



bushfire&natural
HAZARDSCRC

A heatwave classification for heat related fatality risk

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An Australian Government Initiative





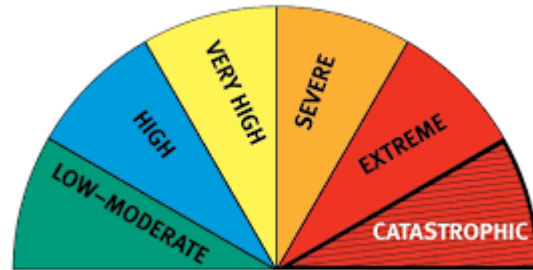
BNHCRC scenario project

- Develop a set of **realistic disaster scenarios**:
 - TC, EQ, ECL, HW in QLD, VIC/SA and NSW
 - Quantify hazard magnitude and risk thresholds
 - Assess vulnerability and exposure at risk
- Use this framework to help:
 - Better understand / **communicate** about extreme disaster risk
 - **Assess capability** from emergency management sector

Heatwaves

- HW are responsible for *more deaths than all other natural perils in Australia put together* (Risk Frontiers, 2014)
- Lack of a **clear definition** of a HW event
 - pressing need for a common intensity metric
- BoM developed the **Excess Heat Factor** with this goal in mind
- Our aim is to create a **category system for risk to human life**





Hazard risk categories

- What we can learn from other perils (TC/BF):
 - Need for a **simple and clear** cat system
 - Extension beyond initial scope is dangerous
- What we aim to achieve here:
 - Define a category system specifically for **risk to human life**
 - Quantify that risk for each category: **guidelines** as to what can be expected

Saffir-Simpson Hurricane Scale

1 MINIMAL DAMAGE
Winds 74–95 mph
Storm Surge 4–5 feet

2 MODERATE DAMAGE
Winds 96–110 mph
Storm Surge 6–8 feet
Small trees down
roof damage

3 EXTENSIVE DAMAGE
Winds 111–130 mph
Storm Surge 9–12 feet
Moderate to heavy
damage to homes.
Many trees down.

4 EXTREME DAMAGE
Winds 131–155 mph
Storm Surge 13–18 feet
Major damage to all
structures.

5 CATASTROPHIC DAMAGE
Winds >155 mph
Storm Surge > 18 feet
Severe damage to all structures.

Starting point: Excess Heat Factor

- The EHF metric takes into account:
 - the **ability** of the local community **to adapt** to its climate
 - the impact of **sharp temperature spikes** that do not allow such acclimatization
- **A positive EHF indicates a heatwave**
- A HW event magnitude can be measured by
 - the **peak EHF**
 - the **accumulated EHF (Heat Load)**

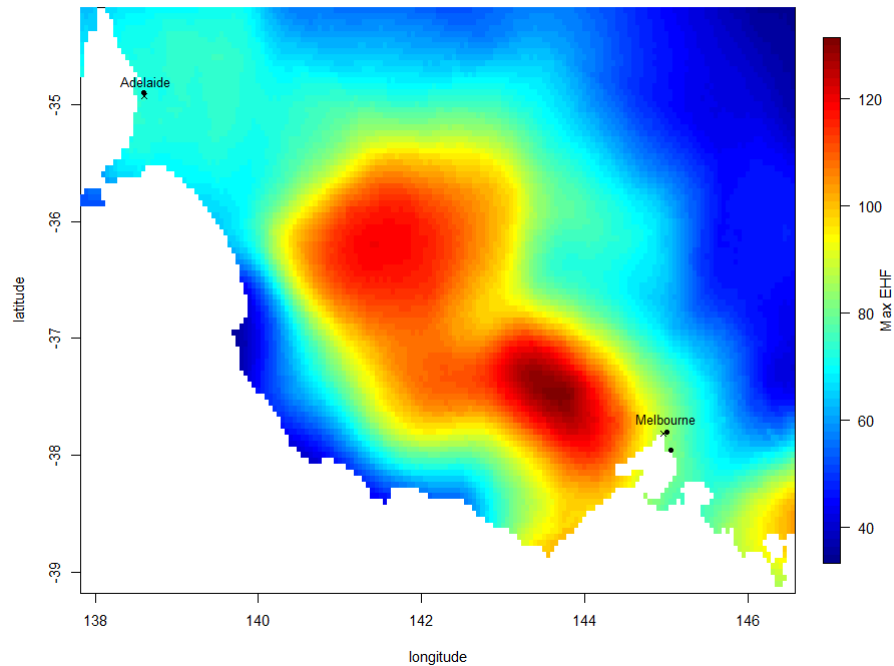




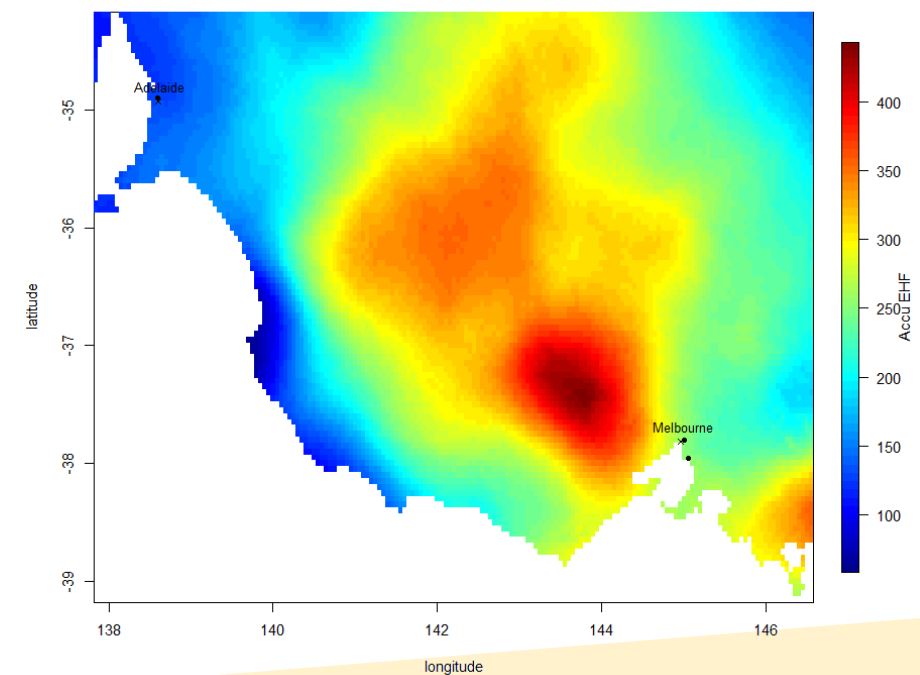
Spatial definition: event “footprint”

- An event starts when **first grid cell in domain has EHF > 0**
- Finishes when last cell turns back to EHF=0

