ANALYSIS OF RAPID DAMAGE ASSESSMENT DATA FOLLOWING SEVERE WINDSTORM EVENTS

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TC Debbie, 2017

Rapid Damage Assessment (RDA) Data

→CTS assessments = lots of engineering detail, fewer locations

→RDA = less detail, more locations

→Trained emergency services personnel (typically on foot)

→Building condition and description, build type, roof type, etc.

→Condition = No Damage, Minor, Moderate, Severe, Total

→Collected very quickly → informs response/recovery efforts

Building Condition

Minor

→ Superficial damage, glass breakage

→ Ridge capping and gutter damage

→ Structure is habitable

→ Less than 25cm water

BNE Thunderstorm, skylight/window glass breakage

**per QFES Damage Assessment Operator Guide V5*

Building Condition

Moderate

→ Roofing cover damage

→ Door/window frames damage

→ Power impacted

→ Internal linings/fixtures damaged

→ 25cm – 100cm water

BNE Thunderstorm, partial roof sheeting removed

Building Condition

Severe

- → Roof structure significantly damaged (damage to roof trusses)
- → Walls/ceilings collapsed or unstable
- → Structure is not usable/habitable
- → Structural dmg that could be repaired
- → More than 100cm water

BNE Thunderstorm, all roof sheeting removed

Building Condition*

Total

→ Complete failure of major structural components (e.g. collapse of walls, foundations or roof)

→ Only foundations remain

→ Structure is unsafe and not habitable

→ House pushed off foundations

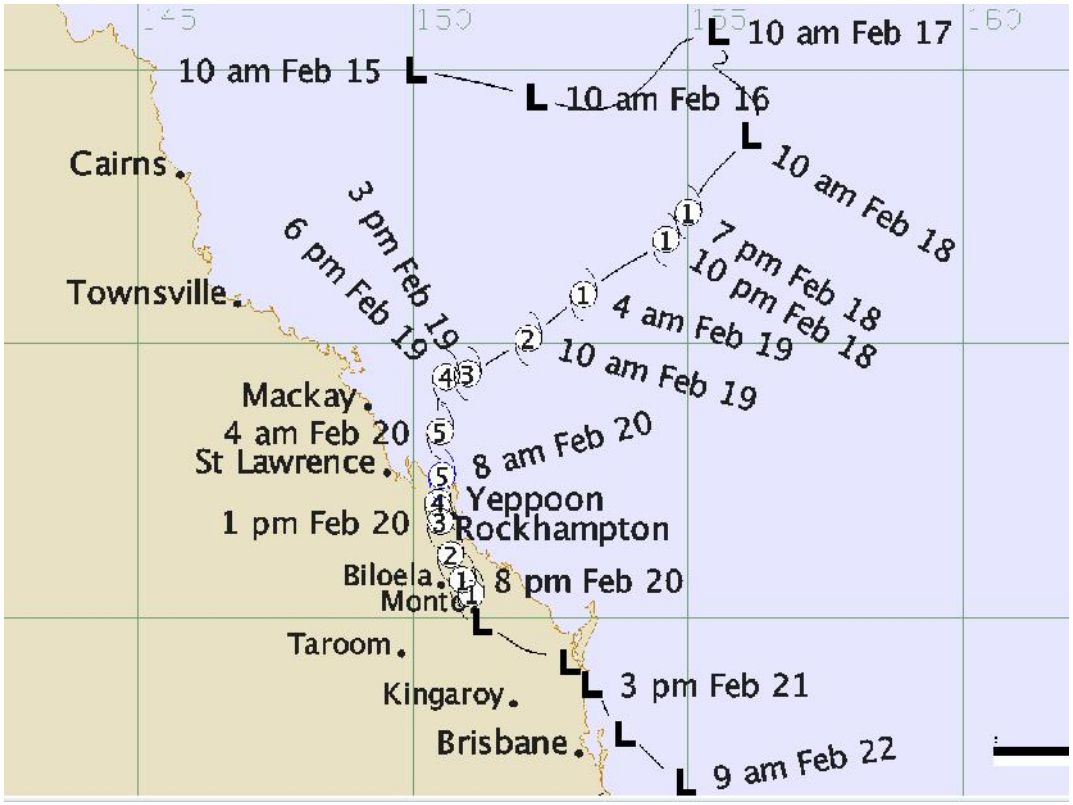
*data require engineering "conversion"

TC Marcia, Nerimbera Football Club

Severe Wind Events

Brisbane Thunderstorm (2014)

TC Marcia (2015)

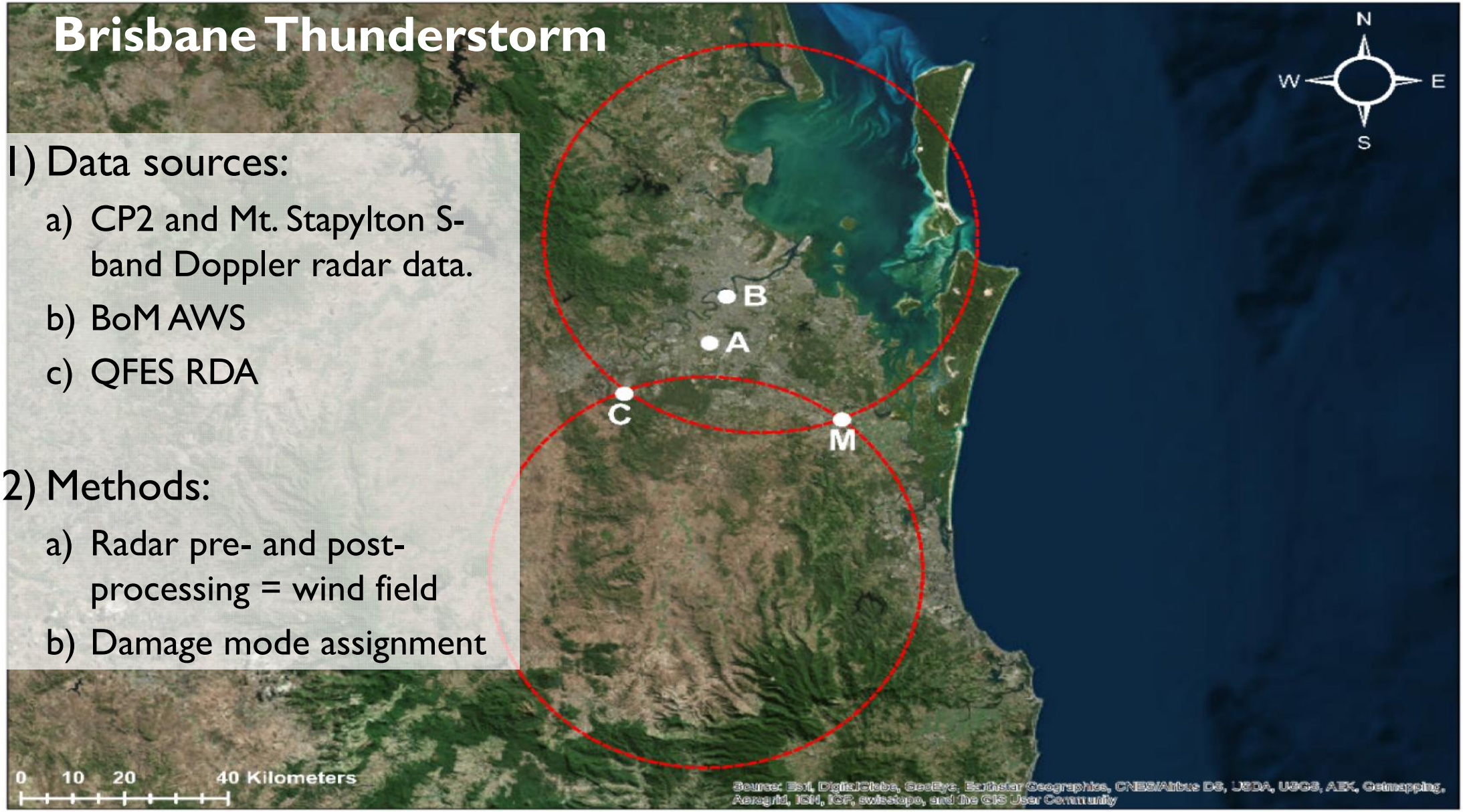



$1,400,000,000
Brisbane
Photo credit: ABC

Brisbane Thunderstorm

1) Data sources:
   a) CP2 and Mt. Stapylton S-band Doppler radar data.
   b) BoM AWS
   c) QFES RDA

