

Wildfire Threat Analysis (WTA)

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*Wildfire research and its impact on policy, planning and operations;
the Swinley Forest fire. Greenwich, 10 Apr 2015*

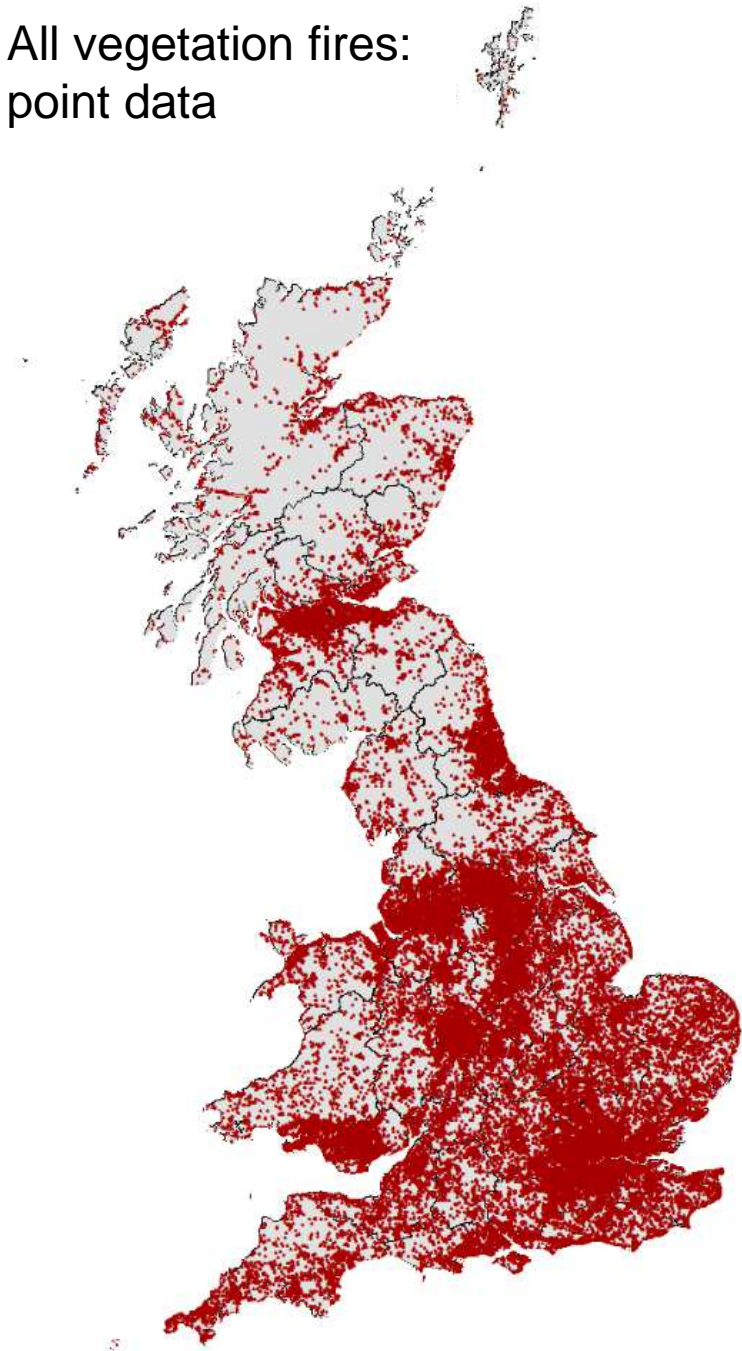
Vegetation fire in GB

- Fire Service Incident Recording System (IRS)
- 5 years for England, FY 2009/10 – 2013/14.
- 4 years for Scotland and Wales, FY 2009/10 – 2012/13
- Peri-urban

Acknowledgments:

- Data: Dept for Communities & Local Government, courtesy of Forestry Commission England
- Map: Sam Grundy, MGeog, University of Manchester.

All vegetation fires:
point data

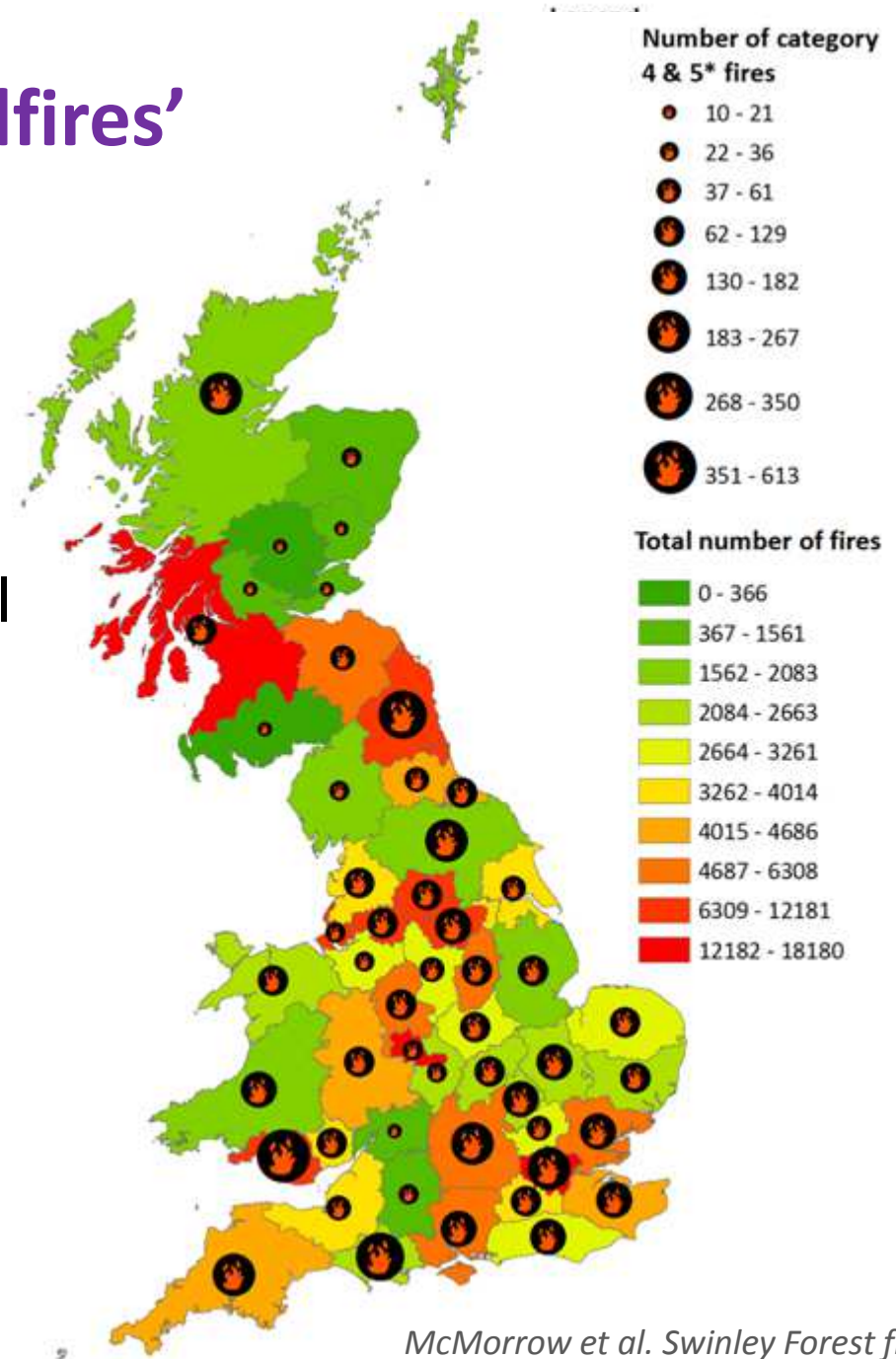


Vegetation fires vs 'wildfires'