Peak EHF over the event



EHF accumulation over the event



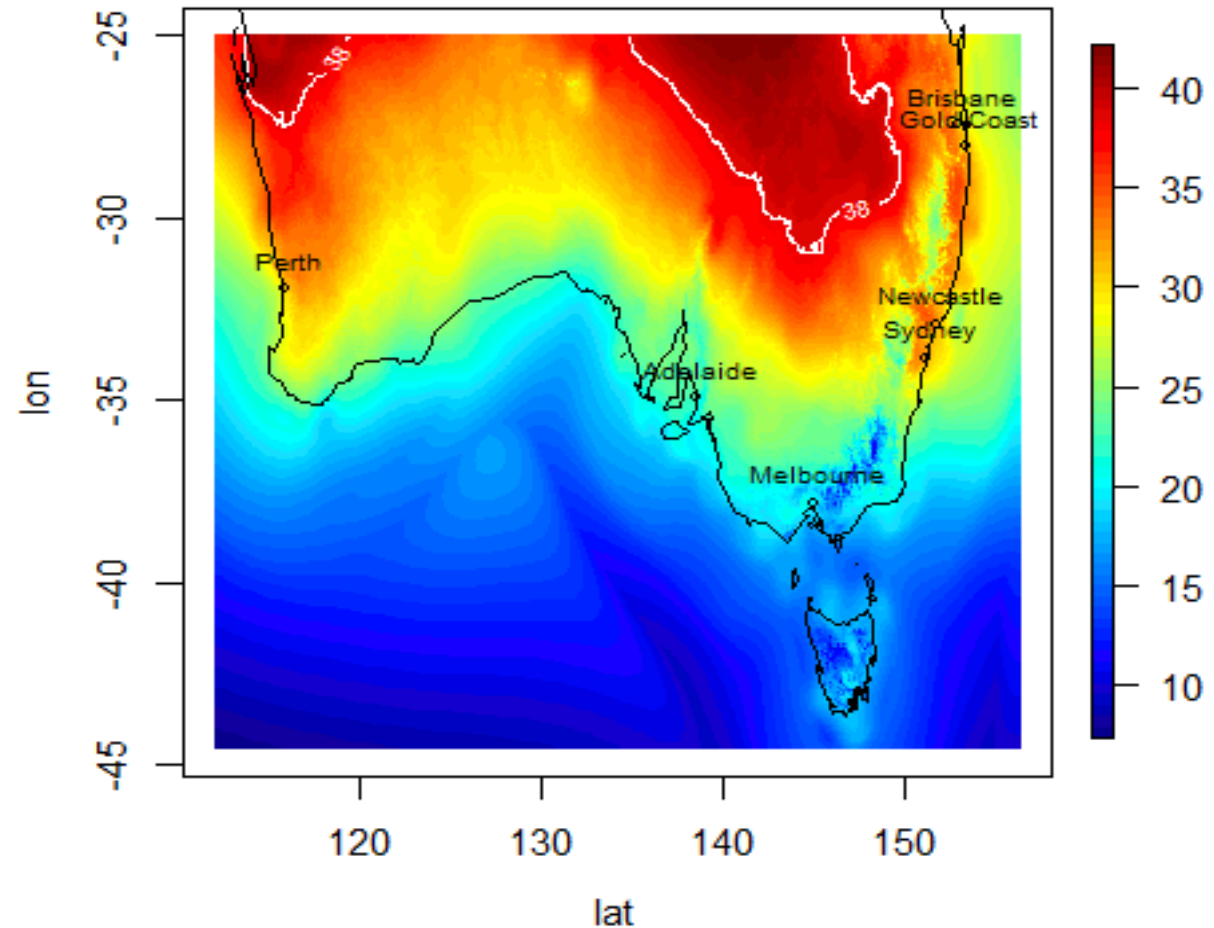
JAN 1959



EHF & fatalities: input data

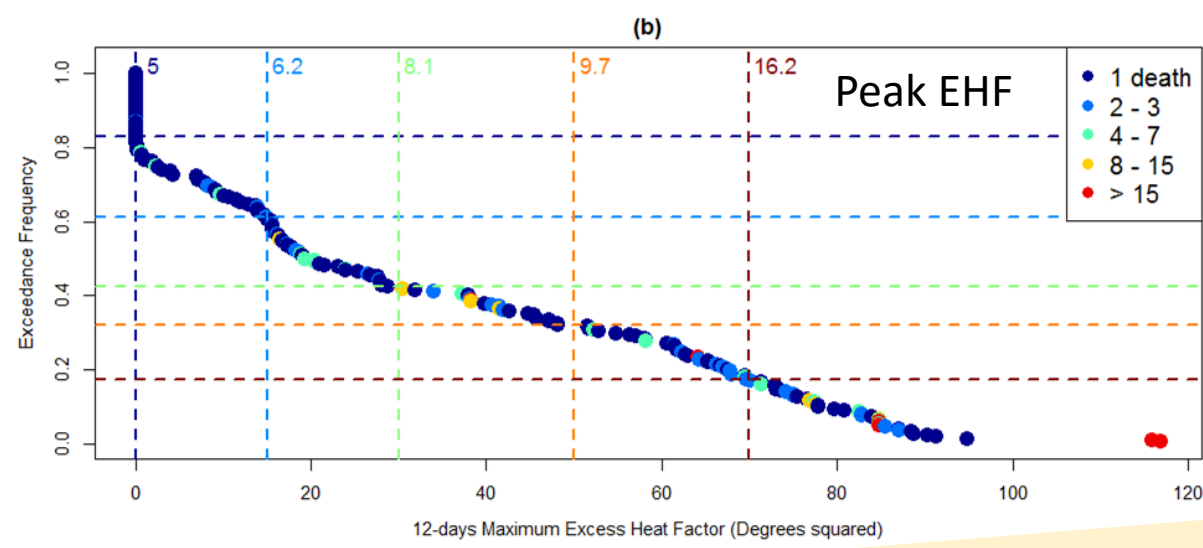
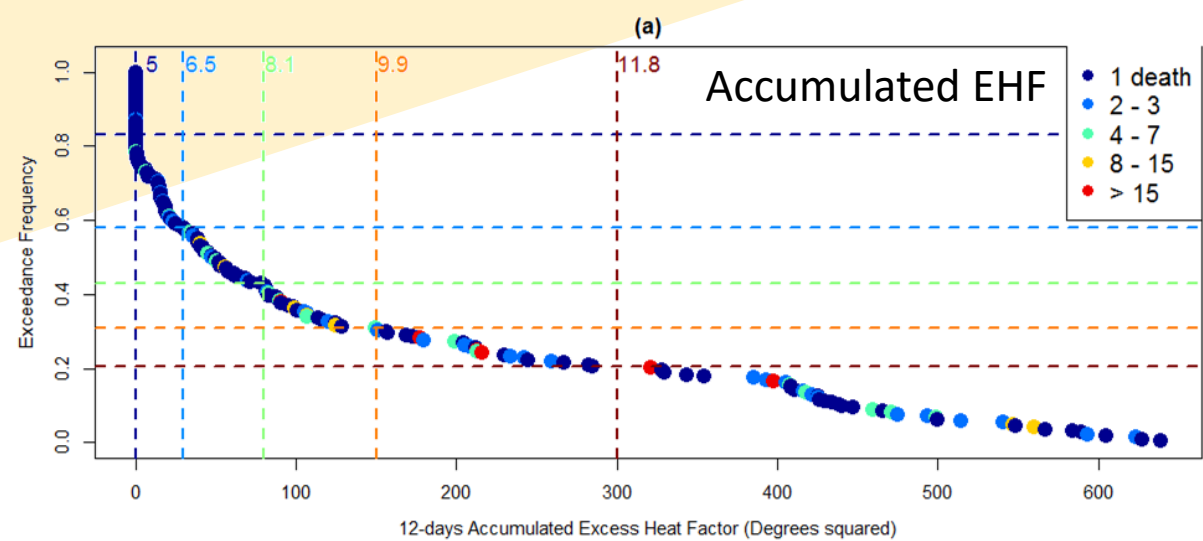
- BoM: 100 year record of gridded daily temperatures (max, min).
- Risk Frontiers' fatality database (Peril Aus): date & location of fatalities + cause of death.

Maximum daily temperature [C]: 18/12/2008



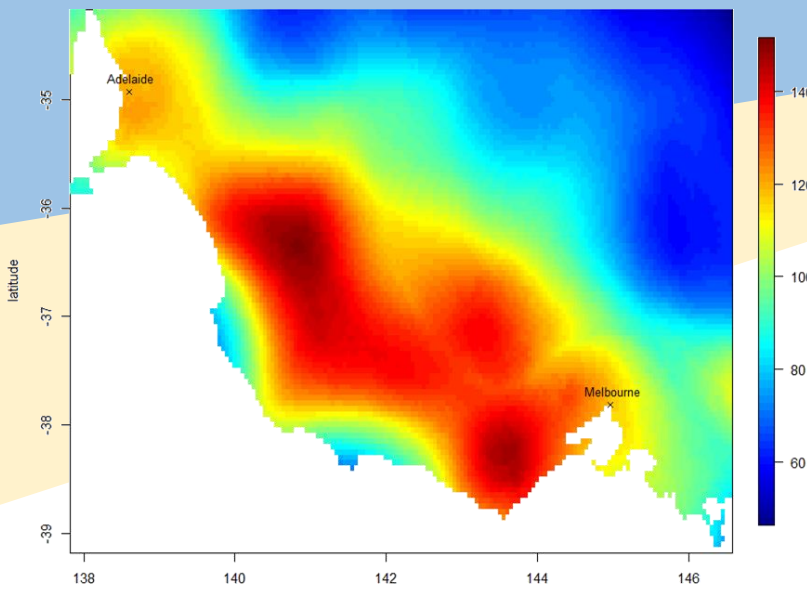
Fatality risk categories

- For each fatality record (224), compute EHF estimates (EHF_{sum} , EHF_{max})
 - 12 days period

