Filling the Gaps in Remote Sensing Data using Social Media

Guido Cervone
cervone@ucar.edu

Associate Professor
Department of Geography and Institute for CyberScience
GeoVISTA Center
The Pennsylvania State University

Affiliate Scientist
Research Application Laboratory
National Center for Atmospheric Research

NCAR

ONR NATO Workshop
Brussels October 8, 2013

Exciting Time for Geography

Never in History

- Known so much about the Earth
- Unprecedented access to data
- Society so much at risk

My Passions

- Environmental hazards
  - Constant threat
  - Natural, man made and technological
- Remote sensing and simulations
  - Observe and forecast
- Geoinformatics
  - The rate at which geospatial data are generated exceeds our ability to analyze them
  - Techniques for the analysis of large, dynamic, and geographically distributed spatiotemporal data

My Passions

- Environmental hazards
  - Constant threat
  - Natural, man made and technological
  - Main theme of my research
- Remote sensing and simulations
  - Observe and forecast
  - Main data source of my research
- Geoinformatics
  - The rate at which geospatial data are generated exceeds our ability to analyze them
  - Techniques for the analysis of large, dynamic, and geographically distributed spatiotemporal data
  - Main computational algorithms for my research

Research Goals

- Disaster Relief and Humanitarian Assistance
- Real time analysis
- Data $\Longrightarrow$ Knowledge

Remote Sensing Disaster Assessment

- De-facto standard in observing the Earth and its environment
- Real time high-resolution data
- Crucial during disasters
- International cooperation (e.g. International Charter for Space and Disasters)

March 2011 Japanese Earthquake

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Mr. Guido Cervone
Center for Earth Observing and Space Research
George Mason University
4400 University Drive
MS 5C3
Fairfax, Virginia 22044

MAR 2 9 2011

Dear Mr. Cervone:

The March 10, 2011 earthquake and tsunami was a great tragedy for the nation of Japan. I would like to commend you and your colleagues for your impressive effort and commitment made in response to the demands of the disaster and the request of the Government of Japan. Your hard work and personal sacrifices benefited the Japanese and U.S. agencies assisting in the response effort during a very busy and difficult time.

The efforts you have put forth in collecting and analyzing imagery and creating maps depicting the areas impacted by the disasters, have been recognized and appreciated by many agencies responding to the disaster. As Hiroshi Murakami of the Geospatial and Information Authority of Japan (GSI) indicated in a message:

> "the image maps posted by Brenda Jones (all created by U.S. Volunteers) seem to cover most of the important coastal areas of Iwate Prefecture, and will be very helpful for understanding the impact. The weather in the region did not allow us to take air photos today, and these image maps are very helpful. I was impressed that so much information on the damaged areas becomes available on the web immediately after the earthquake by many experts in the world."

On behalf of our Japanese and U.S. agency colleagues, the USGS would like to recognize your contributions to the 2011 Japan Earthquake/Tsunami Response Effort and extend our sincere thanks and appreciation for your immediate action and quick response to the request for assistance. This positive response to the Japanese request for assistance would not have been possible without your help.

