Crowdsourcing and Citizen Science at the U.S. Geological Survey

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USGS Acting Deputy Director

National Advisory Council for Environmental Policy and Technology

September 28, 2015

U.S. Department of the Interior
U.S. Geological Survey

USGS Mission

The USGS serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

Crowdsourced Data and Social Media:

An Infrastructure for Assessing & Monitoring Hazards, Geospatial Data, and Ecological Systems

- Did You Feel It?
- TED: Tweet Earthquake Dispatch
- Did You See It?
- Is Ash Falling?
- Quake Catcher Network
- National Map Corps
- iCoast, iPlover
- National Phenology Network
- Nonindigenous Aquatic Species (NAS) database
- Crowd Hydrology/Social Water
- Cricket Crawl
- Bird Phenology Program, Bird Breeding Survey
- And More!

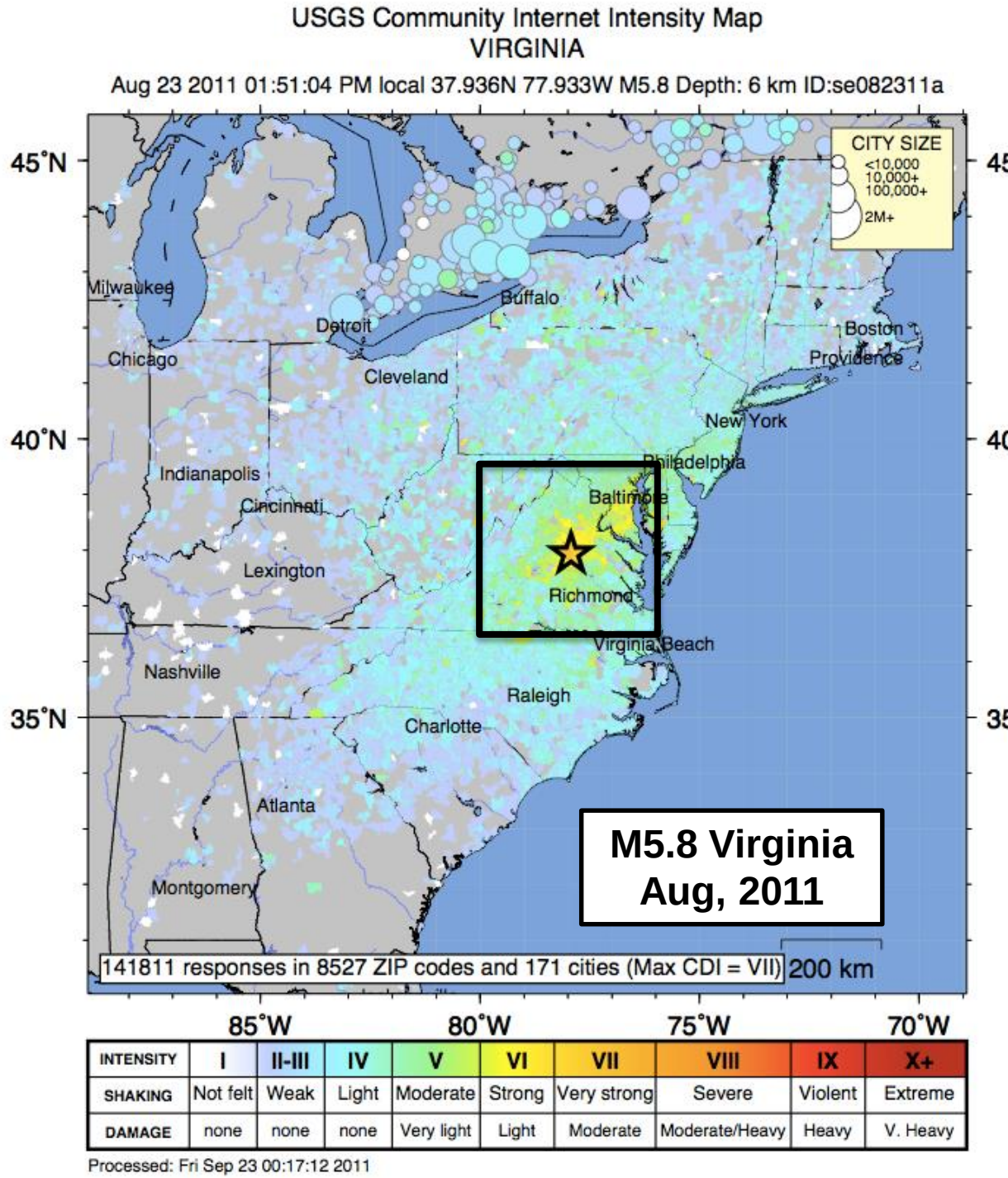
USGS

Did You Feel It?

Rapid & automatic intensity maps based on felt reports submitted online.

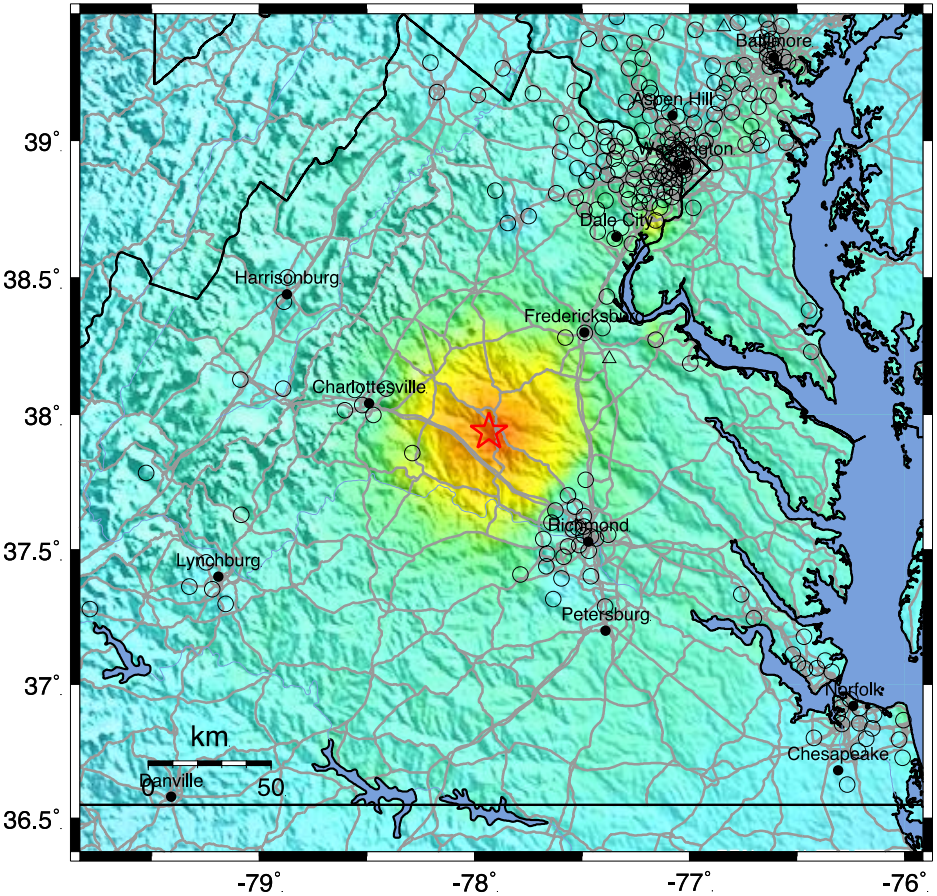
- Users answer simple online questionnaire.
- Color-code ZIP-code to community's average intensity.
- Replaces traditional postal questionnaire.

