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USGS Plans Wave Data Collection & Delivery Improvements

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The U.S. Geological Survey (USGS) has a goal of improving coastal storm response by increasing the amount and quality of storm tide, storm surge, and wave data collected and made available in conjunction with the landfall of a hurricane or severe coastal storm. Recent funding received from the Department of Interior, and made available by the Disaster Relief Appropriations Act of 2013, will make this possible. For future hurricane landfalls, additional equipment will be deployed and an enhanced network of monitoring sites will be used to collect and deliver overland storm-surge and storm-wave data to forecasters, emergency managers, modelers, and other interests. A major new addition to the USGS effort is the collection and delivery of wave data to support the improvement of circulation and wave models which are used by forecasters and planning agencies to warn of and predict coastal impacts as a result of the winds and water driven onshore by a storm.

Most operational forecast models include both a storm surge modeling component and a storm wave modeling component. The former is used to estimate the spatial and temporal distribution of water depths and flows while the latter is used to estimate the spatial and temporal distribution of wave heights and wave energy during a storm. Wave forecasts are important not only for their use in direct prediction of damages to natural and man-built features impacted by the waves, but also for characterization of the interactive effects of storm waves on storm surge. Storm wave models use meteorological and storm surge forecasts as well as the characteristics of coastal bathymetric features in order to make their predictions. Two significant challenges in coastal storm-wave modeling are: (1) adequately parameterizing the complex physical interactions of ocean waves as they pass over and through unique near-shore features such as beaches, wetlands, and infrastructure, and (2) obtaining sufficient high-quality near-shore and overland wave-height and frequency data against which model results can be compared. The USGS's goal in this effort is to address these challenges to the maximum extent possible.

As depicted in Figure 1, storm waves are those motions of the sea which remain after the slower-

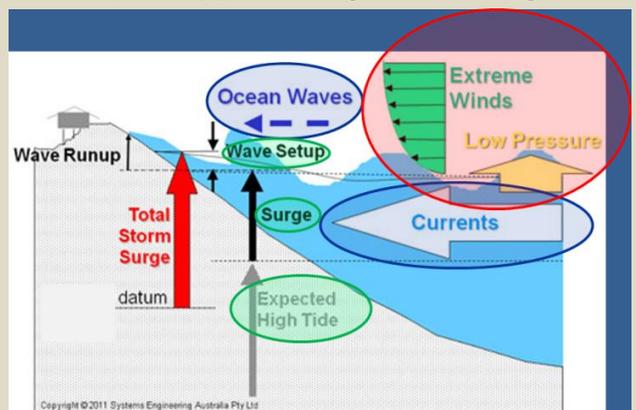


Figure 1.—Components of near-shore motions in response to coastal storm forces.

varying storm surge (composed of tide, surge and wave setup) is accounted. Storm waves are more rapidly-varying and of a finer spatial scale than storm surge. These motions are much more difficult than surge to interpret when viewed as a time-series of water levels; the sea surface during a storm is often wildly convoluted, with periodic “wave-like” patterns being difficult to discern.

The Principle of Superposition (Figure 2) leads to the decomposition of a single complex time-series into a set of periodic time-series with different amplitudes and frequencies. These periodic time-series reveal important information about the energy contained in the original time-series.

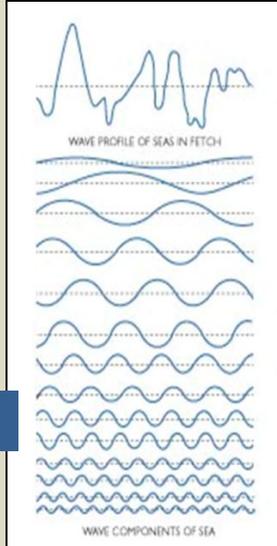


Figure 2.—A graphical representation of the Principle of Superposition.

A mathematical operation known as a Fourier Transform is often used to decompose the wave time-series into the sum of periodic time-series of different amplitudes and frequencies (figure 3). When these amplitudes and frequencies are graphed and analyzed, they reveal important statistical information about the waves, including the total amount of energy contained in the wave field, much of which may be expended at the shoreline in wave breaking, and further inland during mechanical deformation of wetland vegetation, transport of sand and sediment, and damage to coastal infrastructure. Accurate forecasting of this wave energy, as well as understanding of the processes that absorb wave energy as a storm moves inland is a major goal of the USGS storm-wave monitoring and data-delivery effort.

