

Empowering Citizens to Ground Truth Science

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National Geospatial Advisory Committee Meeting

Crowd-Sourced Data Spotlight Session

March 17, 2015

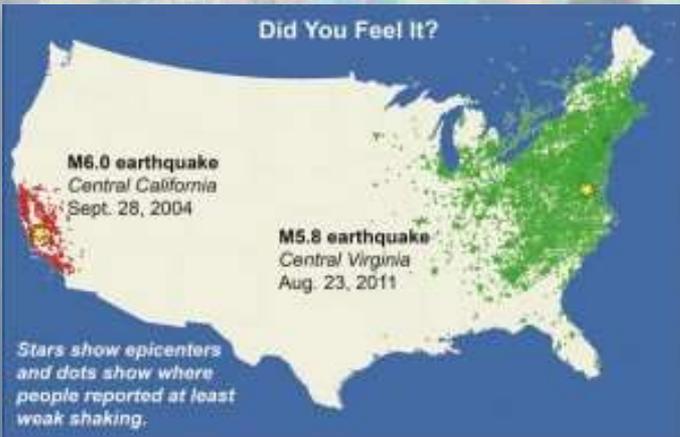
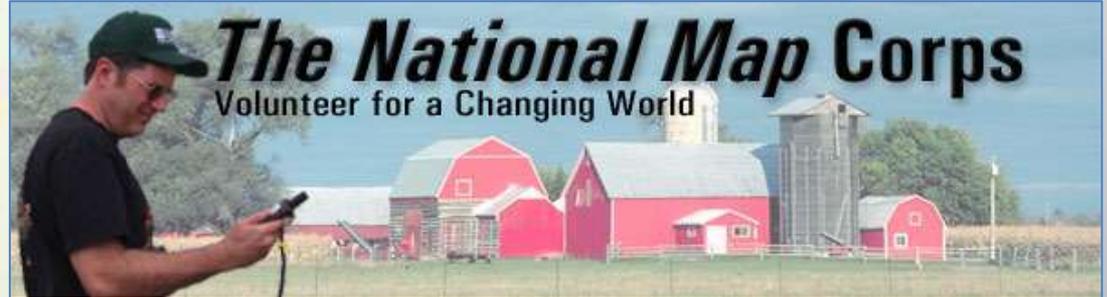
The Rise of Public Engagement

- **Citizen Science** is a form of open collaboration where members of the public participate in the scientific process in ways that may include identifying research questions, making new discoveries, collecting and analyzing data, interpreting results, developing technologies and applications, or problem solving.
- **Crowdsourcing** is a process where individuals or organizations submit an open call for voluntary contributions from a large group of unknown individuals (“the crowd”) or, in some cases, a bounded group of trusted individuals or experts.
- **Crowdmapping** is a process where individuals or organizations submit an open call for volunteered geographic information (VGI) or information with an associated geographic location from volunteers to produce collaborative maps.

(Definitions from the Federal Community of Practice for Crowdsourcing and Citizen Science)

