bushfire&natural HAZARDSCRC

IMPACT –BASED FORECASTING IN THE COASTAL ZONE: EAST COAST LOWS – The use of emergency management data in the validation of spatial wind impact forecasts

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Australian Government
Department of Industry, Innovation and Science
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Australian Government
Geoscience Australia

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Bureau of Meteorology

PROJECT OBJECTIVE

To develop a pilot capability that will make useful predictions of community impacts of extreme wind & rain with the goal of improving timely mitigating actions by a range of stakeholders.

The Workflow

IMPACT FORECASTING WORKFLOW

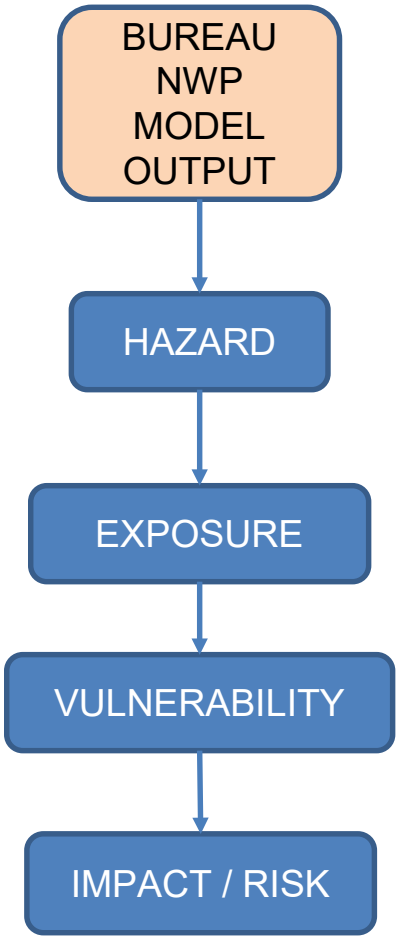
Workflow integrates the hazard, exposure and vulnerability to evaluate impact

Hazard: what causes the damage? Winds, rainfall, flooding, etc.

Exposure: what assets might be affected by the hazards? People, buildings, agriculture?

Vulnerability: How much damage will be caused?

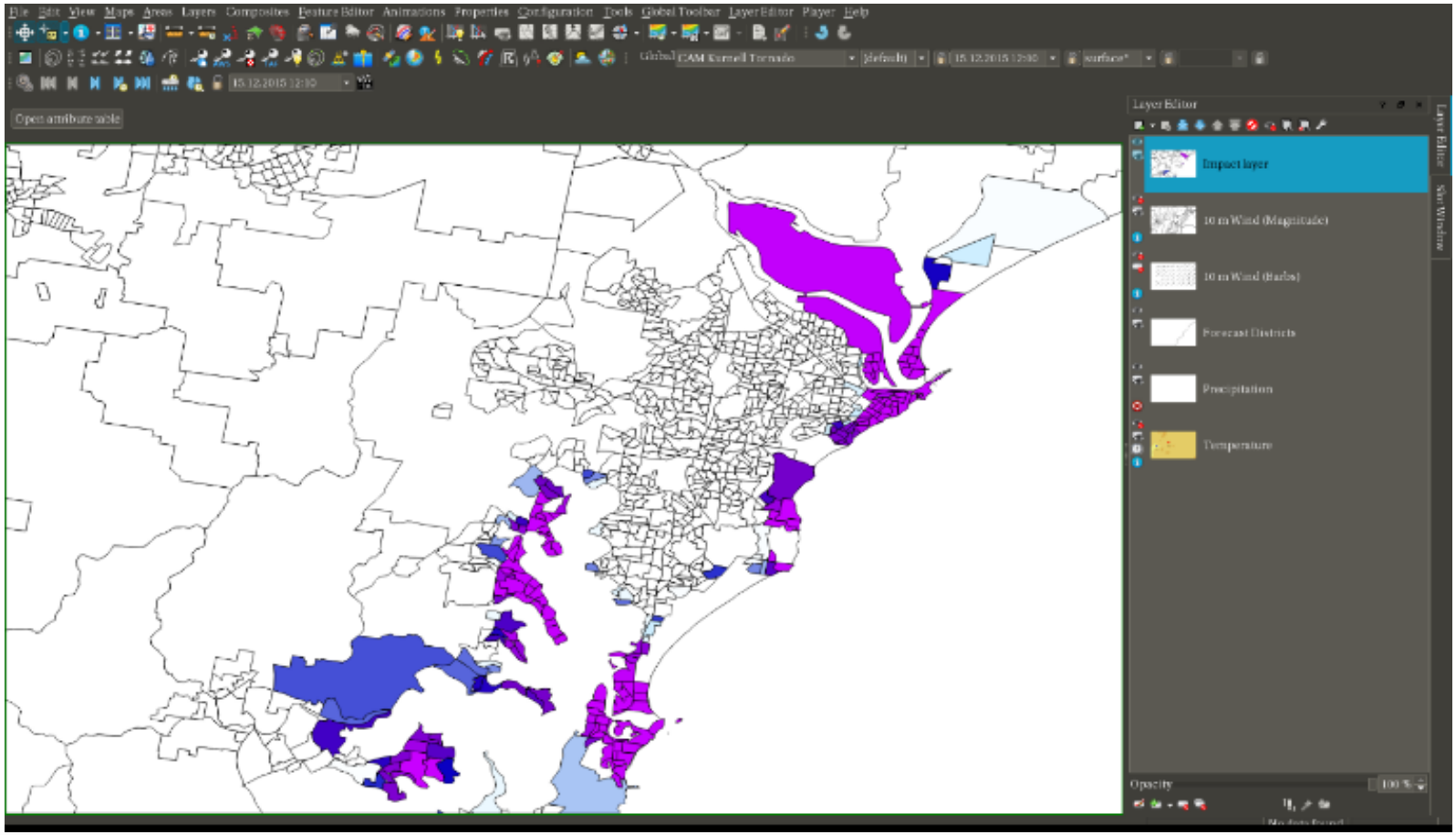
There are issues with each stage of the process!



