USGS TX Water Dashboard: Leveraging Web Mapping and Twitter to Distribute Real-time Water Info
Introduction to USGS

- Dept. of Interior - Founded in 1879
- Six Science Mission Areas
  - Water Resources
  - Ecosystems
  - Energy, Minerals and Environmental Health
  - Core Science Systems
  - Climate and Land-Use Change
  - Natural Hazards
- Nationwide about 9,000 employees
- Conduct interdisciplinary scientific monitoring, assessment, and research... distribute that information to the public
Water Resources Mission –

...to provide (deliver) hydrologic information and understanding needed by others to achieve the best use and management of the Nation’s water resources. USGS accomplishes this mission in cooperation with State, Local, and Other Federal Agencies.
In cooperation with…..

- Work with over 100 municipalities, river authorities, groundwater districts, local, state, and Federal agencies (many cooperate to help fund the network of streamgages)
Transition at USGS TXWSC

- Over the last 5 years, have slowly transitioned from **data production** shop to **web visualization** and geospatial analysis
- Mined staff talent and built a team with diverse set of skills, infrastructure to sustain growth in this arena (server/network)
- Significant **R&D** to add new tools and capabilities
**Process Old vs. New**

**RESEARCH**
- Create data products
- Publish digital data

**COMMUNICATION**
- Expose data via web development

**Benefits?**
- Broader audience (limitless*)
- Effective communication (stories)
- Data comes alive (interactive)
- Mission centered (distribute data/information)

USGS
What happened in the last 5-7 years?

- Google Maps/Earth
- Mobile Technology
- Open Source!!!
- ArcIMS went away...
- Maps everywhere
- Infographics used
- Social Media emerging
- Renewed focus on communicating to both technical and non-technical audience

USGS
Documenting our path:

Three published USGS Fact Sheets:

- **2002-07** - [https://pubs.er.usgs.gov/publication/fs20073076](https://pubs.er.usgs.gov/publication/fs20073076)
- **2008-09** - [https://pubs.er.usgs.gov/publication/fs20093039](https://pubs.er.usgs.gov/publication/fs20093039)
- **2010-14** - [https://pubs.er.usgs.gov/publication/fs20143117](https://pubs.er.usgs.gov/publication/fs20143117)
Where we started…

- **Team** – Florence Thompson, Joseph Vrabel, Deanna Terry, Victoria Stengel, Sally Holl, DSS
- **Released in July 2013** - Traces the Nation’s major rivers upstream and downstream via Hydro 1M networked hydrography
- Real-time streamgages for the Nation, current weather radar, ability to create detailed reports
- General and event-based usage (Animas River)
- **March 2016 v3 Release** with improved basemaps and 2 APIs for developers
Stream tracing at the national-scale!

http://water.usgs.gov/streamer/
Public response

- Released July 2013, v2 2014, v3 2016 (mobile)
- 600K unique users, trace 4.1 billion miles of streams
- 15+ articles written about Streamer
Walker Basin Hydro Mapper

- Team – NVWSC, Florence Thompson, Joseph Vrabel, Deanna Terry, Victoria Stengel, DSS
- Streamer approach using local-scale data for closed basin on NV/CA border (March 2015)
- Infographic approach on homepage with full-frame mapping application (animation), plus dynamic stacked hydrographs for visualizing multiple site locations at once
- Use NWIS webservices throughout!

USGS

Click here to view interactive map
Realtime data at the basin-scale

http://nevada.usgs.gov/walkerbasinhydromapper/
Supporting the USGS Mission

"Web-based solutions, like the Walker Basin Hydro Mapper, help provide an interactive and easily understandable framework for a massive amount of water data to be presented in a clear and concise way," said Joy Morris, Director of the National Fish and Wildlife Foundation’s Walker Basin Restoration Program. “Using this approach for visualization and presentation of data simplifies the science for easy consumption by the public and stakeholders alike."
Highlighting the Value and Utility of USGS Real-time Data During Floods (and Droughts)

USGS Texas Water Dashboard -- Flood Preparedness – There’s a New USGS Map (or App) for That
Overview

- Case Study: Memorial Day Flooding 2015
- What were Web Analytics telling us?
- Full-frame Mapping Application
- Data Distribution using Twitter
- Live Demo
- Results so far!

