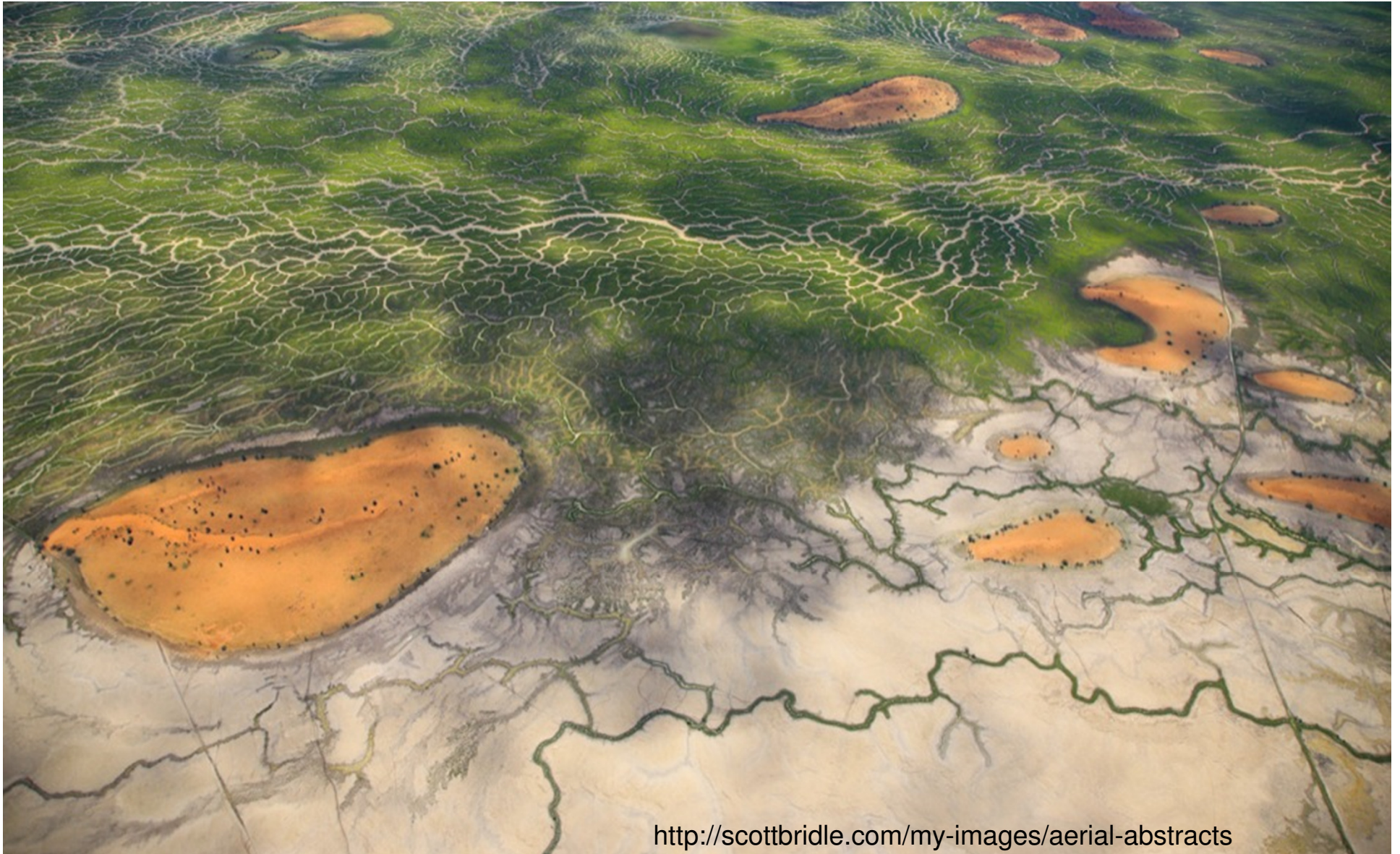


# ***Early Flood Warning Systems***

**Thomas Pagano (Thomas.C.Pagano@gmail.com)**

**Bureau of Meteorology, Melbourne Australia**



<http://scottbridle.com/my-images/aerial-abstracts>

# Outline

## 1. Types of early warning systems

Monitoring

Rainfall-runoff model predictions

Advanced systems

2. Challenges for forecasters

3. Emerging resources



# Nepal: Community-based early warning

**Nepal has limited infrastructure and few resources.  
Data, particularly automated data, is limited.**



