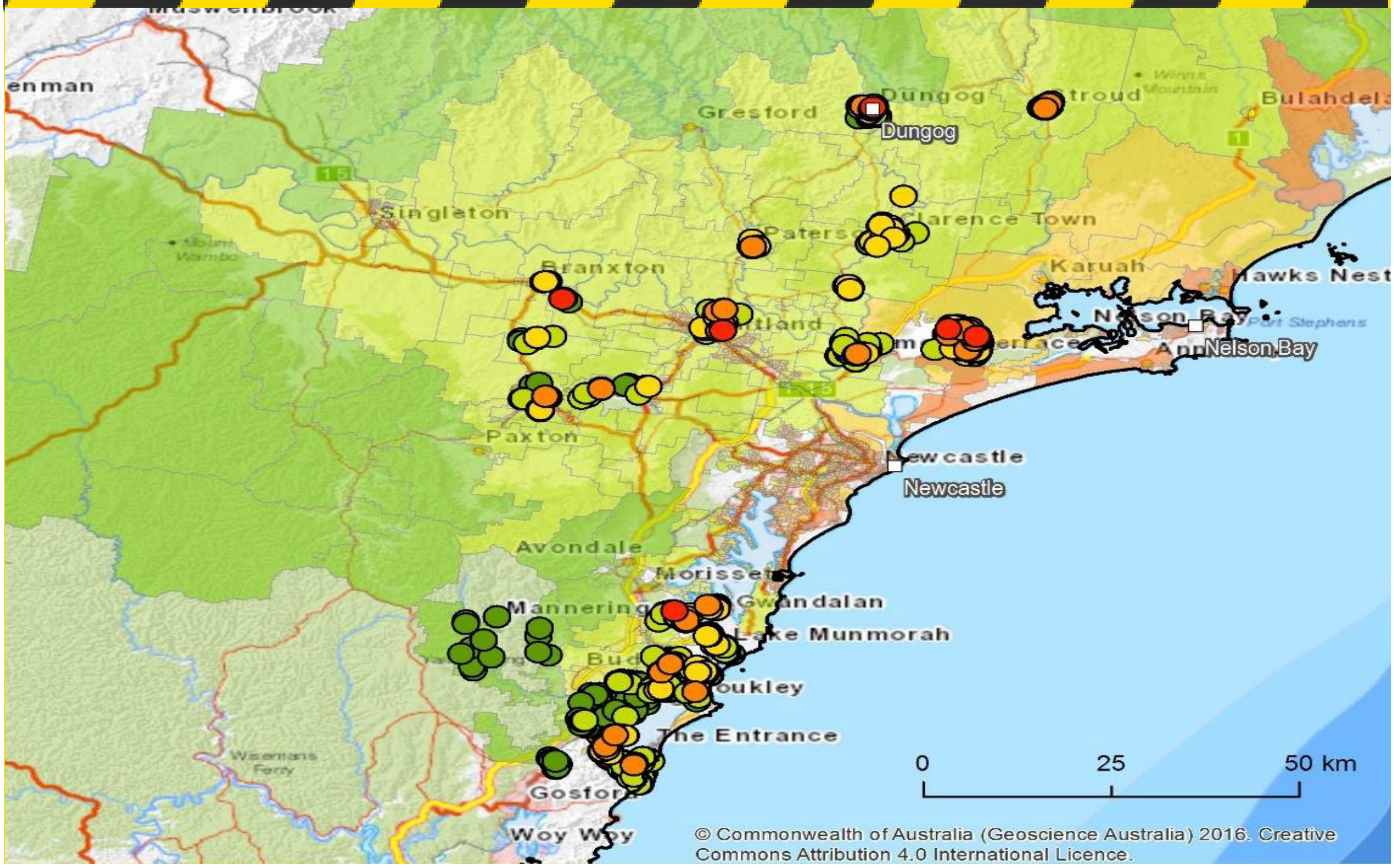
bnhcrc.com.au

REPORT ON THE SECOND END-USER WORKSHOP – 25 AND 27 AUGUST 2020

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

Harald Richter[1], Craig Arthur[2], David Wilke[1], Mark Dunford[2], Martin Wehner[2] and Beth Ebert[1]
1 Bureau of Meteorology, 2 Geoscience Australia



