Points and polygons: Mapping wildfires from fire statistics (and satellites)

Julia McMorrow

Senior Lecturer in Remote Sensing,
NERC Knowledge Exchange Fellow,
School of Environment, Education and Development,
University of Manchester
julia.mcmorrow@manchester.ac.uk

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WHAT FIRE STATISTICS CAN (AND CAN'T) TELL US

FIRE POINTS

- National scale mapping using IRS
- Local/regional scale mapping and GIS modelling
- Moorland fire case studies

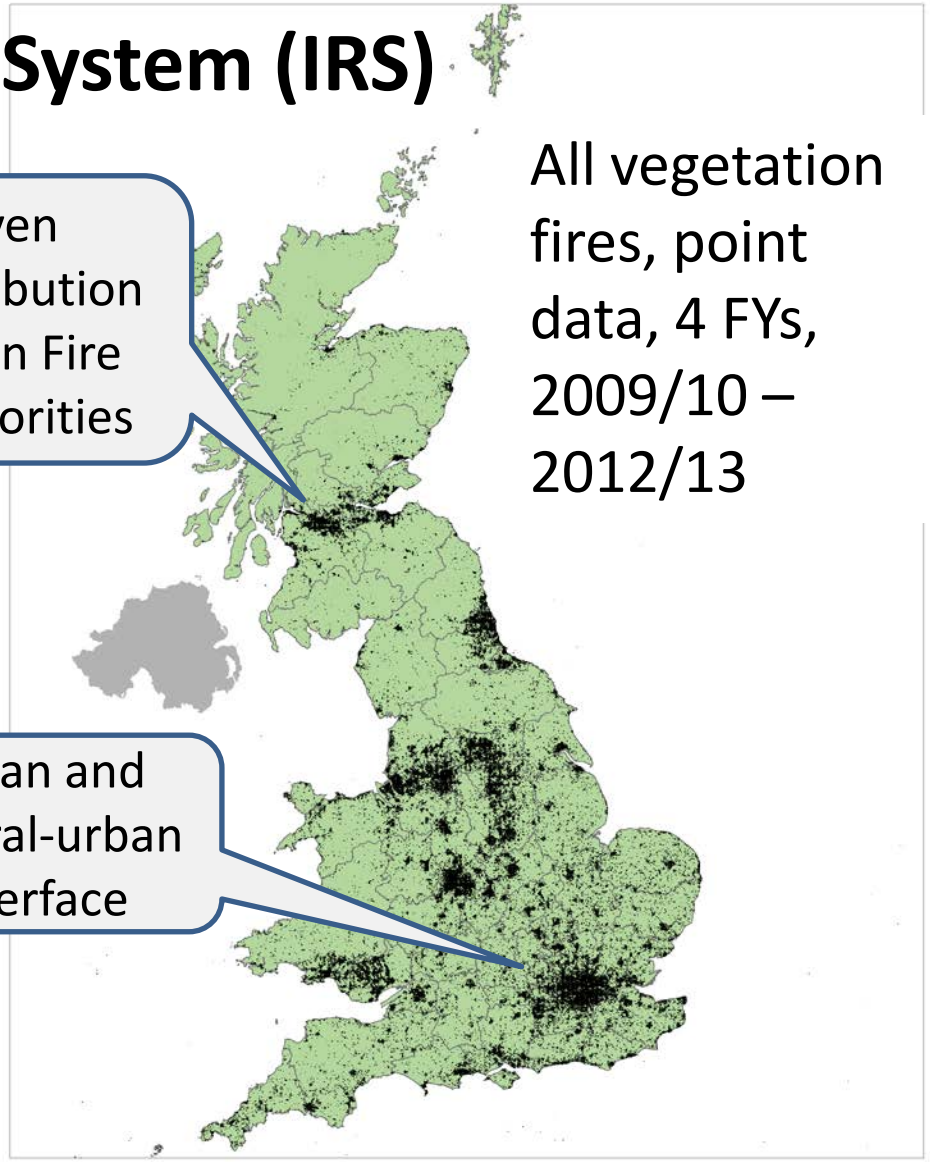
POLYGONS

- Polygons in practice; Peak District National Park Fire Operations group fire records and Dorset Explorer

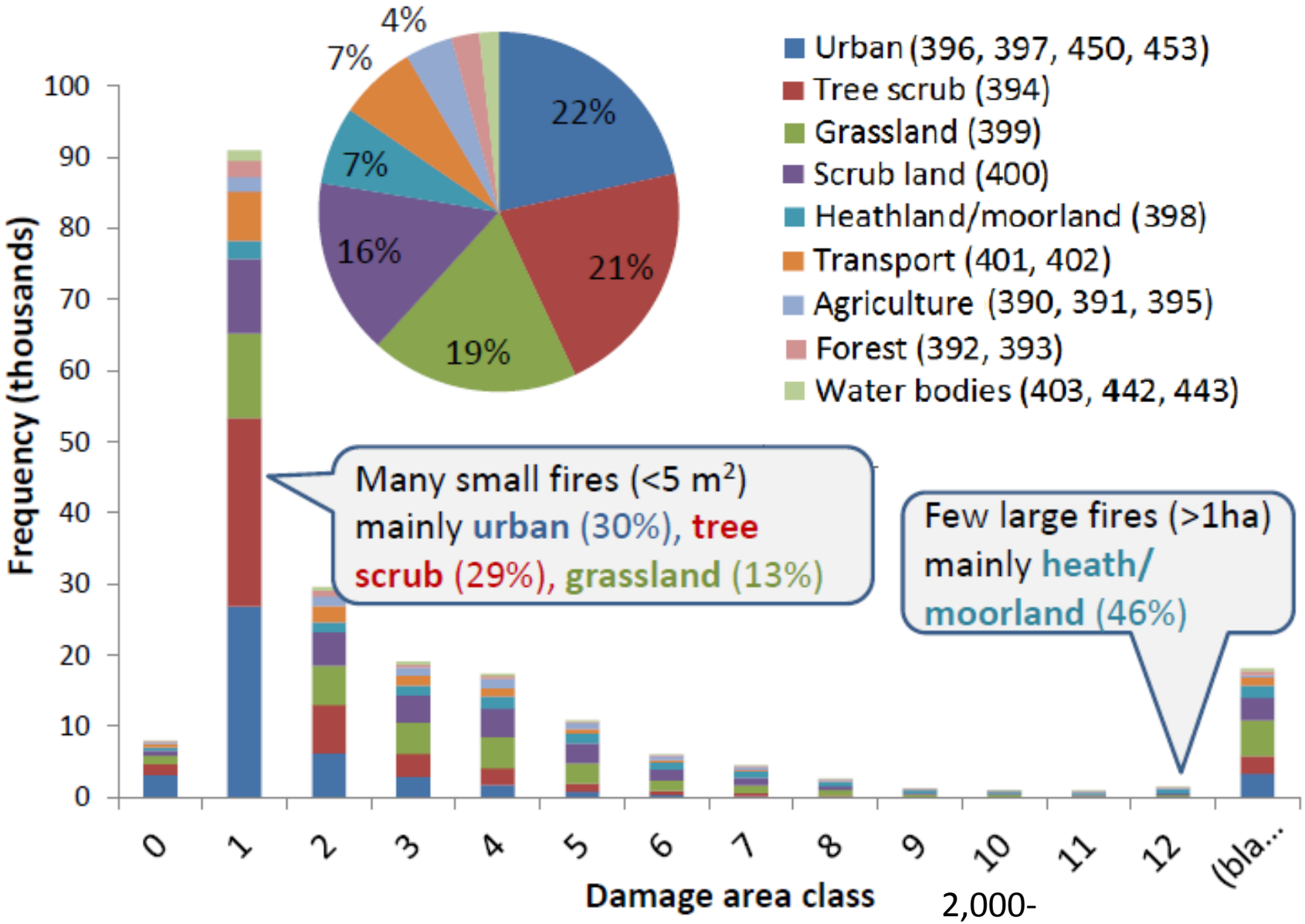
TAKE HOME MESSAGES

GB Fire and Rescue Service Incident Recording System (IRS)

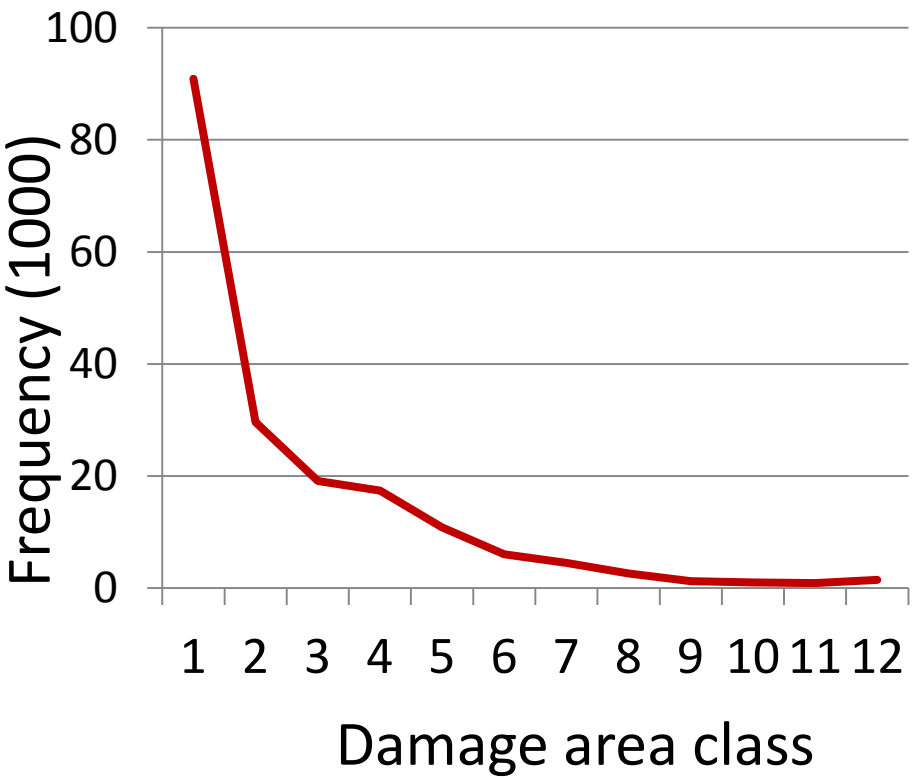
- Nationally consistent recording of all vegetation fires since 1st April 2009 across 57, now 50 FRS
- Geo-located point allows mapping and overlay (e.g. on peatland or protected areas) and GIS modelling
- Many ways to map and analyse in GIS; work in progress
- 18 categories of vegetation fire, by IRS property code