USGS



USGS ShakeMap : VIRGINIA

Tue Aug 23, 2011 17:51:04 GMT M 5.8 N37.94 W77.93 Depth: 6.0km ID:082311a

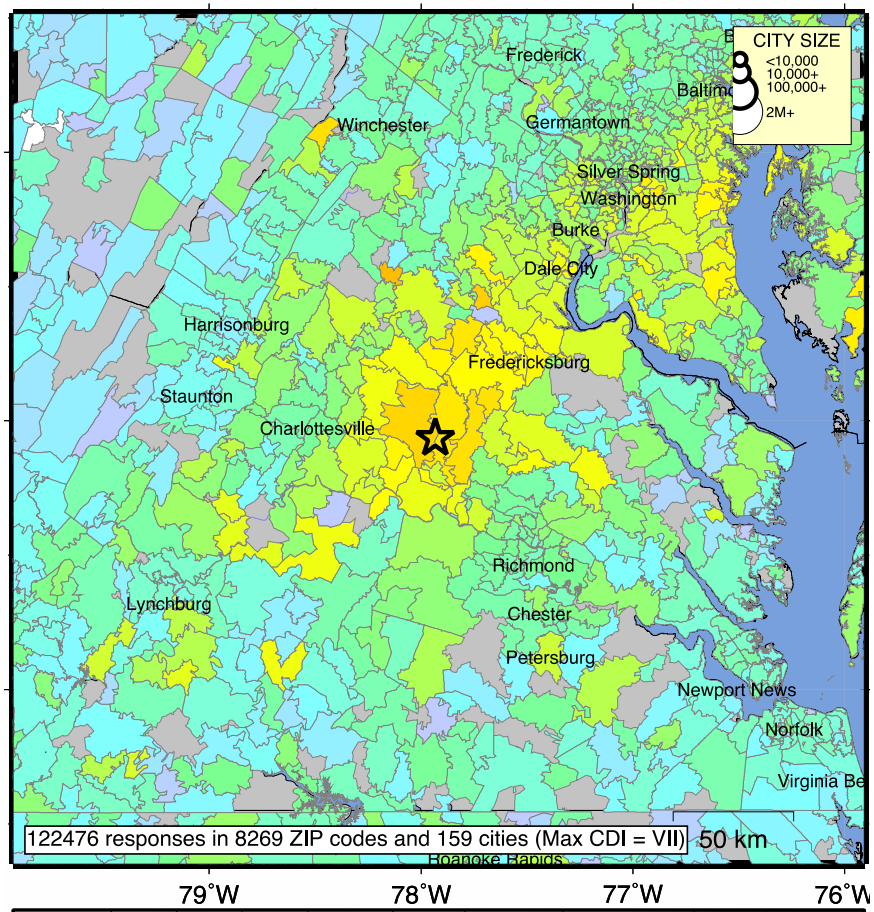


Map Version 4 Processed Tue Aug 23, 2011 01:50:45 PM MDT -- NOT REVIEWED BY HUMAN

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

USGS Community Internet Intensity Map VIRGINIA

Aug 23 2011 01:51:04 PM local 37.936N 77.933W M5.8 Depth: 6 km ID:se082311a



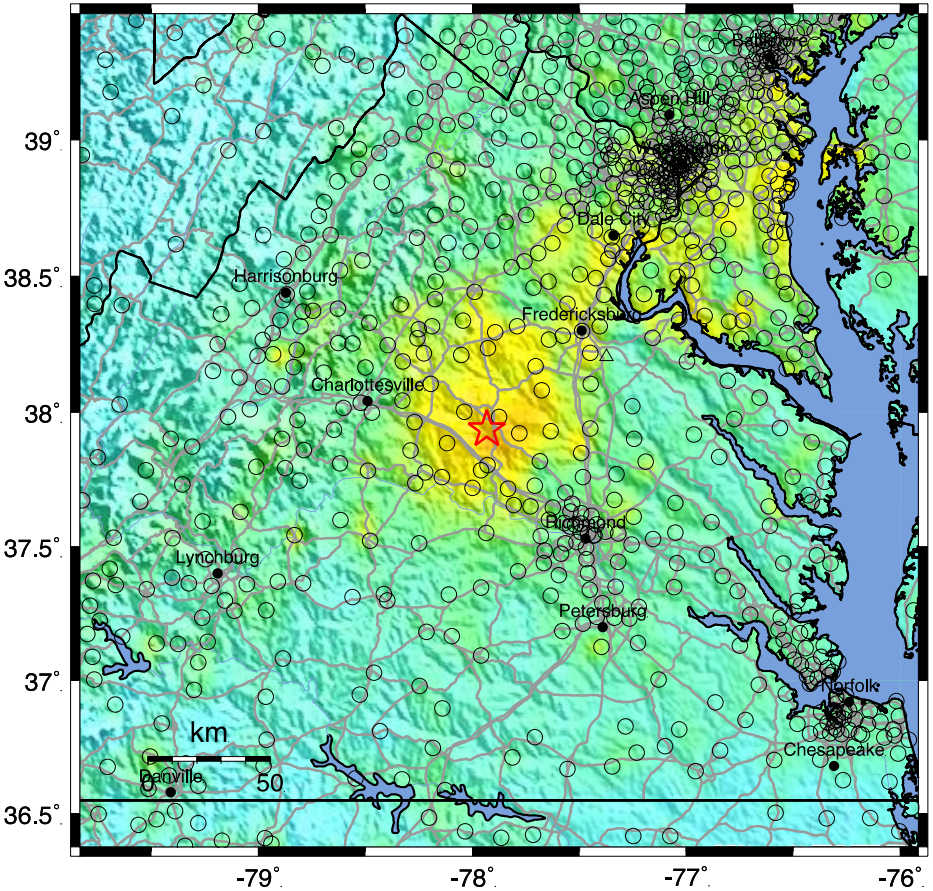
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

Processed: Wed Aug 24 11:12:25 2011

ShakeMap

USGS ShakeMap : VIRGINIA

Tue Aug 23, 2011 17:51:04 GMT M 5.8 N37.94 W77.93 Depth: 6.0km ID:082311a



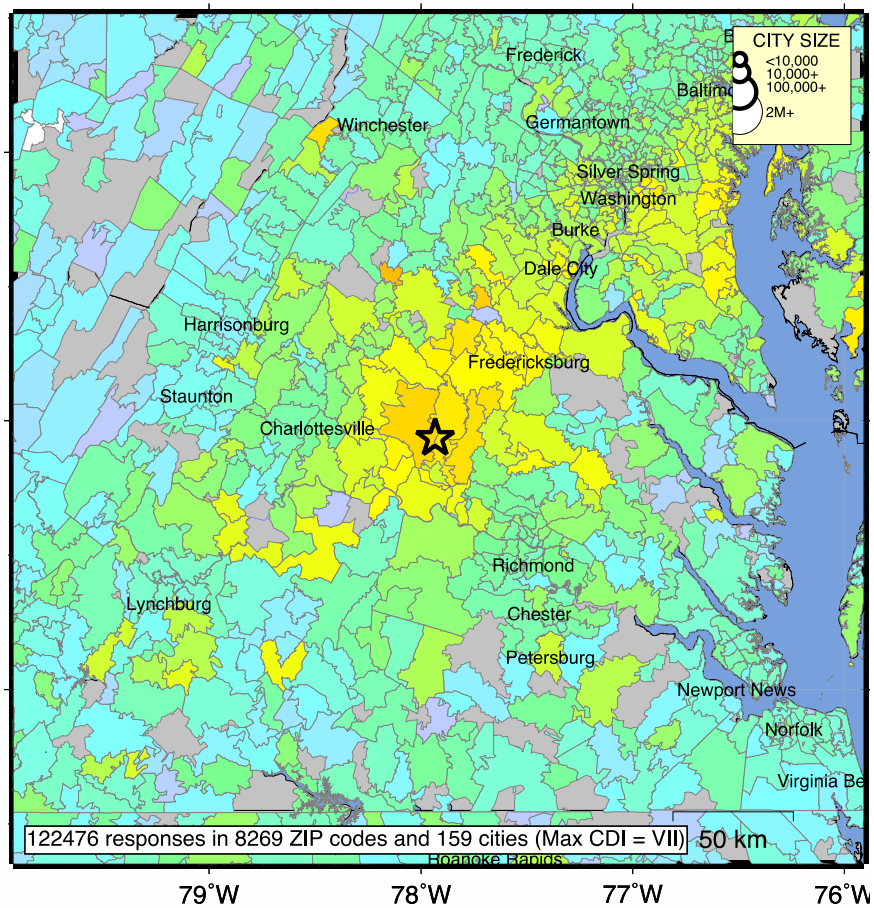
Map Version 6 Processed Wed Aug 24, 2011 08:50:09 AM MDT -- NOT REVIEWED BY HUMAN

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

"Did You Feel It?"