Have heuristic vulnerability relations w.r.t. 0.2 sec wind gusts

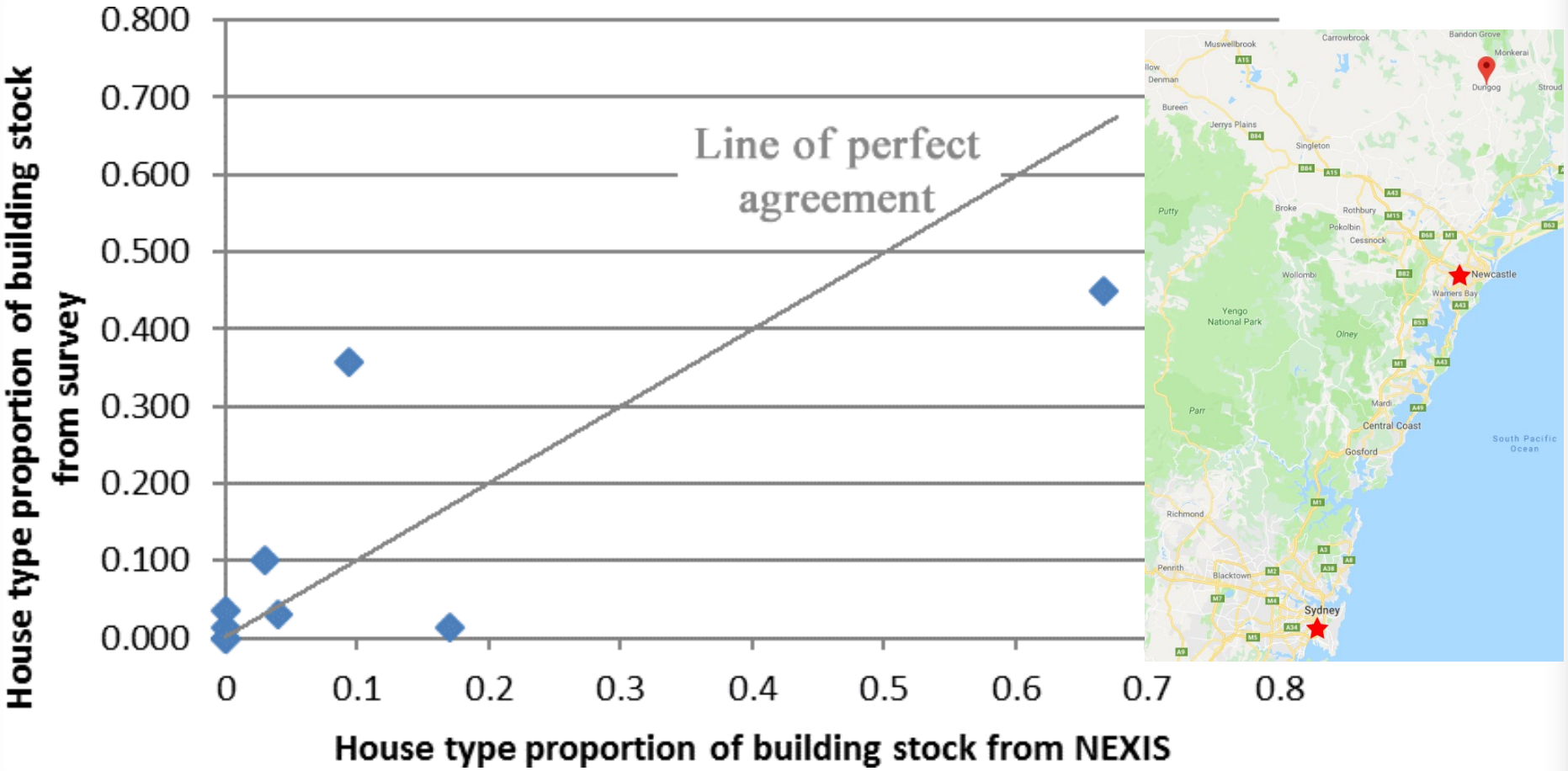
NEXIS Database

IMPACT FORECASTING WORKFLOW "NOMINAL" SPATIAL WIND IMPACT ON RESIDENTIAL BUILDINGS (This was the "Easy Bit")



Challenge 1: Exposure data in places where we need to derive them from surrounding information

