, Associate Professor QUT

Ms Gayle Reynolds, Community Research Associate QUT

Dr Cath Cosgrave, Director Attract Connect Stay

Dr Hazel Dalton, Senior Research Fellow, CSU

Project partners

Resilient CARE program, with received funding from the Australian Government

Bundaberg Domestic and Family Violence Community Working Group, Community Partner

QUT

Severity and Economic Impacts of Global Natural Disasters

OVERVIEW

Natural disasters worldwide have become more frequent, with a 22% increase in annual events and 37% more people affected from 2000–2024 compared to 1975–1999. While high-income countries face greater disaster risk, low-income nations continue to bear the heaviest burden, as global data shows:

Disaster Events and Impacts (2000–2024)

Total Events:

Low-income countries – 1,395
High-income countries – 2,731

Average Annual Economic Losses (% of GDP):

Low-income countries – 0.45%
High-income countries – 0.20%

Average People Affected (per 100,000 per event):

Low-income countries – 56
High-income countries – 4

Source: EM-DAT (1975-2024)

OUR APPROACH

A comprehensive global disaster severity index will be developed, featuring:

- 18 key variables using a multi-source approach.
- AI-assisted automated data collection spanning 23 years.
- Annual indices to measure economic impacts from global to national levels.

OUTCOMES

The research aims to achieve the following key outcomes:

- **Develop a Global Multidimensional Disaster Severity Index**
  Captures cross-country variations in severity.
- **Identify and Expand Determinants of Disaster Severity**
  Identifies and expands key influencing factors.
- **Estimate Economic Losses**
  Quantifies losses from global to national levels.
- **Assess Sectoral Impacts (Nepal Case)**
  Assess sector-specific effects.
- **Evaluate Post-Disaster Resettlement Intentions**
  Evaluates willingness of affected individuals to return home.

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Source of Ph.D. Funding
QUT Postgraduate Research Award.
Image: Getty Images

Climate Care: Co-Designing Analogue, Digital and Experiential Tools for Mental Health in a Changing World

OVERVIEW

The psychological and social consequences of extreme weather events and climate change, from acute eco-distress, and anxiety to long-term trauma, displacement grief, and climate-related depression, are significant and vary across generations and can be precursors to significant harm, including individual self-harm, gendered violence and PTSD.

Particularly in Queensland, more frequent extreme weather events, including heatwaves, bushfires, cyclones, droughts, and floods, are damaging natural ecosystems and destabilising the social and emotional foundations of daily life, including routines, relationships, livelihoods, and support networks.

There is a pressing need for a preventative, community-led, multi-modal, cost-efficient, and scalable mental health promotion response that:

- moves beyond clinical settings;
- leverages artificial intelligence (AI);
- strengthens local support and MH literacy;
- builds resilience.

OUR APPROACH

Our approach prioritises lived experience and local knowledge, moving beyond traditional top-down, siloed interventions to pioneer a systems-aware, place-based, intergenerational, community-led model.

Our project builds on existing knowledge and targets priority populations disproportionately affected by climate-related stress and disruption; intergenerational residents in regional, rural and remote Queensland, which faces more frequent and severe extreme weather events than most Australian states, such as the Millenium drought (1995–2009), Queensland Floods (2010–2011, 2013, 2022), Cyclone Yasi in 2011, 2019-20 Black Summer bushfires and, in 2025 ex-Cyclone Alfred.

OUTCOMES

We address the complexity of climate-related mental health needs in regional, rural and remote areas by co-designing three Analogue, Digital, and Experiential (ADE) tools:

(i) Climate First Aid (low-tech peer support),
(ii) Climate Care AI (digital), and
(iii) Creative Resilience (experiential engagement).

Together, these ADE tools build resilience through diverse accessible, scalable, and inclusive entry points, enabling individuals, communities, and clinicians to recognise and respond to climate anxiety/distress.

Each tool will be evaluated for its resonance, accessibility, scalability, and effectiveness in fostering mental health resilience across diverse regional, rural, and remote populations; young, old, and Indigenous.

While this is a large research grant that is is currently under review, the project team are very interested in exploring potential collaborations, partnerships, and knowledge-sharing initiatives in this area.

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Climate Change, Housing and Human Rights

OVERVIEW

The right to housing is guaranteed in international law, which requires governments take the necessary steps to ensure that all people can enjoy this right and to protect against foreseeable risks.

Without adequate and appropriate housing, a range of other rights will also suffer, such as rights to education, health, culture, physical security, and even the right to life. However, presently in Australia no human rights legislation recognises the right to housing, despite experiencing a deep and broad housing affordability and availability crisis.

Climate change poses a significant, multifaceted threat to the right to housing and its key component, habitability. Not only do climate impacts, such as extreme heat, excessive rainfall or flooding, and increased air pollution because of bushfire smoke, dust storms, and similar airborne hazards, undermine habitability but climate change also compounds existing structural housing inequalities for Aboriginal and Torres Strait Islander peoples

KNOWLEDGE GAP

Australia is in the process of drafting a national housing plan. The National Housing Plan Summary Report (DSS, 2025) recognises the interconnection between housing, human rights, and climate change. The Summary Report notes that more focus is needed to prepare housing for a different climate and acknowledges the pressing need for strict regulatory standards to ensure that new builds consider risks such as flooding, bushfires, and erosion.

Nevertheless, there is a need for these obligations to be implemented across a range of different policy areas including:

- Disaster Regulation
- Human Rights protection
- Aboriginal and Torres Strait Islander Housing regulation
- Planning and Development laws
- Climate adaptation laws
- Insurance laws

CONCLUSION

At present there is policy fragmentation in Australia which risks the intersecting issues of housing, human rights and climate change either being addressed in policy siloes or falling between the cracks.

Significant reforms are required across multiple policy areas to enhance the protection of housing and human rights in the face of climate change. The Daniel Billy decision of the UN Human Rights Committee shows how Australia is currently failing to protect the human right to housing in the Torres Strait.

In addition to strengthening existing residential tenancy laws, human rights laws provide a protective legal framework for groups at risk of climate-related harm in the context of housing.

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Assessing air quality impacts from the 2023 bushfire season

OVERVIEW

Between late October and November 2023, more than 1,000 vegetation fires burned across Queensland, destroying over 180 properties. Smoke from these fires was a major source of particulate matter (PM), with fine particles ($PM_{2.5}$) posing serious health risks, penetrating deep into the lungs and bloodstream with have no known safe exposure threshold [1]. As bushfire frequency and intensity increases, monitoring PM levels during fire events is critical for public health preparedness [2].

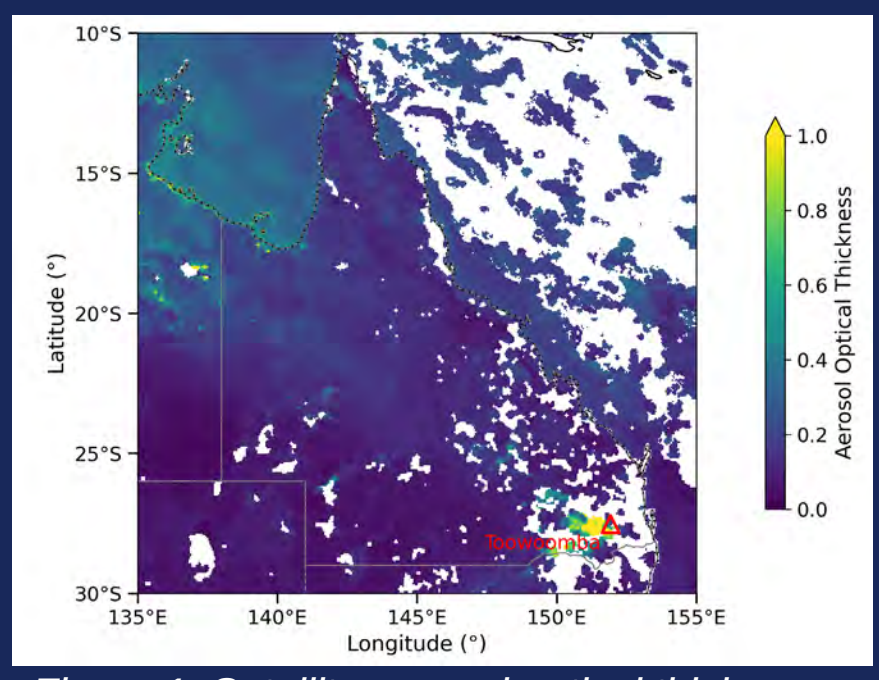

Figure 1: Satellite aerosol optical thickness plot for weekly mean $PM_{2.5}$ in QLD at height of bushfire from 4-10th October 2023.

