MODIS-detected fire regime for Great Britain: 2007-2011

Olisa Ogbechie and Julia McMorrow
School of Environment and Development, University of Manchester olisaogbechie@gmail.com, julia.mcmorrow@manchester.ac.uk

Aim and objectives

Aim: To analyse Great Britain's fire regime from online satellite fire databases utilising the Moderate Resolution Imaging Spectrometer (MODIS).

Objectives

- To describe the spatial and temporal characteristics of Great Britain's fire regime from MODIS satellite databases.
- To compare satellite-detected fires for Spring 2011 against fires reported in the Incident Recording System (IRS)
- To determine the limitations of employing satellite data for studying fire regime.

Method

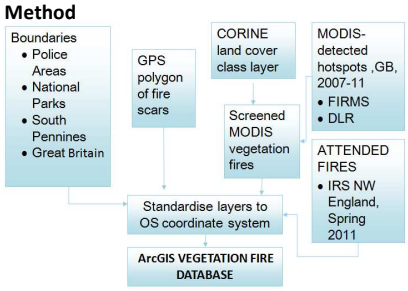

Figure 1: Development of vegetation fire database

Screening out false positives (Figure 1).

- MODIS FIRMS hotspots were overlaid on CORINE land cover in ArcGIS. Screened out those falling on non-vegetation classes; urban, construction.
- Bare rock class included as 250 m bare rock pixels can include vegetation. Result referred to here as 'MODIS vegetation fires'.

Timing of fire occurrence

- 89% of the total 859 fires detected occurred in spring (Figures 2 and 3)
- Figure 4 and 5 show that majority of these occurred in 2007 (198 fires) and 2011 (255 fires, January to May). Coincides with period of higher than average mean temperature and sunshine (Met Office, 2011)

MODIS-detected fire distribution within Police areas

- Number of MODIS vegetation fires was mapped by Police area (Figure 6). Most (214) were in the Northern Constabulary in Scotland
- Also mapped as density per km2 (Figure 7). South Wales has highest vegetation fire density. High in northern Scotland. Lowest in England, except in the northwest.

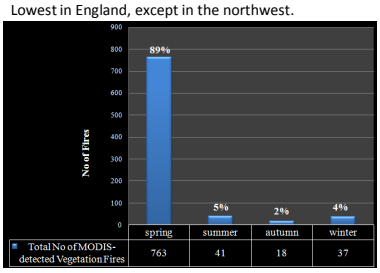

Figure 2 : Seasonal distribution (%) of all MODIS-detected vegetation fires, Jan 2007 – May 2011)

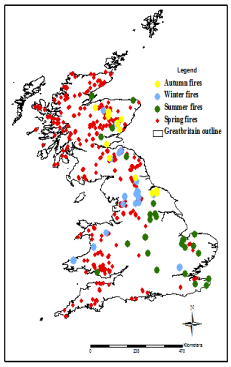

Figure 3: Seasonal distribution of MODIS-detected vegetation fires (Jan 2007 – May 2011)

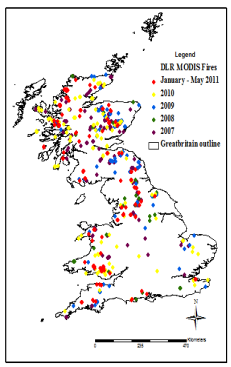

Figure 4: Yearly distribution of MODIS-detected vegetation fires (Jan 2007 – May 2011)

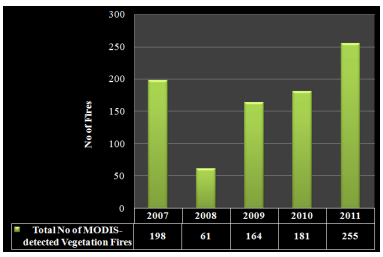

Figure 5: Yearly distribution of MODIS-detected vegetation fires , Jan 2007 – May 2011

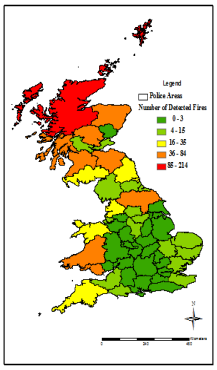

Figure 6: Number of MODIS-detected vegetation fires, Jan 2007 – May 2011, by Police area

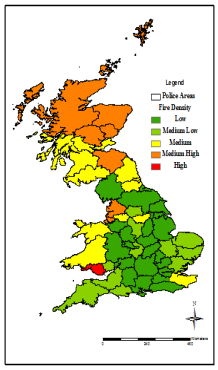

Figure 7 : MODIS-detected vegetation fire density per km2 , Jan 2007 – May 2011, by Police area

Spring Fires 2011

South Pennines

- Only 6 fires were detected in the South Pennines, but 15 'major' fires were reported in IRS (Figure 8).
- Poor spatial match of MODIS points with IRS fire location. IRS records a single ignition point. MODIS records fire front at time of overpass.

