

Social Media Monitoring In Disasters and Emergencies

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NATIONAL SECURITY TECHNOLOGY PARTNERSHIPS
www.csiro.au



Real world context for our research

- Victorian bushfires, February 2009, 173 people killed; more than 1800 homes destroyed; \$4.3Billion losses



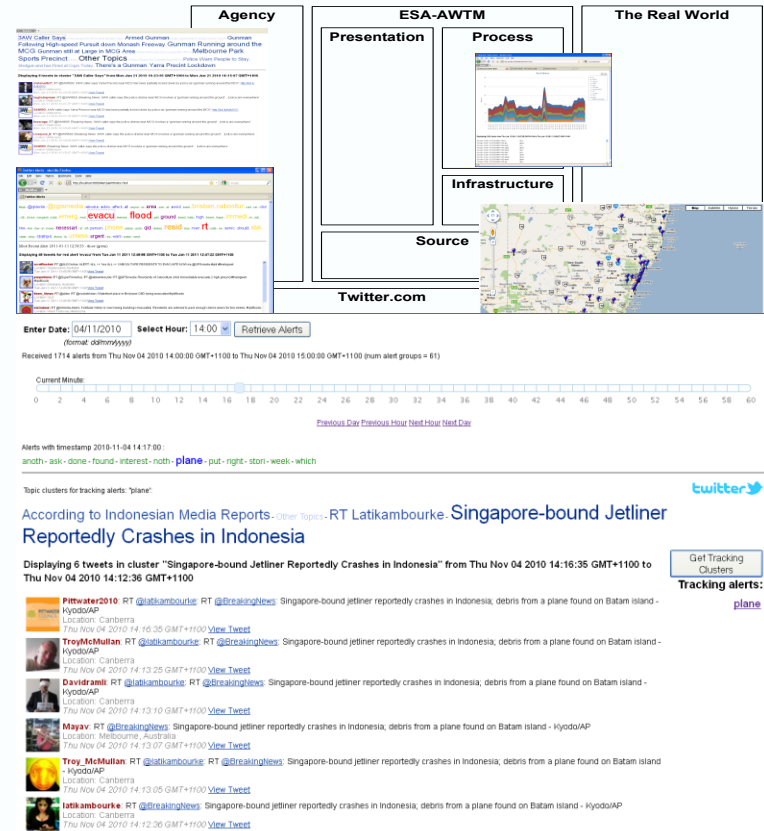
Emergency Situation Awareness from Automated Web Text Mining

Context: Victorian bushfire situation information reported in real-time on social networks, but not easily consumable by crisis coordinators

Problem: Crisis coordinators need tools to manage the Tweet deluge:

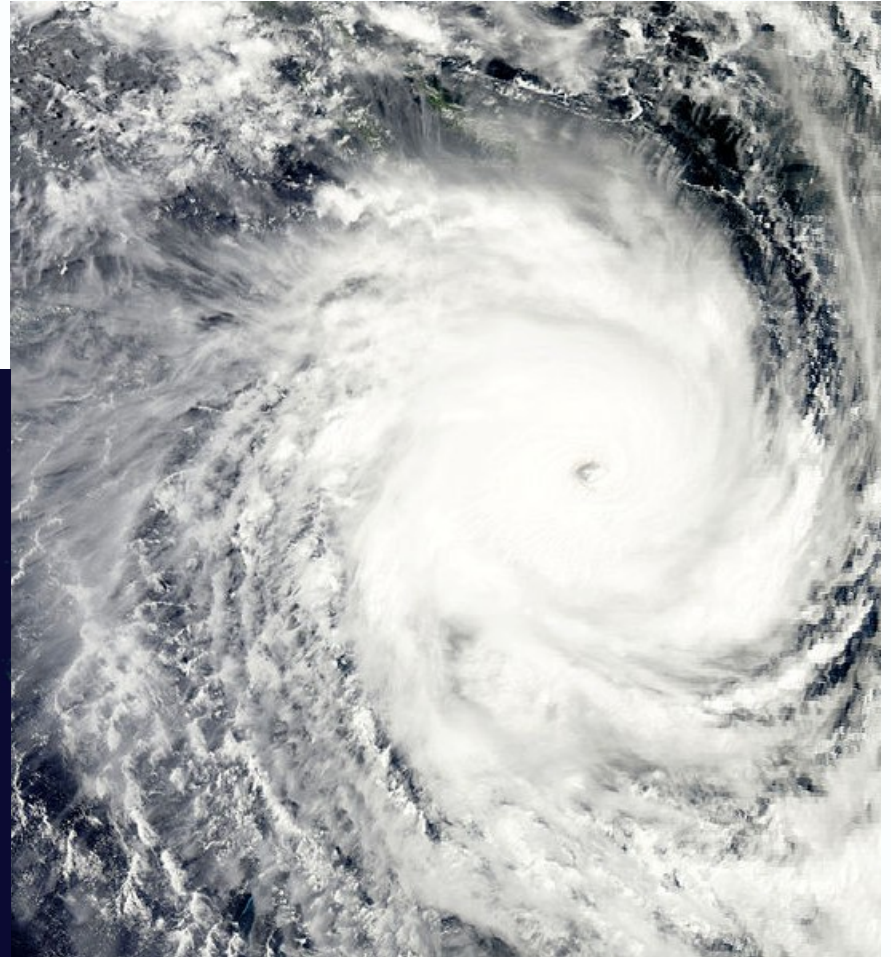
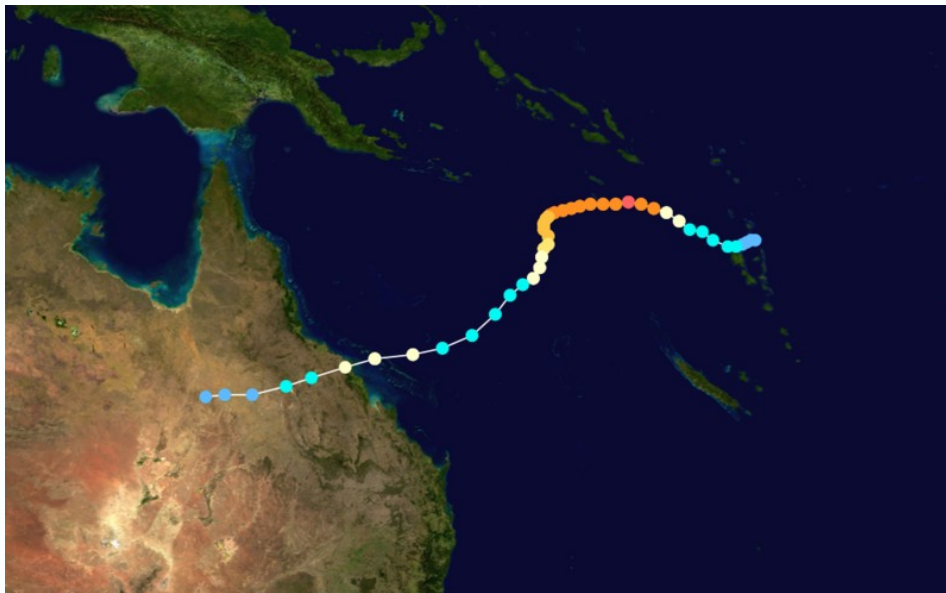
- **capture , analyse & display** data near real time
- **detecting and alerting** on events of interest
- **condensing and summarising** content to reduce watch officer load
- **classify and review high-value messages** enabling officers to quickly understand impact of real-world events on people and infrastructure
- **focus and track issues** as they arise, evolve and decay over time
- perform **forensic analysis** of incidents