Exciting technical challenges will be faced in this effort. Among those challenges are: (1) acquiring and testing the instrumentation to measure and record wave data in an energetically vigorous environment, (2) designing robust, stable, portable, and recoverable platforms on which to deploy the instruments, (3) developing deployment strategies that allow for safe, rapid and targeted placement of instruments where they will collect the most valuable information available from each individual storm, and (4) creating data analysis, display and distribution tools that place the storm-wave data, and derived products, quickly in the hands of those who need it.

Over the next two years, the USGS will be working closely with local communities to provide better coastal storm surge data and tools, and with forecasters and modelers to improve coastal storm forecasts and damage estimates. These products will be used by coastal communities to increase their storm risk awareness, prepare improved response plans, and assist planners with developing more resilient infrastructure and communities.

Additional information on USGS efforts to support rebuilding from Hurricane Sandy can be found at:

http://www.usgs.gov/blogs/features/usgs_top_story/usgs-awarded-supplemental-funds-to-support-hurricane-sandy-rebuilding/?from=title

Information on the latest funding received by the USGS to support the protection of Atlantic coast communities can be found at:

<http://www.doi.gov/news/pressreleases/secretary-jewell-announces-162-million-for-45-projects-to-protect-atlantic-coast-communities-from-future-storms.cfm>

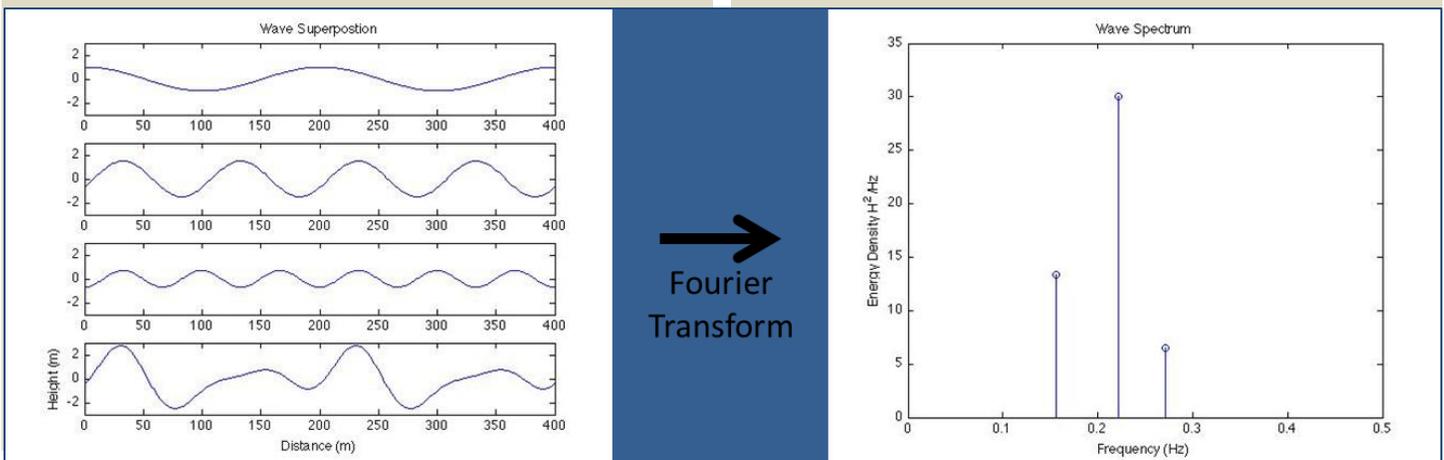


Figure 3.—Diagram of superimposed waves transformed to spectra.

Rating Curves for Flood Detection

Brian Iserman, P.E., CFM, NHWC Editor
JE Fuller/Hydrology & Geomorphology, Inc.

Real-time precipitation and stream stage stations are important building blocks of a flood detection system. Once installed, they provide valuable data to decision support systems used by meteorologists, hydrologists, flood responders and floodplain managers. But how do we relate the stage measured at a stream gauge to the flood threat to the community and appropriate response? The answer is found in the stage-discharge rating curve.

Most members of the hydrologic warning community appreciate the importance of reliable stage-discharge rating curves. The purpose of this short article is to identify some often overlooked aspects of the development and use of stage-discharge rating curves.

Why rating curves?

