DAFNI
Data & Analytics Facility for National Infrastructure

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An Agent-Based Model of Flood Infrastructure Resilience




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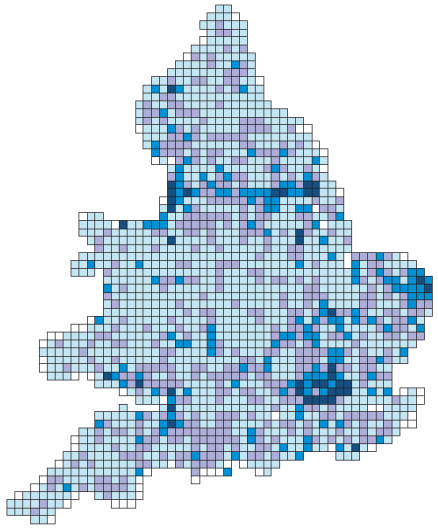
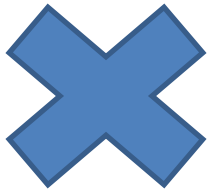
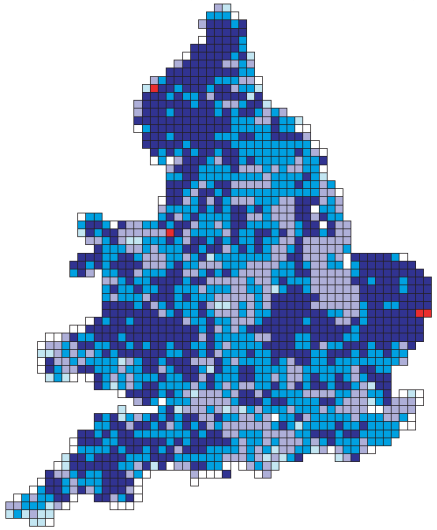
Typical assessment of flood risk

Property location

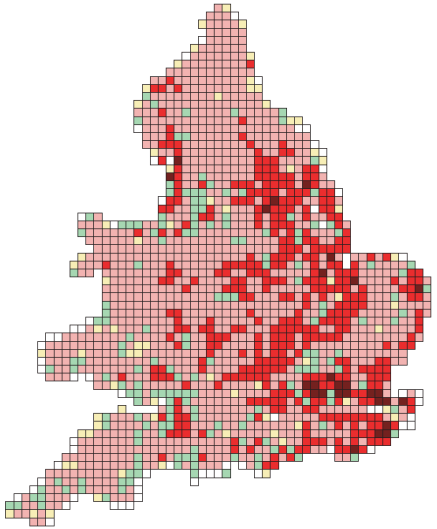




Probability of flooding



Flood Risk
(Expected Annual Damages)



Flood resilience

- Why do some floods generate higher damages or lead to greater loss of life – even in the same location?
- Why are some communities 'back on their feet' much more quickly?
- Role of individuals, communities, organisations in mediating short term risks and preparing for long term risks are crucial
- Resilience to a flood event does not just come from big flood defences but timely warnings, temporary barriers, evacuation
- Resilience is also enabled and enhanced by land use planning, design and operation of infrastructure networks etc.

ABM to capture flood incident responses

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Spatial data:
- Flood defences
- Ground elevation
- Transport network
- Property type and location

etc.

Behaviour rules:
- Normal interaction
- Response to warning
- Response to floodwater

etc.