Solution: We are building services to collect, detect, assess, simplify and report situation information in near-real-time from Twitter text streams



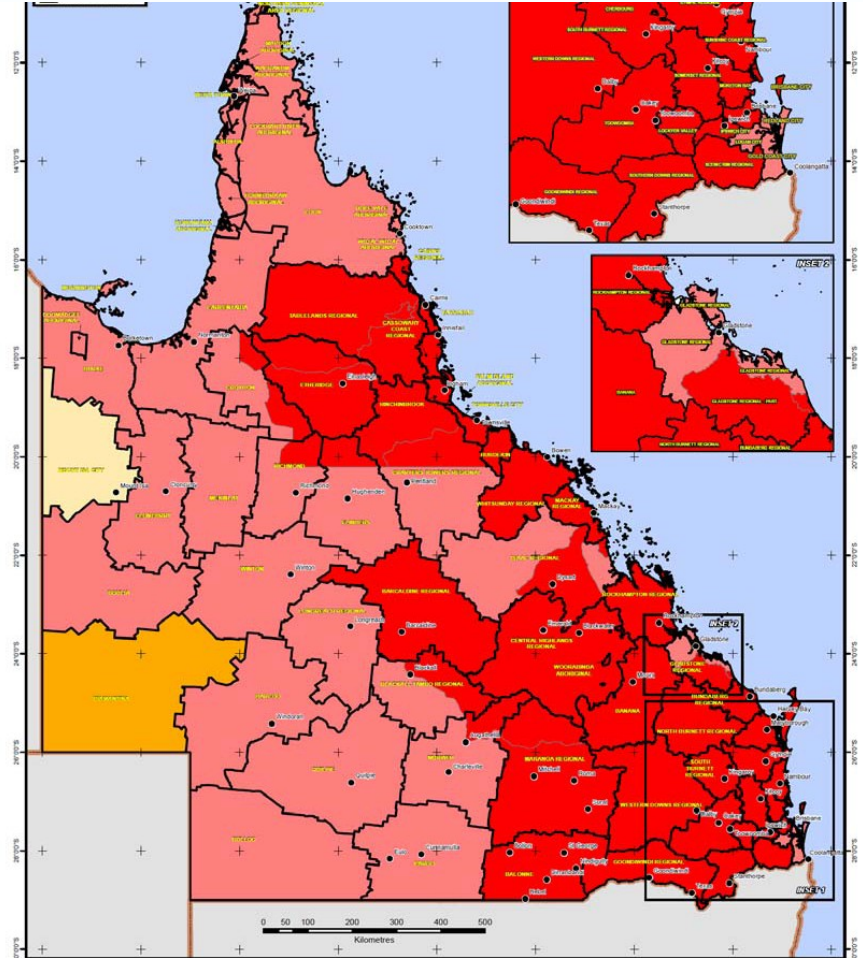
Real world context for our research

- Cyclone Ului;
St George Floods March 2010;

