Data and Apps for Statewide Flooding Emergency Response in Texas

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Acknowledgments: Texas Division of Emergency Management, City of Austin, National Weather Service, University of Texas at Austin, University of Illinois Urbana-Champaign, Utah State University
Texas Flood Response Project

FEMA DR 4223 #001 - April 2016 to March 2018
Led by Dr. David Maidment & Harry Evans, UT Austin
and Michael Ouimet, TDEM Critical Information Systems

• Develop local prototype flood planning template
• Conduct tabletop exercises on local prototype
• Conduct stakeholder meetings at the local, regional, state and federal level
• Produce flood response maps linked to NWS flood forecast to depict likely extent of flooding on a regional basis in Texas
Texas Flood Response Project

**County Partners**
- Travis County Commissioners
- Capital Area Fire Chief Association
- Travis County Emergency Management
- Blanco County Emergency Management
- Williamson County Emergency Management
- Wharton County Emergency Management
- Williamson County Fire Chiefs
- Upper Brushy Creek Water Control District
- San Marcos Emergency Management
- Hays County Emergency Management

**State Partners**
- **Texas Division of Emergency Management (TDEM)**
- Texas Natural Resource Information Systems (TNRIS)
- Texas Water Development Board (TWDB)
- Texas Commission on Environmental Quality (TCEQ)
- Texas Department of Transportation (TxDOT)
- Texas Floodplain Managers

**City Partners**
- City of Austin
- Austin Fire Department
- Austin Flood Early Warning System (FEWS)
- Austin Homeland Security Emergency Management (HSEM)
- Houston Office of Emergency Management

**Federal Partners**
- National Weather Service (NWS)
- National Oceanic Atmospheric Administration (NOAA)
- Federal Emergency Management Agency (FEMA)
- US Geological Survey (USGS)
- US Army Corps of Engineers (USACE)
Texas Flood Response System

The QUESTION: How do you go from a radar rain map to flood inundation map showing impacts?

Keeping in mind… “we’re predicting a flood based on a prediction of rain, neither of which has happened”
- Greg Waller, WGRFC
Proposed Approach

Three key elements:
- Strategic Flood Base Map
- Real-Time Inundation Map
- Flood Impact Assessment System
Large areas of Texas lack flood information
Also needed: Address Points…

Used for dispatching emergency response equipment in 9-1-1 systems
What we collected...

Texas Address Points as of May 2017

Who helped us:

CSEC/Geo-Comm:
- 213 counties, ~2.9 million addresses

Texas 9-1-1 Alliance & EGRT:
- 41 counties, ~6.1 million addresses

Totals:
- 254 counties, ~9 million addresses
Then merged...

Simpler schema, with county, COG, district & region ID’s for easy aggregation

Created one feature class for flood risk study and planning
Data Quality Issues with Address Points

• Address locations not all on the same basis
  • "road centerline address vs. physical structure location"

• Jurisdictional overlaps result in some addresses duplicated, with different locations, density and attributes
  • "City vs. appraisal district vs. ECD"

• Errors of missing or incorrect data
  • "County name, community name, address location"

• Numerous different county/region address schemas

• "Keeping pace with rapid growth of Texas population"
  • 400,000 people moved here July 2015-July 2016
  • 1.3 million people moved here since 2010
  • "San Antonio Current, Dec 20, 2016, sacurrent.com"
Importance of Address Point Accuracy

Will emergency personnel know where to go?

CSEC 9-1-1 geospatial data assessment project uses the National Standard for Spatial Data Accuracy (NSSDA) to quantify the horizontal spatial accuracy of address points and road centerlines.
Next: A method for estimating flood risk…

Height Above Nearest Drainage (HAND)

*Flooding occurs when Water Depth is greater than HAND*
Height Above Nearest Drainage for Texas

Computed on Univ of Illinois CyberGIS supercomputer from 10m National Elevation Dataset: CONUS HAND computed in ~ 1 day

Method can be performed on moderate basins with desktop GIS
Last step: add HAND elevation...

Simple raster operation to apply HAND elevation at each address point as an attribute.

Further development and testing is in progress to refine HAND values along coast and wherever else needed.
Address points attributed with HAND using LIDAR
Austin, Texas: A data rich community
Detailed engineering modeling on creeks
Austin, Texas: A data rich community
The Goal:
Identify potentially impacted structures for a given flood event in advance if possible, or in near-real time
Common Operating Picture for Each County

Identify neighborhoods at risk from flooding using FEMA flood maps and interaction with county Emergency Management Coordinator.