NEXIS vs. SURVEY AGREEMENT FOR DUNGOG NSW



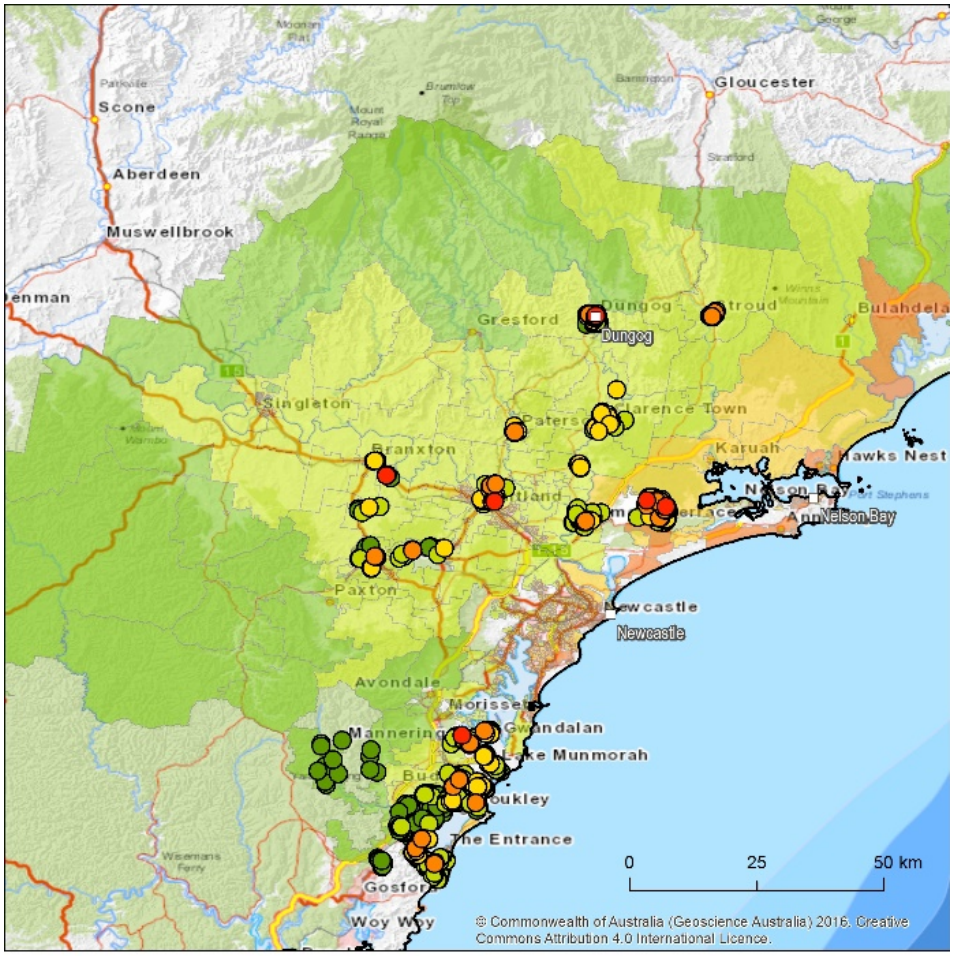
Best available exposure data

It can be done – see WA exposure data

Need for better exposure information in unsurveyed locations

Challenge 2: The Impact Forecast – Damage Data Mismatch Challenge (affects Validation)

GROUND TRUTH DATASET #1: EICU RDA DATA



Mean damage state (estimated) using PSWG hazard

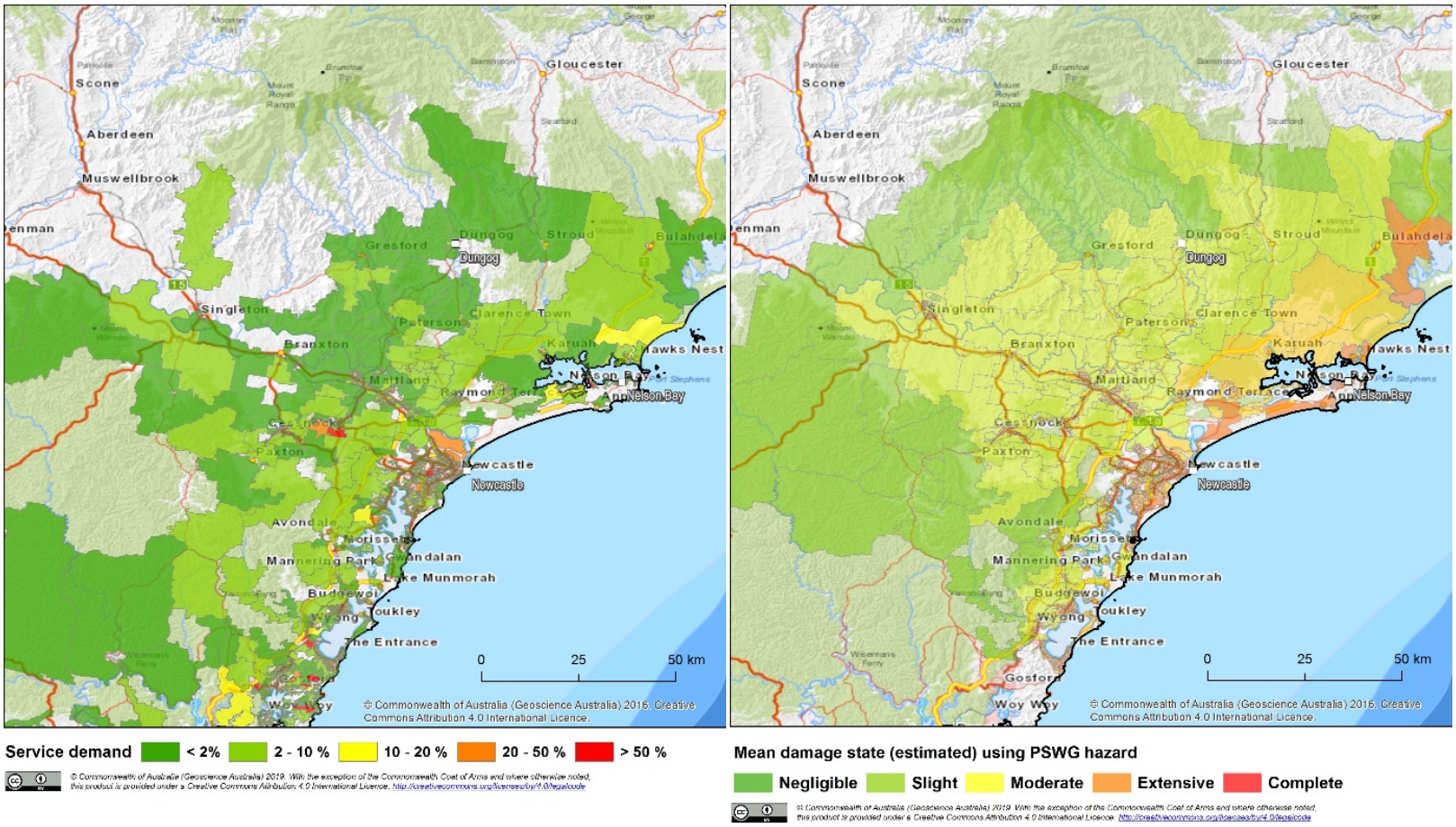
Negligible | Slight | Moderate | Extensive | Complete

