Projected changes in hail damage potential and swath properties over Australian cities under global warming

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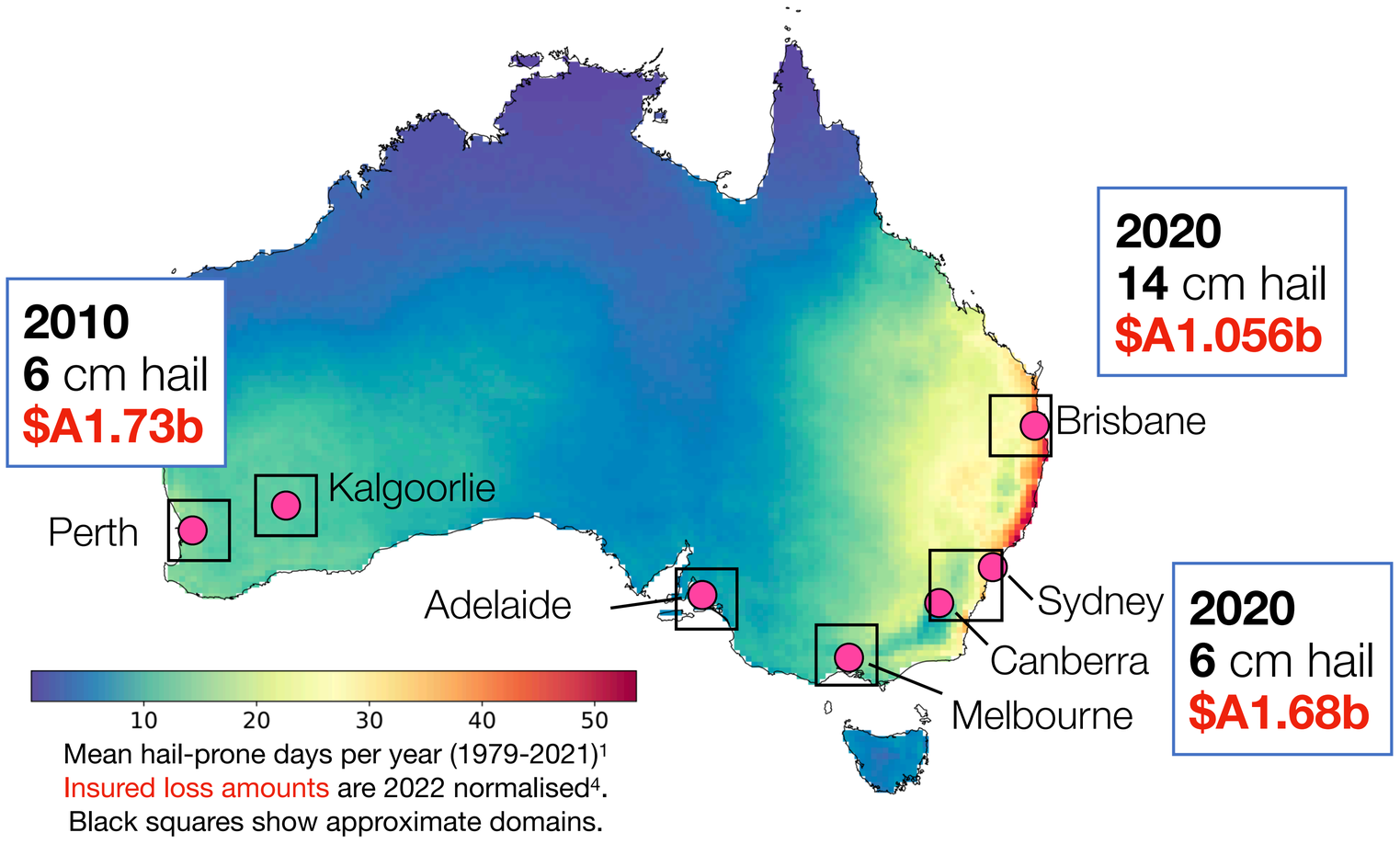
Hail causes significant damage in Australia



- Hail drives insured losses. Hail damage increases with **hail size,** and **impact area**.
- **How does climate change affect hail damage potential?**
- We used WRF and HAILCAST[2] to model storms over six domains covering **>65% of Australia's population**.
- We simulated convective seasons (Oct-Feb) for historical **(1989-2009)** and future **(2080-2100)** epochs. Epochs are separated by **~2.4 C mean warming**.
- Boundary conditions are from Xu et al., 2021[3]. Output has 3 km grid spacing and hourly resolution.

Hail sizes and frequency are projected to increase over some cities

- We used **extreme value distributions** to model daily maximum hail size (true maxima) and hail-proximal wind speed (hourly instantaneous) per domain.
- Significant **increases in maximum hail size** were projected for Sydney, Melbourne, Perth, and Kalgoorlie.
- Hail-proximal winds were **projected to decrease around** Melbourne, Sydney/Canberra, and Perth.
- Hail frequency was **projected to increase** ~29% for Sydney and ~15% for Brisbane.