Resilience actions:
- Evacuation strategy
- Flood warning *etc.*

Event conditions:
- Storm surge
- Failed defence
- Time of day *etc.*

ABM Platform

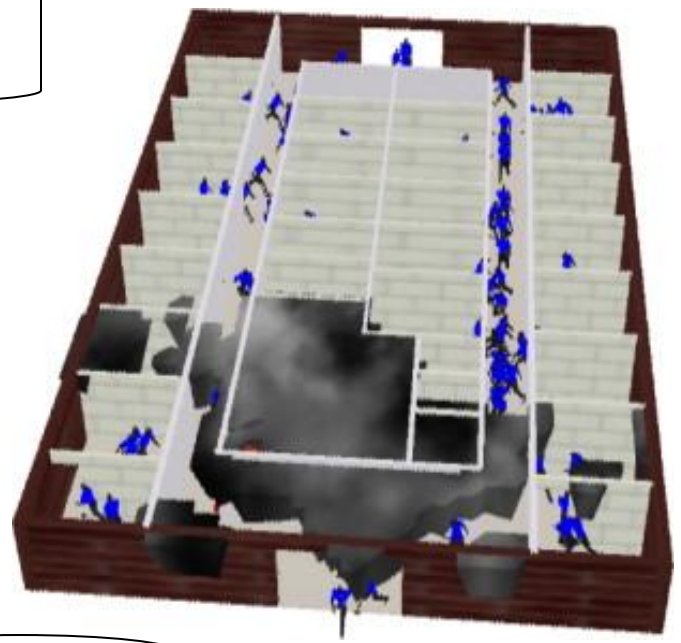
Hydrodynamic simulation

Agent simulation

Risk analysis

Vulnerability information:
- Economic
- Drowning

etc.