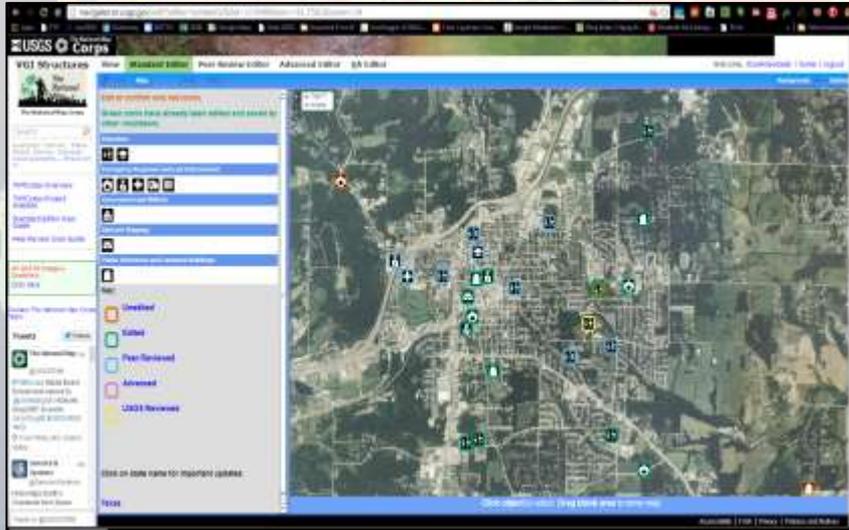
USGS Citizen Science Projects

<http://txpub.usgs.gov/myscience/>

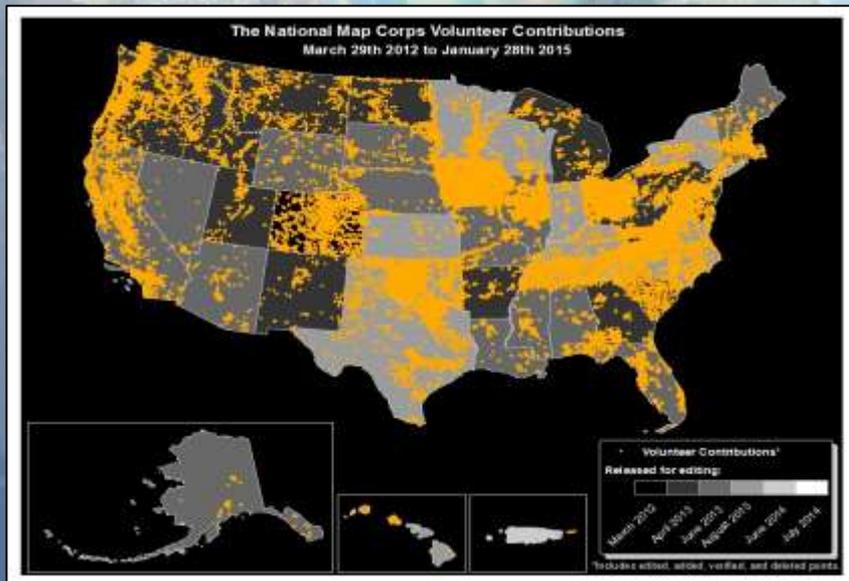


The National Map Corps

<http://nationalmap.gov/TheNationalMapCorps>

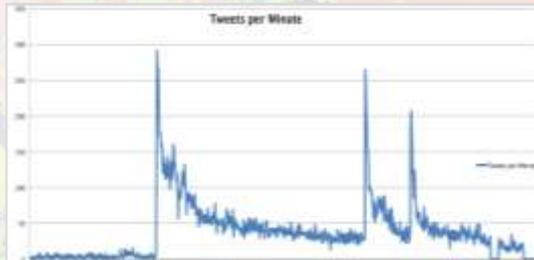


- Uses the Open Street Map platform but not the data due to licensing issues
- Volunteers map public building structures (e.g., police stations, post offices, schools, hospitals)
- Volunteered Geographic Information (VGI) is peer reviewed then officially integrated into The National Map
- Over 2,400 volunteers have contributed more than 116,000 points



Tweet Earthquake Dispatch

<http://earthquake.usgs.gov/earthquakes/ted/>



Los Angeles, California, United States (9/18) 2012/09/07 07:03:26 [Tedect]

USGSSted@usgs.gov <USGSSted@usgs.gov>

Fri, Sep 7, 2012 at 1:03 AM

Twitter event detection
NOT AN OFFICIAL USGS ALERT
NOT SEISMICALLY VERIFIED

Triggering Tweets

2012/09/07 07:03:26
UL: Los Angeles, CA
GEO: 34.053, -118.245 (C)
GEOB: Los Angeles, Los Angeles County, California, United States
TXT: Ok that earthquake I felt

2012/09/07 07:03:26
UL: Los Angeles, CA
GEO: 34.053, -118.245 (C)
GEOB: Los Angeles, Los Angeles County, California, United States
TXT: Quake!!!!