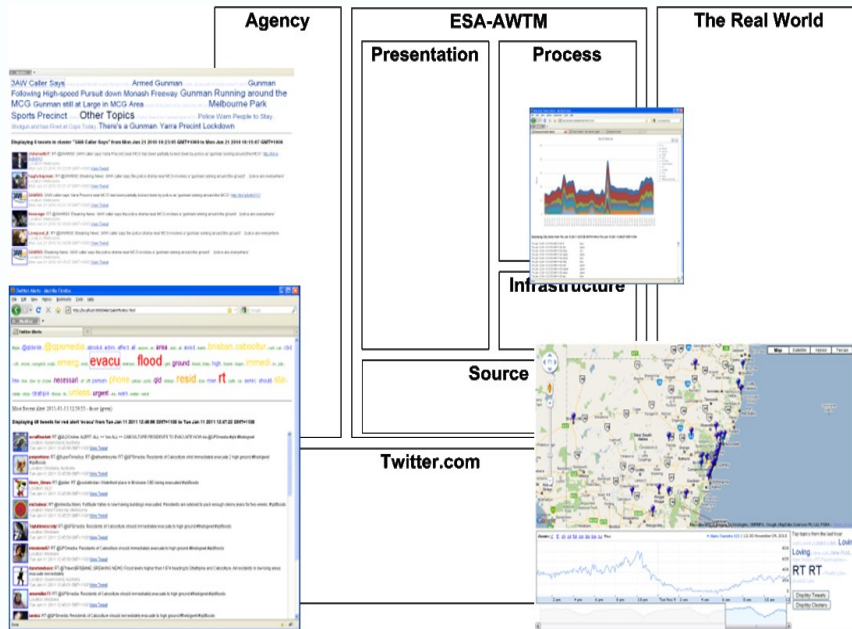


Real world context for our research

- Queensland's summer of sorrow:
 - Tropical Cyclones Tasha & Anthony November 2010-February 2011;
 - Lockyer Valley Flash Flood January 2011 (22 lives);
 - Brisbane Flood January 2011;
 - Severe Tropical Cyclone Yasi February 2011;
 - \$3.71 Billion



Emergency Situation Awareness



Provide near real-time situation awareness from social-media text streams for crisis coordinators

We do this by:

- collecting and analysing real time Twitter feeds
- detecting and alerting on unusual activity
- clustering and condensing message content

Research goals are:

- develop and evaluate new burst detection schemes
- develop and evaluate new incremental clustering
- develop and evaluate active learning classification

Collaborators and Trial Partners Include:

Attorney Generals Department

Queensland Department of Community Safety

Melbourne City Council

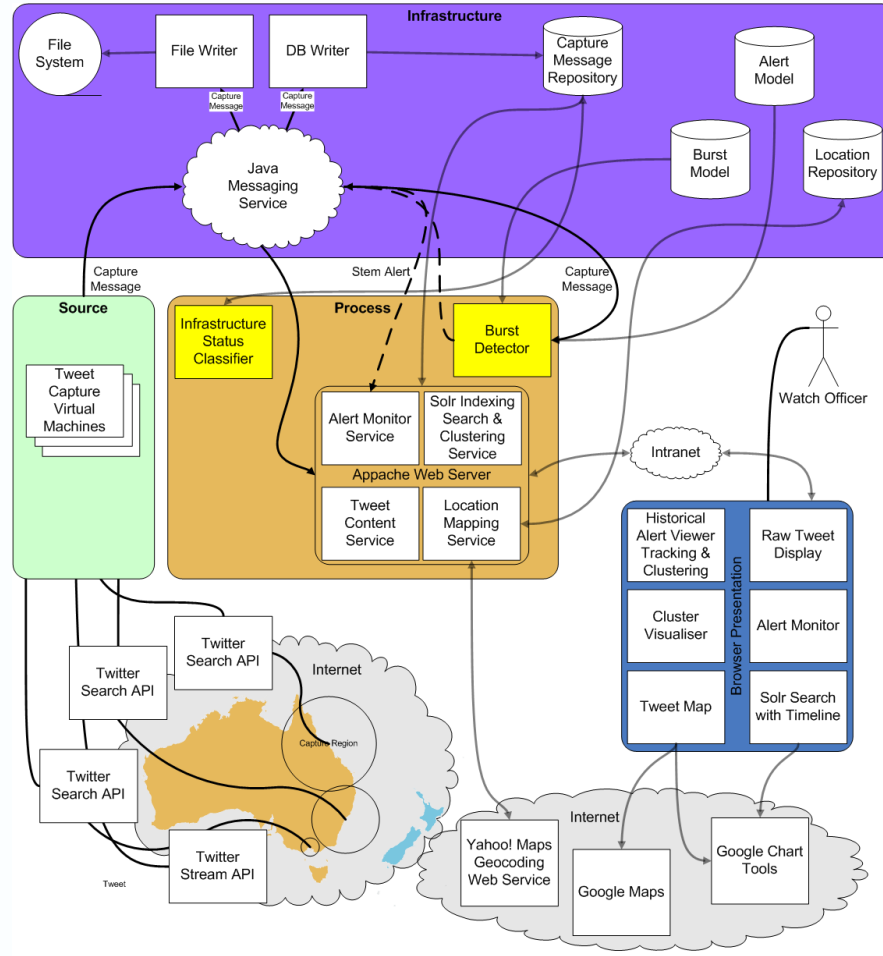
Publications include:

Cameron, Power, Robinson, Yin: Emergency Situation Awareness from Twitter for Crisis Management, WWW12 Workshop on Social Web for Disaster Management

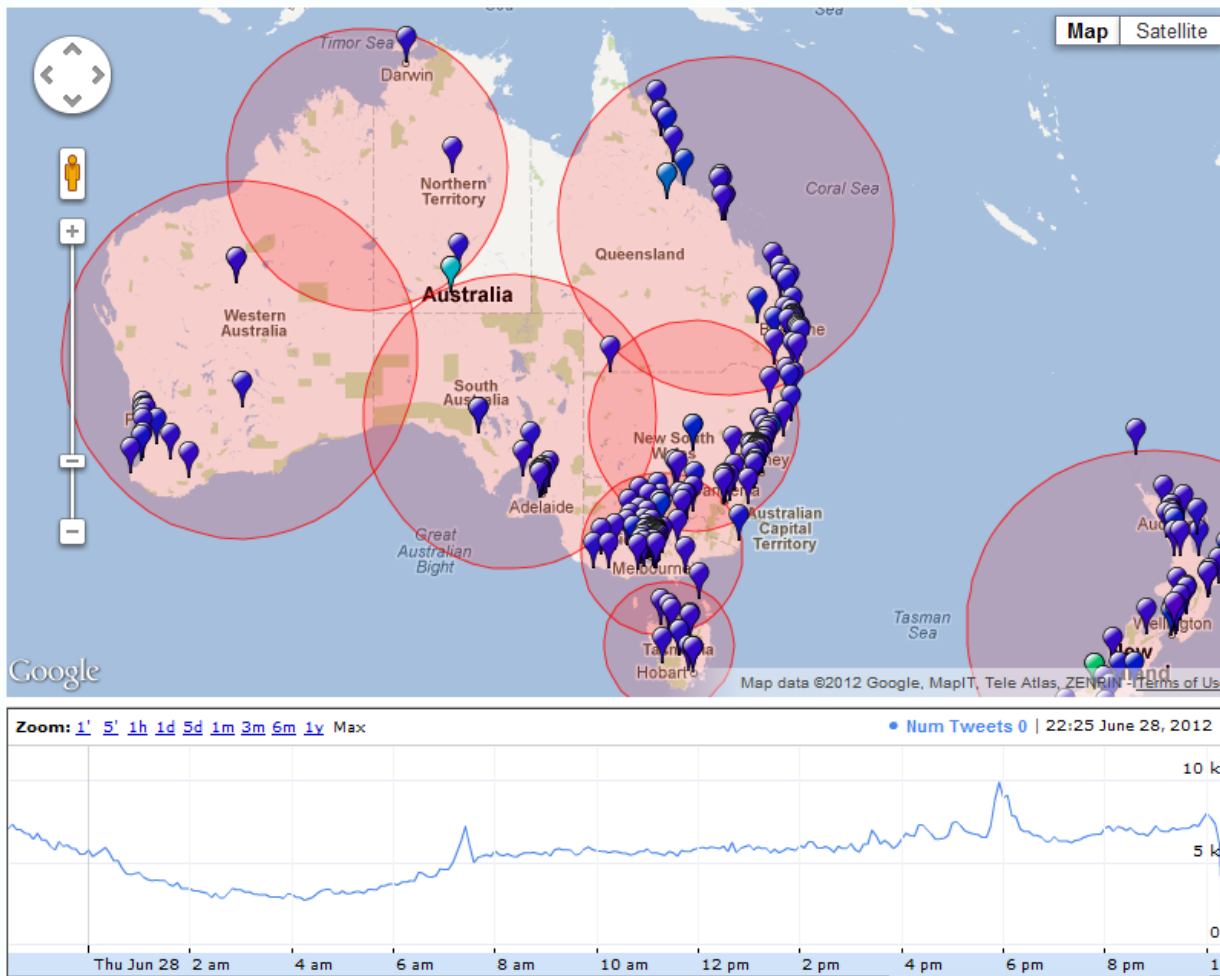
Yin, Lampert, Cameron, Robinson, Power: Using Social Media to Enhance Emergency Situation Awareness, IEEE Intelligent Systems (to appear)

Capture, Analyse & Display

Architecture



Tweet Map



Red circles show capture regions

Markers show geo-coded locations of tweets

Number of tweets in 5 minute window

Near Real-Time Search (flu headache)

- If terms used in an incident of interest are known, near real-time search techniques can be used.

