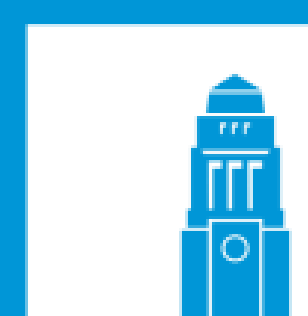


# Impact of the 2018 Saddleworth Moor wildfires on Air Quality and Health

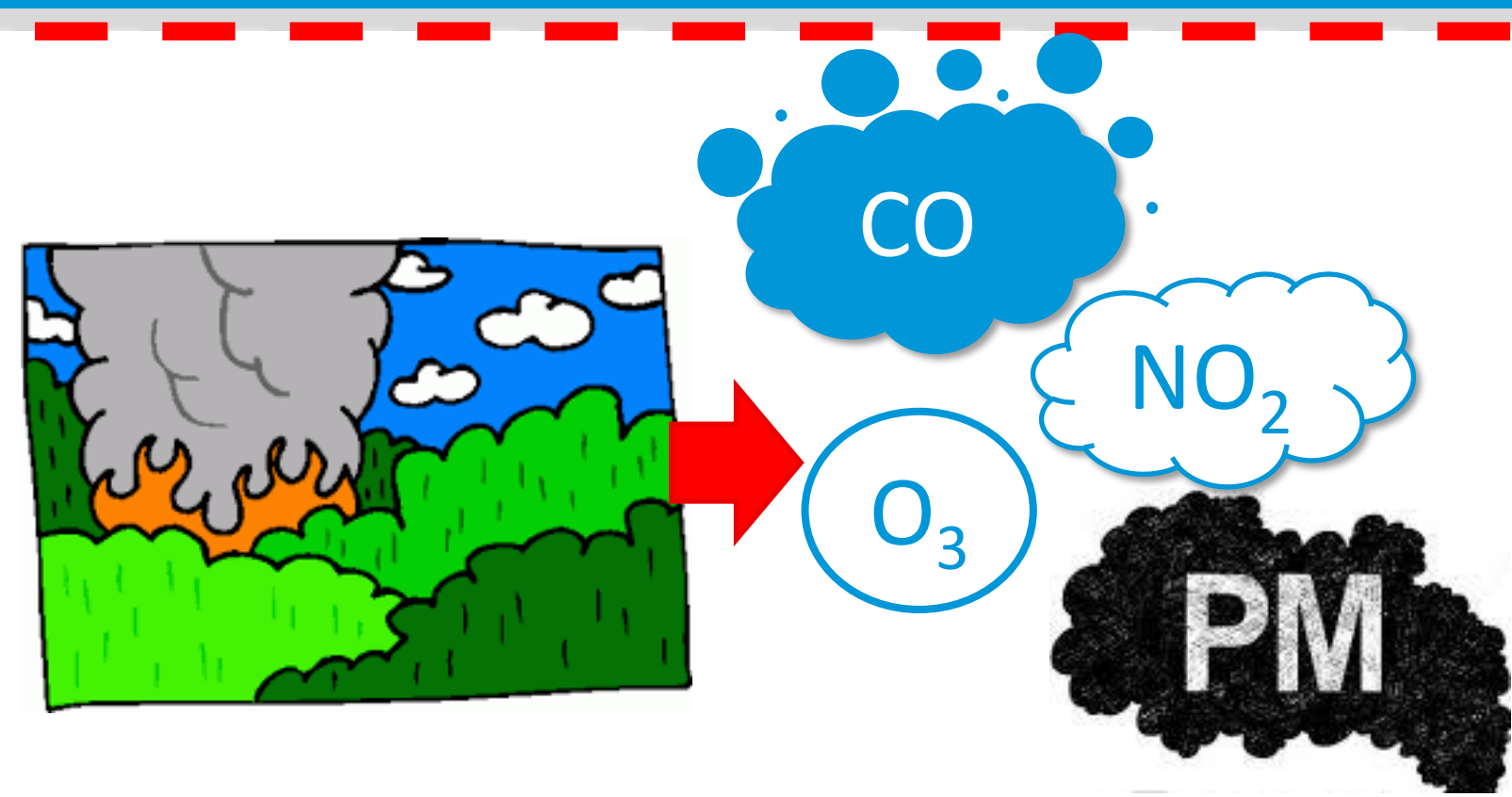
Ailish M. Graham<sup>1</sup>, Pope RJ<sup>1,2</sup>, McQuaid JB<sup>1</sup>, Bruno AG<sup>3,4</sup>, Moore DP<sup>3,4</sup>, Harrison JJ<sup>3,4</sup>, Chipperfield MP<sup>1,2</sup>, Arnold SR<sup>1</sup>, Pringle K<sup>1</sup>, Conibear L<sup>1</sup>, Butt E<sup>1</sup>, Reddington C<sup>1</sup>, Keily L<sup>1</sup>, Rigby, R<sup>5</sup>, Lee, J<sup>6,7</sup> and Wilde, S<sup>6</sup>