EICU Rapid Damage Assessment classification

- No Damage - 0%
- Minor Impact - 1-25%
- Major Impact - 26-50%
- Severe Impact - 51-75%
- Destroyed - 76-100%

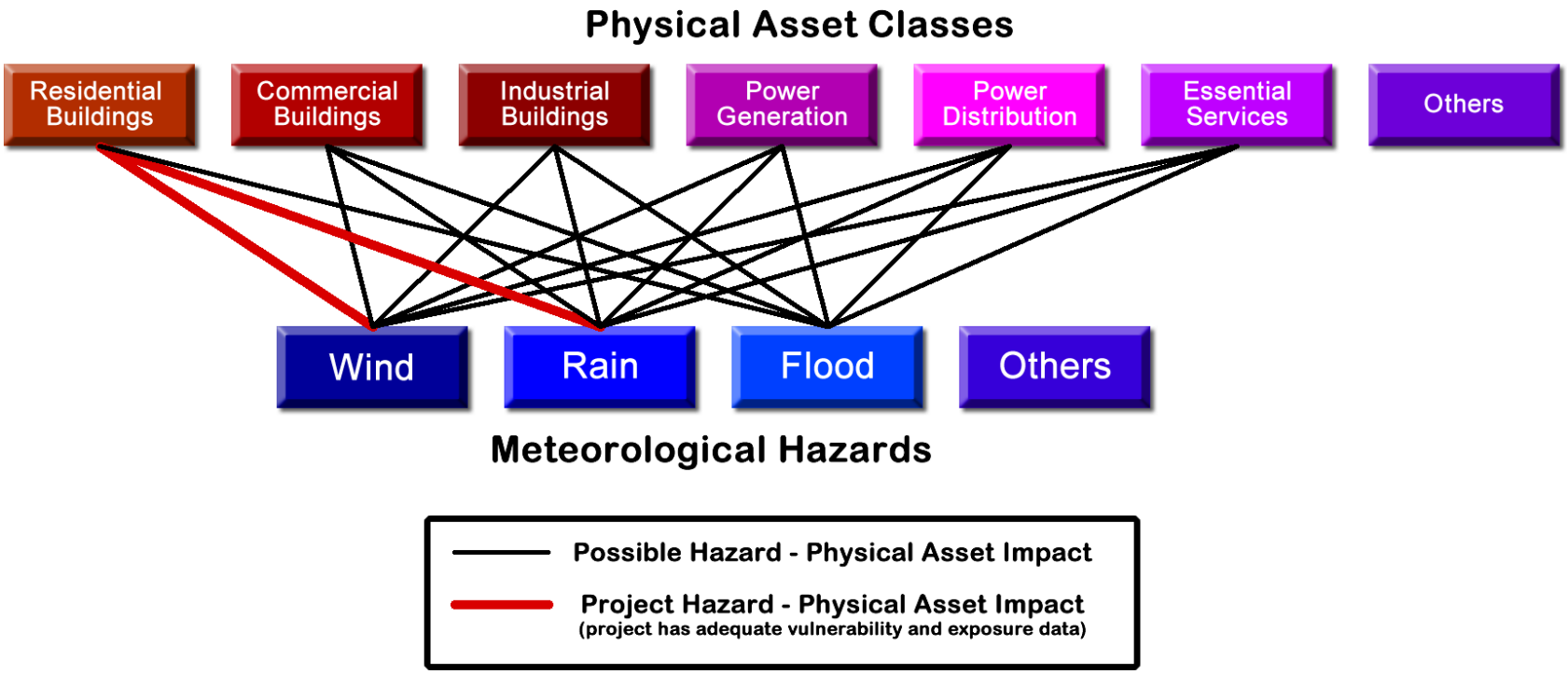
High quality damage assessment data, but only in a few locations
[need better coverage]

GROUND TRUTH DATASET #2: SES CALLOUTS



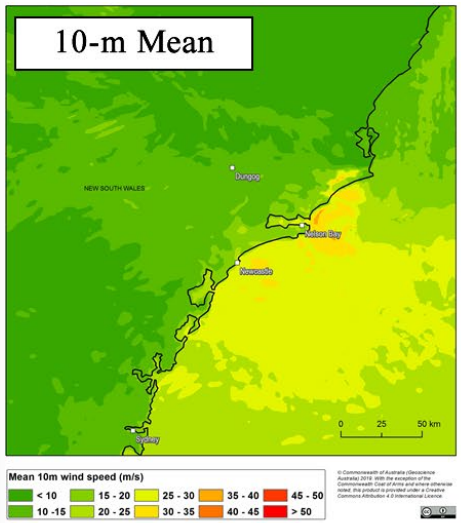
Left: SES Service Demand reflects multi-hazard impacts on multiple asset classes; Right: single hazard (wind) impact on single asset class (residential building)