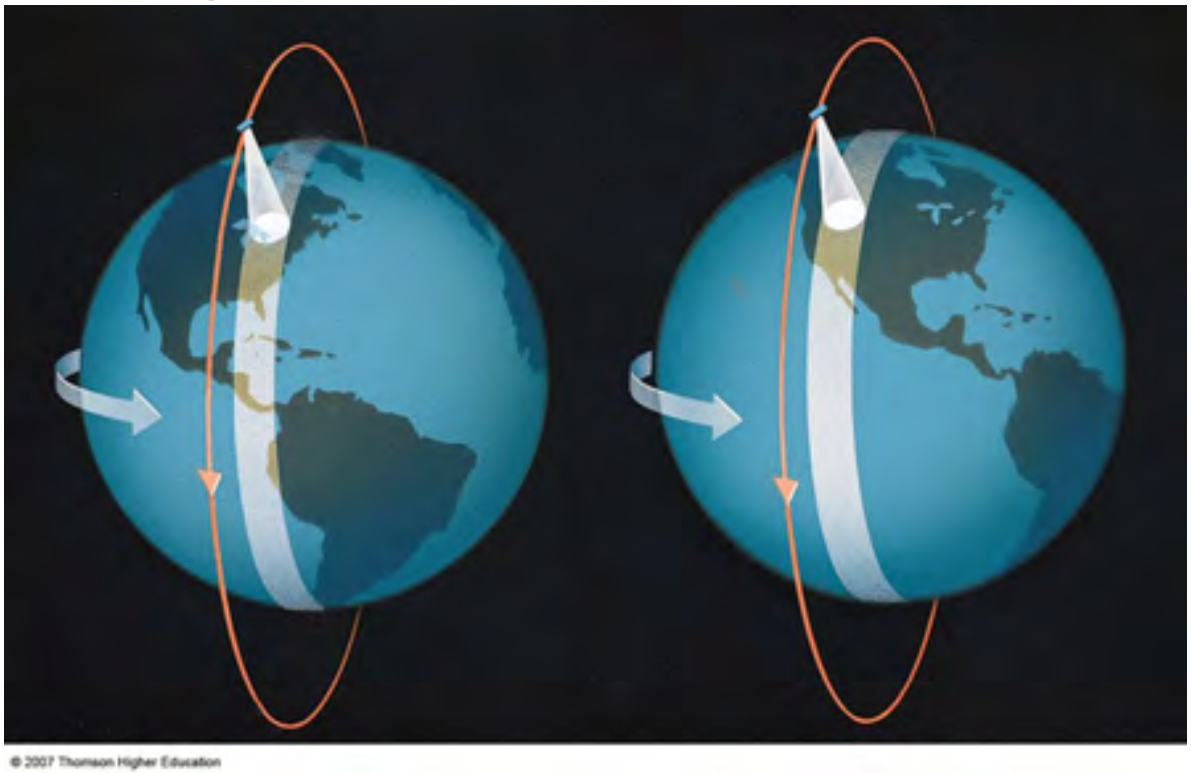
Sincerely,

William S. Leith
Acting Associate Director for
Natural Hazards

G. Cervone, G. Manca, *Damage Assessment of the 2011 Japanese Tsunami Using High Resolution Satellite Data*, Cartographica, 46(3), 2011

Remote Sensing Challenges

- Revisiting Time



- Atmospheric Transparency

Solution

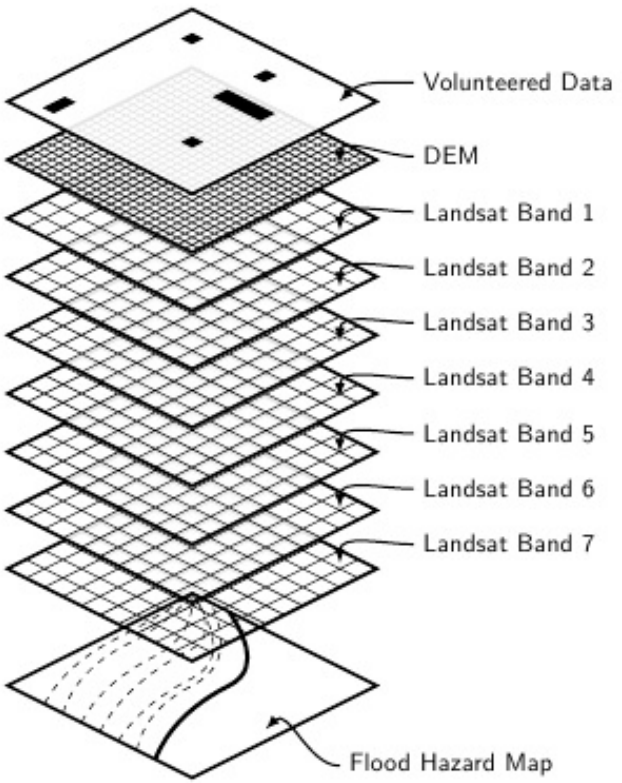
- Filling the Gaps in Remote Sensing Data Using Social Media
  - Data Fusion Problem
  - Remote Sensing: high spatial resolution, low temporal resolution
  - Social Media: low spatial resolution, high temporal resolution