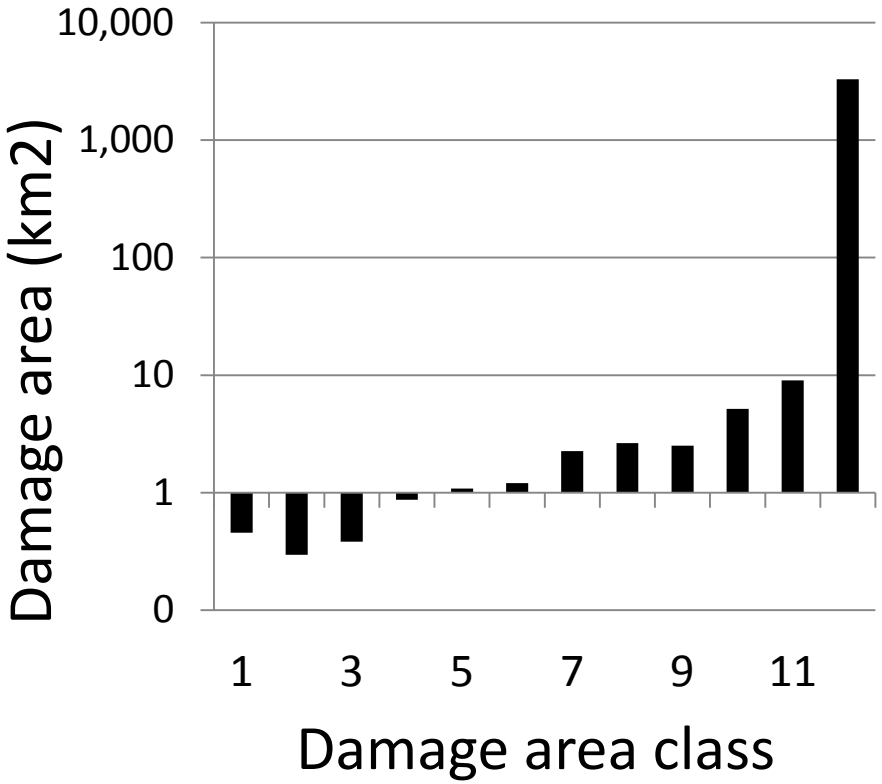


Breakdown by property type



Number and estimated damage area of GB fires are inversely related



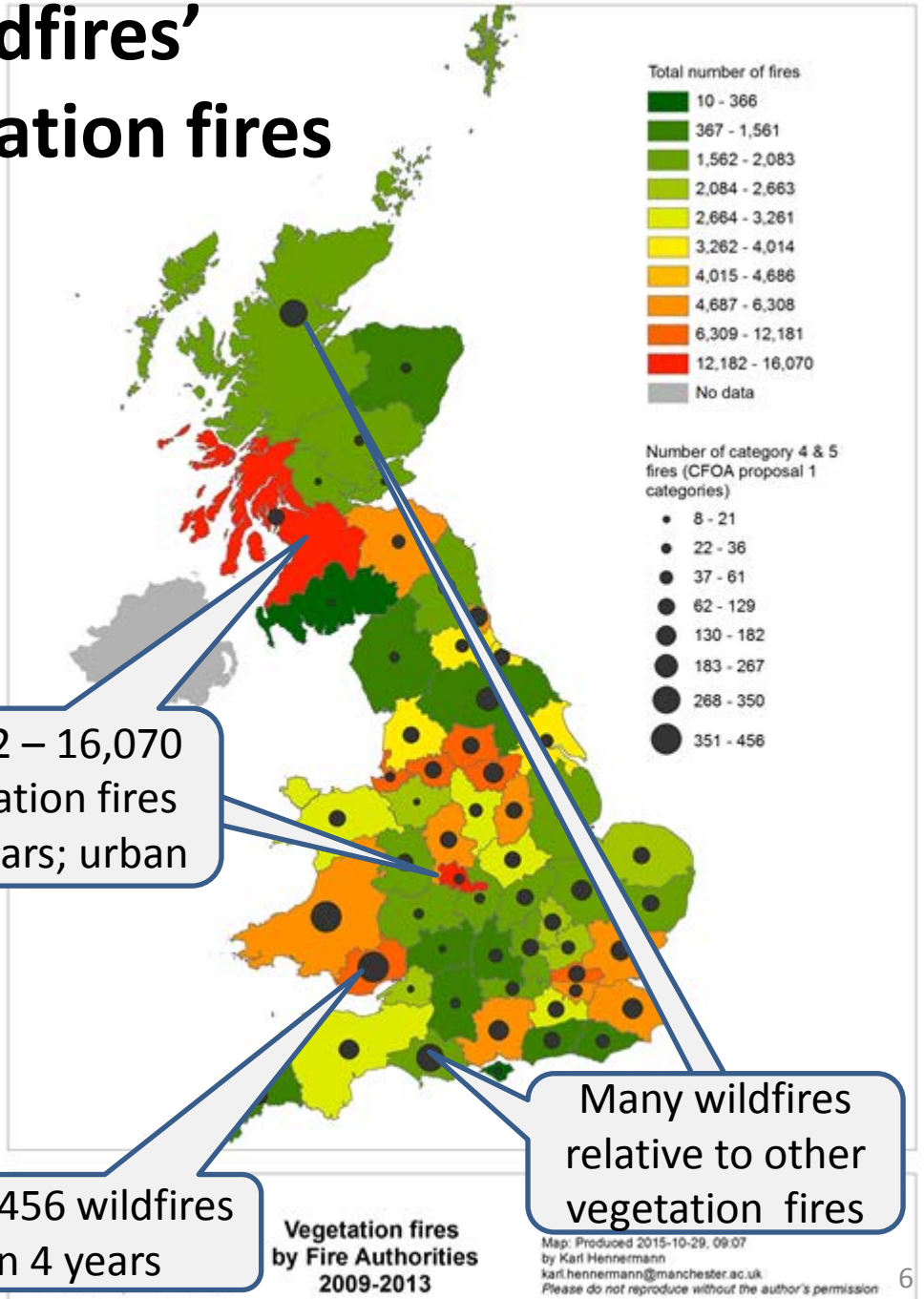


- Almost half GB fires are very small (<5 m^2) but only account for well under 1% of the damage area
- Under 1% are large (>1ha), yet account for over 96% of damage area

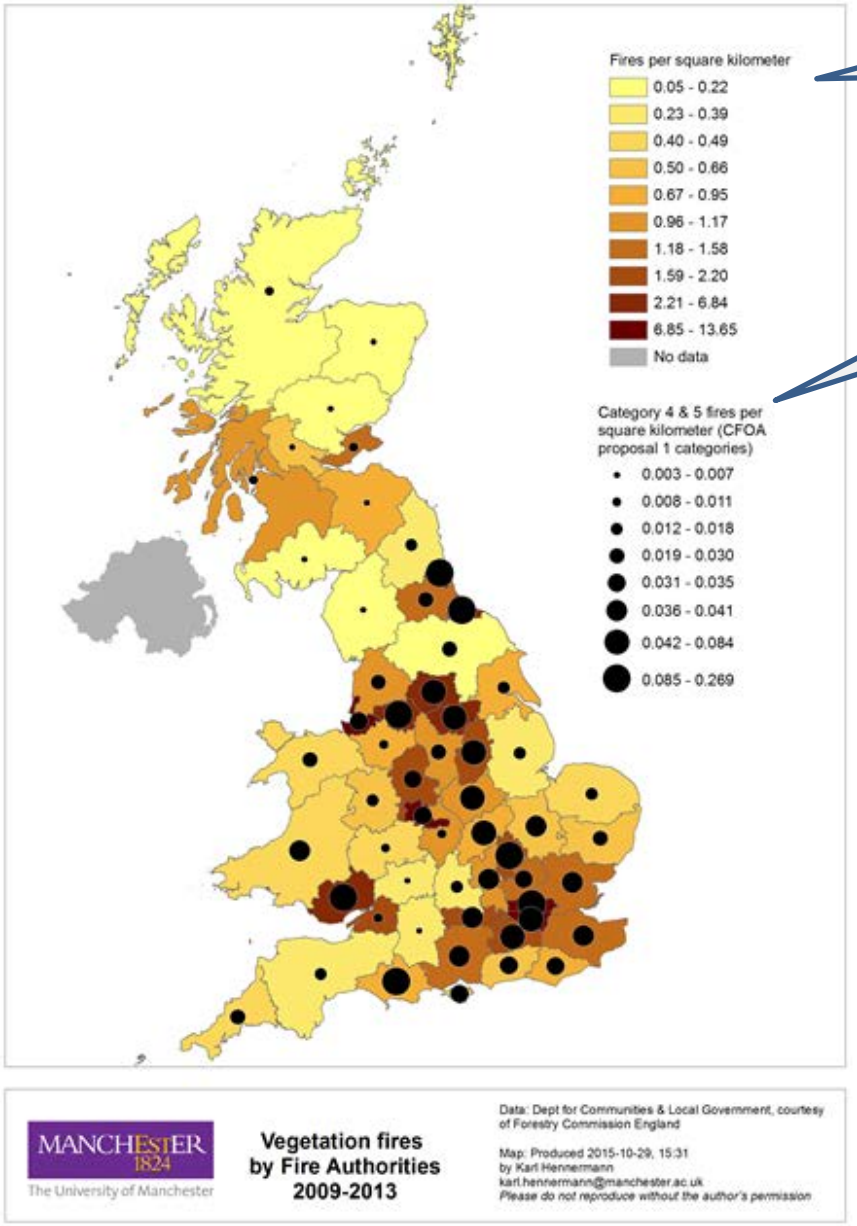
Separating ‘wildfires’ from smaller vegetation fires

- Shading shows number of all vegetation fires by Fire Authority for 4 FYs, 2009/10 – 2012/13
- Circles show number of ‘*wildfires*’ using 3 IRS criteria
  - ≥ 1 ha *or*
  - ≥ 6 hours callout *or*
  - ≥ 4 vehicles

From [Scottish Government (2013) Operational Guidance, Wildfire](#) (CFOA Wildfire Group, proposal 1, category 4 & 5)