OUR APPROACH

This study utilised a dual-data approach to offer a novel, local-scale assessment of bushfire-driven air quality changes by:

- Calculating weekly averages of $PM_{2.5}$ and PM_{10} from Toowoomba hourly ground station data in 2023 to compare with 2022 (a non-bushfire year)
- Classifying weeks as “Bushfire” or “No Bushfire” based on Disaster Recovery Funding Arrangement declarations.
- Analysing satellite-derived aerosol optical thickness (AOT) with Himawari to evaluate smoke load and validate ground-based trends.

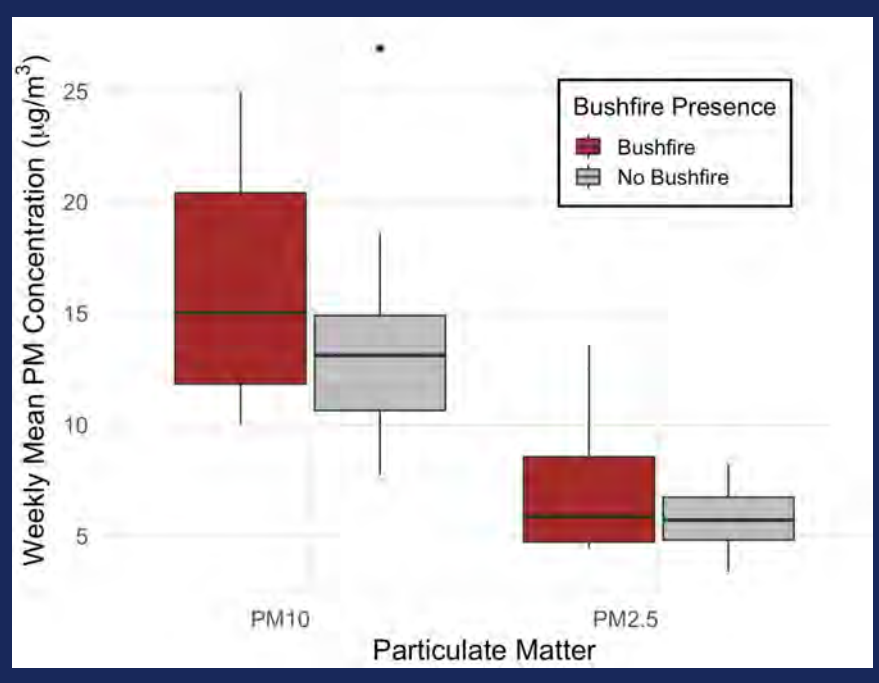

Figure 2: Weekly mean concentration of PM_{10} and $PM_{2.5}$ during periods with and without bushfire activity.

OUTCOMES

Bushfire weeks in 2023 had significantly higher and more variable $PM_{2.5}$ and PM_{10} concentrations than non-bushfire weeks, indicating more frequent or intense smoke events. Satellite observations confirmed these trends, with notable increases in aerosol optical thickness and cloud cover during fire periods, consistent with elevated smoke plumes.

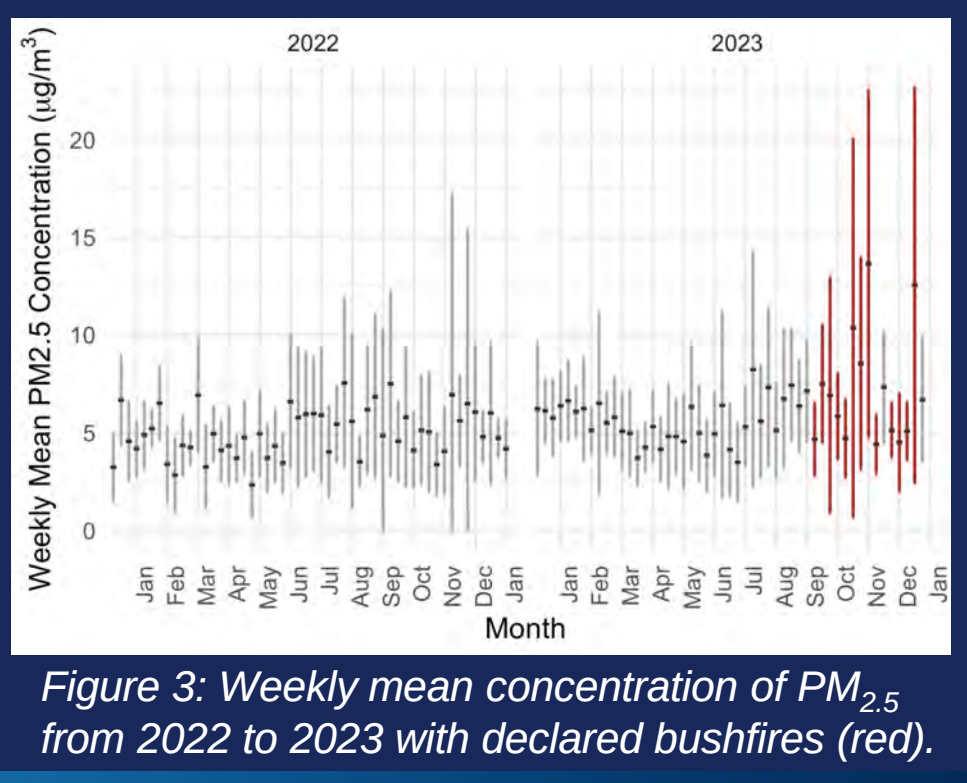

Figure 3: Weekly mean concentration of $PM_{2.5}$ from 2022 to 2023 with declared bushfires (red).

These findings highlight clear bushfire-driven degradation of air quality in Toowoomba, while validating the use of combined ground and satellite data for local smoke impact assessment.

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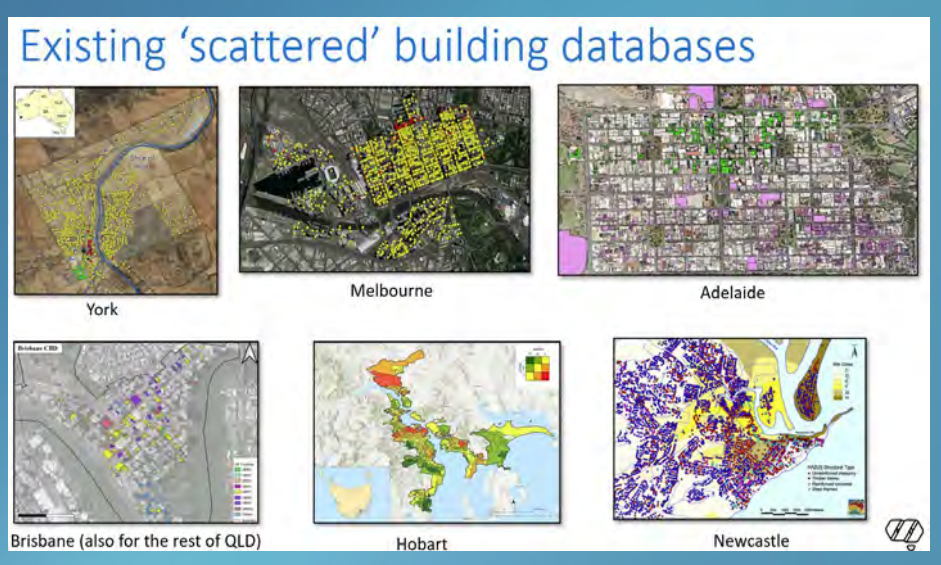
Unreinforced Masonry Building Database for Risk Mitigation

OVERVIEW

Unreinforced Masonry (URM) buildings are prevalent in Australia and potentially vulnerable to earthquakes. Artificial Intelligence and geospatial technologies can be utilized to locate URM structures for:

- ❑ Appropriate classification based on seismic vulnerability
- ❑ Geospatial scenario study of building damage
- ❑ Emergency response training exercise development before disaster; and
- ❑ Enhancing emergency response strategies

A nationally consistent Australian database is yet to be developed. Existing databases are scattered and limited in scope. This project, funded by Natural Hazards Research Australia, aims to develop a nationally-consistent database.