**Hand sirens for flood alarm**

# Nepal: Community-based early warning

**Version 1**



**Lookout towers for floods  
(originally for dangerous animals)**

**Version 2**



**Use what people  
are familiar with**

**Learn from experience  
to refine your system**



# Examples from Jakarta

Upstream video of river



Downstream flood marks



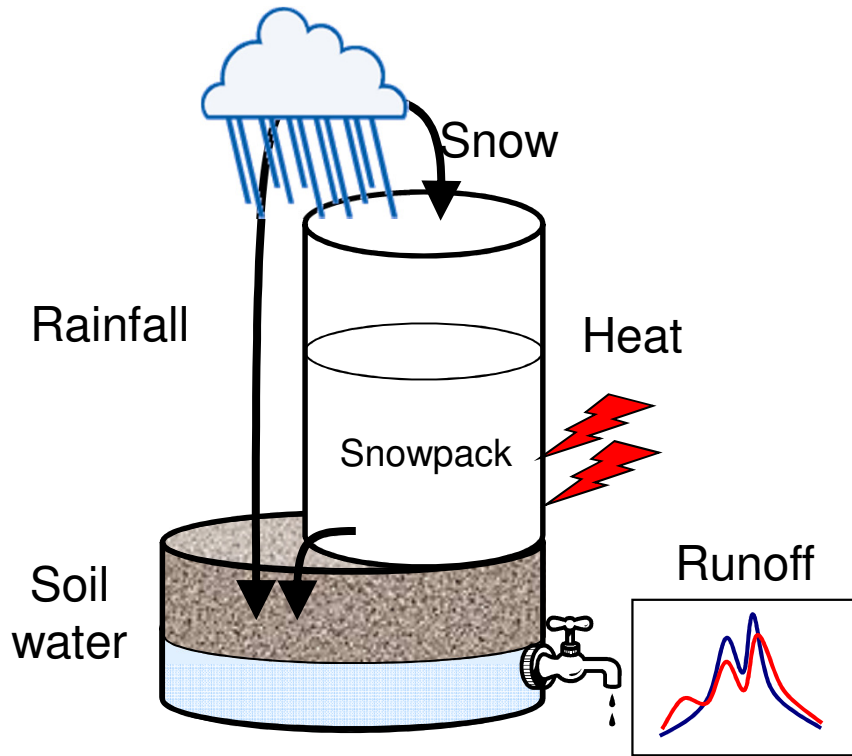
18 hours later

Community message boards



In many places,  
upstream river monitoring  
gives early warning for  
those downstream  
(i.e. no computer model)

# Rainfall-runoff models



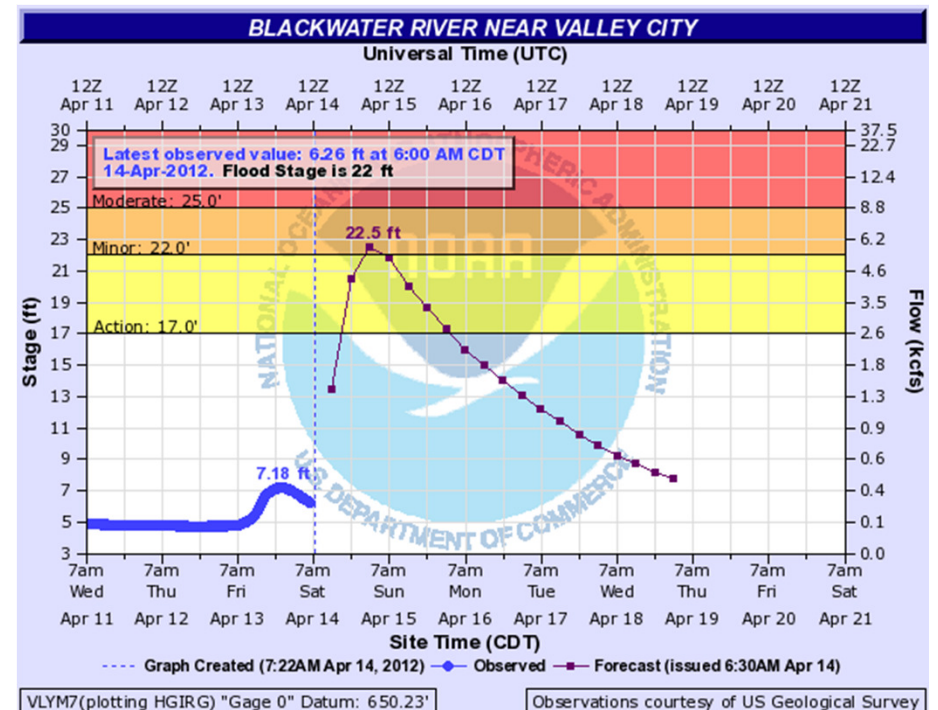
Inputs: Precipitation (past + future)

