**Ricardo
Energy & Environment**

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Air Quality Travel Planner for Welsh Cities

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Outline of Today's Presentation

- Introduction to the Air Quality Travel Planner Concept.

- Results of RapidAir Modelling.

- Portable Monitoring to Improve Model Validation.

- The prototype Air Quality in Wales "Wayfinder" website.

- Questions and Feedback.

# Why is there a need for a tool for AQ Route Planning?

- Local authorities are encouraging active travel, and walking to school.
- Sustrans, Living Streets initiatives promoting cycling and walking.
- High profile of poor air quality issues.
- Public health concerns.
- We should empower the public to make an informed choice.

Can we achieve the goal in a meaningful way?

- IT perspective – Yes - high resolution, fast modelling and web portal.
- Validated by reliable AQ data from the WAQDB and local sensors.
- Nationally accessible transport and fleet statistics.
- Good engagement with LAs, public and NGOs in Wales for promotion.
- But the outcome needs to be easily understood (prototype review/discussion!).
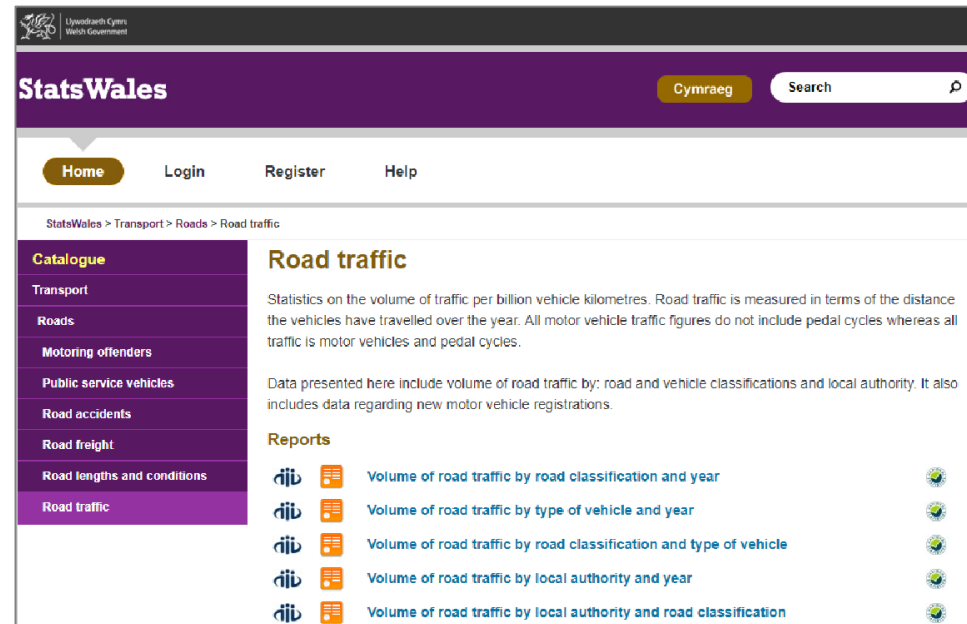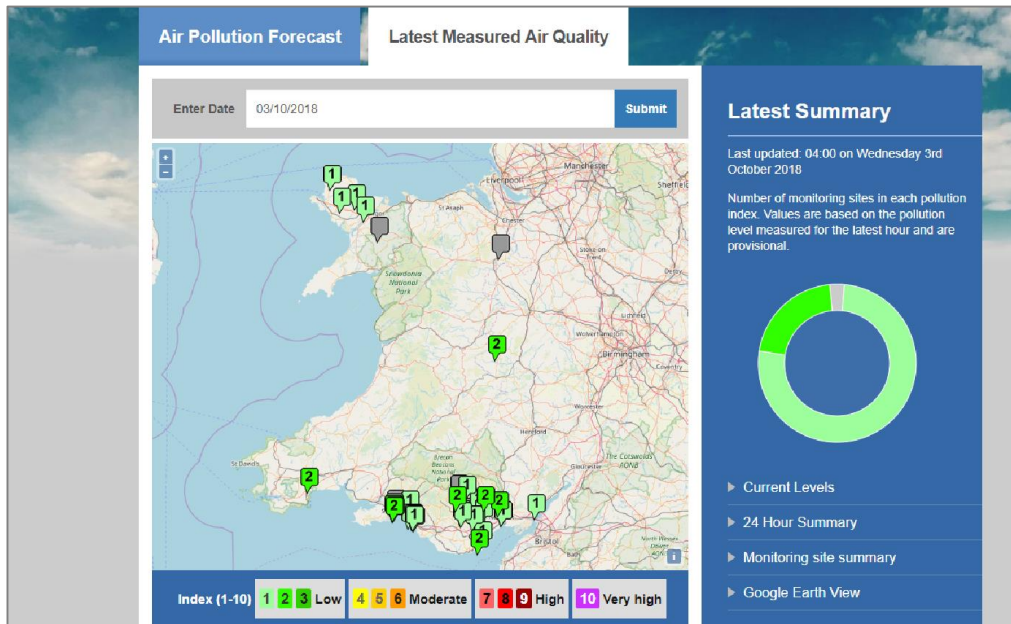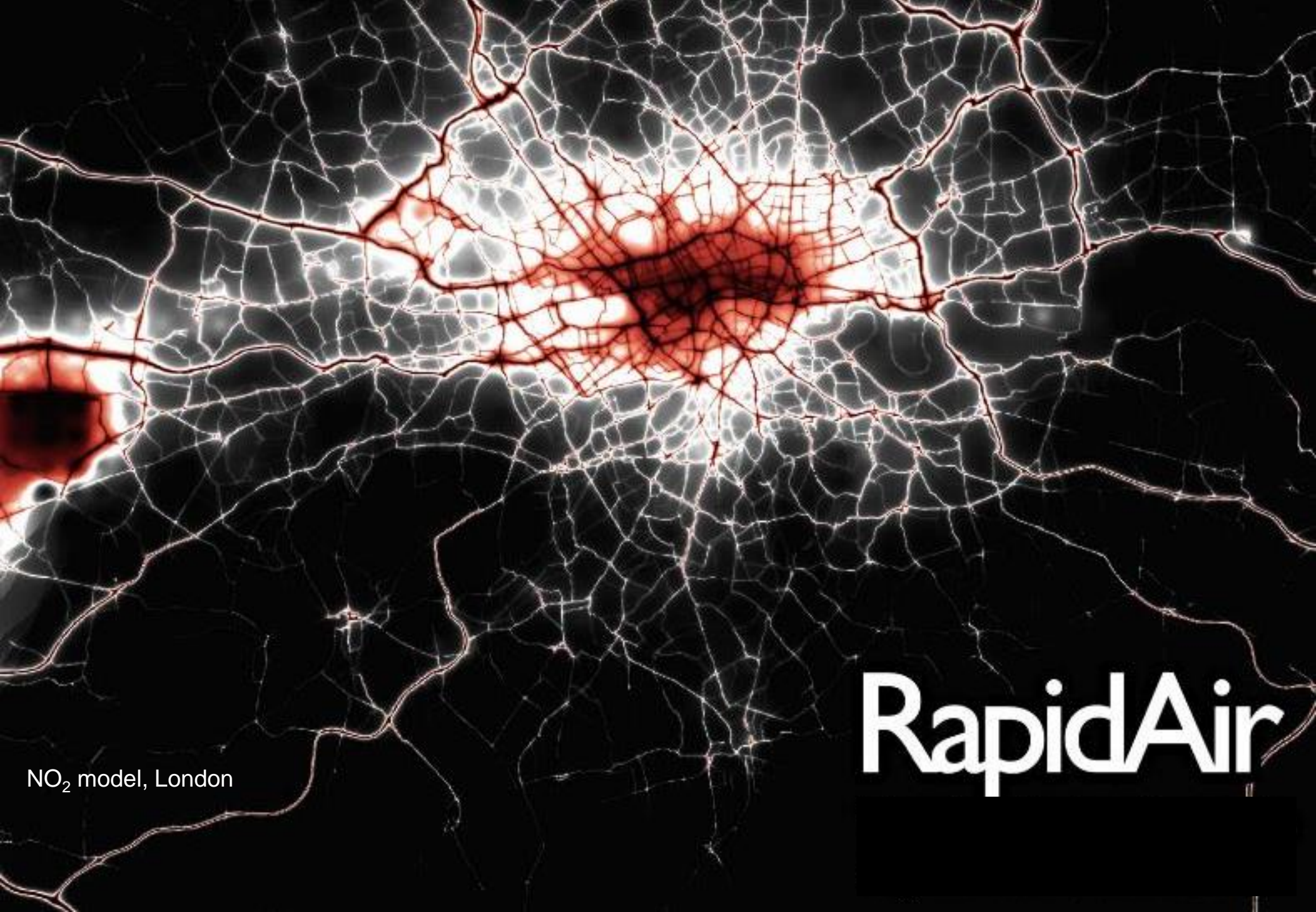
NO$_2$ model, London

