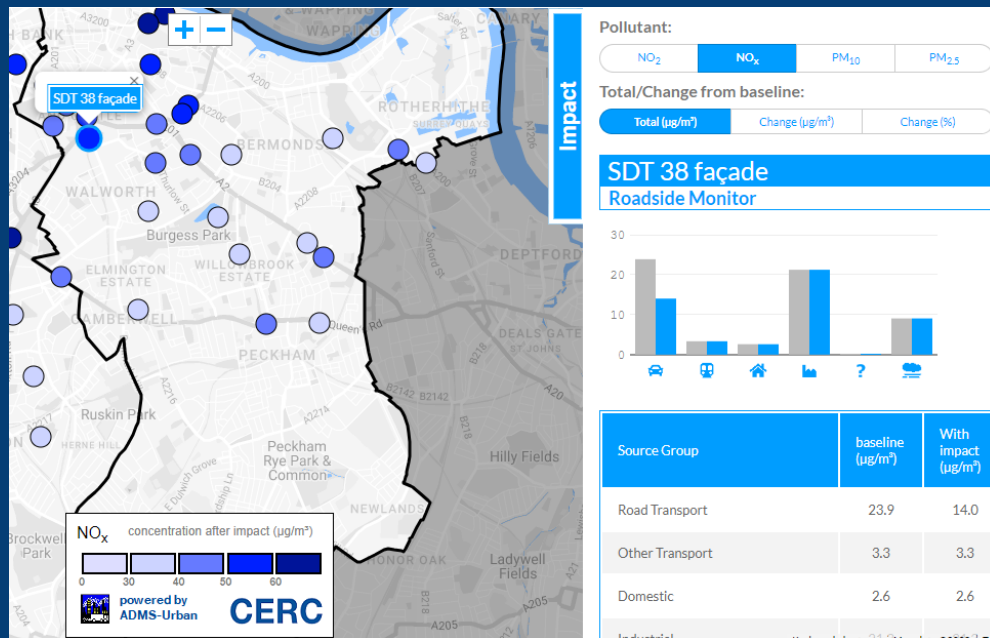


Online applications of high resolution ADMS-Urban model output

Chris Johnson



ADMS-Urban & ADMS-Roads User Group Meeting

30 November 2023

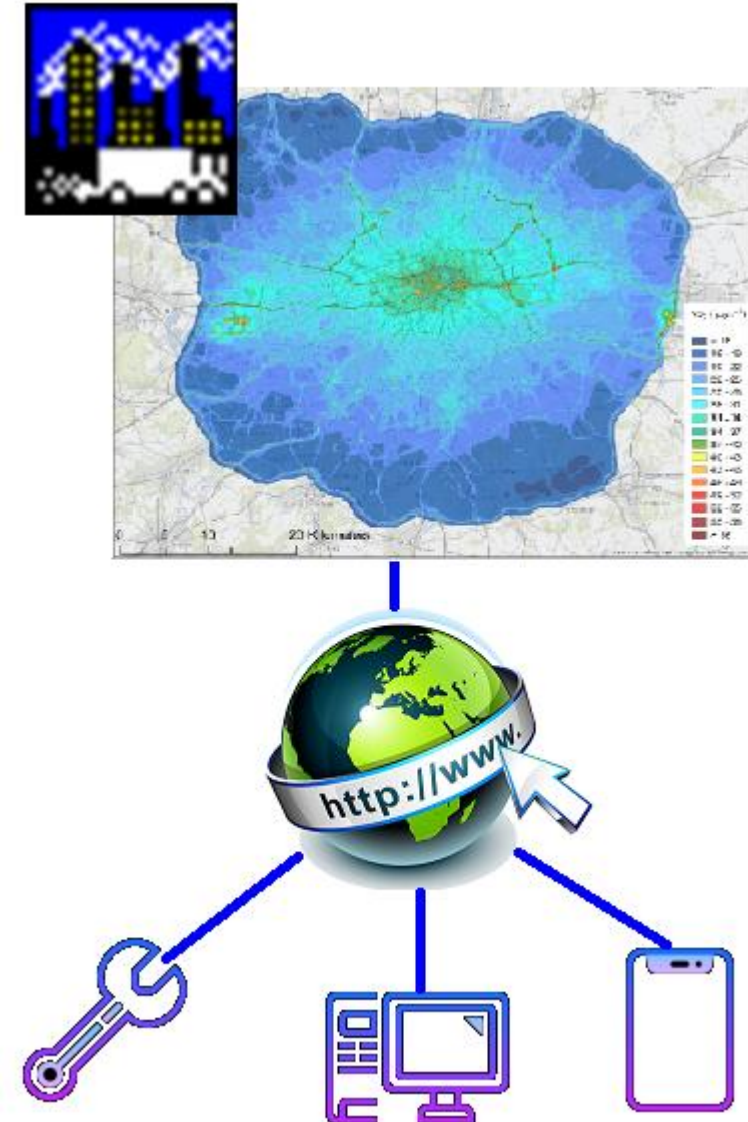
York

ADMS-Urban and the internet

Using the internet, ADMS-Urban model results can be:

- Shared to a wider audience
- Available in near-real time
- A data source for an app
- The basis for new tools