Australian Government
Bureau of Meteorology

Australian Government
Geoscience Australia

Version	Release history	Date
1.0	Initial release of document	15/01/2021

Publisher:
Bushfire and Natural Hazards CRC

January 2021

Citation: Richter H, Arthur C, Wilke D, Dunford M, Wehner M & Ebert B (2021) Report on the second end-user workshop: 25 and 27 August 2020 – Impact-baed forecasting for the coastal zone: East Coast Lows, Bushfire and Natural Hazards CRC, Melbourne.

Cover: East Coast Low. Source: Geoscience Australia

TABLE OF CONTENTS

ACKNOWLEDGMENTS

The project team would like to thank all participants in the End-User workshop for their time and contributions to the discussion across the two days of the workshop, and other contributions through the course of the project.

END-USER WORKSHOP

A virtual End-User Workshop was held on 25 and 27 August 2020 to present key outcomes of the *Impact-based forecasting for the coastal zone: East Coast Lows* project. This was the second end-user workshop for the project, and focused on four key themes:

1. Verification of impact forecasts
2. Demonstrating evolution of impact forecasts
3. Identifying needs to deliver and support future impact forecast products
4. Future utilisation opportunities.

We invited participants from emergency services agencies in Queensland, NSW, Victoria, South Australia and Western Australia, along with Emergency Management Australia (EMA). Also participating were a number of Bureau of Meteorology (BoM) officers who are embedded within the respective State Operations Centres in several states. A full list is provided at the end of this report.

AGENDA

Day 1

Introductions and project background (15 minutes)

Demonstration of the verification process (45 minutes)

Demonstration of multiple lead time impact forecasts (30 minutes)

Q&A session (30 minutes)

Day 2

Guidance material to support impact forecast products (30 minutes)

Delivery methods (30 minutes)

Utilisation project (30 minutes)

VERIFICATION PROCESS

David Wilke (BoM) provided a presentation on the verification work undertaken for the April 2015 East Coast Low. The aim is to evaluate how well the impact forecast performs, in turn looking at how much value the integration of exposure and vulnerability information adds compared to a simple wind hazard forecast.

Verification requires data from the response agencies in the form of Rapid Damage Assessment (RDA) and/or Requests For Assistance (RFA).

The event was a complex, multi-hazard event, with impacts arising from wind, rain ingress and flooding, as well as intermediary actions (such as tree fall). There was a significant volume of RDA data collected by the Emergency Information Coordination Unit (EICU, NSW) for individual houses. We were also provided with RFA data from NSW SES. For the verification process, we focused on the EICU RDA data, as it included categorical damage estimates, as well as a description on the source (underlying hazard) of damage (e.g. wind, flood, etc.). The RFA data covered a wider range of assets including powerlines and poles down, vehicle damage, injured animals all of which are not included in our forecast products.

David presented four different wind parameterisations derived from the BARRA-SY reanalysis in order to find that near-surface wind variable that verifies best using the RDA data. Alongside the reanalsysis-based wind predictors, a Basic Wind Impact Forecast (BWIF) was also evaluated. The BWIF uses only wind information from BARRA-SY, and produces the three categories of no damage (10-m wind gusts < 90 km hr^{-1}), damaging winds (gusts > 90 km hr^{-1}), and destructive winds (gusts > 120 km hr^{-1}). The inclusion of the BWIF allowed a comparison of our more sophisticated impact forecast with a simplistic wind-only reference forecast.

