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Expert | Impartial | Innovative

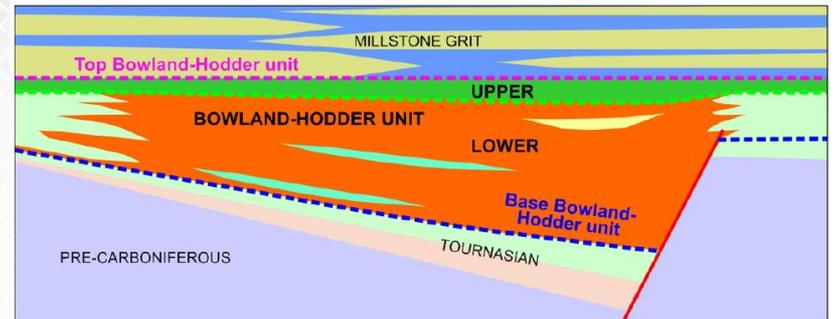
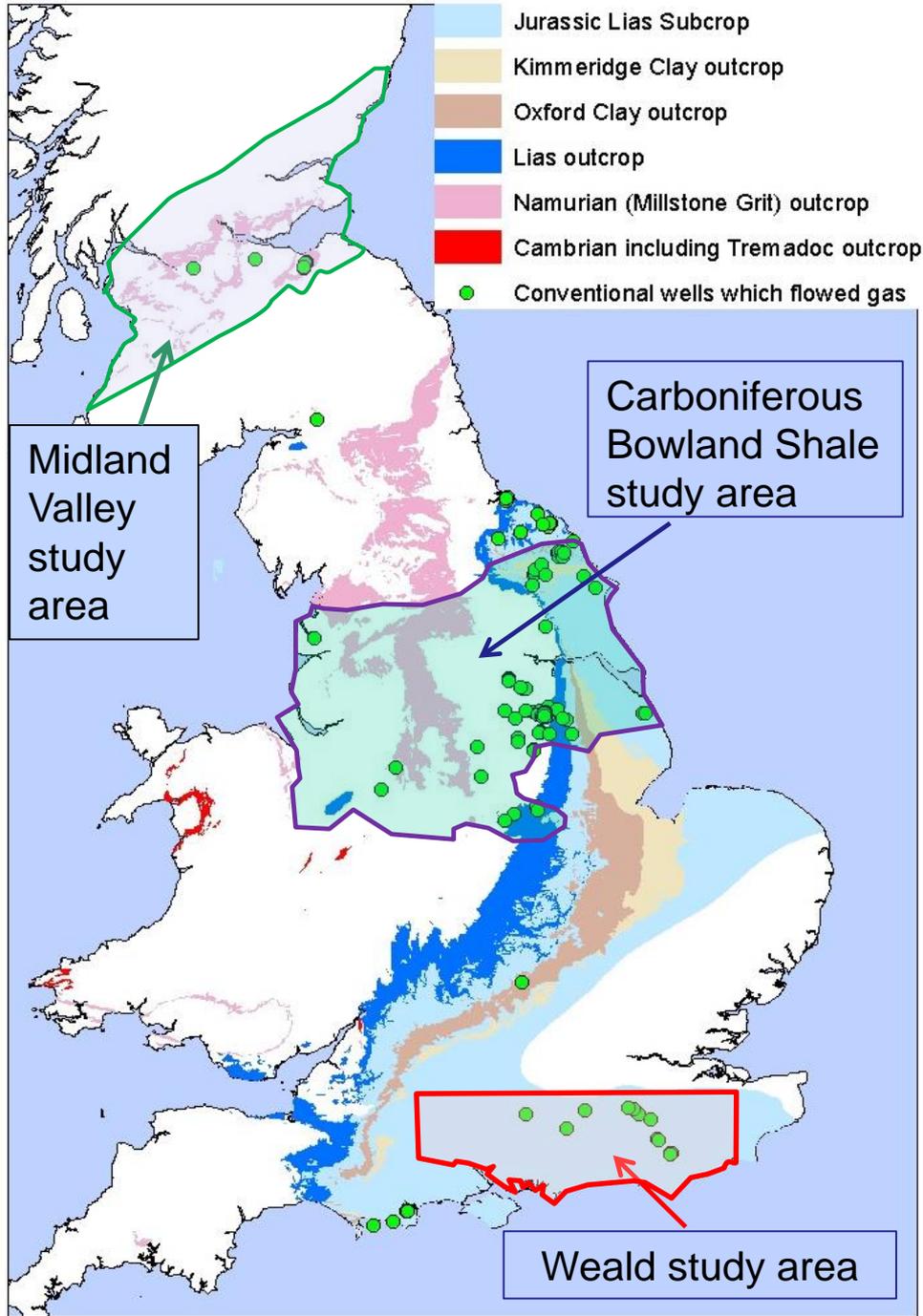
Gateway to the Earth

Monitoring the impacts of “fracking”

Rob Ward
Director of Science
British Geological Survey



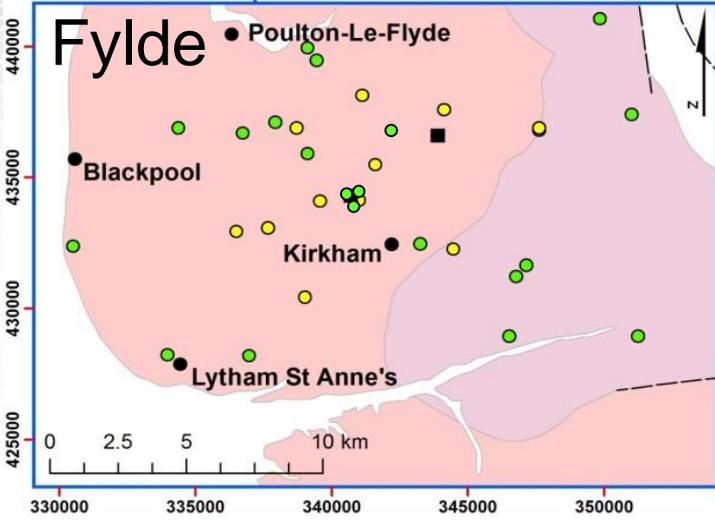
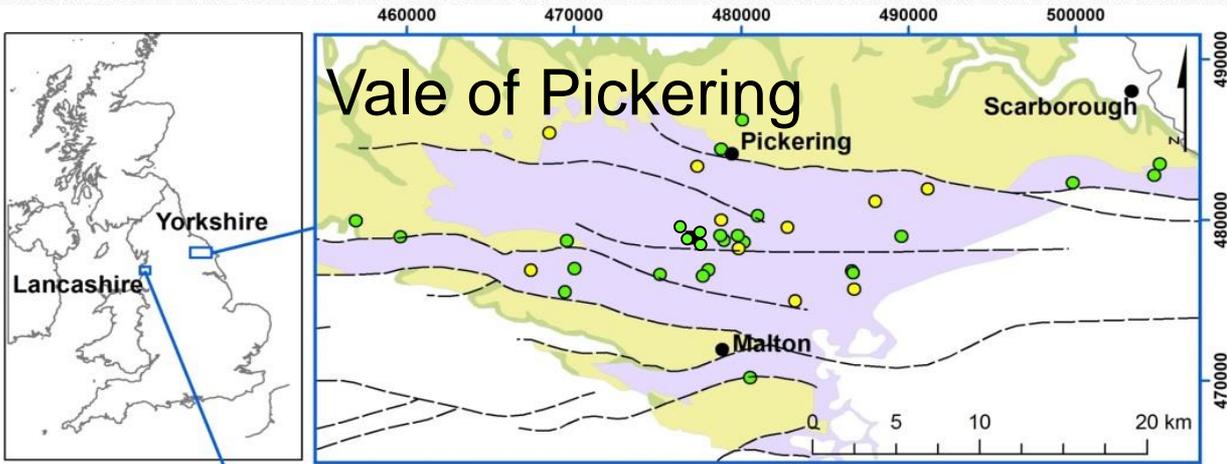
Shale gas potential in the UK



