Flooding Rain Impact Recognition and Messaging

Irene 2011 Waitsfield, VT

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NWS Houston-Galveston

Maria 2017

Harvey 2017

Acknowledgements: John Metz, Frank Alsheimer
How would we message this?
Rainfall Amounts (*county scale*):
5 to 25” isolated 38”
5 to 30” isolated 43”

Soldiers on displaced mesquite block pavers.
San Antonio, TX 1921
Harvey was unprecedented with not only the max amounts, but also concerning the size of the extreme rainfall footprint.

6.5 million experienced > 30 inches!
In just Harris county...

1,000,000,000,000,000 gal.
3200 astrodomes
15 days

Texans like to count in astrodomes

And... we love the Astros
The rainfall footprint can be very large and well inland.

38.70 in (983 mm) in Yankeetown, Florida, in 24 hours, which became the largest 24 hour rainfall total on record for the U.S.
Danger of directly comparing storms to highlight a threat

Allison (2001) vs. Harvey (2017) Total Rainfall

This area received less than 6 inches during Allison and 25-40 inches during Harvey
Recipe for Heavy Rainfall

1) Very high moisture transported northward from the tropics.
2) Very efficient warm rain processes.
3) Slow movement (< 10 mph) of some storms (mainly Gulf of Mexico and Southeast).
4) Interactions with extratropical systems and their associated boundaries, jet streaks, etc.
5) Interactions with terrain as the storms move inland.

Sat August 26th 4 AM > Tue August 29th 4 PM (84 HRS)
Average Speed of Movement = 2.7 KTS

Advisory: Speed (KTS)
24  5
25  2
26  0
27  1
28  1
29  2
30  2
31  3
32  3
33  4
34  3
35  3
36  3
37  4
38  5

Houston Metro Flood
When I get asked, “How much rain are we going to get or how bad will it flood?” I often feel like…

“There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.”

Donald Rumsfeld
What are our Knowns/Unknowns?

- **(Known-Known)** The tropical cyclone will bring heavy rainfall.

- **(Known-Unknown)** Where are the bands going to setup, and who will get the most rain?

- **(Unknown-Unknown)** Some impacts? (maybe a flood driven hazmat event)
An Unknown Unknown?

Already swamped with historic flooding and 20 webinars/conf. calls a day
18 spot forecasts for the Arkema Plant explosions in Crosby, TX
How do we effectively communicate our Knowns and Unknowns?

- Through a 2-way communication process that is ongoing (pre-season, just prior to the event, and during the event).

- Through recurring Integrated Warning Team Workshops (IWTWs), drill participation, partner meetings/interactions.

- By utilizing all of the tools that we have at our disposal, and learning which is most effective tool to a decision maker at the proper time.
Harvey at Landfall
Flooding Rain Threat

Weather Forecast Offices issue Hurricane Threat and Impact graphics
For the 4 major threats: Tornadoes, Storm Surge, Wind, and Flooding Rain
An incredible pre-landfall Harvey rainfall forecast.

The maximum was displaced to the southwest, which followed the global models’ placement.

Notice how large the 15-30 inch area is.

The ?’s I kept getting were: “When will the worst rainfall occur?, Will my house flood?, How many structures will flood with this forecast?, Should we evacuate?”
Aided the decision to order additional high water vehicles for Galveston county

Need inundation to provide impact details if ever considering a targeted evacuation

Model: High Resolution Rapid Refresh (Saturday - 5 AM CDT -> 11 PM CDT)

10-20 inches
When do we issue a Flash Flood Emergency?

- A. Multiple swift water rescue teams have been deployed for exceptional flooding.
- B. Total failure of a high hazard dam with potential for catastrophic impact.
- C. Emergency manager communicates that people are in a life threatening situation.
- D. All of the above.
Flash Flood Emergency – Dam Failure

Operators of the Guajataca Dam said it failed at 2:10 p.m. ET, prompting the NWS to issue a flash flood emergency warning for Isabela and Quebradillas municipalities, home to some 70,000 people, the agency said in tweets that went unseen by many in the blacked-out coastal area.
Harvey: Our 4th Flash Flood Emergency Event since May 2015

Go To The Roof!

