24/7 Population modelling for natural hazard assessment

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Acknowledgments

Developing the “Pop 24/7” methodologies:

Professor David Martin
Dr Samantha Cockings

http://www.southampton.ac.uk/geography/research/projects/space_time.page
Background

- Better population estimations are required for hazard risk assessment
- Censuses typically provide a decadal ‘night-time’ population estimation
- This does not take into account the large fluxes of temporary populations during the day
- Events of 2011/12 have focused global attention on natural hazards and their impacts
Conventional density maps

Southampton, UK
Southampton

- Cruise and freight terminals
- Train station
- Retail centre
- Ferry
- University
- Sporting grounds
- City centre developments
- Airport
Flood warnings for UK as storm builds over Atlantic
Met Office issues severe weather warning – high speed winds and heavy rains to batter England, Wales and Northern Ireland

Steven Morris
The Guardian, Thursday 14 June 2012 19.32 BST

Monsoon in summer: more rain is on its way, the Met Office has warned.

Photograph: Andy Rain/PA
“Pop 24/7” overview

• Spatio-temporal gridded population modelling
  – Variable kernel density estimation (KDE)
  – Utilises population centroids
  – Redistributes resident populations according to a temporal profile
  – Population subgroups

• Removal of arbitrary administrative boundaries

• Allows locations of zero population density (Eg. Water)
Analytical overview

Model database → Spatial extent → Target time HH:MM DD/MM/YYYY → Population/SB247

Population/SB247 → Origin centroids → Destination centroids → Temporal profiles → Background mask → Session parameters

Validation log → Data validated?

Yes → Run population model

No → Population surface

Run population model → Population exposure → GIS analysis

GIS analysis → Results database

Results database → Vulnerability indicators
Space-time interpolation

destination centroid

local extent

origin centroid

catchment area

Background mask

Study area

+ Pop. in

- Pop. out

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Temporal Profile

A retail example of a temporal profile derived from the *Time Use Survey 2000* indicating potential shopper numbers for a given time.
Results

- Variable grid size, currently using 200 metre resolution
- Visualization for public communication
- Population weighted to background mask
- Combination and analysis with hazard footprint data
- Application to a UK flooding scenario, using the Environment Agency’s ‘Flood Map’.
(A) 2001 Census  
(B) Model time: 08:00 weekday  
(C) Model time: 12:00 weekday  
(D) Model time: 20:00 weekday

2001 Census Pop. Modelled Pop.
- High: 1598  
- Low: 106  
- High: 5600.6  
- Low: 0

Flood Map © Copyright Environment Agency 2012  
2001 Census Output Area Boundaries © Crown copyright 2003  
Bing Maps Aerial © Copyright Microsoft Corporation and its data suppliers 2010
Example weekday population
Example weekday population
Example weekday population
Example weekday population
Example weekday population
Example weekday population
Example weekday population
Fluvial and tidal exposure
Exposure by age subgroup

![Bar chart showing exposure by age subgroup at different times and tidal conditions.](attachment:image.png)
Student saptio-temporal distribution
Next steps

• Further analysis of results
• Continued development of datasets and temporal profiles
• Application to a hazard scenario
  – St Austell
  – Ulley Dam burst (S. Yorkshire)
• Advances in natural hazard risk management
• Many more potential applications...
Any questions?

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