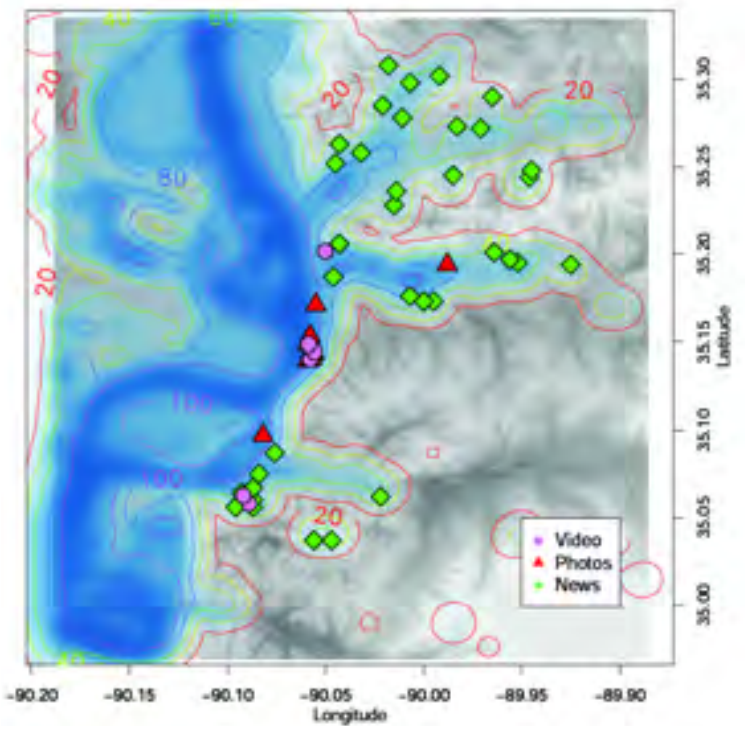
- Augment initial satellite observations with ground information

Social Media, DEM and Remote Sensing for Floods

Goal

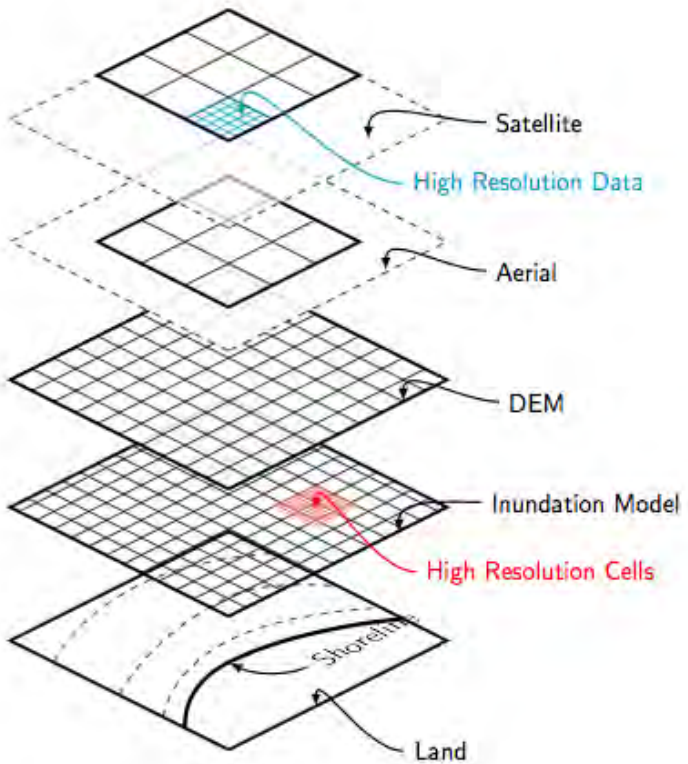
Generate flood hazard maps for the 2011 Memphis floods