Tweet Impressions: 1,831,082

As water rises in the home, an electrocution threat can develop.

Emergency management officials did not want people to become trapped in their attics. Also, they can not see that they need to be rescued in the attic.
Harvey: The Epitome of Overlapping Tornado and Flash Flood Warnings/Threats

Tornado Warning calls to action and Civil Emergency messaging were sending conflicting messages in the flash flood emergency areas:

“Seek shelter now”

“Get on your roof”
<table>
<thead>
<tr>
<th>Time</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>03:31</td>
<td>&lt;HCFCD-Jeff Lindner&gt; HGX: any consideration for FF emergency wording. Have several watersheds nearing bankfull</td>
</tr>
<tr>
<td>03:32</td>
<td>&lt;nws-joshua.lichter&gt; Jeff - Yes. We have been discussing.</td>
</tr>
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<td>03:34</td>
<td>&lt;HoustonOEM Michael Walter&gt; Talked with safety folks at Toyota Center - They're holding people in their seats until the storms clear.</td>
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<tr>
<td>03:40</td>
<td>&lt;media-steve.ayers&gt; Torrential rainfall now HWY 6 N @ Huffmister</td>
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<tr>
<td>03:41</td>
<td>&lt;nwsbot&gt; Local Storm Report by NWS HGX: Houston [Harris Co, TX] trained spotter reports FLASH FLOOD at 10:28 PM CDT -- flash flooding in and around the houston area. multiple water rescues. creeks and bayou coming out of banks. Link: <a href="https://nwschat.weather.gov/lsg/#HGX/201505260328/201505260328">https://nwschat.weather.gov/lsg/#HGX/201505260328/201505260328</a></td>
</tr>
<tr>
<td>03:43</td>
<td>&lt;nws-joshua.lichter&gt; Looking at FFW emergency for southwest Harris into northern Fort Bend. This area has taken the brunt of it and still more rain coming.</td>
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<tr>
<td>03:44</td>
<td>&lt;HCFCD-Jeff Lindner&gt; Halls Bayou 3 ft from bankfull</td>
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<tr>
<td>03:46</td>
<td>&lt;ham-david.a.fanelli&gt; Report from spotter in Mission Bend of water up to curbs</td>
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<tr>
<td>03:47</td>
<td>&lt;nwsghx-melissa.huffman&gt; Flash Flood Emergency coming shortly for SW Harris, Northern Ft. Bend</td>
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<tr>
<td>03:48</td>
<td>&lt;nwsghx-melissa.huffman&gt; This will include Spring Branch, Sugar Land, Stafford, Mission Bend</td>
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<tr>
<td>03:50</td>
<td>&lt;HCFCD-Jeff Lindner&gt; Nearing 7 inches on Buffalo</td>
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<td>03:52</td>
<td>&lt;nwsbot&gt; HGX issues Flash Flood Warning for Fort Bend, Harris [TX] till May 26, 12:45 AM CDT</td>
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S.C. didn’t get Joaquin, but experienced record flooding.

Social media post using the terms **historic**, catastrophic flash flooding.
Harvey – The Impacts and a Devastating Threat

- A slow track over the area will mean **periods of heavy rain** from today into at least Wednesday.
- Impacts: **Widespread flooding** with numerous road closures as rainfall amounts grow through the weekend. Major bayou and river flooding is expected. Some structure flooding is likely.
Future Flooding Decision Support

High resolution convection allowing models driving high resolution inundation forecasts

Better pre-positioning of resources
Better identification of life-threatening risk areas in extreme rainfall cases

Example of NWM-Based Experimental Flood Inundation Maps

Maps support emergency management efforts to stage supplies in non-flooded areas and to target relief efforts

F. Salas, NWC