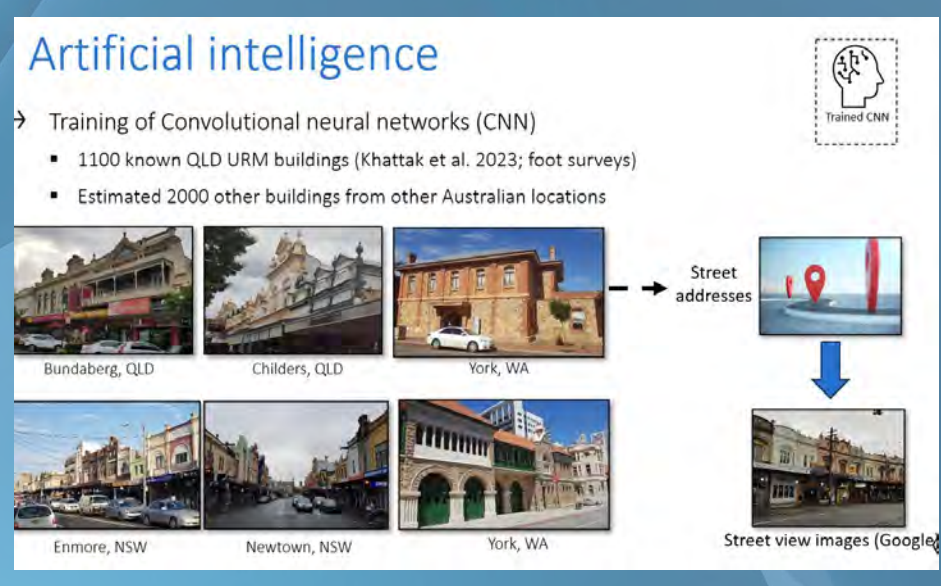
Creating URM Database:

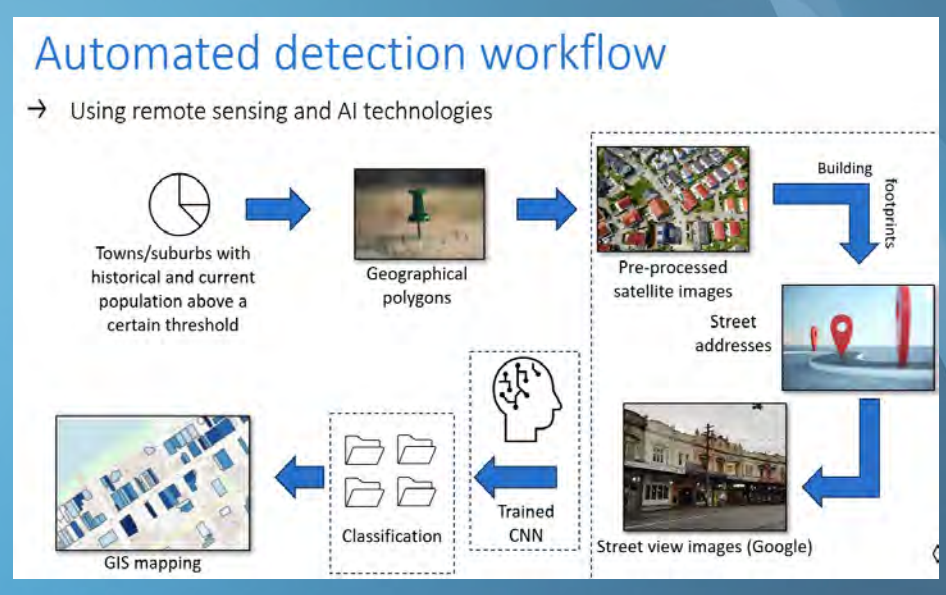
OUR APPROACH

Phase-1: Creating a URM database using previous Geoscience Australia Studies and with building expert annotators.

Phase-2: Training AI model using that database for URM detection.

Phase-3: Developing an AI workflow for Automated detection of URMs, integrating Google Street View.





OUTCOMES

- Enhanced emergency alert systems through the integration of the exposure database with hazard/ impact reports (ShapeMap, FlatGrid etc.)
- Understanding the event impact on emergency response efforts
- Greater understanding of URM-related risks

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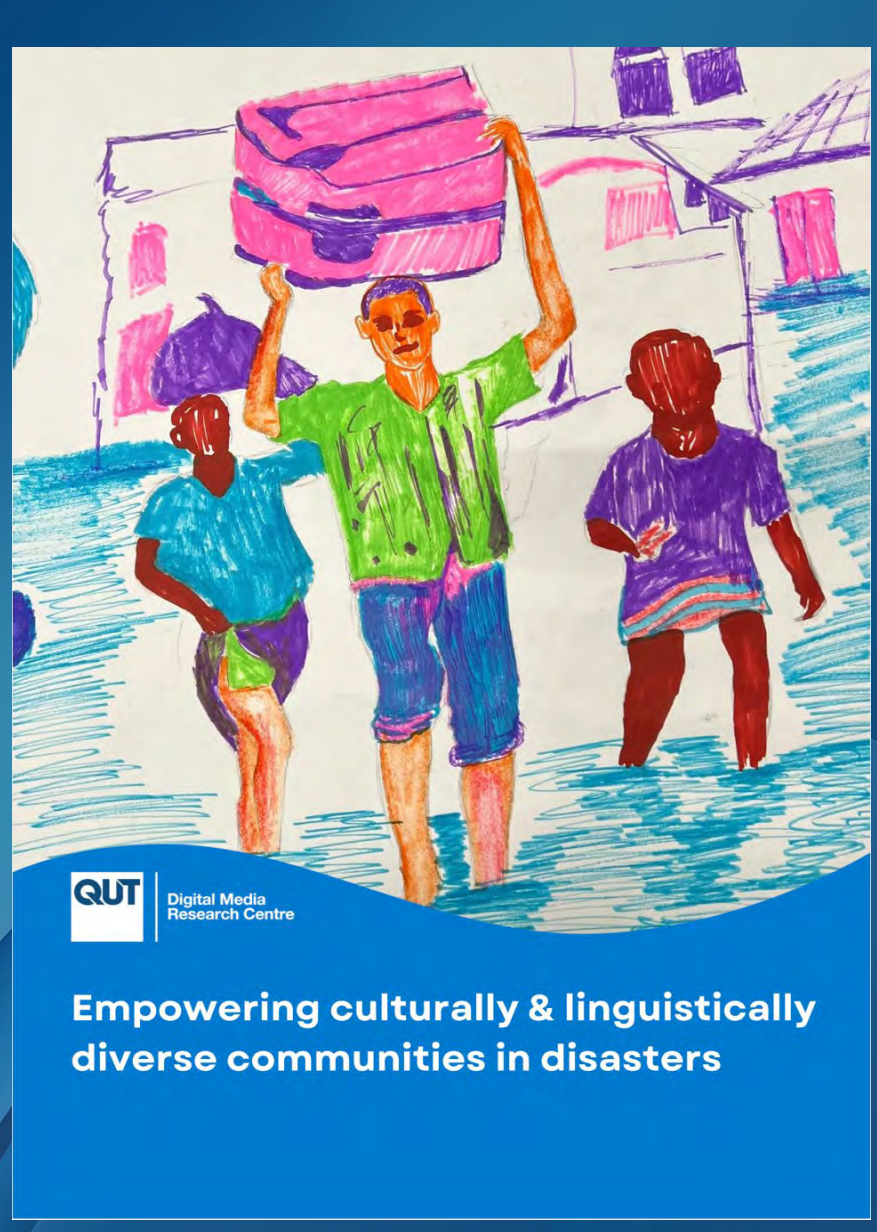
Empowering multicultural communities in disasters

OVERVIEW

Culturally and linguistically diverse (CALD) communities have long faced systemic inequalities during disasters — from language barriers and cultural disconnect to economic divide and limited social support. Despite their wealth of cultural knowledge and lived experiences, Australia's emergency management systems often lack the communication resources needed to strengthen CALD communities' resilience or to integrate their insights into disaster planning and response.

Funded by the Australian and Queensland Governments under the Queensland Resilience and Risk Reduction Fund (QRRRF), this project not only examined the barriers and challenges CALD communities face in emergencies but also explored new opportunities to co-design effective communication systems *with* these communities, ensuring their voices are central to resilience-building efforts.



OUR APPROACH

Featuring participatory action research, this project directly engaged CALD members from seven cultural groups in Far North Queensland: Bhutanese, Chinese, Colombian, Congolese, Indonesian, Filipino, and Japanese. In partnership with the local council, social services, and multicultural organisations in Cairns, we used multi-phased methods for data collection: individual storytelling, resource mapping, co-design/co-production workshops, and validation surveys. CALD community leaders served as critical intermediaries to provide research and cultural support.

OUTCOMES

- **Project Report** – A comprehensive guide to work with Australian CALD communities for collaborative disaster resilience, and a compass for policy development and resource investment in supporting CALD communities for disaster preparedness.
- **Storytelling Toolkit** – A set of practical, storytelling-driven, and culturally responsive tools designed to strengthen dialogue between emergency management sectors and CALD communities through communication, education, listening, and advocacy.