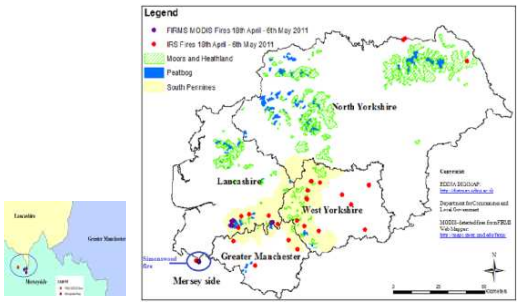

Figure 8: MODIS-detected fires and IRS reported Spring 2011 fires in Lancashire, Greater Manchester, West Yorkshire and North Yorkshire; 18th April – 6th May 2011

Simonswood fire

- MODIS-detected fire at the boundary of Lancashire and Merseyside, confirmed by IRS (Figure 8)
- IRS shows it started 30th April and mobilisation stopped on 3rd May.
- MODIS recorded it on twice on 1st May (Aqua and Terra satellites) and once on 2nd May (Aqua). It only became large or hot enough to detect on 1st May and not after 2nd May.

False negatives: why the Wainstalls fire was not detected

- 2 large fires over a 9-day period at Wainstalls, Ovenden Moor, West Yorks. 4 km² in IRS, ~82 hectare (0.82 km²) from GPS survey carried out ~55days after the start of the fire (Figure 9)
- Long-lived, large fire with no cloud, but not detected by either of the satellite overpasses
- First started on 30th April at 14:52 hrs, too late for Terra satellite overpass at 12:00 and Aqua at 13:50 UTC
- By 1st May, flaming combustion had been subdued, but even if smouldering combustion was hot enough, it could not be detected through the smoke (Figure 10).
- 2nd fire started 2nd May. No cloud but smoke persisted so could not be detected.
- On 3rd and 4th May, the satellite images show cloud (Figure 11) and the intensity of fire had reduced drastically.

Figure 9: Wainstalls fire scar, GPS readings plotted on Google Earth image. Not detected by MODIS. IRS locations shown as orange dots.

Figure 10: Wainstalls fire, West Yorkshire; aerosols hindered fire detection

Cloud cover

Cloud cover limited MODIS fire detection over parts of the UK during the Spring 2011 fires (Figure 11).

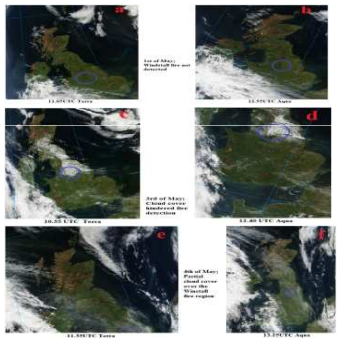

Figure 11: Satellite images (Bands 1,4,3) from the MODIS Rapid Response System 1st , 3rd and 4th May 2011 ; cloud cover hindered fire detection

Source: http://lance.nasa.gov/imagery/rapid-response/

Limitations of satellite fire databases

- Timing of the satellite overpass; fires are missed, especially those at night
- Cloud cover and aerosols hinder satellite detection
- Size and intensity of fire; only fires that are hot enough or large enough are detected.
- False positives; some hotspots are sun glint on water bodies, metal structures or bare rock, or hot plumes from industrial chimneys
- Fire front recorded, not point of ignition.
- Can have >1 detection per fire.

Advantages and recommendations

- MODIS facilitates better understanding of the spatial and temporal distribution of the *largest* fires, especially in spring.
- Provides a whole season picture of largest fires before IRS data are released, and a national overview not restricted to Fire Authority areas
- The picture is only partial; detection is limited by cloud, smoke, fire size and timing of the two day-time overpasses
- False positives need to be screened out using land cover data
- Quantitative evaluation is required against IRS attended fire data, individual fire reports and field visits, and over a larger scale (UK-wide) and longer timescale.

Acknowledgements

- Department for Communities and Local Government, Fire Statistics group
- Andy Newman and West Yorkshire FRS
- Gail Millin-Chalabi, University of Manchester

Bibliography

- DLR Fire Services Statistics http://www.zki.dlr.de/fireservice/stats
- EDINA /Ordinance Survey. http://digimap.edina.ac.uk
- FIRMS, Fire Information for Resource Managers NASA, University of Maryland. http://maps.geog.umd.edu/firms/
- Meteorological Office United Kingdom www.metoffice.gov.uk/
- MODIS Rapid Response System http://lance.nasa.gov/imagery/rapid-response/

Poster presented at Wildfire 2011, 14 – 15 Sep 2011, Buxton, Derbyshire