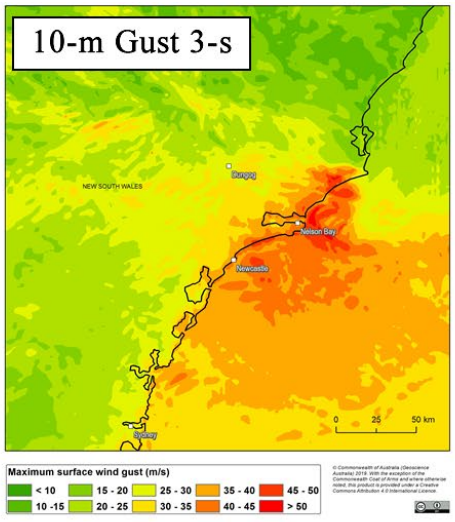
GROUND TRUTH DATASET #2: SES CALLOUTS

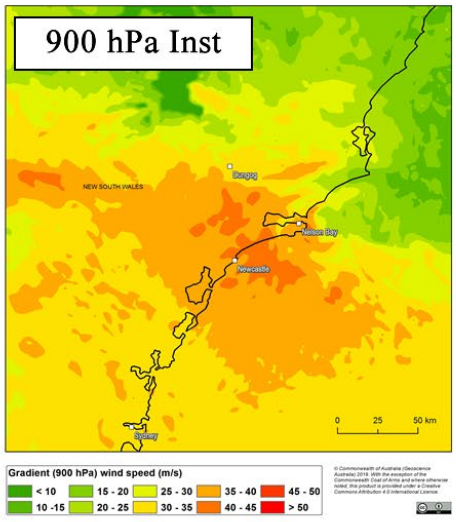


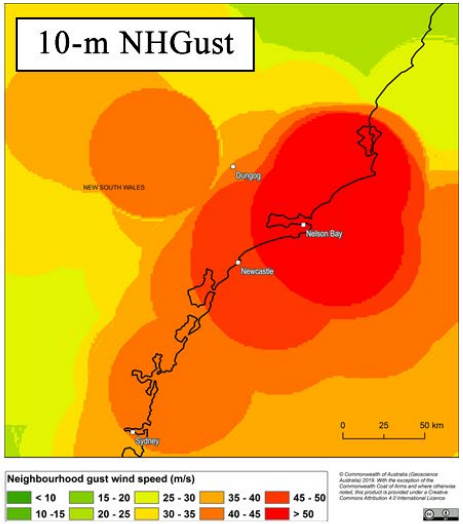
Challenge 3: Sensitivity of impacts to its components – e.g. D(impact)/D(hazard)

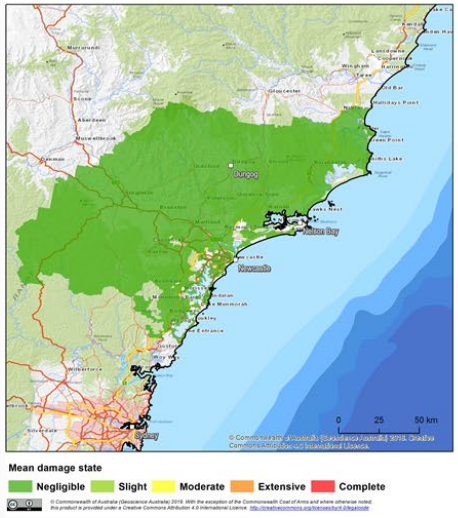
The Choice of most suitable wind impact proxy