Density by Fire Authority



Shading shows number of vegetation fires / Km^2

Circles show number of Scottish manual 'wildfires'/Km^2

Allows for variation in area of Fire Authorities, but still hides variation within them so:

- use census units, e.g. 7,201 Middle Super Output Areas, each of around 7,500 people
- or density of points /km^2

(Grundy & McMorrow , 2015; McMorrow, Hedley & Gazzard, 2015)

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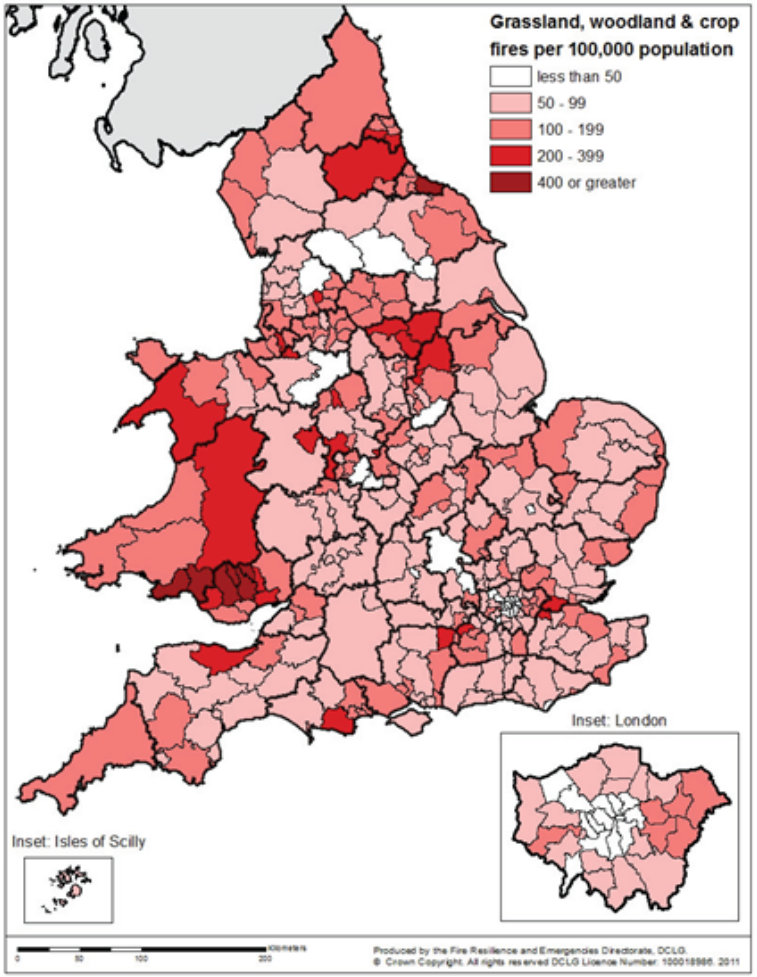
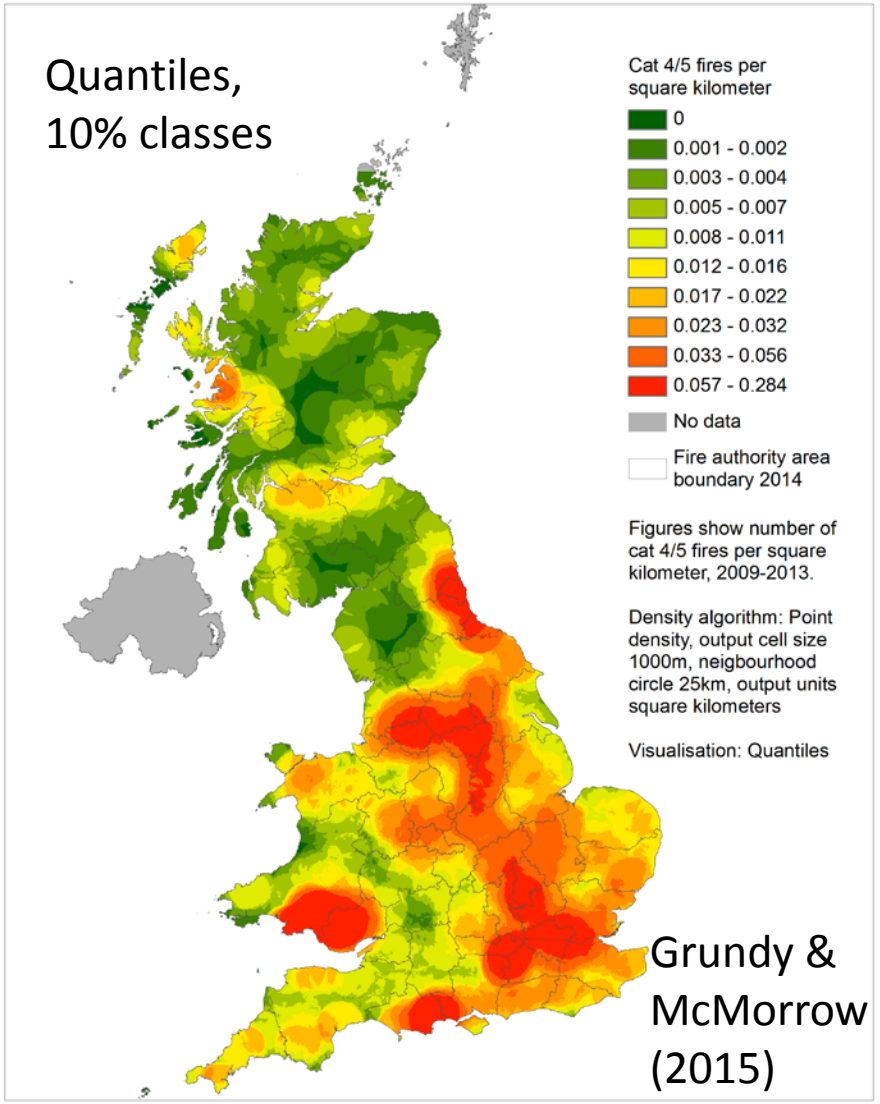
Number of vegetation fires /10,000 people, FY 2010/11



[Fire Statistics GB 2010 to 2011, Dept Communities & Local Government]

Point density of 'wildfires'



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Point density of category 4 and 5 fires, 2009-2013

Data: Dept for Communities & Local Government, courtesy of Forestry Commission England

Map: Produced 2015-11-09, 14:20
by Karl Hennermann for Julia McMorrow
karl.hennermann@manchester.ac.uk
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IRS points for local scale mapping

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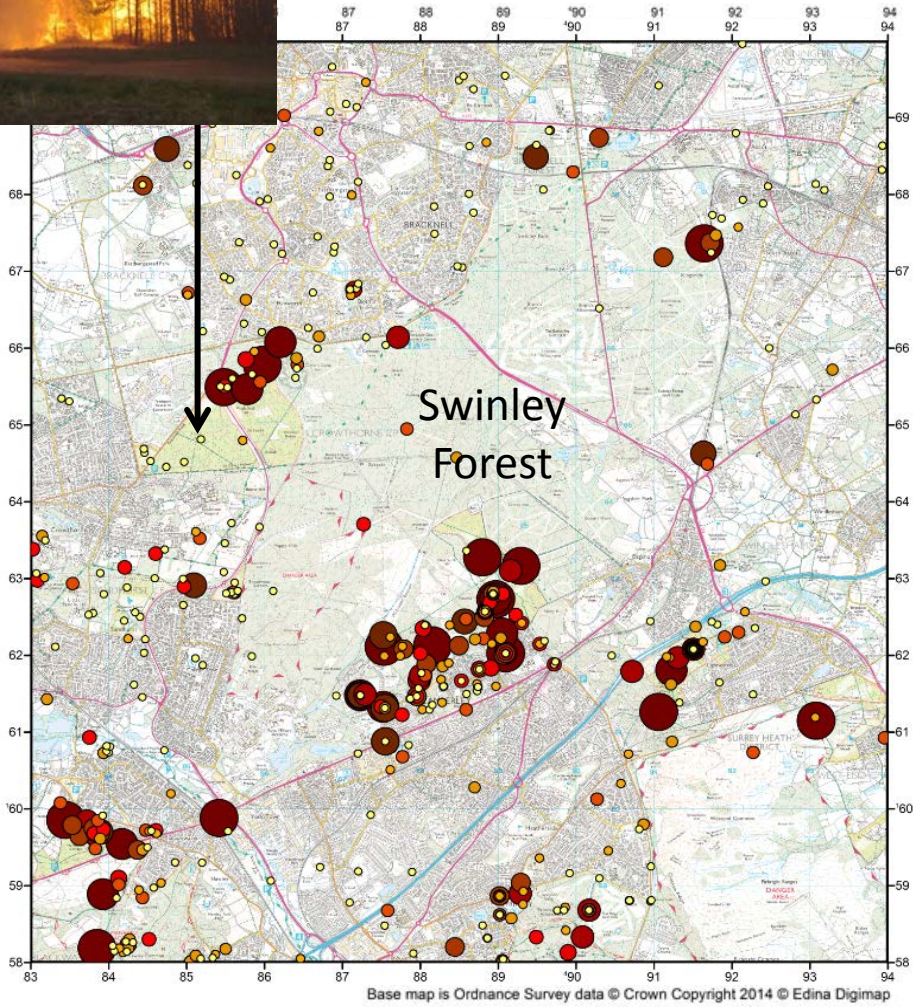
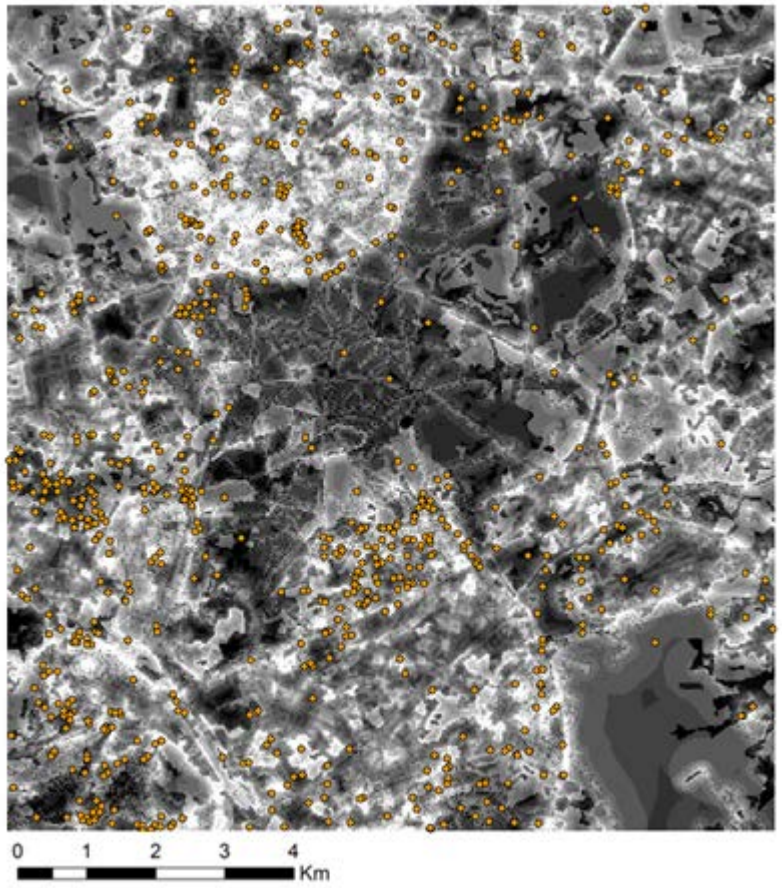
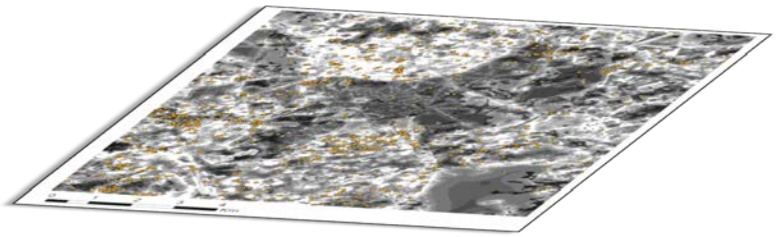
Wildfire Threat Analysis for Swinley Forest rural-urban interface, Berkshire