VIRGINIA

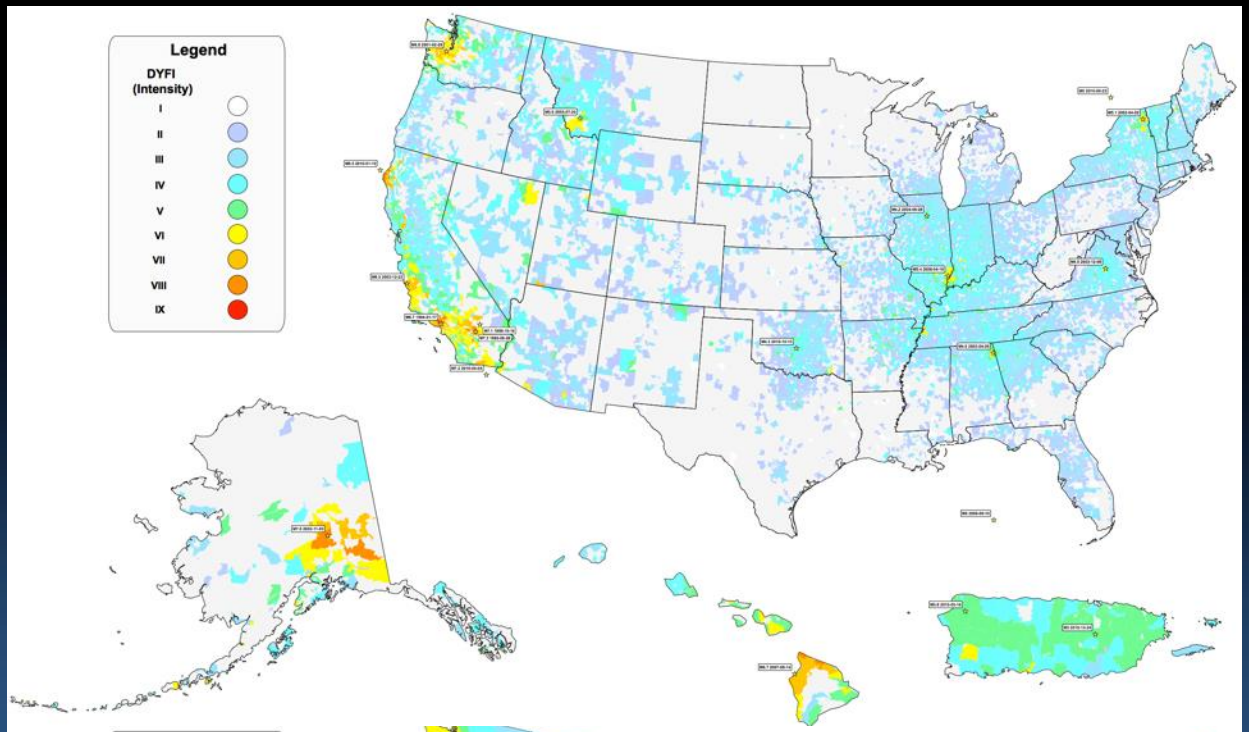
Aug 23 2011 01:51:04 PM local 37.936N 77.933W M5.8 Depth: 6 km ID:se082311a



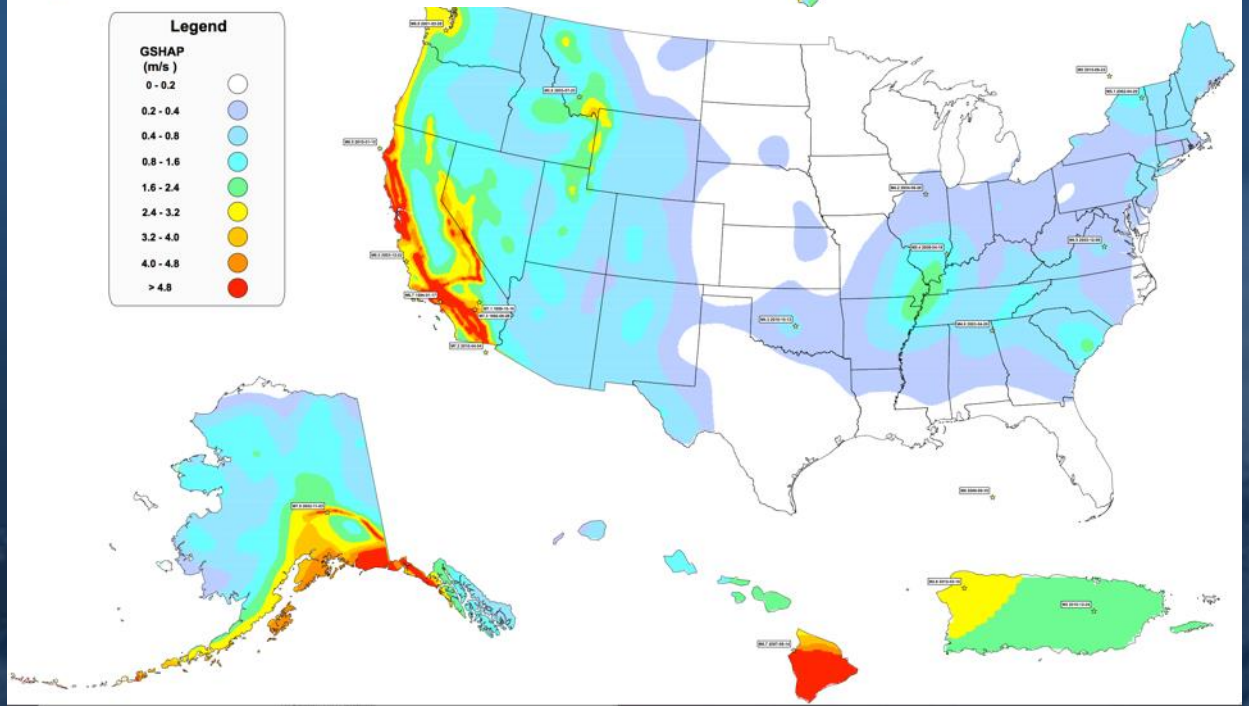
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

Processed: Wed Aug 24 11:12:25 2011

10 Years of DYFI Data (~2 *million* responses)



USGS National Seismic Hazard Map (2% in 50 Year Probability of Exceedence)



USGS

TED: Tweet Earthquake Dispatch

- Alerts for earthquakes worldwide with M 5.5+.
- Magnitude descriptor, location, origin time, link to USGS webpage.
- Alerts include frequency of tweets in event region that contain the word “earthquake” or its equivalent in several languages.

Did You See It?
Landslide Reporting

Landslide Summary

Location Required

Address, zip code, or other information to describe the landslide location.

Input Coordinates Instead

When did you first see the landslide? Required

This may be different than when the landslide occurred.

Date Format: 2011-08-31

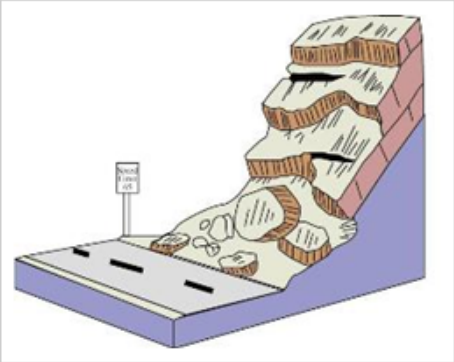
12:00 AM

Landslide Type

Hover your mouse over each option for additional information, or see:

- Fall
- Flow
- Topple
- Rotational
- Translational

A **fall** occurs when a mass of any size detaches from a steep slope or cliff and descends mostly through the air by freefall, bouncing, or rolling.