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Air Quality Impact

Health Impact

Up to 300%↑PM<sub>2.5</sub> due to fires  
4.5 million people exposed above WHO  
24hrs PM<sub>2.5</sub> limit  
150%↑short-term Excess Mortality (E<sub>mPM2.5</sub>)  
Up to 60% of E<sub>mPM2.5</sub> from fires  
Economic cost of mortality £21.1m

## Background

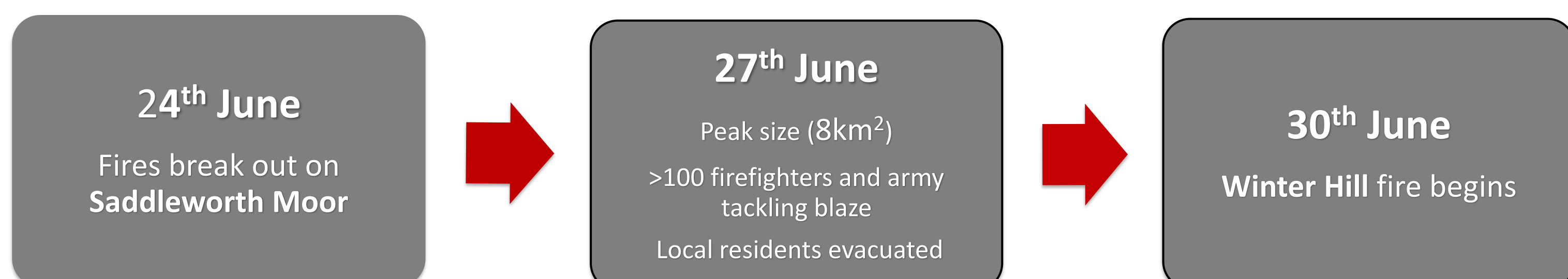
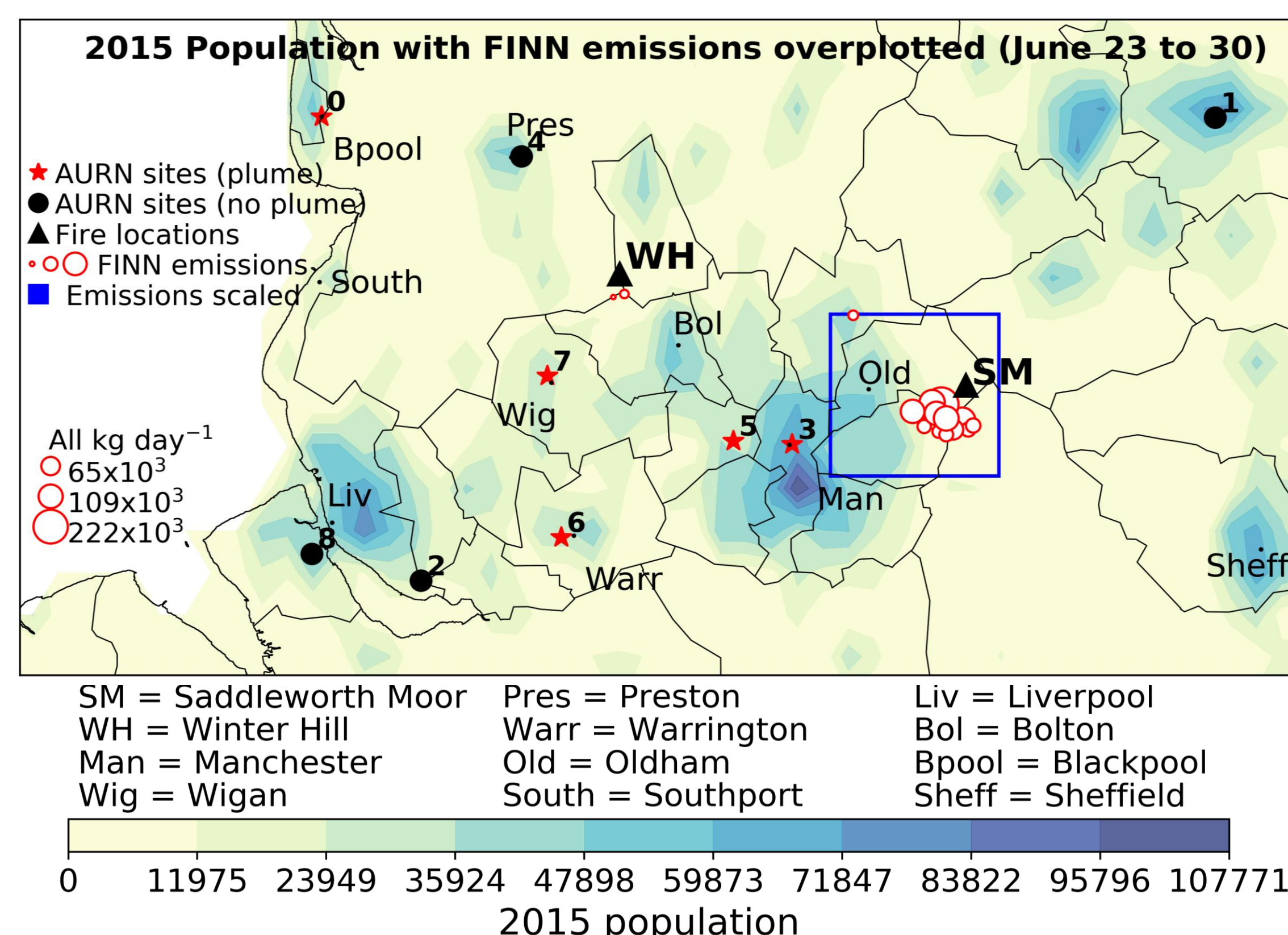
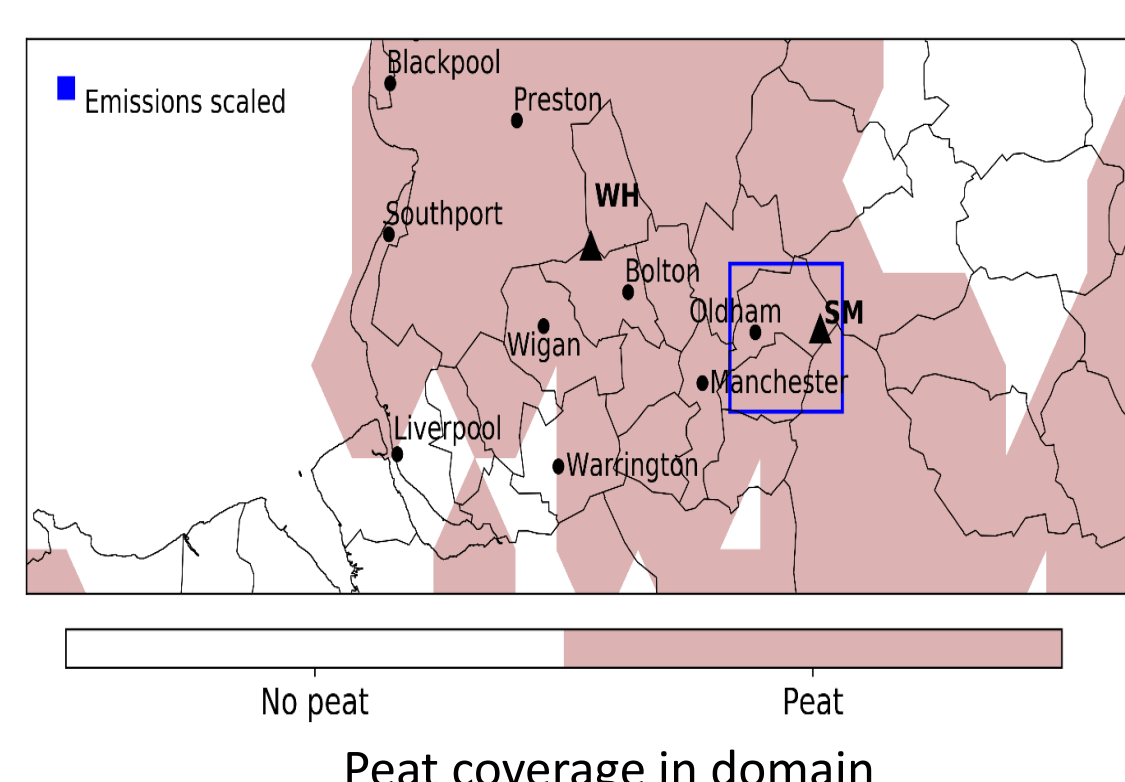


