New approaches to warning: the role of radar

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Today

- The risk we want to reduce, and how much impact can we have on the risk of disasters?

- Assessing risk reduction - actual versus potential improvements. The actual versus potential improvements. One challenge is to show that there is a significant improvement;

- Radar data is used for a wide range of indirect risk reduction activity;

- It is also used for direct risk reduction, mainly through warnings systems;

- The focus could be on areas where time is very tight and it is here that major benefits could be found, eg for tornadoes, and flash floods;

- Rapid dissemination is a problem - an illustration from tsunami warnings shows a new development in transmitting warnings

- Radar on the net auto searched for local implications and then delivered to phones – ie outside the official system.
The components of risk (IPCC – SREX 2012)
RISK ~ Hazard + Exposure + Vulnerability
EXPOSURE GROWTH – development in high hazard areas
A fire resistant roof would greatly reduce vulnerability to bushfire
“Houses built to strict new regulatory standards introduced after the devastation of Black Saturday fared worse than older houses ... a CSIRO report has found.”
“Of seven houses built to the tougher regulations introduced in 2011, four were lost to fire and three survived, the study found.
“The 14 houses built to planning and building regulatory standards between 2003 and 2010 fared much better; three were lost to fire and eleven survived,” the report said.

116 houses lost BUT THE FDI WAS LESS THAN 50! The houses are designed for 100!
Weather and climate - Exceptional heat (and drying) is becoming more frequent

Number of days when the national temperature was in the hottest (99th) percentile

Source: Bureau of Meteorology
The Fire Danger Rating Scale

The hazard
Bushfires and radar
Indirect risk reduction

Radar helps our understanding of the hazard, and can reduce vulnerability through improved predictions – some examples:

• Weather radar - Smoke detection
• 3D radar - understanding smoke plume behaviour
• Synthetic aperture radar – able to map fire and smoke in all conditions.
• Lidar assessment of fuel load.
Showing improvement

When we say improvements we are referring to outcomes in terms of better safety and reduced loss.

It is orthodoxy among most warning system researchers that these outcomes provide are the justification for warnings.

This might be seen as unreasonable as agencies can hardly be held responsible for people’s behaviour.

Technological improvements are frequent, but their impact can be small because attractive as they are, they might offer incremental benefits or fail to address a major problem.

Assessment should be with and without whatever is being assessed, not before and after. (Often justified by other uses.)
Direct impact of radar - warning systems

Flash flooding and radar – flash flood warnings are lacking. Centralised systems have generally failed to assist those at risk of flash floods. Some rainfall gauge systems, but limited.

Tornadoes and radar (see below)

Bushfires – detecting and mapping the fire in all conditions.
Fire warnings - today

- Most people expect to be warned if they are threatened by bushfire and do not plan for the absence of official warning.
- These expectations exist despite long advice that people should not rely upon an official warning. However, this message is not always communicated clearly by agencies, and expectations may be increasing due to the use of new technologies.
- In Black Saturday about 10% had a personal warning from an official source.
- Now it is more like 80% via texts.
- Expectations about the content of warnings, the media used and the messages conveyed vary greatly between those who issue and those who receive warnings.
The usual warning system: an official message, one-way supply of information, assumed uniform audience.

Agency Centred - information always flows from the agency to those at risk.

From:
SOURCE - Prediction (warning) Agency supplying information

To:
AUDIENCE – (some of) Those at risk

Models often include provision for some “feedback”, but usually ignore non-official or “informal” activity.

An issue is that historically most people did not receive warnings in time to take action, or didn’t think they applied to them.
Example of Tornado warnings: Radar has been key
Tornadoes

Approximate warning lead time with radar:
• 3+minutes at the end of the 1980s (radar at night)
• 15 minutes today
• One hour within ten years

One hour of warning would likely save many lives – given an effective delivery and response.

The challenge is communicating the information.
Example of very short lead times, and a different approach to message delivery

Tsunami warning includes Hawaii
The Pacific warning center urges swift action to protect lives and property.

A tsunami carries boats across waters in Kamaishi city port in this still image taken from video footage. (Reuters / March 11, 2011)
Japanese – QZSS (satellite system) Promises very rapid dissemination directly to those at risk.
Combined Use of GPS and International Systems

- Many nations are developing GPS augmentations and/or independent satellite navigation systems
  - Europe (Galileo, EGNOS), Russia (Glonass, SDCM), China (Compass), Japan (QZSS, MSAS), India (IRNSS, GAGAN)

- USG is consulting with all of them to promote GPS compatibility and interoperability
  - Ideally, this will allow seamless, combined use of multiple systems for improved performance
  - Future users will want to use all available systems, driving new equipment sales and applications – significant commercial opportunities, BUT:

- Must maintain level playing field in global marketplace
  - Equal access to signals, information, and user markets
  - No mandated use of one system over another
The normal view of the warning “system” – a one way flow

The public are seen as information deficient. The warning supplies “what they need to know” from an agency perspective. Warning systems are typically conceptualized as a more or less linear flow of information from the forecasting agency to an amorphous public.
A networked approach
multiple flows

- **Centred on those at risk** *(not on the agency)* – needs, priorities, expectations, capacities;
- **Multiple sources and audiences** which may be global *(not a single audience or source)*
- **Networks communicating** *(rather than linear flow)*
- **Accepts crowdsourced information**
- **Demands for information** *(not simply supply)*
- **Competing messages** and priorities *(warning one of many messages)*
- **Negotiated outcomes** *(not just following orders)*
An unofficial system?

- Radar and Lidar images/data are increasingly available online in real time;
- Could these be automatically searched or interpreted continuously for intense rain, precise fire location and direction, or wind (as examples)? (Similar to some aviation applications);
- A successful search could trigger a message to people within an at risk area – this could be sent by a range of methods including QZSS, and integrated with e.g. street view;
- But delivery could be via the informal method of social media – it seems faster. Formal methods would use CAP.
Conclusion

• Radar is used for a wide variety of function in hazard and disaster risk reduction;

• A question is whether the use of a technology translates into improvements in outcome, and whether they can be valued;

• Radar use for very rapid onset hazards provides, or should provide, definite benefits which can be valued (flash floods, fire & smoke, etc);

• An emerging approach combines freely available radar images with social media and other methods for rapid targeted warnings;

• A key issue is effective dissemination.
WARNING

LIGHT UP
A CIGARETTE NOW
AND YOU WILL
QUIT FOREVER...

Serious about service TOTAL
However...

People seek and receive information from many sources including their own observations, their personal networks as well as an increasingly diverse range of media. These sources in turn communicate with each other. Networks and media are increasingly global.

This is facilitated by social media, with information flows in every direction (eg twitter and NSW RFS).
To do this warnings

• Must achieve shared meaning between those providing and interpreting the warning;
• are negotiated with competing messages and priorities – in a “zone” of competition, interpretation and filtering. The zone exists in people’s minds;
• Need to convey or deal with the uncertainty;
• Need to harness the informal and local knowledge