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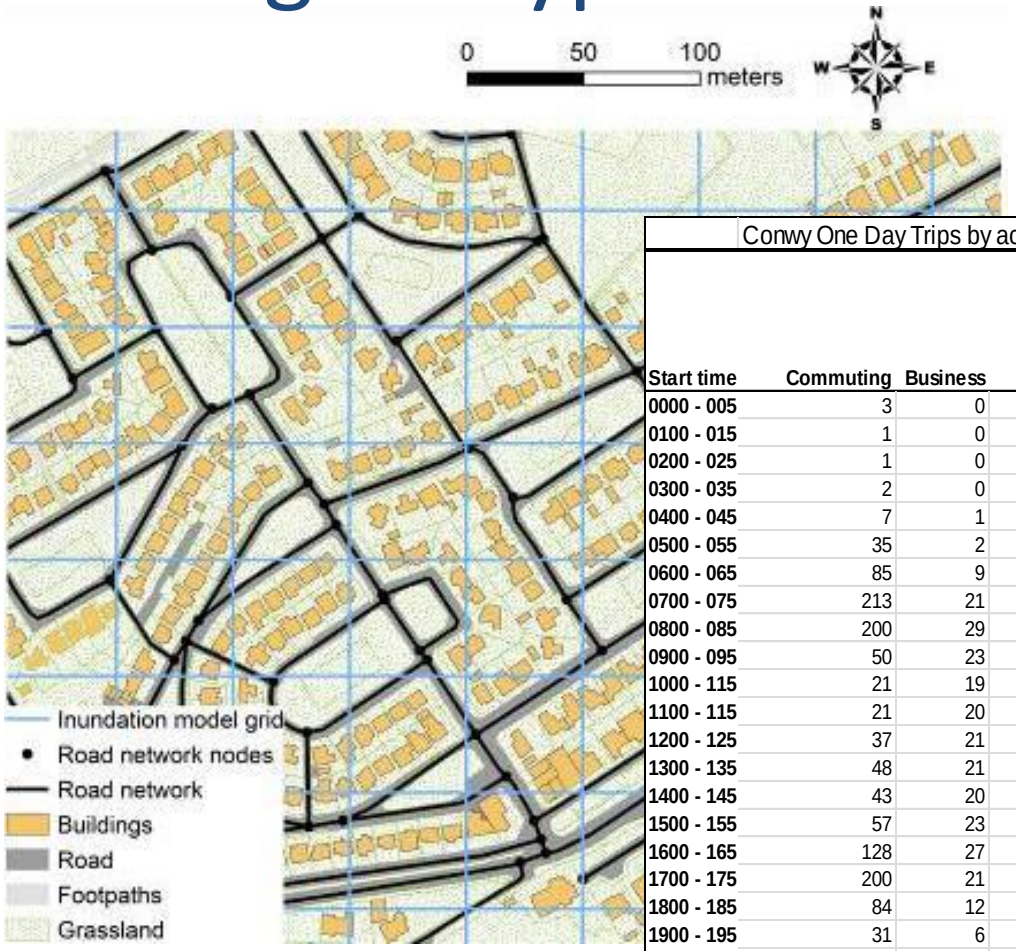
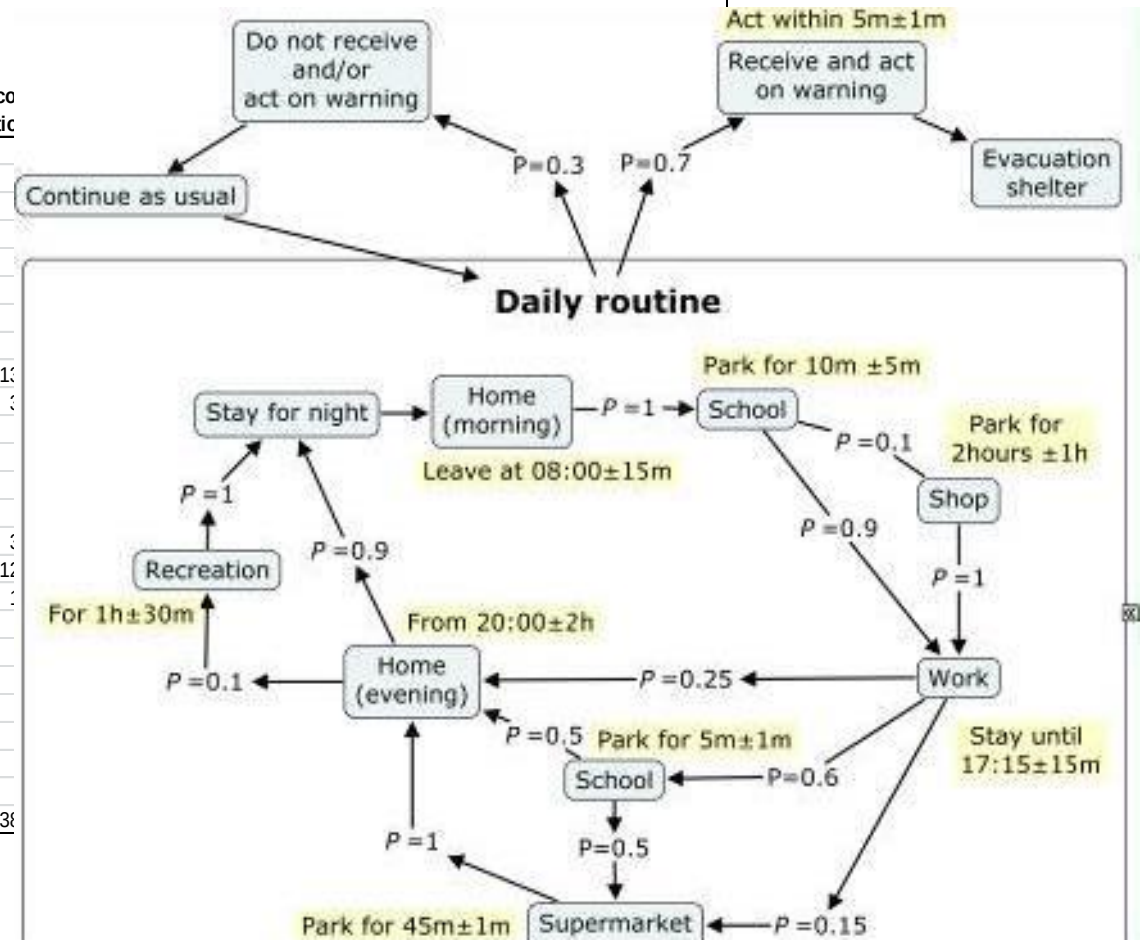
http://www.youtube.com/watch?v=o0EOlc5n9O8