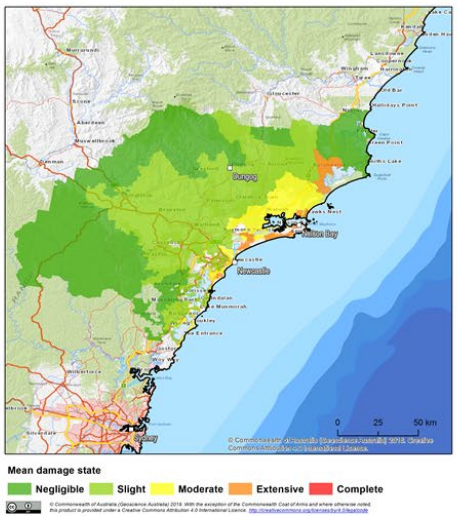


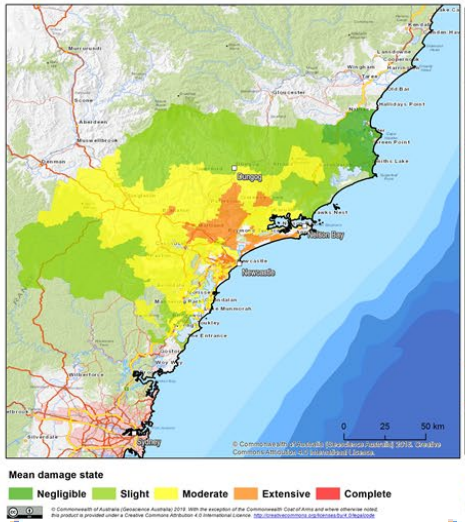


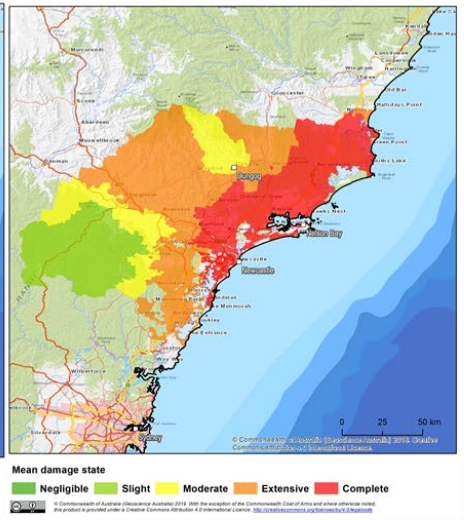










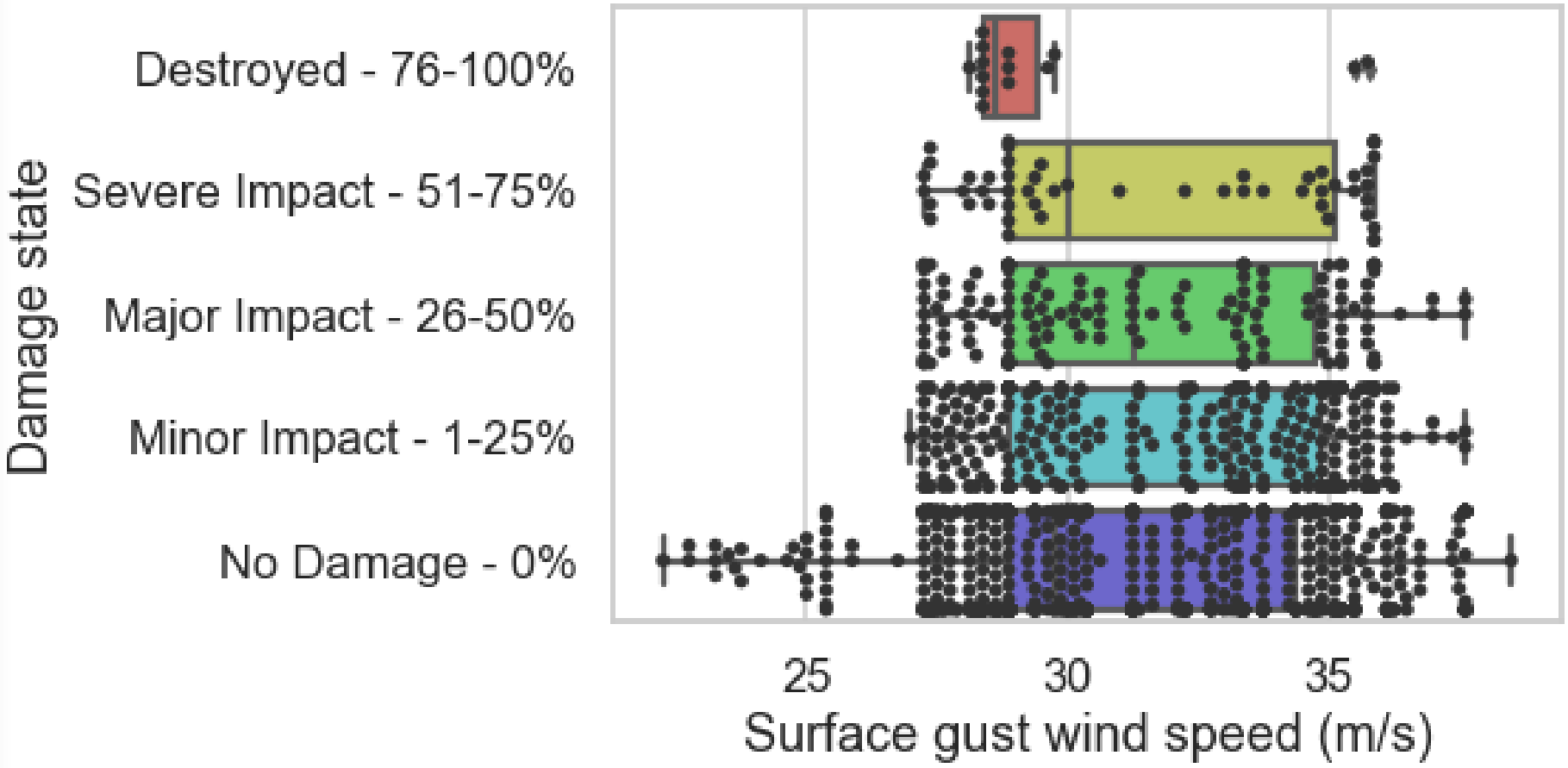


$$U_{gust} = U_{10m} + \sigma_u \frac{1}{k} \log \left(\frac{5\, e^{k\, c_{ugn}} + z_{0m(eff)}}{5 + z_{0m(eff)}} \right)$$