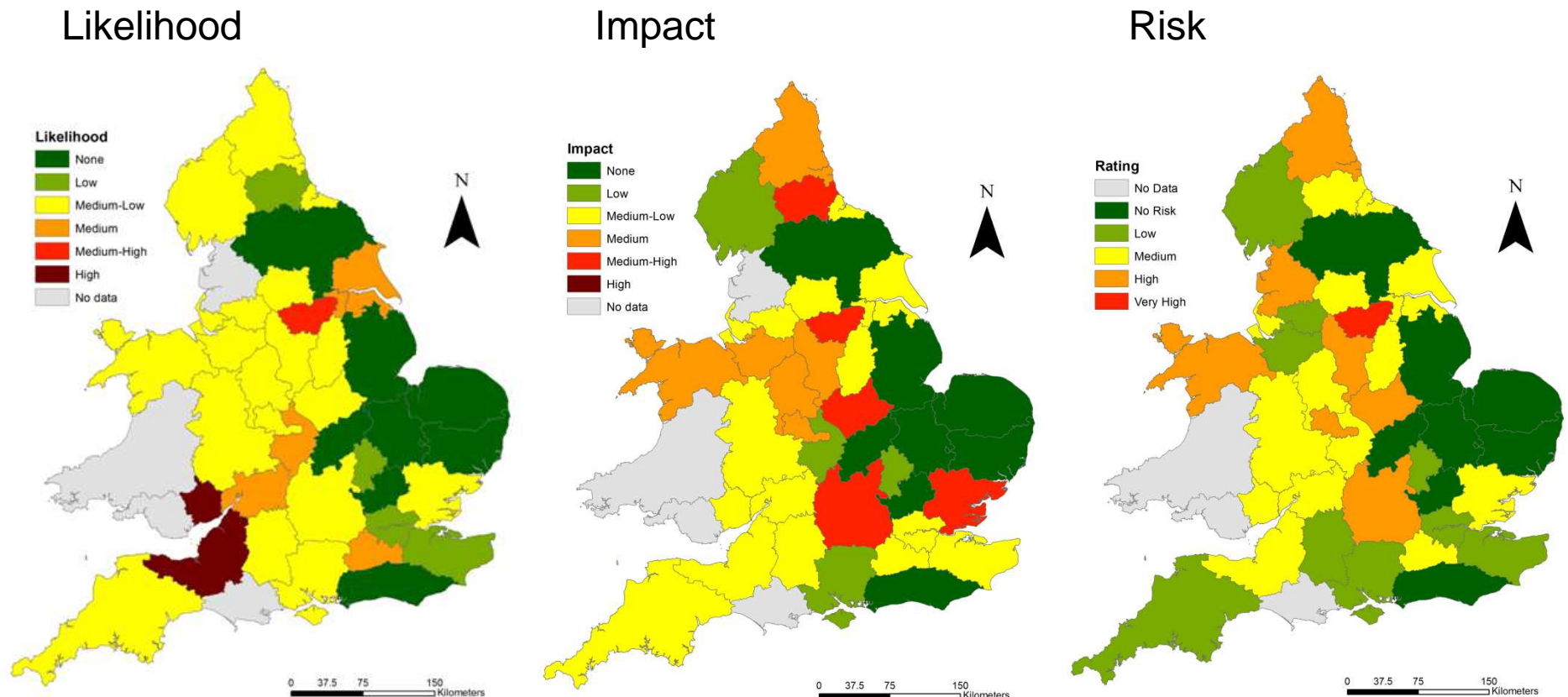
- Shading shows all vegetation fires by Police Areas
- Symbols show large fires ('category 4 & 5'); more rural
 - ≥ 1 ha
 - ≥ 6 hours callout
 - ≥ 4 vehicles

Acknowledgments:

- Data: Dept for Communities & Local Government, courtesy of Forestry Commission England
- Map: Sam Grundy, MGeog, University of Manchester. *Preliminary results : please do not reproduce without the author's permission*



Moorland & Forest Fire in Community Risk Registers



Acknowledgments:

- Data: online Community Risk Registers
- Map: Yongjun Wang, MSc Geographical Information Science, University of Manchester. *Preliminary results only; please do not reproduce without the author's permission*

WTA scoping study

Context: Forestry Commission England (FCE) need to manage wildfire threat to forest assets and to surrounding communities

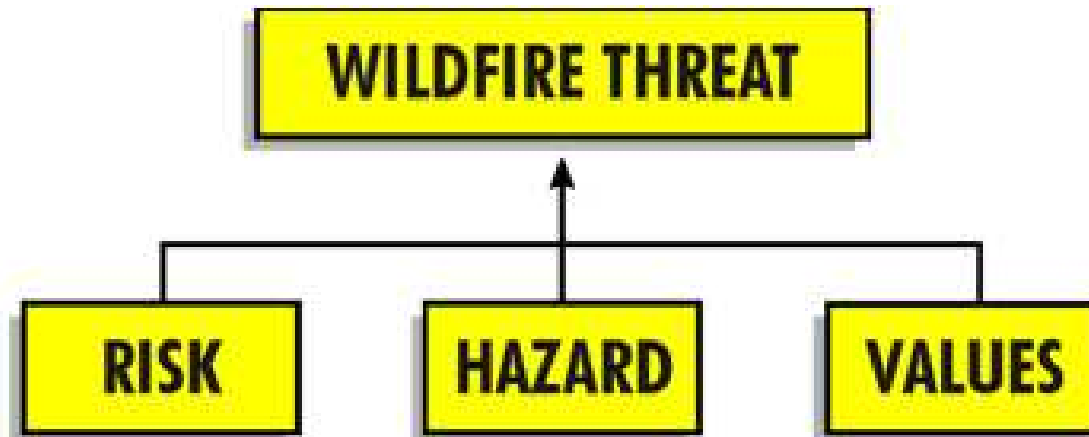
Wildfire Threat Analysis (WTA) framework developed in Canada and applied successfully at national and regional scale in New Zealand

Aim: to evaluate WTA at local scale for a forest-urban interface in SE England

Questions

1. How well does WTA fit with existing UK risk assessment frameworks?
2. Can WTA can be translated into practice as a pilot GIS tool for FCE, considering data availability and sources of uncertainty?

In WTA, threat is a combination of 3 separate GIS modules



Risk (probability) of a fire of a fire starting, regardless of size;
Risk of ignition (RoI)

Hazard
of a fire
spreading

The assets which
would be
affected; Values
at risk (VaR)

http://www.nrfa.org.nz/Operational%20documents/MTA_Wookbook.pdf

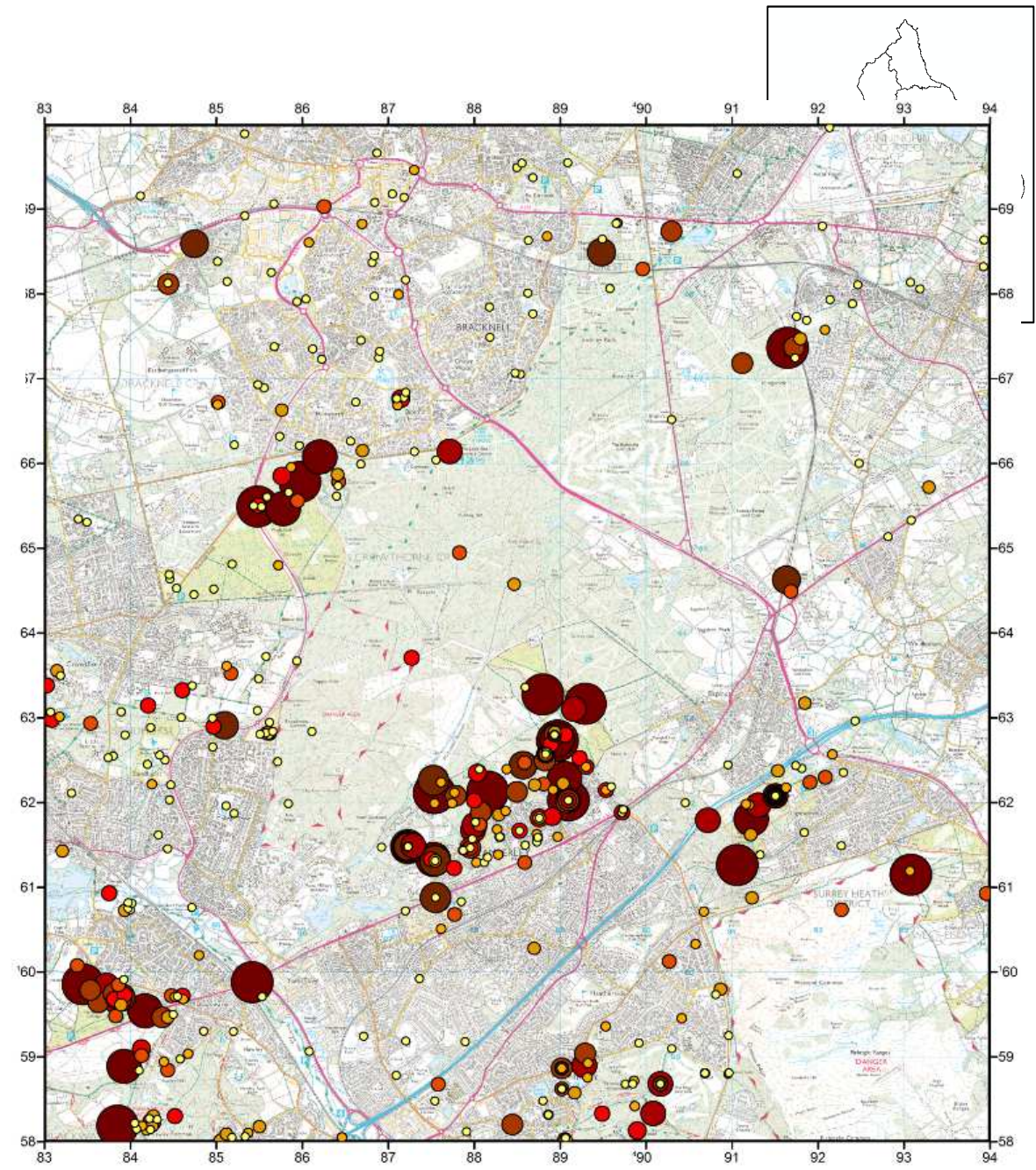
Case study area

964 attended fires in 4 yrs,
2009-2013; Fire Services'
Incident Recording System
(IRS)