Potential evaporation

Some places: Temperature

Outputs: Daily/hourly runoff

Simple: 300 lines of computer code

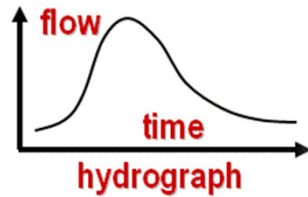


# Advanced forecasting systems

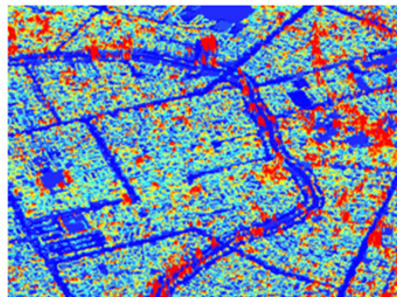
Inundation modelling:



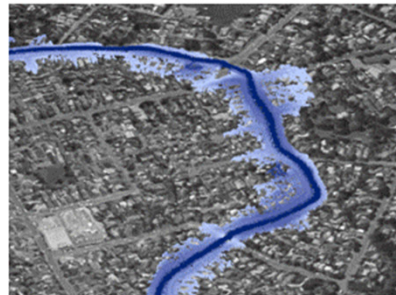
elevation model



hydrograph



surface roughness model

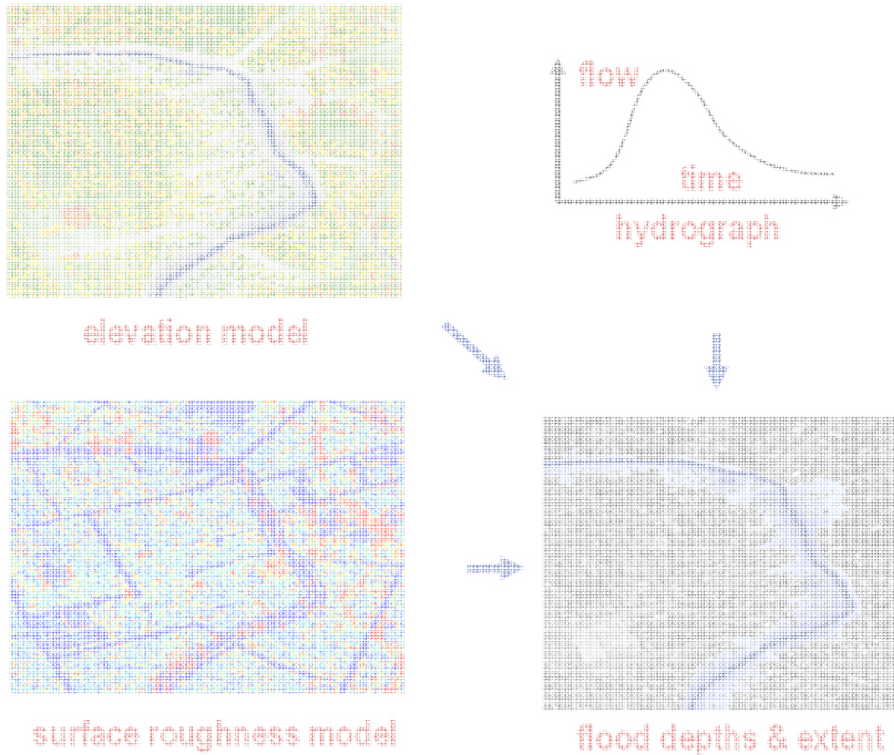