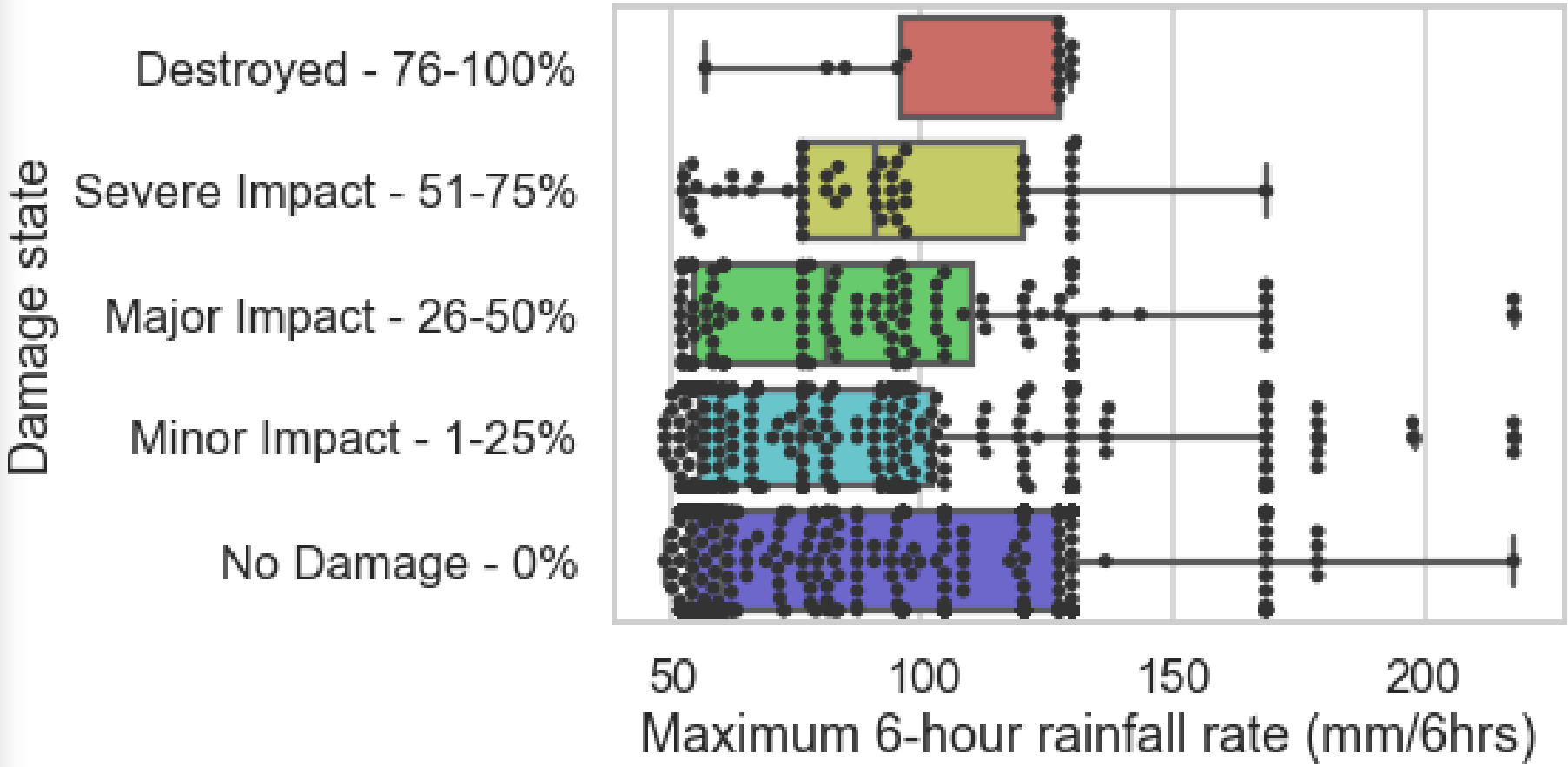
Our scary equation

Challenge 4:
"Impact" is almost always due to multiple hazards

RELATIONSHIP OF SINGLE HAZARD TO DAMAGE (WIND) – NOT GREAT



RELATIONSHIP OF SINGLE HAZARD TO DAMAGE (RAIN) – ALSO NOT GREAT



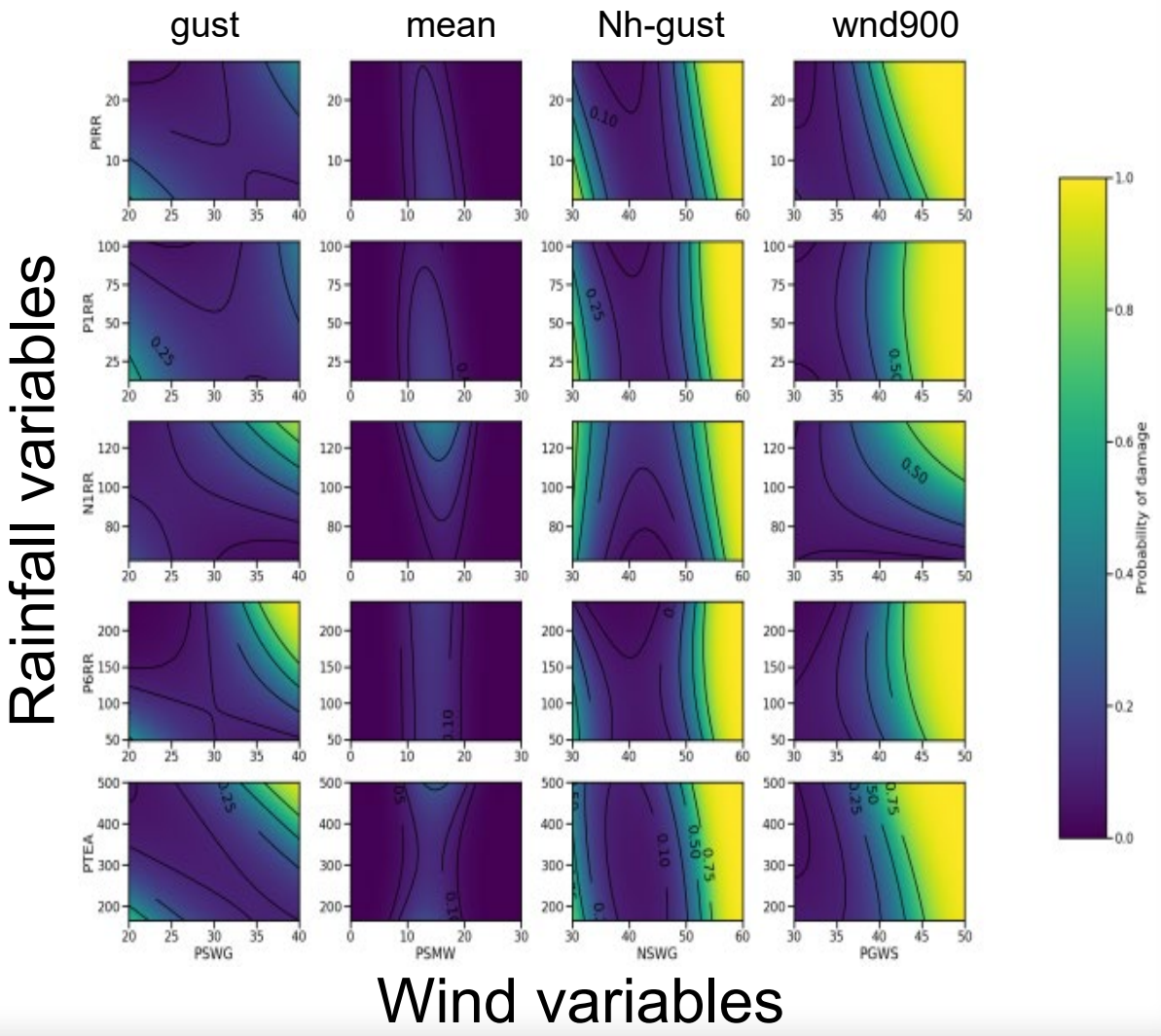
SEEKING A COMBINED PREDICTOR: QDA

1) Prob(damage) as function of 5 rain and 4 wind predictors

1) Mean surface wind has no predictive skill

2) Surface wind gust and gradient wind speed have some skill (yet to be quantified)

3) Rainfall variables are less influential



WE SHALL CONCLUDE WITH A WISHLIST

