Wildfire Threat Analysis (WTA) in a UK Forest-Urban Interface

Julia McMorrow, Jonathan Aylen,
University of Manchester

, Aleksandra Kazmierczak
Cardiff University

Rob Gazzard,
Forestry Commission England

James Morison, Andy Moffat,
Forest Research

Met Office Wildfire Workshop 2014, Exeter, 3-4 Dec 2014

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Scoping study

Need: 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)

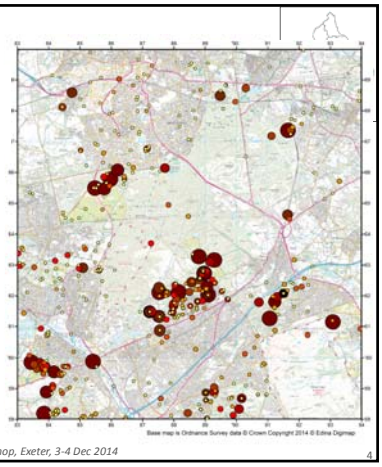
Hazard of a fire spreading

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

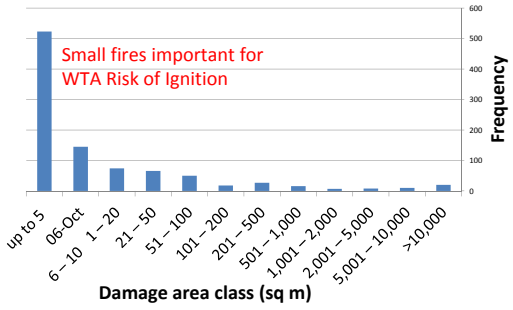
http://www.nrfa.org.nz/Operational%20documents/WTA_Wookbook.pdf

Case study area

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



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** — **Which GIS layers (criteria, factors) to include**
   Sourcing data (90+ layers); understanding data limitations.
2. **Score** — **Capture how layers vary spatially**
   e.g. risk of ignition score of each land cover type; or with distance from urban areas, roads, paths
3. **Weight** — **Relative importance of factors**
   Expert knowledge to weight layers before combining
4. **Map** — **How to represent results**
   Number of classes, etc.
5. **Evaluate** — **Accuracy of the results**

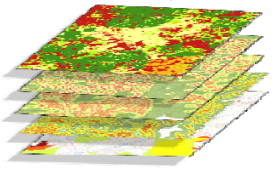
Each WTA GIS module is made up of map layers

IRS vegetation fires to score risk of ignition for all layers, except land cover

WILDFIRE THREAT

RISK | HAZARD | VALUES

Probability of ***sustained*** ignition



- Land cover map 2007 + National Forest Inventory (proxy for fuel and intensity of use)
- Distance to urban areas
- Distance to roads
- Distance to paths
- Access Land
- *[Fine Fuel Moisture Code]*

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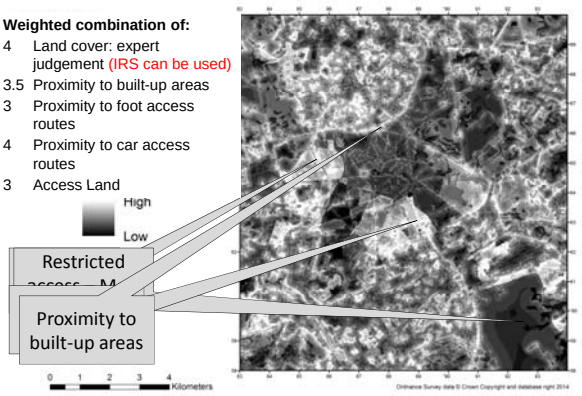
Outputs: Risk of Ignition map to target prevention

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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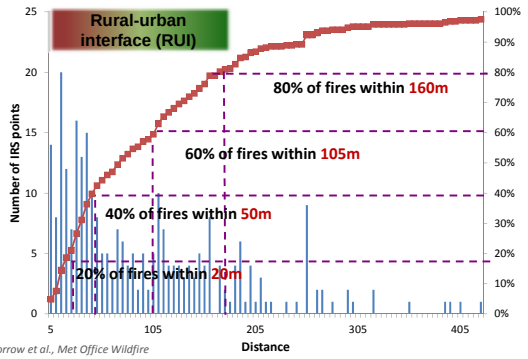
Distance from urban boundary: 5 zones

