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FINDINGS

A better understanding of the built environment can **improve forecasts of wind impact** on residential buildings.

Impact-based forecasting for the coastal zone: East Coast Lows

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Preliminary evidence shows that a prototype residential wind impact forecast, based on the 10-m wind gust from an NWP model and available vulnerability and exposure data, outperforms a wind-based implementation of warning criteria currently used by the Bureau of Meteorology.

Introduction

This project presents a pilot study predicting the **impact of extreme wind** on residential buildings in Australia. The aim is to improve mitigating actions by a range of stakeholders, including emergency services. As part of the project we developed and verified prototype **wind impact forecasts** for the **April 2015 East Coast Low (ECL)**. This event brought significant damage to parts of NSW near Newcastle including the loss of three lives in the town of Dungog.

Methods

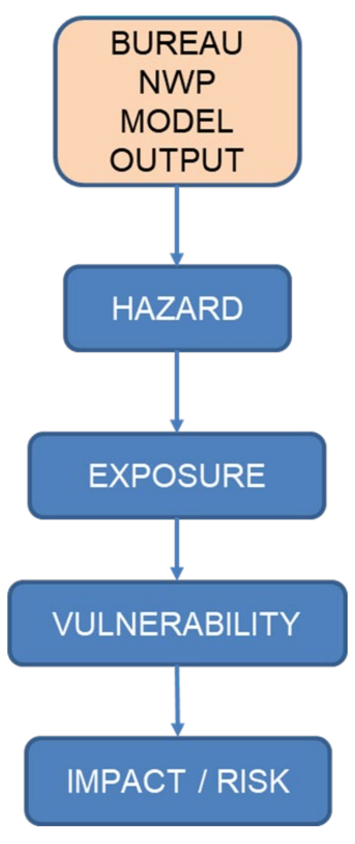

Figure1: Impact forecast workflow

We tested four **wind impact forecasts** based on differing measures of the wind strength from the BARRA-SY reanalysis. These are the event maxima of the surface mean wind, the surface wind gusts, the 900hPa wind and the max. gust within 40 km of a point.

The impact is determined via Figure 1, using residential building exposure data from the **National Exposure Information System (NEXIS)** and idealised heuristic vulnerability curves.

The forecast is expressed as a mean structural loss ratio which we convert to a mean damage state for each SA1 area in three categories: nil, minor and major (Figure 2).

To verify the forecast performance we use Rapid Damage Assessment (RDA) data from the **NSW Emergency Information Coordination Unit (EICU).**

The EICU data records the damage to a building in 5 categories; 1: 'no damage', 2: 'minor', 3: 'major', 4: 'severe' and 5: 'destroyed'.

To compare to the forecasts, observations are filtered to remove damage not due to wind, averaged over SA1 areas, then converted to 3 categories by combining states 2&3 (minor) and 4&5 (major) in the EICU data, shown in figure 2.

We also define a 3-category **reference forecast** which derives the damage state using wind gust warning criteria: nil < 90 km/h; minor: ≥ 90 km/h (**damaging**); major: ≥ 120 km/h (**destructive**). The reference forecast (also shown in figure 2) uses no exposure or vulnerability information.

Results

For predicting wind impact, the **surface wind gust** performed better than the other measures of wind strength. It has an accuracy of 61% which, after optimisation of the damage category thresholds, improves to 66%. Both **outperform the reference forecast** which has an accuracy of only 35%, illustrating that vulnerability and exposure data can add value. The results for the calibrated and reference forecast are compared with observations in Table 1 and Figure 3.

Discussion

The gust impact forecast shows promise at identifying residential areas most impacted by wind. More detailed damage data is needed to improve confidence in performance and further develop the forecasts. We suggest that future **damage reports collect information related to the causative hazard and damage magnitude** to assist quantitative impact forecast development.