2012/09/07 07:03:26
UL: Inglewood, California
GEO: 33.862, -118.396 (C)
GEOB: Inglewood, Los Angeles County, California, United States
TXT: Earthquake

2012/09/07 07:03:26
UL: BOYZ N DA WOOD
GEO: (none, not used)
TXT: Earthquake

2012/09/07 07:03:26
UL: Local
GEO: 36.573, -90.623 (C)
GEOB: Cedar Hill, Jefferson County, Missouri, United States
TXT: EARTHQUAKE

Detection Time:

2012/09/07 07:03:26

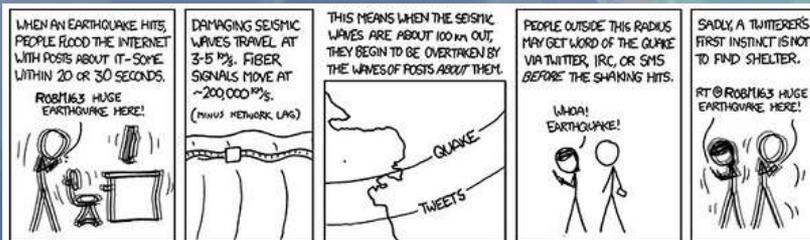
Possibly felt in:

Los Angeles, California, United States (9/18)
34.053, -118.245

City: Los Angeles
Level2: Los Angeles County
Level1: California
Country: United States

los 9
angeles 9
california 3

- Broadcast public Tweet alerts @USGSSted indicating frequency of earthquake tweets and official USGS scientific seismic data
- Internal alert system to detect felt earthquakes based on an event detector algorithm: $C(t) = STA / (mm * LTA + cc)$
- Twitter can be faster and can provide pre-seismological detections
- Detects lower magnitude felt earthquakes in populated but sparsely instrumented regions that can be missed teleseismically
- Inexpensive to develop, access, and use information from the crowd



Tweet Earthquake Dispatch

M 4.0 Hollis Center, Maine

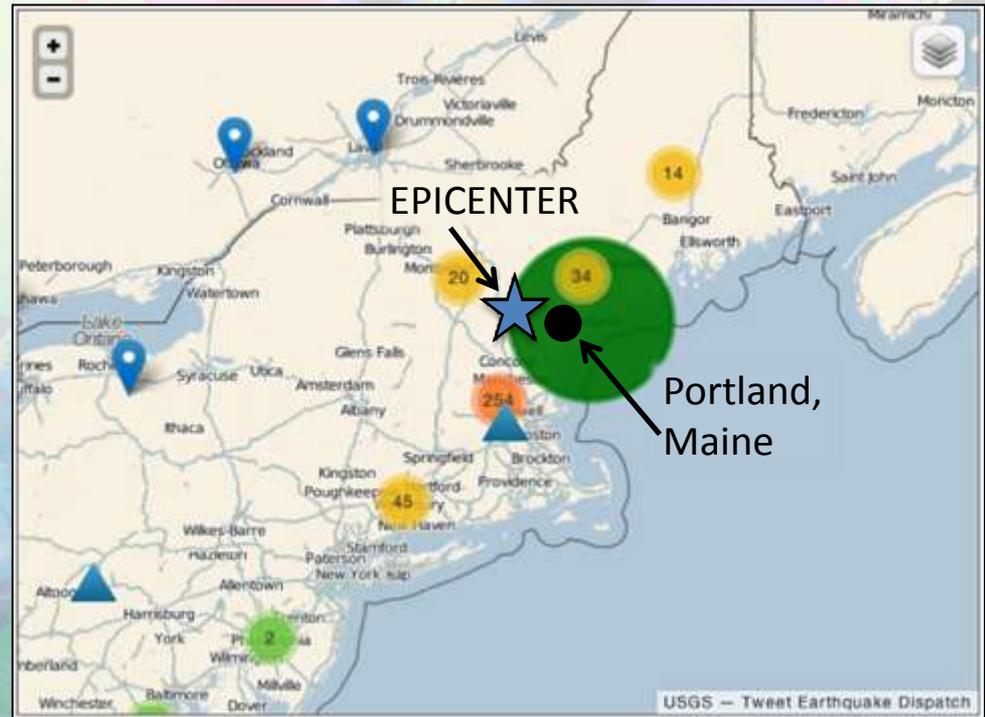
October 16, 2012

23:12:23 UTC (Origin Time)