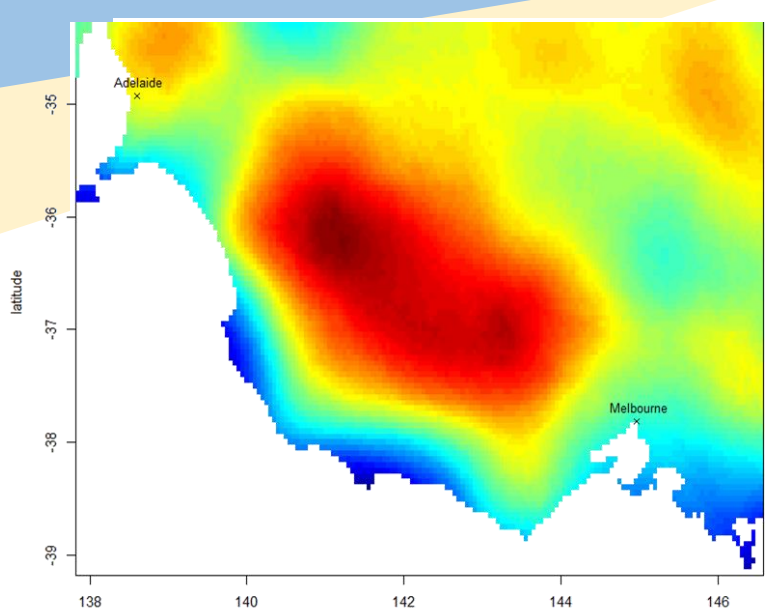


Category	EHF_{sum}	EHF_{max}	Mean number of fatalities	Percentage of record covered
CAT0	> 0	> 0	5	82.6
CAT1	> 30	> 15	6.7	55.4
CAT2	> 80	> 30	8.6	38.9
CAT3	> 150	> 50	10.4	28.6
CAT4	> 300	> 70	18.5	12

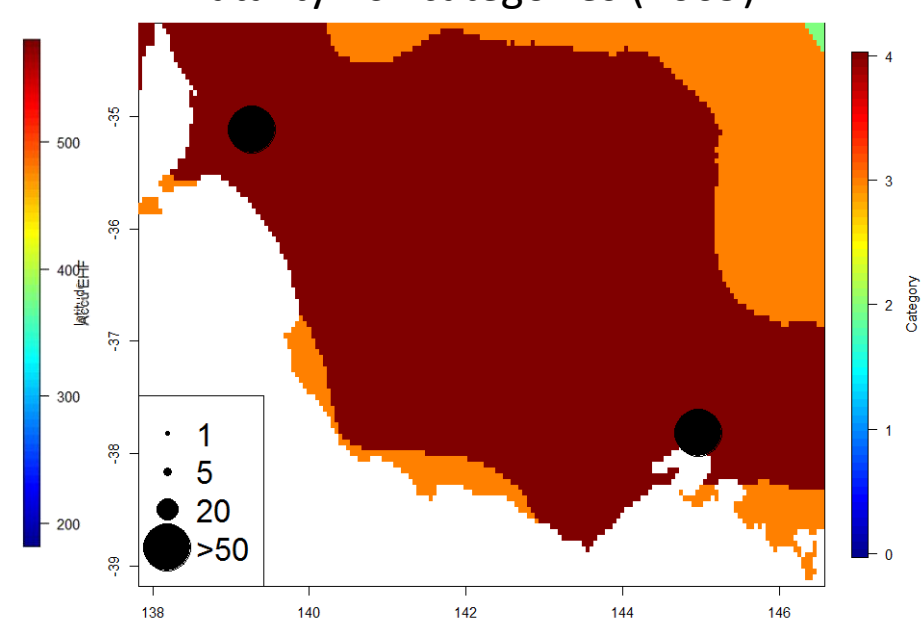
Peak EHF over the event (2009)



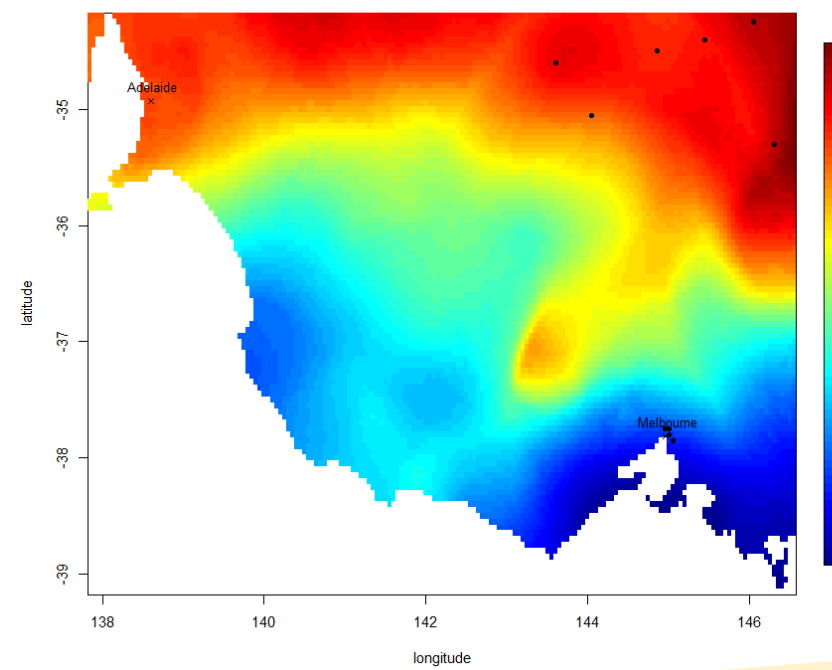
EHF accumulation over the event



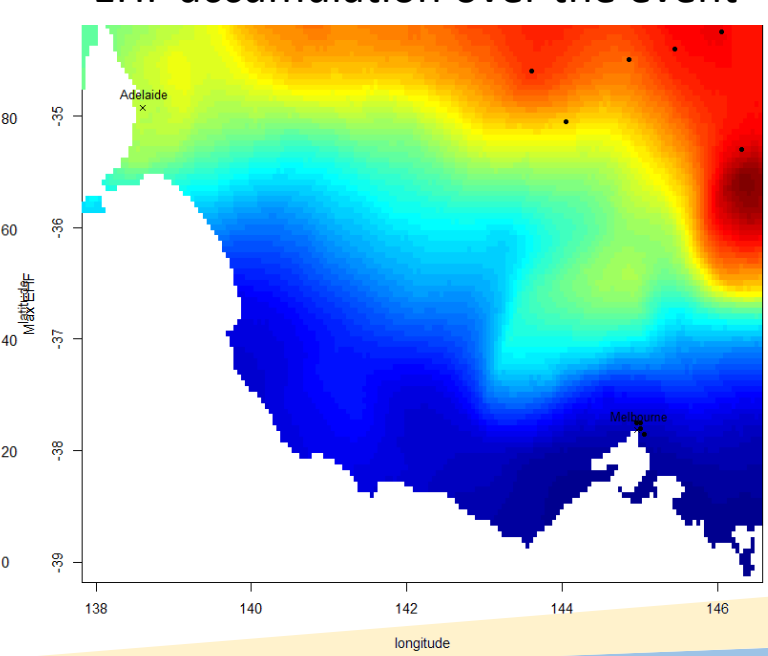
Fatality risk categories (2009)



