JBA Risk Management

Prepared 15 July 2013 for ESRI User Conference 2014

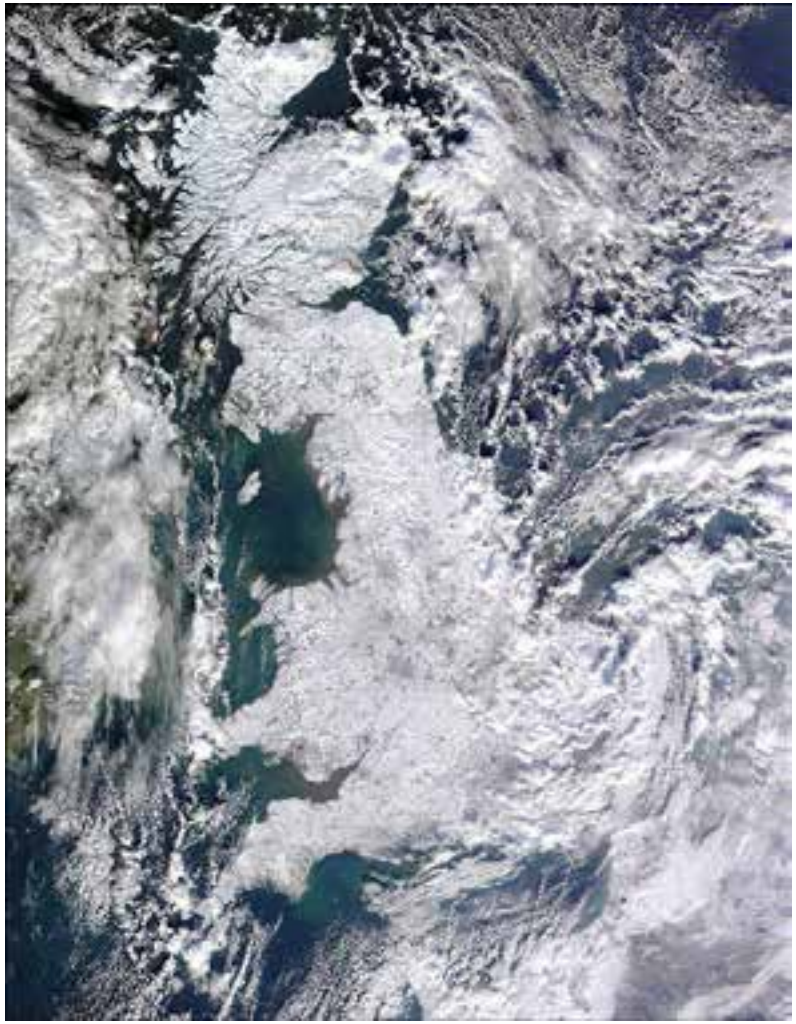
By: Vanessa Balmbra, GIS and Training Specialist
E: vanessa.balmbra@jbarisk.com
O: +44 (0) 1756 799919

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

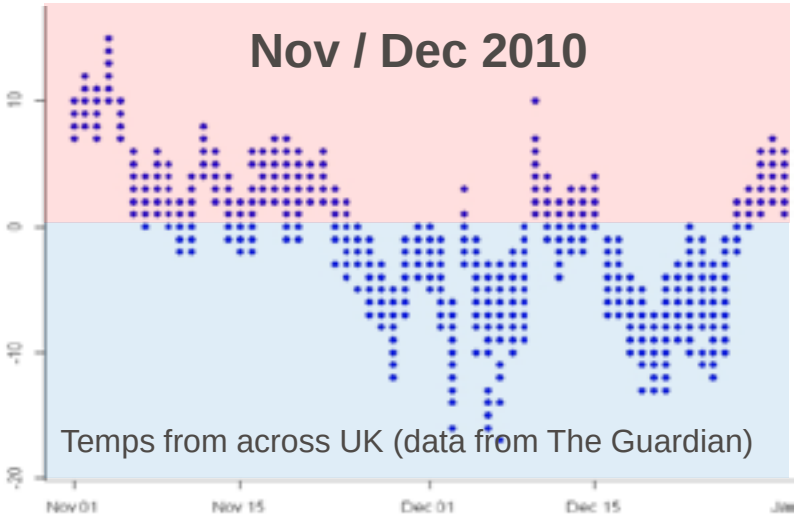


Nasa's Terra Satellite 7 January 2010

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)