RapidAir

# RapidAir is a modular air pollution modelling system for cities

- **RapidMet**- assimilation and processing of meteorological data from surface and upper air stations and running the AERMET model. Met data is processed in the USEPA code and passed to the Point and Road models. We have access to >30,000 meteorological stations around the world.

- **RapidPoint**- AERMOD based dispersion model for stationary sources controlled by custom Python programs. Set up by our experts based on emissions inventories for the city/region

- **RapidRoad**- Advanced convolution dispersion model utilising the latest scientific computing methods via custom Python code to run road traffic emissions simulations in seconds for entire cities and tens of thousands of road sources. Contains our proprietary version of the COPERT emissions model (with >240 vehicle types) for fast road traffic scenario testing. Example run time- London, 10 minutes.

- **RapidStat**- model validation system which compares predictions with pollution measurements and provides standard metrics of performance through a GUI. Links to OpenAir (which we author too)

- **RapidViz**- mapping of results with export functionality using common GIS formats for further processing in a desktop environment.
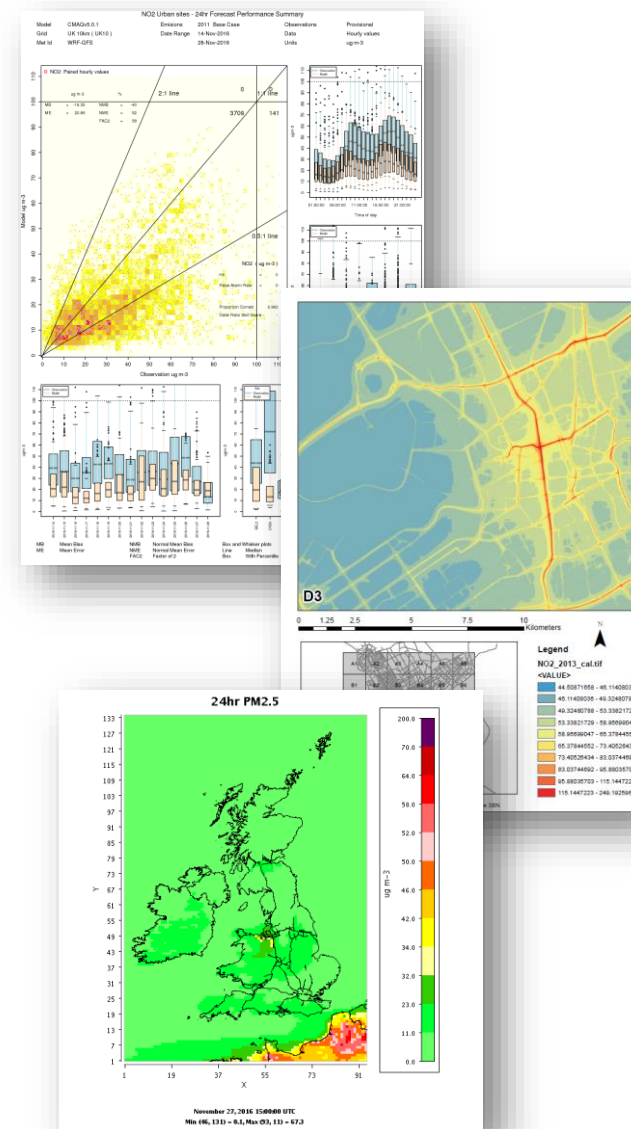
RapidAir conforms to international best practice

- The system has been used in Riyadh, Jinan, London and in supporting numerous other UK local authorities.

- The system utilises the **USEPA AERMET and AERMOD** modelling suites for both stationary and non-stationary sources at the city scale. If required we use either **CMAQ** or **WRF-Chem** for background

- The road traffic module follows guidance laid out by the **USEPA** in their **Hotspot Conformity** series- the statutory method for modelling road traffic sources in the US. We have coupled this to the latest **convolution modelling** methods to create lightning fast dispersion modelling functionality for road transport emissions.