flood depths & extent

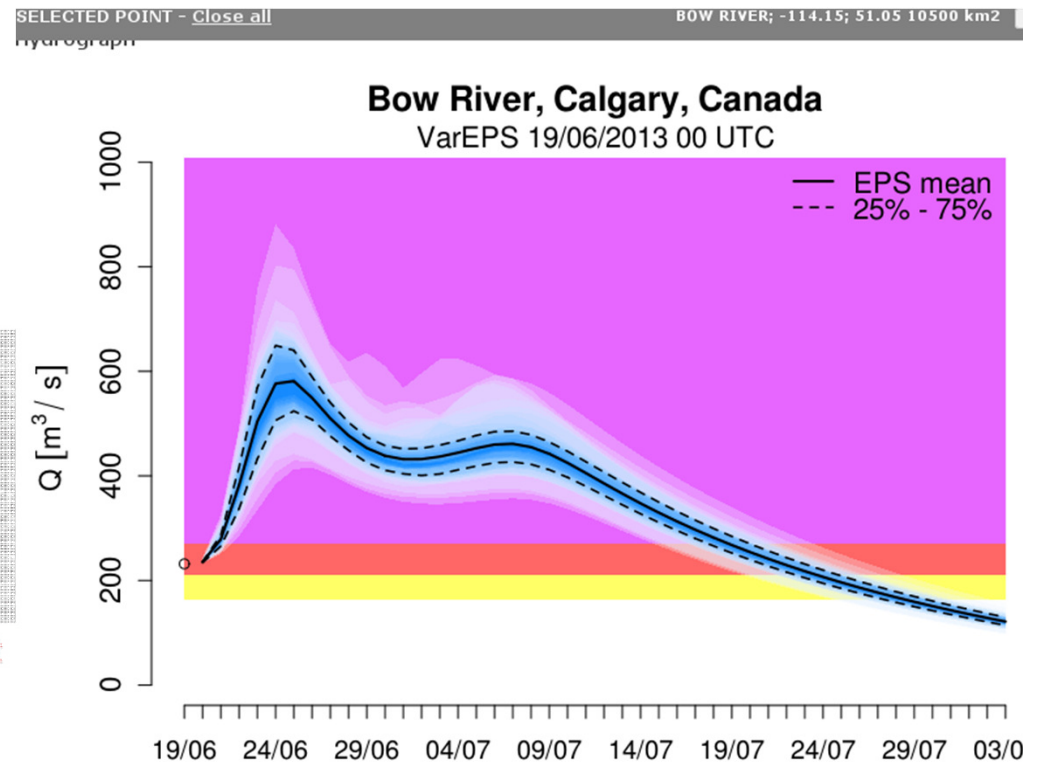


# Advanced forecasting systems

Inundation modelling:



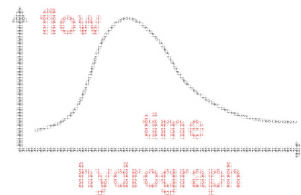
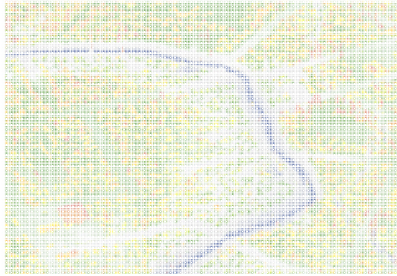
Probabilistic forecasting:





# Advanced forecasting systems

Inundation modelling:

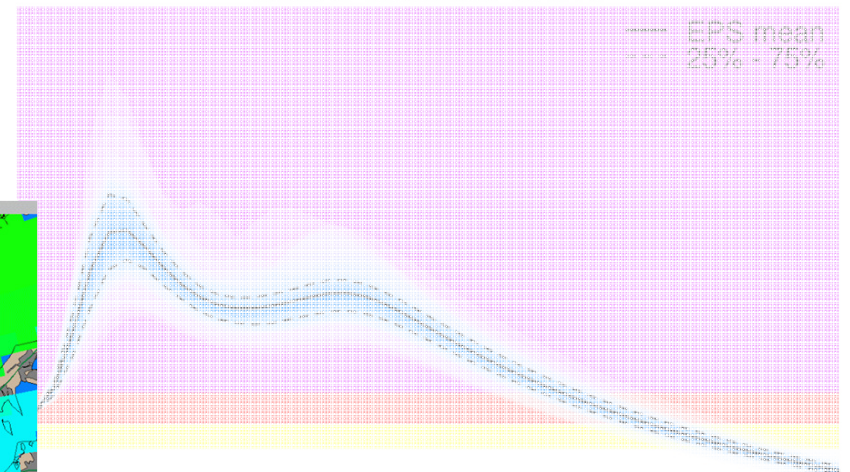


Probabilistic forecasting:



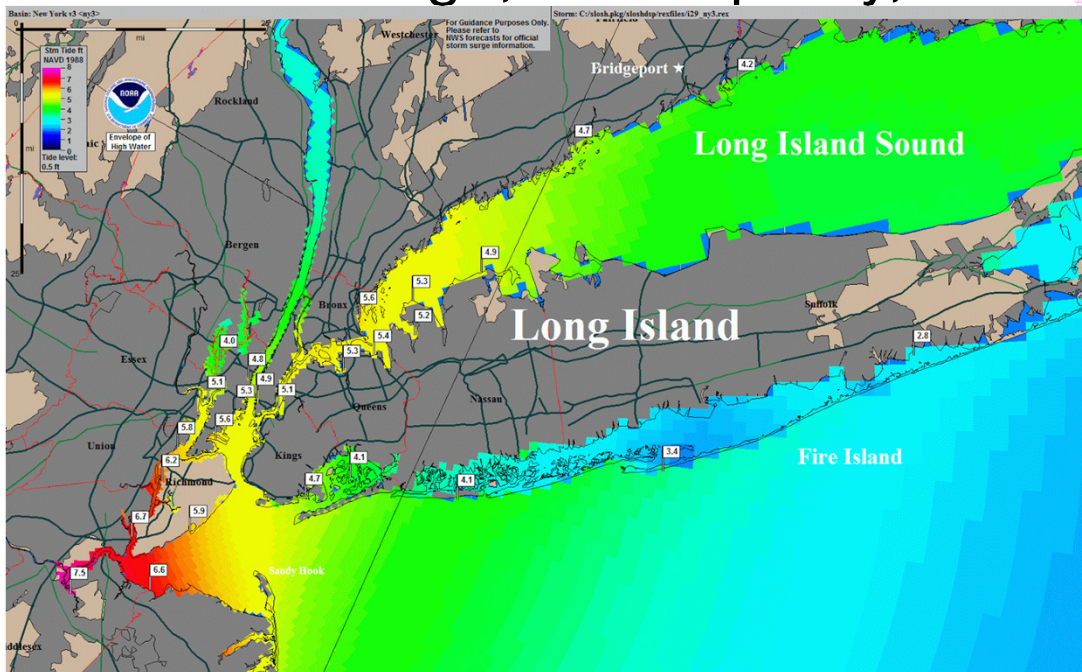
Bow River, Calgary, Canada  
VarEPS 19/06/2013 00 UTC

1000



6 24/06 29/06 04/07 09/07 14/07 19/07 24/07 29/07 03/0

Interdisciplinary forecasts:  
Storm surge, water quality, etc



# Outline

1. Types of early warning systems

2. Challenges for forecasters

Data

Unnatural systems

Communication

3. Emerging resources

# Everyone has data problems

**Too much, too little, not the right density or quality.**

Trouble getting, cleaning, infilling,  
using, archiving, versioning, visualizing, redistributing...

Until 2008, Australian water data managed by 200 entities.





**Important rivers are often not natural.**

**Human influence hard to monitor/predict.**



**World's dirtiest river  
(Indonesia)**

**Toowoomba,  
Australia**



<http://tompagano.blogspot.com/2011/09/manggarai-gate-garbage-part-22.html>

# Communication of forecasts: Is there a difference between forecasting (quantifying the future) and warning (inspiring users to right action)?

Why are these “forecasts”  
not probabilistic?

DEPARTURES			Gate	Time	Remarks
Airline/Flt. No.	Destination				
MEHICANA 933	GUADALAJARA		122	5:40P	BOARDING
AER LINGUS 144	DUBLIN		104	6:00P	BOARDING
MEHICANA 905	MEXICO CITY		102	6:05P	BOARDING
BRITISH AIR 282	LONDON HEATHROW		121	7:15P	NEW TIME
AEROFLOT 322	MOSCOW		106	7:00P	ON TIME
PHILIPPINE 113	MANILA			7:25P	CANCELLED
LUFTHANSA 5299	ZURICH		120	8:25P	NEW TIME
QANTAS 026	AUCKLAND-MELBOURNE		102	8:30P	ON TIME
PHILIPPINE 103	MANILA		104	9:55P	ON TIME
			101	9:00P	ON TIME



Who is the customer?

Should forecasts be public and free?