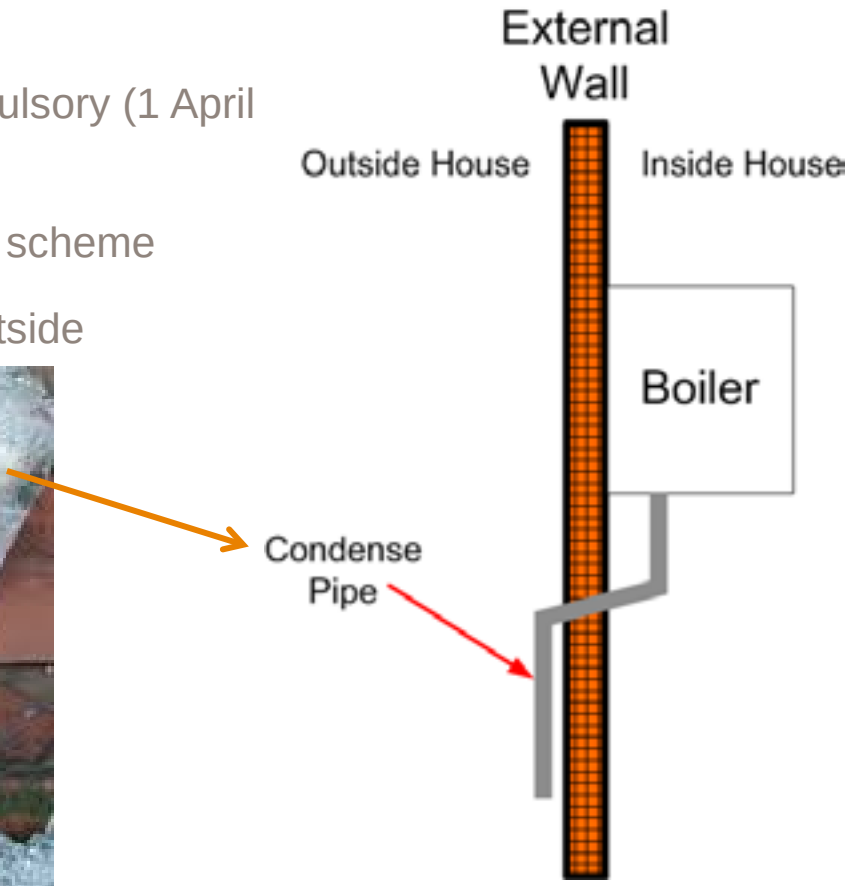
Reactions
LONDON MARKET AWARDS
2014
WINNER

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



Reactions
LONDON MARKET AWARDS
2014
WINNER

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)

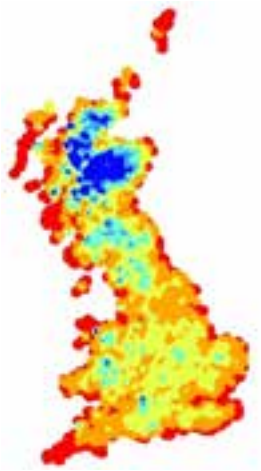
Quantified estimate of freeze risk rather than a qualitative one.

- 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

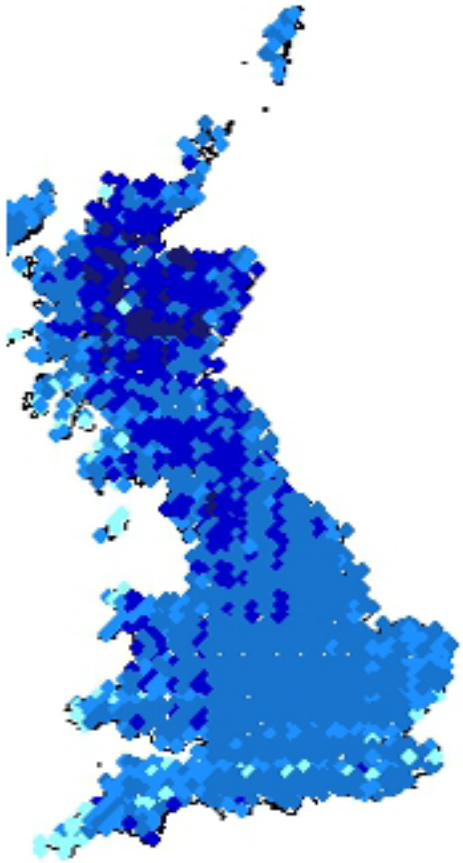
ADR calculation

Freeze hazard maps	Event set	Built environment model	Vulnerability functions
	10,000-year “mini event set” specific to each location is developed and analysed	Inclusive of built environment modelling (“best estimate” results” or based on single vulnerability function)	Freeze damage vulnerability functions calibrated against UK claims data where possible