- We combine the gridded outputs of the models that comprise RapidAir following international best practice. For example if a regional model background is required we zero out the emissions in CMAQ for sources we will model explicitly in the city. This avoids double counting.

- Model performance is judged based on well known metrics such as **Root Mean Square Error, Mean Bias, Index of Agreement and Coefficient of Efficiency**- we take model performance very seriously.

- We believe that sophisticated models must be supported by **compelling data visualisations** to encourage engagement by decision makers and the public.
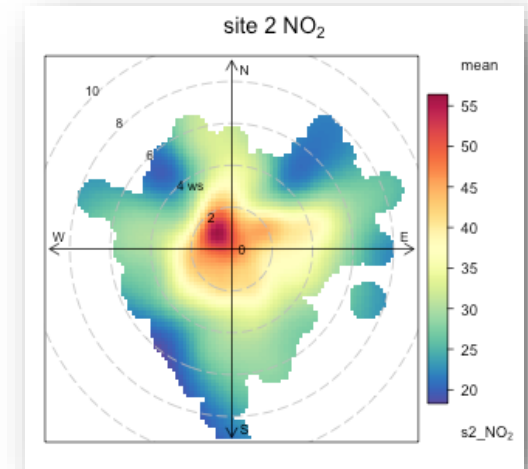
Swansea

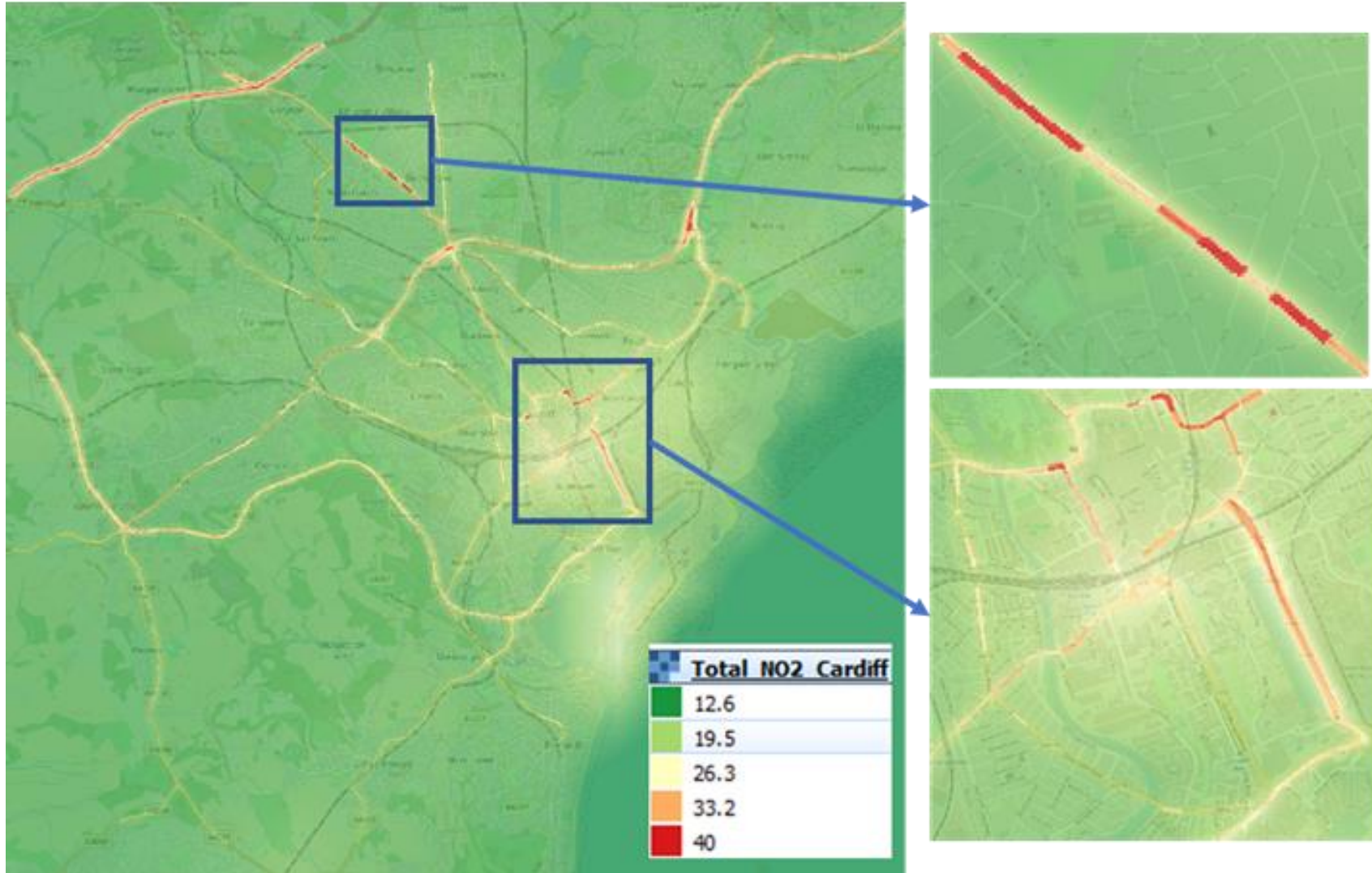- Zoomed hotspot areas are Sketty, and around the town centre.