Credits/Acknowledgements

- Justin Robertson, Joe Vrabel, Ramona Neafie, Florence Thompson, Deanna Terry, TXWSC Management and Staff
Foundational statements

- Data streams used currently available to the public (QC’d, filtered data via NWISWeb Web services)
- Twitter development is all currently ‘public’, stable since July 2015
- Backend architecture was built to support tools (internal and external facing components) at the state and national scale
- Data updated every minute for USGS, every 5 minutes for partners (push-pull services)
Case Study: Memorial Day Flooding

- Wet conditions from early rains in May, increased runoff potential
- 12-13” in 4-6 hours
- Blanco River went from 5ft to 41ft in 4 hours
- >10 fatalities
Confusion: Where is the big picture?

- **Current conditions**
  - USGS streamgage webpages (4 upstream)
- **Forecast conditions**
  - NWS AHPS webpages (1 upstream)
  - Weather conditions (TWC, NWS, WU)
- **Real-time or crowdsourced information**
  - Twitter - NWS, USACE, TDEM, Local Emergency Management, Local Governments, TX Storm Chasers

**How can we bring this all together?**
Web Analytics?

- Can this help decision making?
- Provided to management and web team for analysis
- Executive summary of the event...
Memorial Day Findings (May 22-30, 2015)

- There was a **rapid and dramatic increase** in web traffic (2X weekly average)
- For the TXWSC, **traffic came primarily from new users. Lake/Reservoir data actually more popular than streamflow**
- 40% of users were on a mobile device!
- **Top search terms** (in order): Maps of Texas flooding, Texas flooding map, Map of flooding in Texas, USGS water data, Medina Lake, Texas streamflow
<table>
<thead>
<tr>
<th>Suggested Improvements</th>
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<tbody>
<tr>
<td>Comment</td>
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<tr>
<td>85 List pool levels on real time lake/reservoir level charts.</td>
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<tr>
<td>89 definitions improvements; ie what does &quot;owe&quot; mean?</td>
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<td>89 Allow user to pick 5-10 &quot;favorites&quot; that would come up in a dashboard type report.</td>
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<tr>
<td><strong>93 Zoomable map of Texas and gauge links.</strong></td>
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<td>93 designate normal lake level on text portion</td>
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<td>96 tutorial for gauge data &amp; interpretation</td>
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<td>100 I would like more numbers of cfs flows and times</td>
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<td>100 have a tab just for lake levels showing the full capacity level and a + or - feature</td>
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<tr>
<td><strong>100 Advertise more! Everyone needs to know where they can get exact information without waiting for the news.</strong></td>
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<td>85 measure precipitation at more locations. When I have the upstream and downstream results, I can more accurately approach for our property.</td>
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<td>74 compare flood stage to current data in larger text format</td>
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<td>74 easier link to gage descriptions</td>
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<td><strong>74 Show results more often than hourly, when heavy weather is occurring.</strong></td>
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<td>67 Having the data closer to the top of the page.</td>
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<td>63 Clearer links/descriptions to help get to a page quicker</td>
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<td><strong>44 Should have lake level relative to normal level.</strong></td>
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<td>74 could just spell out flood stage levels to current levels</td>
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<td>67 The river basins are not listed in alphabetical order, so I needed to scroll through to find the one I was looking for.</td>
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<td><strong>63 Clearer instructions/links to locations</strong></td>
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<td>56 Need to know the Ac/Ft in the reservoirs. Only a few sites have this information.</td>
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<tr>
<td>44 cannot tell flood stage of lakes. Should have level relative to normal level.</td>
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<tr>
<td><strong>89 Allow another level of map zooming. It would be helpful for big states (like Texas - where I live) to be able to zoom to an intermediate level such as the county rather than directly from the state to the individual station.</strong></td>
</tr>
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<td>Top Gage Pages</td>
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Conclusions? My impressions