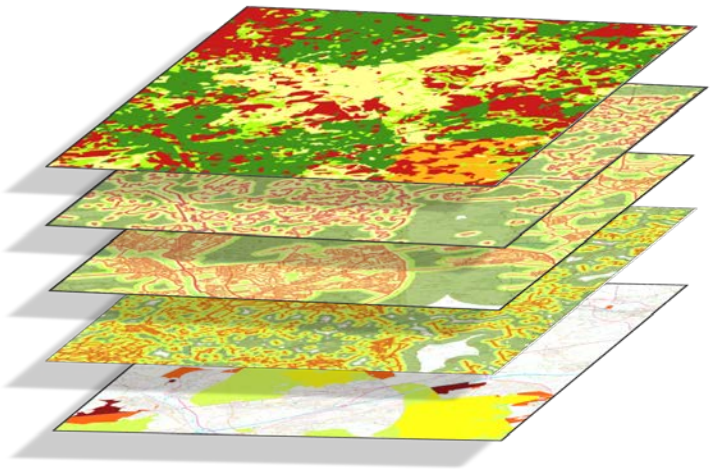


IRS points used to develop risk of ignition GIS model



Risk of ignition modelling using IRS points

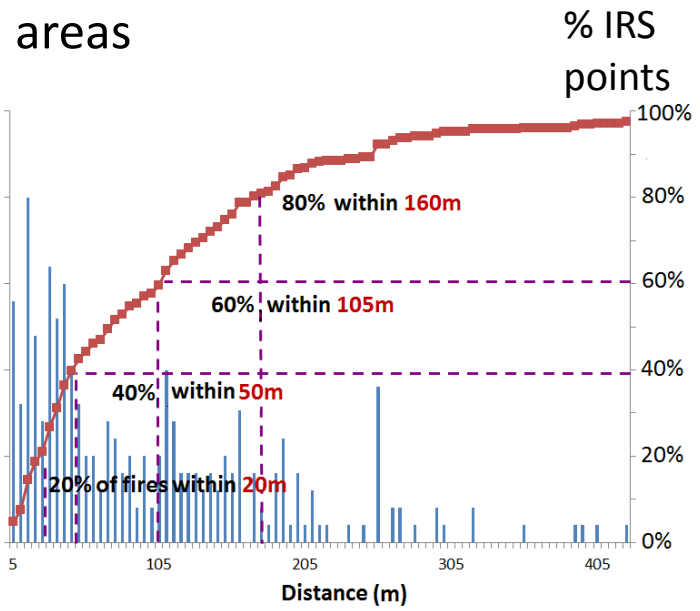




Output: Risk of ignition map; weighted combination of inputs. Weights from stakeholders

Inputs:

- Land cover map (proxy for fuel and intensity of use)
- Distance to urban areas
- Distance to roads
- Distance to paths
- Access Land

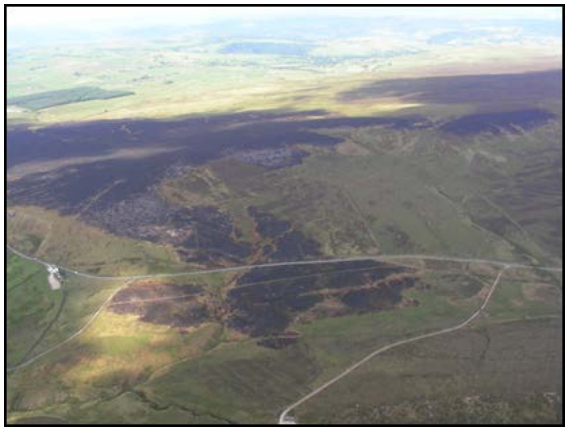


Distance (m)

- IRS fire points used to score layers. Some scores from stakeholder workshop
- 25m cell is too small for **spatial accuracy of IRS** , suits 1 hectare or coarser
- Longer record needed; since 1976 in Peak District.

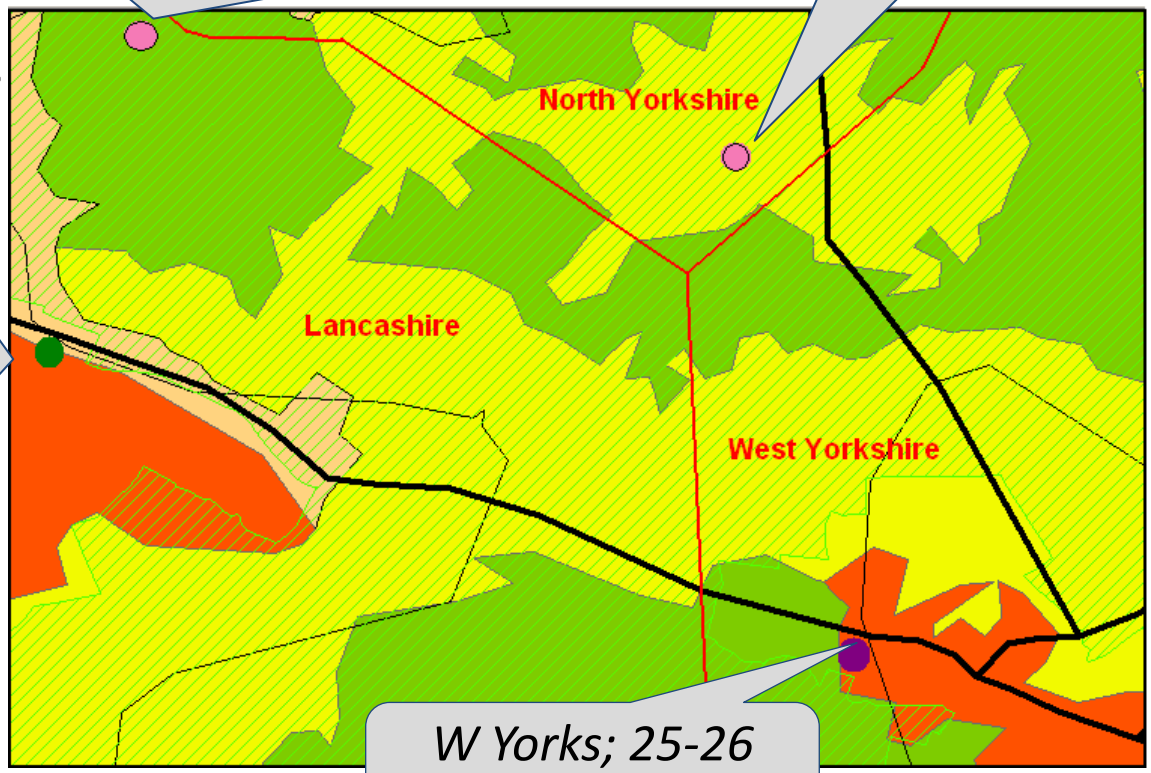
FDR1 fire point location not suited to GIS modelling

9km^2 over-the border moorland fire near Colne, Lancashire, 25-26 July 2006. Multiple recording of rendezvous pts, 2-3km from fire front.