Caveat: accuracy depends on accuracy of IRS point locations



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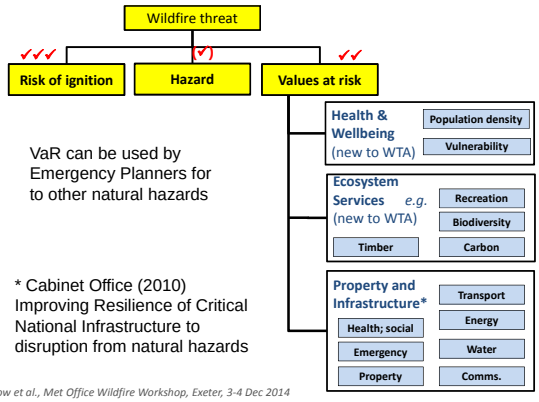
Modified Wildfire Threat Framework



VaR can be used by Emergency Planners for to other natural hazards

* Cabinet Office (2010) Improving Resilience of Critical National Infrastructure to disruption from natural hazards

McMorrow et al., Met Office Wildfire Workshop, Exeter, 3-4 Dec 2014

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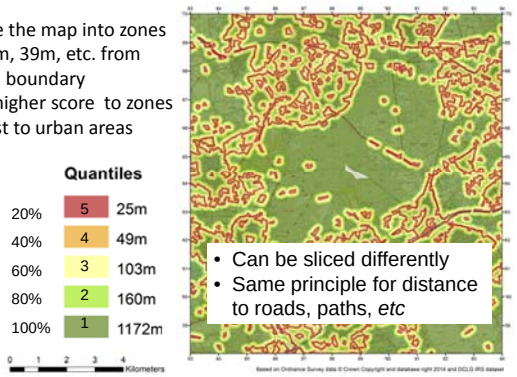
Map layer for distance from built-up areas

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



- Can be sliced differently
- Same principle for distance to roads, paths, *etc*

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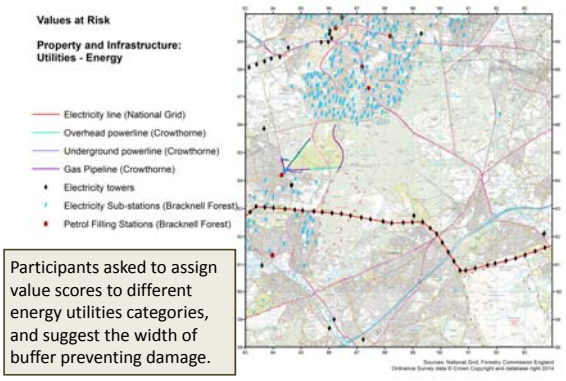
Example of Energy Values at Risk



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

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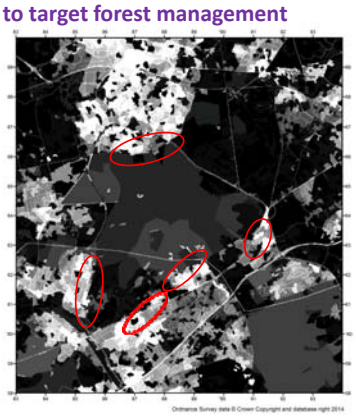
Values at Risk map to target forest management

Weighted combination of:

5 Health & well-being
3 Property & infrastructure
1 Ecosystems services

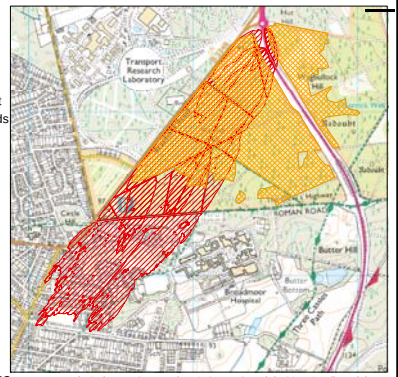
Overlay actual or simulated fire perimeter to quantify areas or number of values at risk..