Having a stage-discharge rating curve associated with your real-time stage station increases the value of the data by a large margin for a relatively low cost.

Consider a stream gauge located 10 river miles upstream of a community that has recently completed a new emergency action plan. The plan includes the closure of an un-bridged river crossing and the evacuation of a subdivision when flow in the river is expected to reach a discharge of 12,000 cubic feet per second. Knowing only the stage at the stream gauge won't help emergency responders to know if they should evacuate the subdivision and close the road. Having the ability to express the stage at the gauge in terms of discharge is the key.

There are several ways to develop this correlation between stage and discharge; it depends on the purpose, the particular physical layout of the stream stage station, the river system and available resources.

Don't overlook simple

Rating curves are an often overlooked component of flood detection systems because of the expected cost and complication, and a lack of appreciation for their value. However, a rating curve developed to define flood threat levels need not be costly; even the most simple analysis can add life-saving benefits.

Consider the community in the previous example. If the stream stage station happens to be at a hydraulic structure such as a bridge, culvert, weir or dam, there may already be a hydraulic analysis associated with the structure. In developed communities, there may also be recent hydraulic analyses associated with channel improvements or a flood insurance study. Such analyses may not be tailor made for a rating curve, but there is information to be gleaned and/or modifications to be done to leverage such existing resources.

Some hydraulic structures, such as culverts and certain types of weirs lend themselves particularly well to development of rating curves because relatively little data collection e.g., field survey and discharge measurements, is required to characterize the hydraulics of these structures. An important consideration then, even before a stream gauge location is selected, is to identify existing hydraulic structures that can facilitate increased value and reliability of the collected data without increasing cost and complexity.

When simple can't be found

Data collection and modeling complexity and cost naturally increase as the complication of the channel hydraulics and/or required accuracy increase. For stream gauges located on smaller river reaches with simple hydraulic characteristics, channel geometry data can be collected from the field using an inexpensive level (construction-grade optical or laser) and rod. Such instruments in the hands of an experienced hydrologist can yield adequate accuracy for assembling a hydraulic model suitable for developing a flood-warning level rating curve. For large and/or complicated river systems, a total station or GPS/GNSS (Global Positioning System/Global Navigation Satellite System) is



JE Fuller staff performing an RTK (Real-Time Kinematic) GPS survey at Devils Canyon at US Highway 60 near Superior, Arizona

preferable and may require the services of a surveyor or outside consultant.

What is important?

Keeping the purpose of the rating curve in mind is important when selecting modeling and field data collection methods. If the purpose of a stream gauge is to develop high-accuracy streamflow statistics, the effort level for developing the rating curve will be significantly greater than if the purpose of the stream gauge is flood warning.

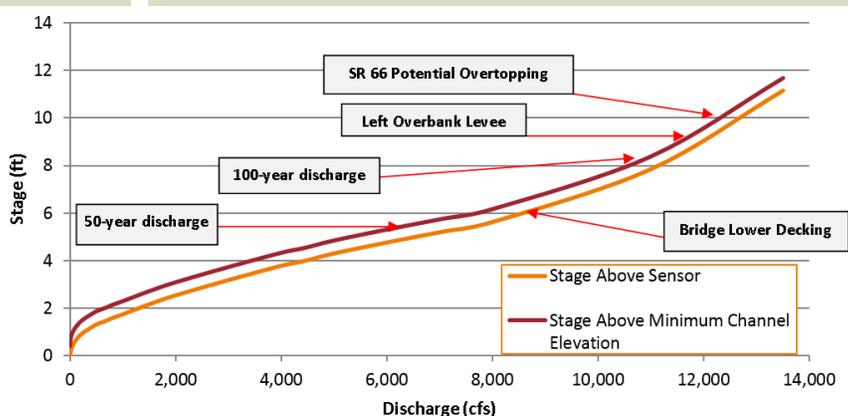
Rating curves for flood warning purposes don't need to be as accurate for stages associated with frequent or daily flows as those developed to characterize streamflow statistics that may be used for projects involving water rights or other critical needs. In such cases, additional work must be done at considerably more expense to manage the accuracy of the rating curve; including detailed reporting and manual flow measurements.

For flood warning, what is most important is an accurate characterization of the less frequent flood flows at thresholds that impact lives and property. The accuracy required for this purpose can be achieved by developing a sound base hydraulic

model and, if possible to do so safely, supplementing the rating curve with opportunistic high-stage discharge measurements.