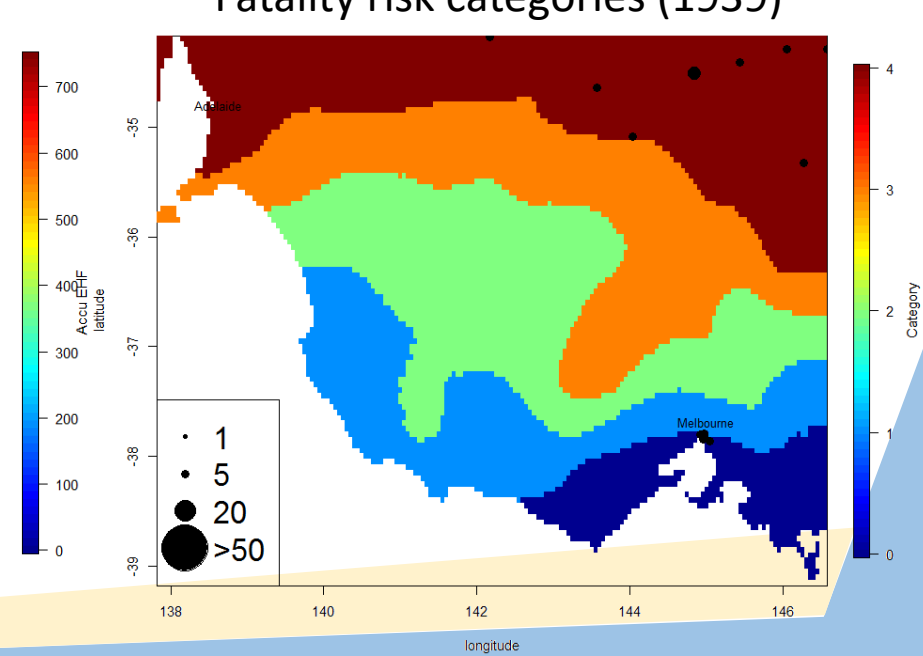
Peak EHF over the event (1939)



EHF accumulation over the event



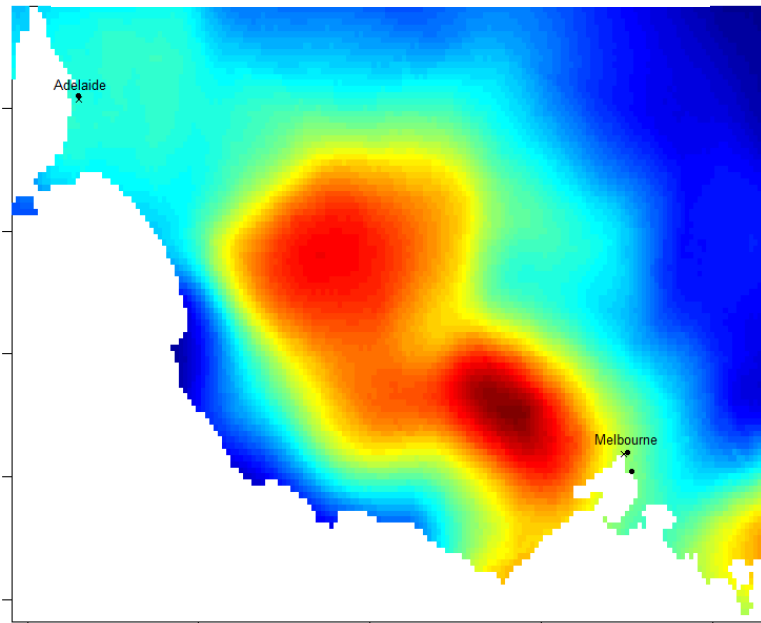
Fatality risk categories (1939)



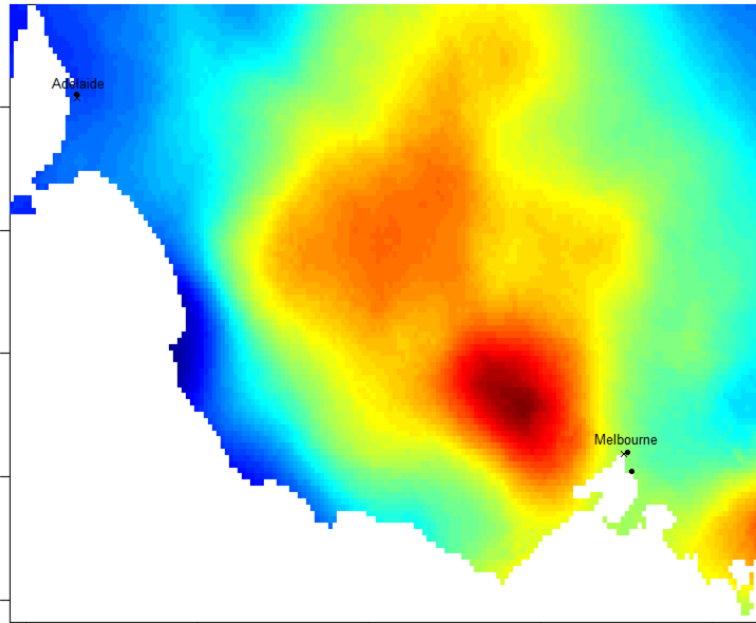


Example: JAN 1959

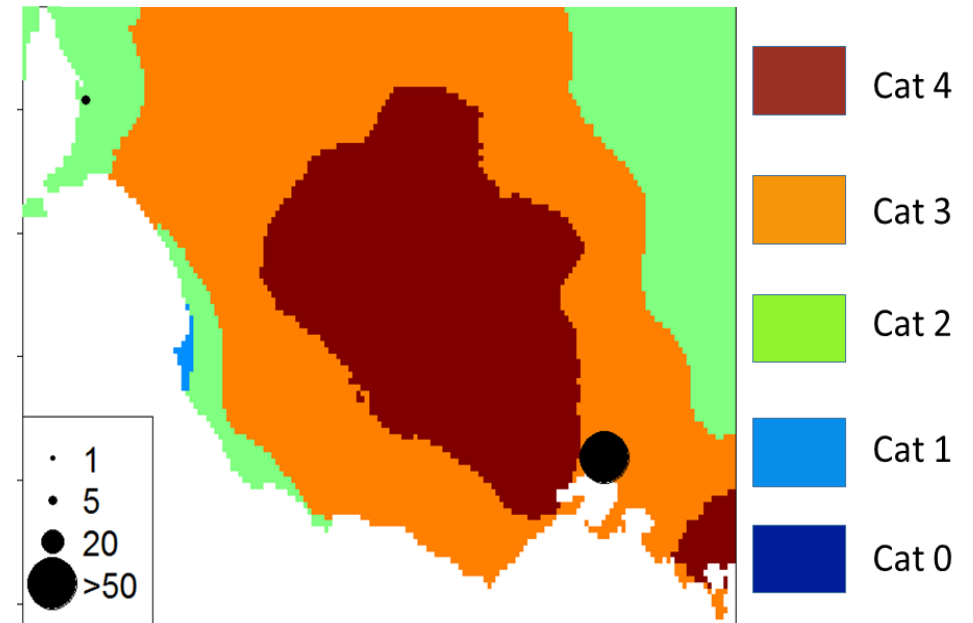
Peak EHF over the event (1959)