Tweet Query:

Update Timeline
Display Tweets
Display Tweet Clusters



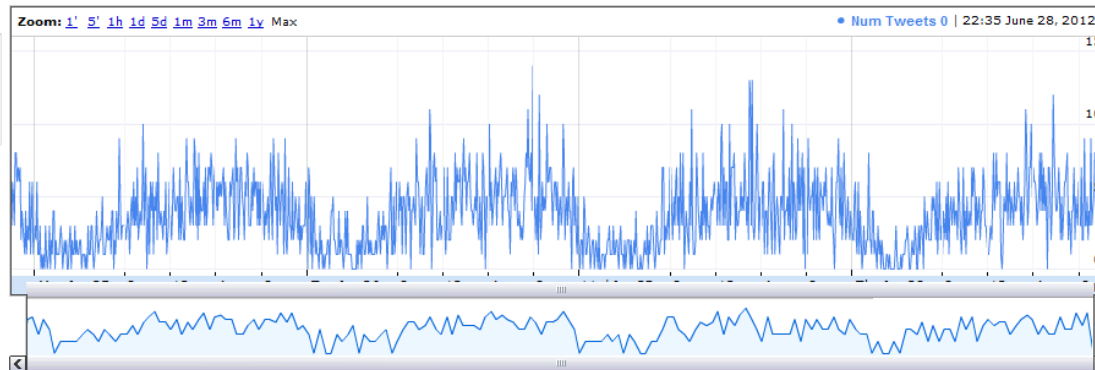
Top topics from the last hour:

Feel Like - Just Like - Just
Thinking - Look Like - **Love** - RT
Hot30Countdown - RT
Kimpoyfeliciano - RT
Luke_brooks - RT NiallerrHoran -
RT RT

Tweet Query:

stem:(flu headache influenza)

Update Timeline
Display Tweets
Display Tweet Clusters



Top topics from the last hour:

Bad - Bed - Days - Fever -
Headache - Lots
of Flu in Melbourne - Sick - T
Know - Time - Work

Detecting and Alerting on Events

Detecting and Alerting

Enable a watch officer to become aware of unexpected or unpredictable incidents

- We interpret this as a statistically significant variation from a background model

Online tools provide trend information, but background model and timeliness of updates is unknown

Our approach is to

- build an historical model of probability of observing word in random 5 minute window
- continuously monitor word frequencies in a sliding 5 minute window
- every minute, compare observed frequency with an historical model
- burst detected when observed > history
- raise an alert when burst exceeds alert
- present watch officer with alerts

Burst model and alert model can be independent

10:51:42 Earthquake

10:52 Nothing much happening

2011 - @thecodysimpson - beiber - chang - codi - hair - here' - justin - march - monei - ok - pajama - rt - secret - sleep - via - x

10:55 Alert monitor

#eqnz - 2011 - 7 - @thecodysimpson - ask - beiber - chariti - defeat - e - get - haircut - here' - hit - hoodi - im - justin - label - onlin - pajama - part - rt - secret - that - them - twitpic - wear - where

11:04 Alert monitor

#eqnz - #itun - 8 - @bezzeraespresso - @greegrec - @nathanaelb - @thecodysimpson - after - anoth - around - ask - bad - big - birthdai - brisban - build - by - chanc - chariti - christchurch - citi - crap - defeat - depp - design - door - earthquak - else' - everi - facebook - fall - fallen - feat - film - free - fuck - guess - hand - here - here' - hit - holli - hoodi - huge - in - injuri - into - johnni - label - learn - long - lot - massiv - mayb - might - narrat - ok - own - pajama - part - ping - plan - r - rt - s - se - shake - show - singl - someone - strang - street - stuff - than - theatr - through - thursdai - tribal - twitpic - up - wear - xx - y - you'll - you'r

Qantas QF32

```
 /cygdrive/c/CSIRO/ESA/trunk
Thu Nov 04 14:18:43 EST 2010 INFO> Received green alert for 'anoth'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'wai'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'ask'
Thu Nov 04 14:19:45 EST 2010 INFO> Received blue alert for 'batam'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'found'
Thu Nov 04 14:19:45 EST 2010 INFO> Received blue alert for 'plane'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'right'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'which'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'week'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'noth'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'done'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'stori'
Thu Nov 04 14:19:45 EST 2010 INFO> Received green alert for 'anoth'
Thu Nov 04 14:19:45 EST 2010 INFO> Received blue alert for 'canberra'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'au'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'ask'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'shit'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'anoth'
Thu Nov 04 14:20:47 EST 2010 INFO> Received blue alert for 'plane'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'done'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'mai'
Thu Nov 04 14:20:47 EST 2010 INFO> Received blue alert for 'canberra'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'break'
Thu Nov 04 14:20:47 EST 2010 INFO> Received blue alert for 'jet'
Thu Nov 04 14:20:47 EST 2010 INFO> Received blue alert for 'batam'
Thu Nov 04 14:20:47 EST 2010 INFO> Received blue alert for 'qanta'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'report'
Thu Nov 04 14:20:47 EST 2010 INFO> Received green alert for 'there'
Thu Nov 04 14:21:48 EST 2010 INFO> Received blue alert for 'media'
Thu Nov 04 14:21:48 EST 2010 INFO> Received blue alert for 'accord'
Thu Nov 04 14:21:48 EST 2010 INFO> Received purple alert for 'batam'
Thu Nov 04 14:21:48 EST 2010 INFO> Received green alert for 'been'
Thu Nov 04 14:21:48 EST 2010 INFO> Received blue alert for 'break'
Thu Nov 04 14:21:48 EST 2010 INFO> Received purple alert for 'explod'
```