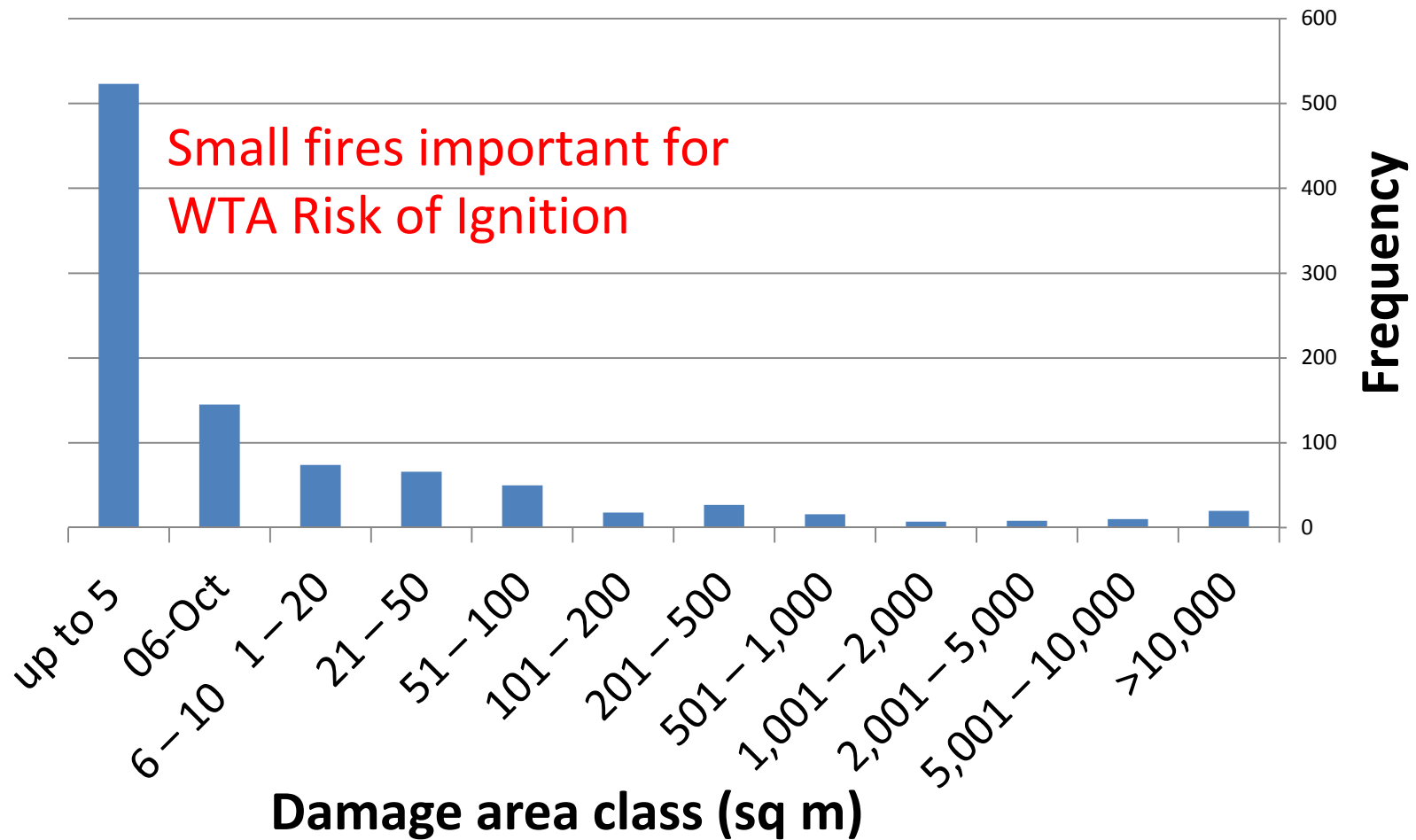
IRS data used to
develop GIS layers

0 1 2 3 4
Kilometers



Base map is Ordnance Survey data © Crown Copyright 2014 © Edina Digimap

Fire size: IRS damage area, 2009/10 -2012/13



WTA Methods

For each module, **Multi-Criteria Evaluation** was used to combine GIS layers (criteria). Guided by expert knowledge from 2 workshops and meetings with individuals; **Delphi approach**



1st workshop

2nd workshop

Meetings

1. Select



2. Score



3. Weight



4. Map



5. Evaluate

Which GIS layers (criteria, factors) to include
Sourcing data (90+ layers); understanding data limitations.

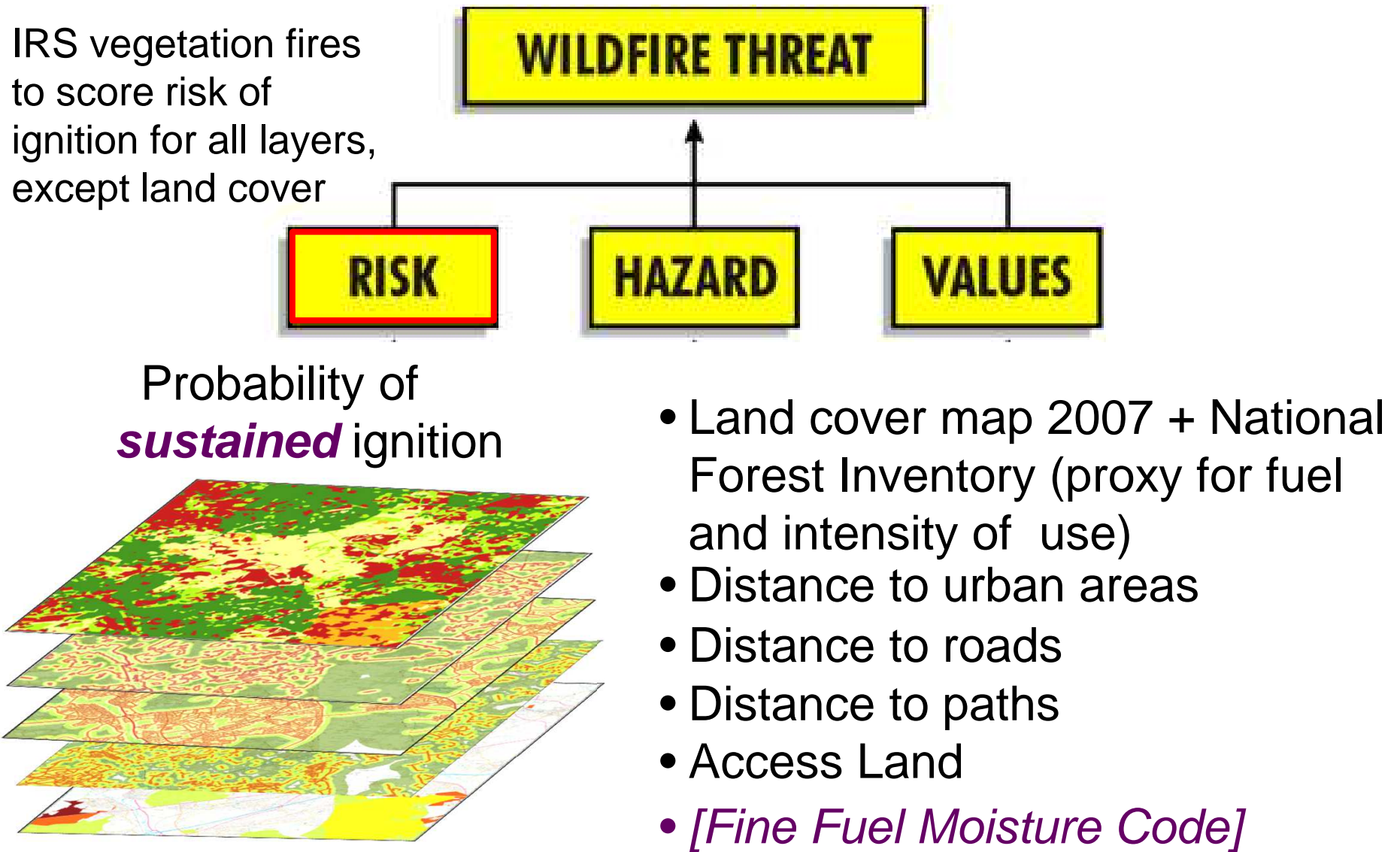
Capture how layers vary spatially
e.g. risk of ignition score of each land cover type; or with distance from urban areas, roads, paths

Relative importance of factors
Expert knowledge to weight layers before combining

How to represent results
Number of classes, etc.