EHF accumulation over the event



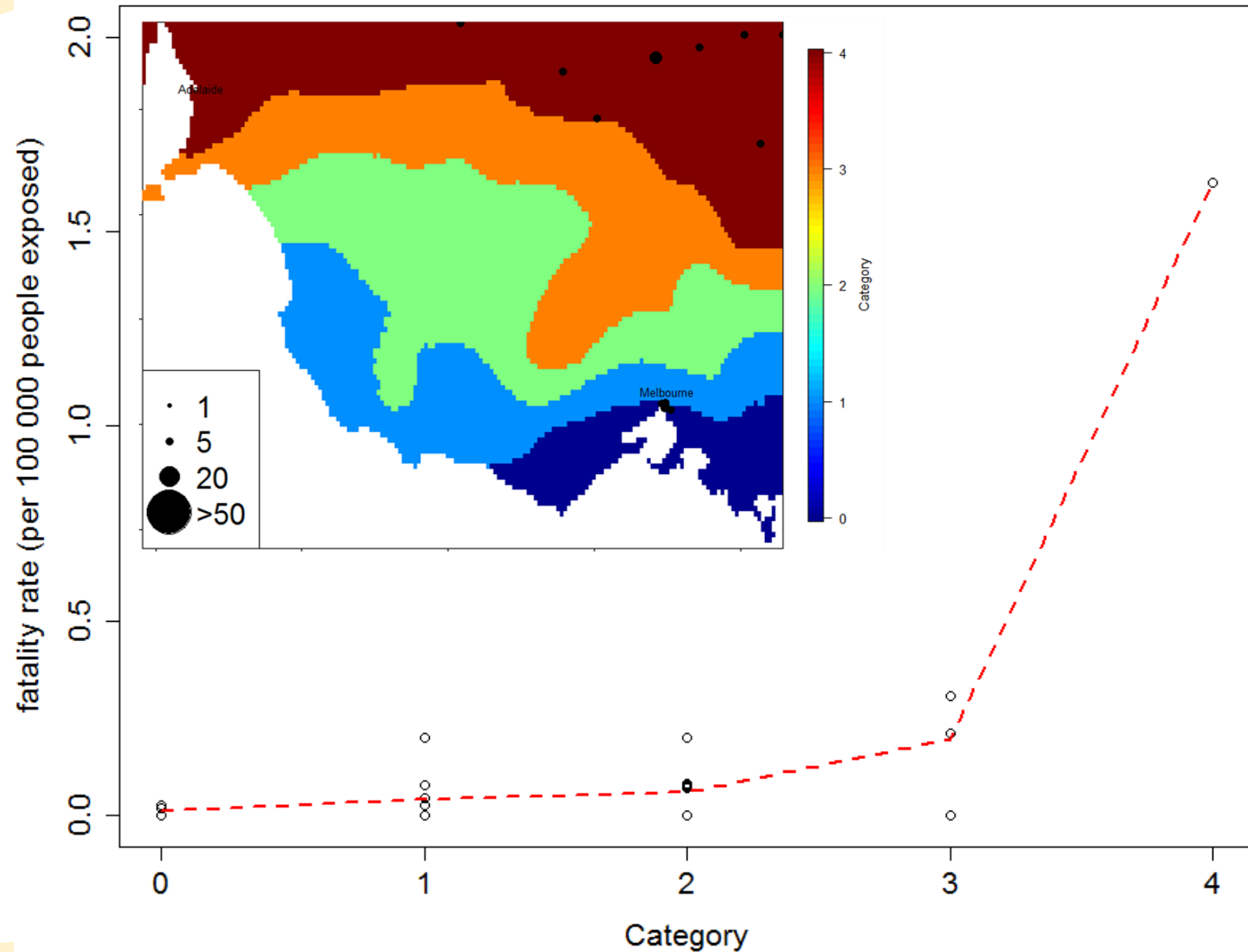
Fatality risk categories (1959)



Quantifying the risk

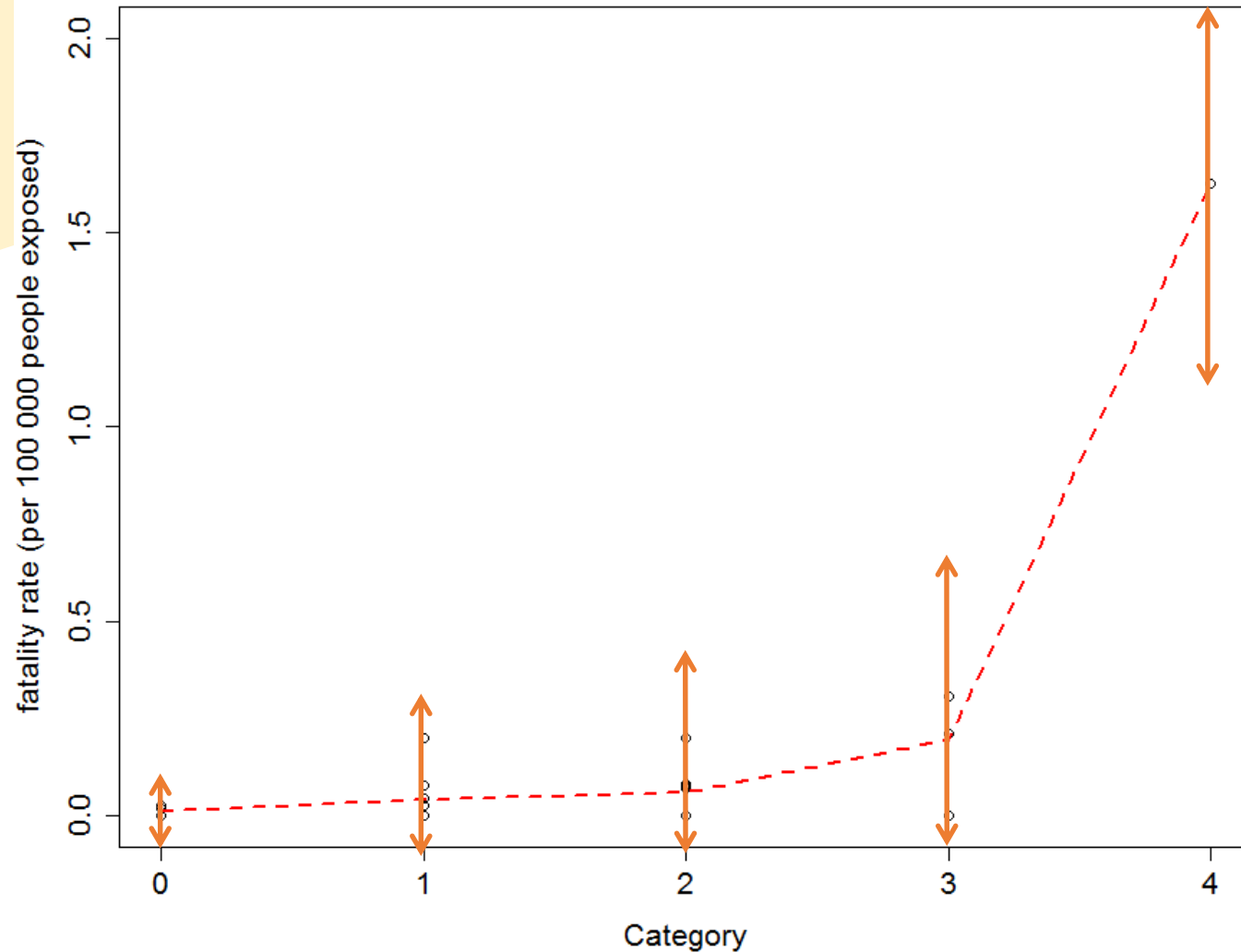
Fatality rate curve

- 10 biggest events of the last decade in Vic/SA
- Census population records trended over the period
- Normalised heat-related fatality records





Uncertainty



- Risk of under-reporting / wrongly-categorising deaths
- Few events to map the range of risk: fatality rate is a distribution at each point
- Range of curves by age, etc... need for more data!
- Communities & governments learn from past experience and improve their level of preparedness



Summary

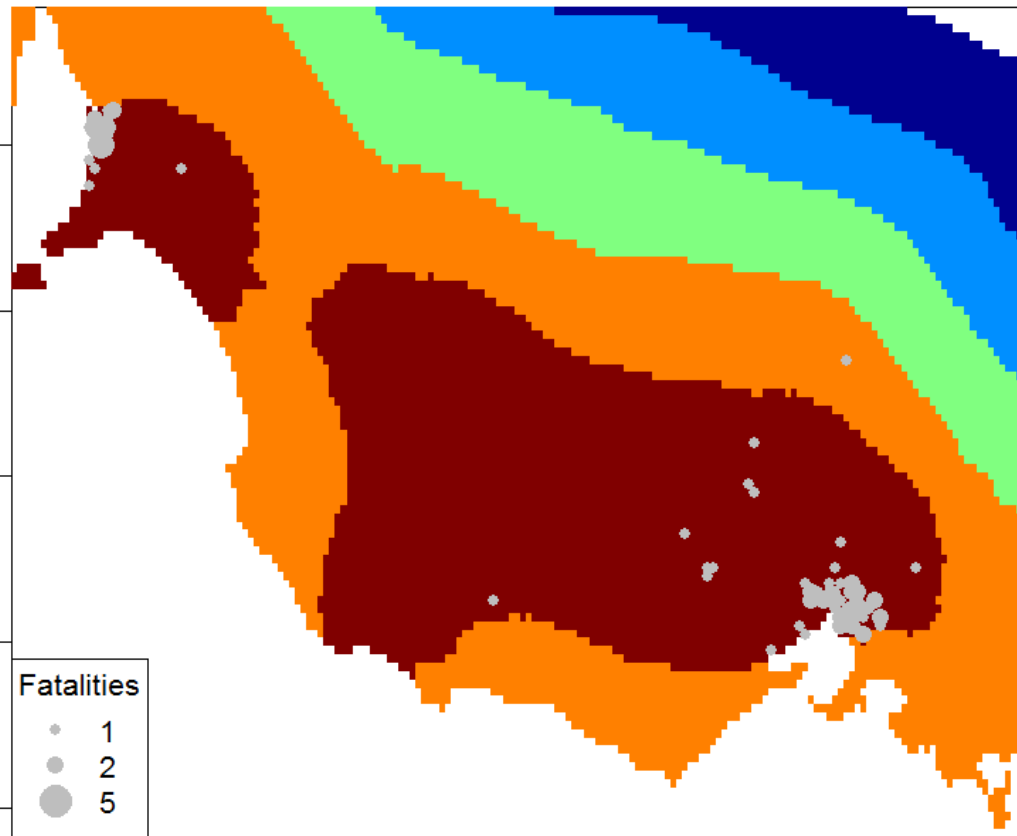
- EHF based category system
- Specifically designed to characterize heat related fatality risk
- Fatality estimates for each category
- These estimates are very uncertain... and more records are needed

