Agenda

- Introduction: Jake Backus, Empathy Sustainability
- Competency Group: Kayla Schulte, Oxford University / Leverhume Centre
- Technology & outputs: Tony Bush, Apertum Ltd
- Q&A

Oxford Mobile Air Quality Measurement, Modelling & Mapping

A broad coalition of air quality experts, academics and actors

Objective:

- Develop human level data –cycling, walking (adult/child) versus driving & public transport

- Map the city spatially and temporally (using GPS and time of day etc.)

- Understand resident's attitudes to air quality and priorities

Purpose

- Inform policy & planning, and understand resident's daily exposure

- Tool to measure air quality measures and cost benefit analysis

- Support behaviour change and give localised advice

- Support best practice, as well as citizen science and community engagement

- Get broad city-wide data and compare versus static city sensors (in limited places) to generate human level exposure

Additional project outputs:

- Add to the evidence for human level exposure to air pollutants and available data

- Advance small, portable, affordable sensor reliability and use

- Advance visualisation for impact research

- Connect with schools and citizen science

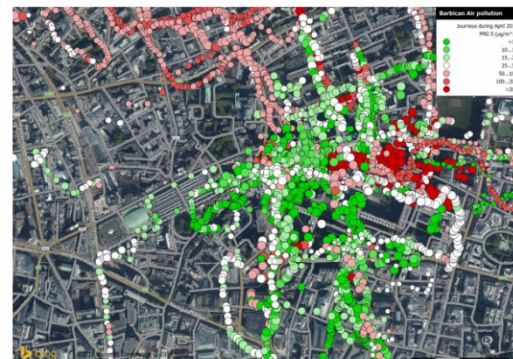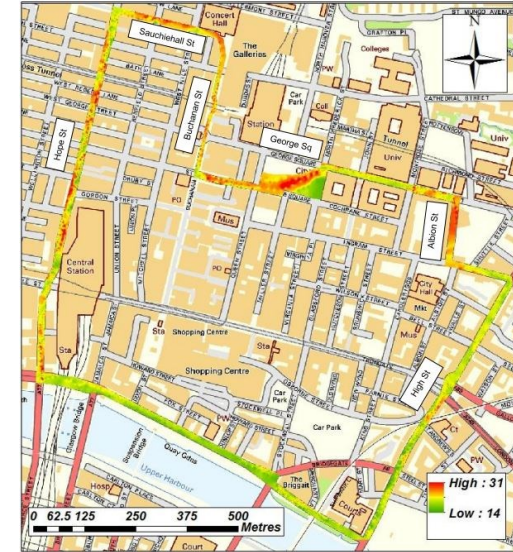- Create a replicatable model which other groups and cities can use

Figure 21: PM₂.₅ measurements taken on all journeys in April 2014; 17 monitoring days (1st-30th), comprising 32 journeys by 8 individuals.

Steering Group

Oxford City Council — Project oversight, monitoring and governance

empathy sustain ability — Project management, stakeholder engagement, schools liaison, data collection

apertum — Data analysis, processes & protocols, equipment modification and housing, user training, data visualisation

Ricardo — AQ measurements, sensor categorisation, OEM liaison and LAQM expertise

University of Oxford — Social research, user competency group and needs assessment, support for what & where to measure

University of Birmingham — Social research, user competency group and needs assessment, support for what & where to measure
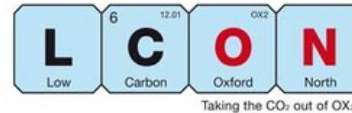
Collaborating partners

Oxford bus company — Mapping the city by bus

OXWASH — Mapping the city by bicycle

Environmental Sustainability at Oxford — Mapping the city by electric van / bicycle (OU postal service)

LCON (Low Carbon Oxford North) — Testing EDT sensors for community use

Oxford Pedestrians Association — Mapping the city on foot

Oxfordshire County Council — Schools WOW programme

First schools & locations

Sensor	Location
3001	Pegasus Primary School
3061	Cherwell School "playground"
3073	Cutteslow roundabout
3073	Wolvercote roundabout
3073	Dragon School
3074	Church Cowley St James CofE Primary School
3075	Walton Street, Mind Shop
3075	JR Hospital entrance
3076	Cheney School
3078	Larkrise Primary School
3078	Divinity Road
3084	Cutteslowe Primary School walk way
3084	Cutteslowe Primary School ring road
3084	Cutteslowe Primary School front
3084	Cutteslowe Primary School Wolsey Road
3089	St Francis CofE primary school
3096	Windmill Primary School
3098	Wolvercote Primary School

