JBA Risk Management

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FROZEN BRITAIN
Overview

- Freeze in the UK
- Frozen pipes and escape of water
- Addressing the problem – mapping and ADR
  - Approach using ArcGIS techniques
  - Inputs and considerations
Freeze in the UK

Insurance claims (ABI 2010):
- Costing £900 million
- 3,500 claims per day during 2010 event
- Average claim £7,000

British Gas: 10,000 callouts in 7 days (2010)

Nasa’s Terra Satellite 7 January 2010

Temps from across UK (data from The Guardian)
Frozen pipes and escape of water

- Escape of water costs insurers £2.5 million per day (ABI)

- Frozen pipes:
  - Pipes generally do not break where ice is formed
  - As water freezes it expands causing pressure to build downstream
  - Pipes fail between the ice blockage and closed faucet
  - Upstream from ice blockage, water can retreat back towards its source and doesn’t build any pressure
Vulnerability to pipe burst

- Regional / environmental variation
- Attics, crawl spaces and outside walls
- Condensing boilers
  - 2005: new builds compulsory (1 April 2005, John Prescott)
  - 2008: boiler scrappage scheme
- Pipes located on the outside
Addressing the issue

Create a freeze hazard map of the UK
- Multiple return periods

Produce an annual damage ratio (ADR)
- Property level
- Postcode level
Annual Damage Ratio (ADR)

Quantified estimate of freeze risk rather than a qualitative one.

- A risk with ADR = 0.06 is 3x more at risk than a risk with ADR = 0.02

ADR x Total Sum Insured = expected monetary loss due to freeze, per annum

Can estimate the premium associated with the freeze element (only) of insurance from a technical perspective
ADR calculation

Freeze hazard maps

Event set

10,000-year “mini event set” specific to each location is developed and analysed

Built environment model

Inclusive of built environment modelling (“best estimate” results” or based on single vulnerability function)

Vulnerability functions

Freeze damage vulnerability functions calibrated against UK claims data where possible
UKCP09 gridded temperature data

- 46 years of data (1960-2006)
- Consistent / continuous
- 5km resolution
- Daily minimum, mean and maximum temperatures
- Interpolated from historical observations accounting for coarse scale effects of:
  - Altitude
  - Longitude & latitude
  - Coastal influence
  - Urban areas

Min temp (0.99 probability threshold)
Hazard map development

Characteristics of Freeze events

- What causes a Freeze claim? - Burst pipe
  - One night of extreme cold
  - Prolonged sub-freezing temperatures
- Akyurt et al. (2002)
  - Supercooling prior to ice formation
  - 4 days of below freezing temperatures, no ice formation for first 3 days
- Testing various classifications of hazard

Hazard map development

Marginal Analysis

- Interested in the extremes – using raw temperature this would be the peaks under the threshold
- Threshold exceedences are fitted to a Generalised Pareto Distribution (GPD)
- Defining the threshold
  - Flexibility to alter threshold for each data station to obtain best fit
  - Can assign a single consistent threshold (i.e. below 0°C)

Output relates return level to return period
Hazard map development

Interpolate output from marginal analysis

- For each 5km cell centroid extract the return level for each return period
- Interpolate
  - Inverse distance weighting (IDW)
  - Raster map

Min temperature associated with the 1 in 100 year event
Hazard map development

Add local scale influences (within ArcGIS)

- Altitude: height mapping / *lapse rates and temperature inversions* (including a 10km coastal buffer)

- Urban density: Corine land use - 5 bands of urbanisation / *urban heat island effects*

Based on literature:

<table>
<thead>
<tr>
<th>Land Use Class</th>
<th>Adjustment Value</th>
<th>Altitude band</th>
<th>Adjustment Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBD</td>
<td>+ 2 °C</td>
<td>&lt;100m</td>
<td>- 1 °C</td>
</tr>
<tr>
<td>Urban</td>
<td>+ 1 °C</td>
<td>100-200m</td>
<td>Zero</td>
</tr>
<tr>
<td>Semi-urban</td>
<td>Zero</td>
<td>200-300m</td>
<td>- 1 °C</td>
</tr>
<tr>
<td>Villages</td>
<td>- 1 °C</td>
<td>300-400m</td>
<td>- 2 °C</td>
</tr>
<tr>
<td>Rural</td>
<td>- 2 °C</td>
<td>&gt;400m</td>
<td>- 3 °C</td>
</tr>
</tbody>
</table>
Postcode level hazard maps

urban density  altitude

Combined

Liverpool  Manchester  Leeds
Built environment model (GB)

Developed using survey data available from Rightmove

Full unit postcode resolution

Incorporates survey data from 13 million properties

Detailed modelling of residential risk types

Location / outline of >2,000 industrial sites

Incorporates house structure, age, height information plus cellar (Y/N), conservatory (Y/N), value information
Vulnerability functions

Expressed as mean damage ratio and standard deviation

Flood: Depth-damage curves

Freeze: Research needed to relate hazard with damage
ADR summary

Inputs:
- 6 return period hazard maps
- Vulnerability Functions
- Built Environment

Outputs:
- Mean and standard deviation
- Property / postcode level
- Residential / commercial
- Buildings and/or contents
ANY QUESTIONS?
Boring legal bits

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