Qantas QF32

```
Select /cygdrive/c/CSIRO/ESA/trunk
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for '#new'
Thu Nov 04 14:31:02 EST 2010 INFO> Received purple alert for 'a380'
Thu Nov 04 14:31:02 EST 2010 INFO> Received blue alert for 'airbu'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'an'
Thu Nov 04 14:31:02 EST 2010 INFO> Received orange alert for 'batam'
Thu Nov 04 14:31:02 EST 2010 INFO> Received red alert for 'crash'
Thu Nov 04 14:31:02 EST 2010 INFO> Received yellow alert for 'indonesia'
Thu Nov 04 14:31:02 EST 2010 INFO> Received yellow alert for 'indonesian'
Thu Nov 04 14:31:02 EST 2010 INFO> Received blue alert for 'island'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'near'
Thu Nov 04 14:31:02 EST 2010 INFO> Received red alert for 'plane'
Thu Nov 04 14:31:02 EST 2010 INFO> Received red alert for 'qanta'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'reuter'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'tv'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'rt'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'over'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'some'
Thu Nov 04 14:31:02 EST 2010 INFO> Received blue alert for '@3aw693'
Thu Nov 04 14:31:02 EST 2010 INFO> Received blue alert for 'accord'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'break'
Thu Nov 04 14:31:02 EST 2010 INFO> Received blue alert for 'explod'
Thu Nov 04 14:31:02 EST 2010 INFO> Received blue alert for 'jet'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'mai'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'media'
Thu Nov 04 14:31:02 EST 2010 INFO> Received yellow alert for 'report'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'there''
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'sai'
Thu Nov 04 14:31:02 EST 2010 INFO> Received blue alert for 'singapor'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'articl'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'sydnei'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'engin'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'shit'
Thu Nov 04 14:31:02 EST 2010 INFO> Received blue alert for '@tzarima'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'most'
Thu Nov 04 14:31:02 EST 2010 INFO> Received green alert for 'stori'
```

Qantas QF32

Displaying alerts with timestamp: 2010-11-04 14:20:00

@3aw693 - accord - **batam** - been - break - done - **explod** - fear - indonesia - indonesian - **jet** - mai - media -
over - phone - **plane** - **qanta** - report - sydney - there'

Qantas QF32

Displaying alerts with timestamp: 2010-11-04 14:20:00

@3aw693 - accord - **batam** - been - break - done - **explod** - fear - indonesia - indonesian - **jet** - mai - media - over - phone - **plane** - **qanta** - report - sydney - there'

Displaying alerts with timestamp: 2010-11-04 14:29:00

#new - @3aw693 - **a380** - accord - airbu - an - **batam** - break - confirm - **crash** - engin - explod - hear - indonesia - indonesian - island - jet - mai - media - near - over - **plane qanta** - report - reuter - rt - sai - **singapor** - some - stori - sydney - that - there' - tv

Qantas QF32

Displaying alerts with timestamp: 2010-11-04 14:20:00

@3aw693 - accord - **batam** - been - break - done - **explod** - fear - indonesia - indonesian - **jet** - mai - media - over - phone - **plane** - **qanta** - report - sydney - there'

Displaying alerts with timestamp: 2010-11-04 14:29:00

#new - @3aw693 - **a380** - accord - airbu - an - **batam** - break - confirm - **crash** - engin - explod - hear - indonesia - indonesian - island - jet - mai - media - near - over - **plane qanta** - report - reuter - rt - sai - singapor - some - stori - sydney - that - there' - tv

Displaying alerts with timestamp: 2010-11-04 14:31:00

#new - 45 - @tzarima - **a380** - airbu - airport - an - **batam** - break - changi - **crash** - emerg - engin - explod - ha - indonesia - indonesian - island - jet - land - mai - media - min - most - music - near - new - next - over - **plane qanta** - report - reuter - rt - sai - singapor - stori - sydney - that - there' - tv

Burst Detection for Disease Surveillance?

I have reservations that our current technique is going to work (at all)!

Trying to detect a slow-moving low-volume phenomenon inside a 5 minute window?

Less than 30 seconds to process 10K tweets in a 5 minute window.

Condensing and Summarising

Condensing and Summarising

Given that a watch officer has decided to investigate an alert, we then needed to provide a way for officers to gain a rapid understanding of topics within bursting words

Topic clustering enables a watch officer to rapidly extract an overview of a situation

Clusters are linked to contributing Tweets, enabling officers to “drill down” to source materials if needed

Rapid understanding of topics contributing to burst

- #eqnz Christchurch 2011

[Eqnz](#) · [Family](#) · [Hopefully](#) · [Huge](#) · **Major Earthquake in Christchurch** · [Massive Earthquake](#) · [New Zealand Earthquake](#) · [Other Topics](#) · [Pray NZ](#) · [Reported as 6.6 Quake](#) · [Updates Soon](#)

- tremor Townsville 2011

[Earth](#) · [Feel a Tremor](#) · **Holy Crap - Just Felt** · [Oh my Lord Fuck we Just](#) · [Other Topics](#) · [RT Cammo](#) · [Room and Things were Shaking](#) · [Shook](#)

- Feel a Tremor Townsville 2011



Nobes84: Did anyone else just feel a tremor in [#Townsville](#) ?
Location: -19.256000, 146.671000
Sat Apr 16 2011 15:35:54 GMT+1000 [View Tweet](#)



JanLeese: Did anyone else just feel that tremor feeling in Townsville?
Location: Queensland Australia
Sat Apr 16 2011 15:34:13 GMT+1000 [View Tweet](#)



becvec: Um did anyone else feel a tremor of some sort in Townsville.
Location: Townsville Queensland
Sat Apr 16 2011 15:33:59 GMT+1000 [View Tweet](#)