Figure 1.a) Drone images of the Saddleworth Fires (from the BBC) b) MODIS visible images, from both NASA's Aura and Terra satellites, of the Saddleworth Moor and Winter Hill fires between 25th-30th June. The red circle highlights the location of Saddleworth Moor when the fires first became visible from space

## Simulation Domain

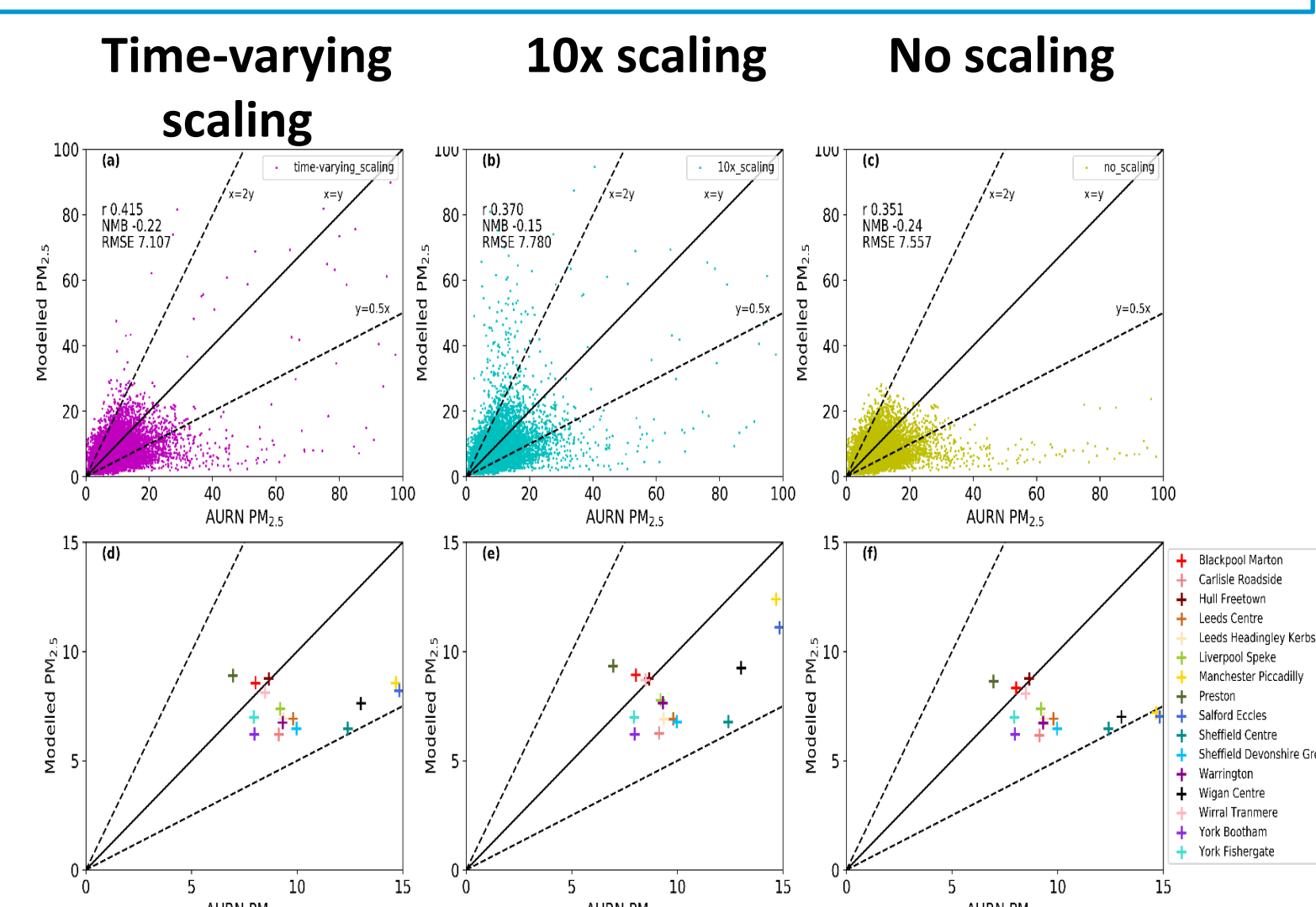


## Scaling FINN emissions

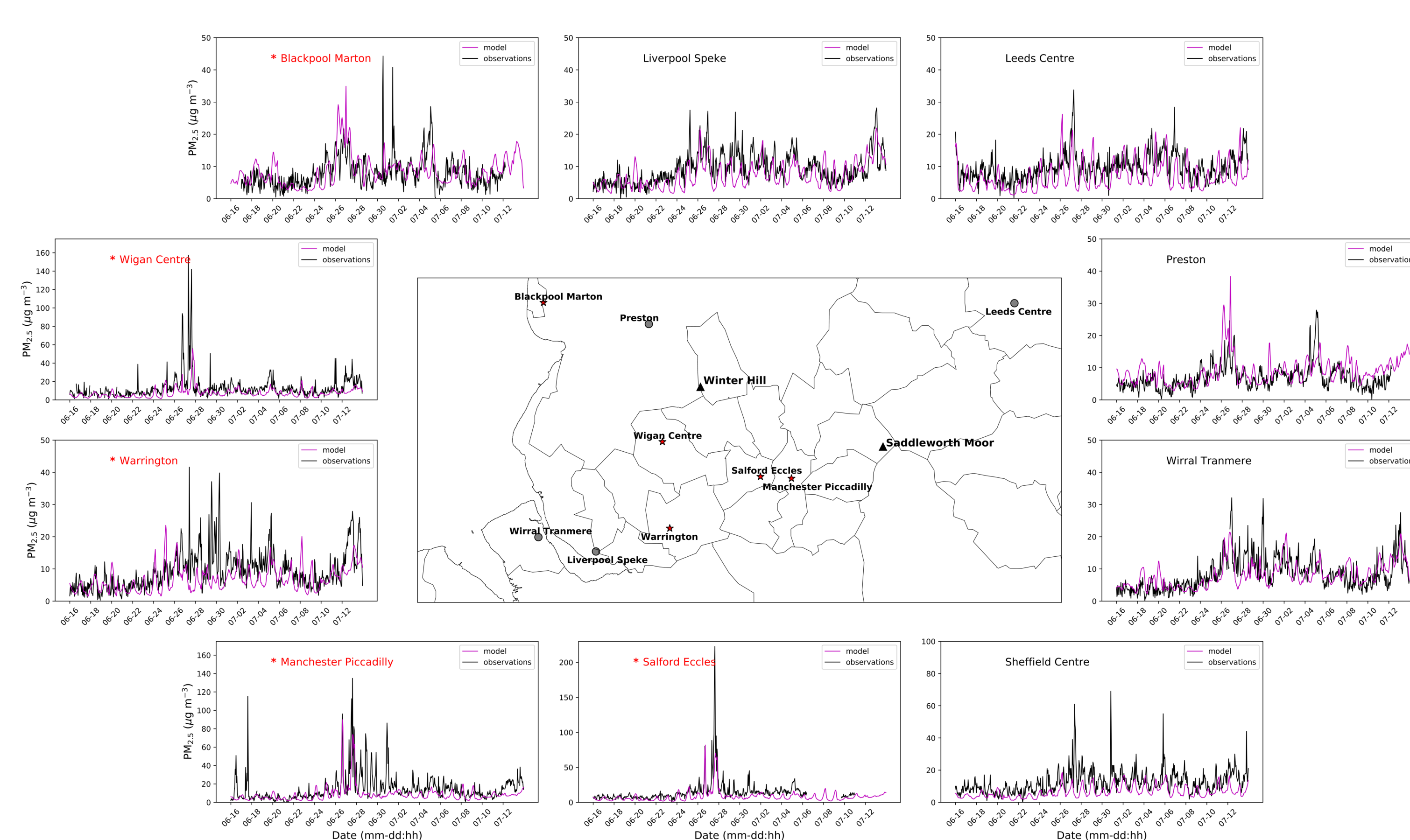


- Fire emissions for 2018 only available from FINN
- They don't include burning of peat
- Therefore we have to scale emissions on Saddleworth Moor as the moor lies on peat soils
- We find time-varying scaling agrees best with observations
- Likely because surface vegetation is burnt first (FINN includes this) before the peat below begins to burn (FINN doesn't include this)