Fire front detected twice by ATSR thermal sensor, night of 25th, 1 - 1.8 km to the north

No fire perimeter



Lanc-ashire FRS; 25 July, FRD1 fire at roadside

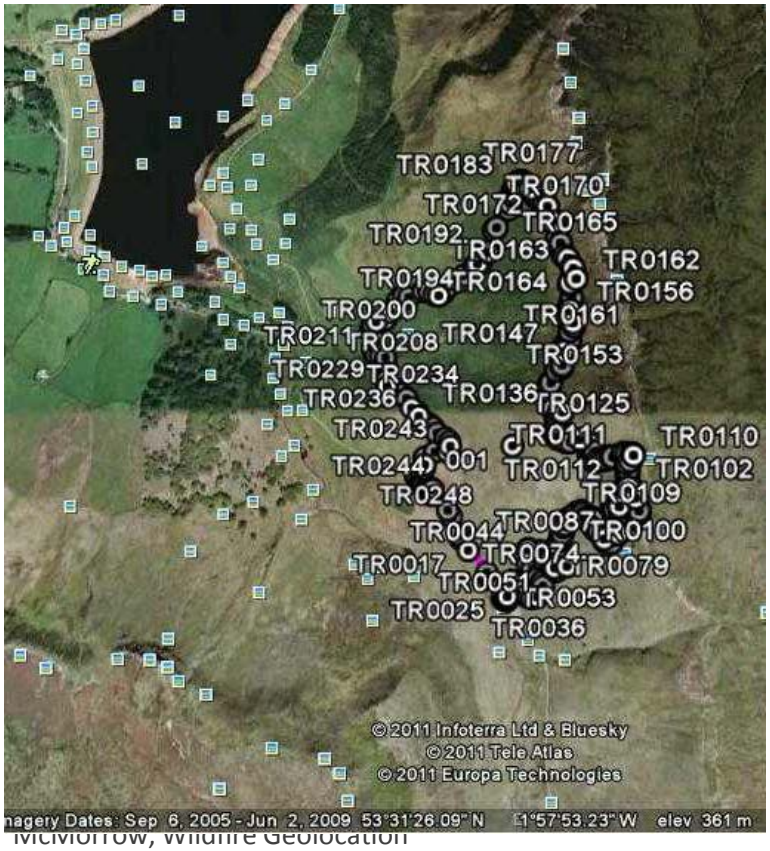
W Yorks; 25-26 July, 3 FDR3

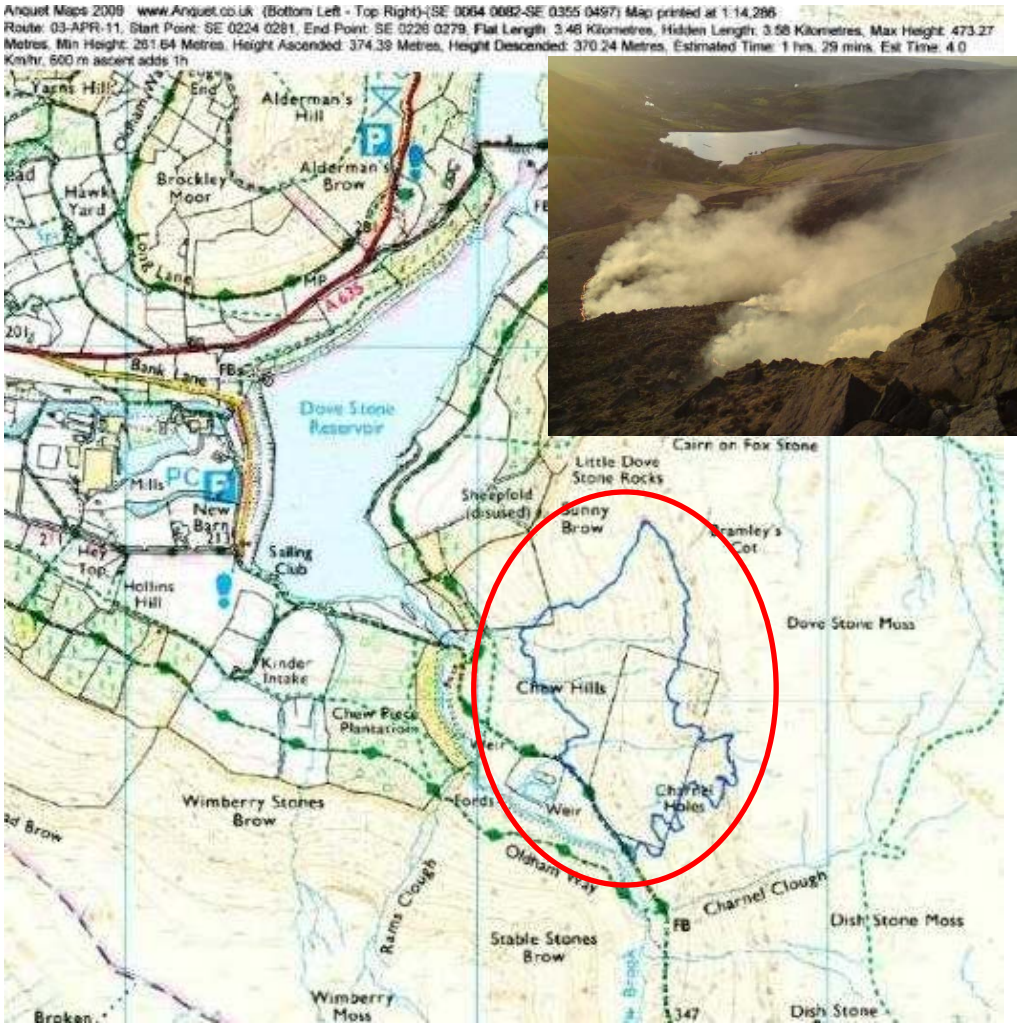
(McMorrow et al., 2011)

Polygons in practice 1: PDNP Fire Operations Group

Peak District National Park (PDNP) Fire Operations Group; rangers began recording perimeters in 2003

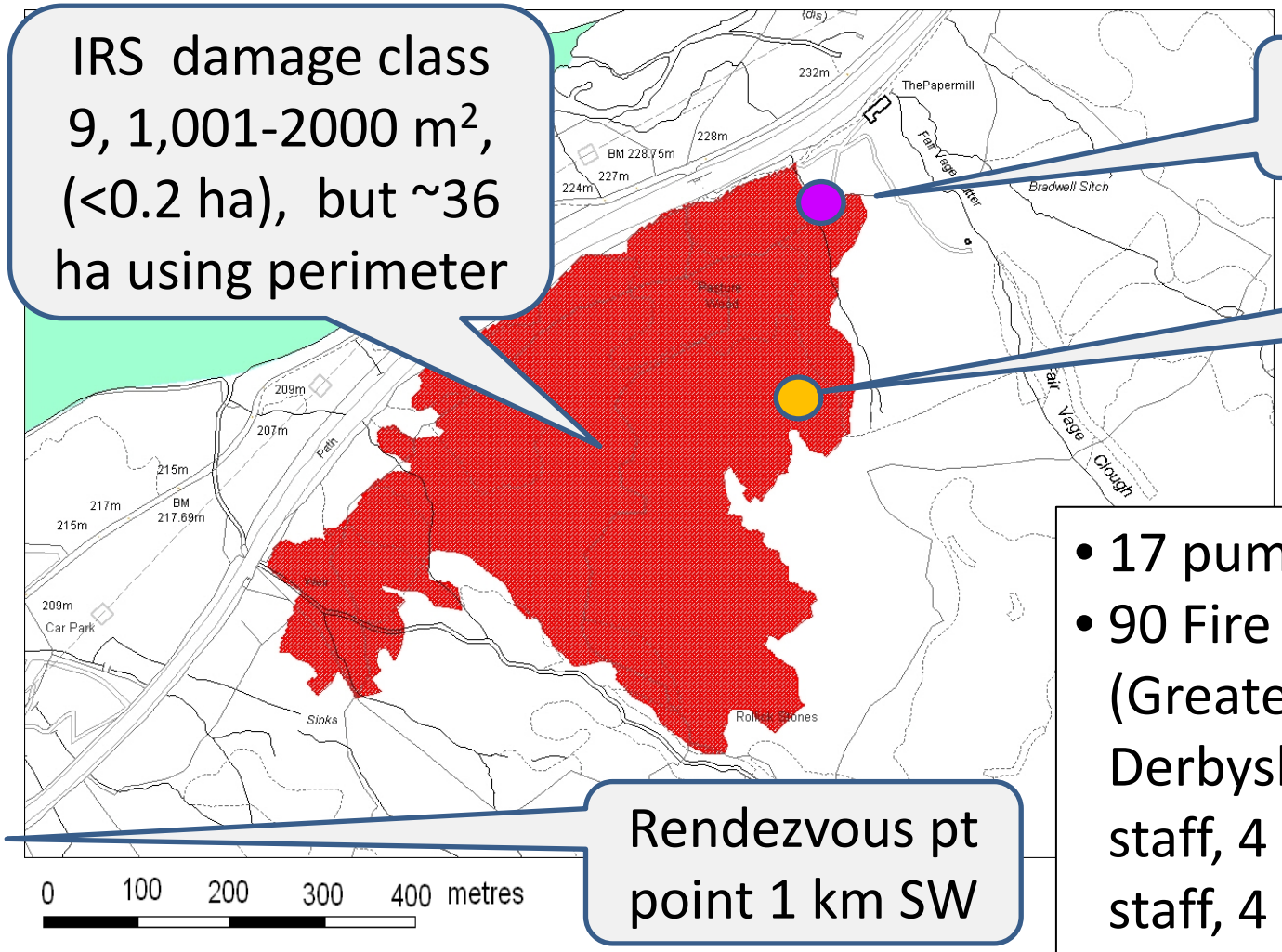
Dove Stones fire, 2 -3 April 2011, Fire Report Number 001/11





Fire perimeters improve burned area estimates

Torside –Wildboar Clough fire 1-4 May 2011, United Utilities mapping



- 17 pumps, 1 Argocat, etc
- 90 Fire Officers from 2 FRS (Greater Manchester & Derbyshire), 14 PDNPA staff, 4 United Utilities staff, 4 gamekeepers (overnight)

Example of PDNP fire record

Peak District National Park Authority — Fire Report Number 011/11
Ranger Service — Fireplan Map Number 14

FIRE REPORT

Date & Time reported	01.05.11 1500	Reported by Contact Number	Christian Evans
Location	Wildbour shoot	Grid ref	SK0799990
Landowner	Mr Evans	Informed	Yes
Site Controller Contact number	Daryl Longston Sean Prendergast	Radio Call sign	Peakland Alpha
R/V Point	Torside C/P	Nearest road head	Woodhead road
Nearest water supply	TPT ponds	Size of fire front	

MOORLAND INFORMATION

Fire Severity Index (FSI)	1 V/Low	2 Low	3 Moderate	4 High

Surface	Heather/Bilberry	Grass	Woodland	Bare P
Dead	Y / N	Y / N	Y / N	Depth to m
Dry	Y / N	Y / N	Y / N	0.5" / 1" /
Green	Y / N	Y / N	Y / N	

Protected Status	ESA	SSSI	SPA	SAC	SAM	NNR	NR

Fire Warning Signs Erected Y / N CRoW Closure Signs Erected

Brief description of the Incident

RV for DFRS, Rangers, UU at Torside Carpark. Rangers & UU moved to the T ponds & set up relay into Pasture wood. Fire Service set up relays to the east their appliances and to the west from the TPT ponds.
2 sectors – initial make-up of 10 pumps – station names attached
Fire service also used beaters & Scotty packs on the flanks.
PDNPA & DFRS centaurs were used on the first day
Gamekeepers attended overnight & relieved in the morning by DFRS, UU & P

Return this form to Chris Porter PDNPA as soon as possible.
Christina.Porter@peakdistrict.gov.uk
Fax: 01629 816291