Return period for **100 mm hail**:

Melbourne:

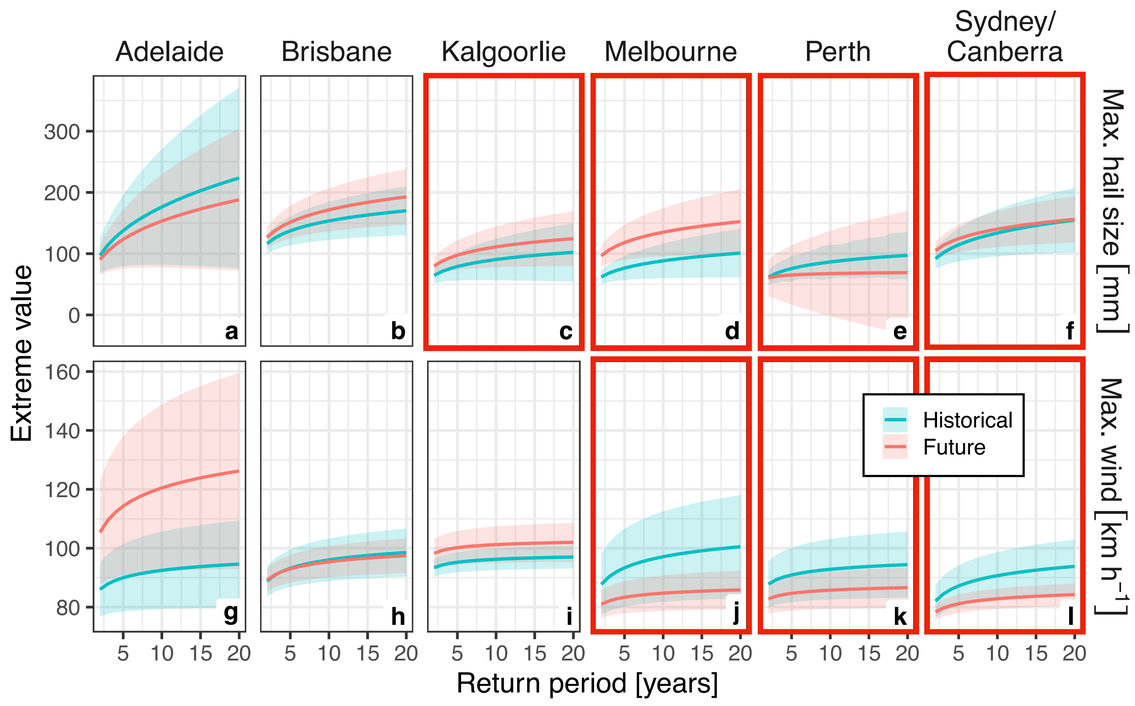
~20 ➔ ~3 y

Kalgoorlie:

~18 ➔ ~6 y

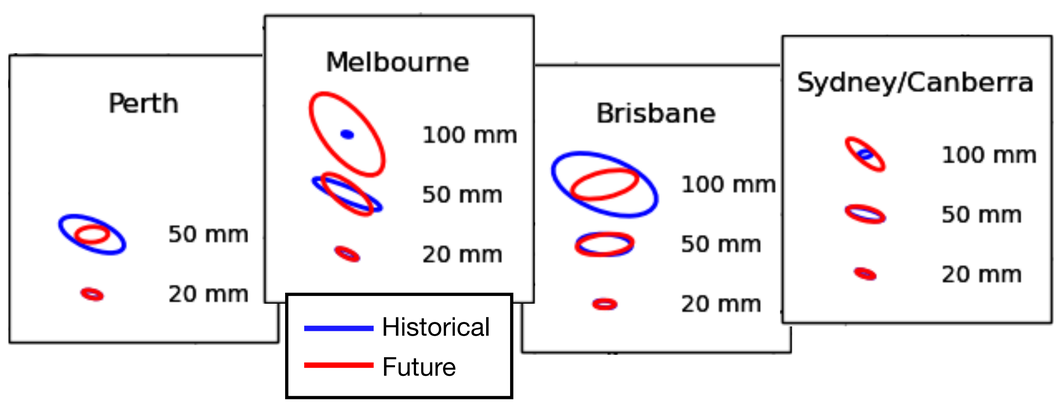
Sydney/Canberra:

~3 ➔ ~2 y



Return periods calculated using extreme value distributions (Pareto for hail, generalised for wind). Red outlines show statistically significant changes.

Environmental parameters show drivers



Mean daily swath ellipses by domain and hailstone size (contained within swath). Areas <4 pixels and those touching borders removed; ellipses fitted to connected areas with 20 mm threshold.

- Increases in hail size around Sydney/Canberra and Melbourne were **driven by increases in instability**. Around Brisbane, there were **offsetting decreases** in bulk vertical wind shear.
- Swath analysis shows increases in total area for storms producing 100 mm hail around Melbourne and decreases around Brisbane, and a **possible severe-storm-track orientation change around Brisbane**.

Paper:

1. Raupach et al., 2023. DOI: 10.1038/s41612-023-00454-8
2. Adams-Selin et al., 2019. DOI: 10.1175/WAF-D-18-0024.1
3. Xu et al., 2021. DOI: 10.1038/s41597-021-01079-3
4. ICA data hub. https://insurancecouncil.com.au.

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