Network

SMART OXFORD THE LEARNING CITY

#clean air

Friends of the Earth

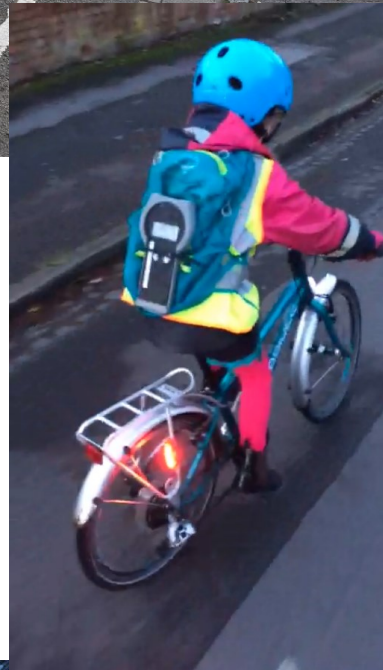**ClientEarth** — Botley Air Action / Network for clean air Citizen science
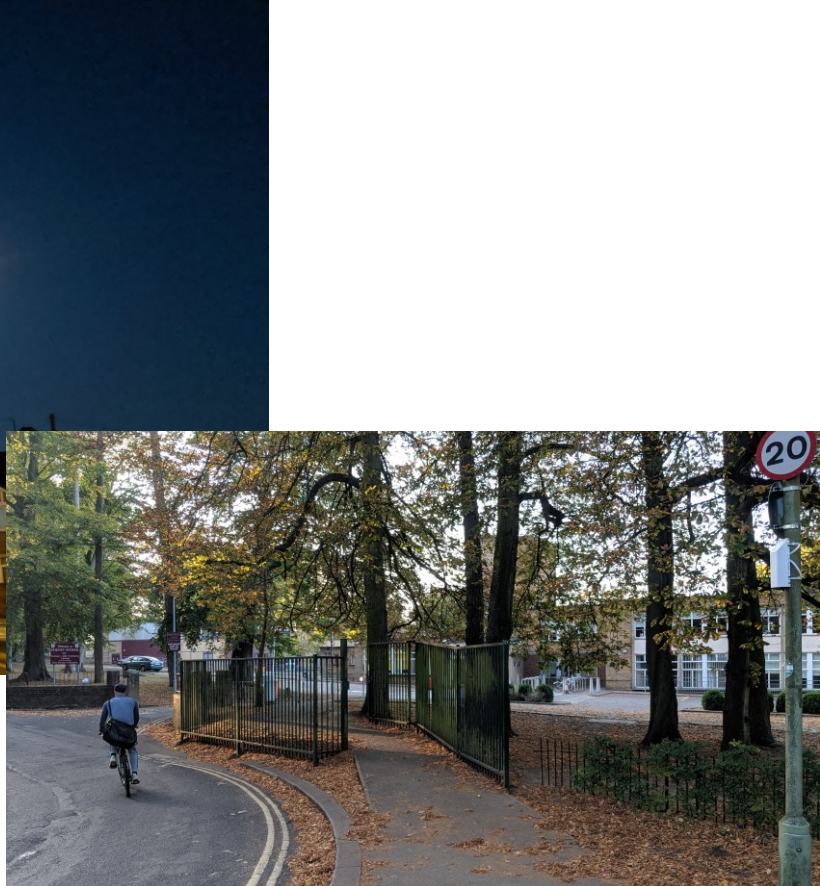
Competency Group Methodology

INSPIRATION

- Whatmore model – flooding in Pickering[1,2]

- Redefine expertise, stimulate collective knowledge production

- Resulted in a tangible solution (bund) – but the truly innovative product was a new mechanism for env. governance

IMPLEMENTATION

8 residents, 3 technical specialists, 3 social scientists

Five, 3-hour thematic sessions:

1. Experience mapping & problem formulation

2. Discussion on technical instrumentation, discussion of health science

3. Residents carry OxAir kit for ~24 hours, keep diary, take photos, supply context & 'lived experience'

4. Discussion of air quality management in practice

5. Participant-led presentations & exhibitions

RESULTS

- Overlapping zones of AQ monitoring interest

- Convergent & divergent areas of AQ management interest

- More to come!