# Outline

1. Types of early warning systems
2. Challenges for forecasters

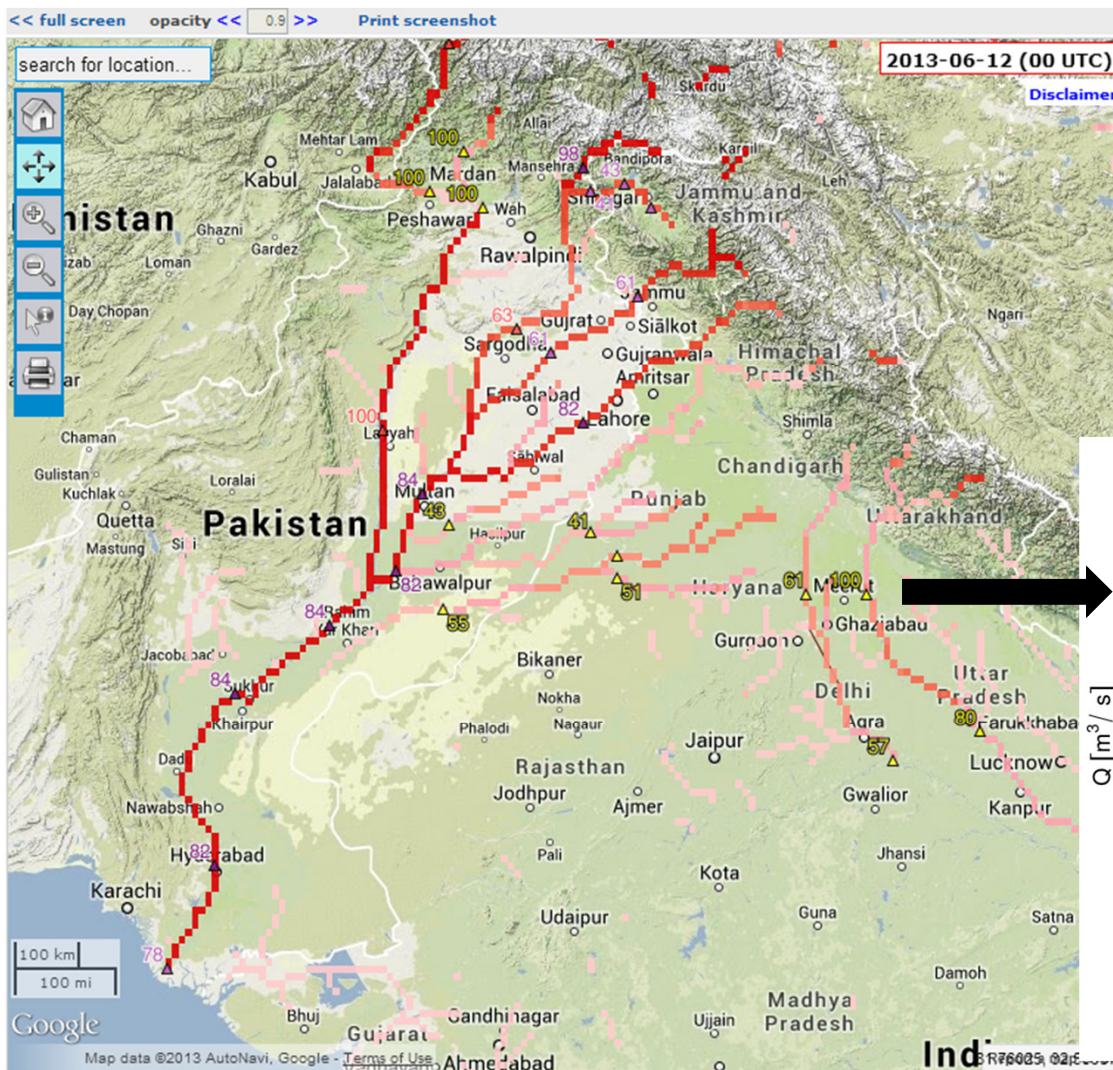
## 3. Emerging resources

Global forecasting systems

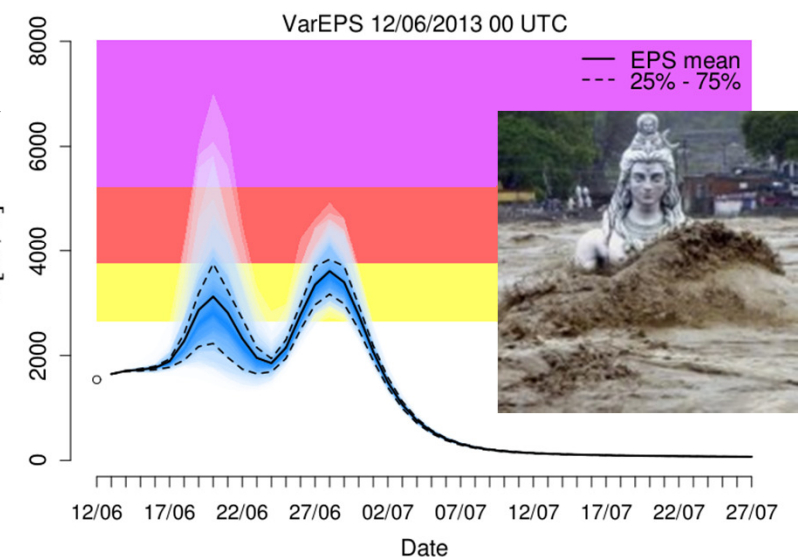
Social media



# GloFAS (Global Flood Awareness System) using the world's best weather forecasts



**Issued:**  
**12 June 2013**  
**Flood:**  
**16-18 June**



<http://www.efas.eu/efas-forecasting.html>

**<< 45 Days >>**

www.google.org/crisismap?crisis=thailand\_floods\_en

Enter an address, then press ↓ and select from menu

Uploaded with ASIGN from AnsuR



[Large version](#)

Caption: Uploaded with ASIGN from AnsuR  
Location: 13°57'10"N 100°31'46"E  
Date: 2011-11-06 14:16:06