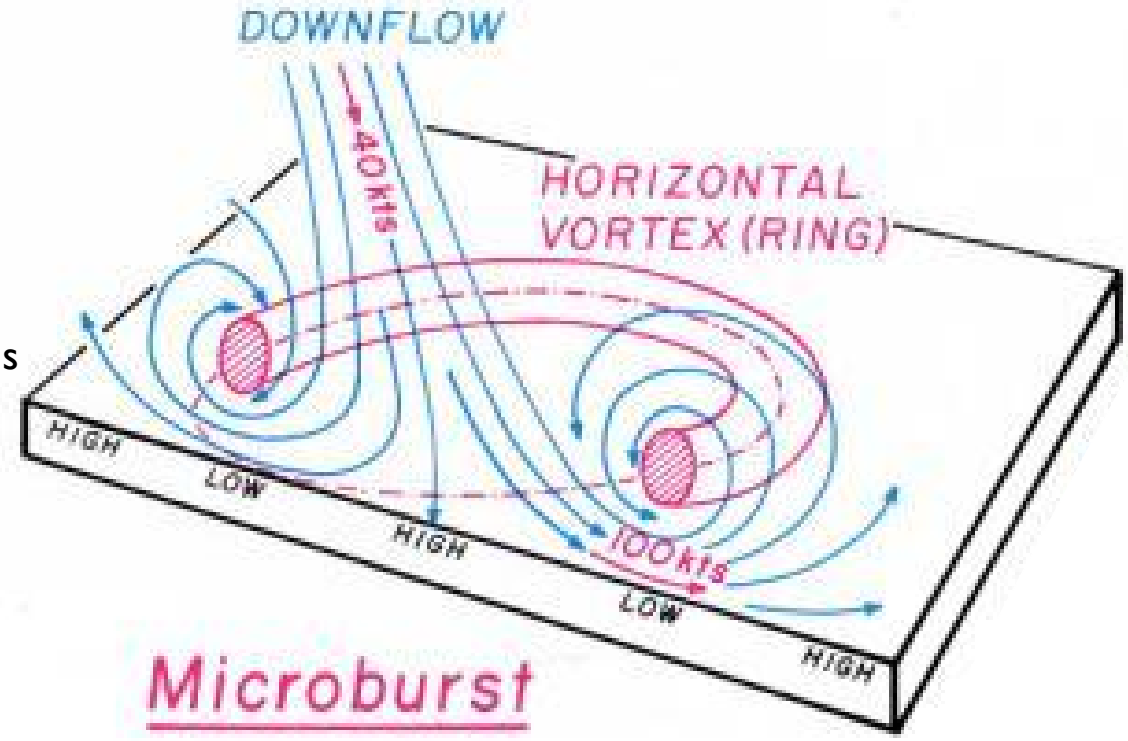
2) Methods:
   a) Radar pre- and post-processing = wind field
   b) Damage mode assignment