Condensing and Summarising (flu headache)

Bad - **Bed** - Canberra 2cc - Coming down with the Flu - Feeling Better - Gave me a Headache - Having a Really Bad Headache - Hay Fever - Headache since in School - **Hope** - Lol - Lots of Flu in Melbourne - Massive Headache - Migraine - Music - New Favorite -

Other Topics - RT ChazzaiA - Serious Case - **Sick** - Skrillex Gives me a Headache - Stay Cold and Flu free this Winter - Stress - **Time** - Today - Tonight - Weird - Worst - Year

Displaying 3 tweets in cluster "Lots of Flu in Melbourne" from Thu Jun 28 2012 22:27:18 GMT+1000 to Thu Jun 28 2012 22:14:50 GMT+1000



[Cluster](#) [Older Tweets](#)



AllergyNet: RT [@ChazzaiA](#): Google flu trends is showing lots of flu in Melbourne. Yeah. Lots of flu in Melbourne. <http://t.co/0JLxw7In> (Not too late for a vaccine!)

Location: Melbourne

Thu Jun 28 2012 22:27:18 GMT+1000 [View Tweet](#)



brookmanknight: RT [@ChazzaiA](#): Google flu trends is showing lots of flu in Melbourne. Yeah. Lots of flu in Melbourne. <http://t.co/0JLxw7In> (Not too late for a vaccine!)

Location: Melbourne

Thu Jun 28 2012 22:25:03 GMT+1000 [View Tweet](#)



ChazzaiA: Google flu trends is showing lots of flu in Melbourne. Yeah. Lots of flu in Melbourne. <http://t.co/0JLxw7In> (Not too late for a vaccine!)

Location: Melbourne

Thu Jun 28 2012 22:14:50 GMT+1000 [View Tweet](#)

Classifying high-value messages

Classifying high-value messages

Some information watch officers need to perform their tasks is not always perceived to be important by the social network. This is a true needle in a haystack problem!

To assist officers in assessing the severity of an incident, we have built statistical text classifiers using machine learning techniques

Positive	Negative
 <p>JohnAscroft: Burst water main and some sand up in street. Bad quake! #eqnz Location: Christchurch, New Zealand Tue Feb 22 2011 10:58:59 GMT+1100 View Tweet</p>	 <p>isaacfreeman: Another huge quake. Felt as big as the first one. Trying to type with trembling fingers. #eqnz Location: Christchurch, New Zealand Tue Feb 22 2011 10:54:06 GMT+1100 View Tweet</p>
 <p>gavb: Giant rocks fall on houses and cars in Sumner #eqnz http://twitpic.com/42dm4j Location: Sumner, New Zealand Tue Feb 22 2011 11:01:17 GMT+1100 View Tweet</p>	 <p>onewilliamsj: To all my chch peeps: stay safe. Hope you're all ok #eqnz Location: undefined Tue Feb 22 2011 11:05:00 GMT+1100 View Tweet</p>
 <p>Martin_NZ: Ferrymead bridge is unpassable due to todays #EQNZ Location: -43.477749,172.579036 Tue Feb 22 2011 11:10:44 GMT+1100 View Tweet</p>	 <p>Phil_Wheeler: Initial magnitude estimated 6.3 for latest #eqnz: gfz2011dqyh http://bit.ly/hvl33w Location: undefined Tue Feb 22 2011 11:05:07 GMT+1100 View Tweet</p>
 <p>AwhinaH: Woah liquifaction and a split road down radley st in woolston #chch Location: Christchurch, New Zealand Tue Feb 22 2011 11:13:02 GMT+1100 View Tweet</p>	 <p>ThomasMeadia: Another aftershock, ground looked like an ocean. University evacuated #eqnz Location: Christchurch, NZ Tue Feb 22 2011 11:08:20 GMT+1100 View Tweet</p>

Classifying high-value messages

Positive and negative examples of Tweets have been labelled in a training set. This training set then used to construct the classifier. The classifier uses text features like part-of-speech and phrase structure, rather than searching for a given set of keywords

Infrastructure impact classifier identifies Tweets likely to contain evidence useful to watch officer in assessing the impact of an incident on roads, bridges, houses, buildings, power, water, sewerage and communication infrastructure

Positive	Negative
 <p>JohnAscroft: Burst water main and some sand up in street. Bad quake! #eqnz Location: Christchurch, New Zealand Tue Feb 22 2011 10:58:59 GMT+1100 View Tweet</p>	 <p>isaacfreeman: Another huge quake. Felt as big as the first one. Trying to type with trembling fingers. #eqnz Location: Christchurch, New Zealand Tue Feb 22 2011 10:54:06 GMT+1100 View Tweet</p>
 <p>gavb: Giant rocks fall on houses and cars in Sumner #eqnz http://twitpic.com/42dm4j Location: Sumner, New Zealand Tue Feb 22 2011 11:01:17 GMT+1100 View Tweet</p>	 <p>onewilliamsj: To all my chch peeps: stay safe. Hope you're all ok #eqnz Location: undefined Tue Feb 22 2011 11:05:00 GMT+1100 View Tweet</p>
 <p>Martin_NZ: Ferrymead bridge is unpassable due to todays #EQNZ Location: -43.477749,172.579036 Tue Feb 22 2011 11:10:44 GMT+1100 View Tweet</p>	 <p>Phil_Wheeler: Initial magnitude estimated 6.3 for latest #eqnz: gfz2011dqyh http://bit.ly/hvi33w Location: undefined Tue Feb 22 2011 11:05:07 GMT+1100 View Tweet</p>
 <p>AwhinaH: Woah liquifaction and a split road down radley st in woolston #chch Location: Christchurch, New Zealand Tue Feb 22 2011 11:13:02 GMT+1100 View Tweet</p>	 <p>ThomasMeadia: Another aftershock, ground looked like an ocean. University evacuated #eqnz Location: Christchurch, NZ Tue Feb 22 2011 11:08:20 GMT+1100 View Tweet</p>

Classifying high-value messages for disease surveillance?