Peak District National Park Authority — Fire Report Number 011/11
Ranger Service — Fireplan Map Number 14

ACTION **ON SITE**

Fire and Rescue Services in attendance

Derbyshire	Incident No: 51200054	Time: 1540
South Yorkshire	Incident No:	Time:
West Yorkshire	Incident No:	Time:
Cheshire	Incident No:	Time:
Gtr Manchester	Incident No: 51200054	Time: 1544
Staffordshire	Incident No:	Time:
PDNPA Rangers Service		Time: 1600
NT Warden Service		Time: -
United Utilities		Time: 1600
Moorland Keepers		Time: 1600
Helicopter Co.	Pennine Helicopters	
Authorised by: UU	Time Called:	Time: 1740

PDNPA Ranger/Warden Personnel Attended

1	Sean P	11	Peter S - UU
2	Andy V	12	Ian L - UU
3	Martyn S	13	Morgana R - UU
4	Gordon D	14	Nigel H
5	Sheila McH	15	Julia Ruddy - Pennine
6	Kevin T	16	Tia D - UU
7	Fiona D	17	James Kelly - Gamekeeper
8	Andy S	18	Tim Barholt - Gamekeeper
9	Martin W	19	Jed Hudson - Gamekeeper
10	Andy C & Mark B – 02.05.11 Terry P & Paul W – 03.05.11	20	Andy Kirk - Gamekeeper

Incident Closed Down (Time & Date) : 1230

Wildfire Boundary Mapped & Attached Y / N

Ignition Source – Grid reference SK079990

Centre of Fireground – Grid reference

De-brief Notes/Recommendations

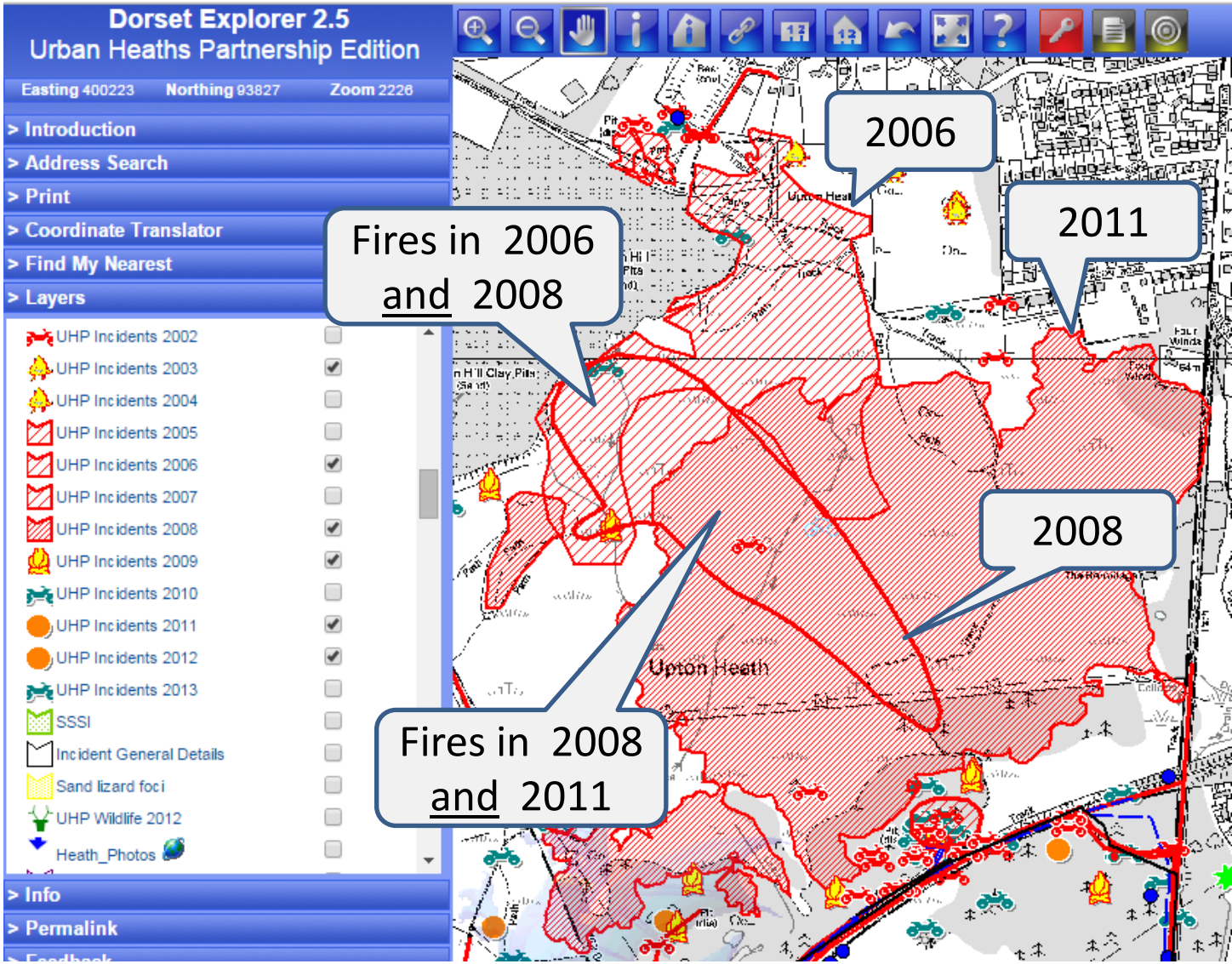
Return this form to Chris Porter PDNPA as soon as possible.
Christina.Porter@peakdistrict.gov.uk
Fax: 01629 816291

- Location, date, time, size, landowner, etc.
- Moorland info
- Description of incident
- Partners attending, with incident numbers & times
- Resources deployed
- Debrief notes
- Mapped polygon, ignition point grid ref, photos.

Polygons in practice 2: Dorset's GIS

Dorset Explorer

- Multi-purpose GIS for Urban Heath Partnership
- Enables fire recurrence to be mapped and queried



Andy Elliott, A.C.Elliott@dorsetcc.gov.uk

Take-home messages

1. **CONSISTENCY OF POINTS**: between partners:
   - ***Location***; *inside* the fire perimeter, not rendezvous point, ideally estimated ignition point. Ideally 12 figure grid reference.
   - ***Thematic accuracy***: vegetation fire categories (Gazzard, 2012).
   - ***Completeness***: IRS better than FDR --records all vegetation fires (McMorrow et al., 2011). Use to identify 'wildfire' from other vegetation fires (Grundy & McMorrow, 2015)
2. **POLYGONS NEEDED** -- wildfires are spatial incidents:
   - ***Improves accuracy and completeness:*** damage area; auto-populate data fields; fire recurrence interval
   - ***Practicalities: who*** should record. ***How*** to manage the data.
3. **CROSS-REFERENCE**; record all incident numbers
4. **LONG RECORDS** improve accuracy of GIS models and forecasting (McMorrow et al, 2009; Albertson et al. 2009, 2010) , but 4 years is a start if it includes wet, dry and average years

WHAT EARTH OBSERVATION CAN (AND CAN'T) TELL US

DURING FIRE:

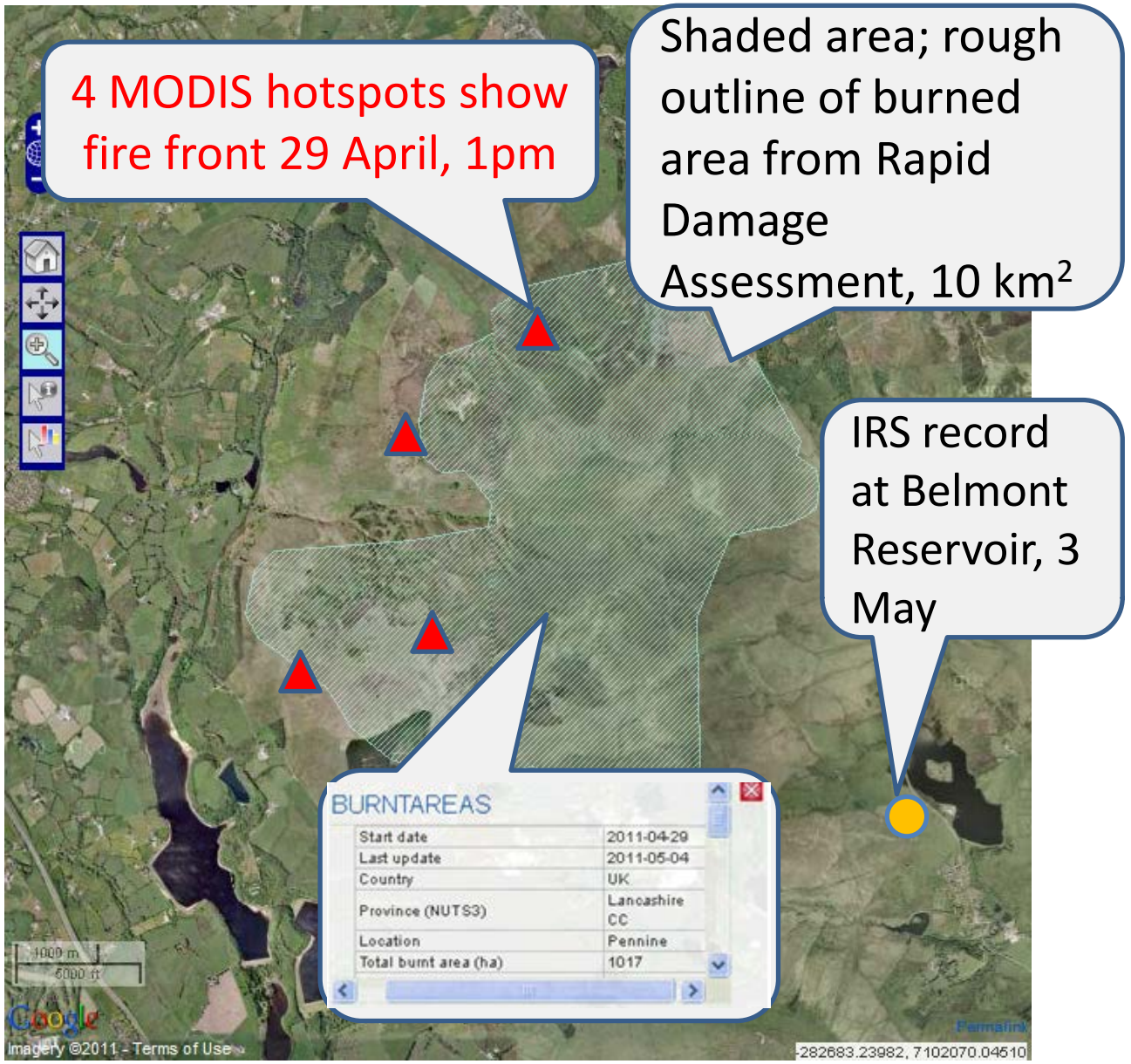
- **Hotspots** – fire fronts; active thermal sensing from satellite sensors MODIS and VIIRS