Thunderstorm Downbursts

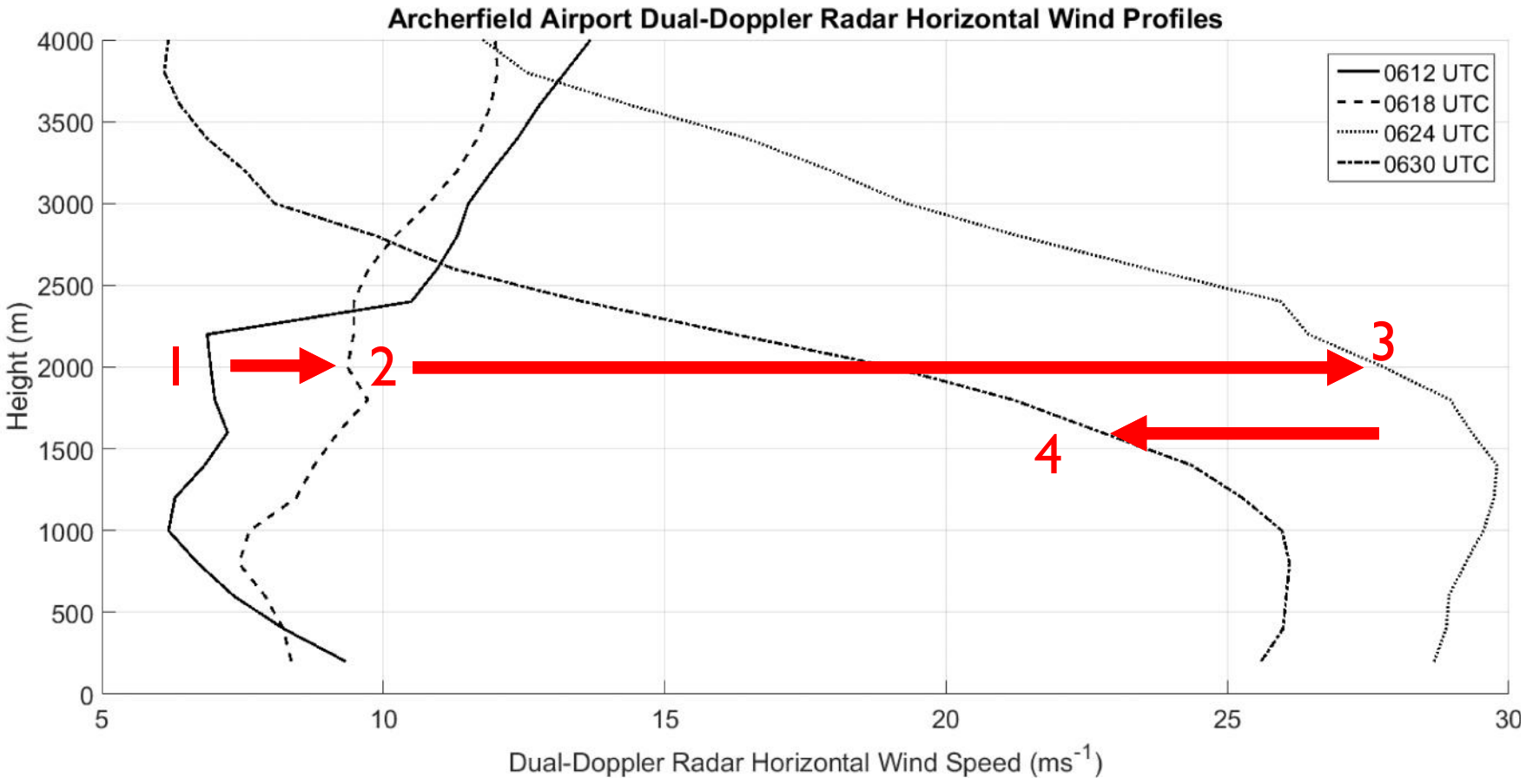
Dimension

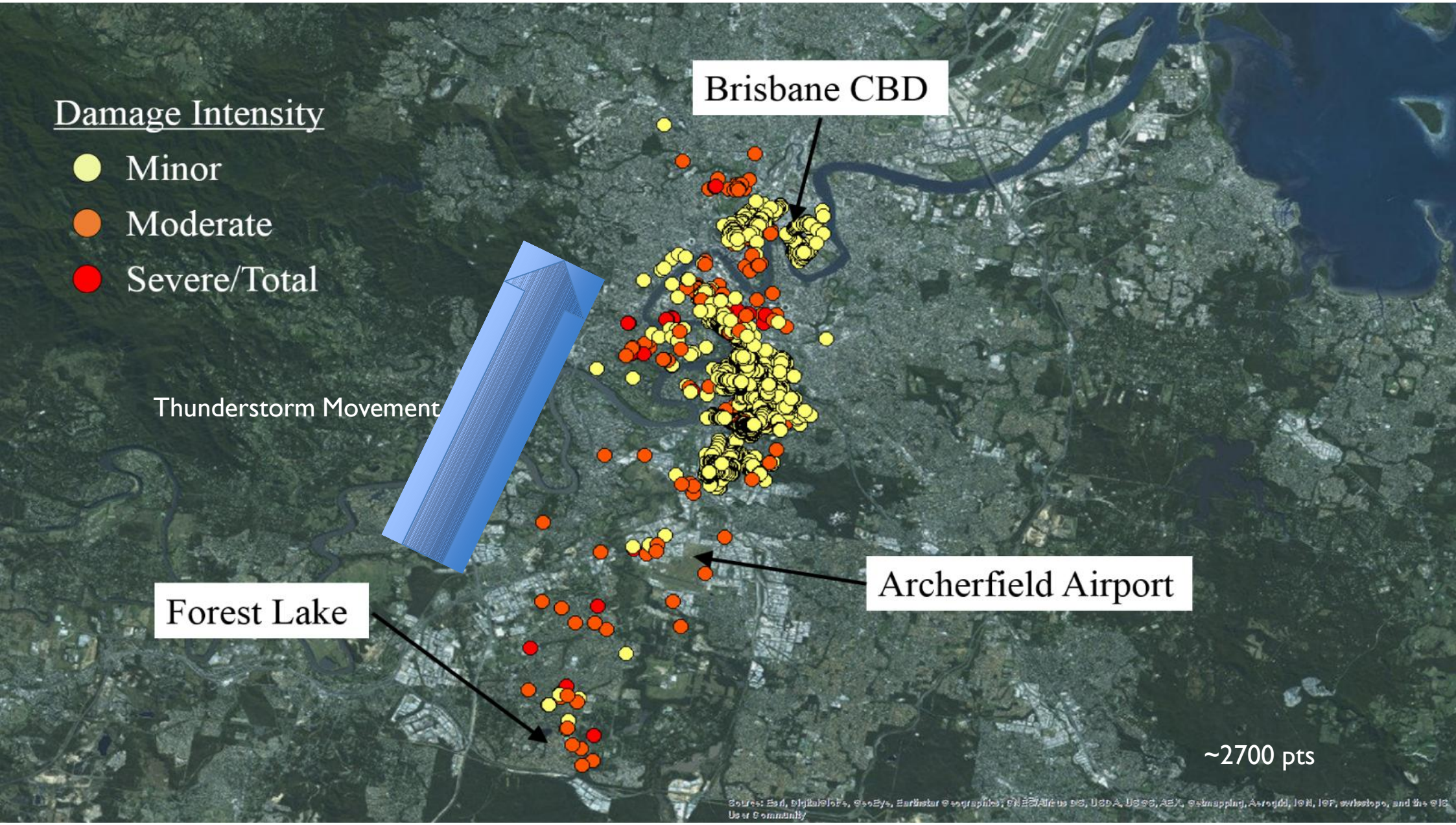
- **Frontal systems (Gales)** — 100s of kms
- **Tropical cyclones**
- **Thunderstorms**
  - **RFD/FFD**
  - **Microbursts** — 100 m to 10s of kms
  - **Tornadoes**



Schematic of a downburst and tornado by Fujita
(Image reference - http://www.tordach.org/topics/tornadodef_en.htm)

Doppler Radar Observations *Krupar et al.




Damage Intensity
Minor
Moderate
Severe/Total
Brisbane CBD
Thunderstorm Movement
Archerfield Airport
Forest Lake
~2700 pts