Environmental monitoring

- National, regional and local surveys/programmes
- Integrated environmental monitoring:
 - Water, air, seismicity, ground motion, soil gas and radon
- To provide high quality (spatial and temporal) data to:
 - Inform public, industry, regulators of environmental baselines, their natural variability and change
 - Assist in shaping regulatory monitoring and good practice
 - Improve understanding of sub-surface in the context of shale gas (avoid issues encountered in North America)
 - Test/research new monitoring technology/sensors
 - Detect environmental change arising from industrial activities

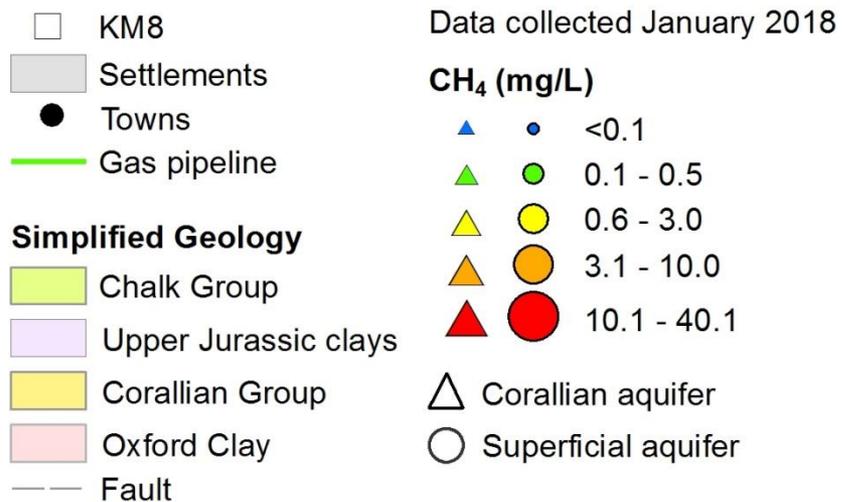
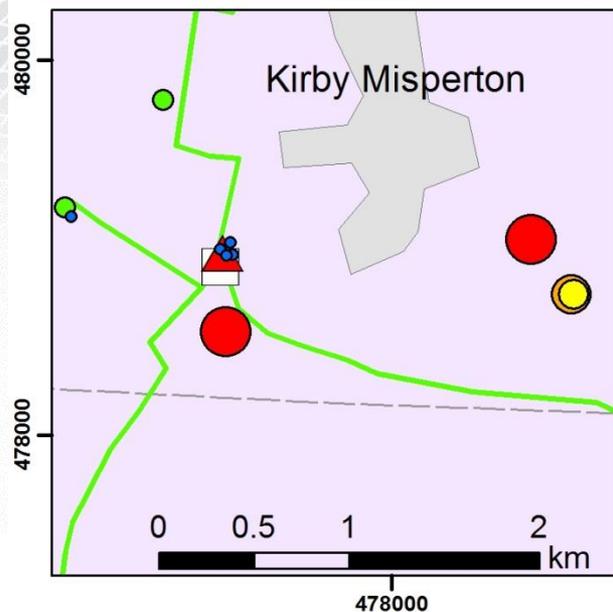
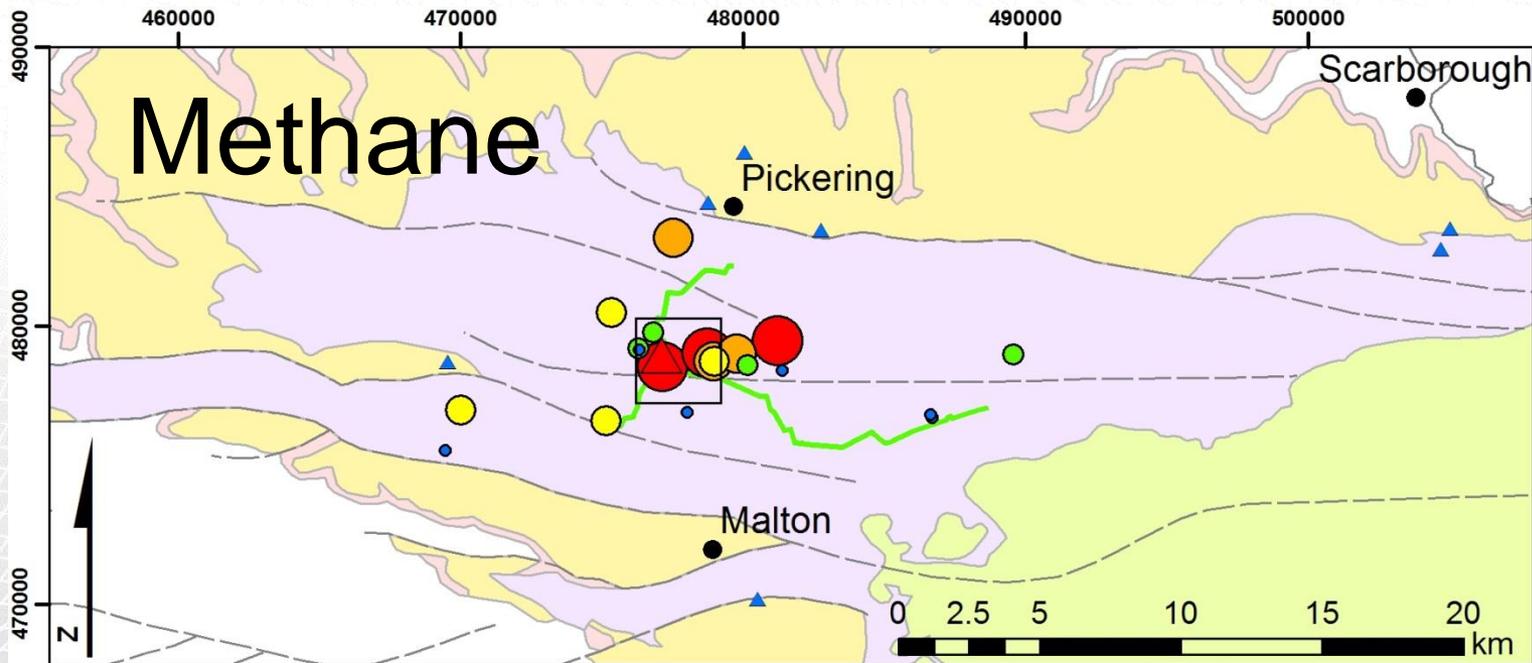
Water quality monitoring