- Enables crowd-sourced, online landslide reports
- Qualitative information may be used in USGS reports

Is Ash Falling?

- New system collects public ash fall observations and accumulations
- Users invited to submit observations during an eruption, worldwide
- Information will help USGS and NWS scientists track eruption clouds and ash fallout, and refine ash fall modeling efforts

http://www.avo.alaska.edu/ashfall/ashreport.php

USGS

Quake-Catcher Network

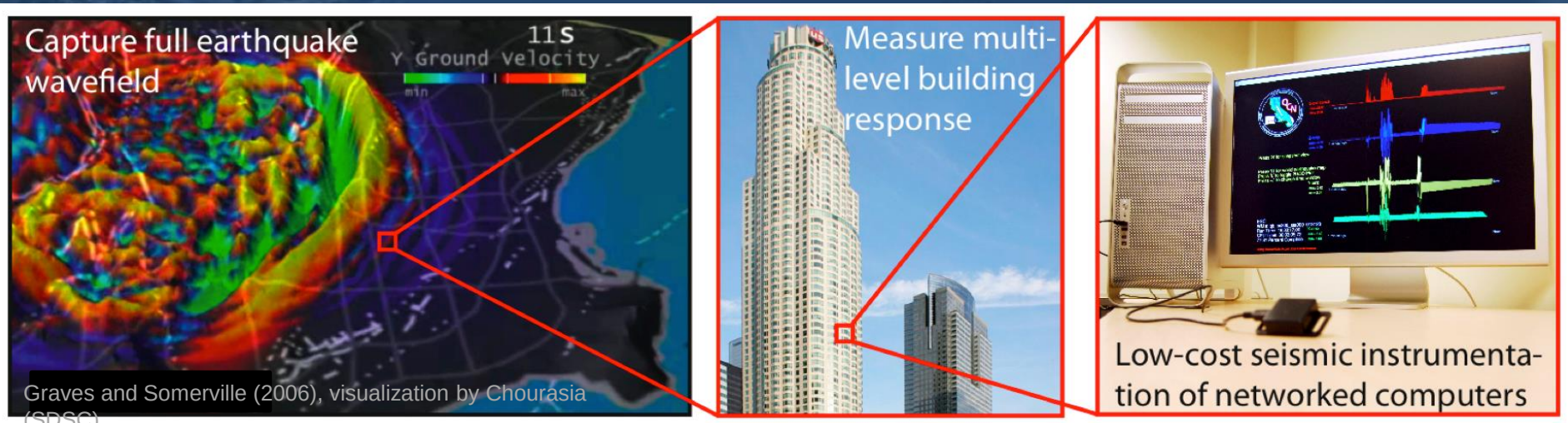
http://qcn.stanford.edu

Dense strong-motion (M>3) network:

- Involves the public in seismic data collection by installing low-cost sensors in homes, businesses and schools

Objectives:

- * Community understanding of earthquake risk and seismology
- * Rapid earthquake detection and characterization
- * Earthquake source imaging
- * Wave propagation

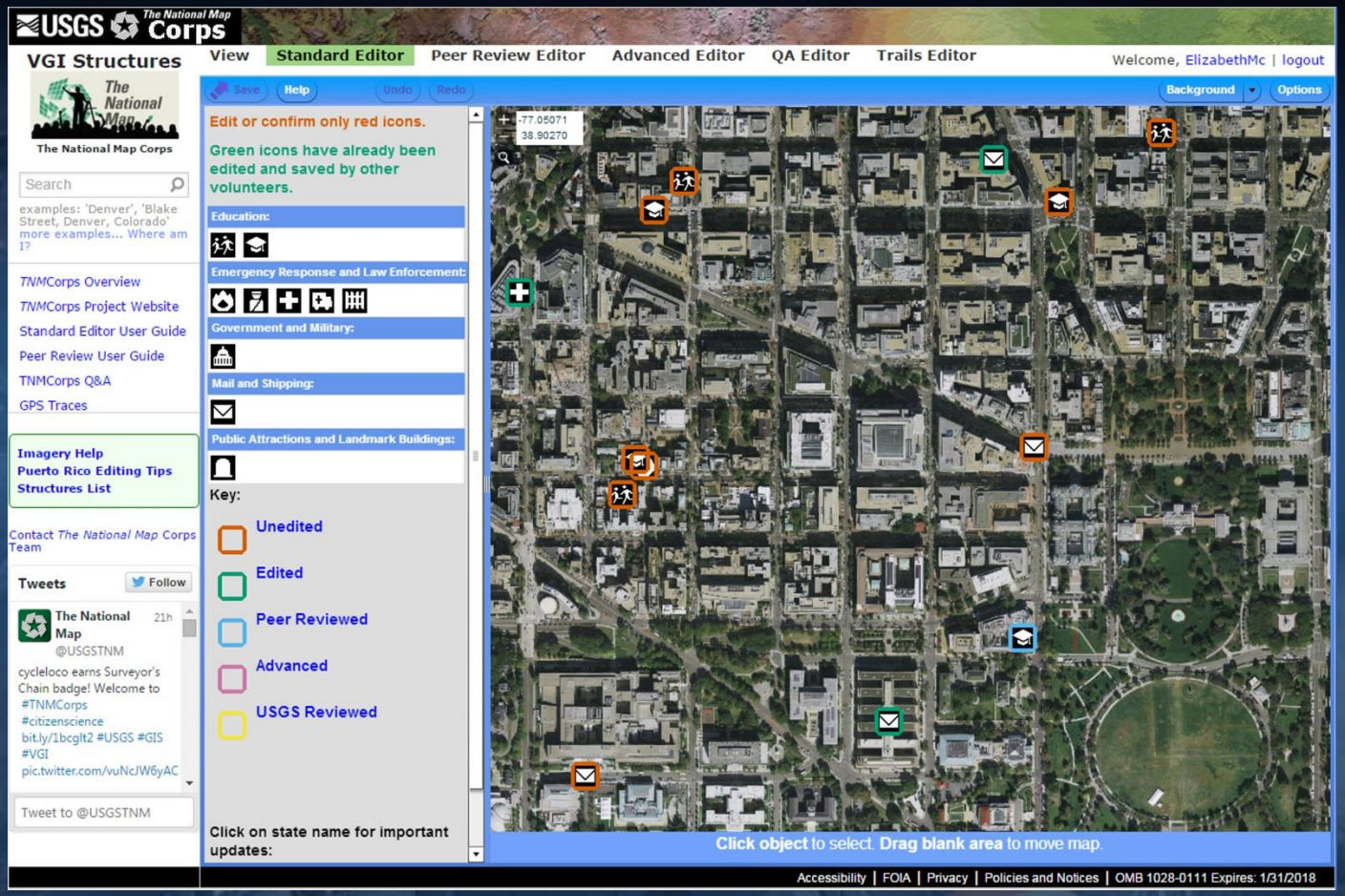


Graves and Somerville (2006), visualization by Chourasia (SDSC)

National Map Corps

Crowdsourcing used to update USGS mapping data

- Volunteer Map Editors (general public)
- > 2,800 volunteers
- 10 structures-nationwide
- 147,000 points since 2013
- Data become part of The National Map and US Topo Maps