Category	EHF _{sum}	EHF _{max}
CAT0	> 0	> 0
CAT1	> 30	> 15
CAT2	> 80	> 30
CAT3	> 150	> 50
CAT4	> 300	> 70



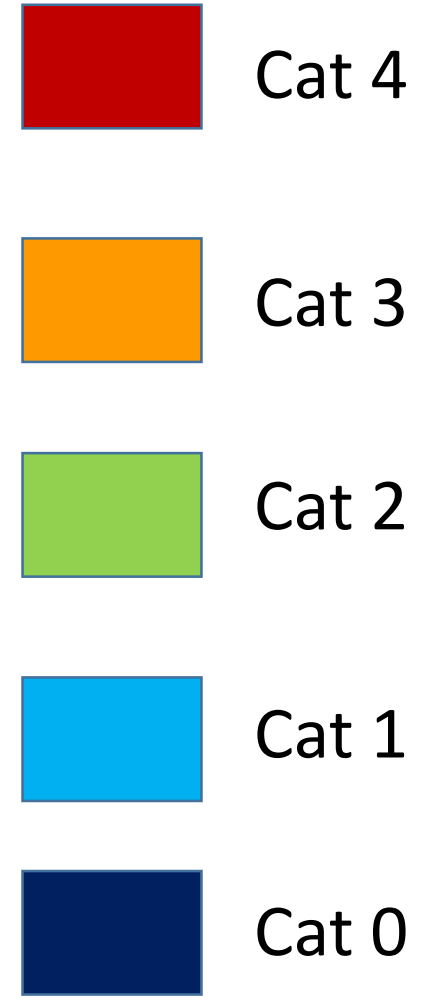
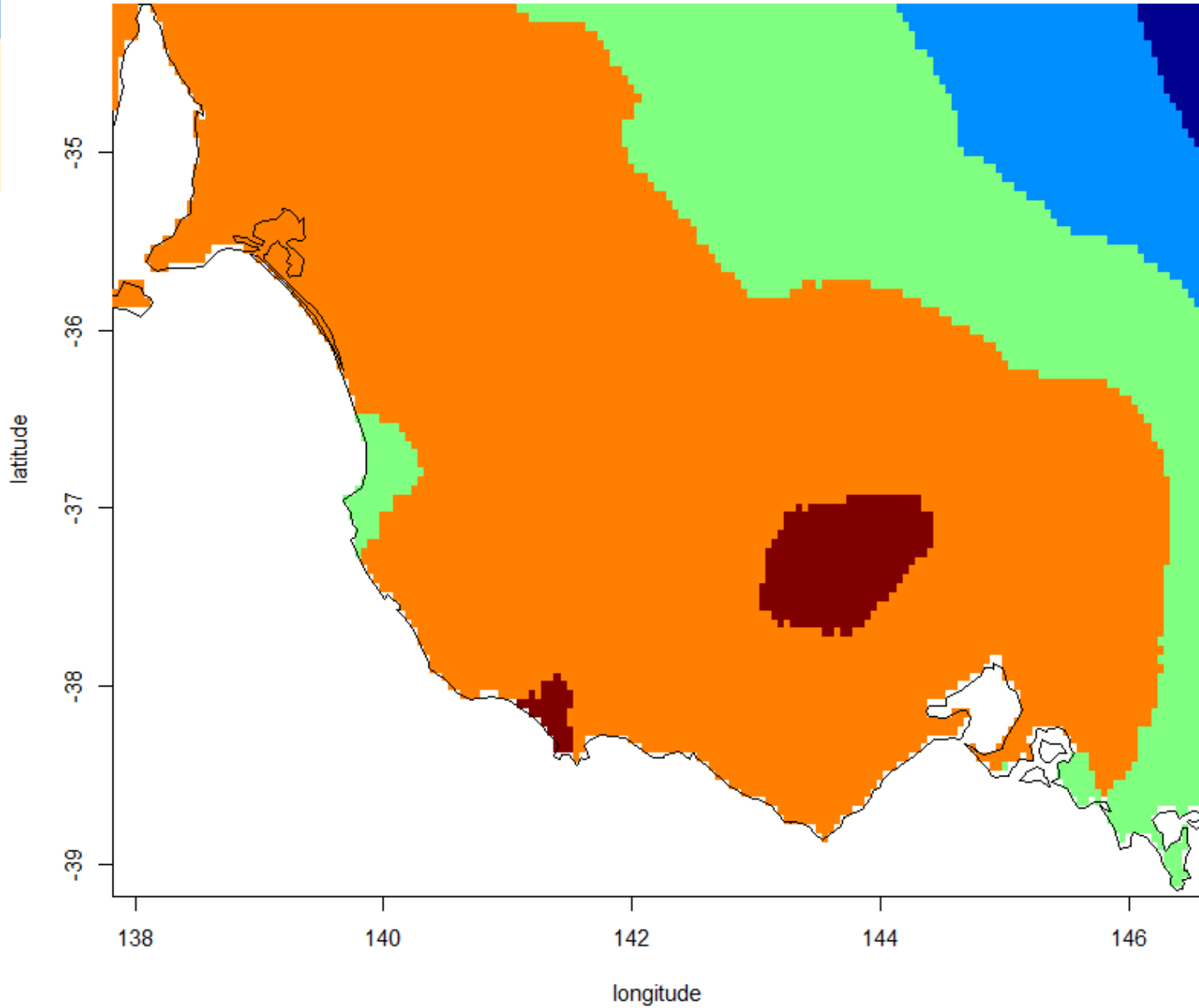
Scenario building

Coastal event: 86 fatalities



- Generate hazard footprint (EHF_{sum} , EHF_{max}) consistent with historical obs... but potentially more extreme
 - Principal component analysis
- Compute associated categories
- Make assumptions on population density
- Apply fatality curve to compute death rate
- Sample a number of fatality for each cell