- Potential fracking sites
- Sample Sites**
 - Groundwater
 - Surface Water
- Geology**
 - Corallian Group
 - Amphill Clay and Kimmeridge Clay formations
 - Oxford Clay Formation
 - Mercia Mudstone Group
 - Sherwood Sandstone Group
 - Fault

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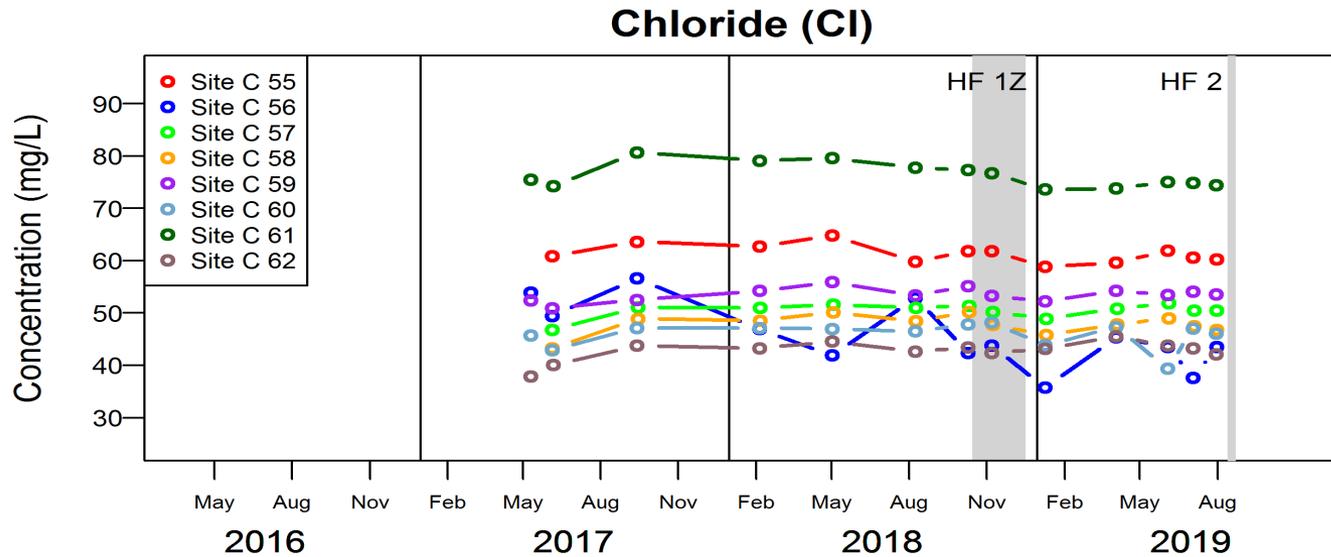
- Existing/new boreholes
- Sampling/analysis
 - (* Surface waters)
 - Unstable parameters (pH*, EC*, dissolved O₂, T*, redox)
 - Inorganic/organic chemistry*
 - Dissolved gases (incl. CH₄, CO₂, Rn, noble gases)
 - Stable isotopes (δ¹⁸O, δ²H, δ¹³C DIC/CH₄)
 - Radium



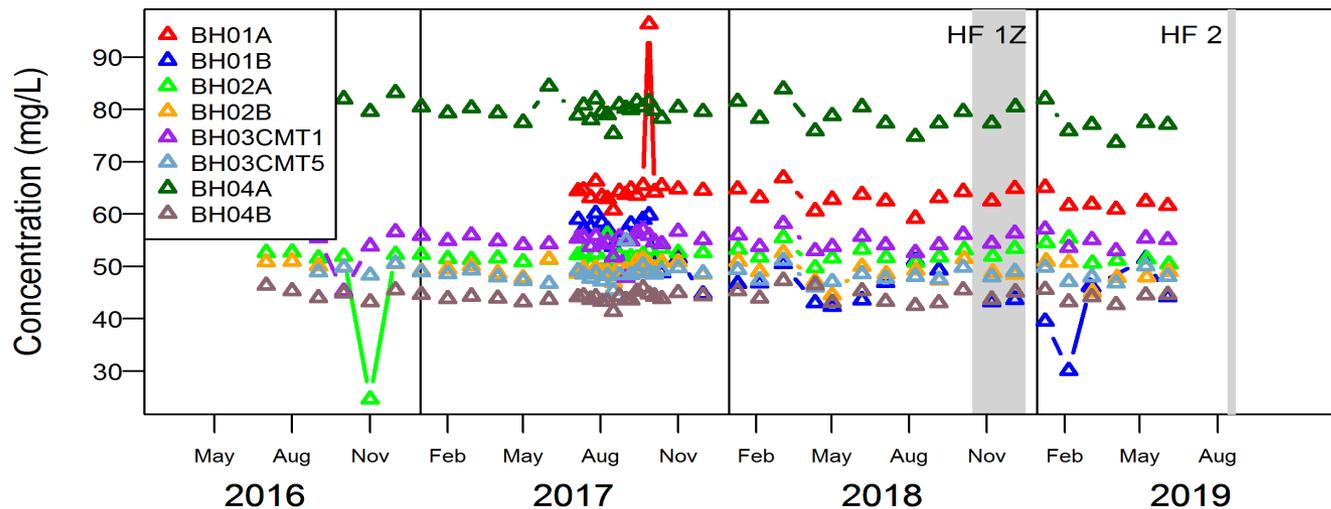
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Shale gas site – groundwater