- Mobile development critical, growing usage
- Must have better mapping applications for delivery of water data, expected by users
- Our water data is technical at times, help/tutorials of interest
- Lake level information incomplete
- Need to mature/evolve data distribution tools
- More data points, increased data frequency and access being requested!
Solutions? TXWSC Approach

1.) Full-frame mapping application

- Highlight the value and use of the USGS Observations Network – **Dynamic mapping** of all real-time stream, lake/reservoir, precipitation and groundwater sites in Texas (~750 sites)

- **Handshake with complimentary datasets**
  - NOAA NWS products – Radar, QPF, precipitation totals, current watches/warnings, satellite data
  - Drought Monitor
Solutions? TXWSC Approach

2.) Use Twitter as a Data Distribution Tool

- **External facing** – *Autonomous feed*, provide current river stage/discharge after exceeding NWS flood stage, handshake to NWISweb
- *Standalone product and fully embedded* into full-frame mapping application
- **Internal facing** – *Autonomous feed* monitors gage network, low-overhead reporting to data program staff when sites drops off NWISWeb (stage, discharge or precipitation)
USGS TX FloodWatch
@usgstxflood

291 @USGS real-time streamgages in TX have NWS flood stage defined. This data feed provides current USGS river stage/discharge for sites above NWS flood stage.

Texas, USA

USGS TX FloodWatch @usgstxf... 12m
#USGS08067100 - Trinity Rv nr Moss Bluff, TX
Stage: 13.99ft ▲
Discharge: N/A
waterdata.usgs.gov/tx/nwis/uv?sit...

USGS TX FloodWatch @usgstxf... 17m
#USGS07336820 - Red River near De Kalb, TX
Stage: 27.60ft ▼
Discharge: 63,600cfs
waterdata.usgs.gov/tx/nwis/uv?sit...

USGS TX FloodWatch @usgstxf... 17m
#USGS08065000 - Trinity Rv nr Oakwood, TX
Stage: 39.55ft ▲
Discharge: 32,300cfs
Autonomous data feed designed to alert @USGS TXWSC Data Program staff when streamgage station is not reporting stage, discharge, or precipitation to NWISWEB.
Texas Water Science Center on Twitter

USGS TX FloodWatch
@USGS_TexasFlood
200 @USGS real-time streamgages in TX have flood stage defined by @NWS. This autonomous feed delivers river stage/discharge data for sites above flood stage.
Texas, USA - http://t alcanç usgs.gov/twaterdashba...

USGS TX RainWatch
@USGS_TexasRain
This autonomous feed delivers data for over 300 @USGS real-time precipitation stations in Texas experiencing heavy, extreme and violent rainfall rates.
Texas, USA - http://t alcanç usgs.gov/twaterdashba...

When the Power is Out, Social Media Can Be a Lifeline

During the 2015 flooding in Texas, many people throughout the state were without power and relied on social media to get the latest information about current water conditions.

With the help of Twitter, the Texas Water Science Center developed two fully-autonomous feeds to distribute water level and precipitation data: USGS TX FloodWatch (@USGS_TexasFlood) and USGS TX RainWatch (@USGS_TexasRain). The FloodWatch feed automatically sends out tweets anytime one of about 300 selected USGS streamgages throughout the state rises above the NWS-defined flood level, and delivers information within minutes. The RainWatch feed tweets when rainfall exceeds a rate of 0.4 inches per hour.