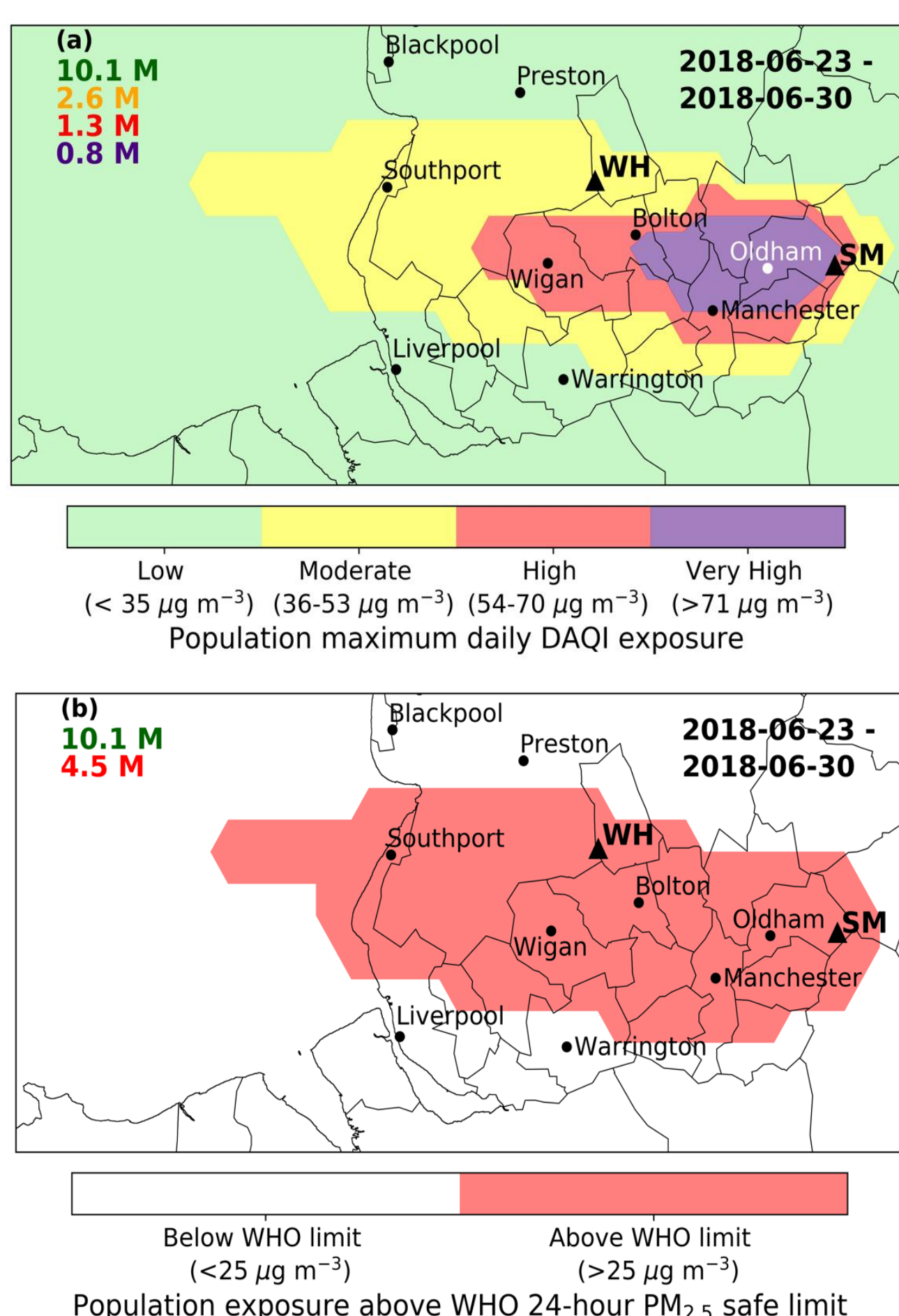
| Daily Evaluation Statistic | Time-varying Scaling | 10x Scaling | No Scaling | No Fire Emissions |
|----------------------------|----------------------|-------------|------------|-------------------|
| r                          | 0.77                 | 0.74        | 0.69       | 0.62              |
| RMSE                       | 4.27                 | 4.31        | 5.06       | 5.30              |
| MB                         | -1.59                | -0.95       | -1.84      | -1.98             |
| NMB                        | -0.19                | -0.10       | -0.22      | -0.24             |
| MAE                        | 2.30                 | 2.22        | 2.48       | 2.59              |
| NMAE                       | 0.31                 | 0.31        | 0.33       | 0.34              |