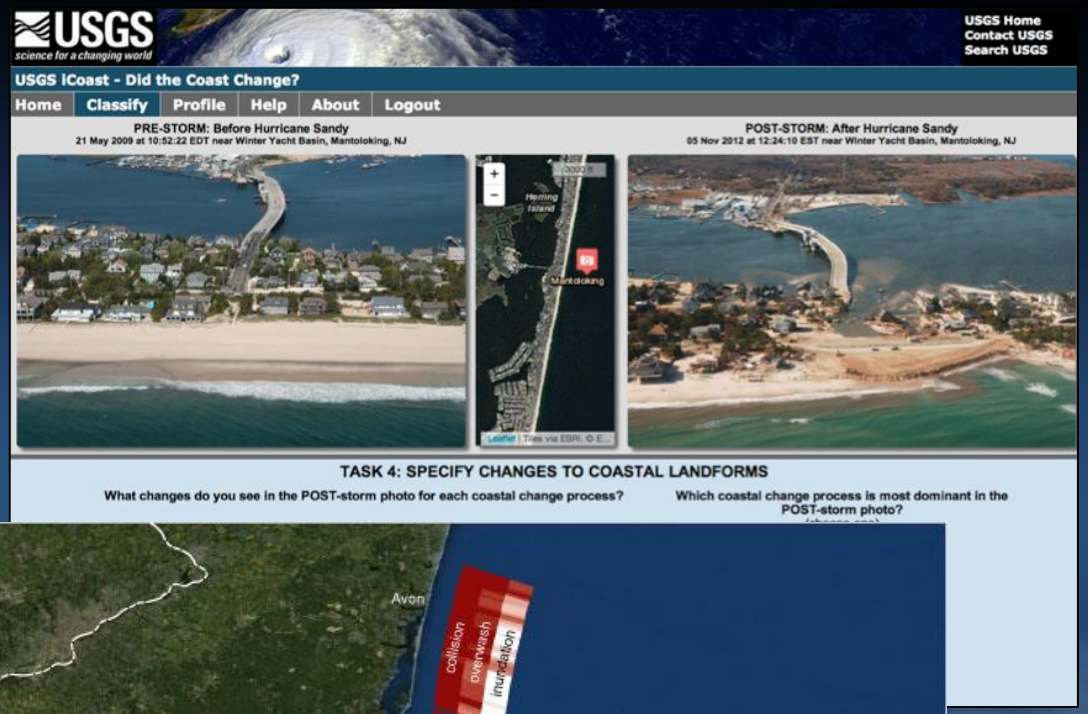
USGS

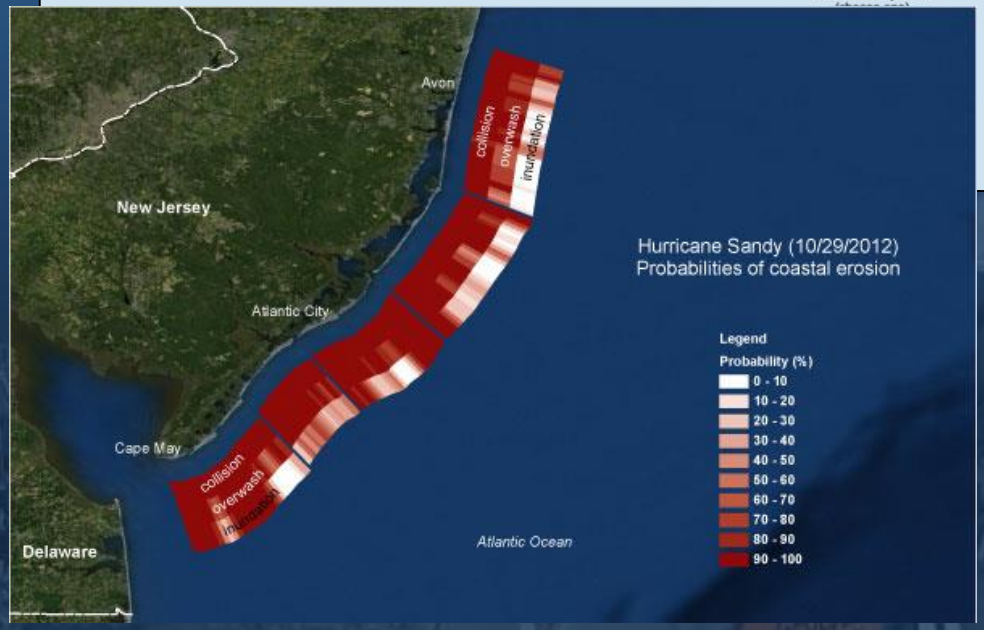
https://navigator.er.usgs.gov nationalmapcorps@usgs.gov

iCoast – Did the Coast Change?

Crowdsourcing to groundtruth prediction models

- Compare and classify aerial photos of the coast before and after Hurricane Sandy
- Ground truth and generate coastal change predictions using a Bayesian Network
- Educate the public about coastal vulnerability from extreme storms

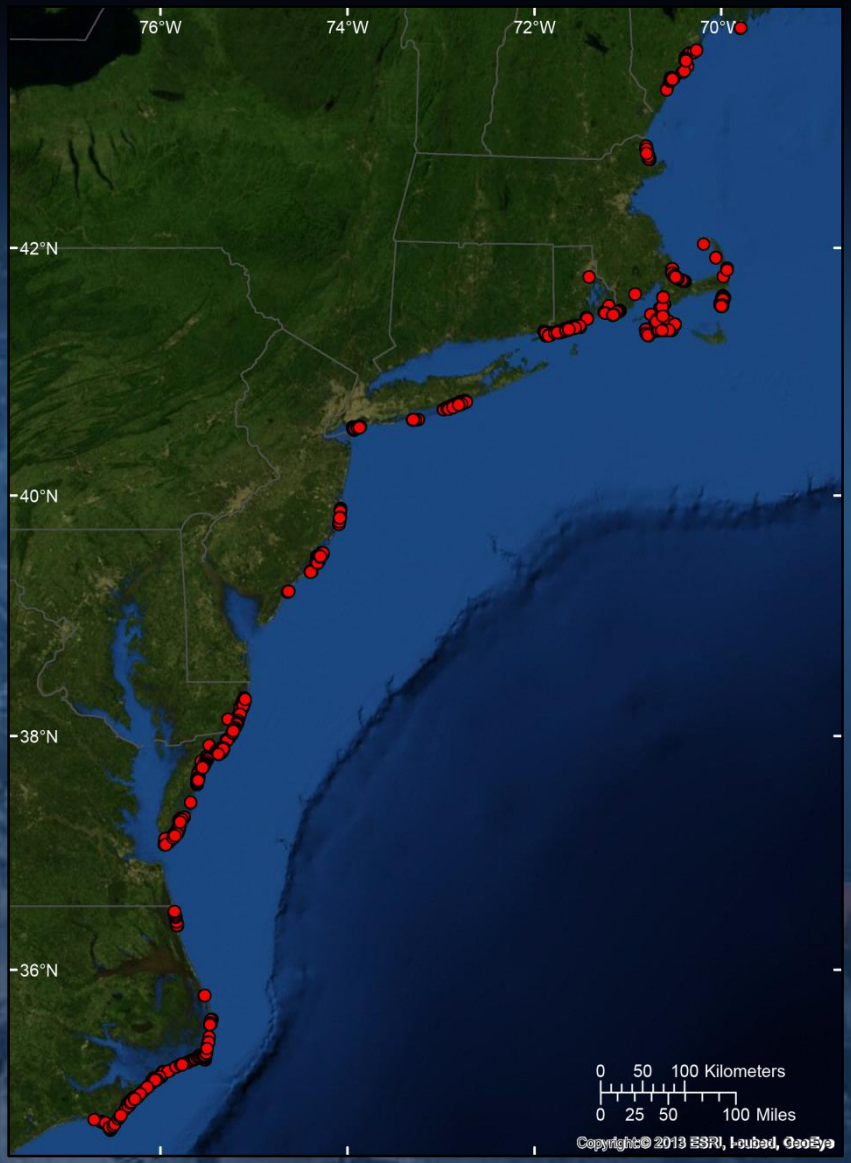




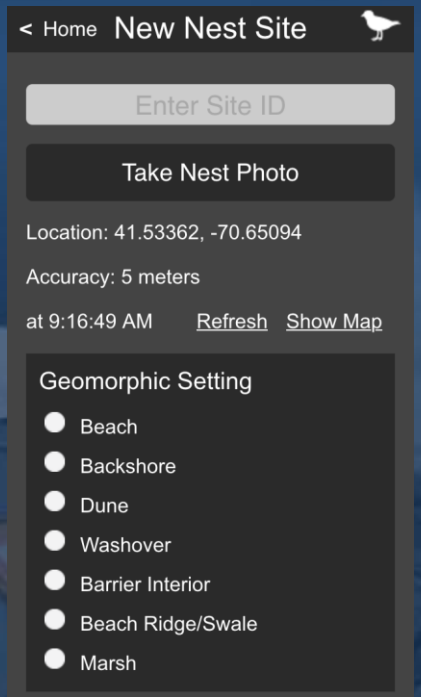
coastal.er.usgs.gov/icoast

USGS

iPlover app- Forecasting the effects of sea-level rise on piping plovers



- Extensive DOI, state, NGO partner network
- Great way to collect a lot of data quickly using standardized protocols
- Vastly increases spatial domain
- Bayesian network analysis can deal with fuzzy observations