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Scan the QR code →

Performance Of Steel-framed Roof Under Combined Wind and Bushfire Conditions

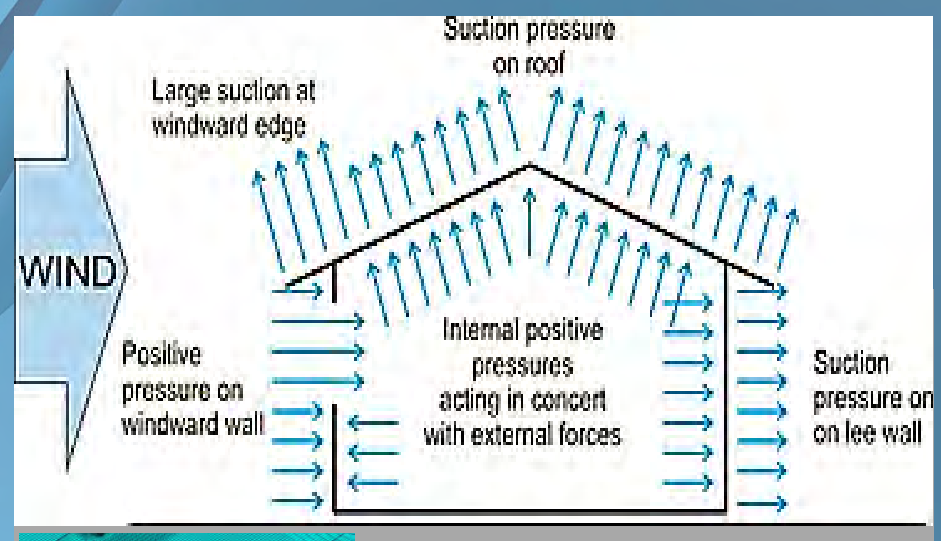
OVERVIEW

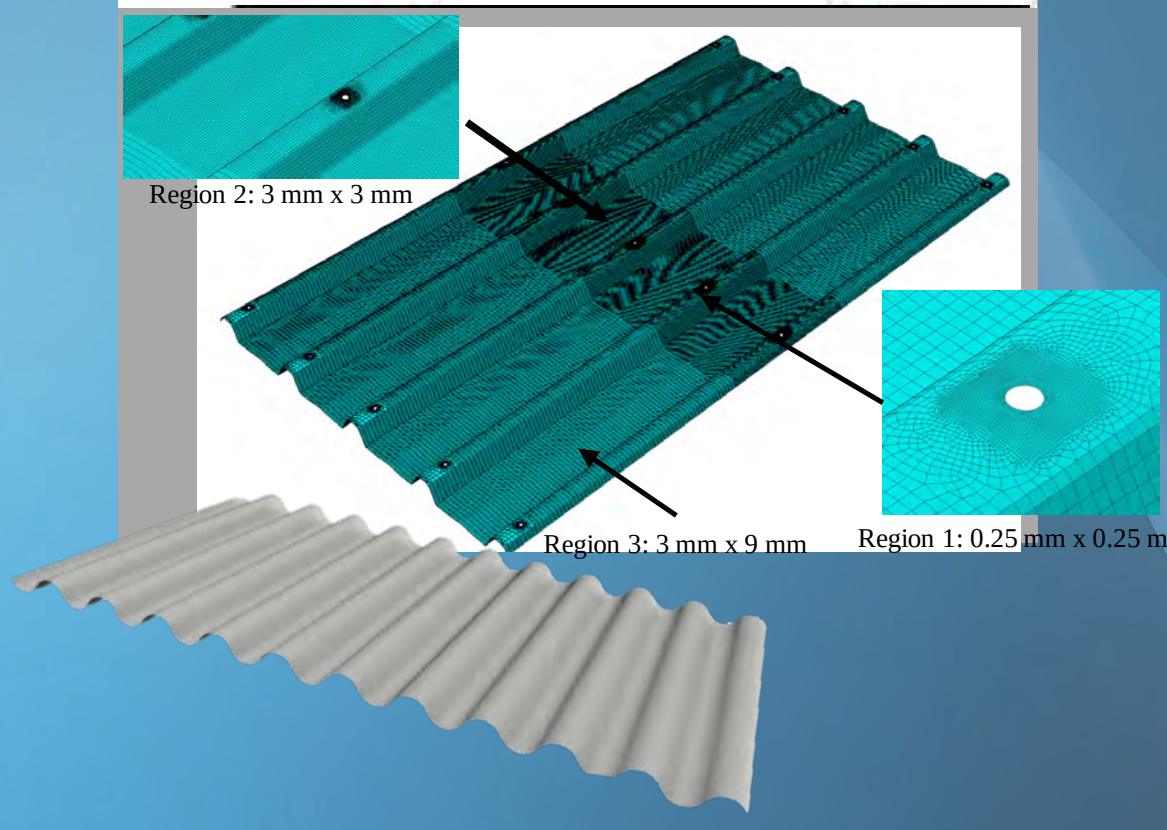
During bushfires, buildings are exposed not only to extreme heat and flames but also to very strong, turbulent winds. These conditions can cause rapid buildup of pressures inside and outside the building, which, combined with rising temperatures, can lift or even blow off roofs.

Roof failures can lead to the loss of the building envelope, allowing fire, heat, and embers to penetrate the structure, dramatically increasing the vulnerability of the entire building. Understanding these combined effects is essential for designing buildings that can survive bushfire events.

OUR APPROACH

This research investigates the failure mechanisms of roofs under simulated bushfire conditions, accounting for both wind forces and heat loads. By closely examining how different LSF roof types respond to these stresses, we identify critical weak points and inform design solutions that prevent premature failures.





OUTCOMES

Our study has led to the development of new design equations and guidelines that engineers can use to enhance roof performance under bushfire conditions. These tools provide evidence-based methods to improve buildings' structural resilience, reducing the risk of catastrophic failure during fires.

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Enhancing Bushfire Resilience of Buildings: External Light-gauge Steel-framed Walls and Shutters

OVERVIEW

Windows, shutters, and external light-gauge steel-framed (LSF) walls are critical components of buildings in bushfire-prone areas, yet they are vulnerable to intense radiant heat and direct flame exposure. Existing bushfire-rated systems are often costly and not fully optimized for performance, limiting their adoption in at-risk communities.

OUR APPROACH

Our research combines large-scale fire experiments and advanced numerical modelling to investigate the performance of external LSF walls, windows, and shutter systems under varying Bushfire Attack Levels (BAL), including both radiant heat and flame zone exposures. It also explores innovative, fire-resistant materials and composite designs to develop cost-effective, high-performance bushfire protection solutions.

OUTCOMES

The results provide quantitative evidence that simple, retrofittable bushfire shutter solutions can significantly enhance bushfire resilience, demonstrate the efficacy of LSF walls in mitigating heat and flame damage, and offer evidence-based guidance for designing more affordable and reliable bushfire-resistant building envelopes.

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Assessment and Resilient Design of Buildings for Bushfires using Advanced Technologies