Event 3

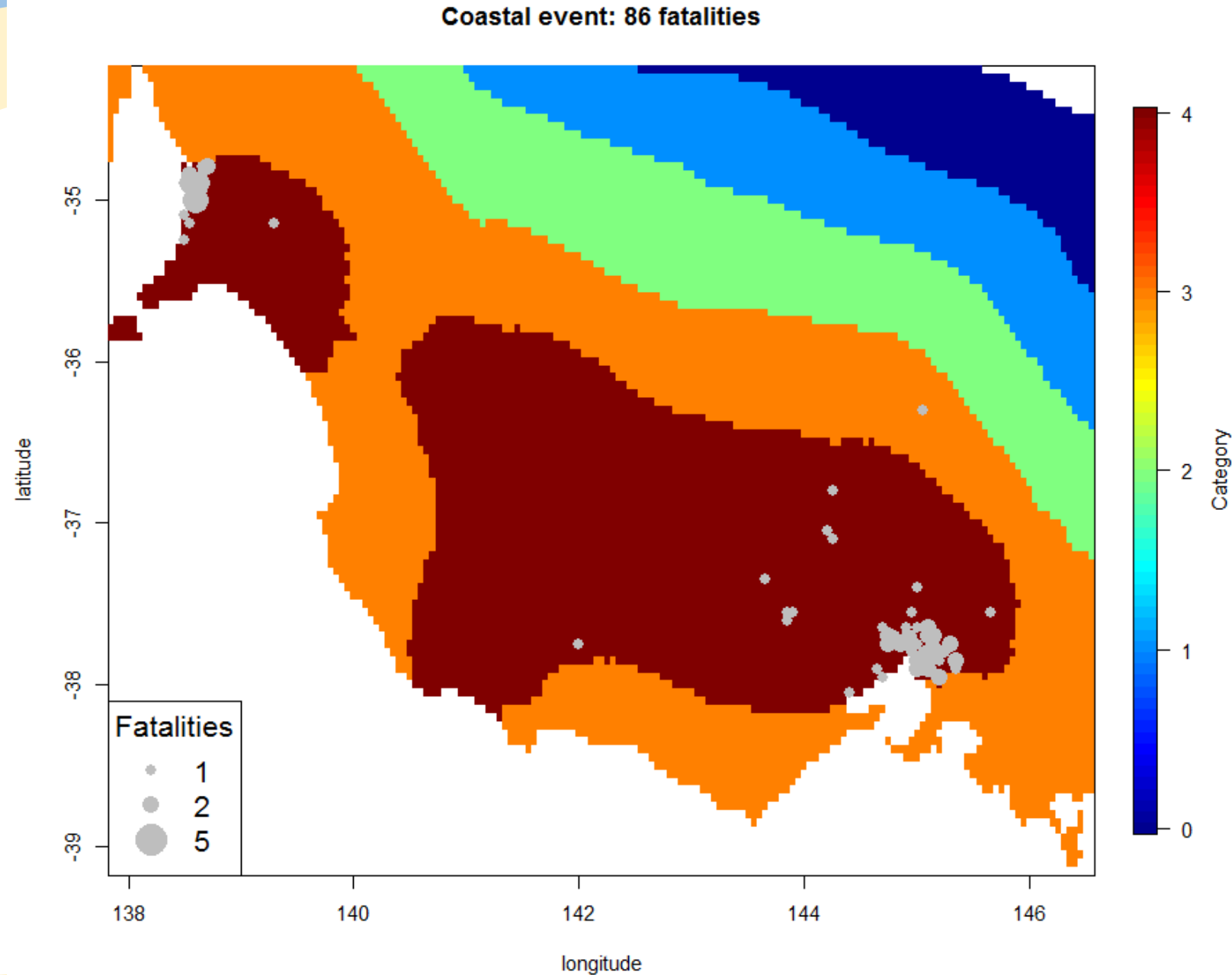


Historical
event
footprints



Scenario 1

- Coastal event impacting both Adelaide and Melbourne with Cat 4 HW
- 86 fatalities

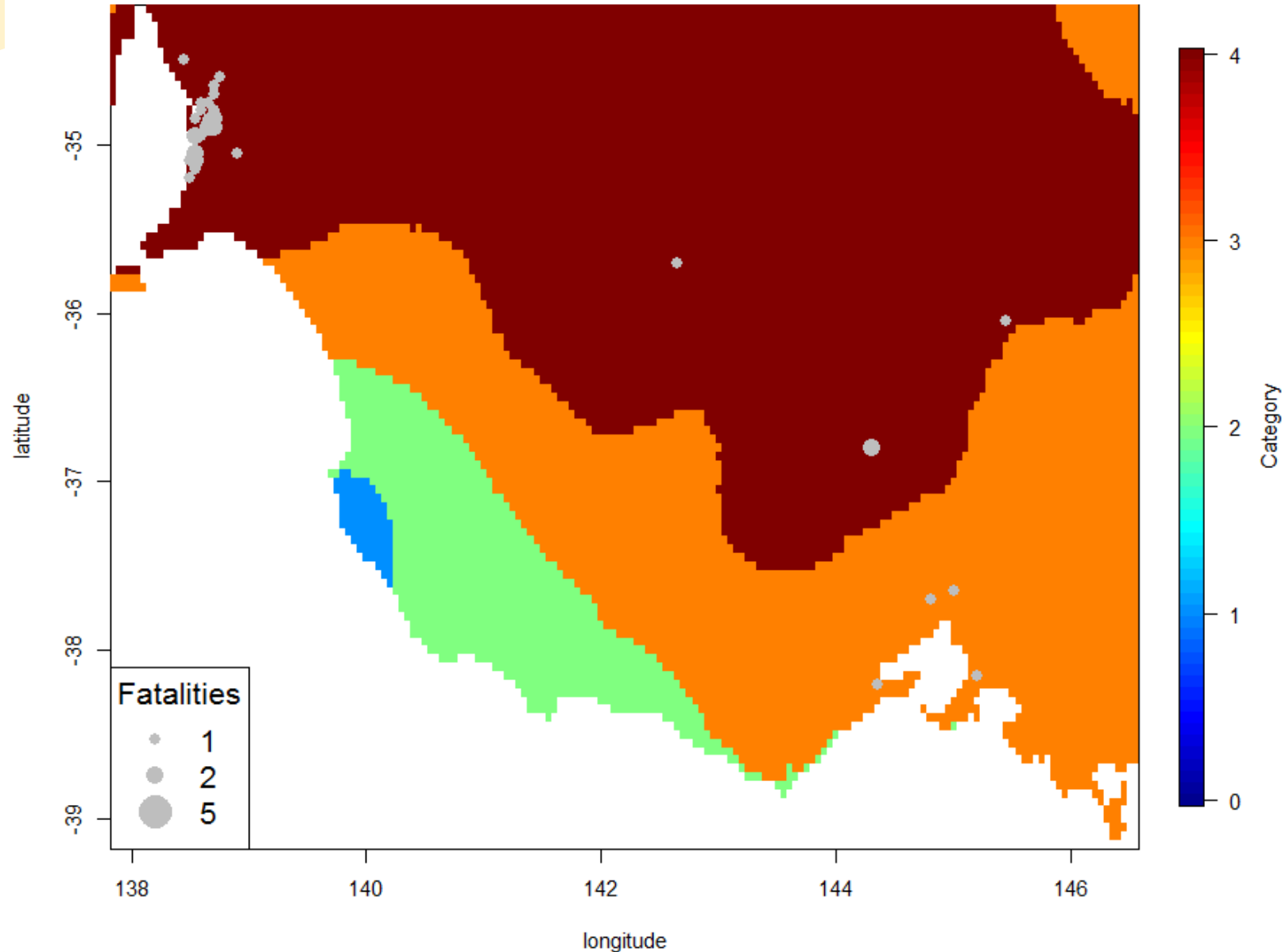




Scenario 2

- Inland event
- Higher intensity overall hazard but impacting less populated regions
- Adelaide in cat 4 and Melbourne in cat 3 risk
- 35 fatalities