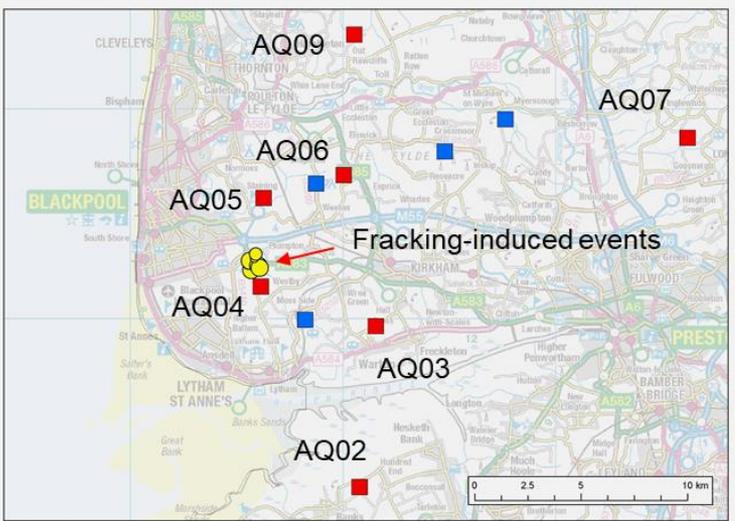
BGS
data



Cuadrilla
data



Seismic monitoring – Fylde, Lancashire



British Geological Survey
NATURAL SCIENCE ENVIRONMENT RESEARCH COUNCIL

Home > Research > Seismicity of Preston New Road, October 2018

Environmental Monitoring

Seismicity at Preston New Road, October 2018

Since hydraulic fracturing operations started at Preston New Road, near Blackpool, some earthquakes have been detected close to the area of operations. Details of these events can be found here.

BGS has deployed additional surface seismic sensors across the north of England to help provide an independent assessment of both the baseline levels of natural earthquake activity and any induced seismicity. This dense network of sensors allows us to detect smaller earthquakes than we are typically able to do in other parts of the UK. The data from this network is openly available and all the seismic activity that we detect will be published on our web site.

The Oil and Gas Authority (OGA) has strict controls in place to ensure that operators manage the risk of induced seismicity. Details of which can be found here. This includes a requirement for operators to undertake detailed geological studies, and submit a Hydraulic Fracture Plan (HFP) setting out how they will control and monitor the fracturing process and assess the risk of induced seismicity.

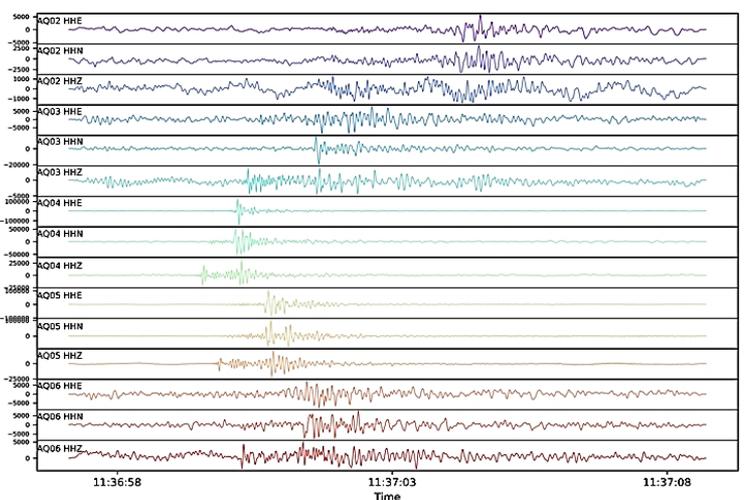
BGS is not a regulatory body. Our role is to provide impartial data that is available for everyone to view and analyse. Current regulations require operators to stop hydraulic fracturing if an event with a magnitude of 2.5 ML or above occurs during operations. It is the responsibility of the operators themselves, not BGS, to carry out real-time seismic monitoring in order to comply with Traffic Light regulations and any decision to stop will be based on the information provided by operators rather than by BGS.

Our seismic monitoring provides an impartial source of earthquake data and calculated earthquake magnitude and location. A list of events in the last 100 days can be found on our Recent Events page. Data from our stations are viewable on the Real Time Seismograms page of our website. Magnitudes are local magnitude (ML) and are calculated to one decimal place, as is standard practice in earthquake seismology.

Permanent (blue triangles) and temporary monitoring stations (green triangles) in the North of England

NERC SCIENCE OF THE ENVIRONMENT
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Ground motions recorded on nearby stations for the magnitude 0.8 ML event on 26 October



Earthquakes around the British Isles in the last 100 days

Last updated: Tue, 08 Jan 2019 10:40:01 (UTC)