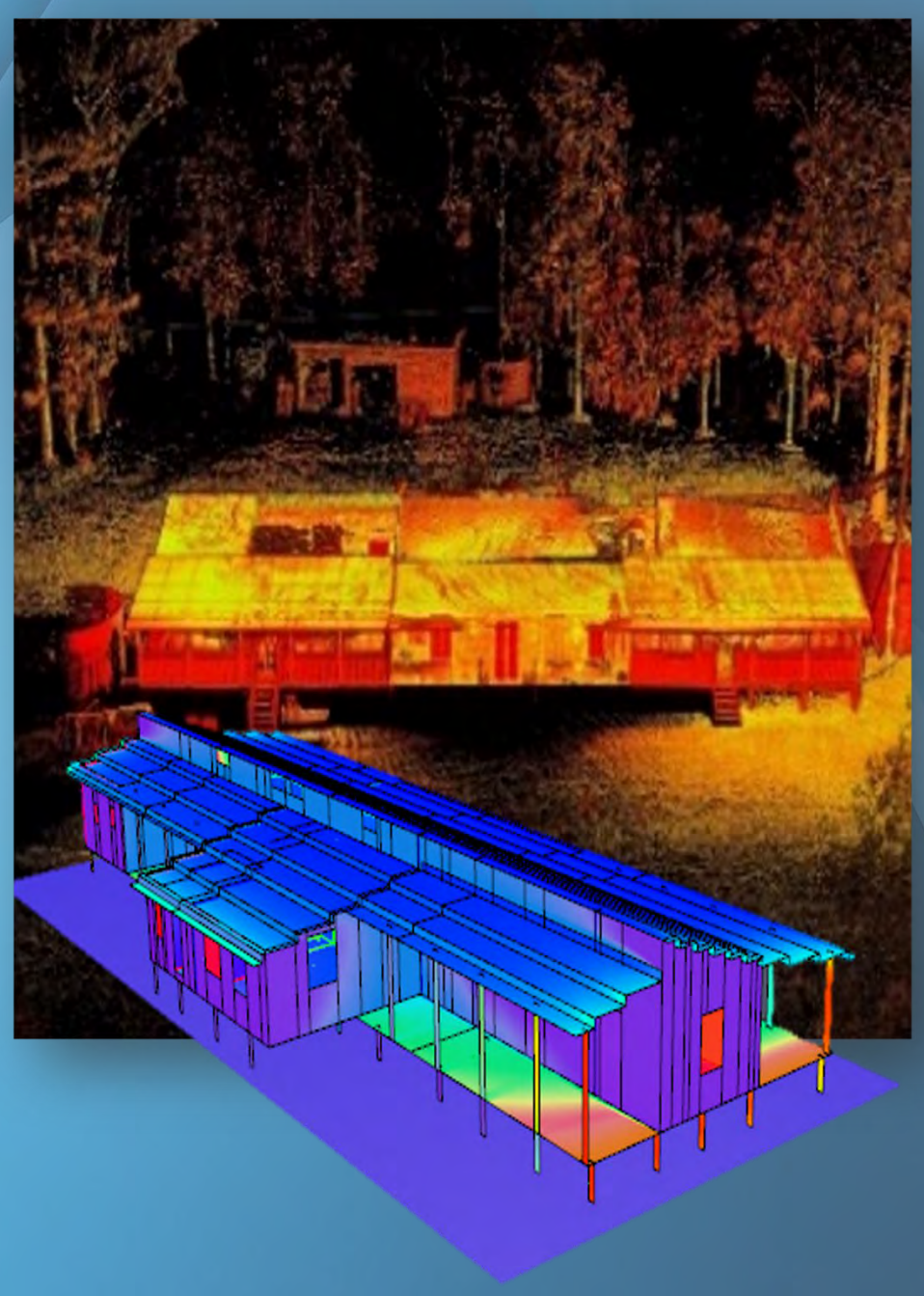
OVERVIEW

Understanding bushfire risks to buildings is increasingly difficult in changing environments. Building footprint information is often incomplete or outdated, vegetation and fuel loads constantly change, and the way fires interact with the landscape and weather makes predicting impacts complex. These challenges make it hard for councils, communities, and homeowners to know which buildings are most at risk and how to act to reduce damage.

OUR APPROACH

We combine advanced technologies with bushfire expertise, using drones to capture up-to-date site information and heat transfer modelling to assess how buildings respond to fire.

This provides clear, actionable insights for communities and stakeholders to better understand risk and take proactive measures.



OUTCOMES

Our recent post-bushfire study in the Scenic Rim Regional Council area showed how this approach can identify risks to council-owned buildings, helping guide preparedness, mitigation, and future planning for safer, more resilient communities.

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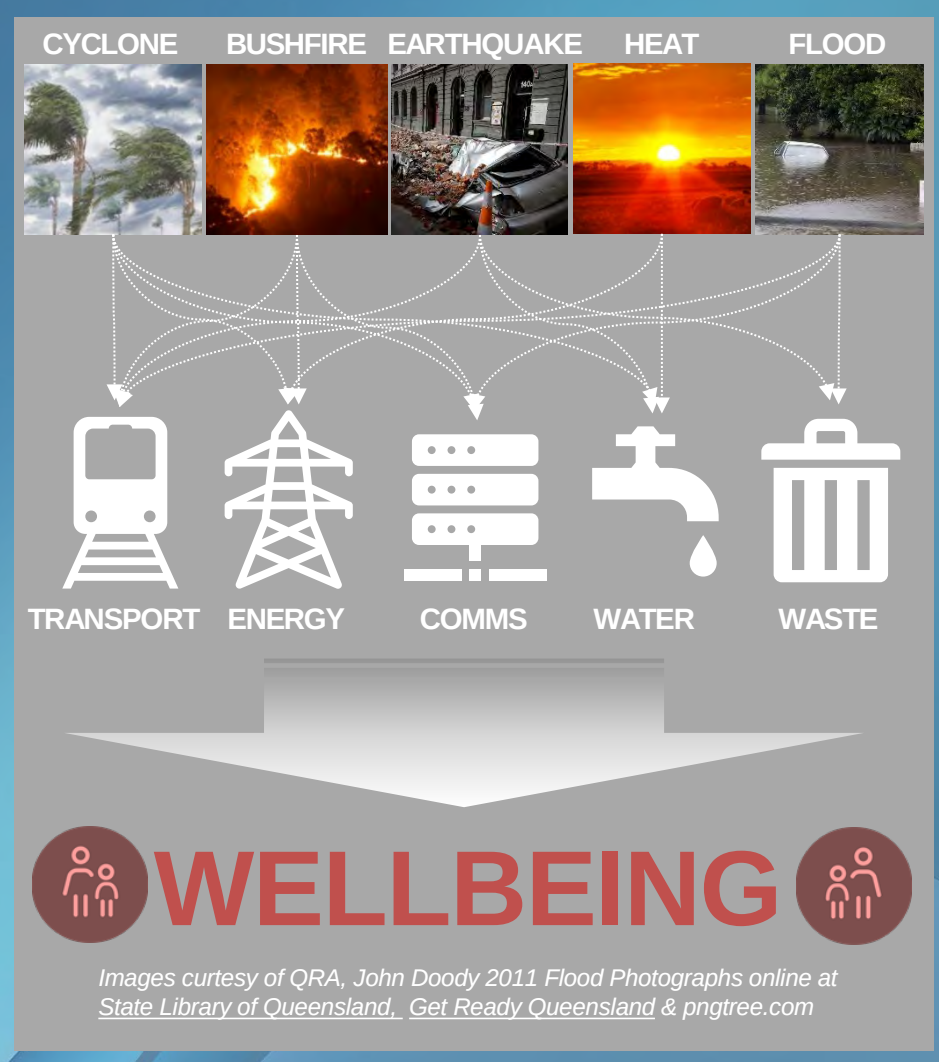
Holistic Economic Modelling for Disaster Resilience Investment

PROBLEM

Current cost benefit analysis methods miss critical impacts as many are difficult to quantify, lack locally relevant values or are not well defined across different hazard types (cyclone, heatwave, bushfire, flood, earthquake) and in multi-hazard situations. This limits the ability for effective investment decision-making and often leads to underinvestment in disaster risk reduction and resilience.

This study aims to:

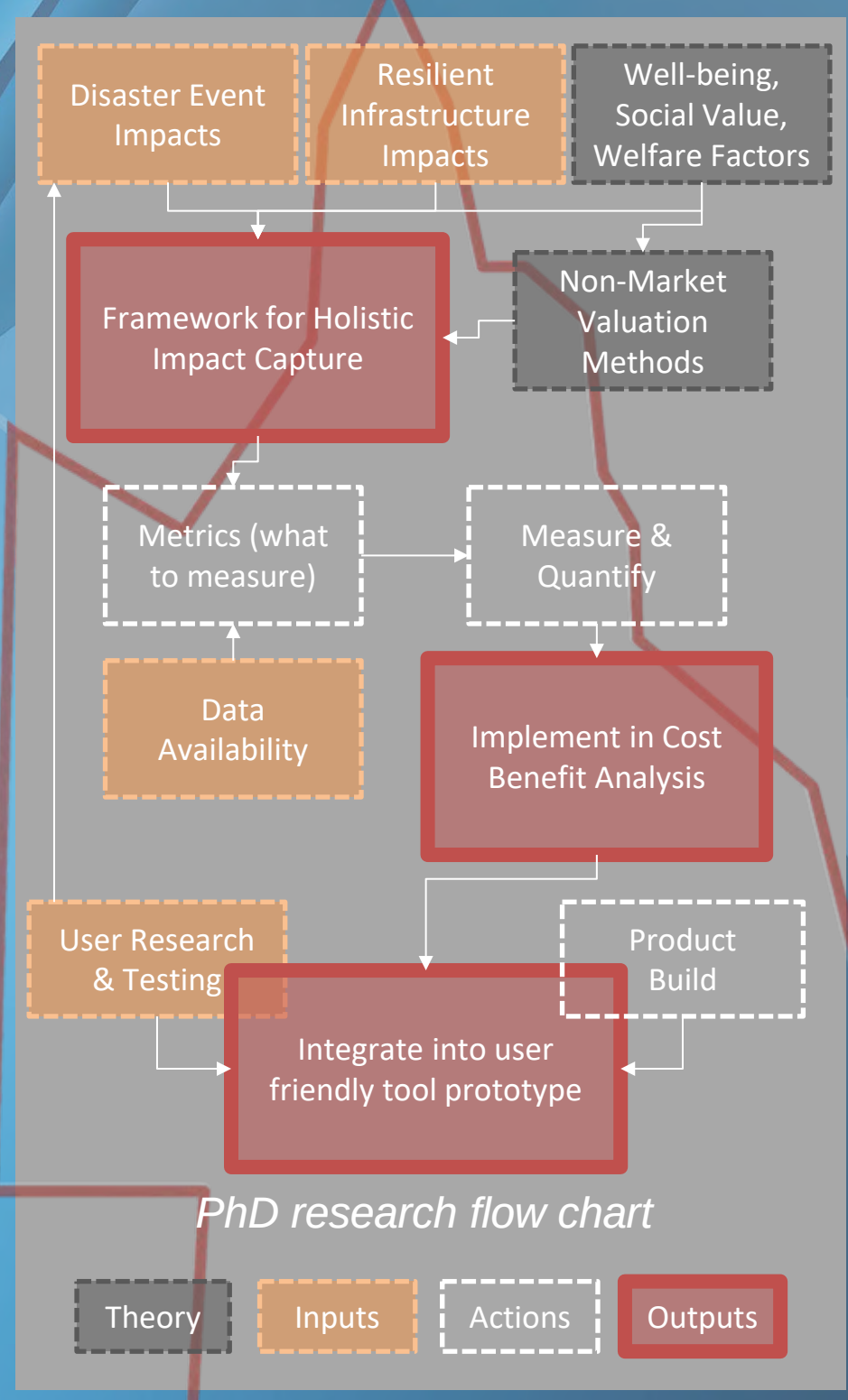
- *identify the full spectrum of impacts from infrastructure damage of all types of disaster events in a Queensland context,*
- *develop a framework to ensure all impacts are captured,*
- *test and refine methods to quantify them*
- *and integrate findings into a user-friendly standard cost benefit analysis tool for use by local and state government in planning for a more resilient future.*