Total_NO2_Swansea
	12.6
	19.5
	26.3
	33.2
	40
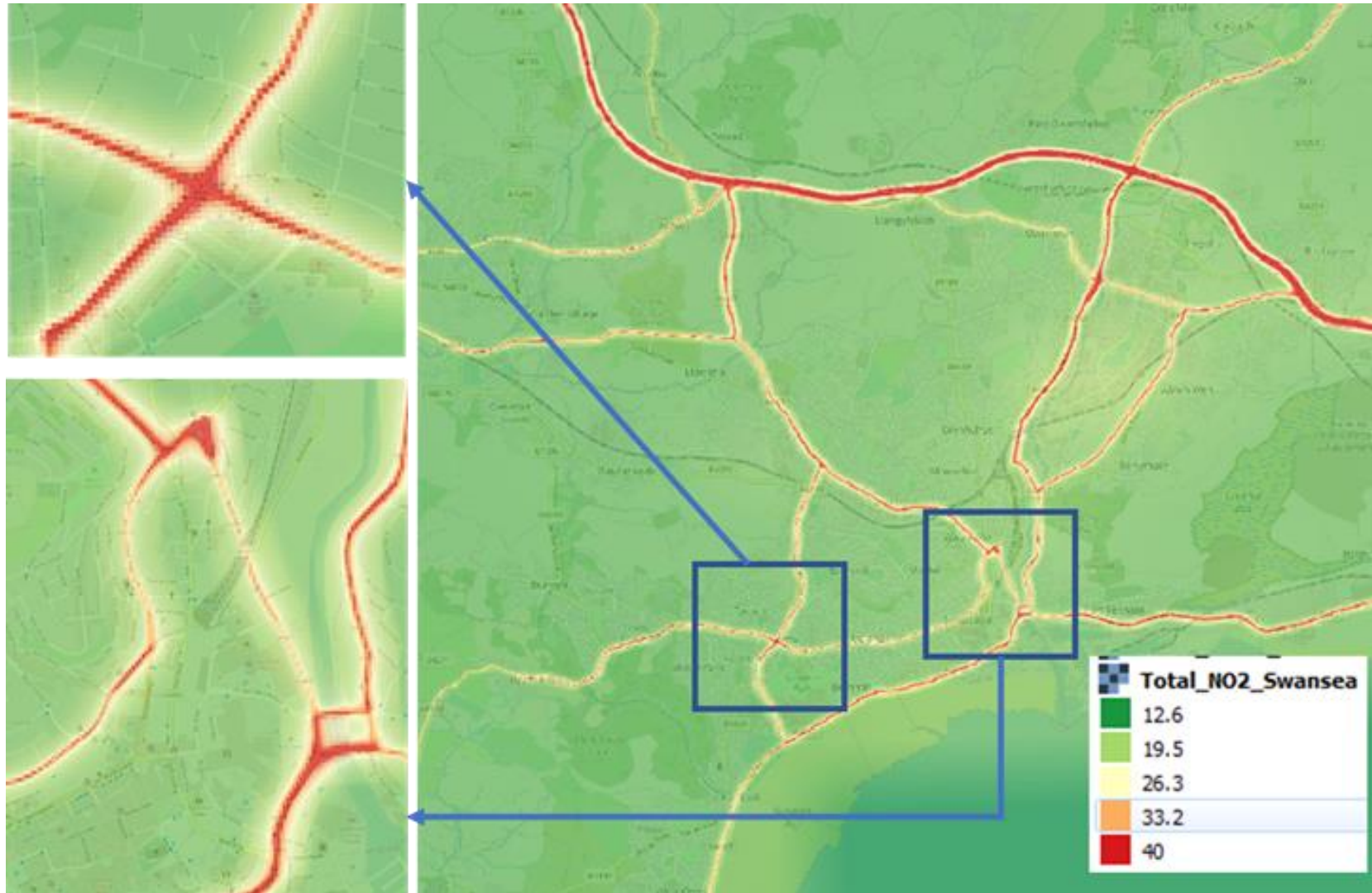
Newport