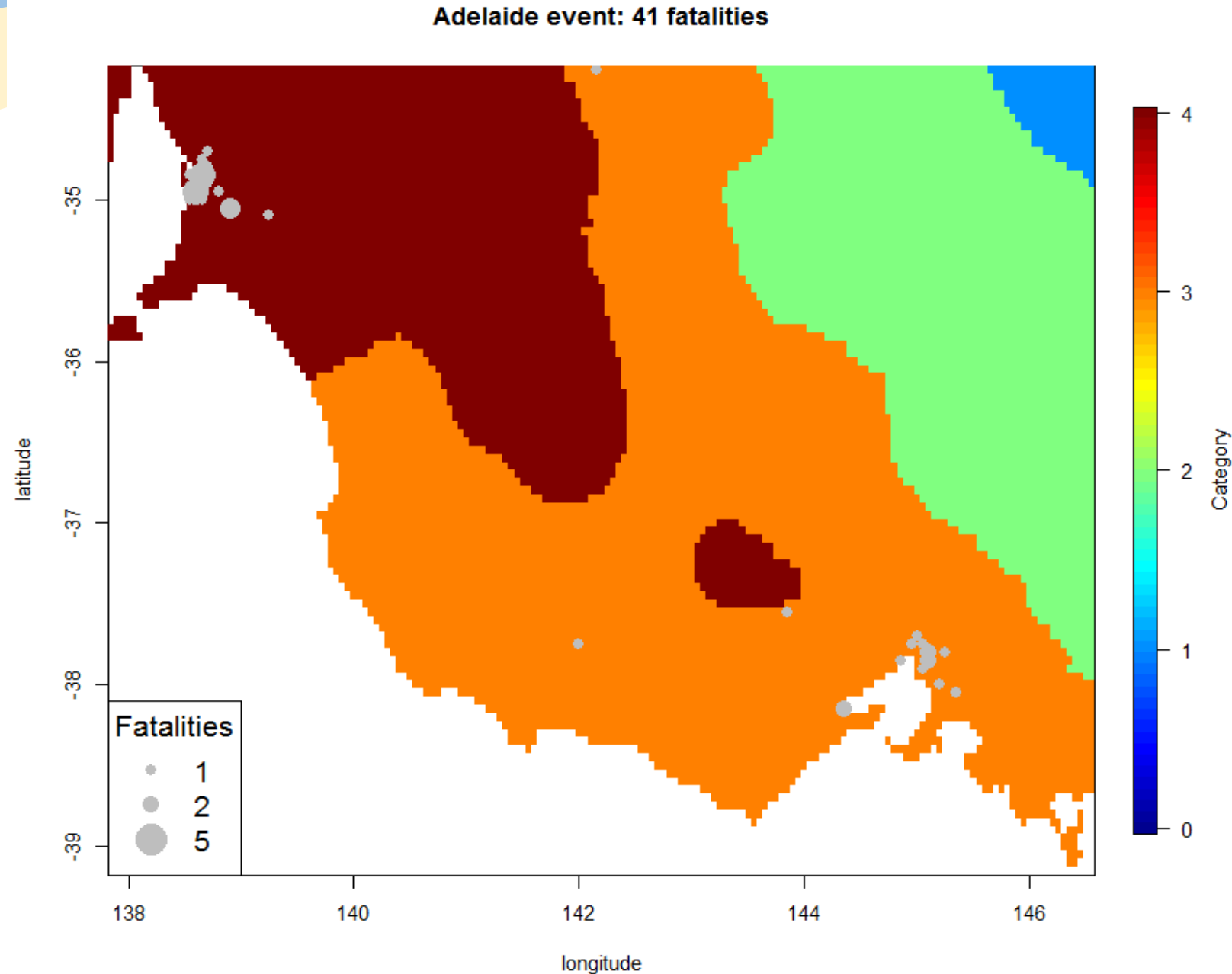
Inland event: 35 fatalities



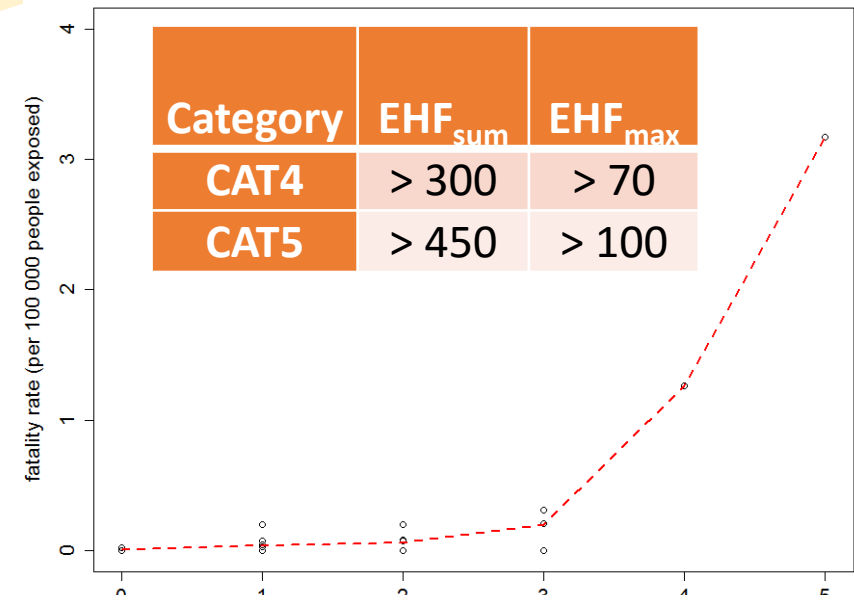


Scenario 3

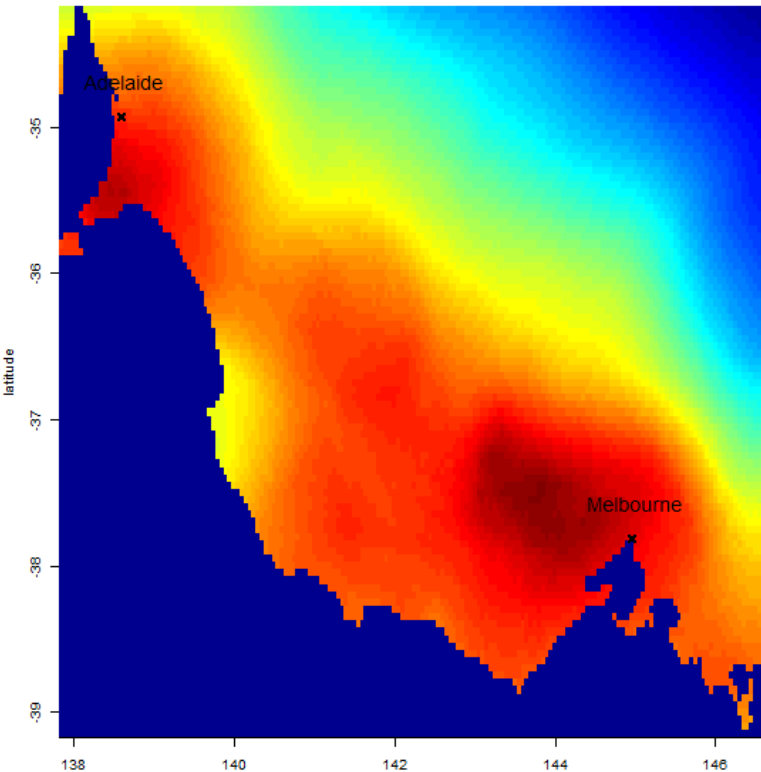
- Most severe of the 3 scenarios in terms of hazard intensity
- Peak Cat 4 risk in Adelaide
- Melbourne in Cat 3 risk
- 41 fatalities



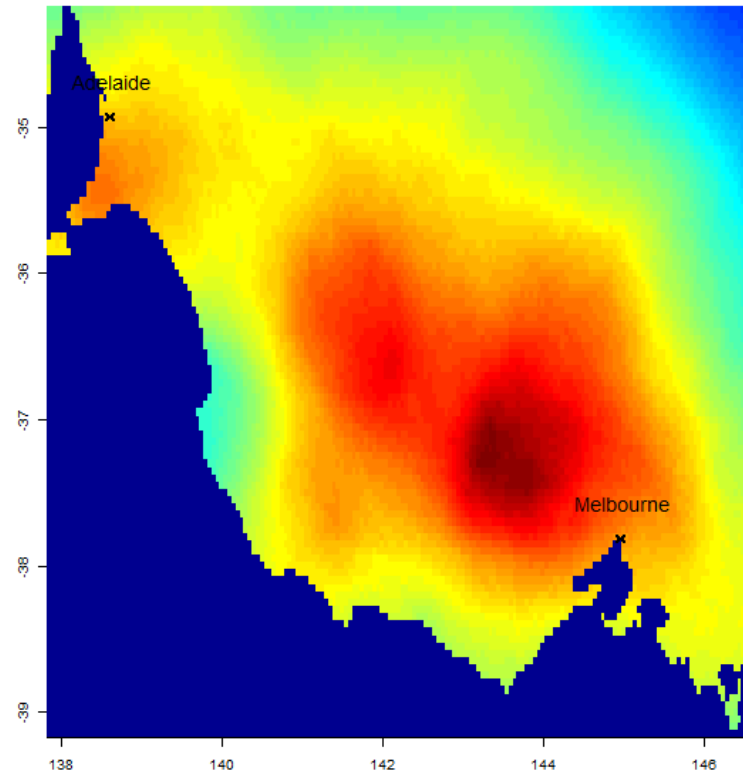
Extreme scenario



Peak EHF over the event



Accumulated EHF over the event



Xtreme event: 231 fatalities