AFTER FIRE:

- **Burnt area** mapping -- **radar** for fire perimeters in cloudy climates
- Burn severity
- Rate of recovery

Anglezarke Moor, West Lancashire

EFFIS Burnt Area Locator

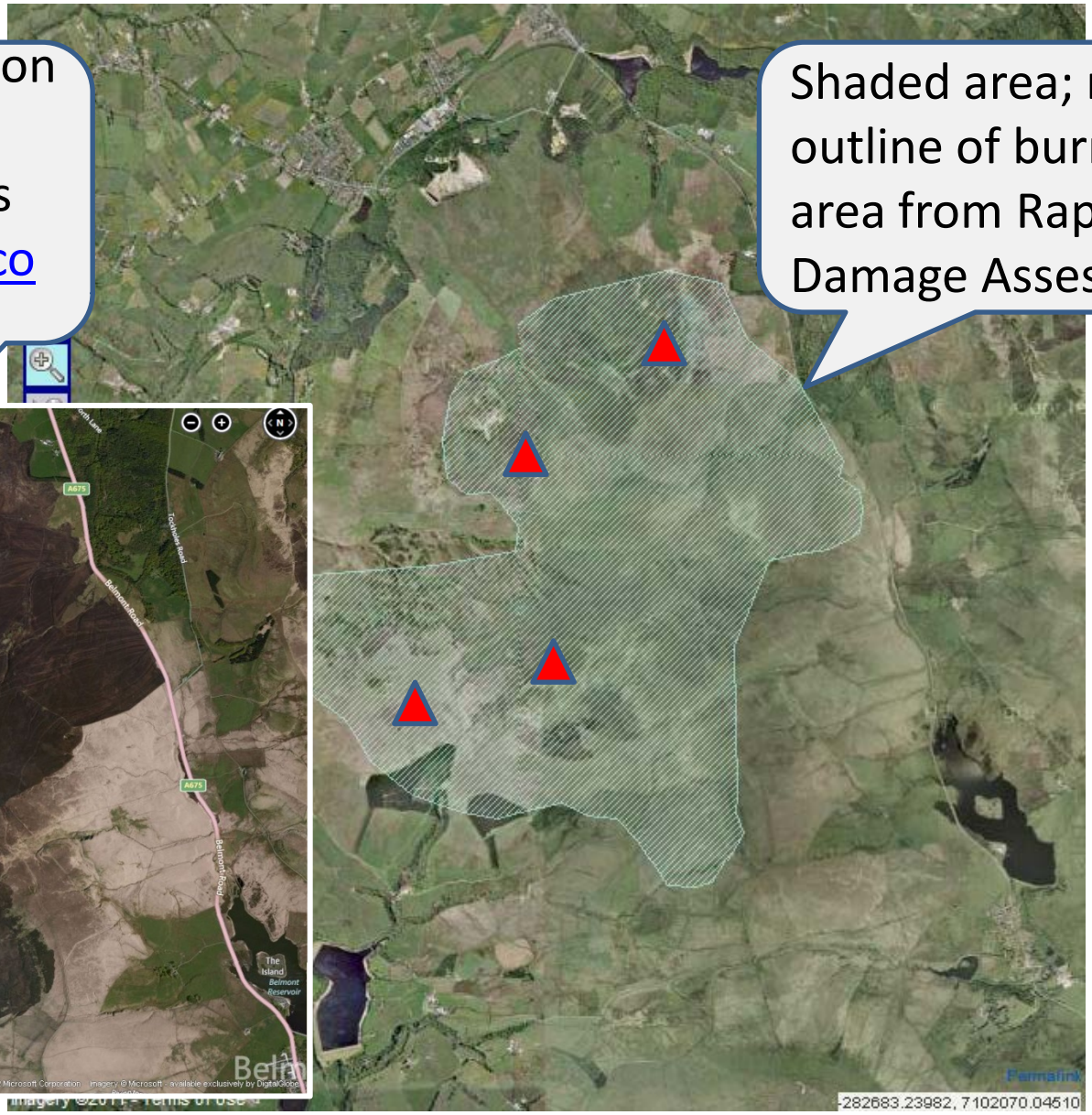


http://effis.jrc.ec.europa.eu/current -situation

Anglezarke Moor, West Lancashire

Burned area seen on Digital Globe images, Bing Maps http://www.bing.com/mapspreview

Shaded area; rough outline of burned area from Rapid Damage Assessment



http://effis.jrc.ec.europa.eu/current -situation

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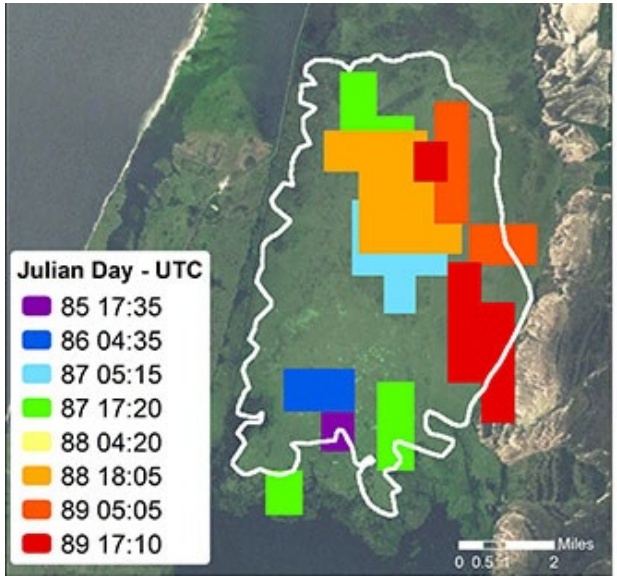
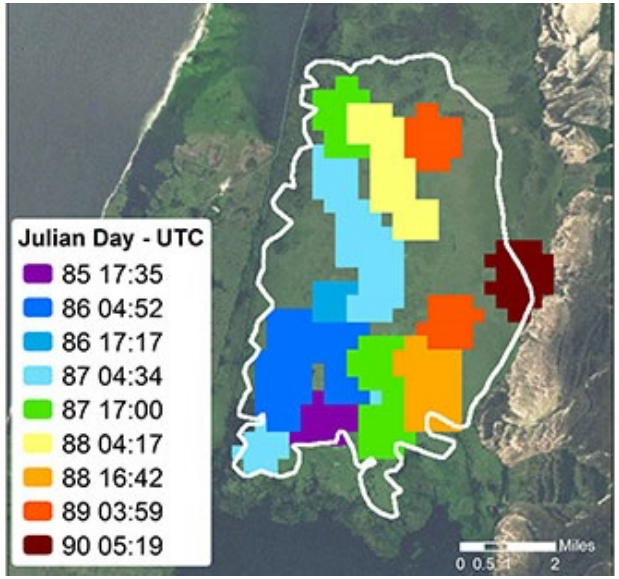
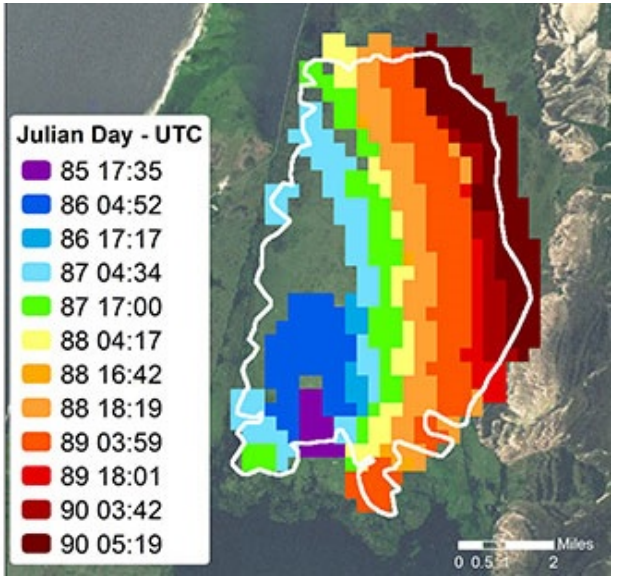
Which sensor for detecting active fire fronts?





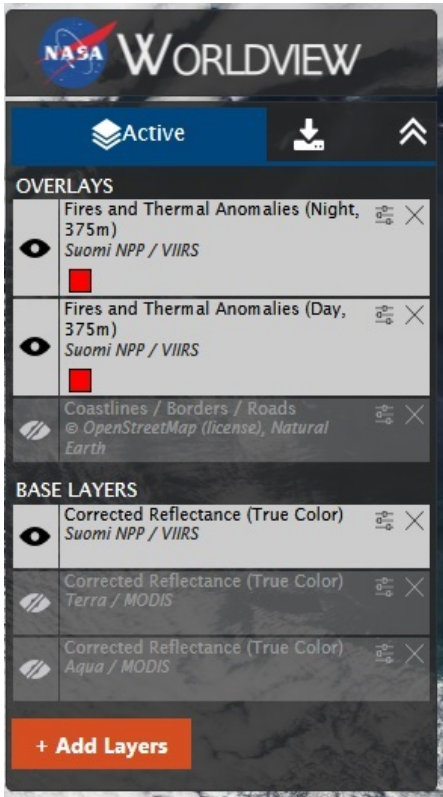


MODIS 1 km VIIRS 750m VIIRS 375 m

Taim Ecological Reserve, S Brazil

VIIRS, 14 March 2016

Heather moorland, W Yorkshire



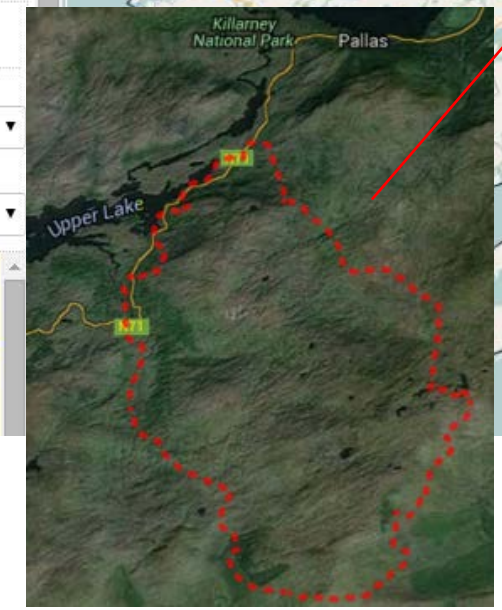
39 hotspots in GB; 34 of these were vegetation fires, 5 were false positives. At least 5 hotspots in Ireland