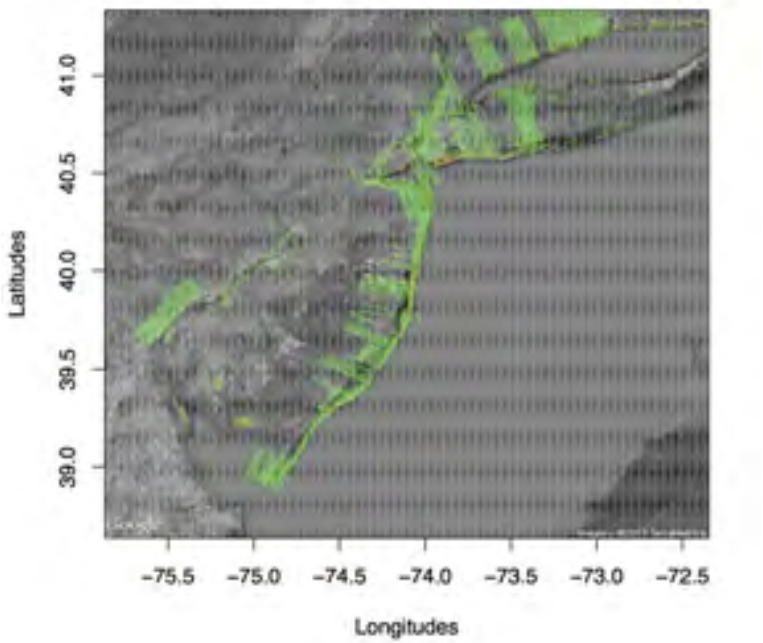




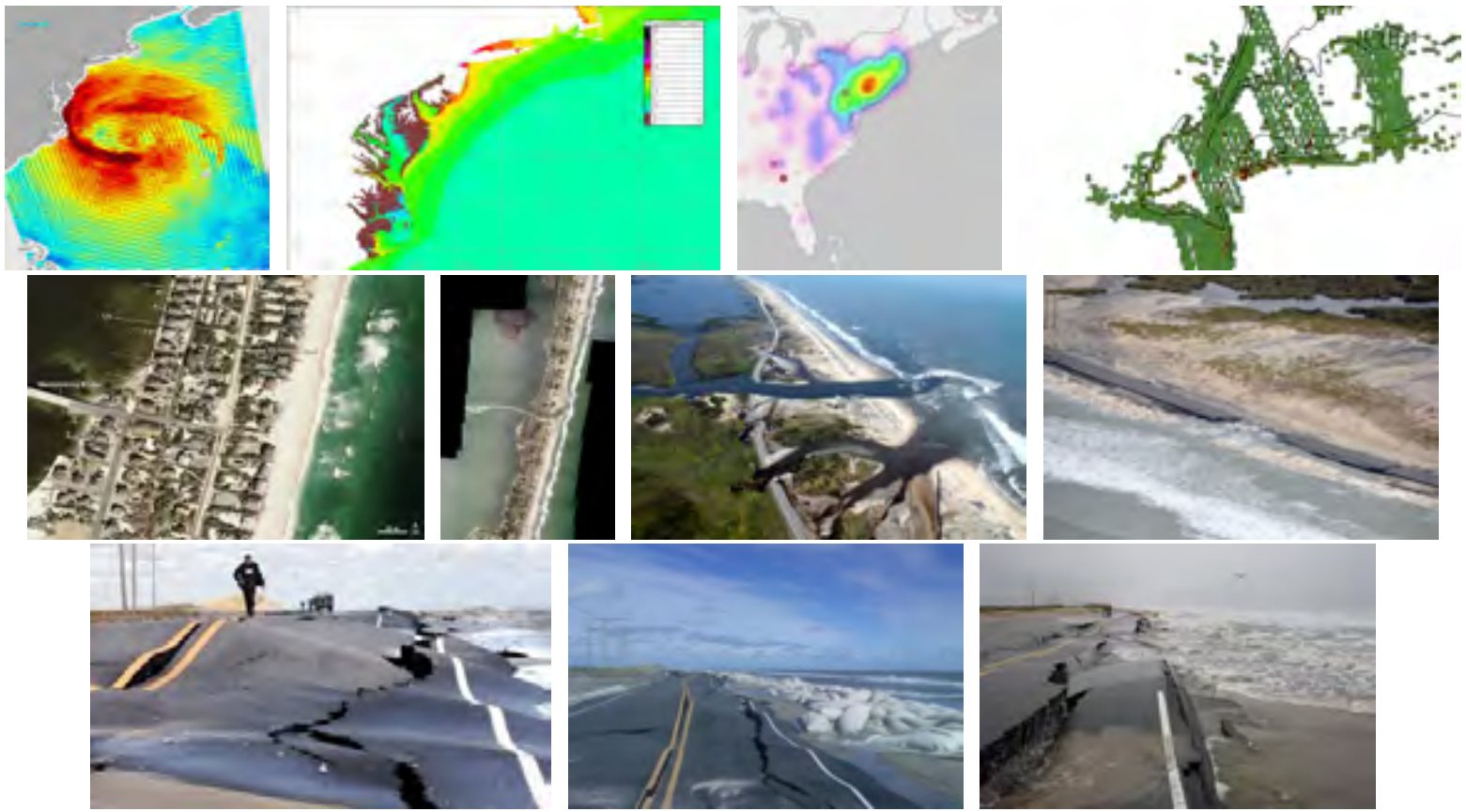
E. Schnebele, G. Cervone, *Improving Remote Sensing Flood Assessment Using Volunteered Geographical Data*, accepted in Natural Hazards and Earth System Science on January 22, 2013