A critical tool for enabling adaptive responses to climate change

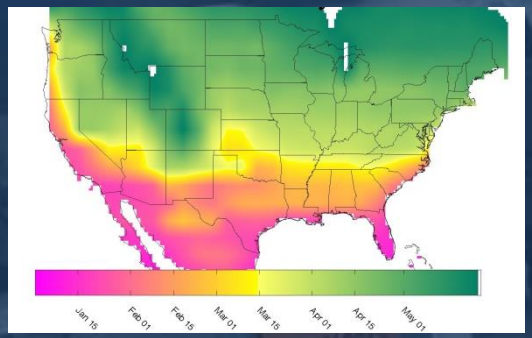
Phenology: the study of seasonal plant and animal life cycle events

Phenology…

- Is simple to record and understand
- Integrates biological and physical processes across scales
- Informs human & ecosystem health, agriculture, recreation…
- Data + models = human adaptation to climate change

Nature's Notebook…

- A national monitoring initiative for scientists & citizens
- Engages agencies, NGOs, academia, public
- Standard protocols for plants & animals
- Quality observations from 1000s of stations
- On-line data entry, tools, maps, stories, downloads
- Provides capacity for other science networks (e.g., NEON)
- Education: train future scientists, improve data quality
- Remote sensing facilitates scaling from leaf to globe



Modeled "onset of spring" (2014)

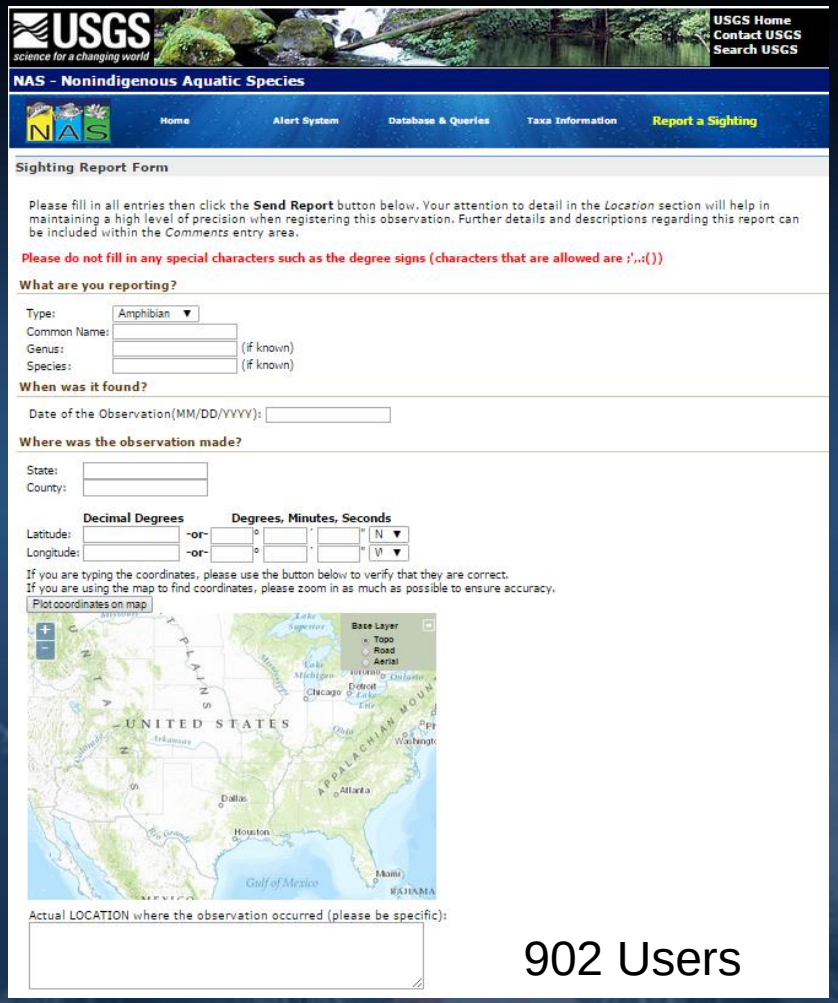
USGS

www.usanpn.org/natures_notebook

Nonindigenous Aquatic Species Database

- Central repository for spatially referenced biogeographic records of introduced aquatic species
  - >380,000 records for 1,075 spp.
  - Data from 1790 -> present
- Sighting Report form
  - Official reporting form for Aquatic Nuisance Species Task Force
  - Allows public submissions

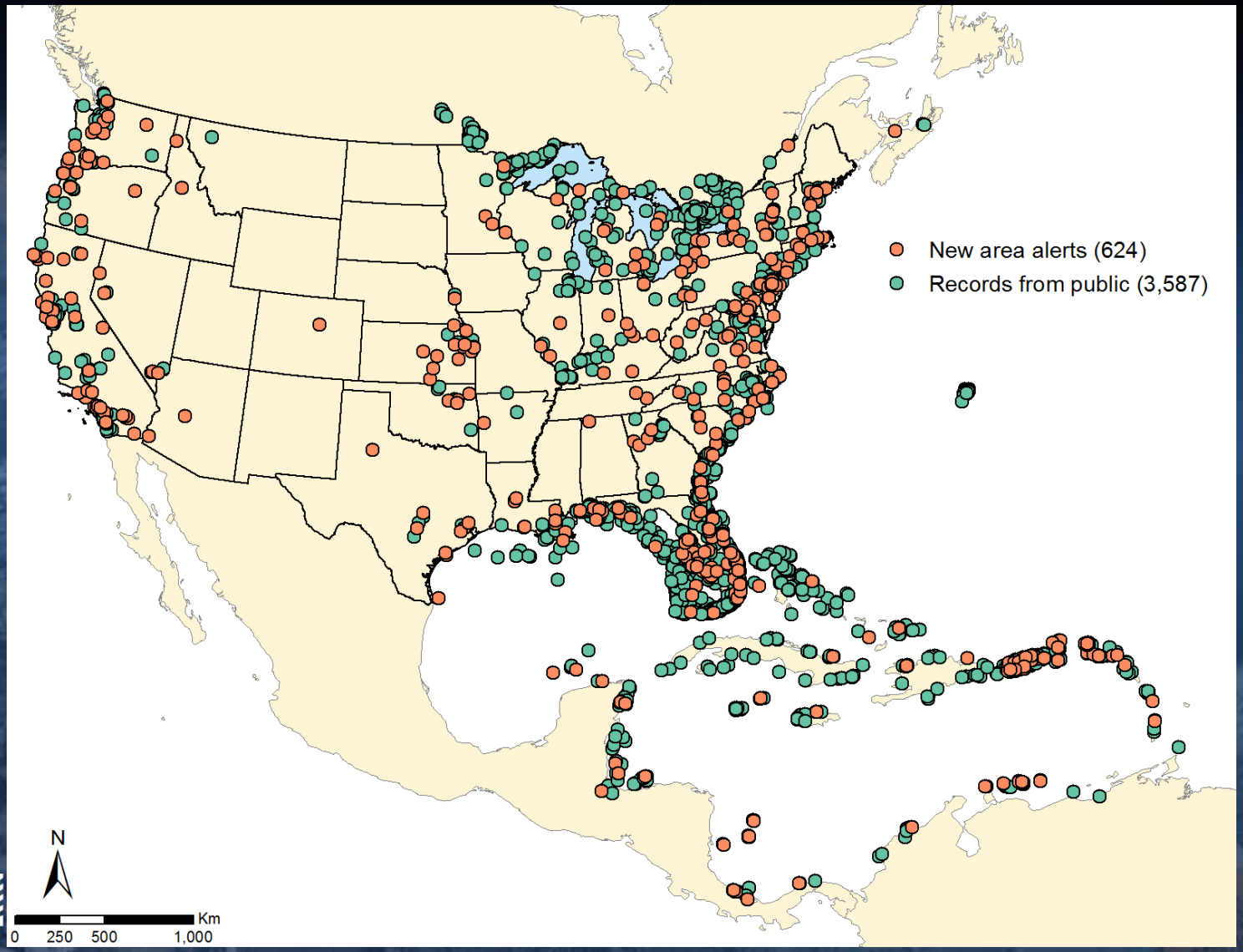
http://nas.er.usgs.gov
http://nas.er.usgs.gov/SightingReport.aspx
http://www.usgs.gov/stopANS