Anatomy of a USGS TX FloodWatch tweet

USGS TX FloodWatch
@USGS_TexasFlood

#USGS08036500 - Angelina Rv nr Alto, TX
Height: 29.53ft ▼ (29ft)

Station Number
Station Name
Most recent instantaneous
NWS Flood Level
Benefits

- NWISWeb is solid foundation, need ‘global’ and basin-scale view of all current data
- Responding to user needs and feedback
- Takes advantage of our already public data streams and… meets people where they are!
- Fully automated and has both external and internal benefits to USGS!
- Not revolutionary, but may be evolutionary
- Data distribution comes in many forms…
- How responsive is it?....
Temporary Streamgages Installed to Assist Texas Flood Response

Release Date: JUNE 1, 2016

Reporters: Do you want to interview USGS scientists as they measure flooding? Please contact Jennifer LaVista.

Additional temporary streamgages have been installed by U.S. Geological Survey field crews to assist with flood response near the populated Lake Jackson area in Texas. Rapidly deployable streamgages can be installed temporarily to provide emergency managers with additional information needed to help protect public safety.

USGS crews have installed two gages off of bridges on the Brazos River; one near West Columbia and the other near Brazoria, Texas. Both gages are currently transmitting information every hour, and will report more frequently if water levels rise above flood stage. Real-time information for these gages can be found directly online.

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Jennifer LaVista
Public Affairs Specialist
Time for a live demo?
Links!!!

- Twitter accounts –
  - USGS Texas Floodwatch – http://twitter.com/usgs_texasflood/
  - USGS Texas Rainwatch – http://twitter.com/usgs_texasrain
- Twitter Help –
  http://tx.usgs.gov/about/twitter.html
Future Development Possibilities

- National implementation!
- Testing Twitter components and assessing utility
- Mobile application
- Rate of change service very exciting
- Basin/State-scale summary information
- Geo-query functions
- Much more!
Results so far!

- Great response from media (Print and TV)
  - San Antonio, Houston, Austin
- Twitter ‘Impressions’ around 1M in the first (almost) two months
- Increased web traffic by 10X to tx.usgs.gov
- Feedback from TX EOC, First Responders, Partner Agencies (NWS, USACE, more!)
- Increased number of return visitors 50/50%
- Still want more information and feedback!

USGS
Federal flood officials in Texas use Twitter to alert

Rick Jervis, USA TODAY 11:12 p.m. EDT June 1, 2016

Faced with relentless floods, Texas-based federal officials are turning to a new ally in the war on rising water: Twitter.

The U.S. Geological Survey, the federal agency responsible for monitoring river levels, recently launched a pair of Twitter feeds -- @USGS_TexasFlood and @USGS_TexasRain -- that give out automated, real-time river levels and rainfall amounts during heavy rains.

The feeds help first-responders and flood forecasters see river gauges in real time and help with decisions ranging from when to evacuate to weekend forecasts.

The initiative is a pilot program that could someday be rolled out on a national level, said Daniel Pearson, of the USGS Texas Water Science Center in Austin, who helped develop the application. USGS already uses Twitter to help confirm earthquakes, but these are the first fully-autonomous flood and rain related accounts.

“By using social media, we could meet [users] where they’re at on their platform to get information more readily,” he said.
Using Twitter as a ‘go-to’ communication channel during severe weather events

Thursday, June 2, 2016 | By Jim Moffitt (@snowman), Developer Advocate [15:35 UTC]

At its core, Twitter is a real-time public broadcast channel. These characteristics make Twitter a natural platform for public safety communication and early-warning systems. During serious state-wide Texas rains and flooding over the 2015 Memorial Day Weekend, Twitter organically emerged as the go-to communication channel for the United States Geological Survey (USGS) and other federal, state and local agencies. As widespread power outages occurred, Twitter became an essential source for up-to-date meteorological data and agency announcements.

Since those events, the USGS Texas Water Science Center began exploring new ways to share real-time observation data on the Twitter platform. As a result two fully-autonomous Twitter accounts were created: @USGS_TexasFlood and @USGS_TexasRain. These Twitter accounts disseminate real-time rain and river sensor data that exceed flood-stage and rainfall thresholds. As shown in the example below, the Tweets contain unique, searchable hashtags based on the USGS site ID, current river or rain data, along with a link to that site’s page on the USGS National Water Information System (NWIS) system.
Questions or comments?

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