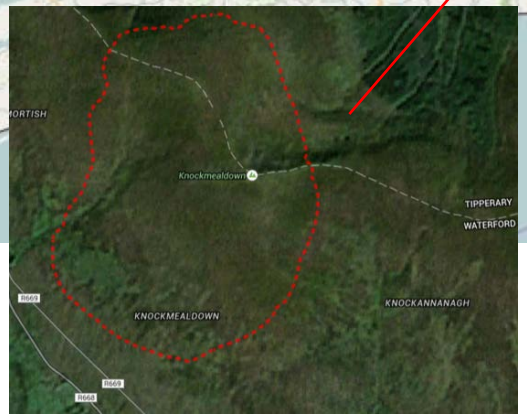
False positive, greenhouses, Isle of White

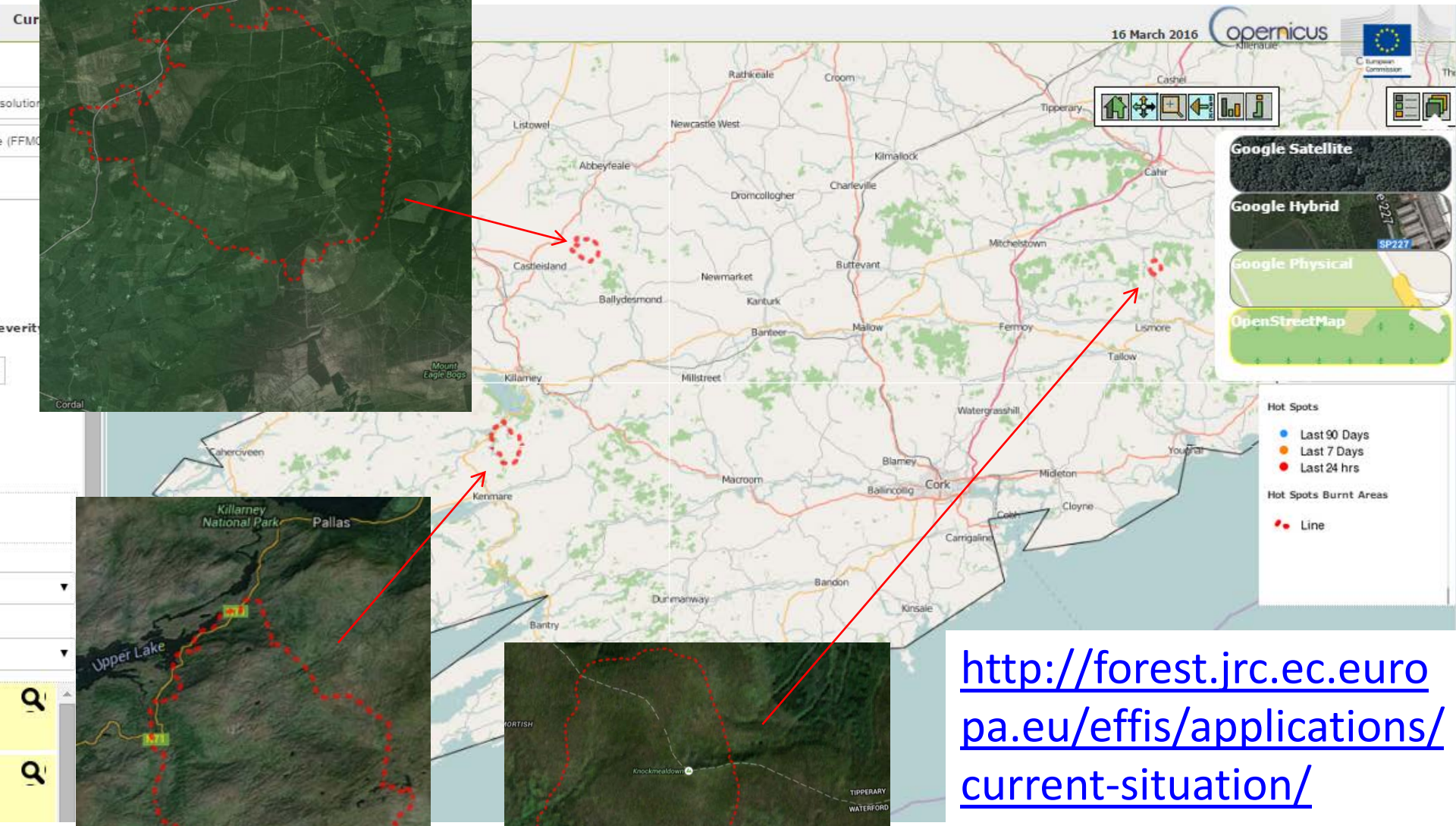
http://earthdata.nasa.gov/earth-observation-data/download-nrt-data/viirs-nrt#ed-corrected-reflectance

MODIS misses at least half IRS fires in Scotland due to cloud, small size or short duration (Critchey & McMorrow, 2015)

SW Eire 16 March 2016, EFFIS

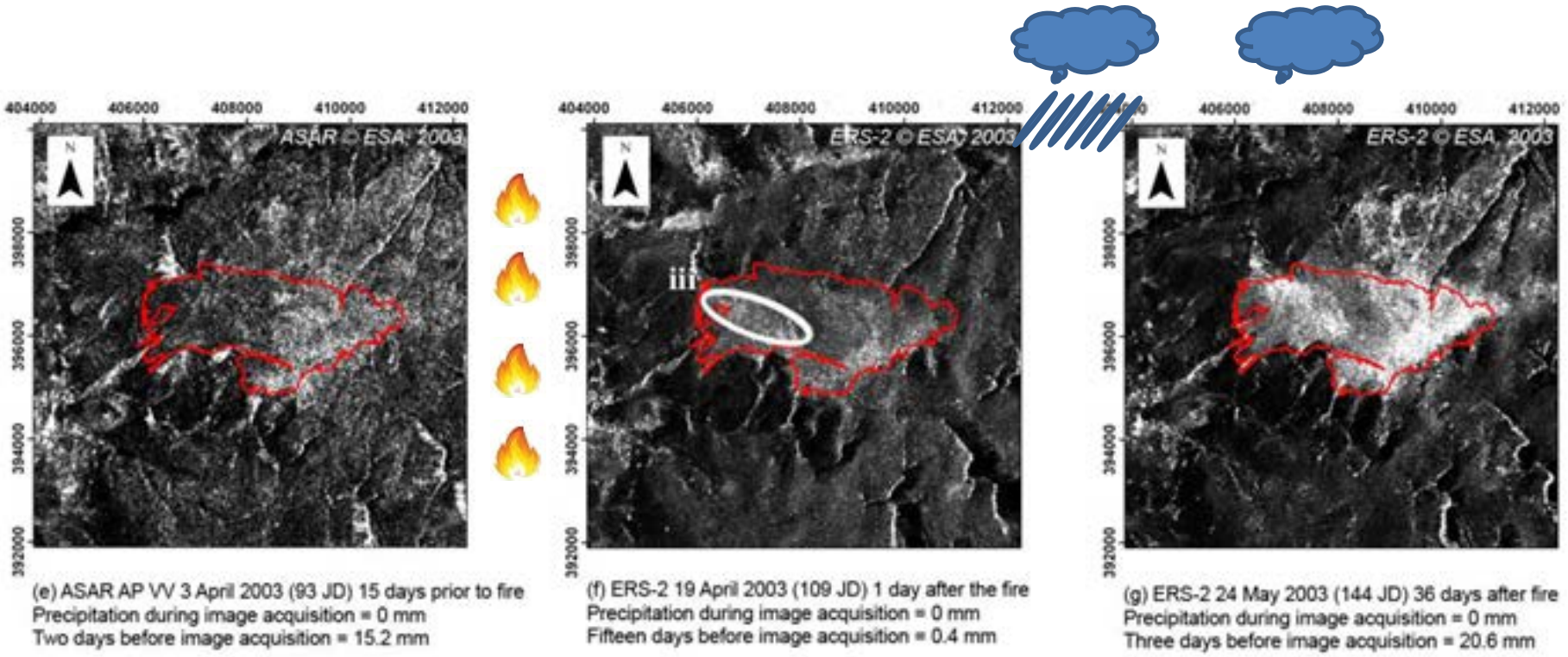


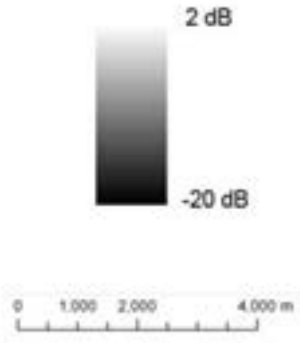




http://forest.jrc.ec.europa.eu/effis/applications/current-situation/

RADAR images detect burn scars through cloud and at night





Bleaklow 18 April 2003, 7km^2 fire exposes peat. Rainfall on exposed peat enhances bright tones of fire signal up to 3 months afterwards (Millin-Chalabi et al., 2014)

Satellite-detected fire databases

- Fire Information for Resource Management System (FIRMS): email alerts, data downloads, Web Fire Mapper
- European Forest Fire Information System (EFFIS): Current situation, Fire history, etc
- German Space Agency (DLR) MODIS Fire Service; Interactive map, Satellite overpasses (images)
- Advanced Fire Information System (AFIS) app; hotspot map, etc
- Monitoring Trends in Burn Severity (MTBS); perimeters and burn severity isnide polygon , USA
- Geopspatial Multi-Agency Coordination (GeoMAC); Hotspots and perimeters, USA
- Etc.

Thank you for listening

Contact:

julia.mcmorrow@manchester.ac.uk

Improving management of UK wildfire through knowledge exchange

Knowledge for Wildfire

www.Kfwf.org.uk

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