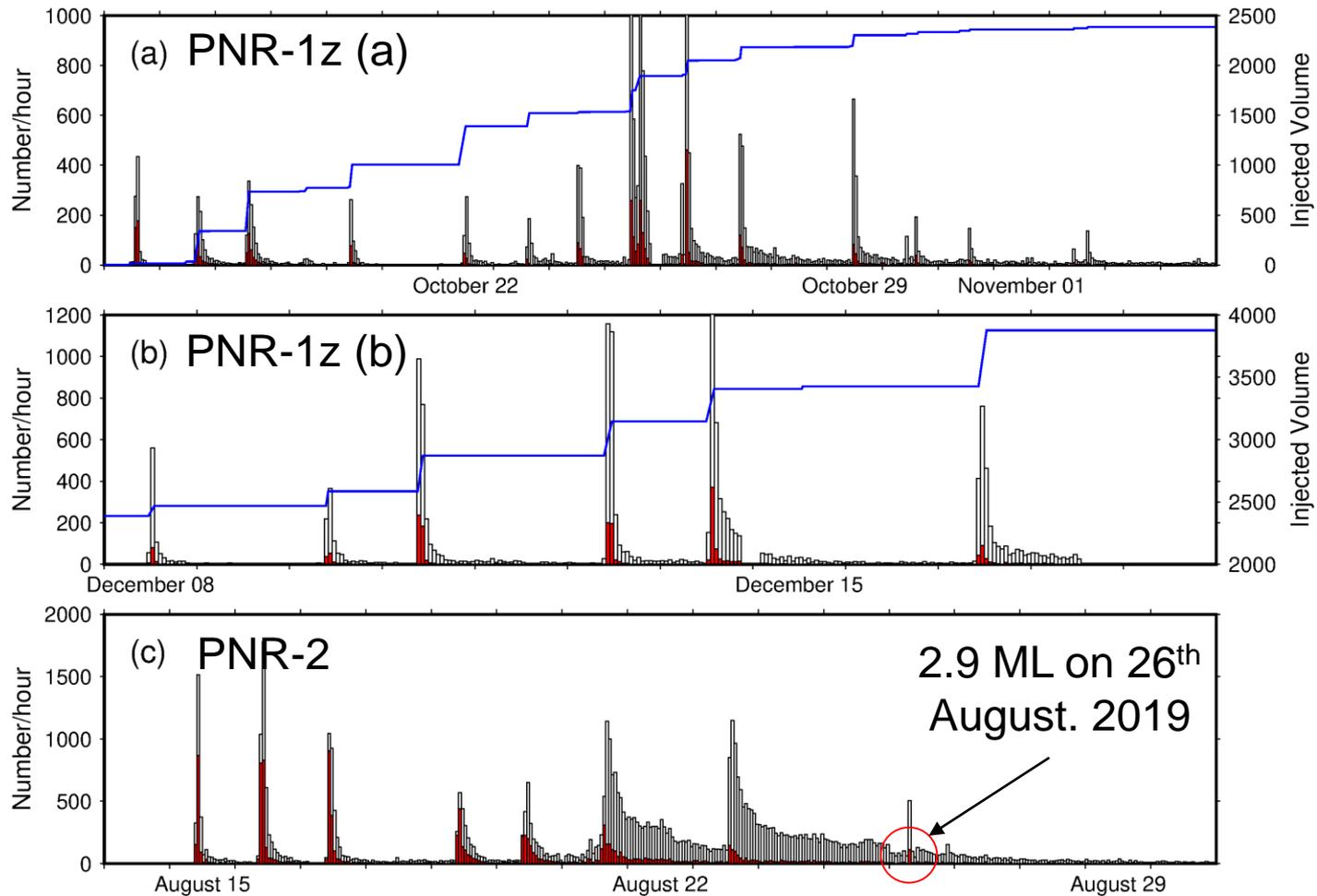
This list is linked to a database that contains information about all the seismic events that we detect and locate. Locations and magnitudes may change as events are re-analysed and revised.

Depths are rounded to the nearest km and all events shallower than 1 km are listed as 1 km. Magnitudes are local magnitude (ML) and are calculated to one decimal place, as is standard practice in earthquake seismology.