- **Travis County**
  - Minor Flooding: 2 buildings
  - Moderate Flooding: 24 buildings
  - Major Flooding: 90 buildings
  - Record Flooding: 104 buildings

- **Wharton County**

Summarize information for **urban counties**

Prepare information for **rural counties**

... Buildings
• Collaboration between Austin Fire Dept and Flood Early Warning System

• Flood operational maps for 23 Austin creeks

• HSEEP process over last 2 years

• Now being deployed in fire trucks in paper and pdf format
Flood Operational Maps

Flood depth in houses
- 3ft
- 6” – 3 ft
- < 6”

Potentially flooded neighborhoods

Minor Flooding - 2 bldgs
Moderate Flooding - 24 bldgs
Major Flooding - 90 bldgs
Record Flooding - 104 bldgs

Road starts to flood when gage reaches 15ft

Williamson Creek - Westgate
(Westgate to Railroad Tracks)

Map created by AFD and FEWS - Updated August 2016
Texas Flood Response Project

- Develop local prototype flood planning template
- Conduct tabletop exercises on local prototype
- Conduct stakeholder meetings at the local, regional, state and federal level

- Produce flood response maps linked to NWS flood forecast to depict likely extent of flooding on a regional basis in Texas
Forecasts
Version 1.1 operational on 5 May 2017

Now

Analysis
Best estimate of current conditions

Short Range
Hourly for 18 hours ahead, updated hourly

Medium Range
3 Hourly for 10 days ahead, updated 6-hourly

Long Range
Daily for 30 days ahead
Ensemble of 4 forecasts each 6 hours (24 forecasts total)

ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/nwm/prod/

Name | Last modified | Size
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Parent Directory | | |
nwm.t06z.medium_range.channel_rt.f003.conus.nc.gz | 12-Jul-2016 12:09 | 33M
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nwm.t06z.medium_range.channel_rt.f009.conus.nc.gz | 12-Jul-2016 12:09 | 33M
Integrity Checking

Comparing with USACE flood models

Comparing with observed water depth at USGS, LCRA and other gaging sites
Automated workflow for translating NWS forecasts into TDEM impact
Two Commercial Firms: Esri and Kisters

National Water Model discharge forecasts

Assessment of impact

Conversion of discharge to depth

Convert depth to flood inundation
Future Operational Information Flow

Rain maps

Hydrographs from National Water Model

Real-Time Inundation Map

Esri - Kisters Service

Flood Impact Assessment System

Metrics

State Operations Center

Strategic Flood Response Map

Reporting impacts:
- TDEM Area Coordinators
- Disaster District Coordinators
- County Emergency Management Coordinators

Assessment of Conditions
Discussion
Emergency Response
National Water Model Viewer
Flood Impact Dashboard

Texas Flood Impact Dashboard  Impacts based on NWM forecasts, 911 address points, and census data

Filters

Model: NWM - Memorial Day

5/22/2015 0:00:00 AM

REFRESH STATISTICS

Statistics

TOP DIMENSIONS  COUNTRIES  CHARTS  DETAILS

<table>
<thead>
<tr>
<th>Region</th>
<th>Address Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 6</td>
<td>4857</td>
</tr>
<tr>
<td>Region 2</td>
<td>329</td>
</tr>
<tr>
<td>Region 3</td>
<td>77</td>
</tr>
<tr>
<td>Region 4</td>
<td>13</td>
</tr>
</tbody>
</table>

1 - 4 of 4 results

<table>
<thead>
<tr>
<th>District</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDC 12 AUSTIN</td>
<td>Region 6</td>
</tr>
<tr>
<td>DDC 18B AARC/BEXAR CO.</td>
<td>Region 6</td>
</tr>
<tr>
<td>DDC 18A SAN ANTONIO</td>
<td>Region 6</td>
</tr>
<tr>
<td>DDC 17 VICTORIA</td>
<td>Region 6</td>
</tr>
<tr>
<td>DDC 23 BELTON</td>
<td>Region 6</td>
</tr>
</tbody>
</table>

1 - 5 of 5 results

http://txflooddata.esri.com/FloodDashboardmemday/
Flood Inundation Mapping
May 2015 Wimberley Flood

http://crwr-arcgis-p01.austin.utexas.edu/arcgis/rest/services/May2015FloodExtent/MapServer
Flood Inundation in Brazoria County, April 18, 2017

Too much area flooded. We need to analyze this with LIDAR.
LIDAR Terrain Mapping

Texas 2016-2017 Lidar Acquisitions

- TWDB and StratMap partners are acquiring 11,000 square miles winter 2016-2017
- FEMA is acquiring over 50,000 square miles winter 2016-2017

Source of Images: Joey Thomas, TNRIS
Accomplishments in First Year

- 9 million Address Points collected for the entire state
- Determined “height above nearest drainage (HAND) for each point
- Developed statewide synthetic rating curves for all 100K streams in Texas
- National Water Model launched in August – open access
- Kisters gauge network linked to National Water Model
- Esri statewide impacts map (alpha version) created
- Local, engineer scale maps completed and deployed
- Extensive collaboration with NWS, University of Illinois, Utah State University, National Science Foundation, Kisters, Esri, TDEM, TNRIS and UT Austin – Supercomputer computation
Summary

• National Water Model is operational
  • Streamflow forecasts 24x7x365
  • Preparing to publish forecasts and real-time flood inundation maps to NWS regional offices for authoritative reporting
  • Further research is underway to improve flood mapping in coastal areas
Summary

• **Height Above Nearest Drainage (HAND)** rasters available by FTP
• TNRIS will host statewide address points without elevations (still have quality issues)
• Address points with HAND elevations are intended for Public Safety use (aggregate county and basin counts; not a substitute for detailed engineering study)
17-0010 Canton Area Tornadoes

Report to Chief Kidd on potential impact, ground-truthed by David Allen, EGRT
April 29, 2017
17-0010 Canton Area Tornadoes

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Thank you!

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