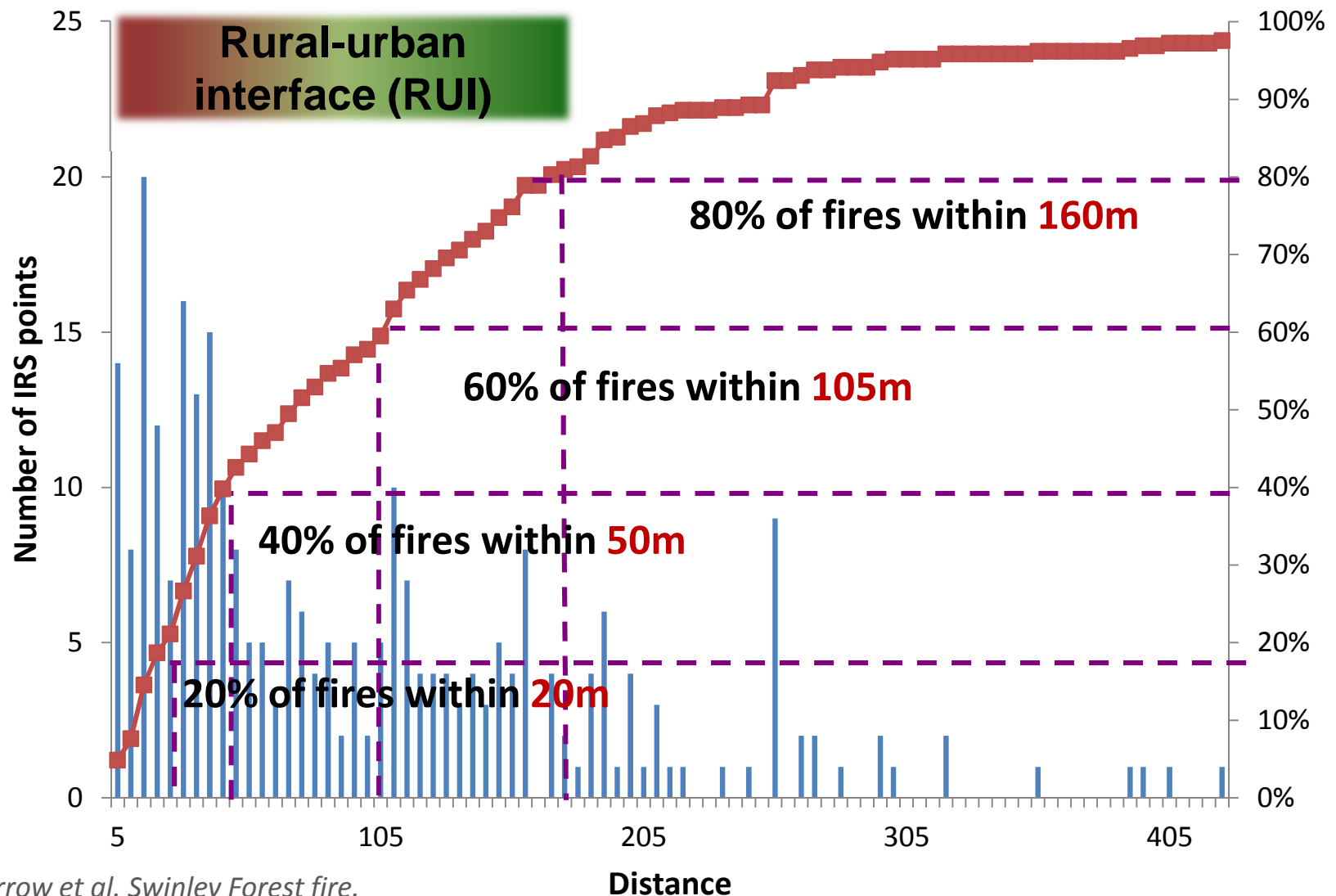
Accuracy of the results

Each WTA GIS module is made up of map layers



Distance from urban boundary: 5 zones

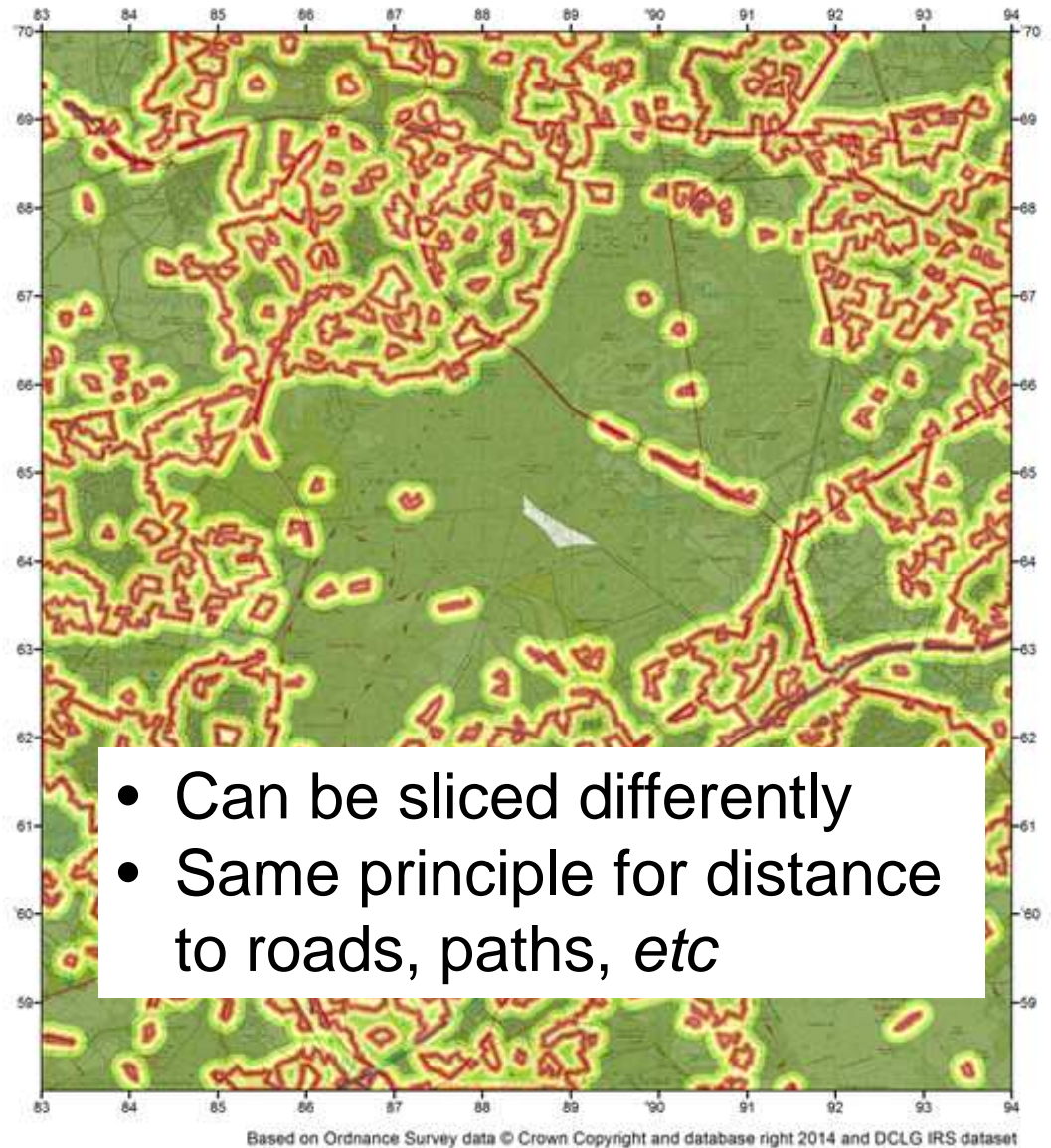
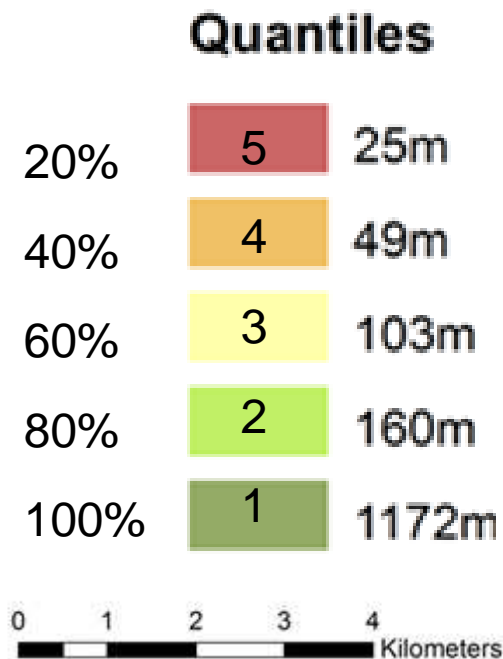
Caveat: accuracy depends on accuracy of IRS point locations



