Real-time surface water flood risk mapping for emergency responders

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Outline

1. Review of two recent surface water flood events
   - London - 2016
   - Birmingham - 2018

2. Real-time flood forecasting
   - Combining short-range predictions and nowcasting
   - A demo of the system
     - London - 2016
     - Birmingham - 2018

3. National mapping of emergency service accessibility and flood nowcasting
   - Progress so far
   - Next steps

3.8m homes in England are at risk from surface-water floods, 2.4m from rivers and sea  econ.st/1RcsYzz
The Devon Way Polling station has been moved due to flooding to:

The Hook Centre
Hook Road
KT9 1EJ

Electoral Services helpline: 020 8547 5026

Supporting children & young people with disabilities & their families

Electoral Services helpline: 020 8547 5026
Impacts on Emergency Response of Fire & Rescue Service

Romford, London, 23 June 2016

Railway bridge at Raynes Park

8-minute target
### The impacts – 23rd June 2016

<table>
<thead>
<tr>
<th>Date</th>
<th>Total number of incident</th>
<th>Average Response time (min)</th>
<th>No. responded over 8 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 June</td>
<td>318</td>
<td>6.0 min</td>
<td>20%</td>
</tr>
<tr>
<td>23 June</td>
<td>1001 (+214%)</td>
<td>14.9 min (+148%)</td>
<td>39%</td>
</tr>
<tr>
<td>24 June</td>
<td>348</td>
<td>6.6 min</td>
<td>21%</td>
</tr>
</tbody>
</table>

The impacts – 23rd June 2016

A more recent event – Birmingham 27 May 2018
Also flooded in 2016 and 2017

**Man in 80s dies in Walsall as flash floods hit Midlands**

© 28 May 2018

Flooding in Birmingham, England (May 27, 2018)
21,896 views
In a changing climate, with increasingly uncertain and ‘unfamiliar’ weather conditions:

City managers: How to make cities more resilient?
Emergency responders: Whether live can be saved?
Researchers: Can new flood modelling techniques be used for improved service resilience?
Flood Nowcasting VS Forecasting

Traditional forecasting provides short-range to long-range predictions of flooding
- Often coarse resolution
- Focus on fluvial flooding
- Not real ‘real-time’
- May not be suitable for surface water flooding

We developed flood nowcasting
Related to weather nowcasting
- Winter rainfall: 3-4 hours (UK)
- Summer thunderstorms: 1-2 hours ahead (UK)
- We predict surface water flooding in real time for the next 6 hours

Overarching framework of the real-time flood forecasting system developed

**Data Server**
Precipitation nowcasting and forecasting
Products (different lead-time)

**Model Server**
High-resolution flood modelling
FloodMap (floodmap.org)

**Mapping Server**
Mapping within UK Cabinet Office’s data portal and other platforms
Demo 1
23 June 2016 – London
UK Referendum Voting Day flooding

All incidents Fire & Rescue Service attended

All flood-related incidents
Hindercast of the 23 June event in London

72-hour hindercast
Demo 2

27 May 2018 – Birmingham

- Sunday – hit the BBC headline
- ‘3rd time in nine years’
- One month of rainfall fell within an hour

"It happened two years ago and people could have protected us."

Residents have filmed the flooded streets around Birmingham

Ben Lees, a 25-year-old drainage engineer, was on his way home on Sunday night when he spotted a submerged vehicle in Walsall and dived into water deeper than 6ft (1.8m) to save a man trapped in the car.
Forecasting versus Nowcasting
Where we are in terms of real-time flood predictions

City-based system
Street-level resolution (2-50 meters)
First real-time flood forecast/nowcasting system of its kind

BBC East Midland April 2017 Interview:
“World-leading technologies have been developed . . .”
“It could be used across the country and around the world ”

Where we are:
We have set up 30 cities in the UK and growing.
Several global cities are also piloted in our system

December 2018
We have provided the 3-hourly nowcasting of surface water flood risks for four city regions in England to the Cabinet Office.

Where we hope to be:
- Improve the accuracy of the predictions
- Help cities to improve their resilience to surface water flooding
Who can benefit?
- City managers
- Emergency responders
- Asset owners
- Humanitarian organisations

How can it be used?
- Strategic planning
- Operational support

Real-time flood forecasting/nowcasting

How can flood nowcasting help emergency responders?

How can it be used: an example
Ambulance Service response time target
- Before July 2017: 8-minutes to 75% of the life-threatening calls
- After July 2017: 7-minutes to 50% of the life-threatening calls

East Midlands Ambulance Service says it needs more resources to meet targets

Photo: Emily Norton for Lincolnshire Reporter

21 March 2018
Vulnerable facilities outside of the Ambulance 7-minute spatial coverage

Green areas are areas that can be covered by Ambulance stations within 7-minute of their drive, assuming normal traffic conditions.

Red dots are care homes outside of the 7-minute coverage

- Drastically decreased spatial coverage
- Increasing number of vulnerable facilities out of reach
- Similar picture for Fire & Rescue Service

### Table 1: Ambulance Service percentage coverage of care homes, sheltered accommodations, schools and nurseries in England within 7-minute drive.

<table>
<thead>
<tr>
<th>Ambulance Service Percentage Coverage</th>
<th>Care Home</th>
<th>Sheltered Accommodation</th>
<th>School</th>
<th>Nursery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline 7-minute</td>
<td>14</td>
<td>8</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>RoFSW 30 year 7-minute</td>
<td>30</td>
<td>23</td>
<td>35</td>
<td>31</td>
</tr>
<tr>
<td>RoFSW 100 year 7-minute</td>
<td>42</td>
<td>33</td>
<td>45</td>
<td>43</td>
</tr>
<tr>
<td>RoFSW 1000 year 7-minute</td>
<td>71</td>
<td>66</td>
<td>73</td>
<td>72</td>
</tr>
</tbody>
</table>
What we are doing - NERC follow-on fund (1 March 2018 – May 2019)

Flood nowcasting for four city regions
- Greater Birmingham
- Leicestershire
- Greater London
- Greater Manchester

Live accessibility mapping for the four city regions

Delivering the mapping to Cabinet Office’s platform in real time
NERC funding under UK Climate Resilience Programme  
NE/S017186/1 (February 2019 - January 2020)

Unlocking the potential of surface water flood nowcasting for emergency services in a changing climate

Research Questions:

1. uncertainty propagation from precipitation nowcasting and forecasting products to high-resolution surface water flood predictions

2. effective communication of complex surface water flood risk information

3. support emergency responders' operational decision making
Thank you! Any questions?!