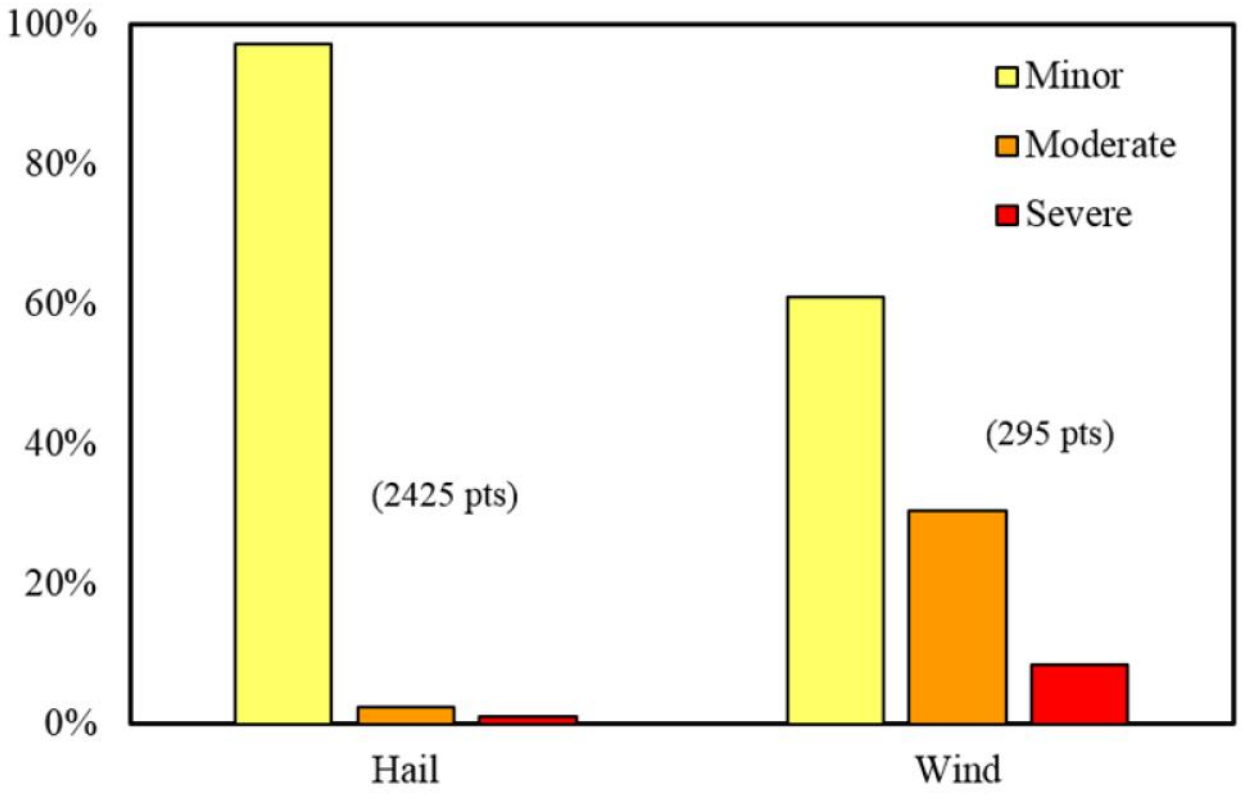
RDA Analysis

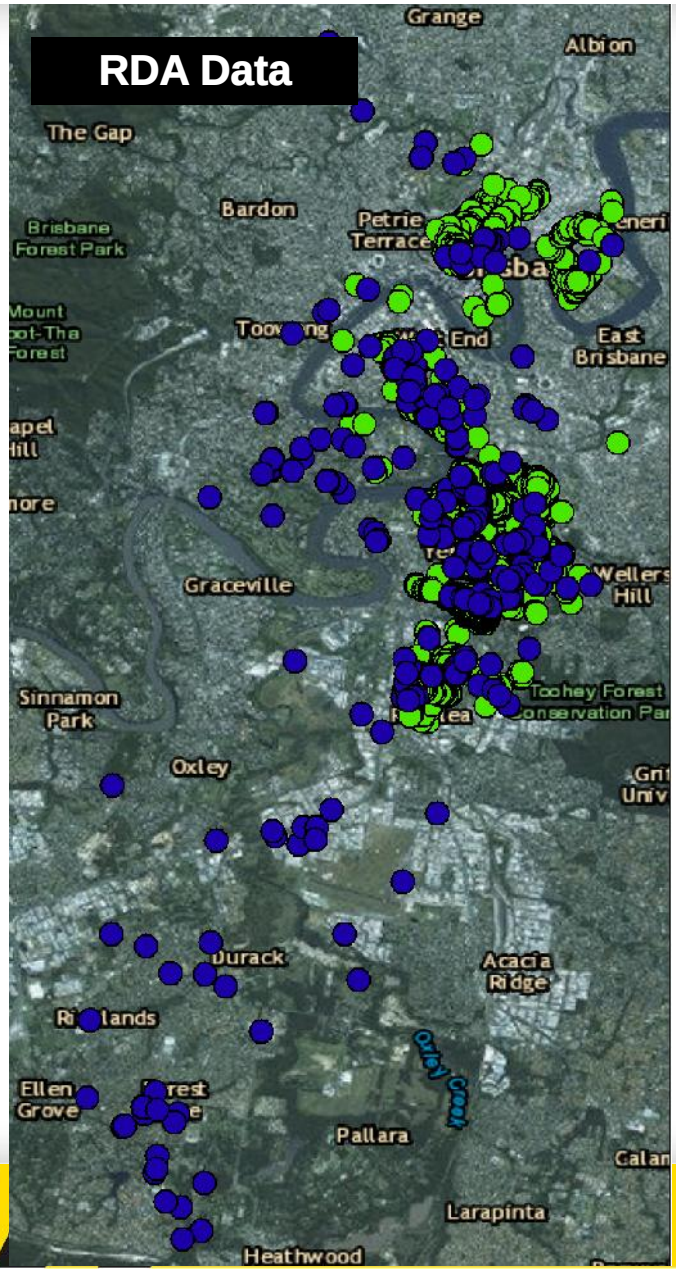
Assign damage modes

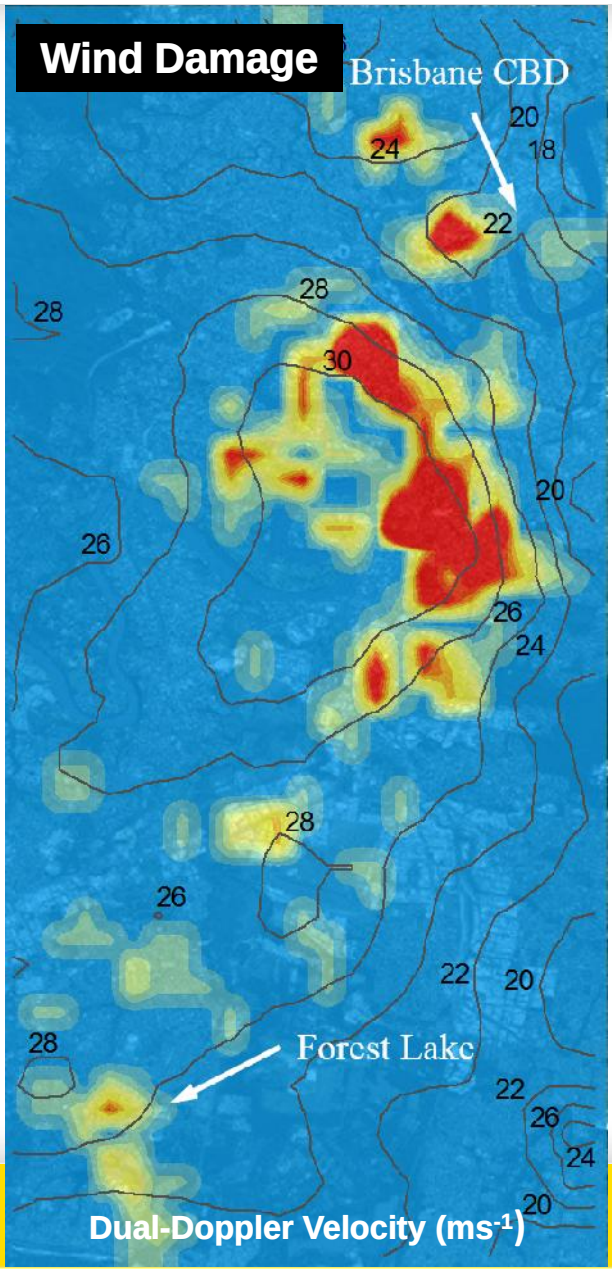
→ Term searches

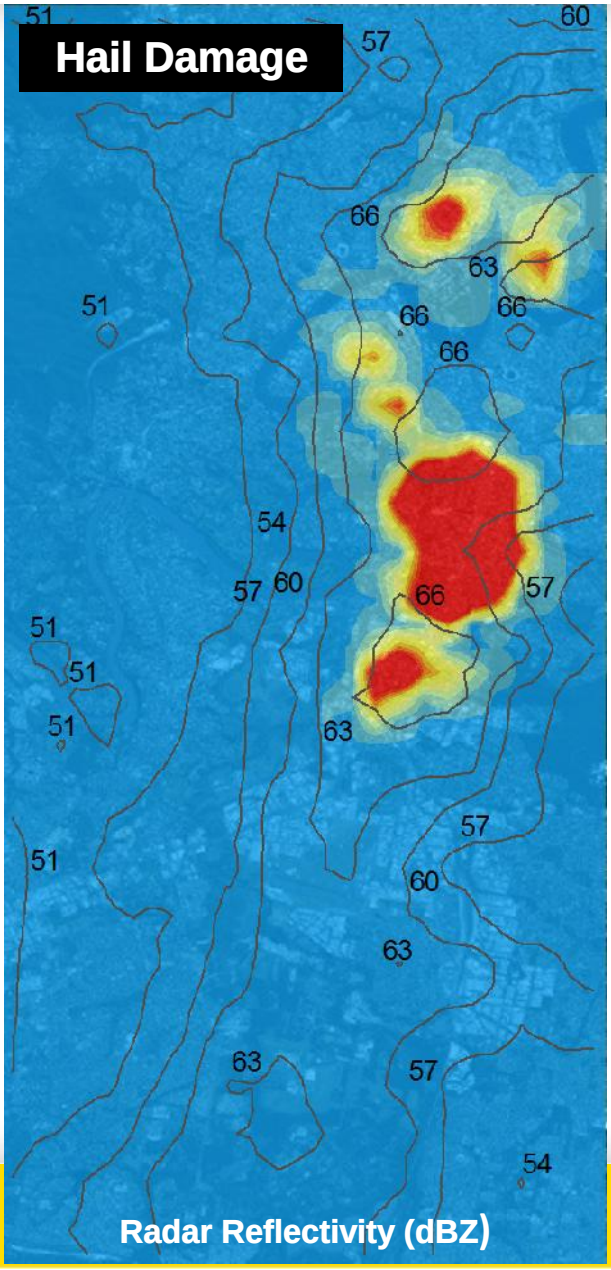
→ Tree damage/debris = wind

→ Review of photographs




RDA Data
Grange
Albion
The Gap
Bardon
Brisbane Forest Park
Petrie Terrace
East Brisbane
Graceville
Wellers Hill
Sinnamon Park
Toohey Forest
Oxley
Acacia Ridge
Pallara
Larapinta
Heathwood
Ellen Grove