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Greenwich, 10 Apr 2015

Map layer for distance from built-up areas

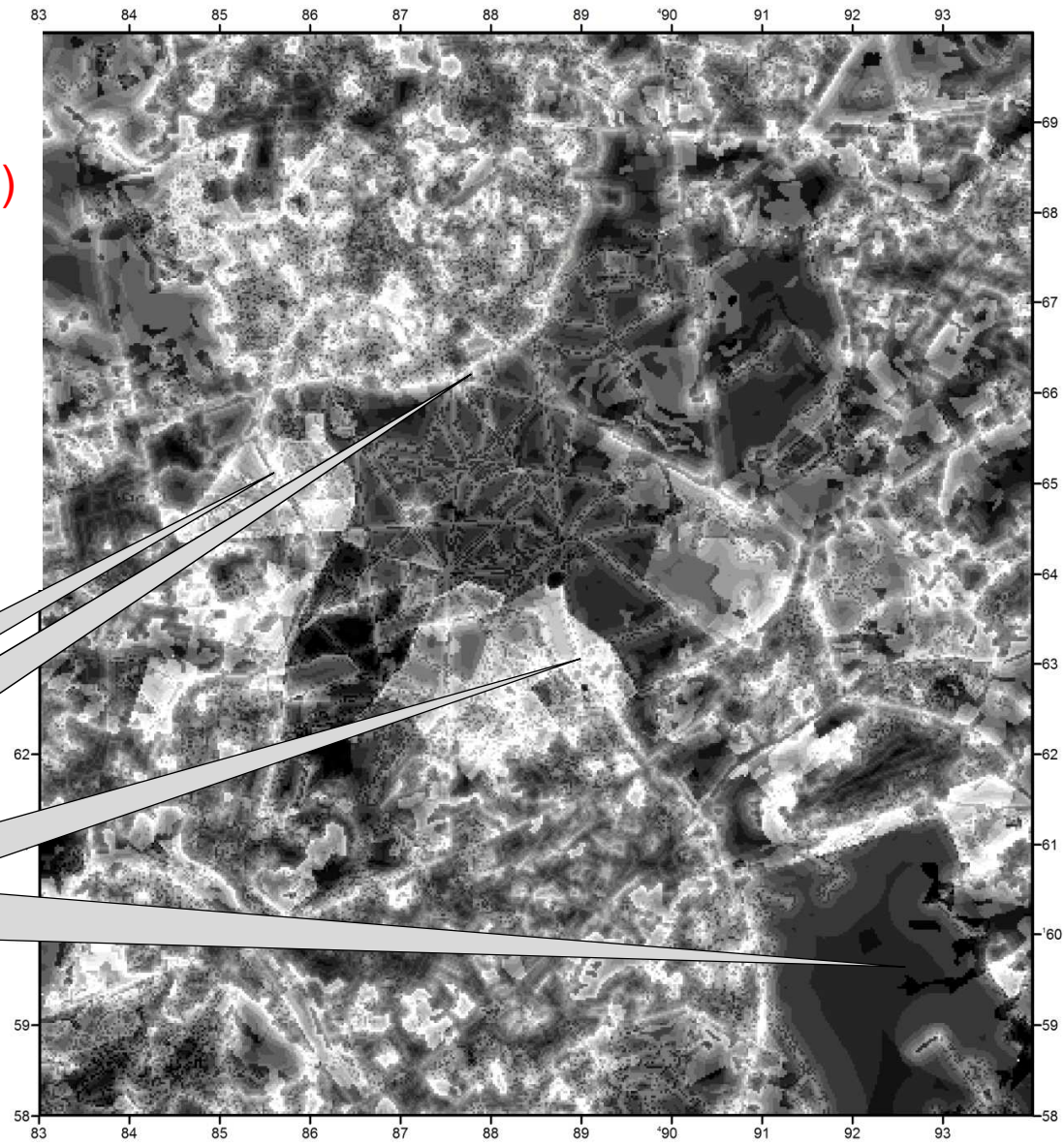
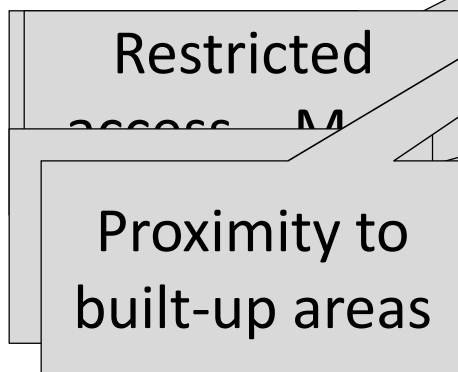
- Divide the map into zones at 25m, 39m, etc. from urban boundary
- Give higher score to zones closest to urban areas



Outputs: Risk of Ignition map to target prevention

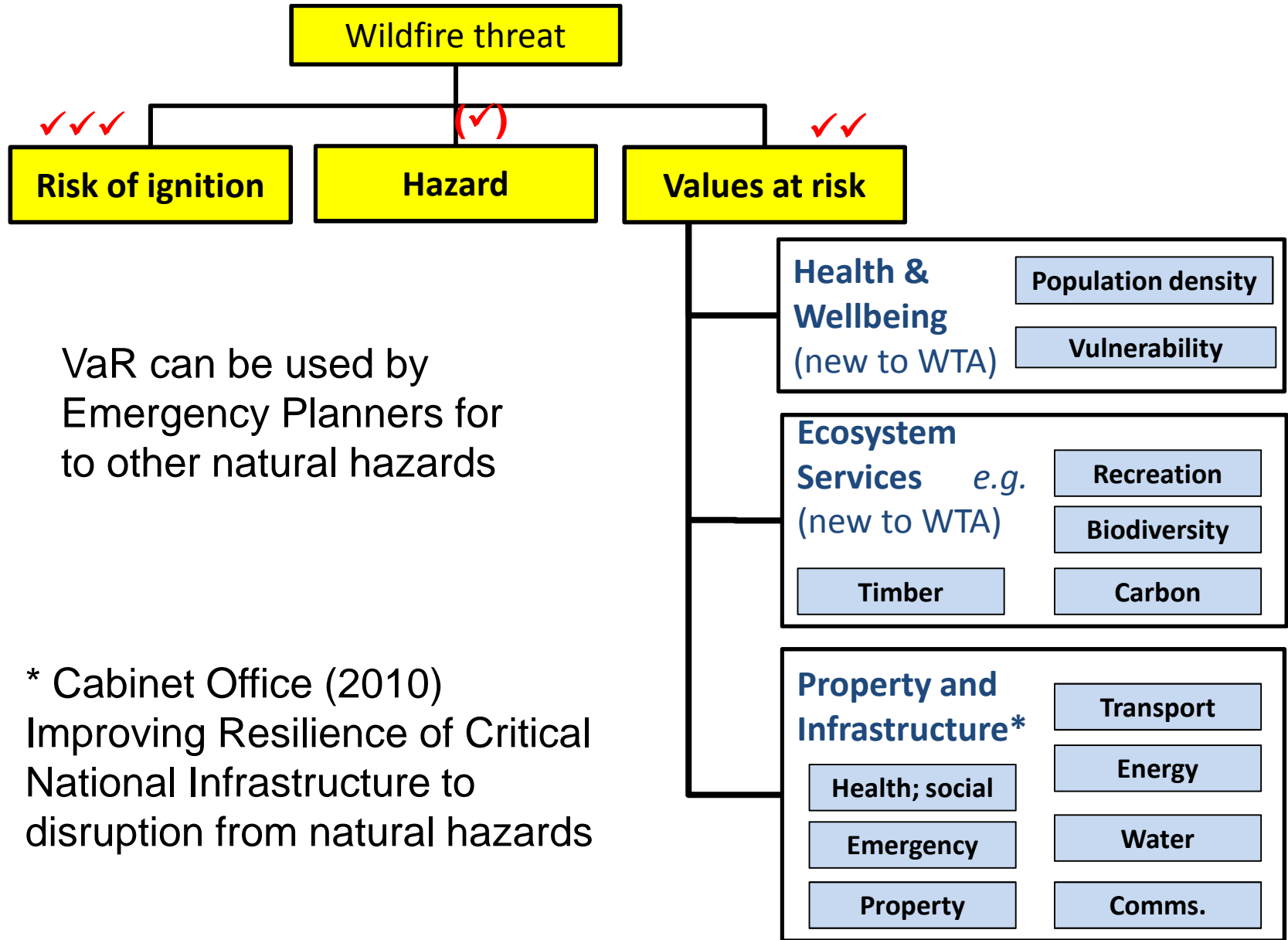
Weighted combination of:

- 4 Land cover: expert judgement (**IRS can be used**)
- 3.5 Proximity to built-up areas
- 3 Proximity to foot access routes
- 4 Proximity to car access routes
- 3 Access Land



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Modified Wildfire Threat Framework



