Flood Forecasting & Warning – Current Challenges

Jason Elliott
Senior Service Hydrologist
NWS Baltimore/Washington

February 23, 2017
Is this really fair? We try to forecast rainfall down to a hundredth of an inch.

Can we agree – we’re not that good??
Anticipating Floods

Looking for clues:
Abundant moisture
Favorable winds
Likelihood of convection

But also:
Are the soils wet?
Are the streams high?
How fast is the rain falling?

No two events are equivalent...
Base Clues are Easy to Find

Computer models tell us when the signals will exist…
Base Clues are Easy to Find

Some even try to make sense of the signals...
Base Clues are Easy to Find

But they are **just signals!** (Can’t be taken verbatim...)

Digging Deeper

The added clues are tougher to spot:
Digging Deeper

The added clues are tougher to spot:
What we do today...

Monitor rainfall estimates & streamflow observations and attempt to anticipate flooding with a one-hour advance notice.
Sometimes a one-hour advance notice is literally impossible. Consider College Park, MD – June 10, 2014:

* Image is from 9am
* Flooding began by 9:57am, with water rescues before 10:00am.
Sometimes a one-hour advance notice is literally impossible. Consider College Park, MD – June 10, 2014:

Really, it didn’t even begin raining until 9:30am!
Hydro Science is Advancing

Past: Flash Flood Guidance
Amount of rain needed to bring small streams to bankfull \(\leftarrow\) this isn’t actually flash flooding!

Present: Average Recurrence Interval (ARI)
How rare is the rain that is falling?

<table>
<thead>
<tr>
<th>ARI (years)</th>
<th>Probability of occurrence in any given year</th>
<th>Percent chance of occurrence in any given year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>1 in 1000</td>
<td>0.1%</td>
</tr>
<tr>
<td>500</td>
<td>1 in 500</td>
<td>0.2%</td>
</tr>
<tr>
<td>100</td>
<td>1 in 100</td>
<td>1%</td>
</tr>
<tr>
<td>50</td>
<td>1 in 50</td>
<td>2%</td>
</tr>
<tr>
<td>20</td>
<td>1 in 20</td>
<td>5%</td>
</tr>
<tr>
<td>10</td>
<td>1 in 10</td>
<td>10%</td>
</tr>
<tr>
<td>5</td>
<td>1 in 5</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>1 in 2</td>
<td>50%</td>
</tr>
<tr>
<td>1</td>
<td>1 in 1</td>
<td>100%</td>
</tr>
</tbody>
</table>

http://hdsc.nws.noaa.gov/hdsc/pfds/index.html
Hydro Science is Advancing

Future: Flooded Locations and Simulated Hydrographs (FLASH)

Provides high-resolution guidance to attempt to predict flooding through traditional (FFG/ARI) and modeled (based on soil moisture) methods.
Hydro Science is Advancing

Future: National Water Model (NWM)
Urbanization

- Anything that cannot be absorbed into the soil becomes *runoff*.
- In an urban area, where surfaces like concrete and asphalt are impermeable, *everything* becomes runoff!
Tidal Flooding

- Mean Sea Level (MSL) is steadily rising...
  (average rate ~1 foot/century)
A NOAA study finds that nuisance flooding (defined as reaching our NWS ‘minor flood’ level) has substantially increased in the last 50 years. This is due to a rise in the base water level, not due to increased storms.

<table>
<thead>
<tr>
<th>City</th>
<th>Average nuisance flood days (1957-63)</th>
<th>Average nuisance flood days (2007-13)</th>
<th>Percent increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annapolis</td>
<td>3.8</td>
<td>39.3</td>
<td>925%</td>
</tr>
<tr>
<td>Baltimore</td>
<td>1.3</td>
<td>13.1</td>
<td>922%</td>
</tr>
<tr>
<td>Washington</td>
<td>6.3</td>
<td>29.7</td>
<td>373%</td>
</tr>
</tbody>
</table>
Tidal Flooding

Severn River at Annapolis

Latest observed value: 1.15 ft at 10:12 AM EST 22-Feb-2017. Flood stage is 2.4 ft.

Site Time (EST)

- Graph Created (10:35AM Feb 22, 2017)
- Observed
- Forecast (issued 1:41AM Feb 22)

Observations courtesy of National Ocean Service
Tidal Flooding

- Some locations can have both freshwater and tidal influence.
- HEC-RAS model being run on the Tidal Potomac to output data for the Upper Tidal Potomac near DC.
New inundation maps available for the upper Tidal Potomac (both freshwater and tidal):

http://weather.gov/washington/PotomacInundationMaps

http://doee.dc.gov/service/FIM
Contact Info

Jason Elliott
Senior Service Hydrologist
NWS Baltimore/Washington

jason.elliott@noaa.gov

http://www.weather.gov/washington