Wind Damage
Brisbane CBD
Forest Lake
Dual-Doppler Velocity (ms-1)

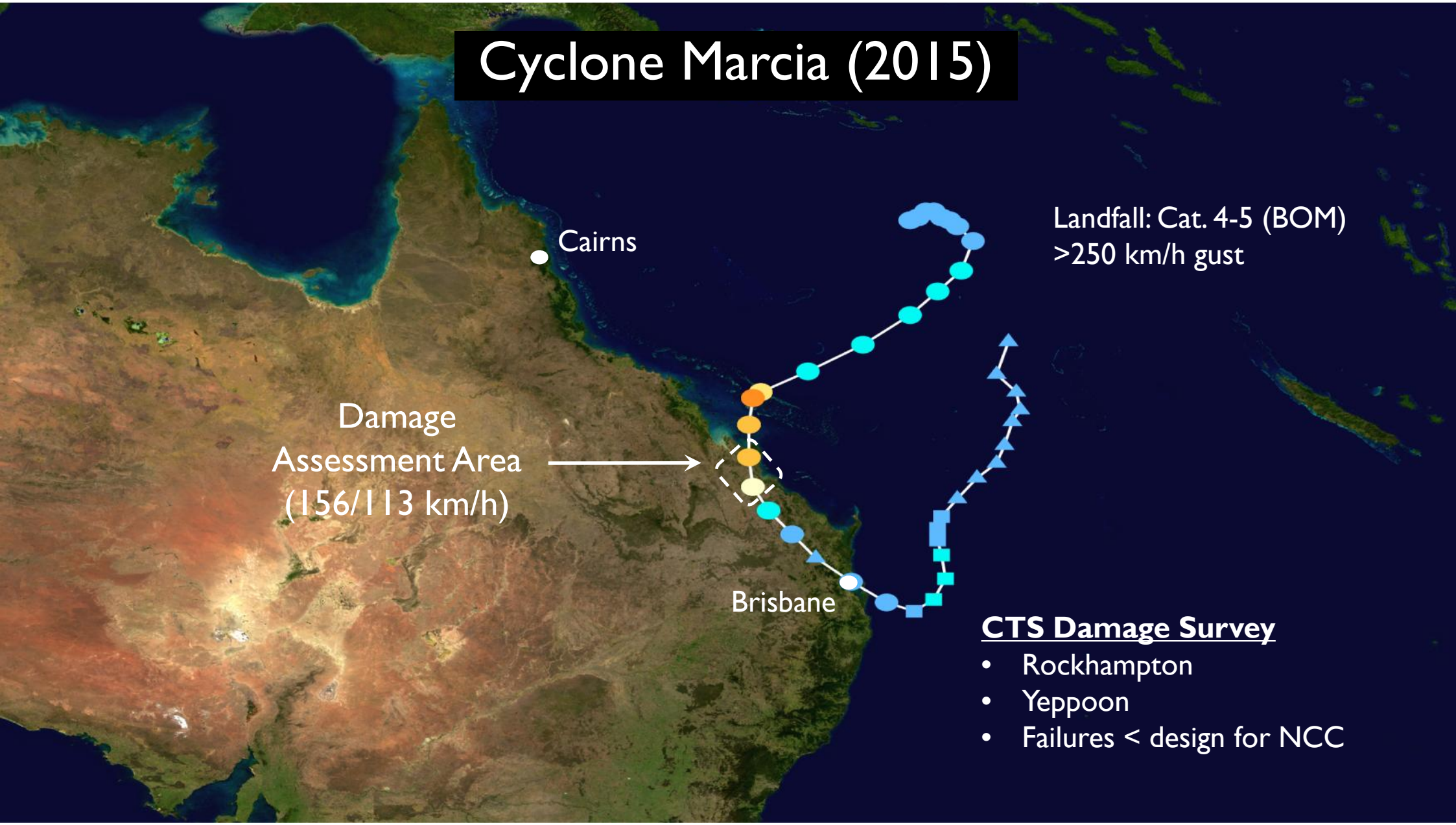

Hail Damage
Radar Reflectivity (dBZ)