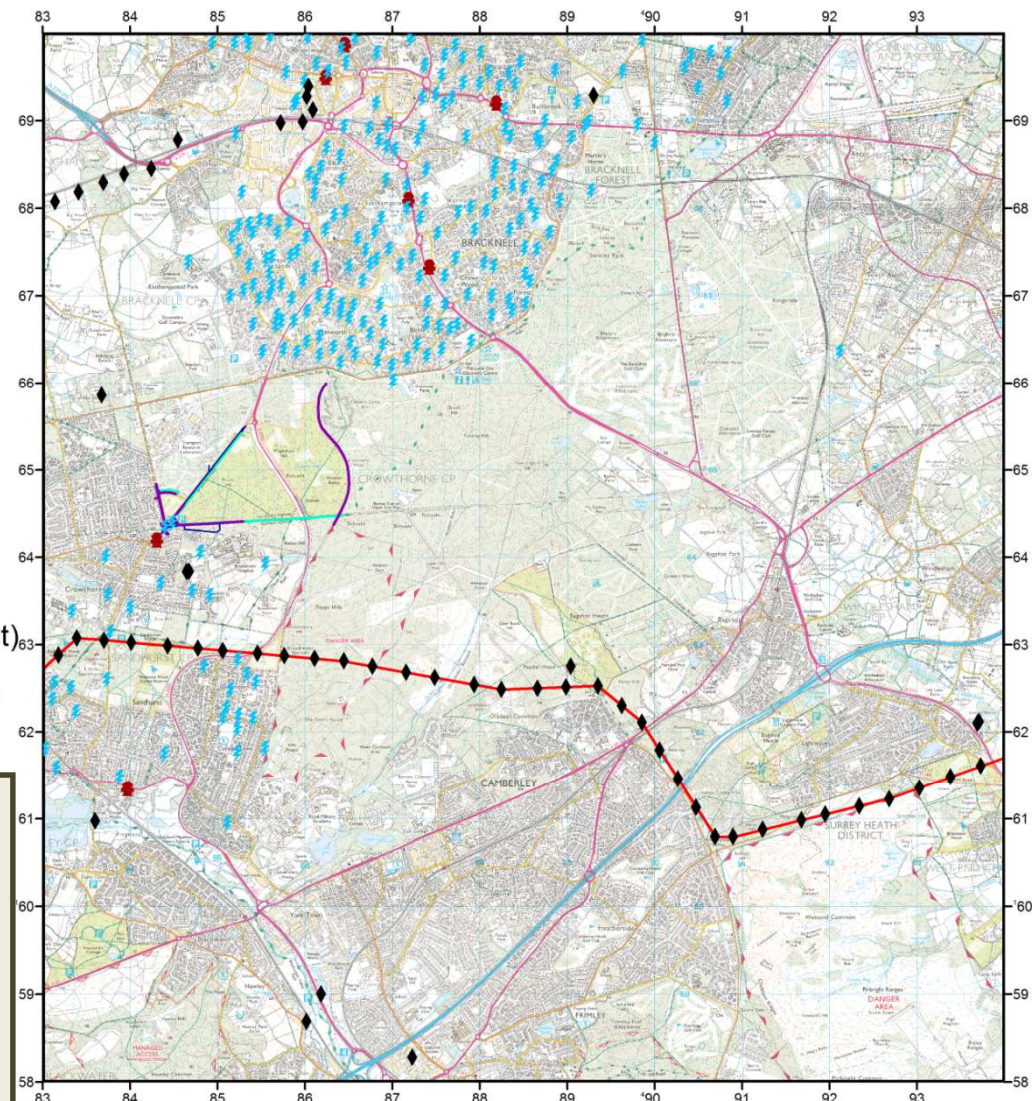
Example of Energy Values at Risk

Values at Risk

Property and Infrastructure: Utilities - Energy

- Electricity line (National Grid)
- Overhead powerline (Crowthorne)
- Underground powerline (Crowthorne)
- Gas Pipeline (Crowthorne)
- ◆ Electricity towers
- ⚡ Electricity Sub-stations (Bracknell Forest)
- ⛽ Petrol Filling Stations (Bracknell Forest)

Participants asked to assign value scores to different energy utilities categories, and suggest the width of buffer preventing damage.



Sources: National Grid, Forestry Commission England
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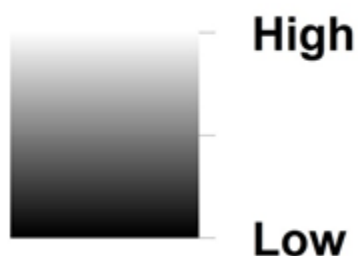
Values at Risk map to target forest management

Weighted combination of:

5 Health & well-being

3 Property &
infrastructure

1 Ecosystems services

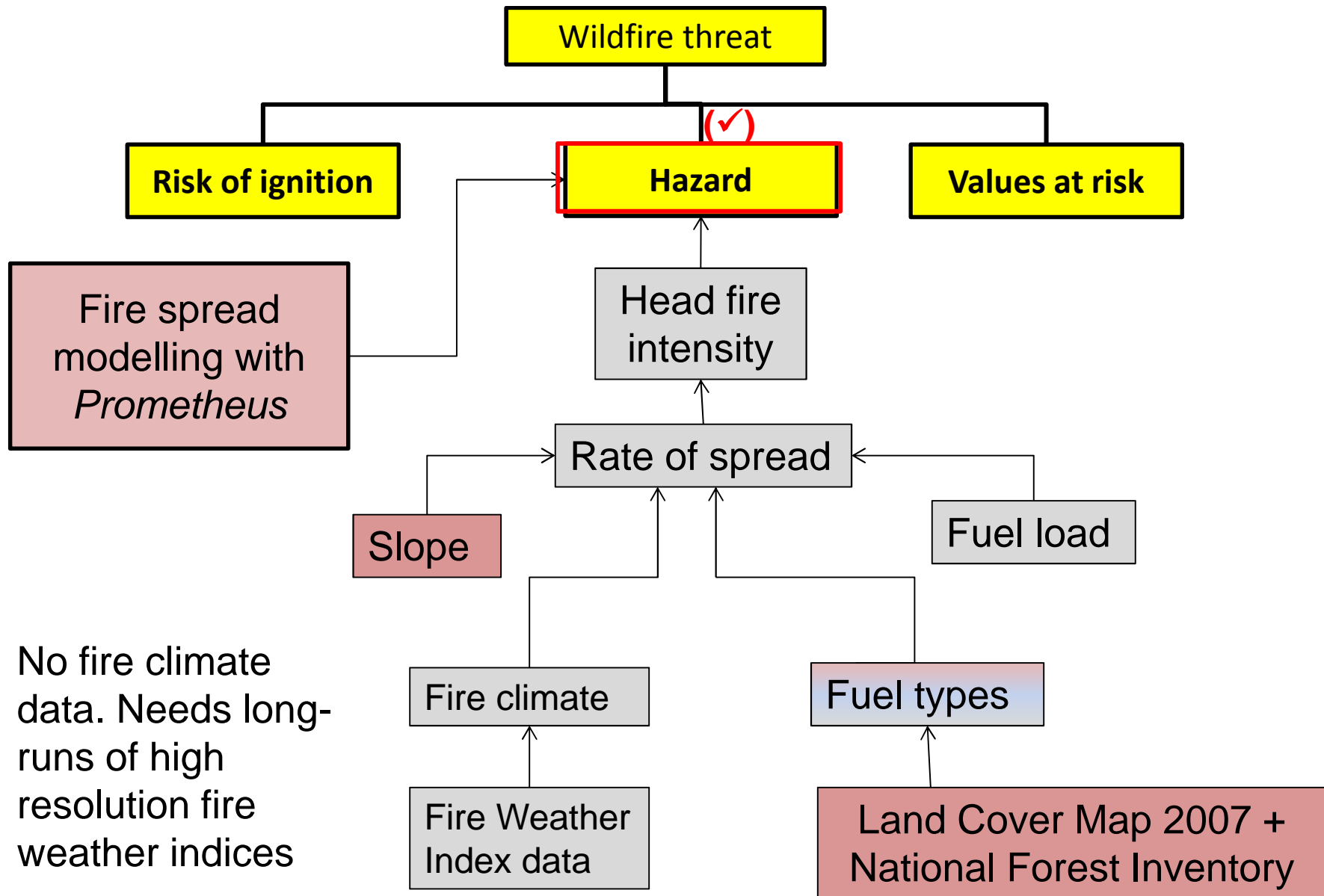


Overlay actual or
simulated fire perimeter
to quantify areas or
number of values at
risk..



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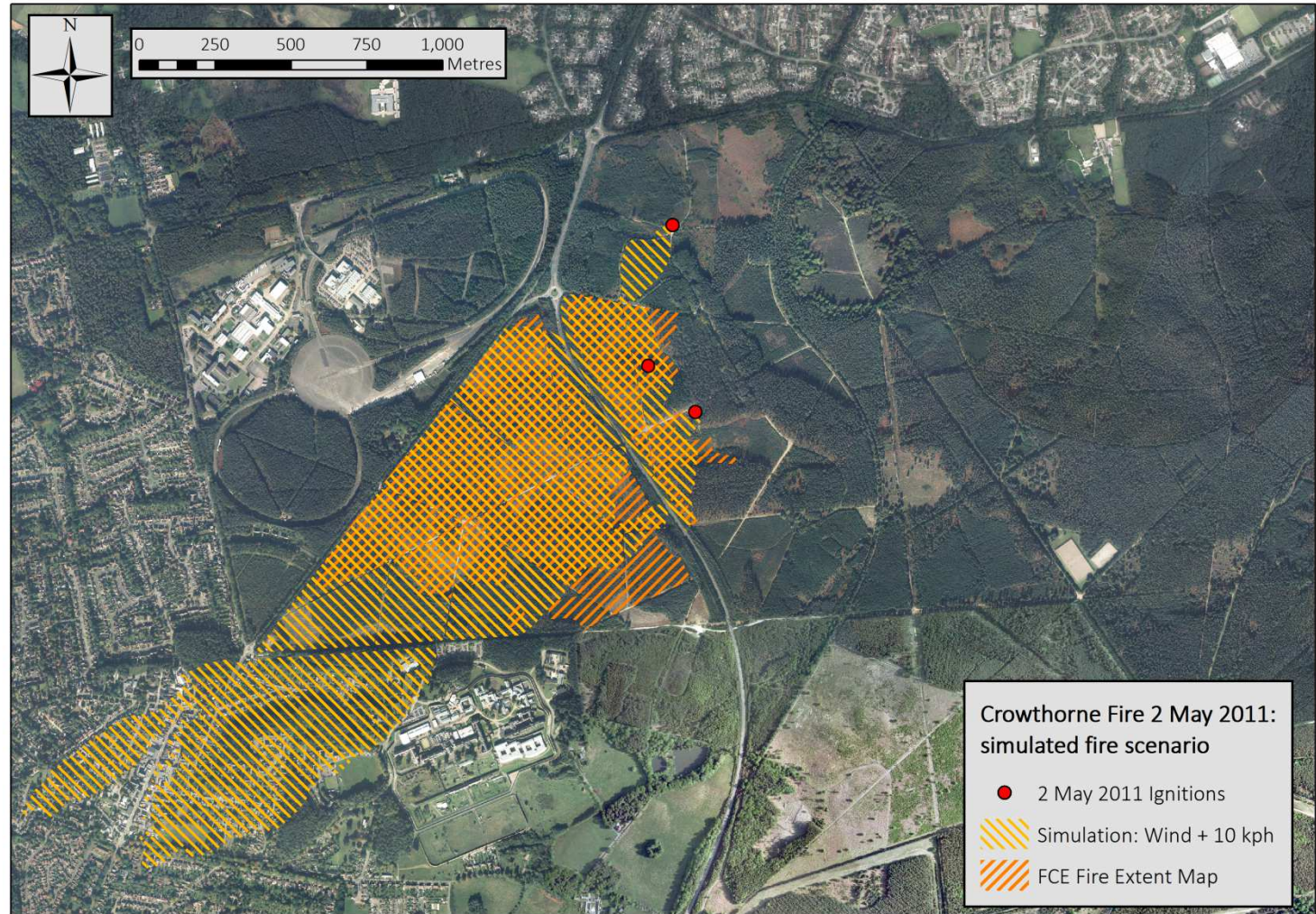
Modified Wildfire Threat Framework