Behaviour model for different demographic and agent types

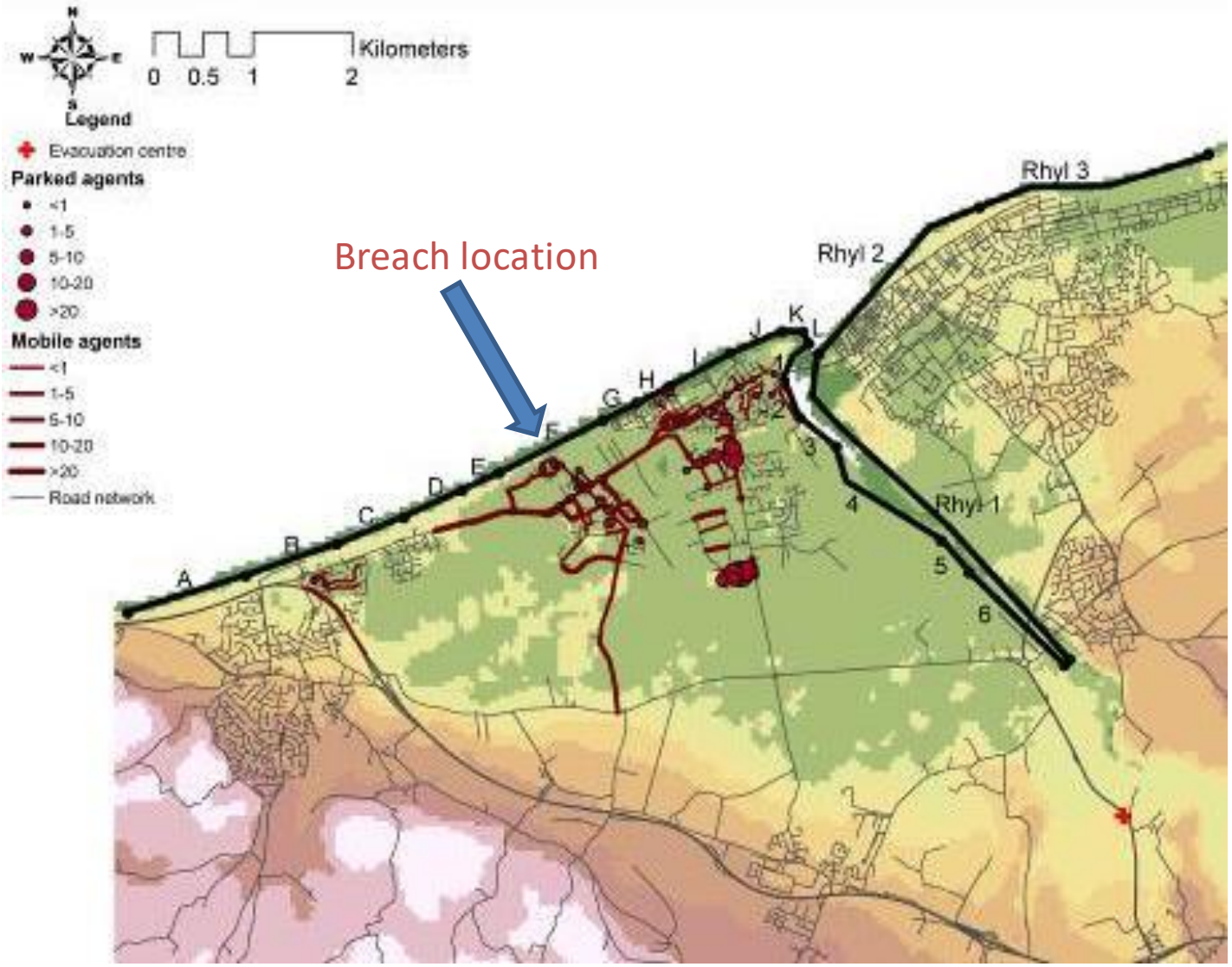


Conwy One Day Trips by activity types

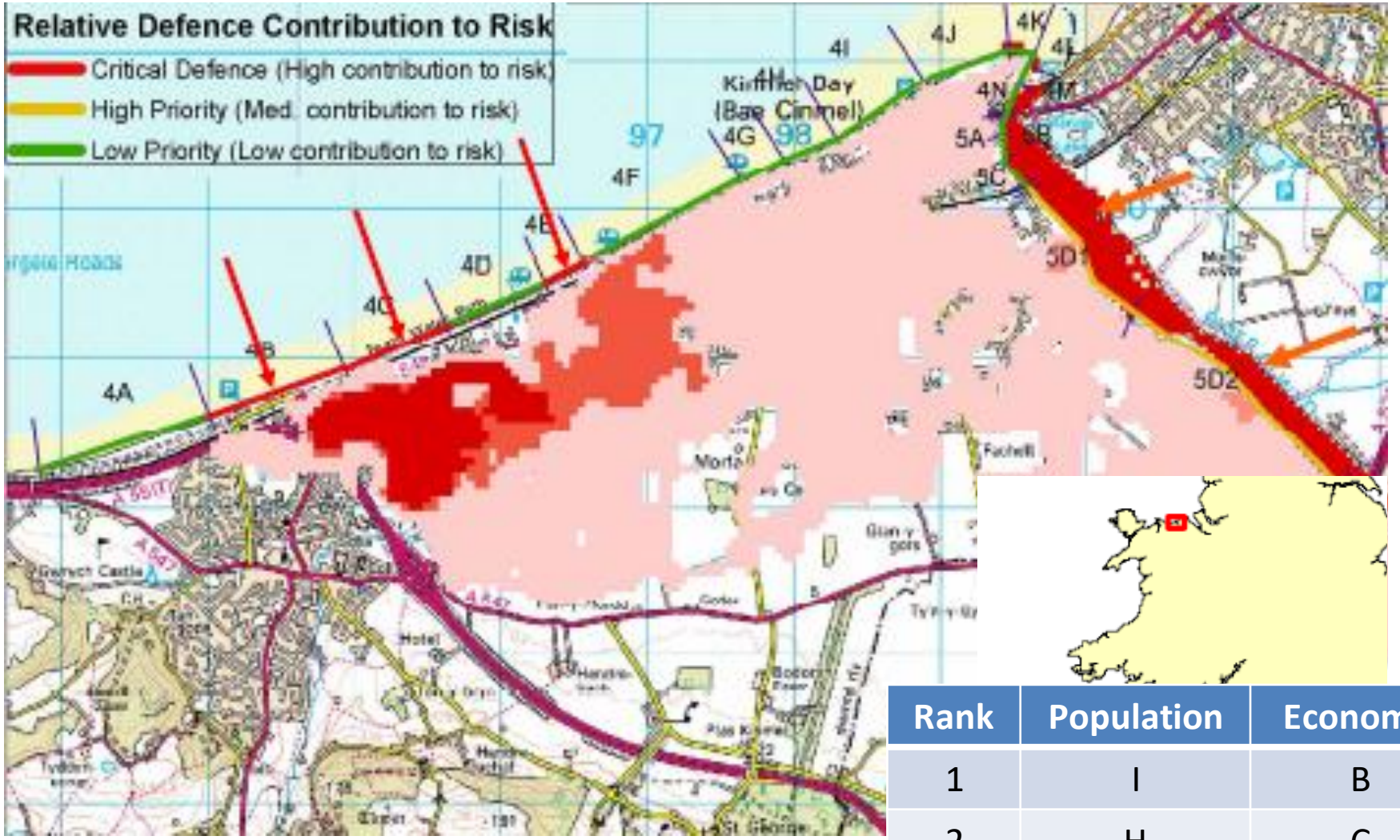
Start time	Commuting	Business	Education	Esco educatic
0000 - 005	3	0	0	
0100 - 015	1	0	0	
0200 - 025	1	0	0	
0300 - 035	2	0	0	
0400 - 045	7	1	0	
0500 - 055	35	2	0	
0600 - 065	85	9	1	
0700 - 075	213	21	38	
0800 - 085	200	29	232	1
0900 - 095	50	23	13	
1000 - 115	21	19	7	
1100 - 115	21	20	8	
1200 - 125	37	21	12	
1300 - 135	48	21	11	
1400 - 145	43	20	15	
1500 - 155	57	23	181	1
1600 - 165	128	27	30	
1700 - 175	200	21	13	
1800 - 185	84	12	4	
1900 - 195	31	6	2	
2000 - 205	22	4	1	
2100 - 215	18	3	1	
2200 - 225	16	2	0	
2300 - 235	9	1	0	
All day	1331	285	570	3