Our forecast product, which integrates the wind speed (hazard) with exposure and building vulnerability curves, defines 5 categories of damage state – negligible, slight, moderate, extensive and complete. These were grouped to three classes to enable a more direct comparison to the reference forecast. How our forecast performs compared to the reference forecast provides insight into the value added by including knowledge of the exposed assets and their vulnerability.

Using contingency tables, David demonstrated a number of measures of skill of the impact forecasts (Table 1). The four near-surface wind predictors are: Point Surface Wind Gust (PSWG), a 3-second 10-m wind gust; Point Surface Mean Wind (10-m mean wind; an average over 10-30 minutes); Point Gradient Wind Speed (PGWS), the wind speed around 1-km above the ground; and the Neighbourhood Surface Wind Gust (NSWG), which looks for the maximum 10-m wind gust within 40 km of a point.

Metric	PSWG	PSMW	PGWS	NSWG	BWIF
Proportion correct	0.61	0.40	0.57	0.037	0.35
Heidke Skill Score	0.099	0	0	-0.0083	-0.012
Gerrity score	0.045	0	0	0.019	-0.16

TABLE 1: VERIFICATION SCORES FOR THE HAZARD PARAMTERS (PSWF, PSMW, PGWS AND NSWG) AND THE REFERENCE IMPACT FORECAST (BWIF)

Matthew Hayne asked if the damage data collected after Tropical Cyclone (TC) events over the last several years could be used for further verification. Presently there is no BARRA data available for the tropical regions that provides a comparable high-resolution input to the BARRA-SY data used in this analysis (see http://www.bom.gov.au/research/projects/reanalysis/ for an outline of the BARRA system). While those damage surveys have been used to guide the ongoing development of building vulnerability functions, the source of hazard data informing that development is from different modelling systems.

Roger Mentha noted that impact assessment has improved markedly over the last 2 years of the project, which may prove valuable for future verification efforts.

Dianne Gordon asked about the potential for using insurance data to support verification. While there is excellent coverage of claims data, this usually does not disaggregate structural and non-structural impacts. It is often reported as event totals as well, making comparison with structural loss ratios challenging. However, we continue to engage with insurance groups to understand impacts.

DEMONSTRATING MULTIPLE FORECAST LEAD TIMES

Craig Arthur (GA) presented a series of impact forecasts for the Perth region linked to a major cold front in late May 2020. The event involved a decaying tropical cyclone (TC Mangga) interacting with a strong cold front approaching southwest Western Australia. A very dynamic and challenging pattern, the numerical model forecast evolved dramatically in the lead up to the event, with forecasts two to three days out indicating potential for wind gusts in excess of 150 km/h over the region. The event was substantially less significant than the model forecasts indicated, with a maximum recorded gust in Perth of 90 km/h and 132 km/h at Cape Leeuwin.

This event emphasised the evolution of the impact forecast due to its sensitive dependence on the weather forecast information as a dynamic component of the forecast through time (the exposure and vulnerability components remain static). This example highlights that meteorologically challenging forecast situations, such as TCs interacting with cold fronts, can lead to significant variations in wind impact forecasts from model run to model run, even at very short (< 24 hours) lead times.

DELIVERY MECHANISMS

There was a consensus that the demonstrated granularity of impact forecast data (Statistical Area Level 1 or SA1) was appropriate for both internal use and community messaging. Dianne Gordon, Matt Chesnais and Steve Gray all articulated a preference for both 3-level and 5-level potential damage categorization to support community messaging and internal response, recovery and preparedness activities, respectively. Fiona O'Loghlin raised concerns over the granularity of SA1 regions outside of metropolitan areas, especially when considering the implications for evacuation and resource allocation.

The raw data could readily be ingested into existing GIS-based analysis and awareness platforms, through channels such as web feature services, or direct download from cloud platforms.

QFES indicated a desire to receive pre-formatted maps.

SUPPORTING MATERIALS

There was vocal support for the idea of embedding human expertise within operations centres, akin to the current arrangements with BoM meteorologists in many states, to aid the interpretation of impact-based forecast information. Fiona and Matt pointed out that user guides are also valuable, but do not replace an on-site human expert.