1. Whatmore, S.J. and Landström, C., 2011. Flood apprentices: an exercise in making things public. Economy and society, 40(4), pp.582-610
2. Stopping floods on the cheap: a success story from Yorkshire (https://www.youtube.com/watch?v=Oh5sjqnTfBO)

Sensor devices

- A prototype portable sensing device

- Alphasense electronic diffusion tubes

- High temporal resolution measurements of nitrogen dioxide, particles, temperature & humidity

- Mobile devices GPS enabled

South Coast

Alphasense
THE SENSOR TECHNOLOGY COMPANY

Sensing tech

Using credible sensors was a must have. Our devices use sensors found in 'e*very*' mainstream, credible sensor system available today (AQMesh, Vaisala, Aeroqual, Bosch, Earth Sense etc.)

Nitrogen dioxide

- Alphasense NO2A43F sensor

- Common across many UK sensor systems, well regarded

Particles

- Alphasense OPC-R1

- Little brother to popular & well regarded Alphasense N2 & N3 systems
- Particle number size bin extrema 0.4-10μm, (configurable)

Noteworthy sensor peripherals

On device

- Raspberry Pi Zero W controller
- GPS
- Low power e-Ink display
- Internal data logging
- Wifi connectivity
- 12-16 hour battery life
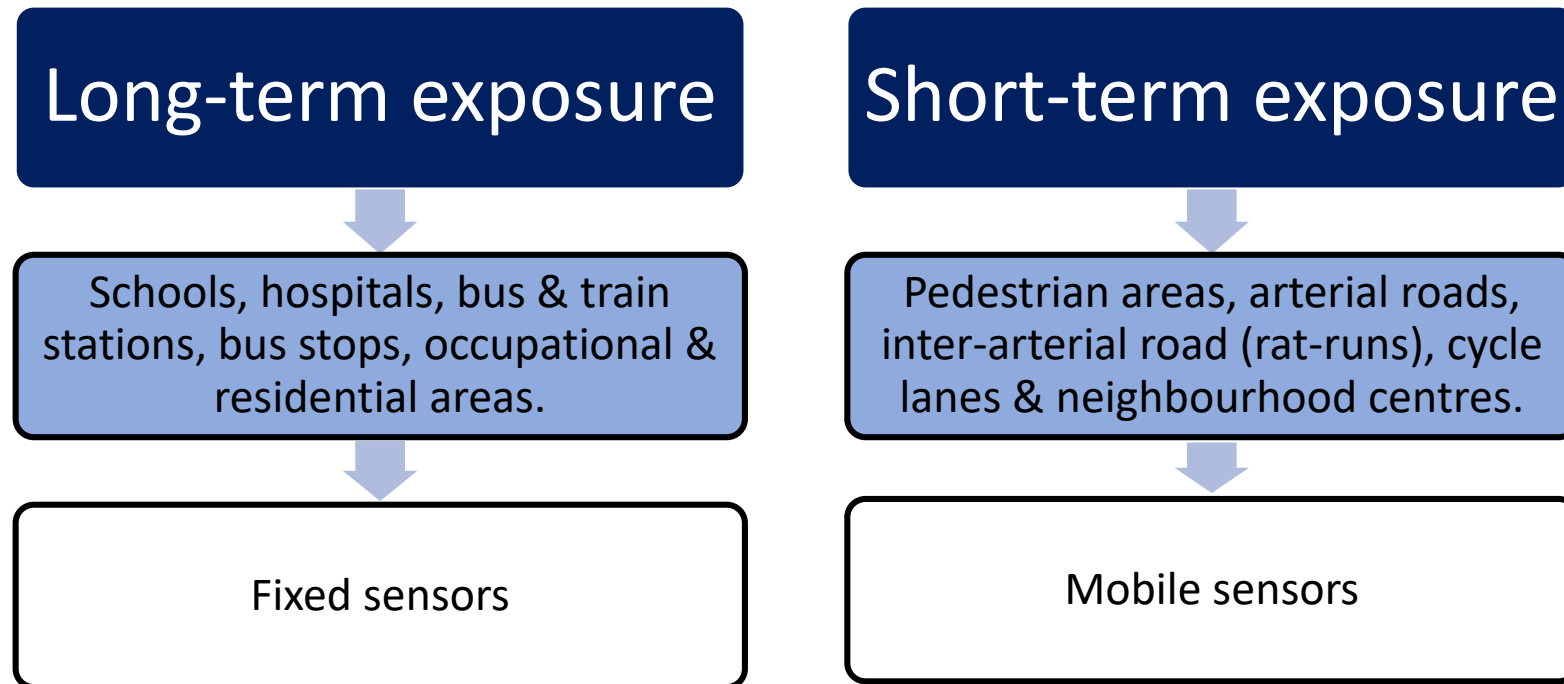- Micro USB charging