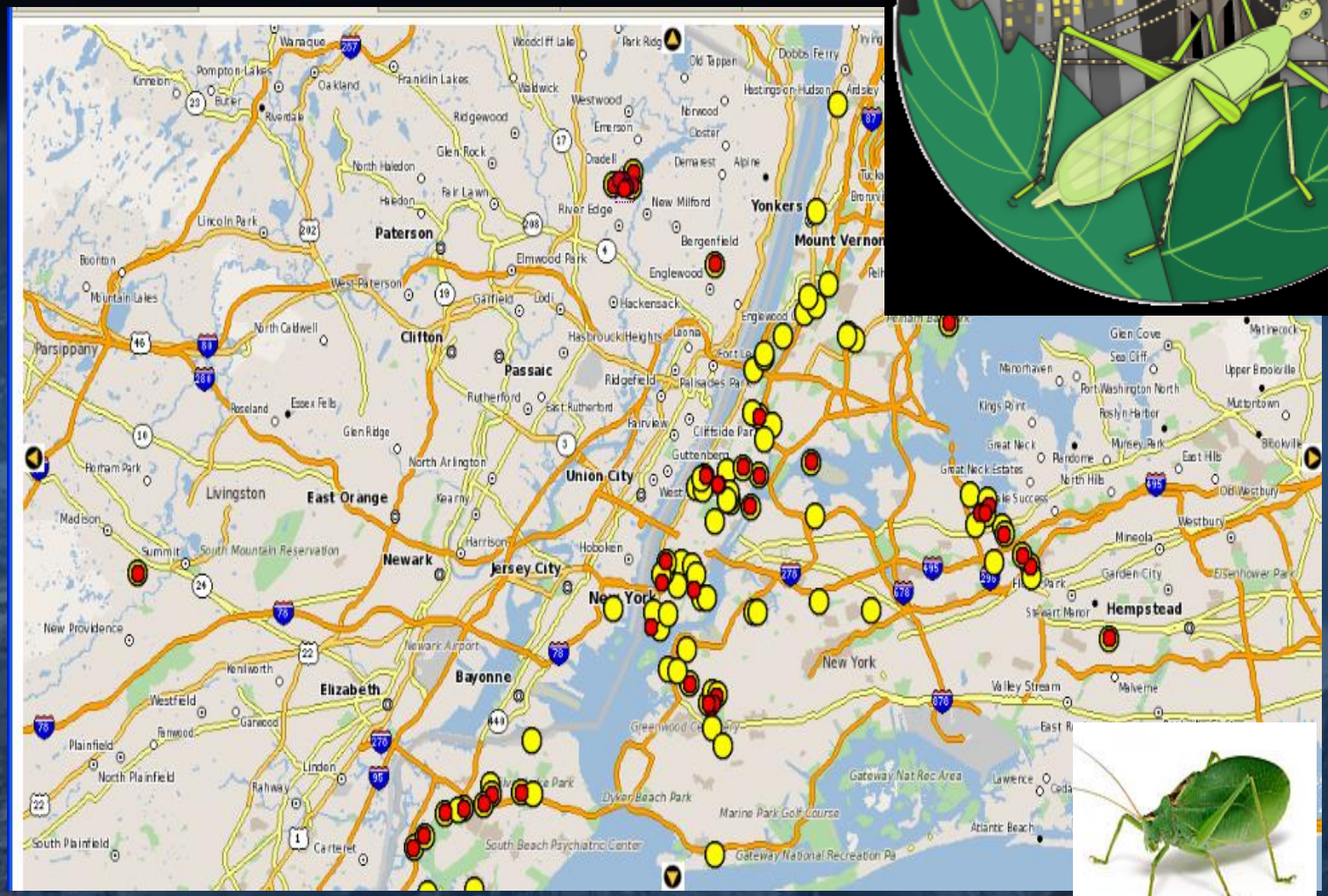
902 Users

USGS

Nonindigenous Aquatic Species (NAS) sighting reports from public



NYC Cricket (and Katydid) Crawl

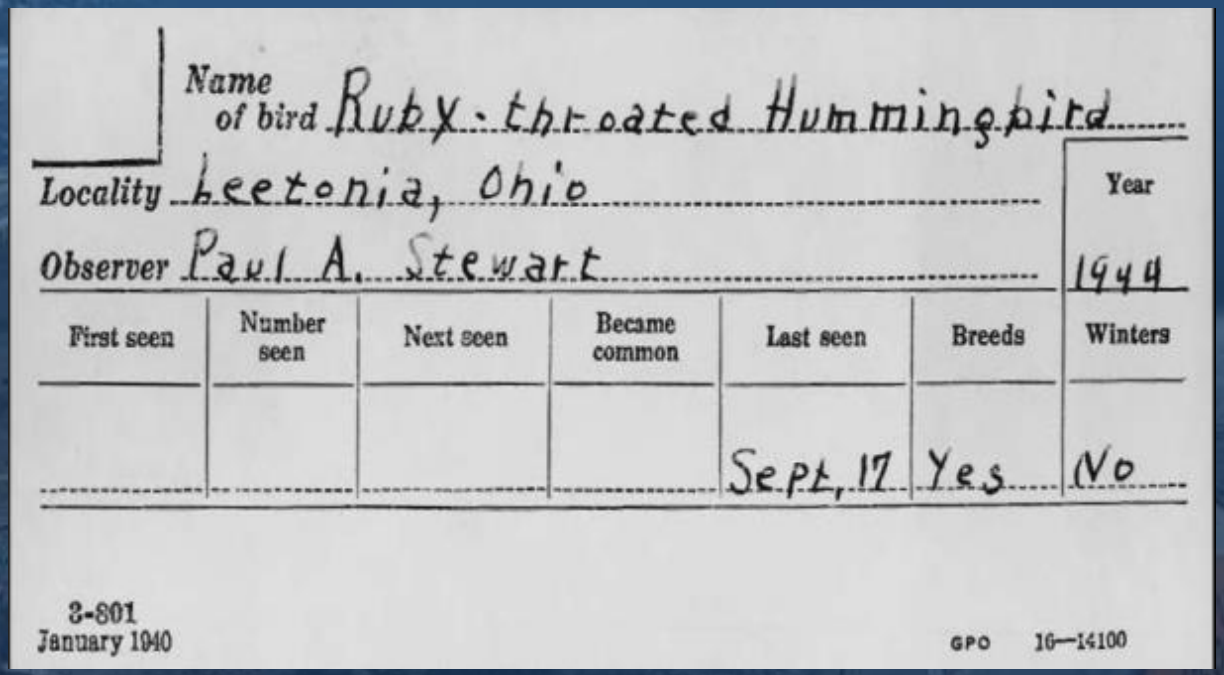


USGS

North American Bird Phenology Program

- Provides access to one of the largest historical, climate change-relevant datasets.
- Houses a unique and largely forgotten collection of several million migration cards that illuminate migration patterns and population status of birds in North America.