OUTCOMES

Verification

Collection and curation of RDA and RFA data will be an integral part of (quantitative) impact-based forecasting as we move into the future to enable ongoing verification and improvement in the underlying model components.

Current wind impact verification performance is not a roadblock for response agencies to integrate such forecasts into their operations. While there remains a level of uncertainty in the precision of the impact forecast products, all agencies agreed this would be an added valuable piece of intelligence and response agencies are willing to take the associated uncertainty into consideration when using impact forecasting products. However, verification will be essential to build confidence in the products, both within response agencies and more generally the public.

Forecast lead times

Users will want as much lead time as possible to inform resourcing and planning decision, but a 24-48 hour lead time will be most effective from an operational preparedness viewpoint. Longer lead times, albeit with lower confidence would also be invaluable – e.g. in the case a mass evacuation is required, a lead time of 1-2 days is inadequate. Beth Ebert (Bureau) indicated that such longer lead time forecasts are not produced by the high-resolution models employed in this project, but that such longer range forecast would still be of potential use.

12-hour increments of impacts can help guide rostering for imminent events (as operations are run on 12-hour shift cycles).

Supporting information

Response agencies emphasised the need to have access to subject matter expertise in the lead up to and during major weather events to support interpretation of any impact forecast products. This extends beyond the current meteorological support arrangements with BoM.

Training guides and/or programs to induct staff working in operations centres would be valuable to provide background information on the products.

Delivery mechanisms

Delivery by existing web services (e.g. WMS and WFS)

Users will want access to a range of metrics from the impact forecasting system to inform different decisions and actions within operational contexts. For example, alignment with the national warnings framework. Development of these metrics will be integrated into future development of the impact processing software.

Additional topics discussed

Roger Mentha noted that essential infrastructure remains a significant priority for emergengy management authorities. Brian Foo related the experience during the 2019/20 summer bushfires where departmental leads with responsibility for essential infrastructure were embedded in the Crisis Coordination Centre to provide advice on the status of communications and electricity assets, and the status of those assets (power, communications including internet access, water) were frequently raised in briefings at the Commonwealth level. Roger also noted that presently Fire and Rescue NSW (FRNSW) are putting their staff at risk to protect essential infrastructure assets. Matthew Chesnais set out the approach taken with Powerlink in Queensland, where the asset operator is provided with appropriate hazard information so they can run impact models internally, then communicate the outcomes back to the emergency management agency. Roger noted the interconnection of (for example) power and communications networks that cross jurisdictional borders, which might not allow a single essential infrastructure owner / operator to comprehensively undertake such internal modelling.

The information provided by the end user group on the ideal future state of impact-based forecasting capability was very valuable.

PARTICIPANTS

Project team members

Harald Richter, Bureau of Meteorology

Craig Arthur, Geoscience Australia

David Wilke, Bureau of Meteorology

Mark Dunford, Geoscience Australia

Martin Wehner, Geoscience Australia

Beth Ebert, Bureau of Meteorolgy

Workshop participants

Roger Mentha, Fire and Rescue NSW (Lead End User)

Steven Hayes, Fire and Rescue NSW

Brian Foo, Emergency Management Australia

Matthew Chesnais, Queensland Fire and Emergency Services

Peter Readman, Queensland Fire and Emergency Services

Justin Whitney, Department of Fire and Emergency Services, WA

Mark Williams, Department of Fire and Emergency Services, WA

Stephen Gray, Department of Fire and Emergency Services, WA

Dianne Gordon, NSW SES

Allison Flaxman, NSW SES

Heather Stewart, NSW SES

Graeme Wynwood, SA SES

Fiona O'Loghlin, VIC SES

Simon Louis, BoM (TAS)

Francois Geoffrey, BoM (NSW)

Jane Golding, BoM (NSW)

Bimal KC, BoM (NSW)

Matthew Hayne, BNHCRC Utilisation Manager