Transportation Assessment after Sandy using Social Media





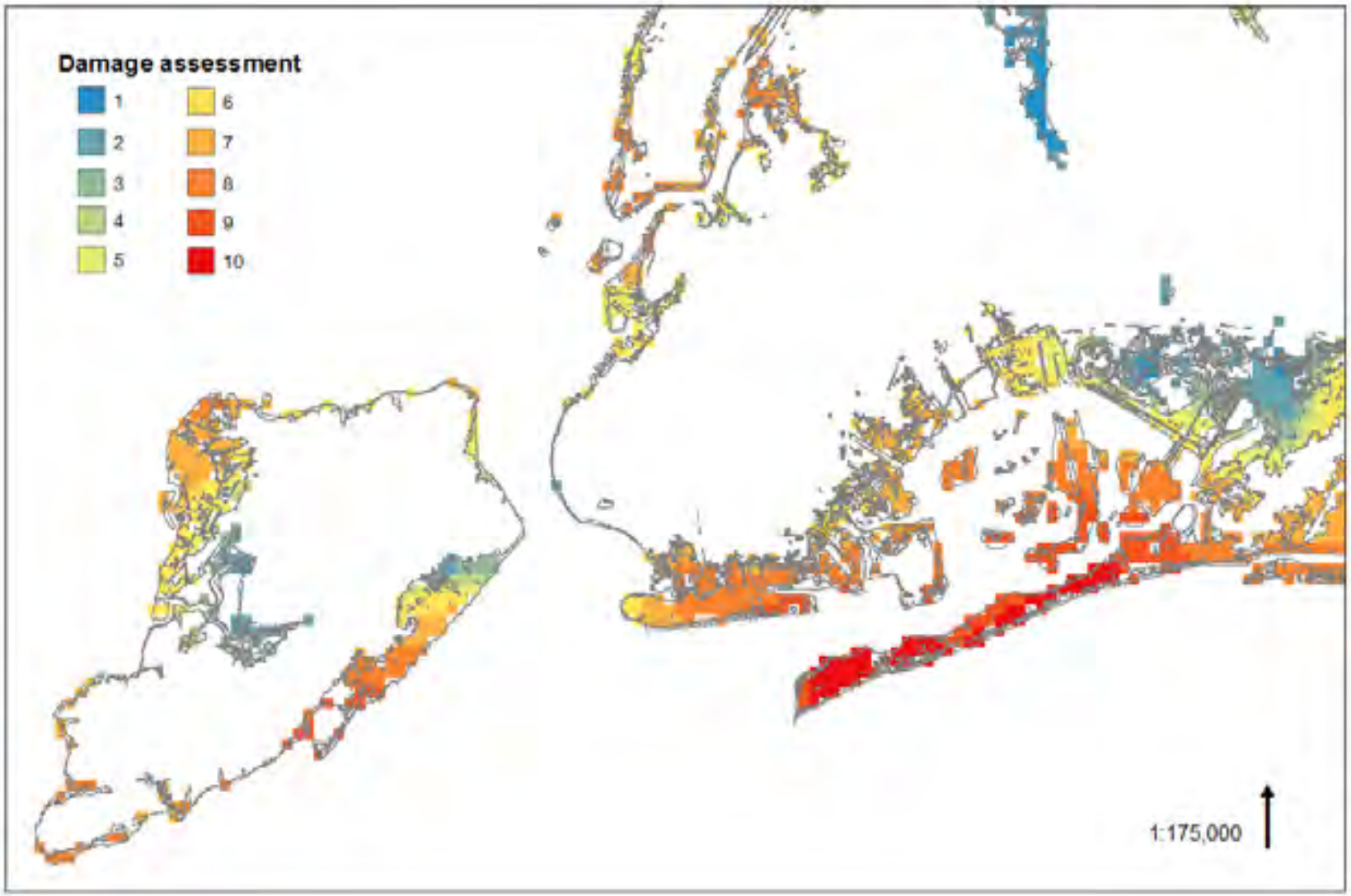
Analysis of Sandy



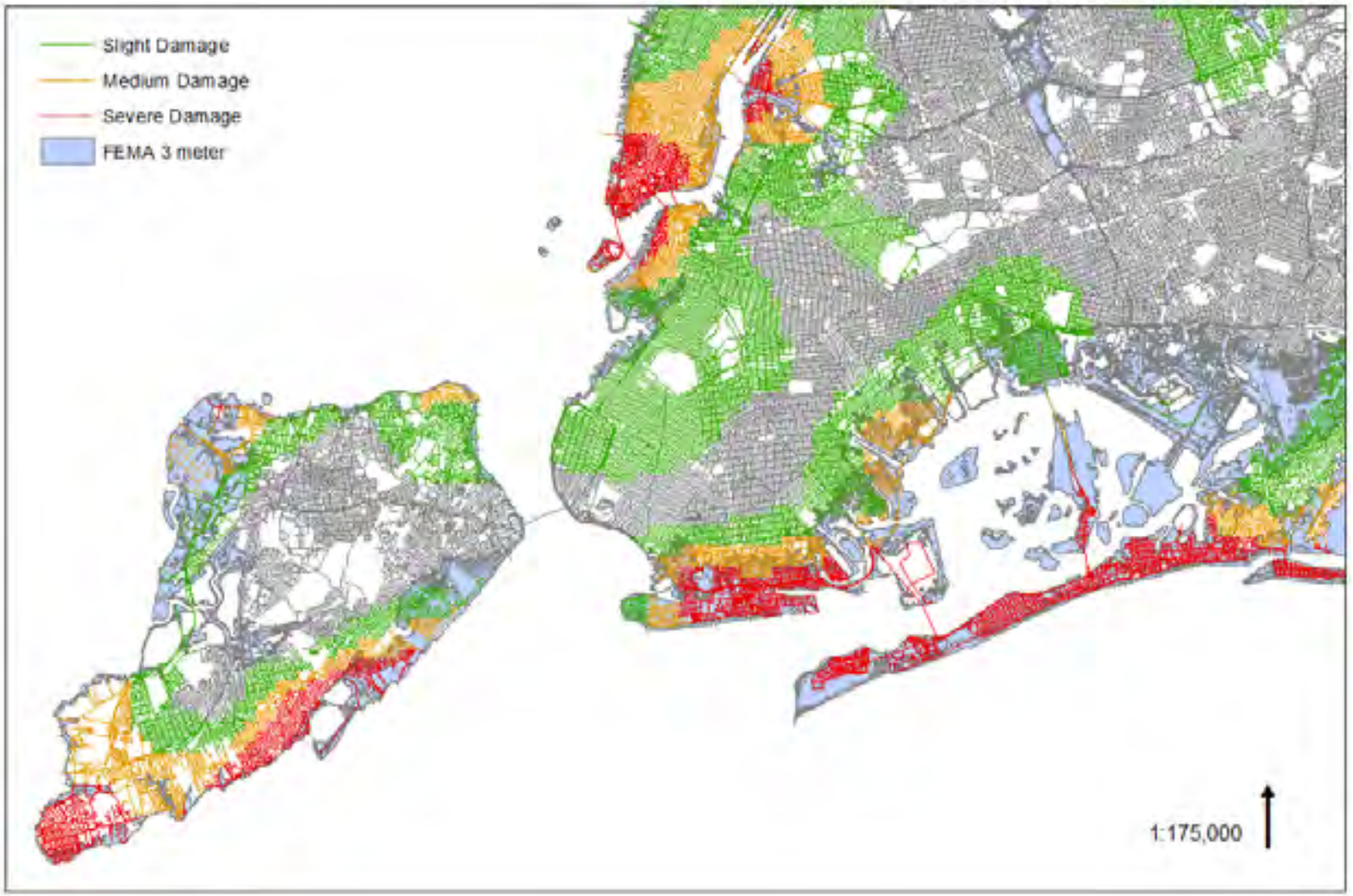
E. Shnebele, G. Cervone, C. Oxendine, N. Waters *Social Media and Remote Sensing Data Fusion for Post-Flood Traffic Assessment*, AAG Annual Meeting, Los Angeles, CA, April, 2013