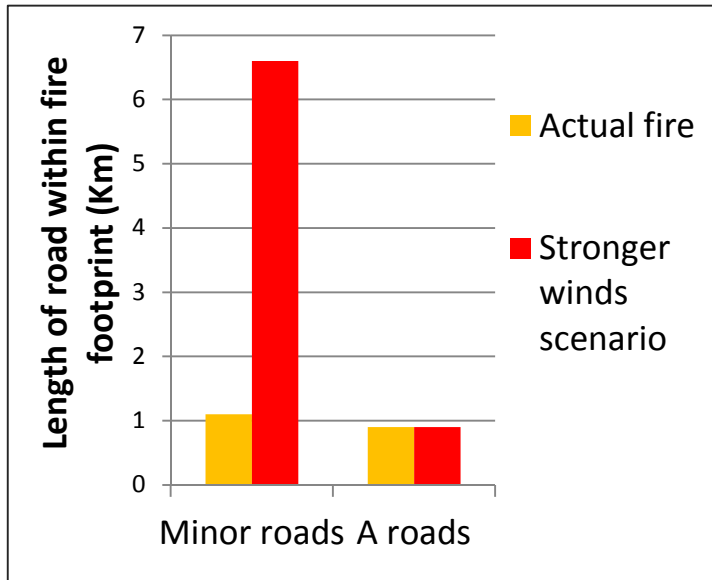
HAZARD: modelled fire footprints

Prometheus fire spread modelling scenarios; wind 10 kph stronger (courtesy of Tom Smith, KCL)

- 86% larger fire footprint
- Mostly conifer & urban
- Smoke plume not modelled

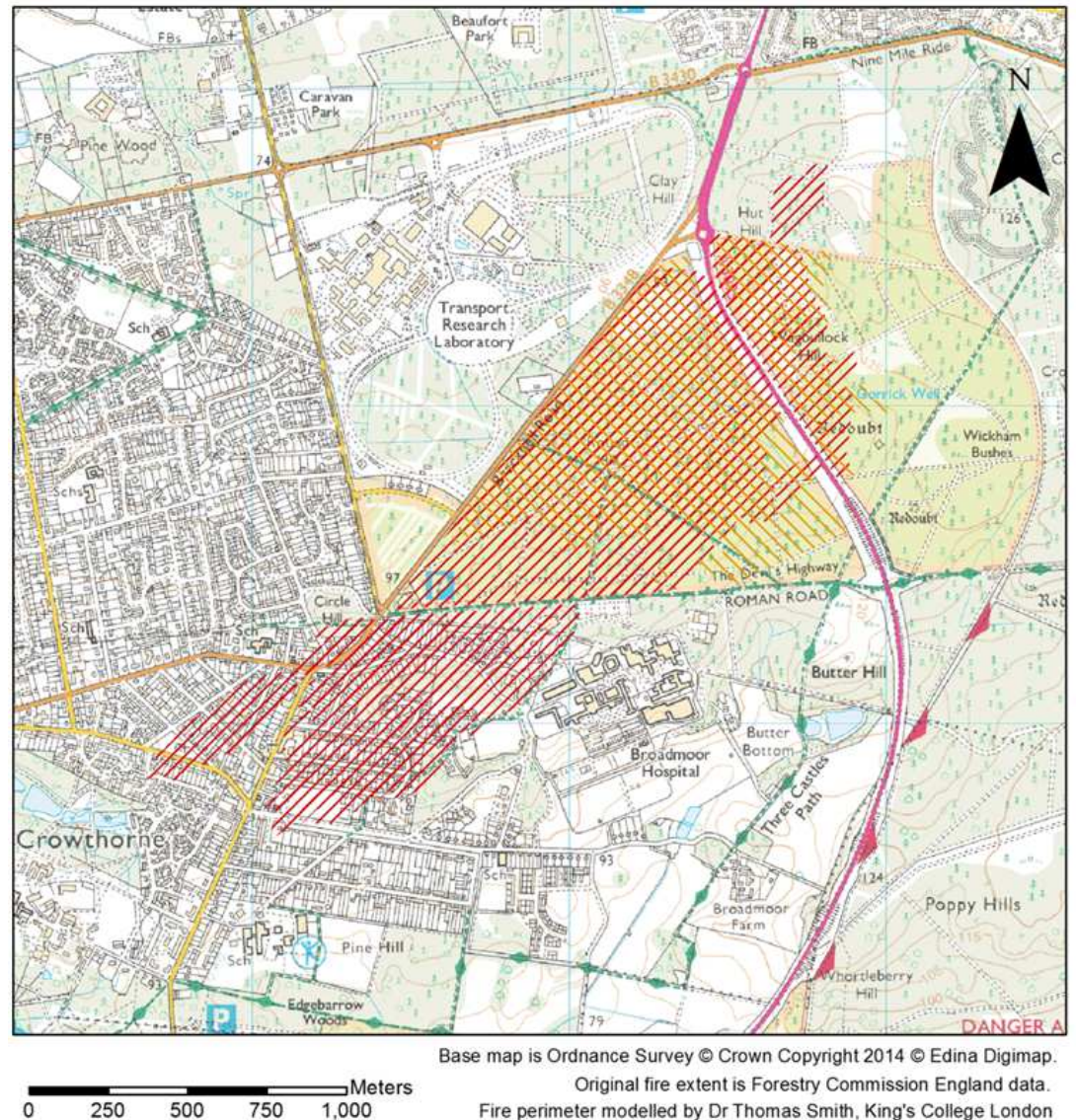


Overlay on VaR: avoided impacts. 'costs'



Within simulated fire footprint

- 13% greater area of timber (9 ha more)
- 6 x greater length of minor roads (5.5 km more)
- 33 ha urban; 791 properties, 1 listed building