Yes indeed!

We now have 2 years worth of data!

Forensic Analysis & Situation Awareness

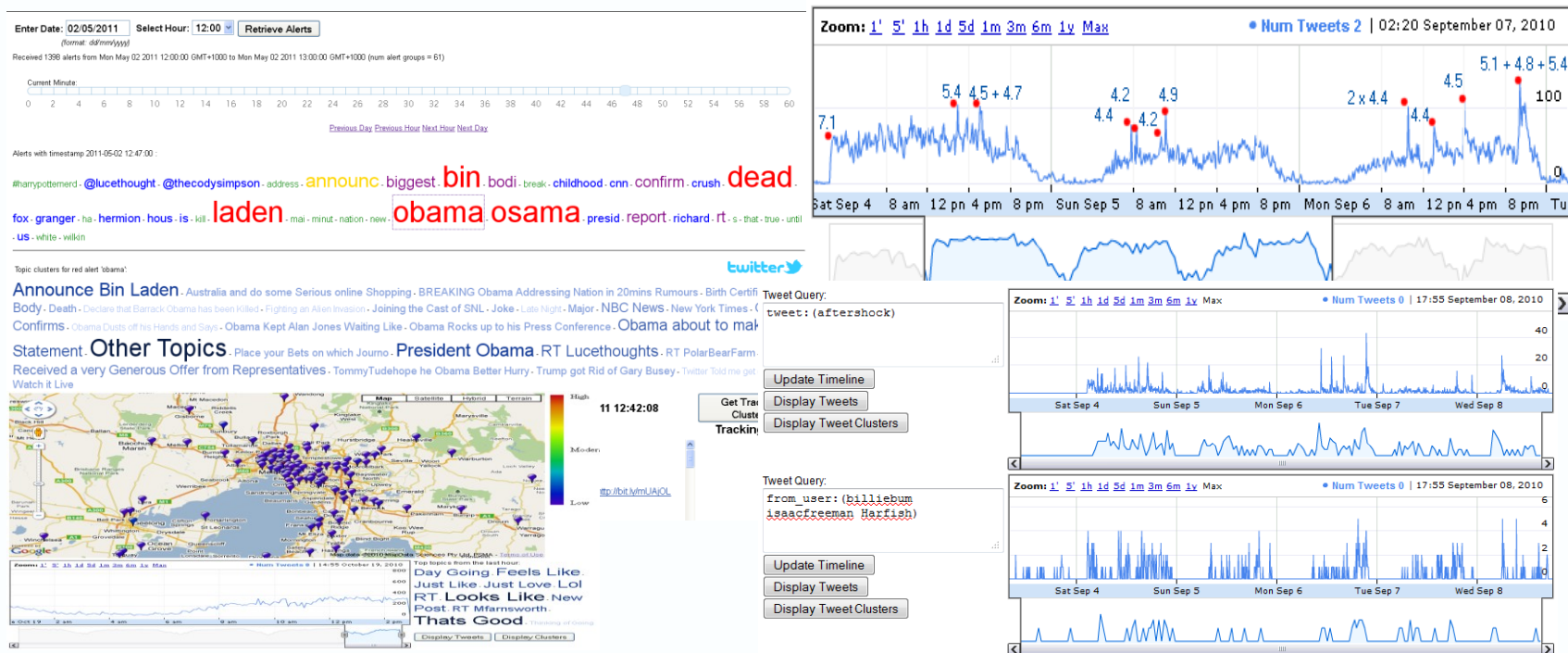
Forensic Analysis

Who knew what where and when?

Enable watch officers to move forward and backward in time

Look at and review the alerts generated

Compare alerts with other knowledge



Fire Emergencies and Natural Disasters

Pilot Impacts Portal - Windows Internet Explorer
https://www.fend.org.au/portal/secure/index.html?page=map

FEND - Pilot Impacts Portal
Fire Emergencies and Natural Disasters
[Change Details](#) [Log Out](#)

Home Framework Registry **Map** Help Acknowledgements Contact Us

Map Satellite

Layers
Locations
Building Information
Historical Events

Enter Date Range:
From 2000
To 2012

Show Events Clear Events

- BOM Cyclone Tracks (1907-2011)
- GA Earthquakes (>4M, 1897-2011)
- DFO Flood regions (1987-2011)
- AFAC Fires (1997-2011)
- AG Disaster Events (1851-2011)
 - Bushfire
 - Cyclone
 - Earthquake
 - Flood
 - Landslide
 - Storm
 - Tornado
 - Tsunami
 - Urban Fire

Reports

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Thank you

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