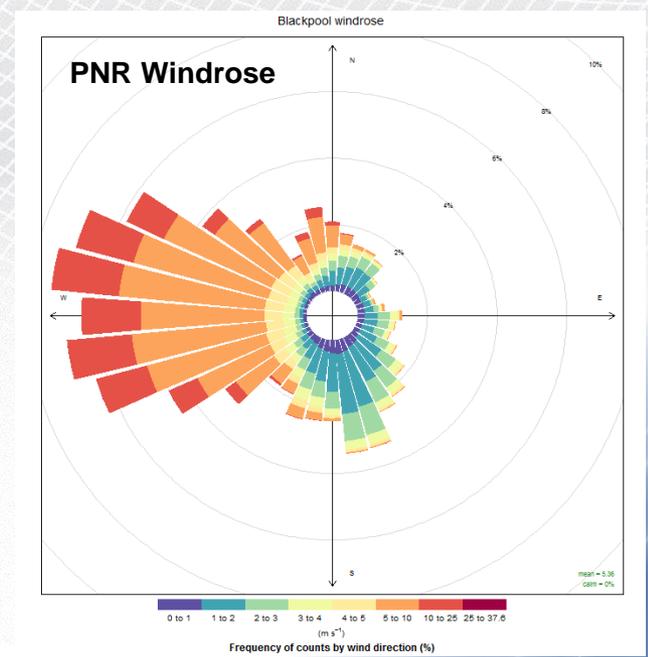
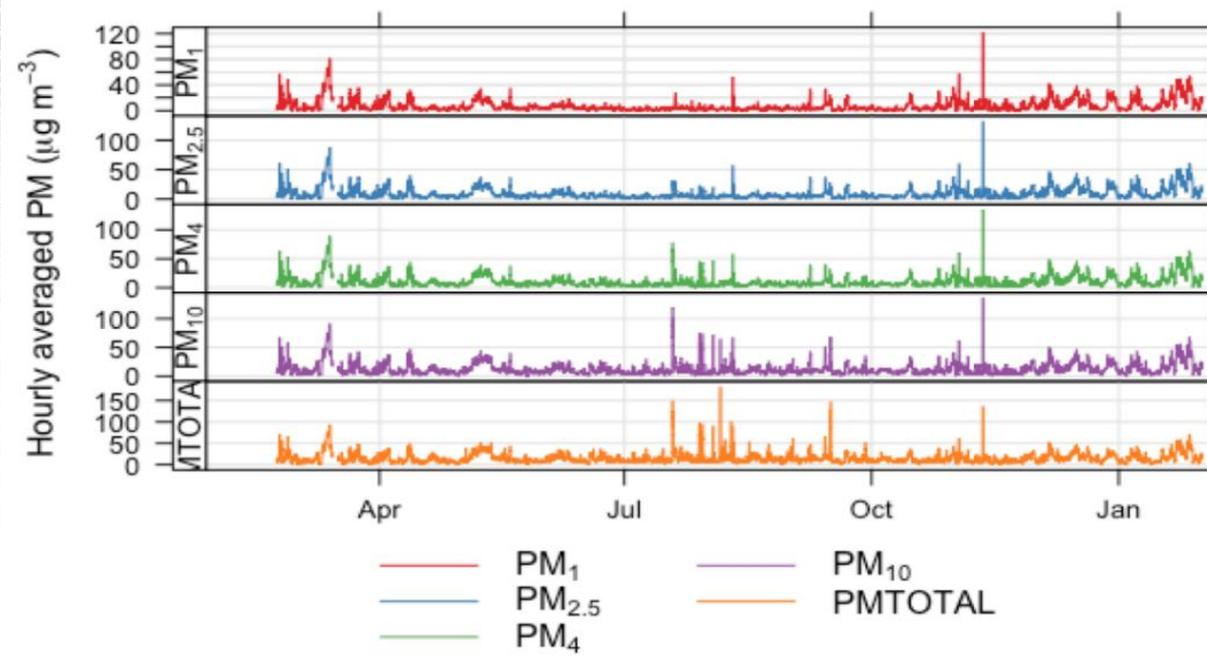
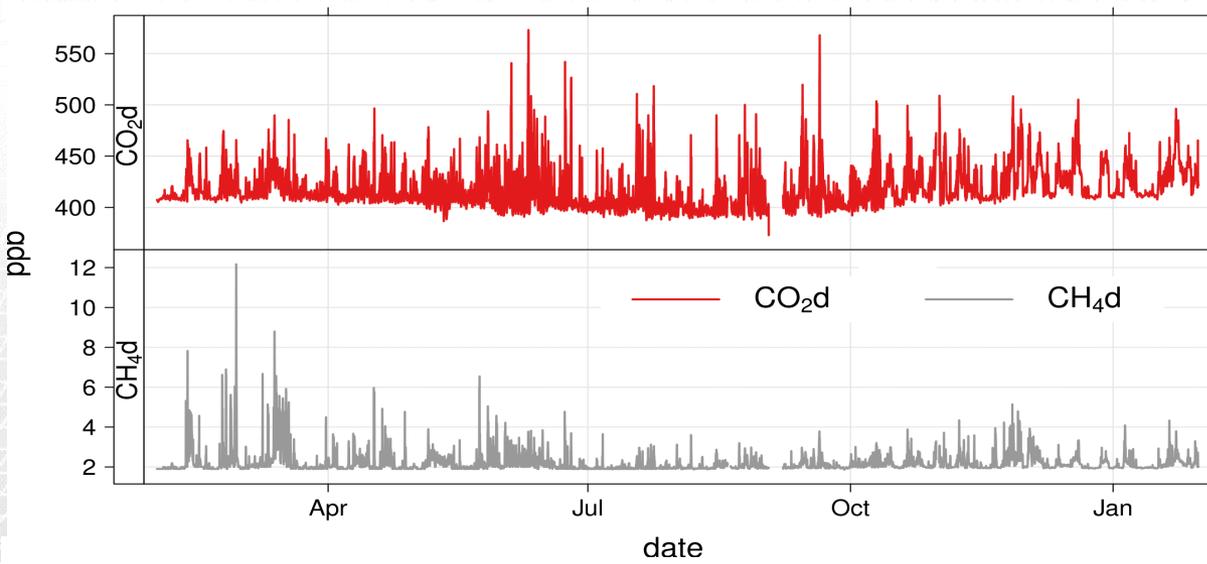
Date	Time (UTC)	Lat	Lon	Depth (km)	Mag	Int	Region	Comment
2019/01/06	22:09:46.3	51.272	-2.959	9	1.7		RODE,SOMERSET	
2019/01/06	18:07:44.2	56.653	-6.256	8	1.4		MULL,ARGYLL & BUTE	
2019/01/03	02:20:54.0	56.584	-5.924	8	2.2	3	MORVEN,HIGHLAND	FELT DRIMMIN...
2019/01/02	23:44:07.1	51.492	-0.970	8	1.5	2	CAVERSHAM,READING	FELT READING
2019/01/01	01:18:31.1	52.412	-3.139	7	1.6		QUABBS,SHROPSHIRE	
2018/12/26	13:06:00.7	54.916	-1.369	1	1.6		SUNDERLAND,TYNE & WEAR	
2018/12/22	17:13:37.3	56.704	-5.886	7	0.7		LAGA,HIGHLAND	
2018/12/19	15:47:54.9	52.963	-4.389	20	1.0		LLEYN PENINSULA	
2018/12/16	20:23:00.0	52.947	-4.557	10	0.6		LLEYN PENINSULA	
2018/12/14	14:51:56.5	53.789	-2.961	2	0.1		BLACKPOOL,LANCASHIRE	
2018/12/14	13:41:05.5	53.789	-2.959	2	0.9		BLACKPOOL,LANCASHIRE	
2018/12/14	13:35:50.1	53.790	-2.963	1	-0.5		BLACKPOOL,LANCASHIRE	
2018/12/14	13:34:42.2	53.789	-2.962	1	-0.3		BLACKPOOL,LANCASHIRE	
2018/12/14	13:18:30.3	53.789	-2.962	1	-0.1		BLACKPOOL,LANCASHIRE	
2018/12/14	13:09:51.4	53.789	-2.960	1	0.1		BLACKPOOL,LANCASHIRE	
2018/12/14	13:06:36.8	53.789	-2.962	1	-0.5		BLACKPOOL,LANCASHIRE	
2018/12/14	13:05:50.3	53.789	-2.963	1	-0.6		BLACKPOOL,LANCASHIRE	
2018/12/14	13:06:05.3	53.789	-2.962	1	-0.2		BLACKPOOL,LANCASHIRE	
2018/12/13	13:25:16.7	53.789	-2.961	2	0.0		BLACKPOOL,LANCASHIRE	
2018/12/12	16:45:46.7	51.924	-4.447	6	1.4		PEN-Y-BONT,CARMARTHNS	