Tweet Frequency:
2754 tweets / min

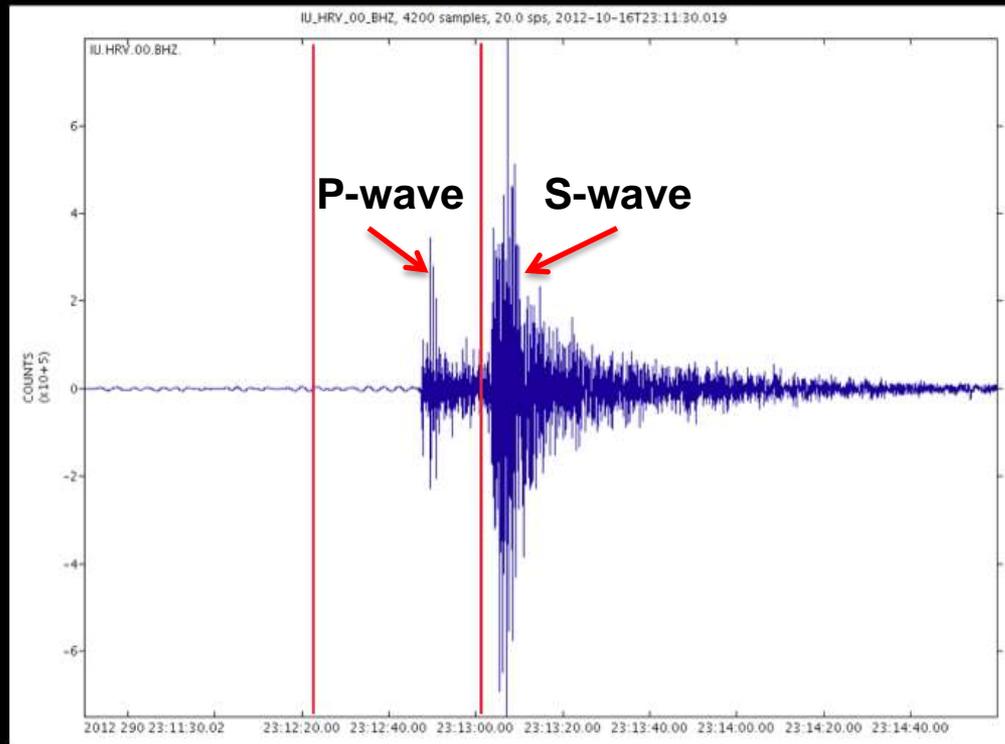
TED Alert Time:
23:13:02
39 seconds after origin time

TED Location Estimate:
Portland, Maine, USA
32 kilometers from epicenter



Tweet Earthquake Dispatch

Adam Dziewonski Observatory, Oak Ridge, MA, USA
(GSN) IRIS/USGS, Harvard University
142 km from Epicenter