Open code base

- It's all on **GitHub**
  https://github.com/south-coast-science
- A significant asset for repeatable research & transparency
- Facilitates community understanding & building trust in sensor data
- Essential while we are still learning about sensor performance

Cloud data host

- Data published to AWS cloud via MQTT
- Remote control of sensor via MQTT & SSH
- Data dashboard diagnostics & device monitoring
- Data processing retrieval from AWS via Python

Multi-modal sampling protocol

- A mixed mode sampling protocol to broaden our understanding short & long-term exposures to NO_2 & PM

| Long-term exposure	Short-term exposure
Schools, hospitals, bus & train stations, bus stops, occupational & residential areas.	Pedestrian areas, arterial roads, inter-arterial road (rat-runs), cycle lanes & neighbourhood centres.
Fixed sensors	Mobile sensors

Expectations

- A spatio-temporal time series for the City of Oxford
- An improved evidence base to support LAQM delivery & holistic local policy design
- Public information for
  - Awareness, education & behavioural change
  - Local (neighbourhood) policies
  - Personal decision making to prevent exposures, emissions & reduce concentrations
- R&D in sensor performance & sensor signal processing
- A better understanding of the place of sensors in the AQ toolkit

Results to date 1 (interactive on the day)
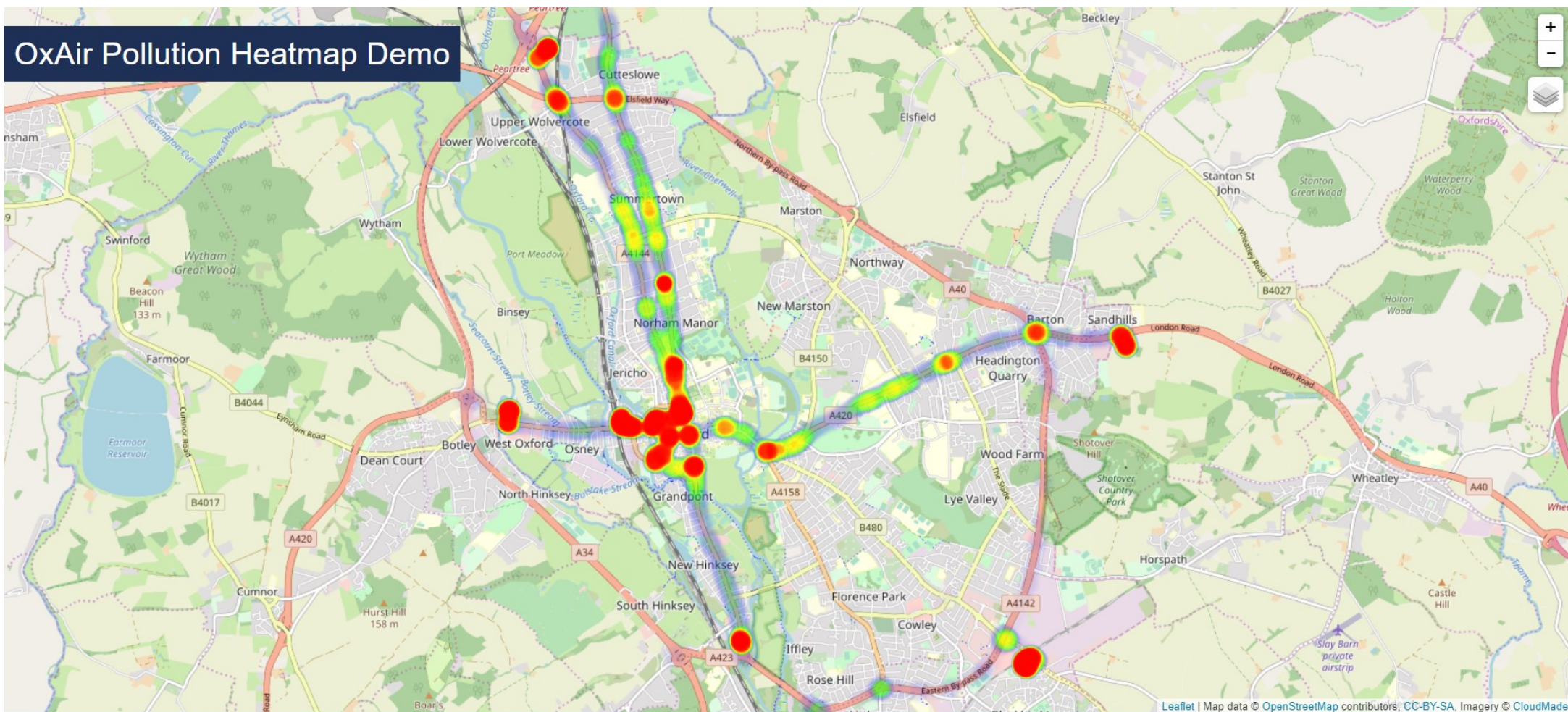
Results to date 2 (interactive on the day)