Fema Flood Map

Damage Assessment

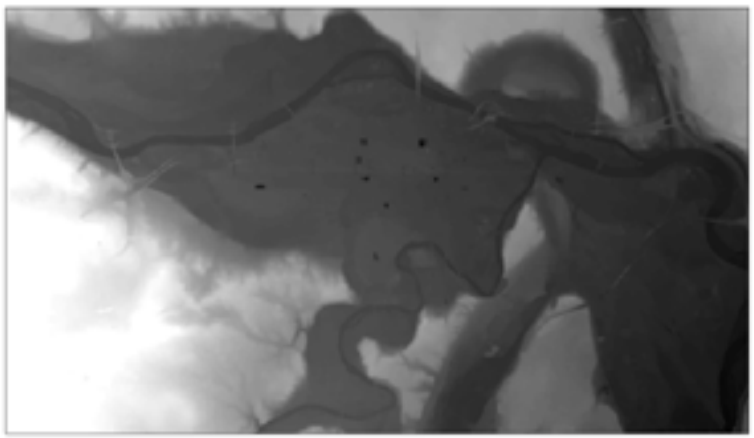


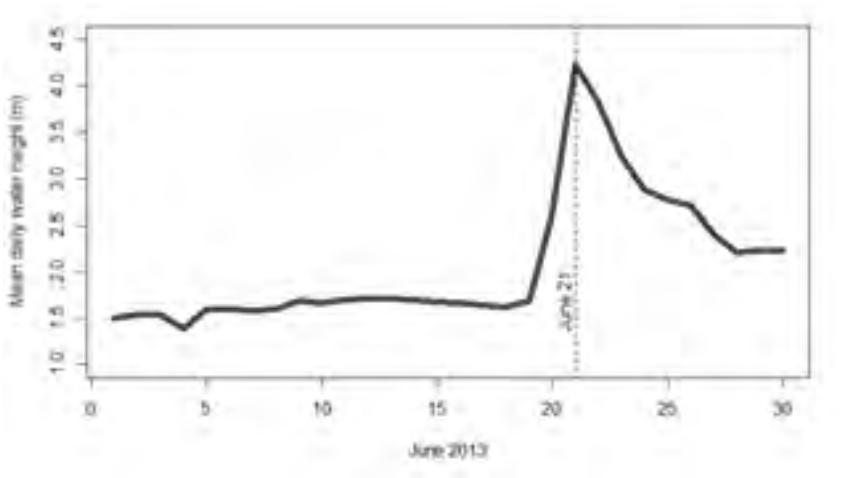
Road Assessment



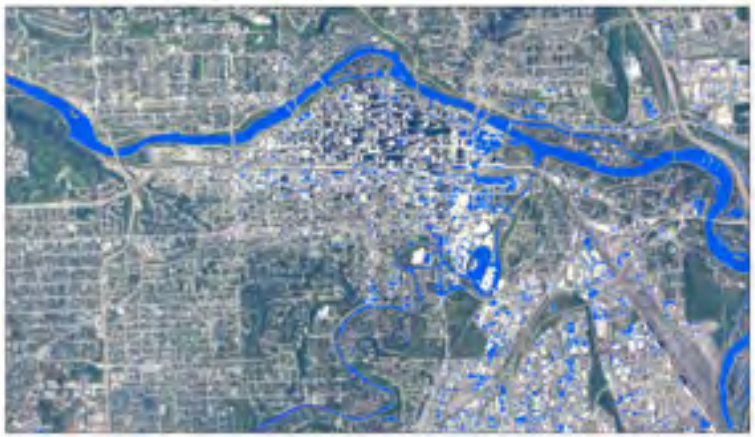
Floods in Calgary

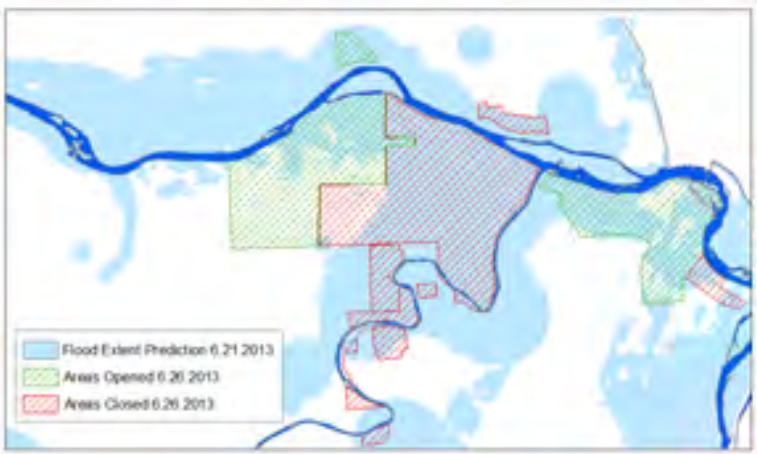
- Largest floods to date
- Remote sensing data before but not after





Water Classification





Temporal Estimation of the Floods

(a) June 21

(b) June 22

(c) June 23

(d) June 24

(e) June 25

(f) June 26

Why limiting to Social Media?

Non-authoritative Sources

- Pictures (e.g. Flickr)
- Videos (e.g. You Tube)
- Micro blogging (Tweets)
- Traffic Cameras
- Cell Phone Data
- News
- Power outage (e.g. NPP)

Conclusions

Summary

- Fill the gaps in remote sensing using social media
- Support HA/DR operations
- Real time analysis
- Identify when data are needed