- The zoomed hotspot area is on Kingsway where there is a public access .

Total NO2 Newport
- 12.6
- 19.5
- 26.3
- 33.2
- 40

Cardiff

- The zoomed hotspot areas are in the city centre, and northern avenue.

| Total NO2 Cardiff	
	12.6
	19.5
	26.3
	33.2
	40

Additional Validation of Modelled Hotspots

- Traditional 'fixed-location' monitoring sites don't cover the local variability in spatial distribution of pollutant concentrations and even when used to validate a model can therefore still misrepresent actual personal exposure.

- For this project Ricardo Energy & Environment used a mobile air quality monitoring capability to measure a number of key health related pollutants.

- The equipment simultaneously records meteorological conditions, global positioning system (GPS) data and video.

- This information is then combined through a state-of-the-art geographic information system (GIS) and data analysis tools to map pollutant concentrations in high-resolution and in near real-time if required.

- It currently comes in 2 platforms;
  - Mobile "trolley" unit.
  - Backpack.
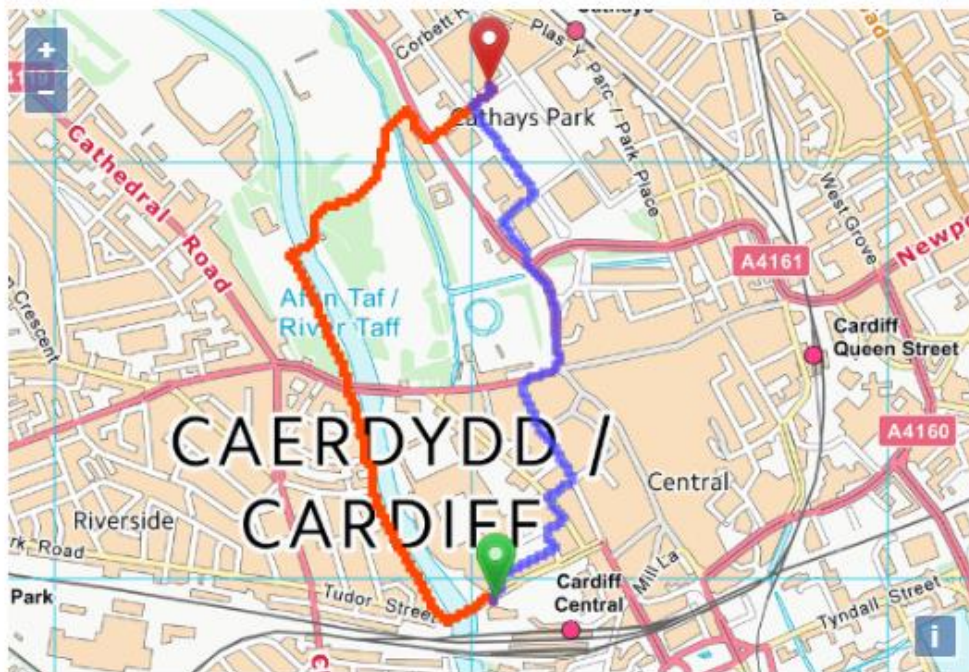
The Mobile Monitoring Unit in Action!
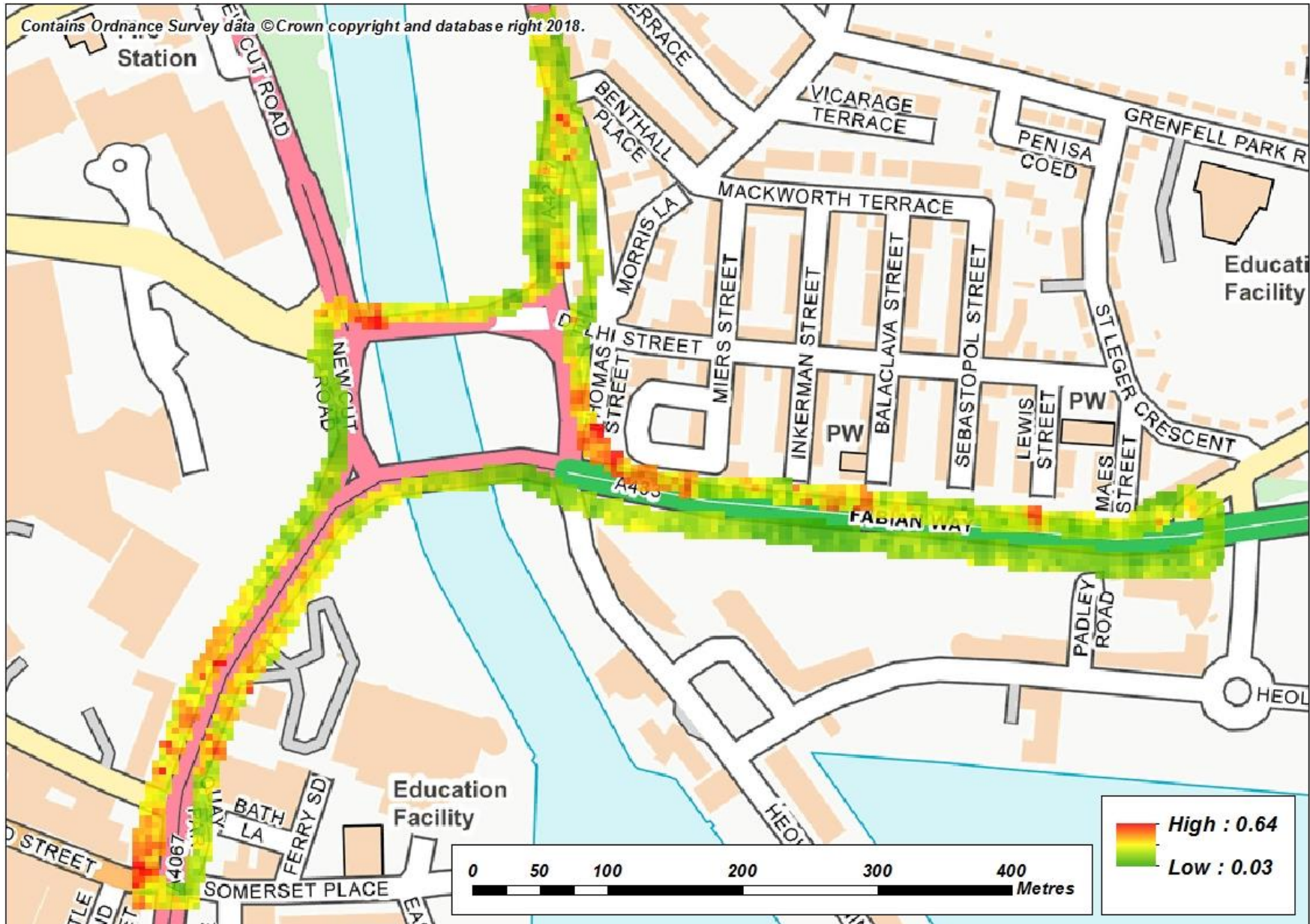
The Prototype Air Quality in Wales "Wayfinder" website

Wayfinder map

Drag the markers (by the bottom point) and click the Submit button.

Two routes will be shown, the shortest and the least polluted. They may be the same. You can hide either route by using the checkboxes below.

☑ **Show Shortest route** - the purple route

Shortest: It should take you 18 minutes to travel 1.4 km.

☑ **Show Least polluted route** - the orange route

Least polluted: It should take you 21 minutes to travel 1.67 km.