Making connections

With a rating curve in hand, the added value will become increasingly clear as correlations between discharge at the stream gauge are made to local roadway crossings, homes, neighborhoods and communities which are susceptible to flooding. The final step in rating curve development is to make those connections so that individuals and agencies responsible for getting the right information to the right people for the right response can perform their duties effectively and efficiently.



Example stage-discharge rating curve with "connections"

Inside The Beltway

Benjamin A. Pratt, P.E., CFM - DCLiaison@hydrologicwarning.org



November has arrived "Inside the Beltway" and I am happy to report that our Federal government is back up and running, full steam ahead! Speaking as one whose flood warning system relies heavily on Federal gages to supply critical hydrologic data, the shutdown was especially disconcerting when a low pressure system set up off the Atlantic coast and produced up to 9 inches of rain in less than 36 hours; a week into the shutdown. Fortunately, we experienced only minor issues with the gage network; all fared well in the end. Nonetheless, the critical role our Federal government plays in our flood warning system was fully realized and will not soon be forgotten!

As the government returned to work, so did the Advisory Committee on Water Information Subcommittee on Hydrology (ACWI/SOH). The ACWI/SOH met Monday, October 28th at the United States Department of Transportation building in Washington, DC. The issue of climate change was central on the agenda and the Committee heard an interesting update on the activities of the Federal Highway Administration related to climate. The presentation is available for viewing on the ACWI/SOH website at <http://acwi.gov/hydrology/index.html>. In other business, the Committee elected Robert Mason, Acting Chief, USGS Office of Surface Water, as the Vice-Chair. Robert will serve the Committee as Vice-Chair for two years at which time he will become Chair and a new Vice-Chair will be elected. Additionally the Hydrologic Frequency Analysis Workgroup announced that it has begun the process of drafting Bulletin 17C! Stay tuned for additional details.

Looking at this week and beyond, we have Veteran's Day and the Thanksgiving holiday upon us. I encourage you all to take the time to recognize and thank those who have served in our armed forces so that we may all live in peace and be thankful for the United States of America!

Operating and Maintaining Flood Warning Systems in Challenging Times

This is the theme of next year's ALERT Users Group Biennial Conference which is to be held at the Atlantis Hotel & Convention Center in Reno, Nevada, May 6-9, 2014.



Symposium topics are to include:

- Flood Warning System Design, Operations, Maintenance & Repair
- ALERT & ALERT2
- The Future of Real-Time Flood Warning
- Watershed & Water Quality Management
- Emergency Management & Preparedness

Please send your presentation abstracts by February 7th to:

augadmin@alertsystems.org

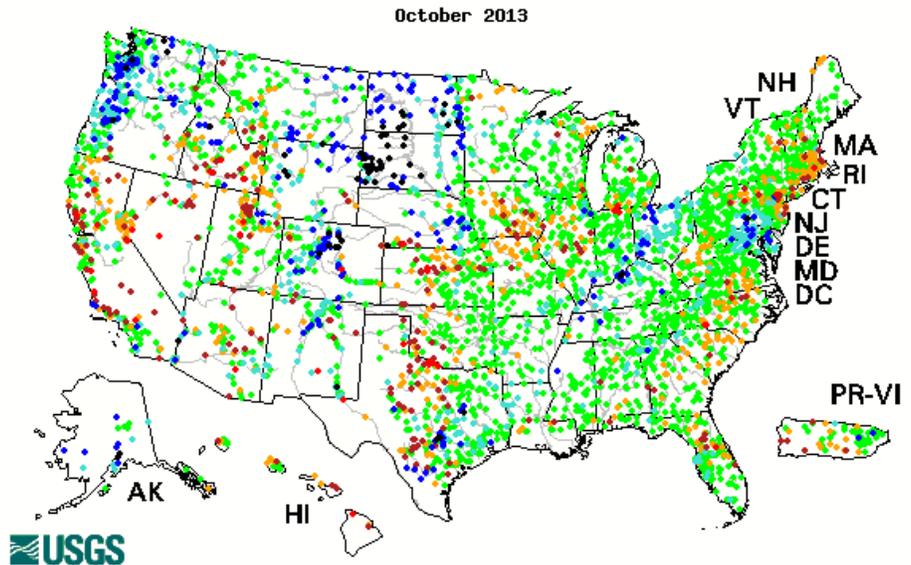
ASCE-EWRI

will host the 2014 International Weather Radar and Hydrology Symposium April 7th-9th, 2014 in Washington, DC. Abstract submission is now **available!**



Please check the [website](#) frequently for updates.