## WRF-Chem Simulated PM<sub>2.5</sub>

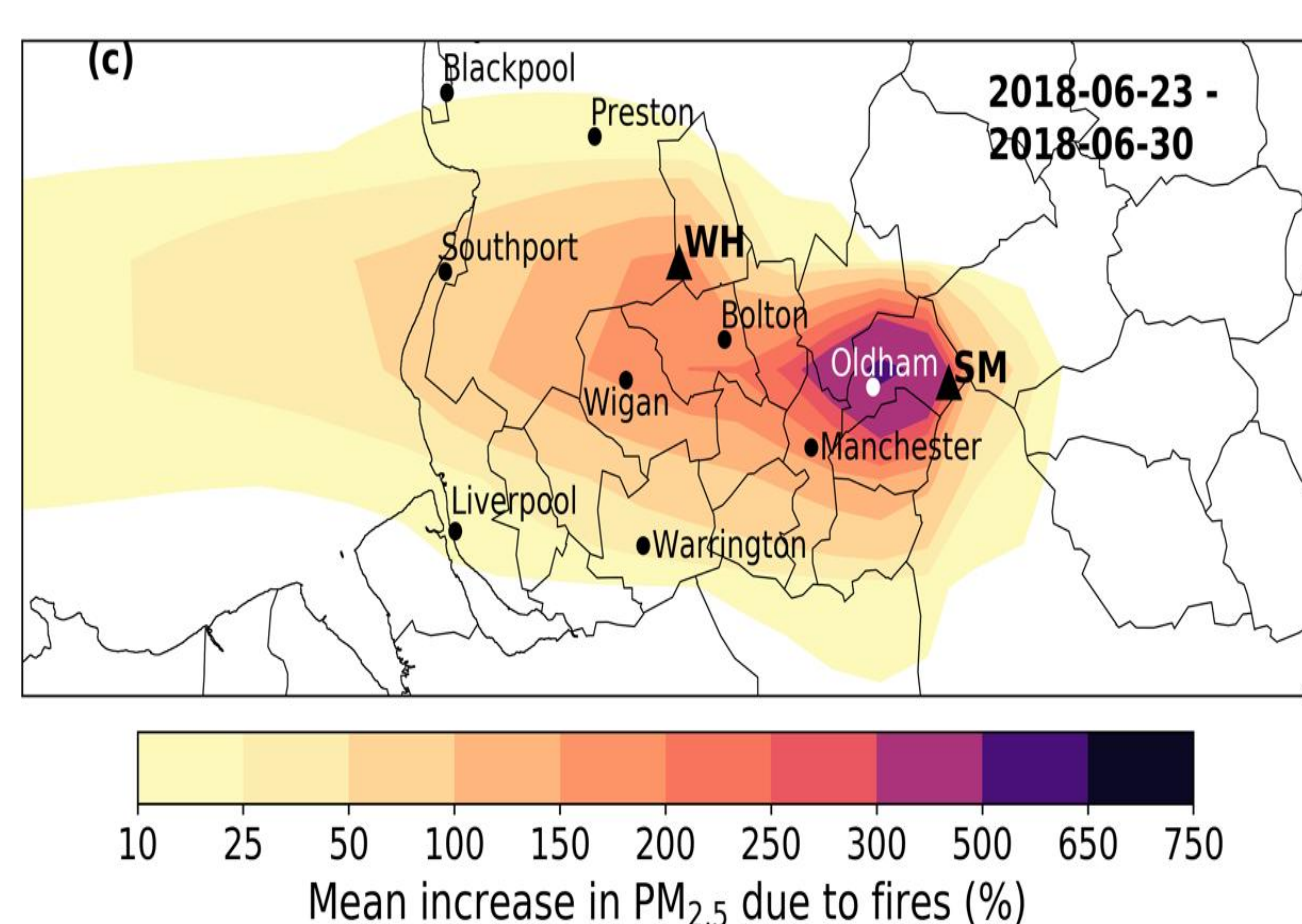


## Air Quality Impact

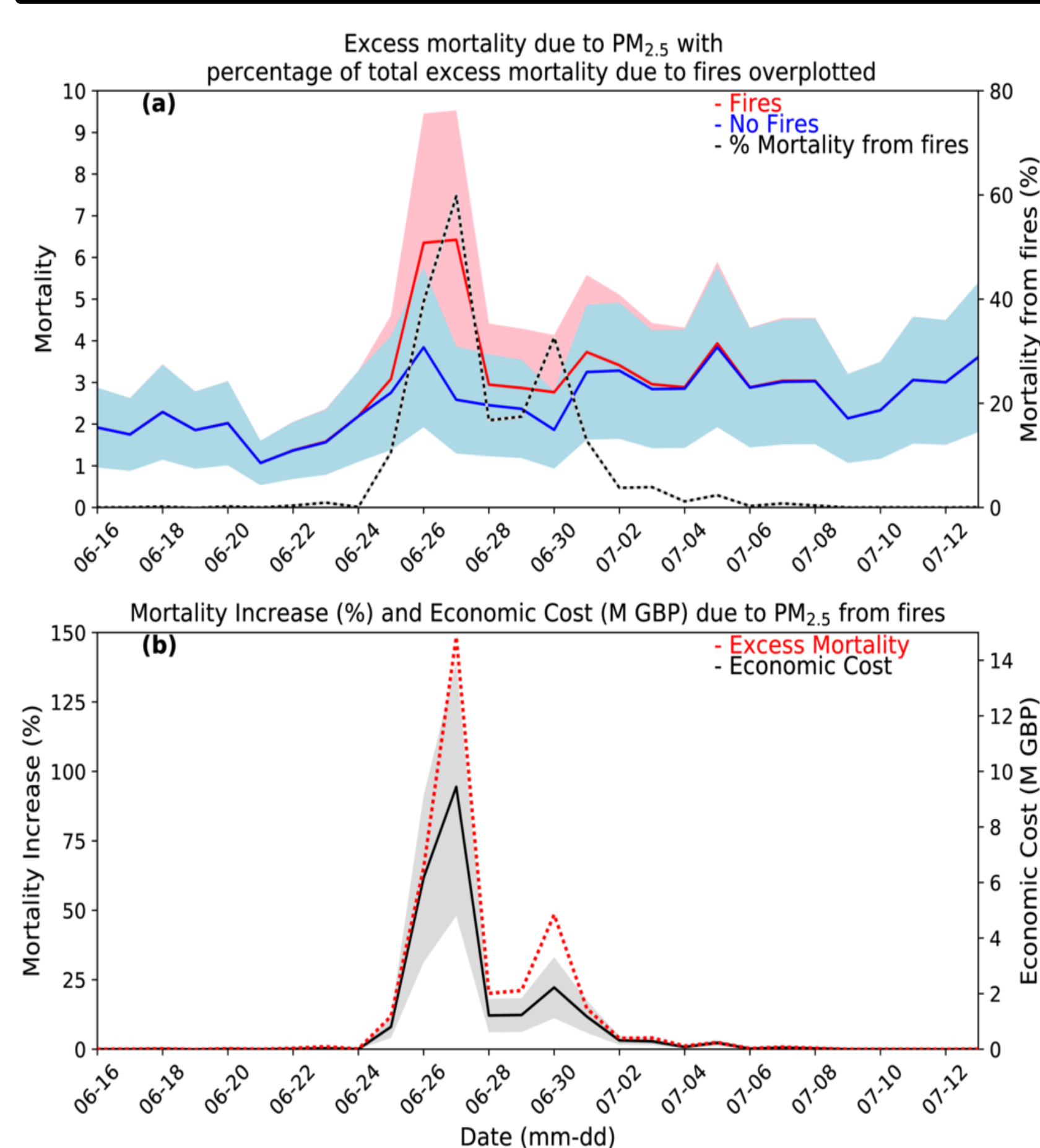


We use the **Daily Air Quality Index (DAQI)**, used by the government to provide advice on air pollution, and the **WHO 24-hour safe limit (25 µg m<sup>-3</sup>)** with **population data to calculate exposure** between June 23-30<sup>th</sup>

- Up to a **300% increase in PM<sub>2.5</sub> due to fires** (Fig. c)
- **4.7 million** people exposed to moderate, high and very high DAQI values (> 35 µg m<sup>-3</sup>) on at least one day (Fig. a)
- **4.5 million** people exposed above the **WHO safe-limit** on at least one day (Fig. b).



## Health and Economic Impact



Using a short-term concentration response function we can calculate the number of deaths brought forward due to exposure to PM<sub>2.5</sub> from the fires (Fig. a). From this we can calculate the economic cost of the mortalities (Fig. b).

- **165% increase excess mortality** due to fires (Fig b red dashed line)
- **Up 60% of deaths brought forward due to fires** (Fig a black dashed line)
- **Economic cost of mortality from fires £21.1 million** (Fig b black line)

Wildfires in the UK have the potential to have a significant impact on AQ and health

Surface observations are from AURN ([uk-air.defra.gov.uk](http://uk-air.defra.gov.uk)). Satellite data is from <https://scihub.copernicus.eu/> and <http://www.temis.nl/airpollution/no2.html>. Reanalysis data is from ECMWF (FRP and ERA-Interim) (<https://apps.ecmwf.int/datasets/data/>). Aircraft data from FAAM is from CEDA (<https://old.faam.ac.uk/index.php/data>)