1. Choose your city.

2. Choose pollutant
   - NO_2 or PM_{10}.

3. Choose the transport mode – walking or cycling.

4. Drag markers to start and end positions for your journey

5. Choose result options for shortest and least polluted routes

6. Press "Submit"

Ideas for a Public Outreach Launch Campaign?

- Engagement with schools
  - Link to Young Dragons and Air Your View Initiatives.
  - Include route-planner details on-line and in training packs.
  - School representatives deploy tubes and collect data on routes.
  - Optional schools DIY sensor kit.
  - Walk to School routes comparison
- Wider outreach
  - Launch events & publicity.
  - Portable monitoring demos at selected schools.

Ideas for Possible Future Enhancements

- Collate more detailed local traffic statistics.

- Include more pollutants - ozone, VOCs, $PM_{2.5}$?

- Add hourly variations and/or forecasts into the mapping.

- Incorporate more sensor data and mobile monitoring to continue improving the model validation.

- Expand to more Welsh cities and urban areas.

- Develop a mobile app or more mobile-friendly version of the route-planner.
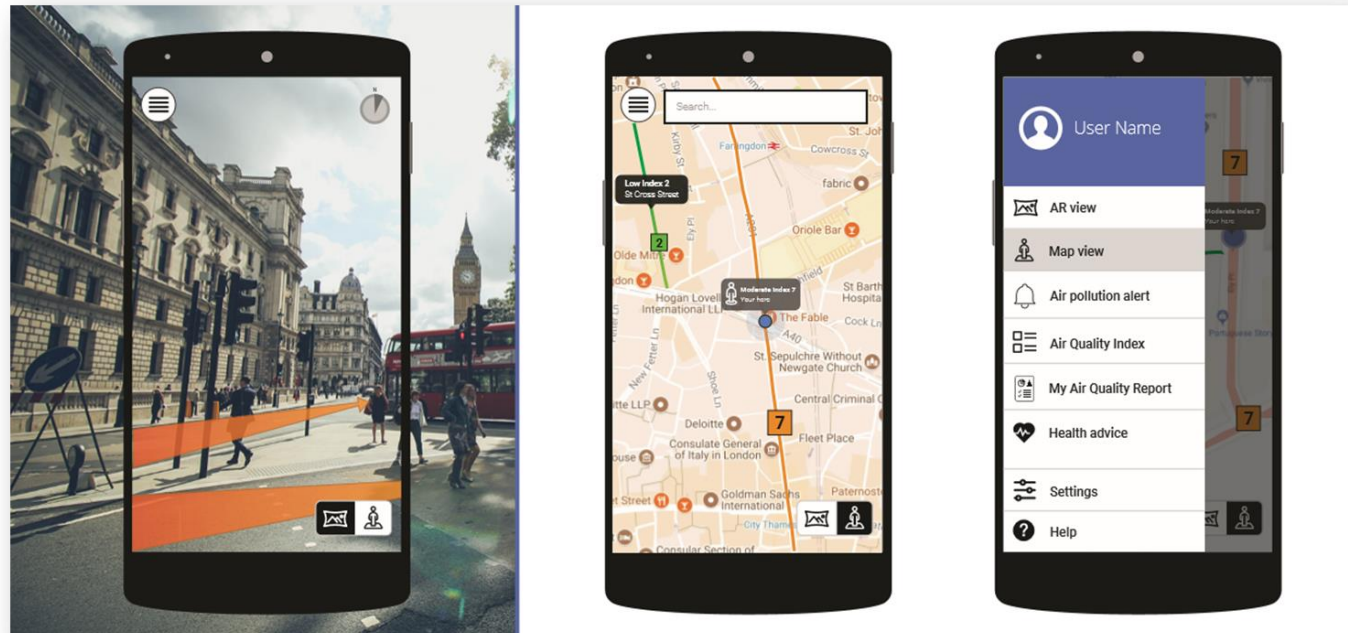
In Summary

- Ricardo, on behalf of Welsh Government, has developed a prototype tool for allowing the public to assess their risk of exposure to air pollution when walking or cycling in Cardiff, Swansea and Newport.

- The high-resolution mapping of NO_2 and PM_{10} concentrations is based on the RapidAir air pollution model validated against available WAQDB data.

- Additional validation of hotspot locations has been achieved through portable monitoring campaigns

- We now need feedback on how to finalise and launch the tool.

Thanks for your Attention!

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