Induced seismicity at PNR

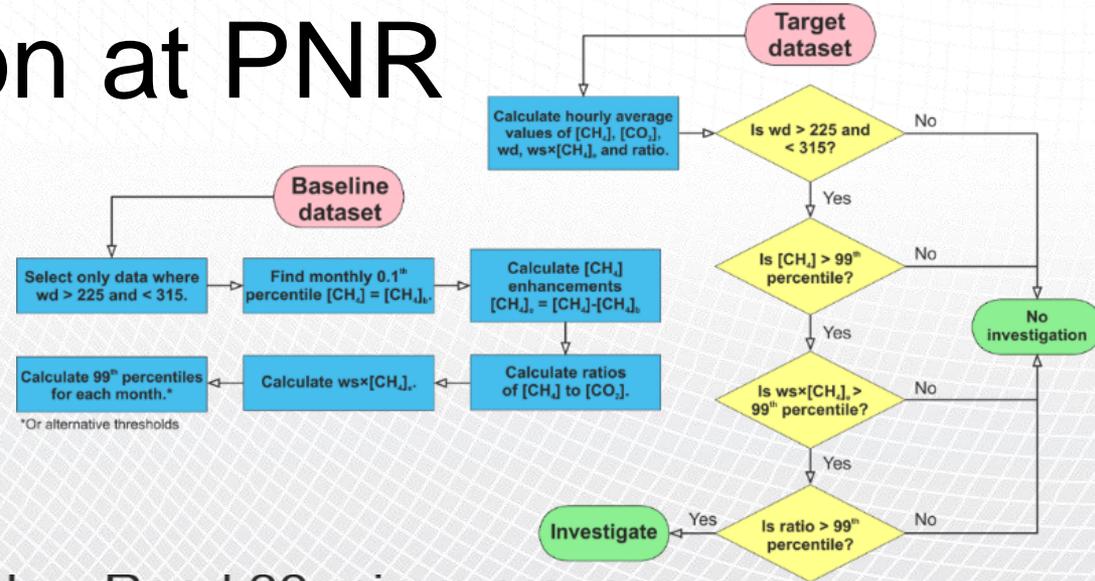


Atmospheric composition at PNR

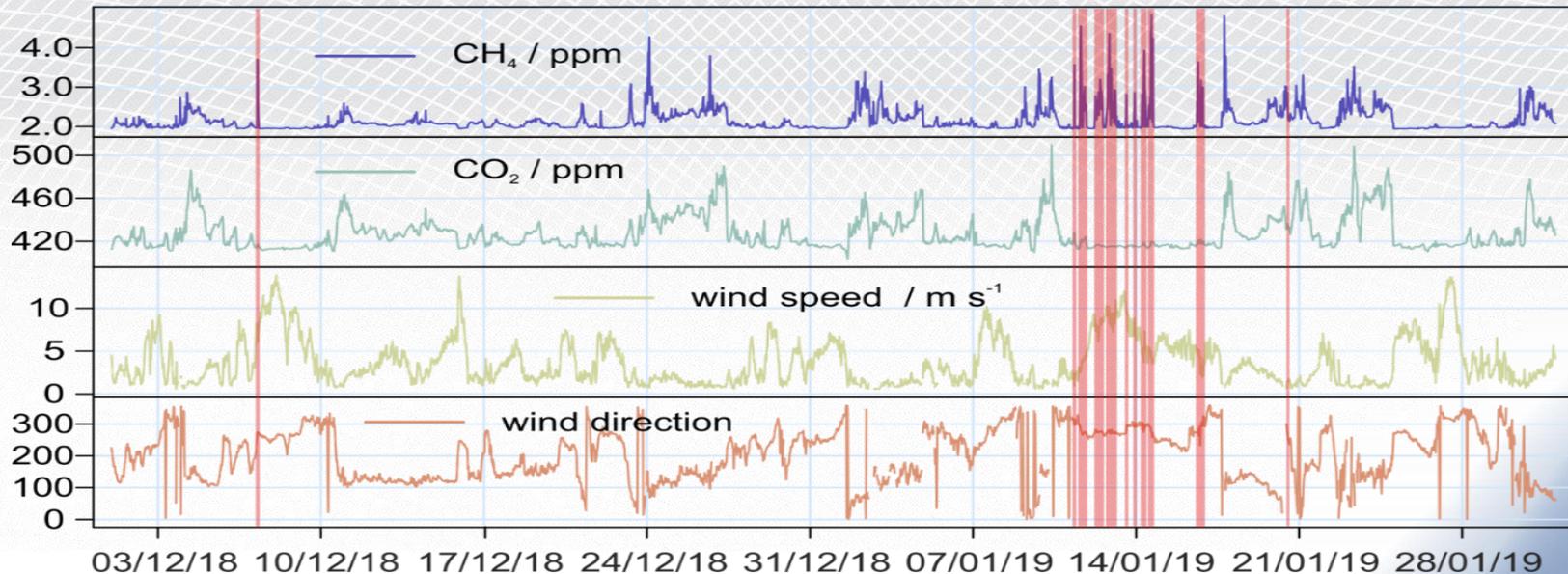


Change detection at PNR

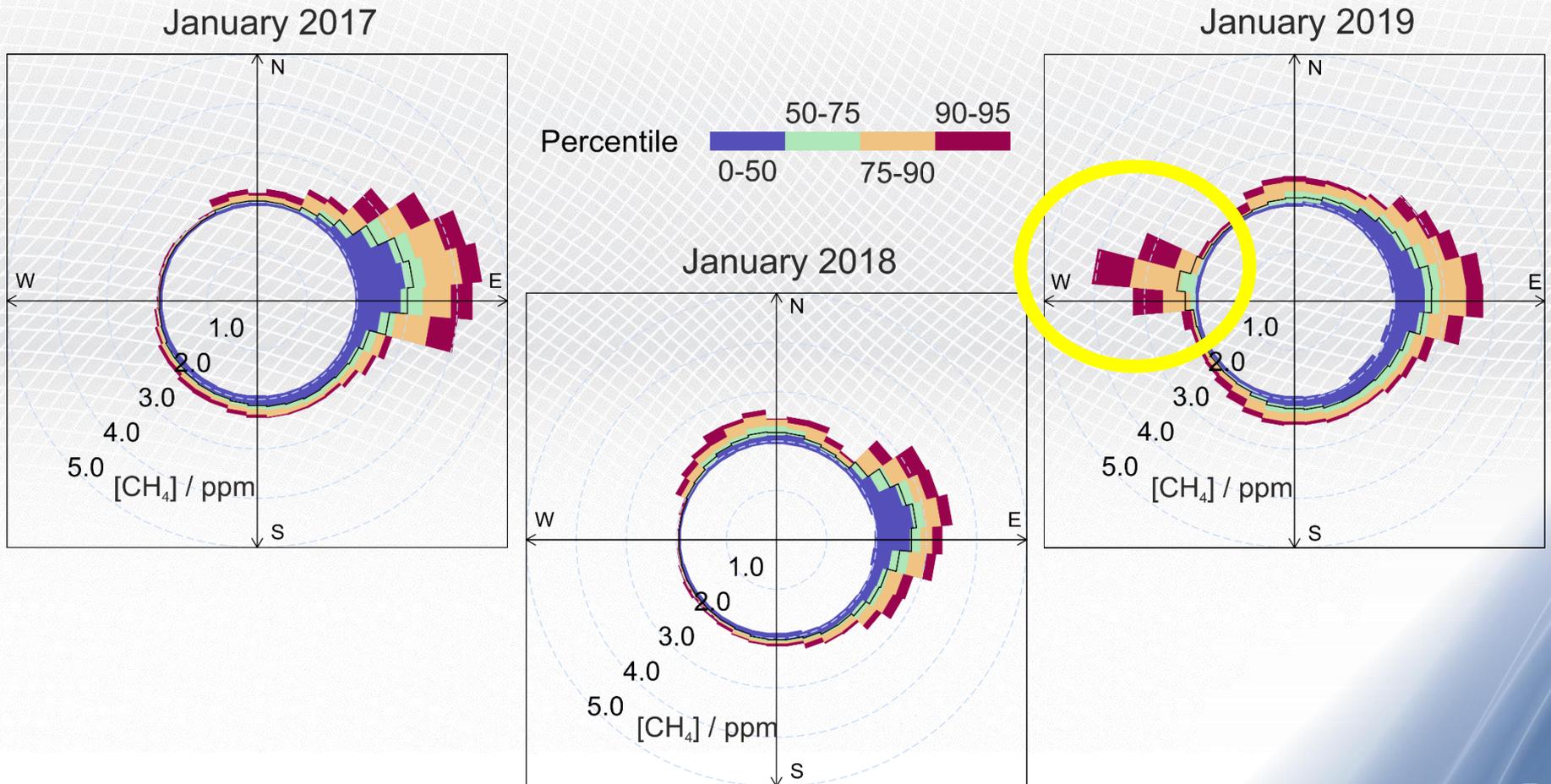
- Enhanced CH₄ due to N₂ lift and release to atmosphere
- Max CH₄ 12.8 ppm