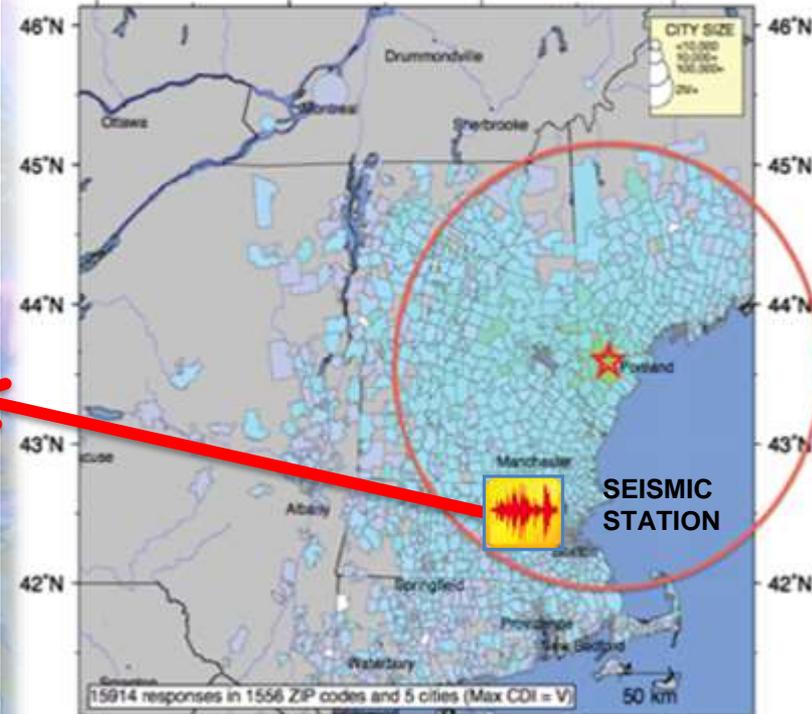
Origin Time
23:12:23

TED Alert Time
23:13:02

Location of the P-wave when Twitter alert was received in Golden

USGS Community Internet Intensity Map
MAINE

Oct 16 2012 07:12:22 PM local 43.5916N 70.6758W M4.0 Depth: 6 km ID:usb000d75b



INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
SANBAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

Processed Wed Oct 17 03:29:37 2012

iCoast – Did the Coast Change?

<http://coastal.er.usgs.gov/icoast>

The screenshot displays the iCoast web application interface. At the top, there is a USGS logo and navigation links. The main content area is divided into two panels: "PRE-STORM: Before Hurricane Sandy" (dated 21 May 2009) and "POST-STORM: After Hurricane Sandy" (dated 30 Nov 2012). Below these panels is a task interface titled "TASK 4: SPECIFY CHANGES TO COASTAL LANDFORMS". This interface includes two questions: "What changes do you see in the POST-storm photo for each coastal change process?" and "Which coastal change process is most dominant in the POST-storm photo?". The first question has four columns of buttons for "Beach Erosion", "Dune Erosion", "Overwash", and "Inundation", each with sub-options like "Loss Sand", "Dune Slump", "Sand Sheet", "Beach", etc. The second question has buttons for "Beach Erosion", "Dune Erosion", "Overwash", "Inundation", and "No Change". At the bottom, there is a map showing the "Probabilities of coastal erosion" for Hurricane Sandy (10/29/2012). The map uses a color scale from white (0-10%) to dark red (90-100%) to indicate erosion risk along the coast.

- USGS lacks the personnel and capacity to analyze all the USGS aerial photos taken after every storm.
- USGS coastal change prediction models need to be validated using geospatial ground truth data.
- Compare and classify aerial photos of the coast before and after extreme storms like Hurricane Sandy
- Ground truth and generate coastal change predictions using a Bayesian Network model
- Educate the public about coastal vulnerability from extreme storms

iCoast – Hurricane Sandy Project

967 Total iCoast users

574 Active users (60%)

7,941 All Post-storm photos classified

462,700 Tags selected in iCoast

45,650 Total classifications (not photos)

2 min 7 secs Average time to classify one photo



iCoast Users

➤ 967 Users

- 574 (60%) users have classified at least one photo
- 393 (40%) users have not classified any photos