Reactions LONDON MARKET AWARDS 2014 WINNER

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

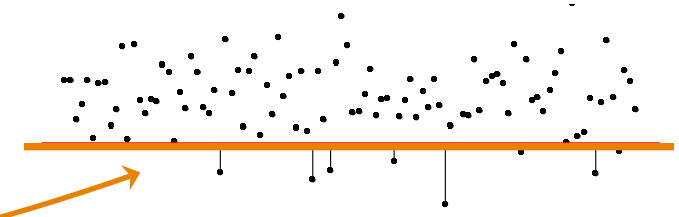
- What causes a Freeze claim? - Burst pipe
  - One night of extreme cold
  - Prolonged sub-freezing temperatures
- *Akyurt et al.* (2002)
  - Supercooling prior to ice formation
  - 4 days of below freezing temperatures, no ice formation for first 3 days
- Testing various classifications of hazard

Akyurt, M., Zaki, G., & Habeebullah, B., (2002) Freezing phenomena in ice-water systems, *Energy Conservation and Management*, **43**, 1773-1789

Hazard map development

Marginal Analysis

- Interested in the extremes – using raw temperature this would be the peaks **under** the threshold



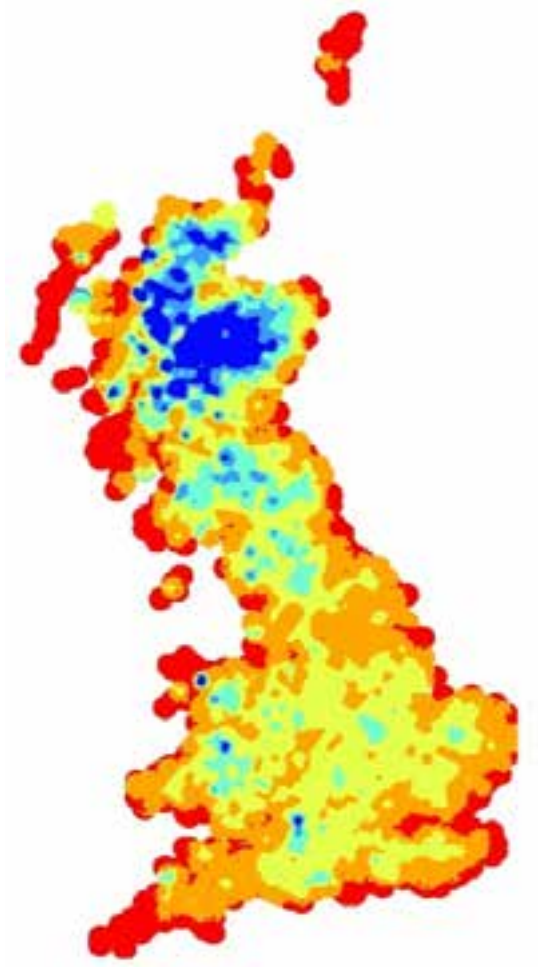
- Threshold exceedences are fitted to a Generalised Pareto Distribution (GPD)
- Defining the threshold
  - Flexibility to alter threshold for each data station to obtain best fit
  - Can assign a single consistent threshold (i.e. below 0^{o}C)

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

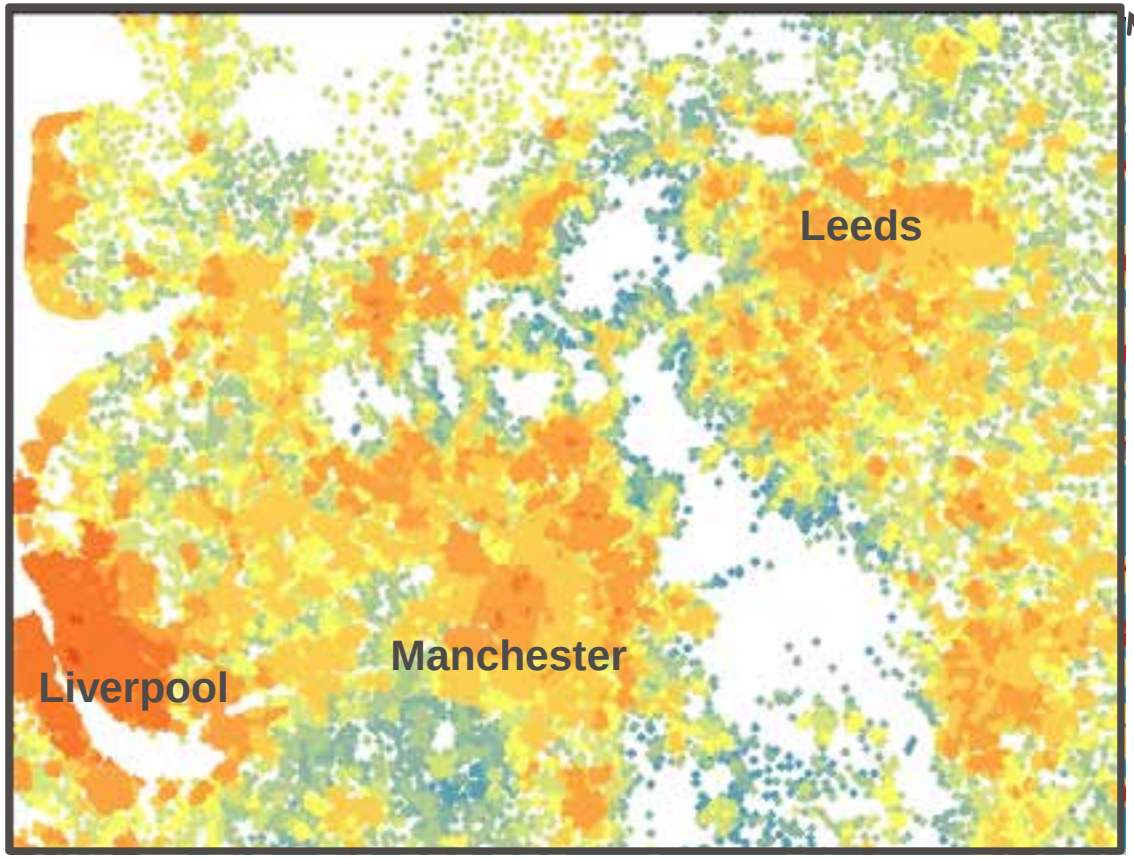
Add local scale influences (within ArcGIS)