Zoom in, process or send this photo  
[Go to ASIGN Online](#)

## Google Crisis Response

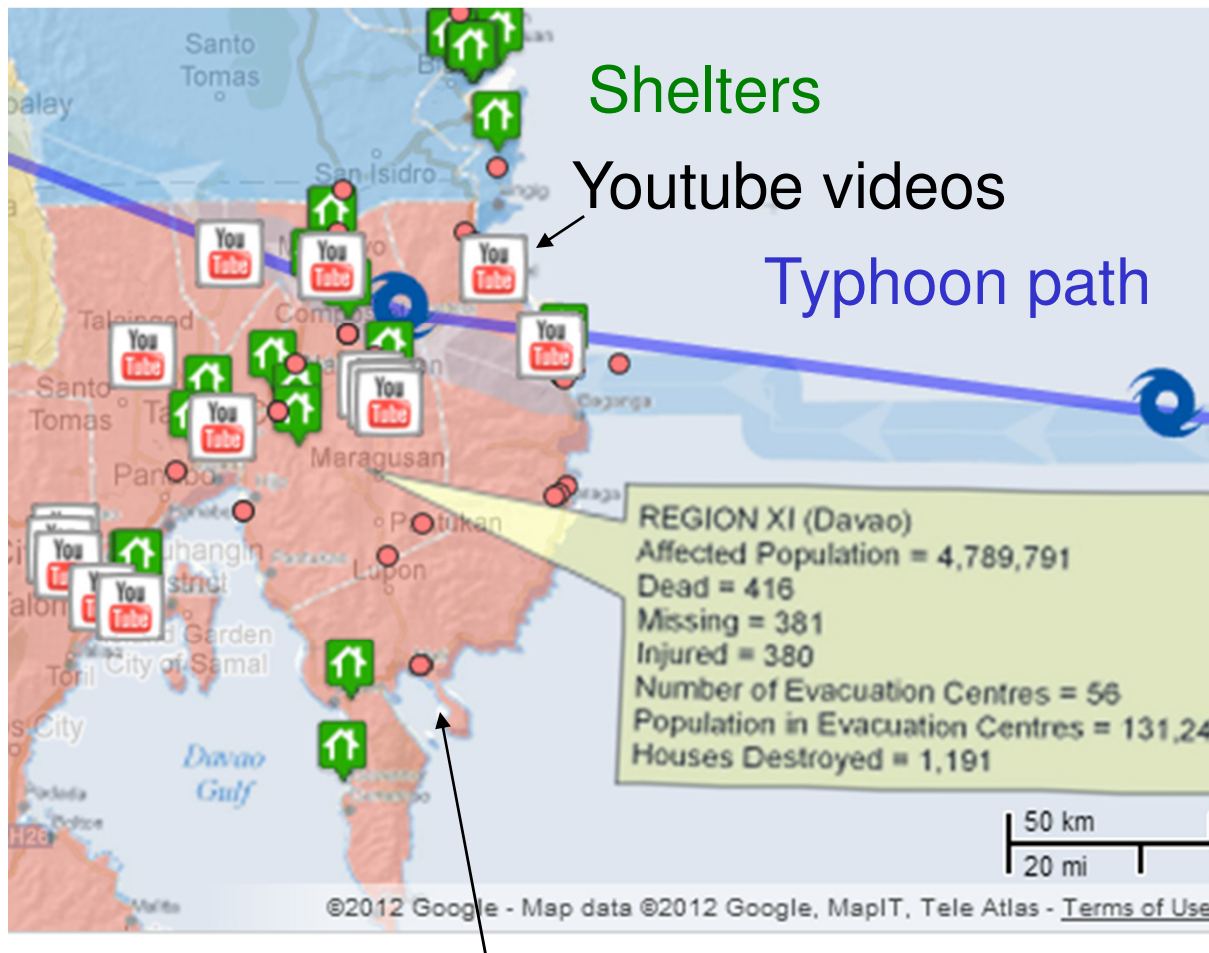
Shelters

Parking

Risk  
areas

Water  
barrier





- ☐ Flood hazard maps (Ilocos, La Union, Pangasinan)
- ☒ Photos and Videos
  - ☒ Crowdsourced Photos and Videos
    - [Zoom to area](#) · [Download KML](#)
    - Content curated from social media by [Digital Humanitarian Network](#) solution team at the request of [UNOCHA](#)
  - ☒ Pablo-related YouTube videos
    - [Zoom to area](#) · [Download KML](#)
    - Selected videos about Typhoon Pablo (Bopha). [CitizenTube playlist](#). Credit: [Storyful](#)
- ☐ Additional hazard maps
- ☒ Scope of humanitarian crisis
 

[Zoom to area](#)  
 Effective: Dec 7, 2012, 4:00 PHT. Source: MapAction via [OCHA ReliefWeb](#).