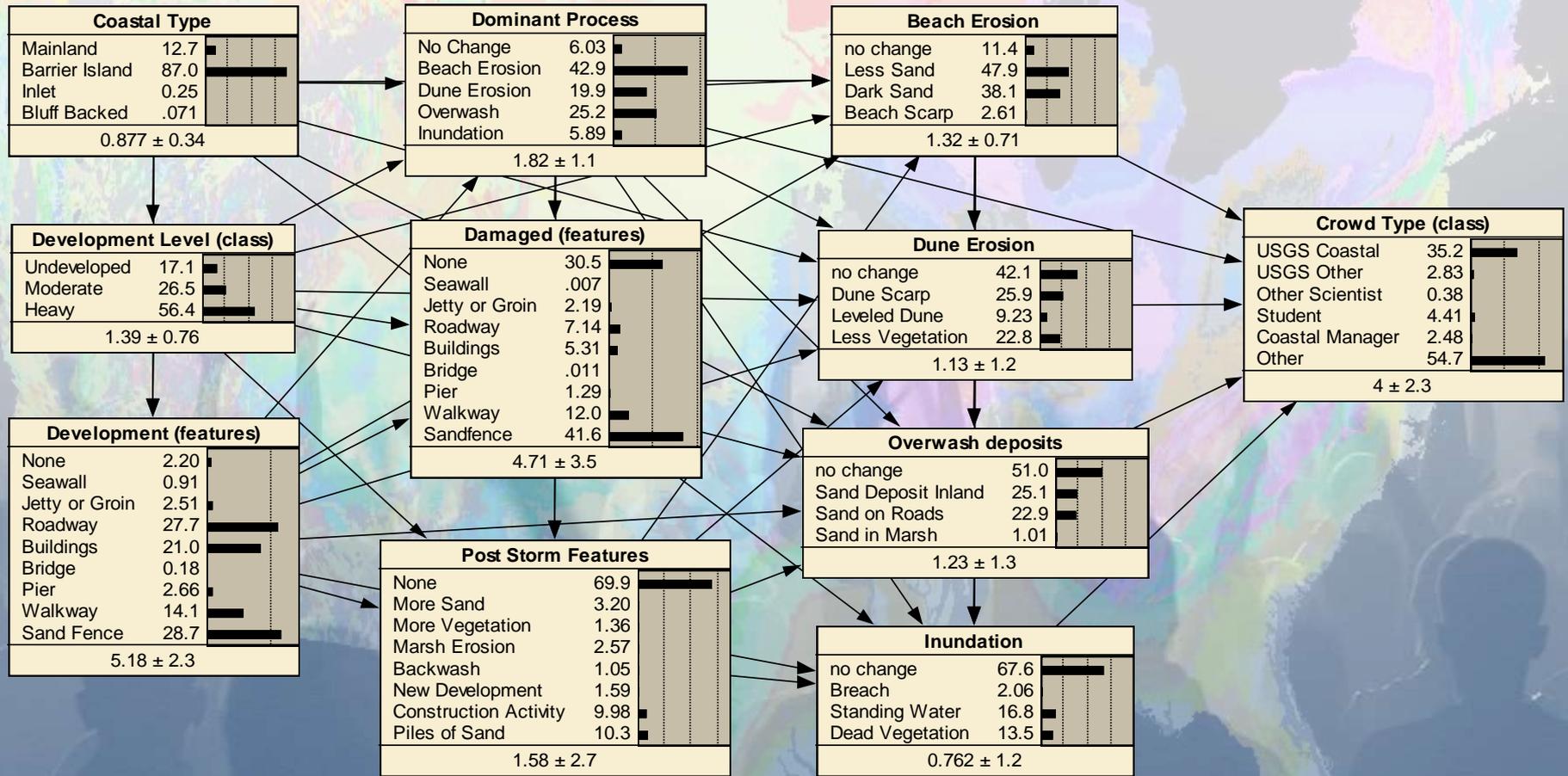
➤ Users by Crowd Type:

- 136 Coastal & Marine Scientist
- 39 Coastal Manager or Planner
- 77 Coastal Resident
- 23 Watersport Enthusiast
- 32 Marine Science Student
- 30 Emergency Manager
- 61 Digital Crisis Volunteer
- 282 Interested Public
- 286 Other

➤ Top Users:

- Over 4,700 classifications
- Retired Air Photo Interpreter
- CAP Airborne Photographer
- GISCorps Volunteers