Overlay on VaR → avoided costs

The actual Crowthorne fire extent
Modelling scenario: stronger winds

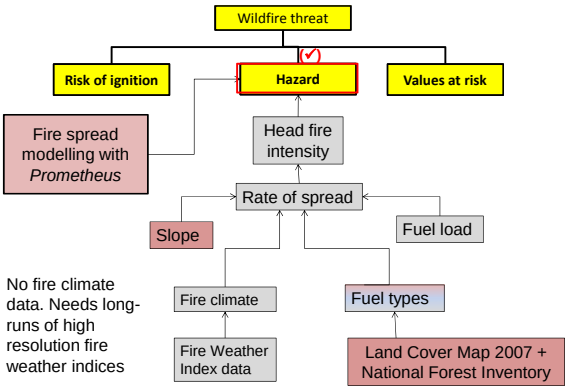
3.4 km more roads would have been directly within fire footprint (excludes smoke plume)



metres
0 250 500 750 1,000

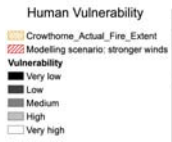
Base map is Ordnance Survey data © Crown Copyright 2014 © Edina Digimap

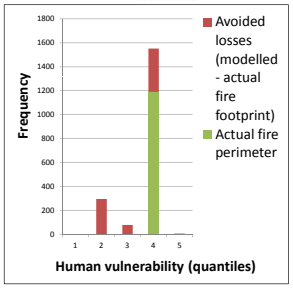
Modified Wildfire Threat Framework

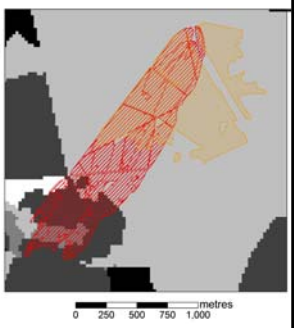


No fire climate data. Needs long-runs of high resolution fire weather indices

Avoided costs







63% larger footprint.
31% more in high vulnerability class

HAZARD: modelled fire footprints

Prometheus fire spread modelling, Tom Smith, KCL

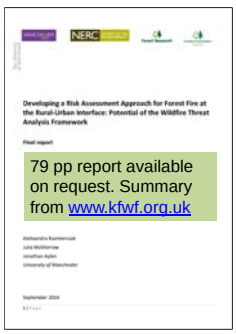
Wind change by 90° from NE to SE'ly

Wind shift by 270° to W'ly

thomas.smith@kcl.ac.uk

Successes

- **Buy-in** from 11 organisations (22 person-days) including FC, Natural England, MoD, Emergency Planners, FRS: *"useful for a commander in the case of an incident to decide where to allocate resources"*
- **Data catalogue** of >90 layers, mostly publically available
- Customised for UK case study: 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 is threat changed by fire itself, fuel management, new housing/ footpath/Country Park, etc?



79 pp report available on request. Summary from www.kfwf.org.uk

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
- **Scalability & transferability** to landscape scale (≥1ha cells); to other types of RUI, especially moorland
- **Variable stakeholders' views** on the 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"*
- **Develop landscape-scale Hazard module** using fire ensemble spread modelling (Tom Smith, KCL)

Nested WTA; national + landscape

Combine Manchester and KCL PURE Associate projects in a nested WTA approach: national (2km) and landscape-scale (≥1ha)

1. National RoI module; IRS-based logistic regression
2. ... incorporating KCL/Met Office's 2km Fire Severity probabilistic Fire Weather sub-indices , calibrated against FMC → seasonal 'ignitability'
3. National 'worst case' wildfire hazard using KCL/Met Office FSI sub-indices with slope, aspect, fuel (LCM2007/NFI)
4. Combine national RoI + Hazard → target critical areas for landscape scale WTA, including VaR.

The University of Manchester · NERC Science of the Environment · Forest Research · Forestry Commission England

Further information

www.Kfwf.org.uk

Julia.mcmorrow@manchester.ac.uk

Thank you for listening