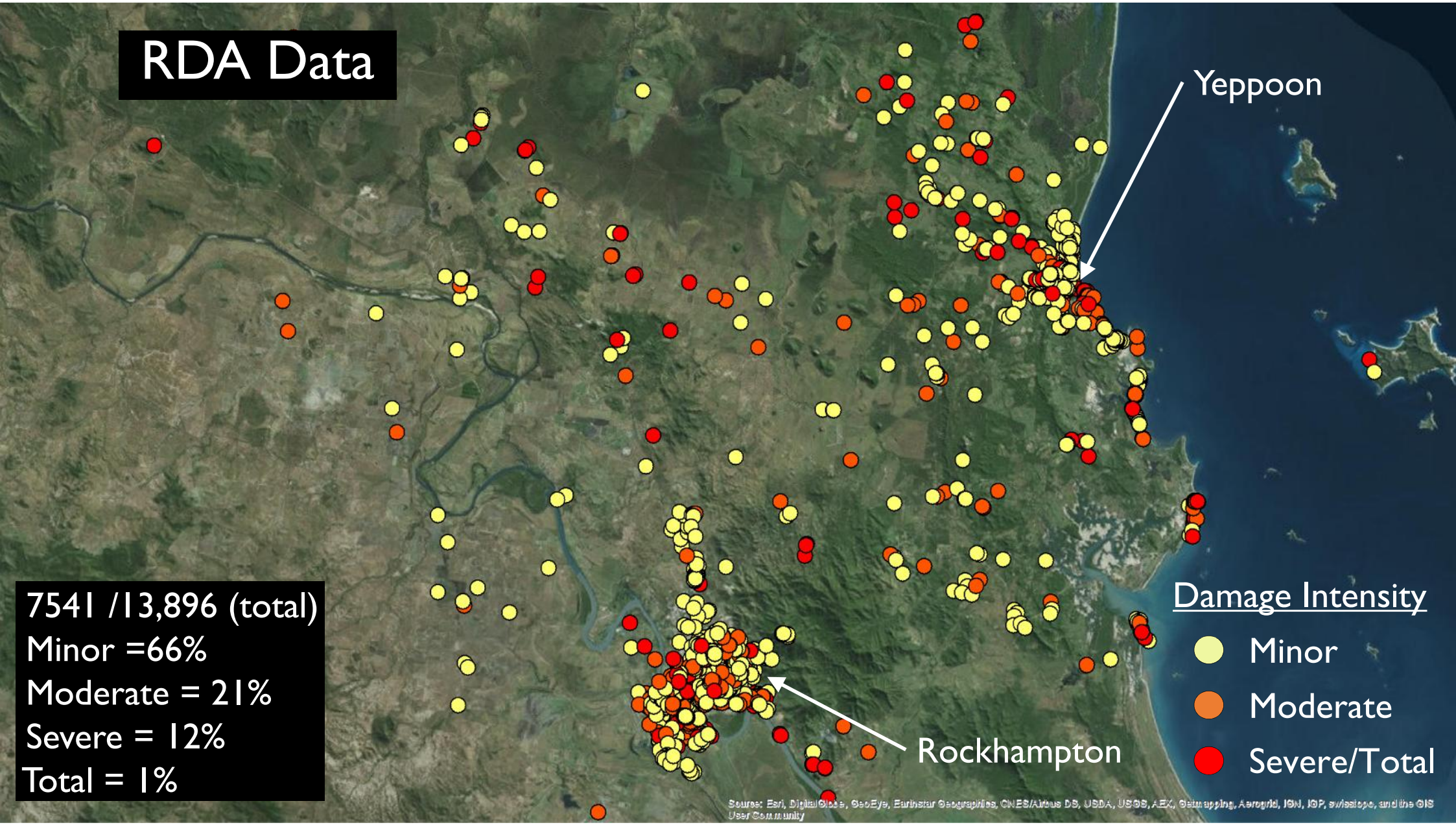
BNE Analysis Summary

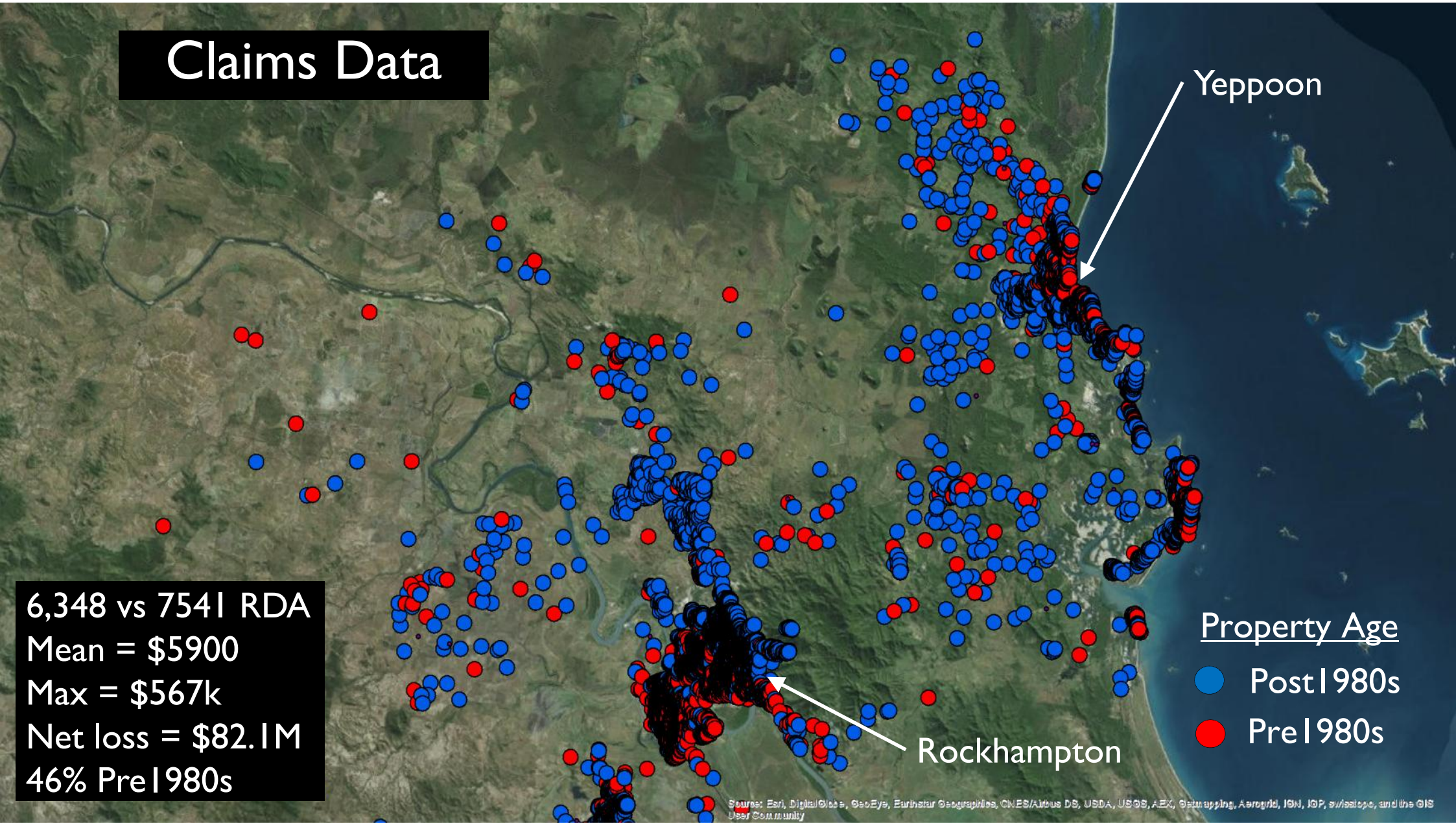
→ Good qualitative agreement w/ radar (200 m) and RDA @ ground-level

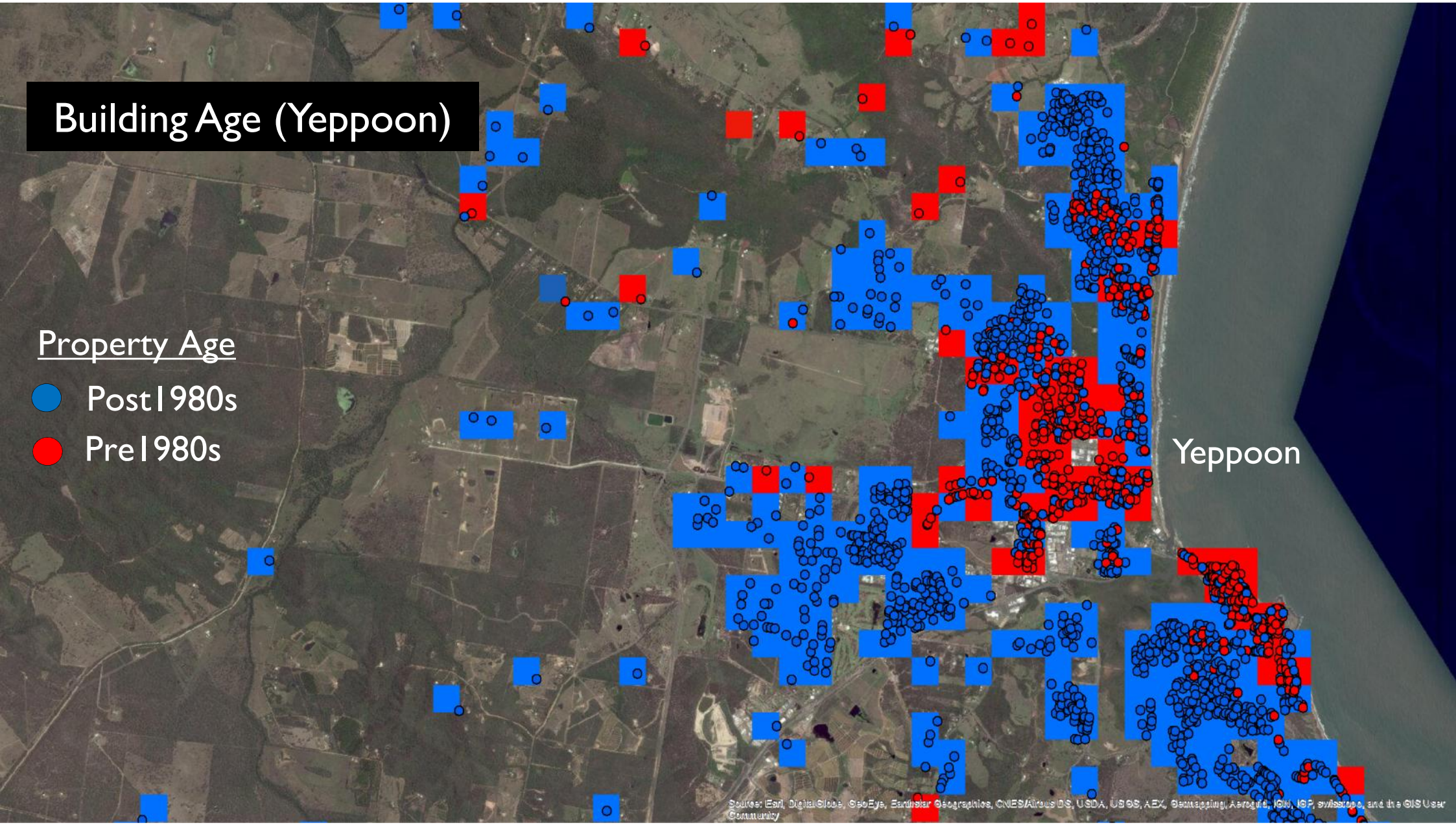
→ Need to explore quantitative relationships