Images curtesy of QRA, John Doody 2011 Flood Photographs online at State Library of Queensland, Get Ready Queensland & pngtree.com

OUR APPROACH

Through a thorough examination of case studies and development of a framework applicable to all disaster scenarios based on economic theory, an approach to calculate the impact of any event and proposed intervention will be developed. Existing non-market valuation methods will be reviewed and applied. New data driven methods will be created for any gaps that are identified in measurement.



OUTCOMES

Enabling more effective and evidence-based investment in disaster risk reduction and resilience through:

- Holistic evaluation of the costs of extreme weather events in Queensland and the impact of investment
- Comprehensive methods to include these results in cost benefit analysis
- Produce a practical disaster resilience and risk reduction decision making tool.

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TOWARDS SIMPLIFIED FLOOD RISK COMMUNICATION

OVERVIEW

Floods across Australia have resulted in severe impacts across diverse geographic and sociodemographic communities. Learnings from these events provide an important opportunity to support future practice, research, and resilience.

Existing flood terminology and language varies by organisation and context (e.g., 1% Annual Exceedance Probability or major flood), making it difficult to understand and apply in the context of purchasing property and translate into flood emergencies.

Communicating probabilities (e.g., 1-in-50 chance v 2% AEP) and uncertainties can have unintended consequences.

This project aims to support flood risk communication systems in partnership with New South Wales and Queensland governments. The research is funded and supported by Natural Hazards Research Australia.

Kellerberin Flood, WA, Carol Gaby

OUR APPROACH

This two-year study began with a review of existing materials in planning and warning contexts, and interviews with organisational and community stakeholders about flood risk. Next, a baseline community survey will be undertaken to underpin co-design workshops with selected communities in New South Wales and Queensland. These workshops will result in flood risk communication systems for subsequent survey testing and validation with Australian communities.


Deloraine Flood, TAS

OUTCOMES

The intended outcomes are:

1. Enhanced guidance on how to translate existing flood maps and data into understandable flood risk level ratings.
2. Evidenced understanding of language and colours that communicate flood risk
3. Improved understanding of flood risk by communities and through warning systems
4. Recommendations about how to implement proposed changes.

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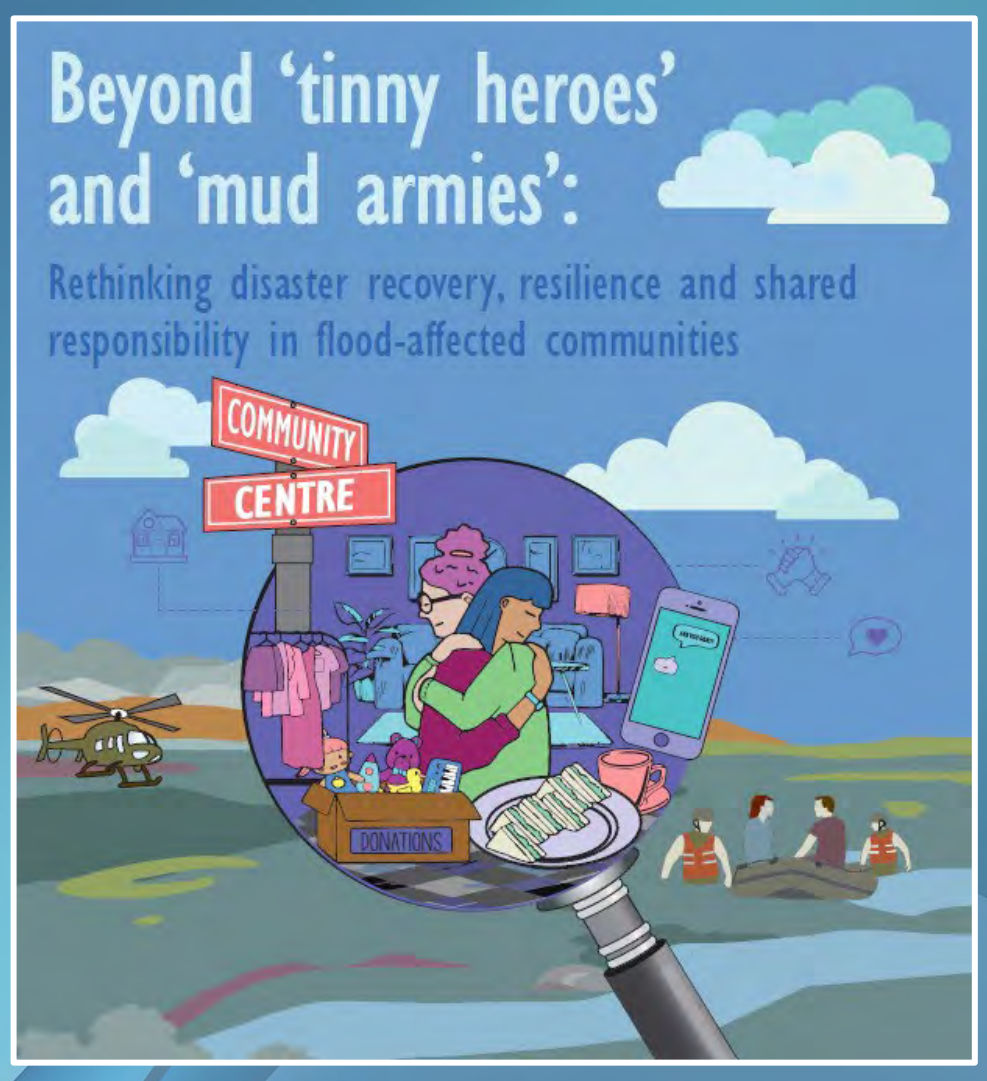
Insights from flood-affected communities across SE Qld

OVERVIEW

Between 22 February and 7 March 2022, SEQ and Northern New South Wales experienced an unprecedented rainfall event. More than 500,000 people, or one-tenth of the state's total population, was directly affected in some way, and the event resulted in official government inquiries which generally acknowledged the important contribution of Community Services Organisations (CSOs), but which did not examine their particular role.



COMMUNITY-LED APPROACH

Community-led approaches to disaster management contest dominant approaches because they require attention be given to knowledges, ideas, and perspectives that are typically marginalised. Studies indicate that disaster management frameworks tend to overlook the ability of individuals and communities to self-mobilise, and that the sector operates from a hierarchical model at odds with participatory community development practices.

The team gathered qualitative data through interviews with workers from grassroots community hubs and neighbourhood centres operating across six suburbs impacted by the 2022 floods.

Place-based CSOs in this study delivered innovative service design to support clients in tailored ways to meet their specific, localised needs.

FINDINGS

Identified themes included:

- Local communities are already self-organising to build local disaster preparedness.
- Effective community-led recovery is individualised, person-centred, and trauma-informed.
- CSOs understand and work within a preparedness paradox: the people who might benefit most from preparedness efforts are often the least willing to engage in community education initiatives about disaster preparedness.
- Unsustainable or uncertain funding undermines the effectiveness of community-led approaches.

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Resilient Schools, Resilient Communities

INSIGHTS FROM THE INTERNATIONAL HANDBOOK OF SCHOOLING IN TIMES OF CRISIS

Schools connect systems of care, coordination, and recovery

Schools are often the first to open, the last to close, and the heart of recovery.

Tuckshops and bathrooms for hygiene, halls for shelter, communications for connection.

Education policy is community resilience policy

Schools sustain the rhythms of everyday life during crisis. They distribute food, information, and care.

Recognising this social function reframes schools from being managed in disasters to being partners in recovery.

Fund schools as resilience hubs

Schools are central to disaster response but policy still treats them as buildings to be repaired, not as social infrastructure to be supported.

Without sustained investment in school infrastructure, educators' wellbeing and leadership capacity, schools cannot fulfil their community role in recovery.

The International Handbook of Schooling in Times of Crisis

Global accounts of educators and school administrators finding hope for their communities during disaster. From war zones to earthquakes, through cyclones, poverty, drought, pandemic, crime, flood and bushfire, each chapter explains why schools are more than just places of learning.