Preston New Road 30-min averages

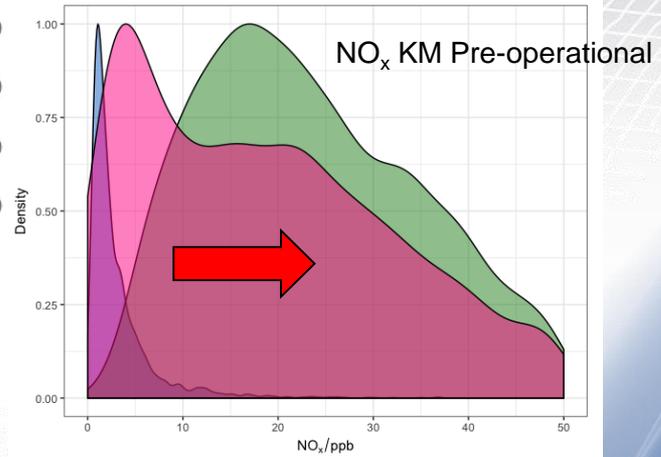
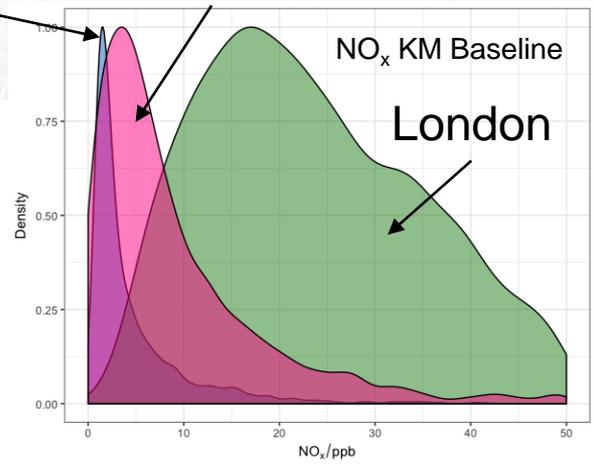
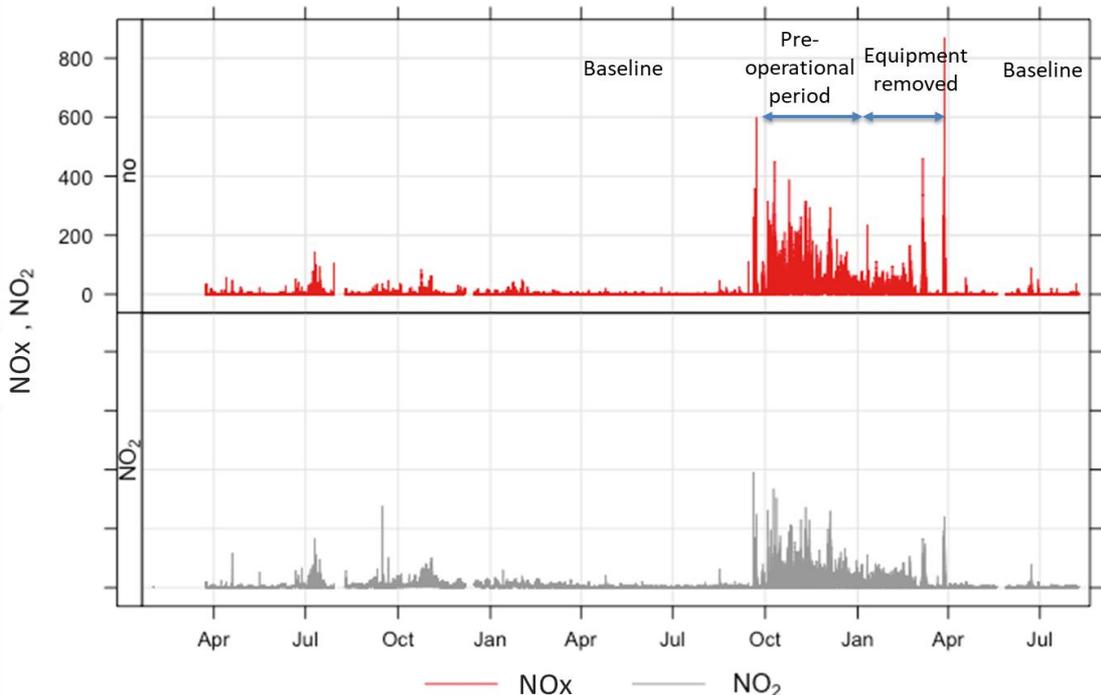


CH₄ correlated with wind direction



Change in air quality at KM8

High Muffles KM8



High Muffles = Rural Background
London = Urban Background

Community engagement

- Web portals: www.bgs.ac.uk/valeofpickering and www.bgs.ac.uk/lancashire
- Real-time data display and reports
- Drop-in events



- Videos, interviews and monitoring guides: www.youtube.com/playlist?list=PLxpcCdkdwTWB5nJlzPedcht_-zjHA6O-7

Meeting evidence needs?

- Public re-assurance
- Development of best practice (industry/regulators)
- Legislation and Policy: Infrastructure Act and the Moratorium
- Robust baseline as basis for change detection
- Enforcement action
- Short- and long-term risk assessment/management
- Research

Thank you



More information at:
www.bgs.ac.uk/valeofpickering
www.bgs.ac.uk/lancashire