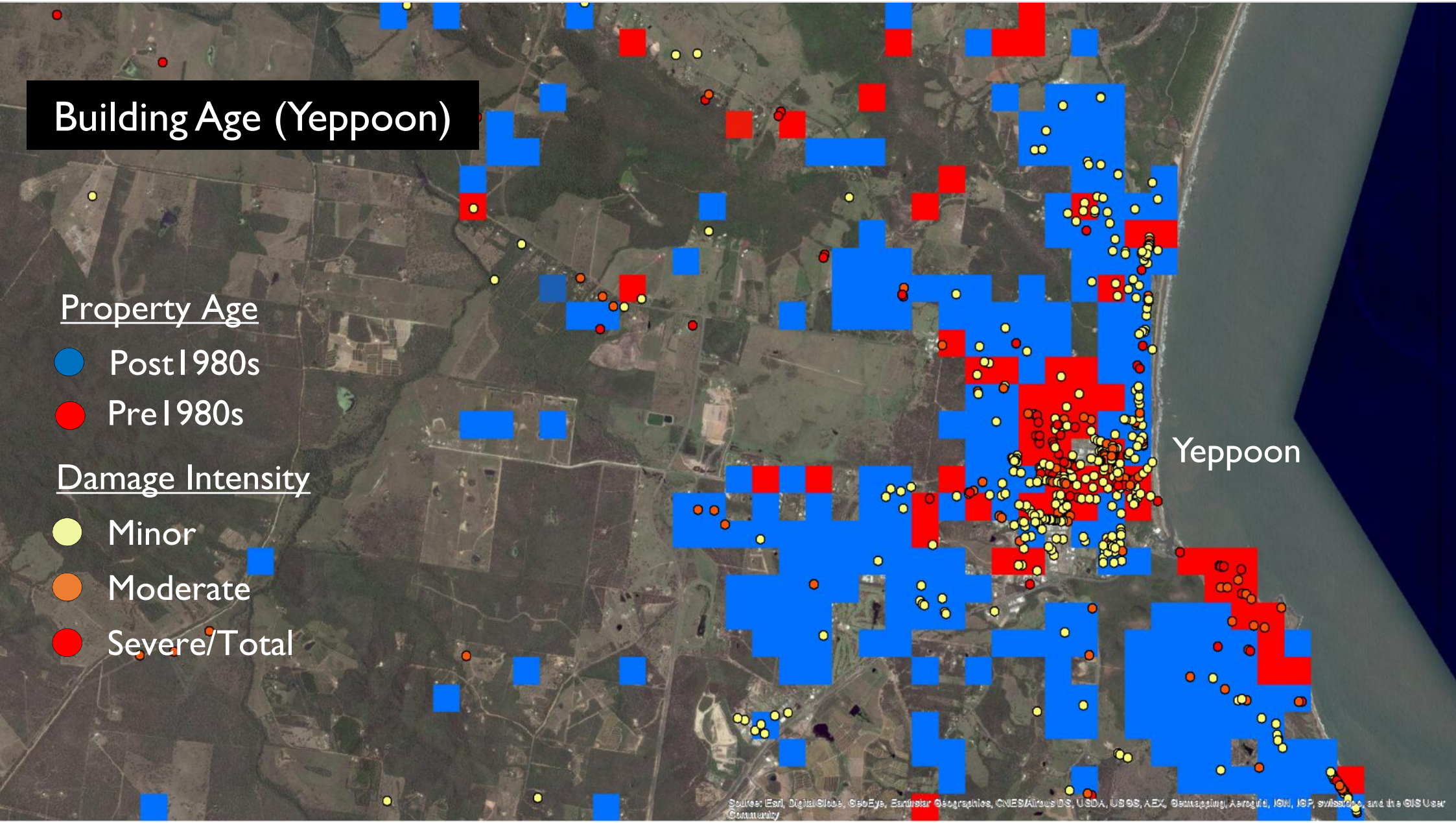
→ Real-time predictive tools w/ RDA as calibration?


Cyclone Marcia (2015)
Cairns
Landfall: Cat. 4-5 (BOM)
>250 km/h gust
Damage
Assessment Area
(156/113 km/h)
Brisbane
CTS Damage Survey
• Rockhampton
• Yeppoon
• Failures < design for NCC


RDA Data
Yeppoon
Rockhampton
7541 /13,896 (total)
Minor =66%
Moderate = 21%
Severe = 12%
Total = 1%
Damage Intensity
Minor
Moderate
Severe/Total
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Claims Data
Yeppoon
Rockhampton
6,348 vs 7541 RDA
Mean = $5900
Max = $567k
Net loss = $82.1M
46% Pre1980s
Property Age
Post1980s
Pre1980s
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Building Age (Yeppoon)
Property Age
Post1980s
Pre1980s
Yeppoon
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Building Age (Yeppoon)
Property Age
Post1980s
Pre1980s
Damage Intensity
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Age vs Performance

→ RDA points assigned age based on claims data (housing only)