Out May 2026

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Disaster Justice and Schools: critical social infrastructure

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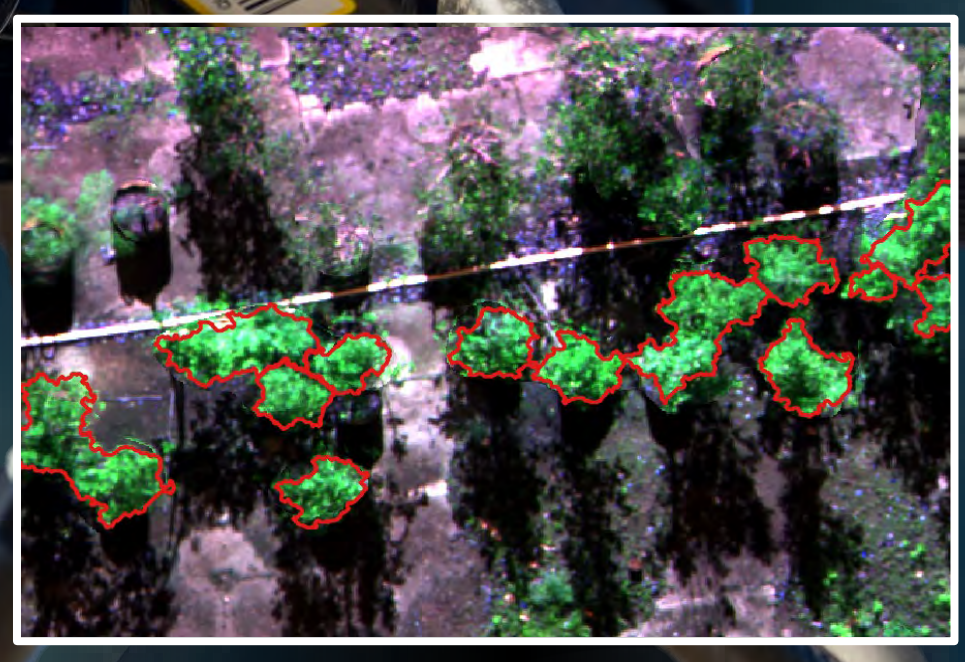
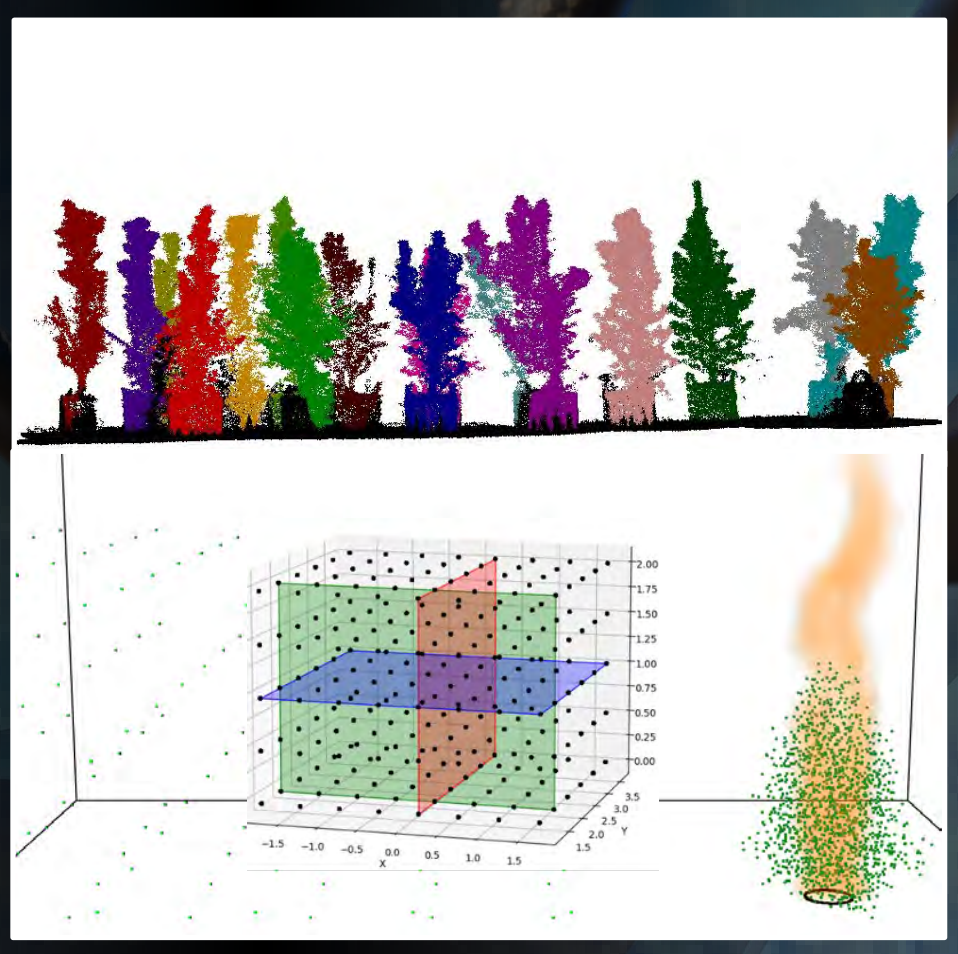
UAS-Based Thermal Response Prediction for Bushfire

OVERVIEW

Ignition of nearby vegetation plays a critical role in building ignition during bushfire. Despite advances in remote sensing (RS), limited research has focused on integrating Unmanned Aerial Systems (UAS) data to quantify vegetation geometry and predict its thermal behaviour during fire exposure. This study addresses that gap by developing a data-driven framework that integrates UAS-based RS with fire dynamics simulator (FDS) to predict vegetation thermal responses, specifically the maximum temperature and heat flux.



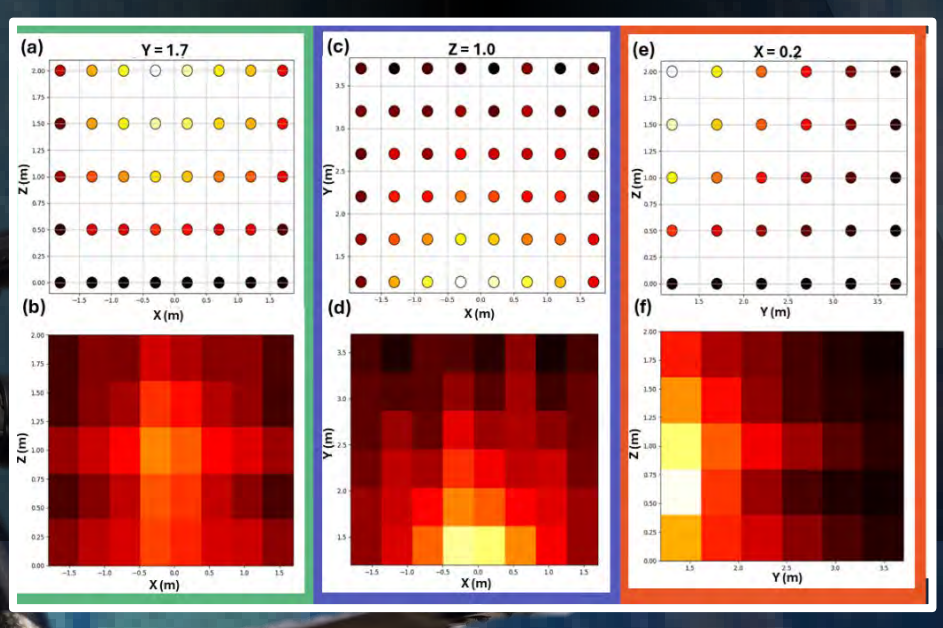


OUTCOMES

- Integrated spectral and LiDAR data using a decision-level fusion approach to delineate the LiDAR point cloud of targeted species.
- Utilised vegetation dimensions with CFD outputs to train ML models predicting vegetation-induced temperature and heat flux.
- Demonstrated that the UAS-based RS approach using AI can replace intensive simulations, enabling rapid, scalable, and non-destructive thermal risk assessment

OUR APPROACH

- Developed a decision-level fusion framework integrating UAS-acquired multispectral imagery and LiDAR data.
- Applied ensemble learning and watershed segmentation to identify individual vegetation patches from multispectral imagery.
- Used RayCloudtools to align georeferenced segmented vegetation point clouds and isolate Syzygium smithii (Lilly Pilly) data.
- Parameterized cone-shaped vegetation models from the extracted geometries.
- Simulated these models in the FDS to obtain temperature and heat flux distributions.
- Trained machine learning models using FDS-derived data to predict vegetation thermal responses.



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QUT

Shared Responsibility

OVERVIEW

During extreme weather events, having clear roles for governments, emergency services, the military, the charity sector, volunteers and individuals is possible – and absolutely necessary.