Bayesian Network Approach

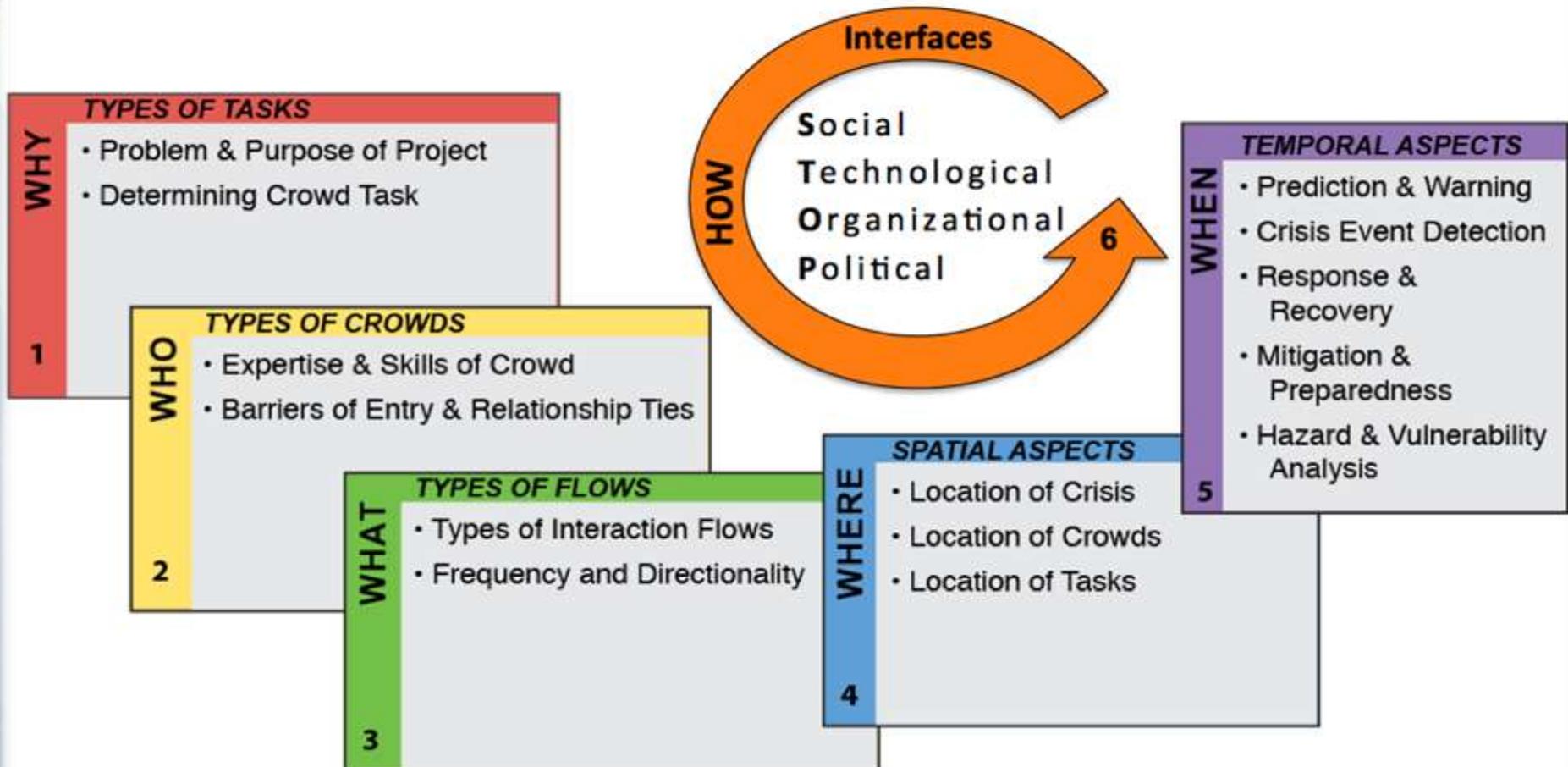


iCoast Results of Bayesian Analysis

- **Observer inputs and analysis have been used to train a Bayesian Network model capable of predicting the coastal process from evidence visible in the oblique aerial imagery.**
- **The Bayesian Network model can also predict likelihood of coastal infrastructure damage.**
- **The crowd-based analysis of the coastal change process was very similar to analysis conducted by USGS experts.**

Liu, Sophia B. (2014). **Crisis Crowdsourcing Framework: Designing Strategic Configurations of Crowdsourcing for the Emergency Management Domain.** *Computer-Supported Cooperative Work (CSCW) special issue on Crisis Informatics & Collaboration.*

Crisis Crowdsourcing Framework



Strategic Geo-Sourcing

- **Strategically crowd-sourcing the development of geospatial visualizations for Energy, Minerals, and Environmental Health USGS data and maps**
- **Engaging citizens at all levels of the research process particularly through geospatial storytelling**
- **Targeting geospatial visualization experts and enthusiasts through local hackathon meetups and the National Day of Civic Hacking June 6, 2015**

Ground Truth via Geospatial Imagery