For more information, please email harald.richter@bom.gov.au

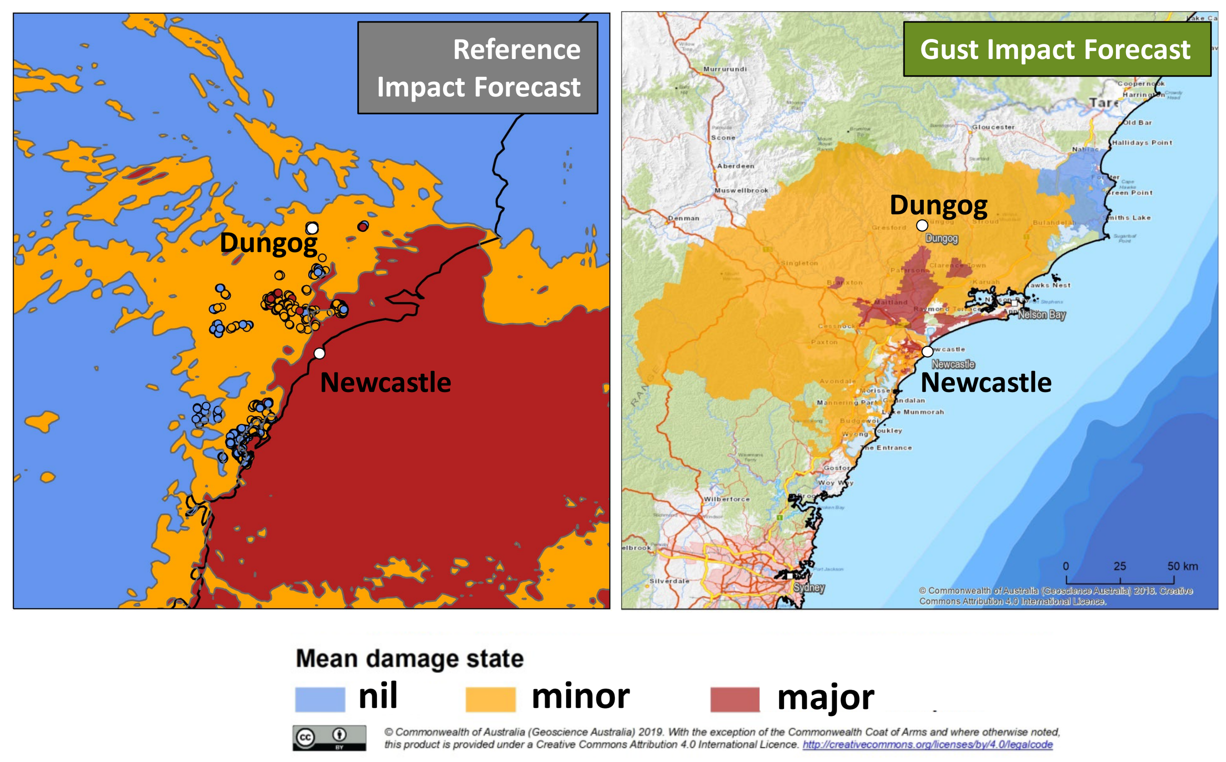

Figure 2: Impact forecasts for the April 2015 ECL. Left; the reference impact forecast based on the event maximum wind gust from BARRA-SY with re-categorised EICU observations overlayed, right; the corresponding SA1 residential gust impact forecast.

Reference

Forecast \ Observed	nil	minor	major
nil	2	0	0
minor	20	27	2
major	11	20	0

Gust Impact

Forecast \ Observed	nil	minor	major
nil	11	3	0
minor	21	43	2
major	1	1	0

Table 1: Contingency tables for the reference and calibrated gust impact forecast/observation pairs. The reference forecast has a significant over-forecast bias with 20 SA1 areas forecast in the major damage state but observed with minor damage, shown in red.

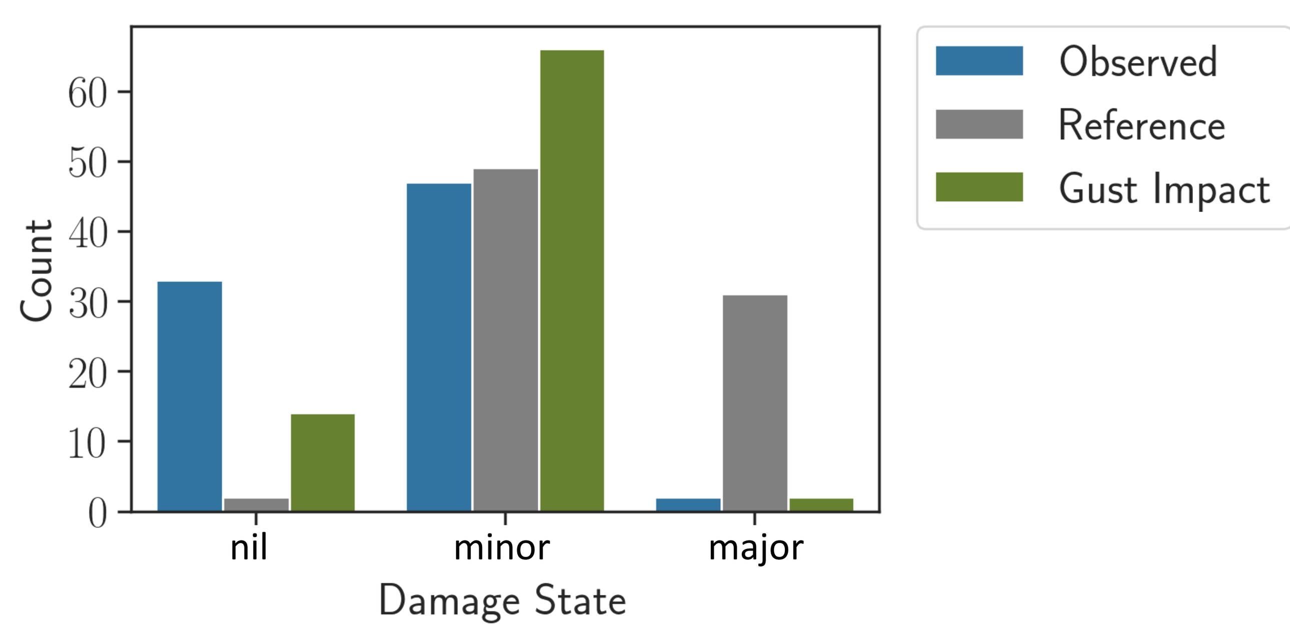

Figure 3: A histogram showing the three-category distribution of observed damage categories, predicted damage categories based on calibrated gusts and the reference impact forecast based on BoM warning criteria.

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