→ Assignments not perfect but reasonable

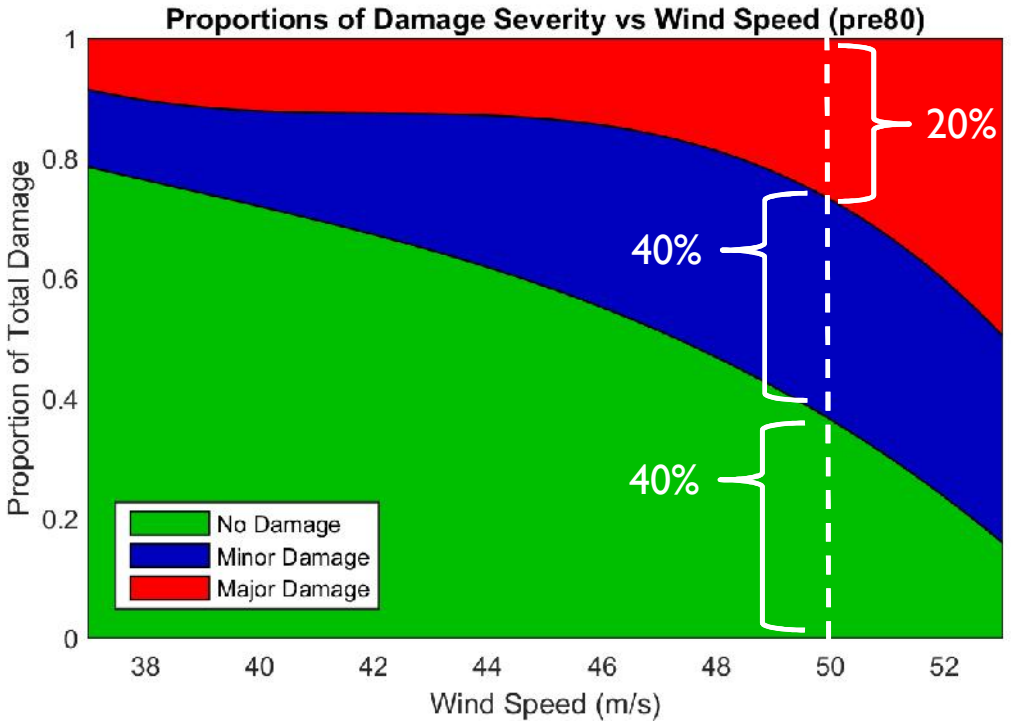
→ Parametric wind field used to assign site-level speed (Krupar et al.)

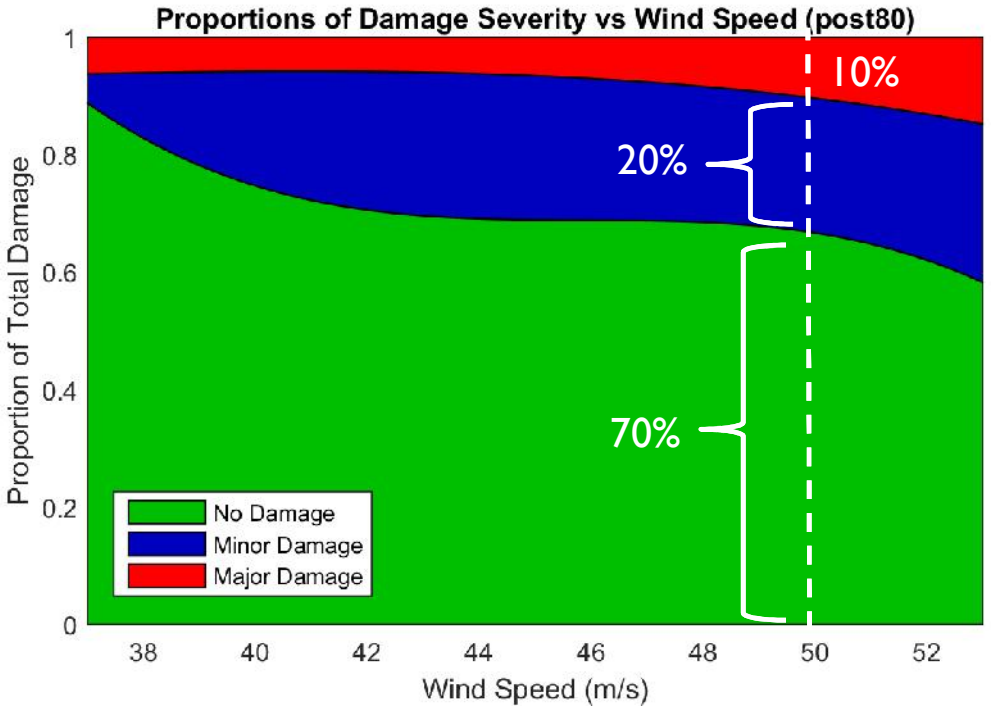
→ Minor = Minor

→ Major = Moderate/Severe/Total

RDA Analysis Outputs

Green = Good Red = Bad





Pre1980s (pre-code) ✗

Post1980s ✓

Discussion

Summary

→RDA enables spatial analysis of damage

→Age vs performance trends affirmed

→Used to examine non-synoptic events

- Harder to gather info than larger synoptic events
- Better datasets may inform code changes

Benefits of RDA

→Enables catalogue of severe events for historical analysis

→Improved forecasting = better preparation

CYCLONE TESTING STATION

Future

→Data is great and has to be rapid

→More damage descriptions (remove unknowns)

→Nomination of damage modes (wind, hail, flood, etc.)

→Merge with GNAF for property ages?

→Develop relationships to $ loss

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Acknowledgements

→BoM
→QFES
→Suncorp
→Advance Queensland Grant
→BNHCRC

More Information

→Journal of the Atmospheric Sciences (JAS)
→Frontiers Journal Paper
→Australian Journal of Emergency Management (October Ed.)

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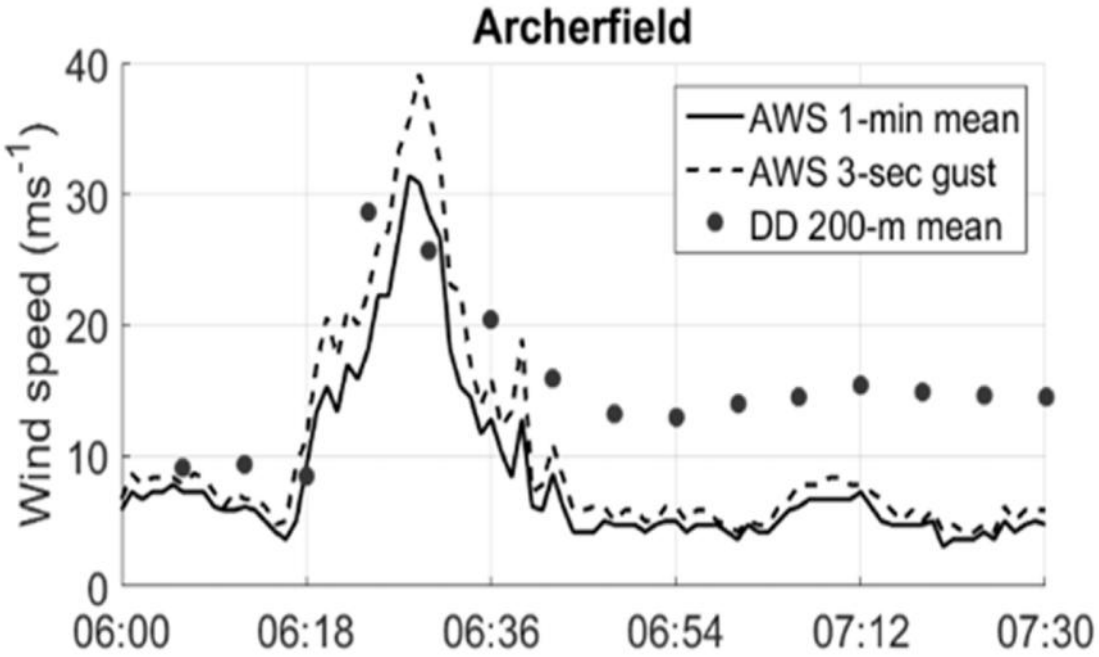
AWS – Dual-Doppler Radar Horizontal Wind History Comparisons

*Krupar et al.



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