- 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:

Land Use Class	Adjustment Value	Altitude band	Adjustment Value
CBD	+ 2 ^{o}C	<100m	- 1 ^{o}C
Urban	+ 1 ^{o}C	100-200m	Zero
Semi-urban	Zero	200-300m	- 1 ^{o}C
Villages	- 1 ^{o}C	300-400m	- 2 ^{o}C
Rural	- 2 ^{o}C	>400m	- 3 ^{o}C

Postcode level hazard maps



urban density **altitude**

Combined

Reactions
LONDON MARKET AWARDS
2014
WINNER

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

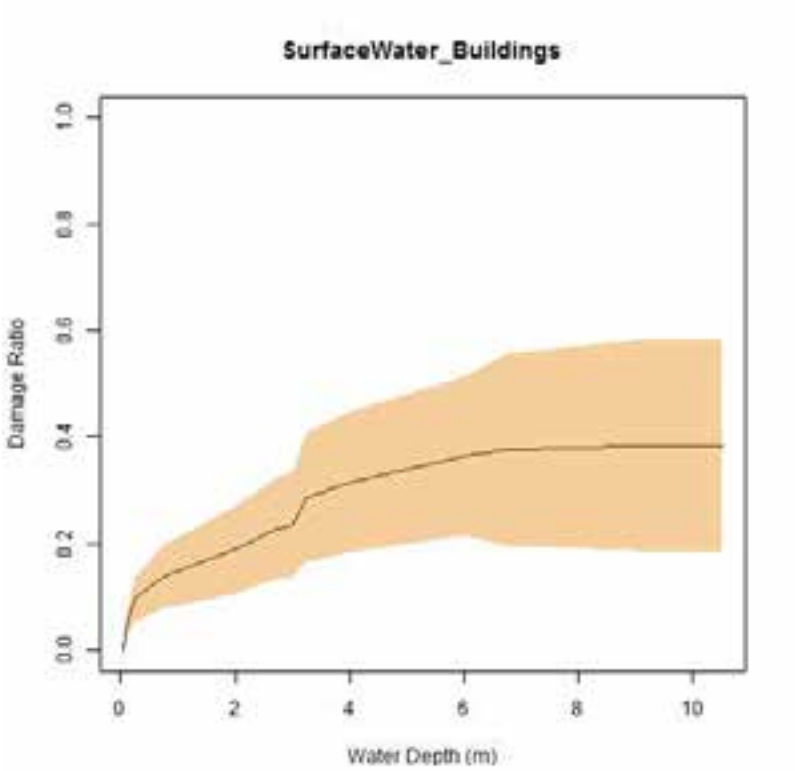
Reactions LONDON MARKET AWARDS 2014 WINNER

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

The stuff in this presentation belongs to JBA. Don't steal it. It's only a presentation and the data presented are modelled, so don't rely on them. If you do, the risk is all your own and JBA won't be held responsible or liable.

Maps where shown:

- *Background maps - Bing Maps © 2014 Microsoft Corporation and its data suppliers*
- *Contain Ordnance Survey data (c) Crown copyright and database right 2014*
- *(c) Geoperspectives*