Particles timeseries from Praxis HH , early Dec 2019.
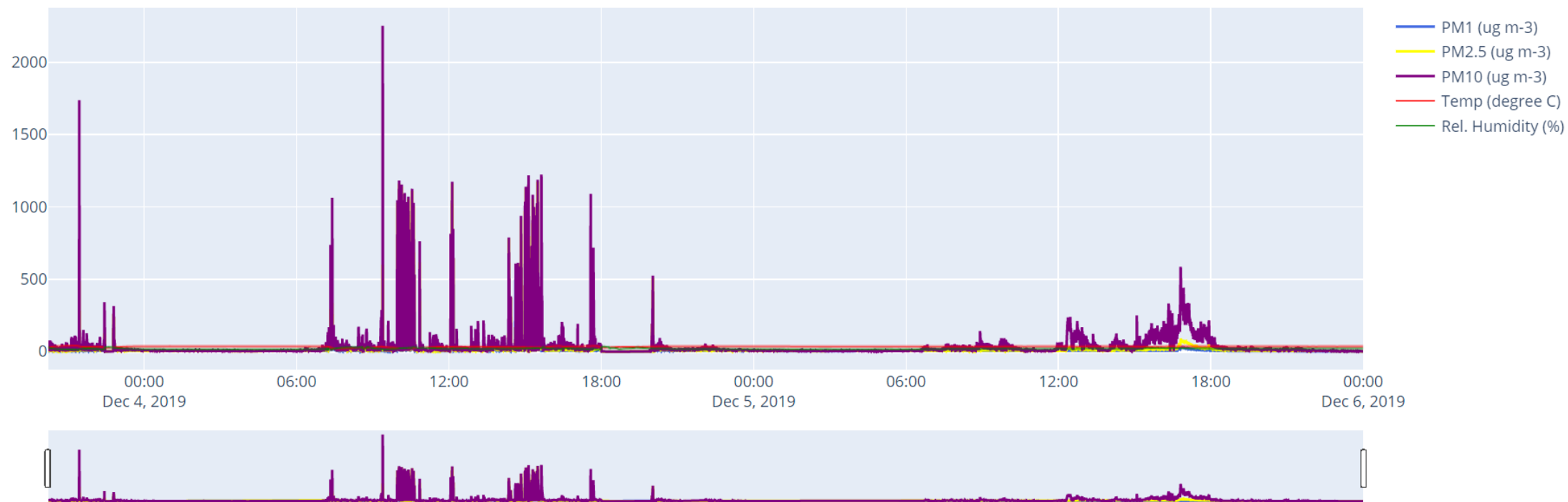
Questions & answers

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