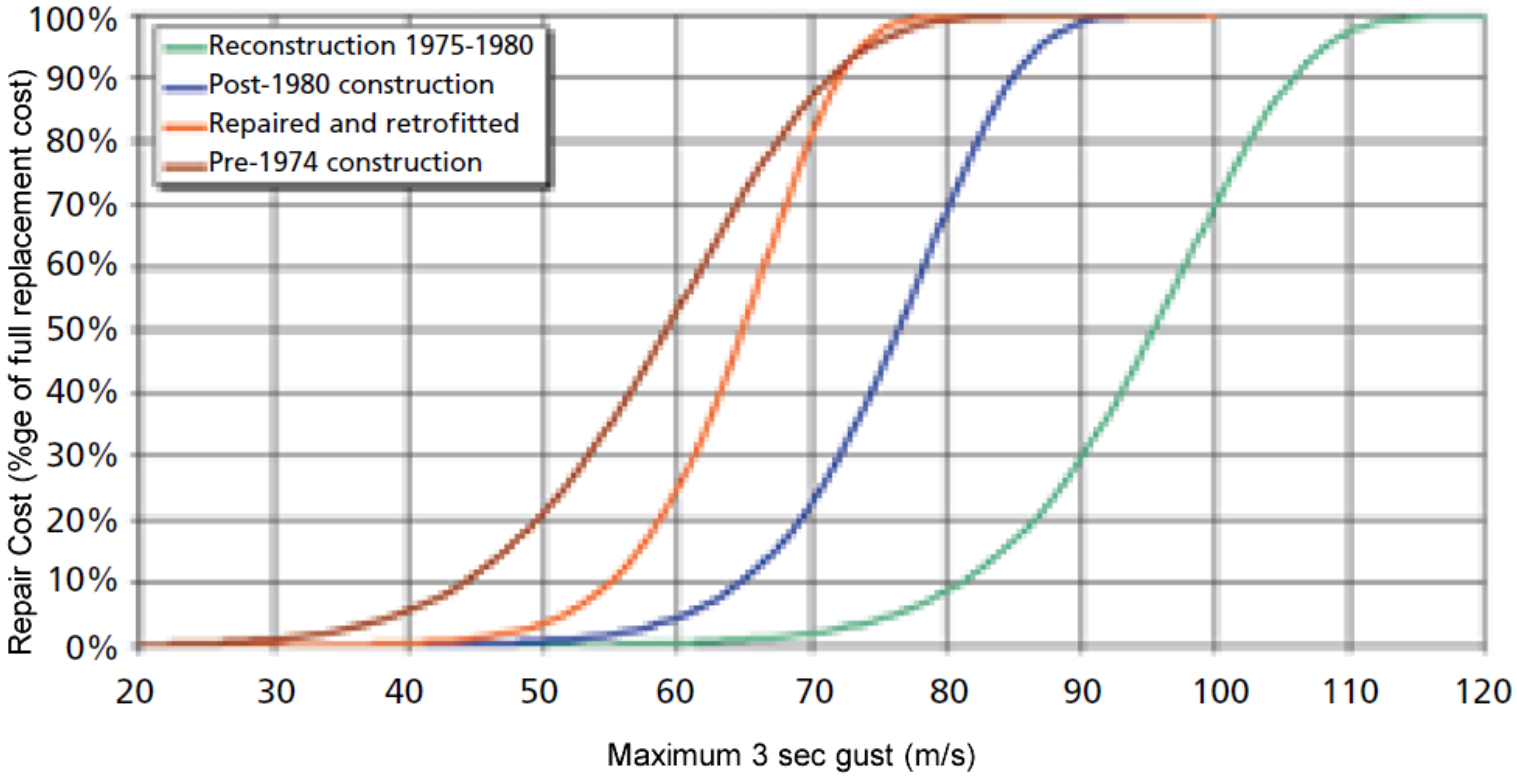
1) EICU Damage Data with better coverage

2) SES Callout Data to include hazard and level of damage

3) Survey of exposure data in those locations that current require statistical inference in NEXIS

4) Many larger-scale wind & rain cases needed to derive data-based vulnerability relations

VULNERABILITY ASSESSMENT LINKS LOCAL WIND GUSTS TO DAMAGE



Vulnerability of houses varies with age (on average)

- A Tracy peak gust of ~70 m s^{-1} (250 km hr^{-1}) almost destroys a pre-1974 house
- A post-1980 house would only suffer ~25% damage