Spatial impacts: Single defence breach

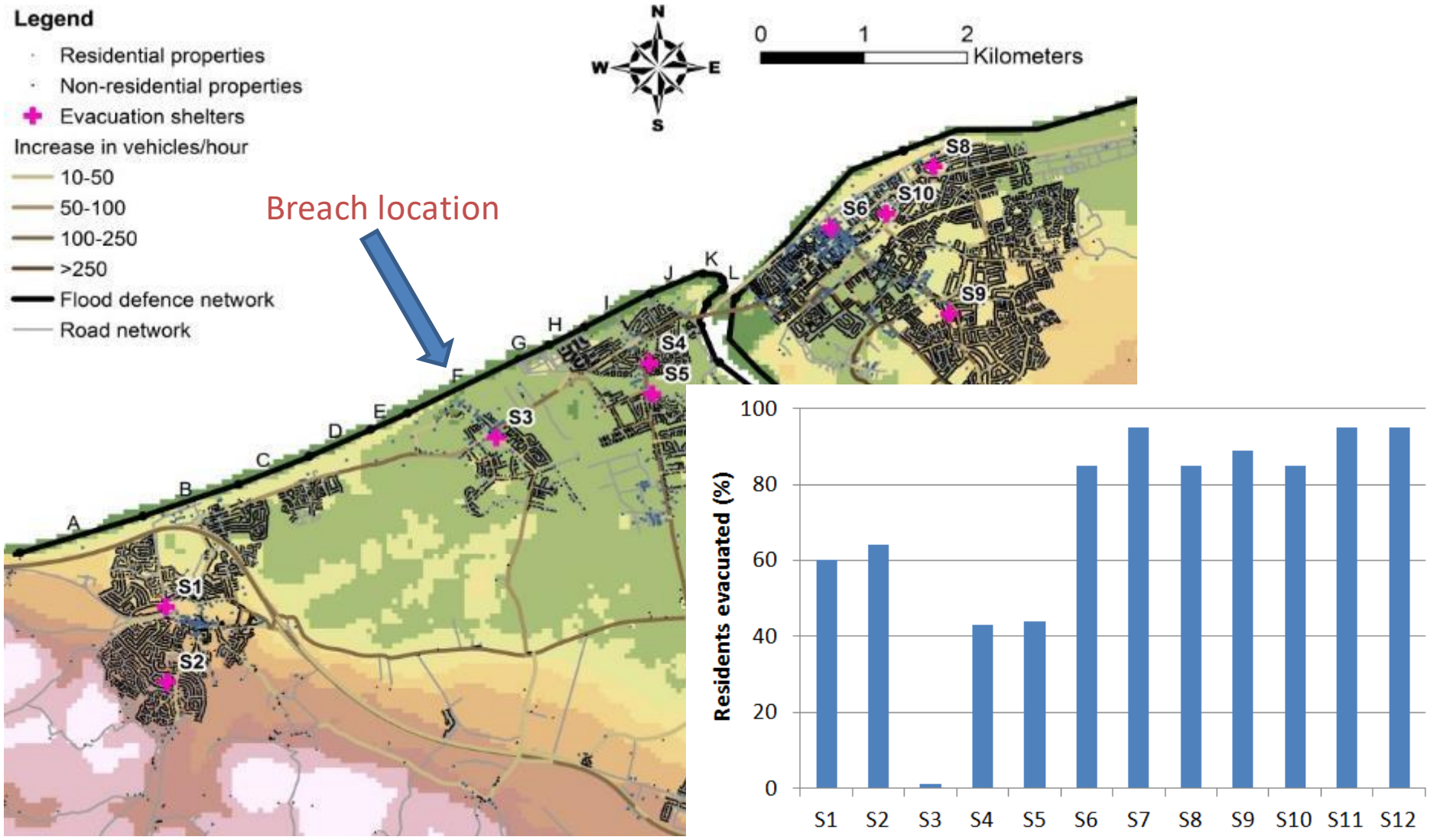


Risk to people vs. property

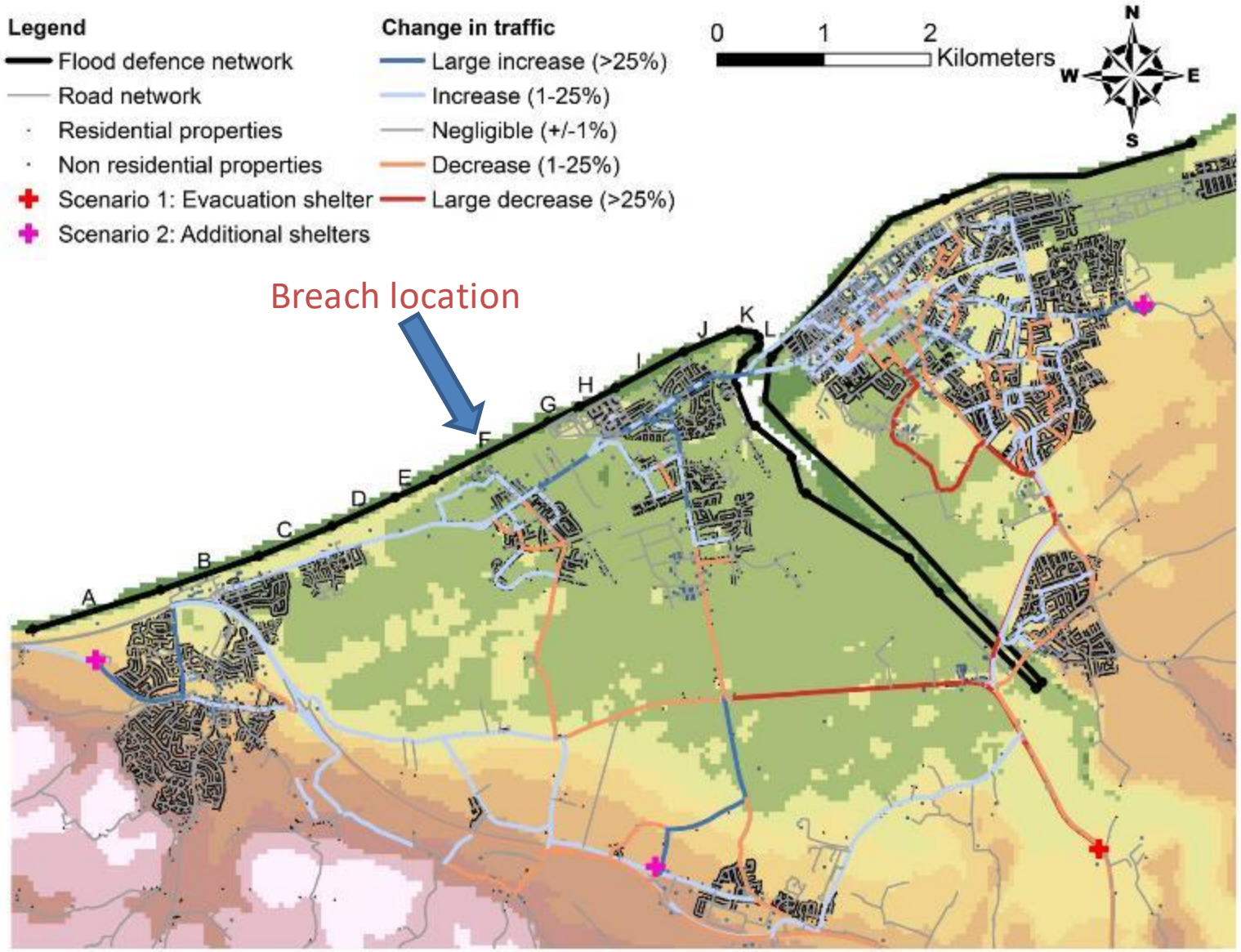


Rank	Population	Economic
1	I	B
2	H	C
3	J	E

Evacuation location



Congestion


Legend
Flood defence network
Road network
Residential properties
Non residential properties
Scenario 1: Evacuation shelter
Scenario 2: Additional shelters
Change in traffic
Large increase (>25%)
Increase (1-25%)
Negligible (+/-1%)
Decrease (1-25%)
Large decrease (>25%)
0
1
2
Kilometers
N
W
E
S
Breach location
A
B
C
D
E
F
G
H
I
J
K
L


Coventry, 2008


Houston, 2005

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Centre of Excellence project

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- Recode in Python and put on DAFNI (PyFIRM v1)
- Data pre-processing toolkit and workflow
- Upgrade model (PyFIRM v2)
  - Improve visualisation
  - Use DAFNI's workflow capabilities to enable third party flood model coupling (e.g. CityCAT)
  - Extend resilience options

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Environment Agency

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