Hydrologic Conditions in the United States Through October, 2013

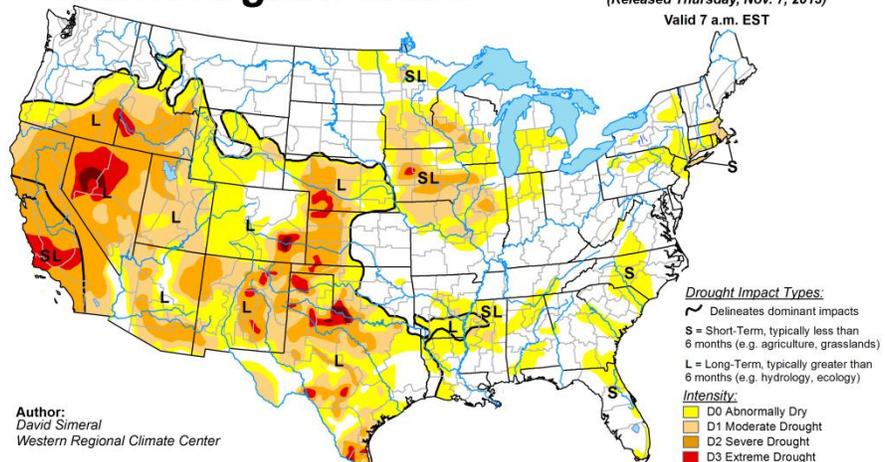


Explanation - Percentile classes						
●	●	●	●	●	●	
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High

Latest stream flow conditions in the United States. (courtesy USGS)

U.S. Drought Monitor

November 5, 2013
(Released Thursday, Nov. 7, 2013)
Valid 7 a.m. EST

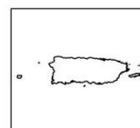
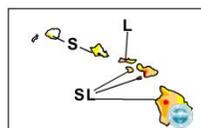
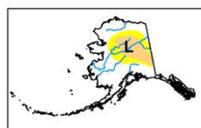


Author:
David Simeral
Western Regional Climate Center

Drought Impact Types:
 ~ Delineates dominant impacts
 S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
 L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:
 D0 Abnormally Dry
 D1 Moderate Drought
 D2 Severe Drought
 D3 Extreme Drought
 D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



USDA
<http://droughtmonitor.unl.edu/>

Latest drought conditions in the United States. (courtesy National Drought Mitigation Center)

**December
Newsletter
Articles Focus:
Hazard
Communication
& Public
Awareness**

NHWC is requesting articles that focus on getting the word out.

Please submit your article that explains how your organization gets the right information to the right people for the right response.

Submit your article to:

editor@hydrologicwarning.org

December 1st is the deadline for inclusion in the December issue.

**Future
Newsletter
Articles Focus**

To give you more time to prepare articles, below is the article focus schedule for the next four months:

**Dec - Hazard
Communication &
Public Awareness**
Jan - Modeling/Analysis
Feb - Data Collection
Mar - Hydrology

NHWC Calendar

June 15-18, 2015 - NHWC 2015 Training Conference & Exposition, Indianapolis, Indiana

General Interest Calendar

April 7-9, 2014 - [2014 International Weather Radar and Hydrology Symposium](#), Washington, D.C.

April 14-16, 2014 - [The Association of State Dam Safety Officials Southeast Regional Conference](#), Montgomery, Alabama

May 6-9, 2014 - [ALERT User's Group 25th Flood Warning Systems Training Conference & Expo](#), Reno, Nevada

August 17-19, 2014 - [American Public Works Association Congress & Expo](#), Toronto, Ontario

September 21-25, 2014 - [The Association of State Dam Safety Officials Dam Safety 2014](#), San Diego, California

(see the [event calendar](#) on the NHWC website for more information)

Parting Shot



New ALERT stream gauge installation on October 9-10, 2013 – Gila River at New Mexico State Route 92



Photos by Ethan Rode, JE Fuller/Hydrology & Geomorphology, Inc.

National Hydrologic Warning Council

Providing Timely, Quality Hydrologic Information To Protect Lives, Property, and the Environment
<http://www.hydrologicwarning.org>