User-uploaded photos

<http://google.org/crisismap/2012-pablo> (Philippines 2012)





## Temporarily testing new Twitter stream on Typhoon Haiyan!!!

Monitoring of media is fairly common in many larger organisations. The use of social media in natural disasters has also den benefits. The same technologies can be used to monitor main stream and social media reports of floods. Making use of US platform we want to show the potential of monitoring floods at the global scale.

The main map shows reports of the last day. Update the time window by moving the slider bellow the map.

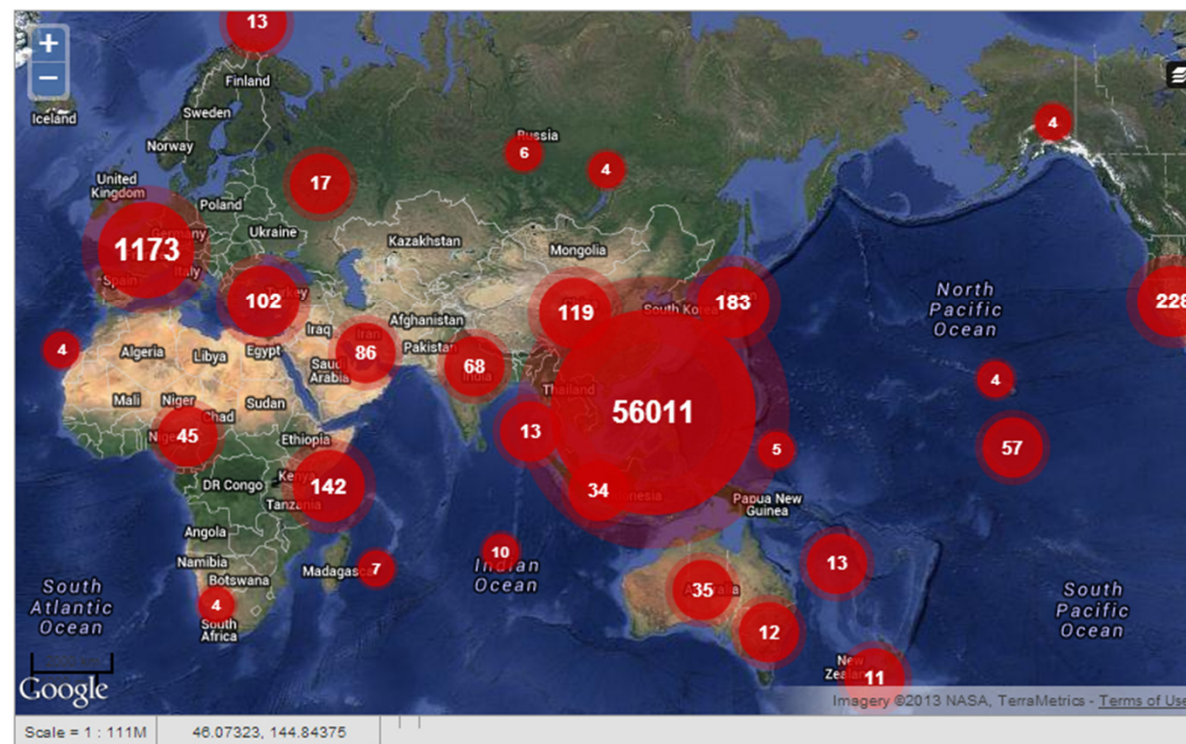
Follow us : [@Twitter](#), [Facebook](#), [Paper Trail](#) ;-)

>50,000 Twitter hits in 3 days Typhoon Haiyan

FILTERS → [ALL](#) [NEWS](#) [PICTURES](#) [VIDEO](#)

[FULL SCREEN MAP](#)

↓ CATEGORY FILTER [ HIDE ]



ALL CATEGORIES

EMM NEWS

GOOGLE NEWS

FLICKR\_FLOODS

EMERGENCY INFO

YOUTUBE

TWITTER

INFOPIG

COPERNICUSRUSH

RAPPLER

### How to Report

By using an app:

[iPhone](#)  
[Android](#)

By sending an email:



# Summary

1. Types of early warning systems  
Observation based -- Modeling -- Advanced systems
2. Challenges for forecasters  
Data -- Unnatural Rivers -- Communication
3. Emerging resources  
Global forecasting systems -- Social media



[Thomas.c.pagano@gmail.com](mailto:Thomas.c.pagano@gmail.com)  
[tompagano.blogspot.com](http://tompagano.blogspot.com)