Transcribing about 40,000 records/month!



Name of bird Ruby-throated Hummingbird

Locality Leetonia, Ohio

Observer Paul A. Stewart

Year 1944

First seen	Number seen	Next seen	Became common	Last seen	Breeds	Winters
				Sept. 17	Yes	No

3-801
January 1940

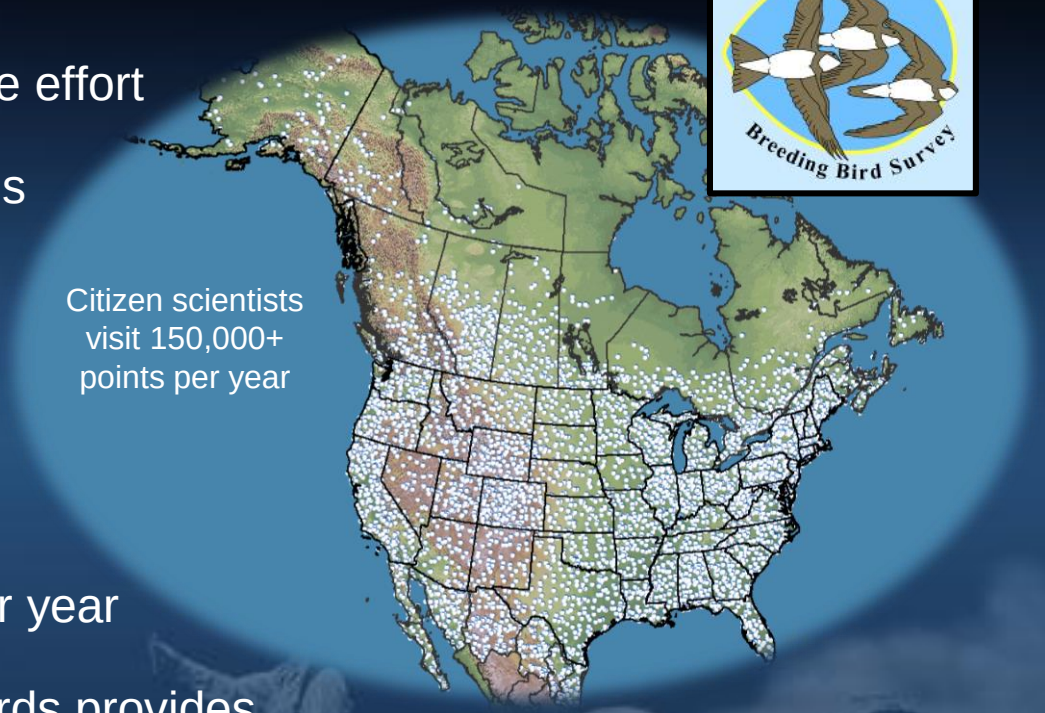
GPO 16—14100

USGS

North American Breeding Bird Survey (BBS)

The foundation of non-game, landbird conservation in North America

- Celebrating 50 years of worldwide recognition as a model for efficient wildlife monitoring
- USGS leads international cooperative effort
- Among the most scientifically rigorous of citizen science programs
- Over 1,800 highly-skilled volunteers participate each year
- Highly standardized bird counts are conducted at over 150,000 points per year
- Database of over 87 million bird records provides a continent-wide picture of the health of bird populations

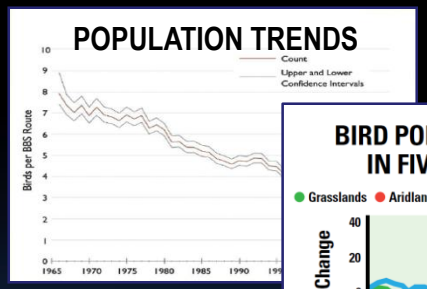


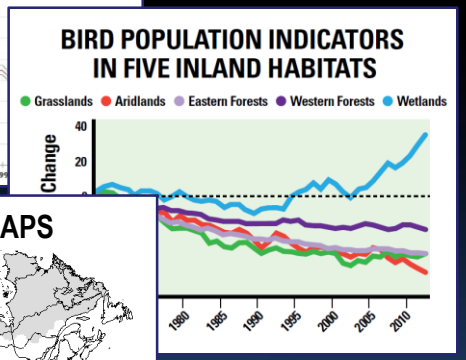
www.pwrc.usgs.gov/bbs

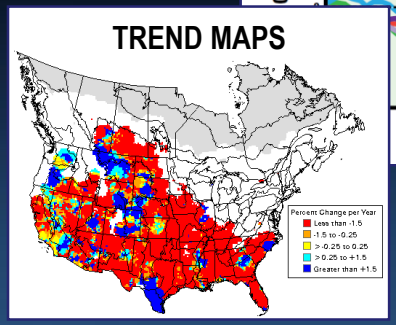
USGS

BBS products and real-world applications

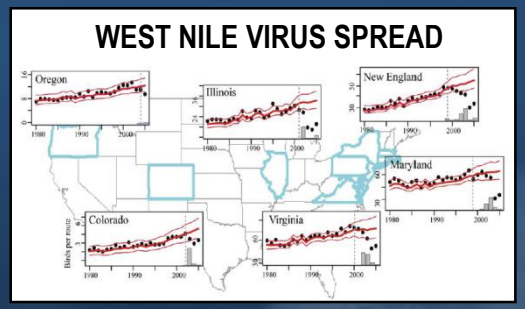
- BBS provides analyzed results at various scales for many political and ecological regions
- Results are freely available and easily accessible to the public via the BBS website
- Results are used extensively by federal and state land-use and conservation policy planners

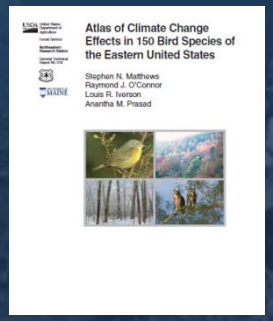


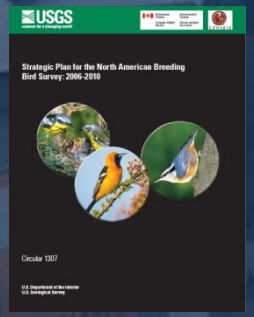




- The research community finds novel uses of the data for addressing emerging environmental issues
- Over 500 peer-reviewed publications have used BBS data as the primary means to answer a research question.







CrowdHydrology *powered by* social water

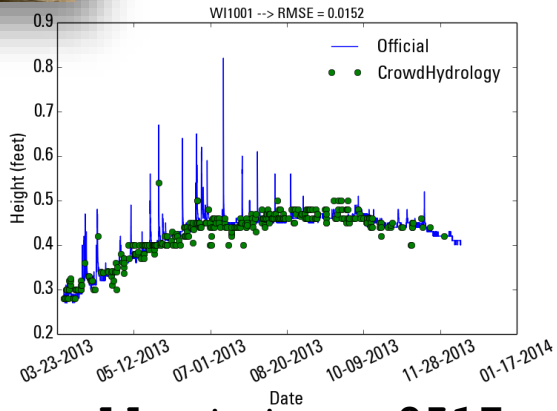
Mike Fienen, USGS WI Water Science Center, and Chris Lowry, University at Buffalo

What's the water height?

Text "WI1009" and the current height to:

608-514-1889

USGS CrowdHydrology



Messages across all states: 8517
Good measurements: 7226
Unusable messages: 15%
Total users: 4632
States with Gages:
WI, NY, IA, UT, OR, MI, PA
Total number of gages: >79

Boise Watershed Watch

- October 10, 2015 (7th annual)
- Water-quality synoptic at 20 sites in Boise River watershed, southwestern Idaho
- Water temperature, pH, DO, turbidity, bacteria, total phosphorus, macroinvertebrates, invasive species

- Local, state, Federal, private sector partnership

www.boisewatershedwatch.org

USGS

Any questions?

applegate@usgs.gov
703-648-6600

USGS