Our study of disaster risk reduction policies at the international, federal, state, regional and local government levels found all these policies refer to the principle of “shared responsibility” – yet none adequately defines what this means.

We found a shift from government responsibility to shared responsibility. This occurred in the 1990s, due to a sense of growing public reliance upon emergency services, and the perceived need for communities to develop their own disaster management capacity.

OUR STUDY

We analysed 12 Australian disaster polices and legislation and carried out interviews with neighbourhood centres, who are often the "first responders" in disasters.

These documents commonly mention “shared responsibility” without clearly defining the meaning or process for implementation.

Failure to define the concept pushes responsibility to individuals to respond and prepare. The policies assume that volunteers and the charity sector would mobilise as needed.

Shared responsibility is also highly susceptible to politicisation, as each level of government can point the finger to another level of government, undermining the effectiveness of disaster response.

OUTCOMES

Our research with community organisations found that these organisations were not familiar with the concept of shared responsibility, and understood it as being a good housemate/neighbour.

We discovered that body corporates are starting to play a role in disaster response. More research is needed to understand such initiatives.

The United Nations Office for Disaster Risk Reduction (UNDRR) is keen for further investigation of how policy documents should define:

- Vertical responsibility: responsibility between different levels of government.
- Horizontal responsibility: responsibility of non-state actors: civil society, business, research and media.

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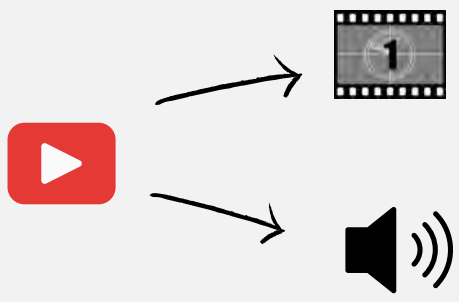
GenAI Media Mapping for Behavioural Comms Insights

Working with Suncorp, we built a multimodal Generative AI pipeline to analyse TV and online ads, converting raw video into structured evidence about the message, how it's framed, and which cognitive biases are invoked in the viewer. The model benchmarks the performance of different message types, enabling practical recommendations for message optimisation.

We are now aiming to redeploy this pipeline to map and improve targeted disaster messaging:

01 VIDEO FILES

Via the ffmpg package, video files of selected messages are split into audio and visual components (mp3 for audio, mp4 for video).



02 AUDIO & SYSTEM MESSAGE PROMPT

Whisper API used with a temperature of 1.0 applied to extract transcript segmented into timestamps (starts, stops, pauses) (verbose JSON output)

Output = csv saved output file "Audio Log"

03 AUDIO & FRAMES/SEC PROMPT

Audio Log (from Step 2) + Frames per second as png files encoded in Base64 (eg. one frame per second of video)

+ system/user prompt

↴

+ to extract structured video log
+ structured output/json_schema response format

Chat completions API with a temperature of 1.0

Output = csv saved output file "Video Log"

04 BIAS IDENTIFICATION AND EXTRACTION

Similar model to Step 3

Audio Log + Video Log + Biases Taxonomy

+ system/user prompt

↴

+ Structured output with json_schema response format

Chat completions API with a temperature of 0.2

Output = csv saved output file "Biases"

BITA

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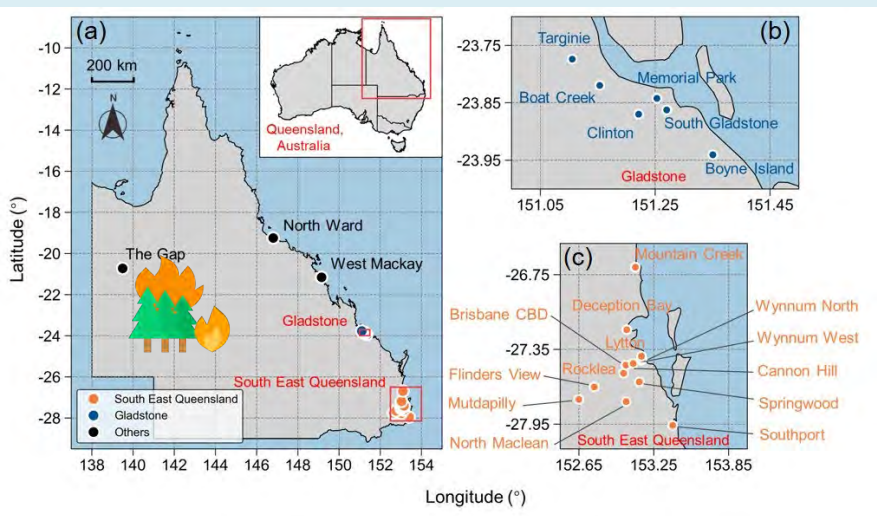
Quantifying Bushfire Impacts on Air Quality in Queensland

OVERVIEW

Bushfires are becoming increasingly frequent and intense, releasing large amounts of fine particulate matter ($PM_{2.5}$) and reactive gases that contribute to tropospheric ozone (O_3) formation. These emissions can travel thousands of kilometres, affecting urban air quality far from the fire.

In Queensland, one of the world's most fire-prone regions, long-term impacts of transported bushfire emissions on urban $PM_{2.5}$ and O_3 remain poorly quantified.

This study investigates the bushfire-impacted air masses and quantifies the contributions of transported bushfire emissions to surface O_3 and $PM_{2.5}$ across 22 monitoring sites in QLD during the 2008–2023 bushfire seasons.



Spatial distribution of 22 sites in Queensland (a), Gladstone (b) and South East Queensland (c).

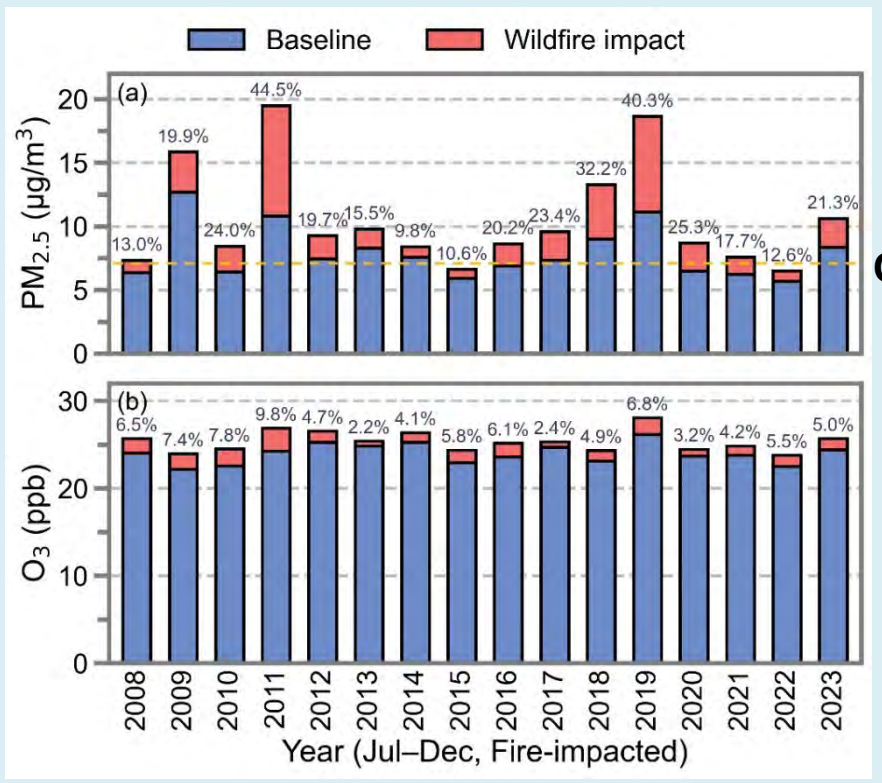
Data source: Queensland Department of Environment, Tourism, Science and Innovation (DETSI)

OUR APPROACH

We integrated multi-source datasets including air quality observations, MODIS satellite fire hotspots, and HYSPLIT back trajectories to identify fire-impacted periods using an optimized trajectory–fire interception method (TFIM). Machine learning models based on Extreme Gradient Boosting (XGBoost) were then trained to isolate the influence of bushfire emissions from meteorological and anthropogenic factors.

The contribution of wildfire can be calculated by:

Δ pollution = observation – baseline model



The annual contribution of wildfires to $PM_{2.5}$ and O_3 concentrations in QLD during 2008-2023 bushfire seasons (July to December).

OUTCOMES

- **5** out of 14 $PM_{2.5}$ exceeding years induced by bushfires;
- Bushfires raised $PM_{2.5}$ concentration by 0.9-8.7 ug/m³, accounting for **10.6-44.5** % annual $PM_{2.5}$ concentration;
- Bushfires raised O_3 concentration by 0.7-2.7 ppbv, accounting for **2.2-9.8** % annual O_3 concentration.

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