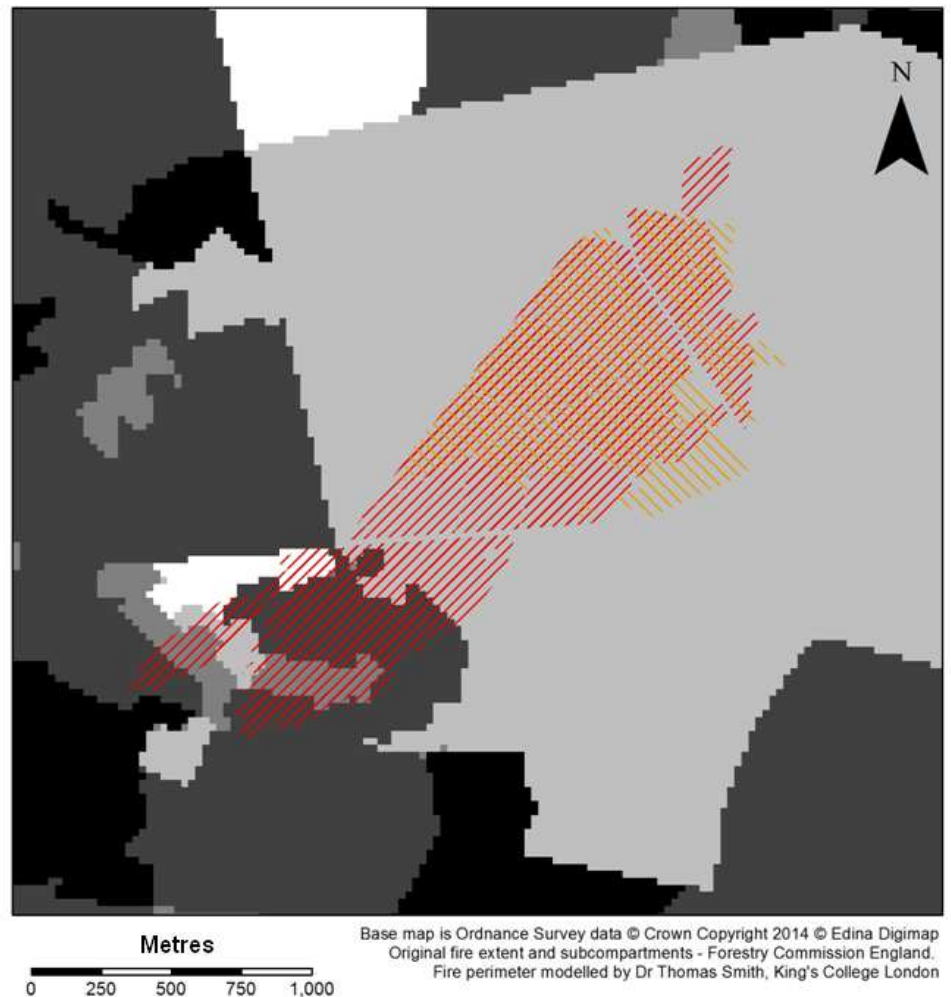
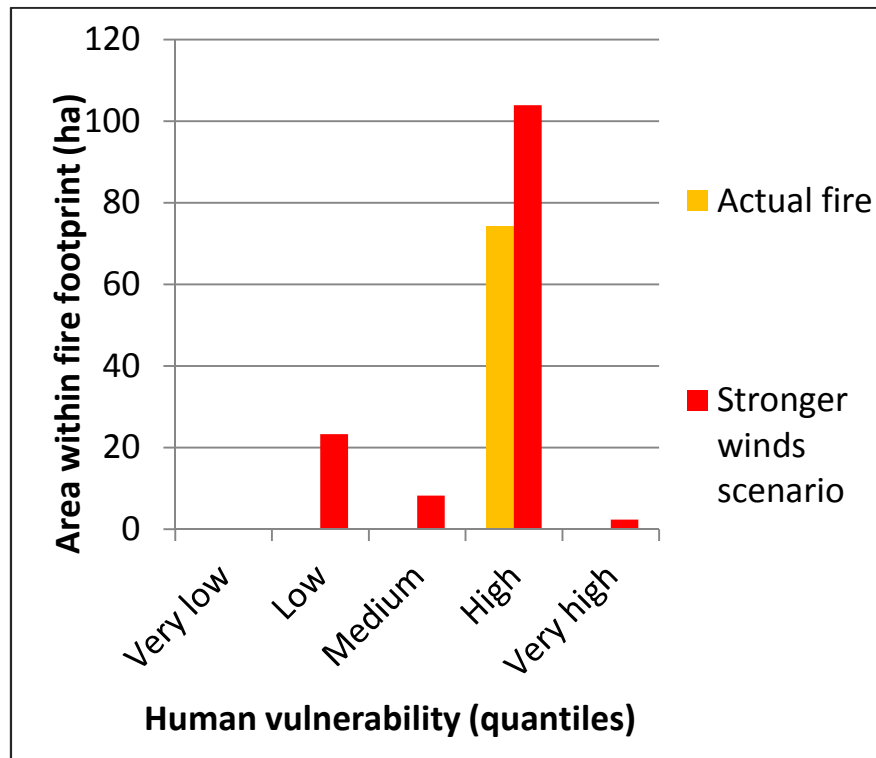


Human vulnerability

Extent of 2011 'Swinley Forest' Crowthorne Wood fire
Fire scenario: 10 kph stronger winds

Human vulnerability

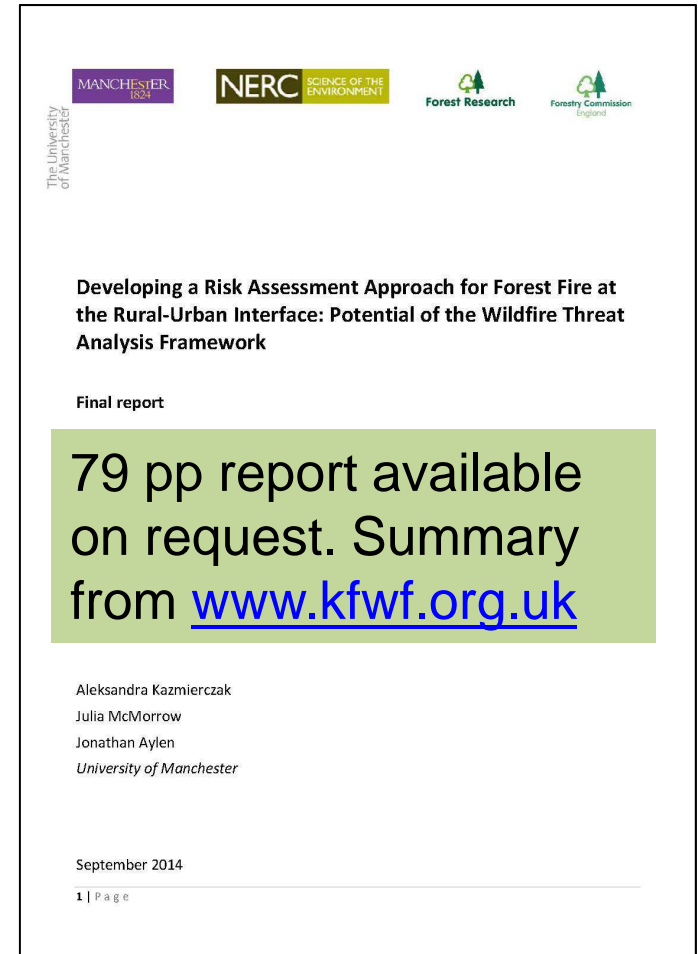
Very low
Low
Medium
High
Very high



- 43% larger area in high or very high human vulnerability class

Successes

- **Buy-in** from 11 organisations (22 person-days) including FCE, Natural England, MoD, Emergency Planners, FRS
- **Data catalogue** of >90 layers, mostly publically available. Re-usable for other hazards
- **WTA adapted** for UK forest-urban interface: added **ecosystem services** and **social vulnerability** – NZ following suit
- **Identified RUI**, 80% fires within 160m
- Potential for **‘What if’ scenarios**:
 - update to post-2011 fire – how was threat changed by fire itself?
 - management, new housing/footpath/Country Park, etc?



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Issues and recommendations

- **Data collation effort** from multiple sources; mostly national datasets, but local data availability and quality varies. Update maps every 5 yrs. Re-use for/from other hazard assessments.
- **Add other ecosystem services** to VaR
- **Is IRS location accurate?** Need nationally-consistent, agreed point on fire ground, ideally estimated ignition point. Preferably fire perimeters
- **Test scalability & transferability** to landscape scale (25m → ≥100 m cells); to other types of RUI, especially moorland. **Most useful scale?**
- **Variable stakeholders' views** on weighting factors. Trying a more objective method; logistic regression based on IRS with 1 ha cells
- **Importance of local stakeholder knowledge for VaR:** *“The [VaR] maps are difficult to understand without having gone through the stages”* **Keep VaR locally defined?**
- **Develop landscape-scale Hazard module** using 2km Fire Weather Indices with fire ensemble spread modelling (KCL)

Nested WTA: national + landscape scales

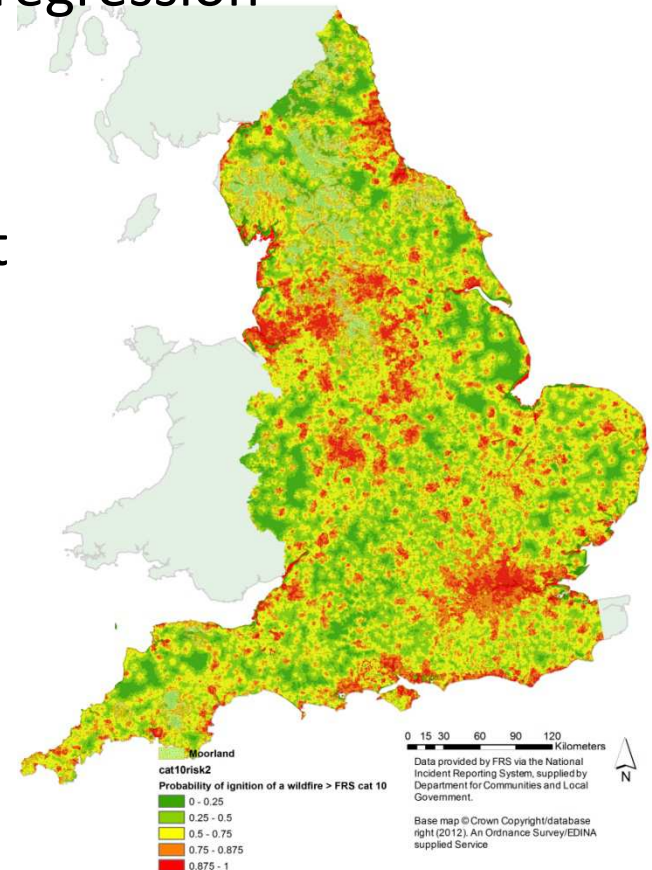
Combine Manchester and KCL projects in a nested approach:
national (2km) and landscape-scale ($\geq 1\text{ha}$):

1. National RoI module; IRS-based logistic regression

... incorporating KCL/Met Office's 2km
probabilistic Fire Weather sub-indices,
calibrated against Fuel Moisture Content
→ seasonal 'ignitability'

2. National 'worst case' wildfire hazard, using KCL/Met Office Fire Weather sub- Indices with slope, aspect, fuel/land cover

3. Combine national RoI with national Hazard → critical areas for landscape scale WTA, especially VaR



Further information

www.Kfwf.org.uk

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Thank you for listening