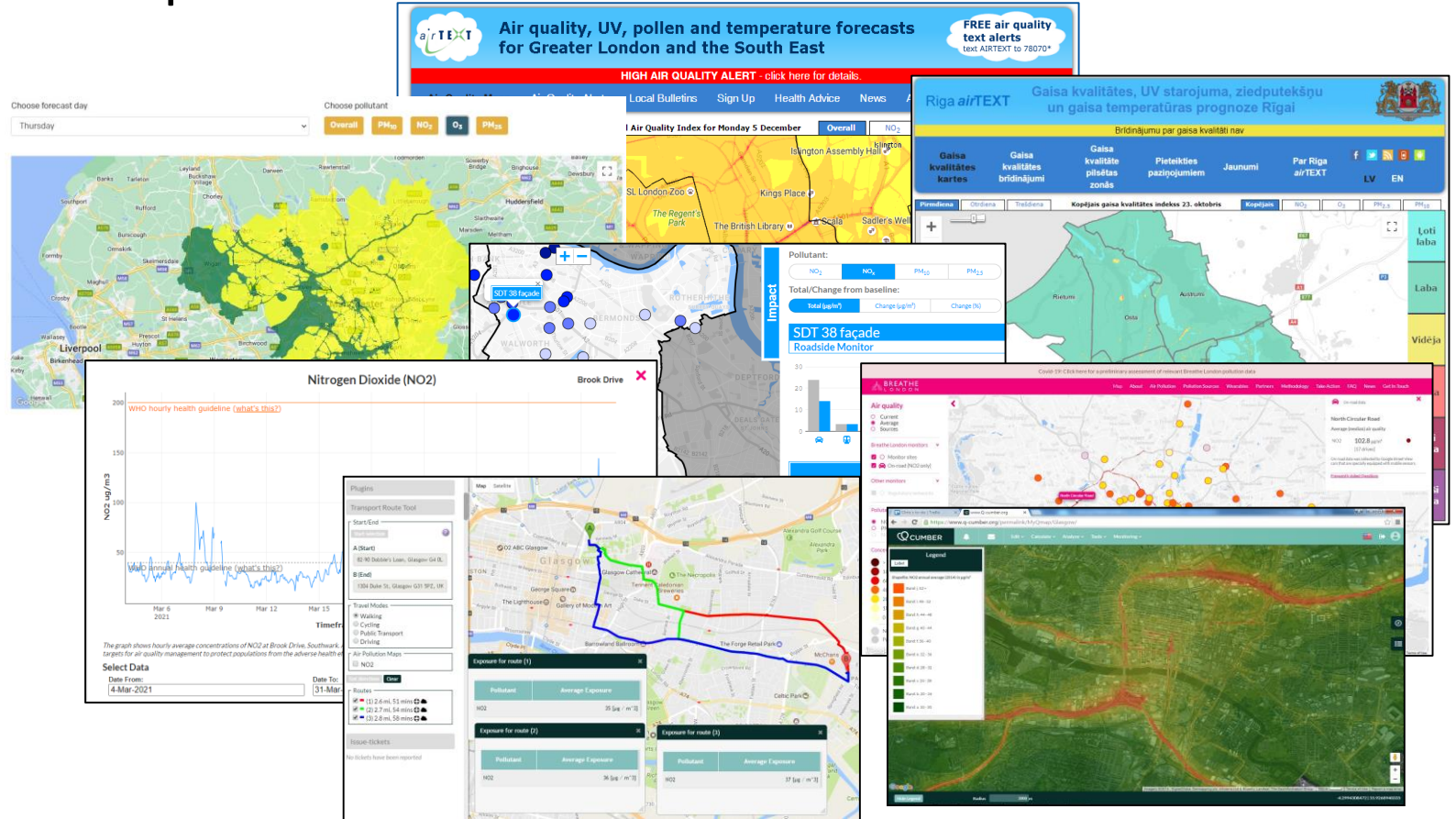
Cloud computing can also provide a scalable platform to execute ADMS-Urban model runs and process the results efficiently.



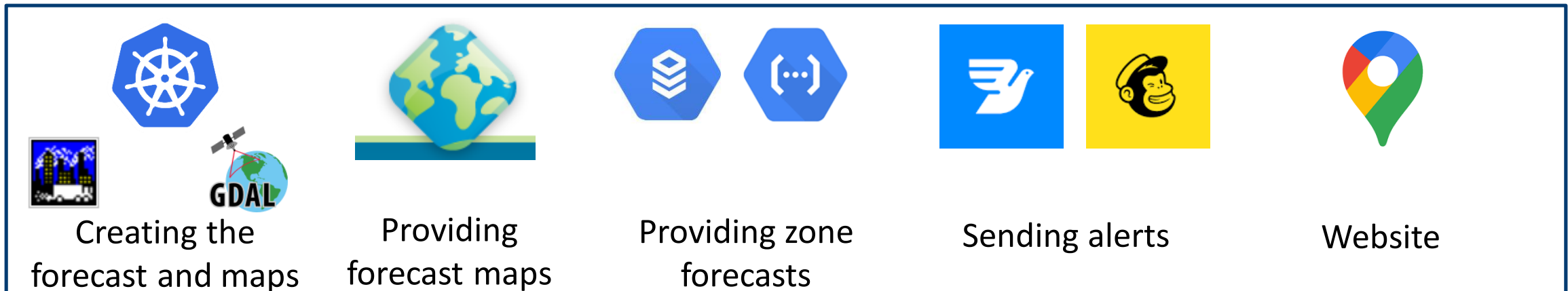
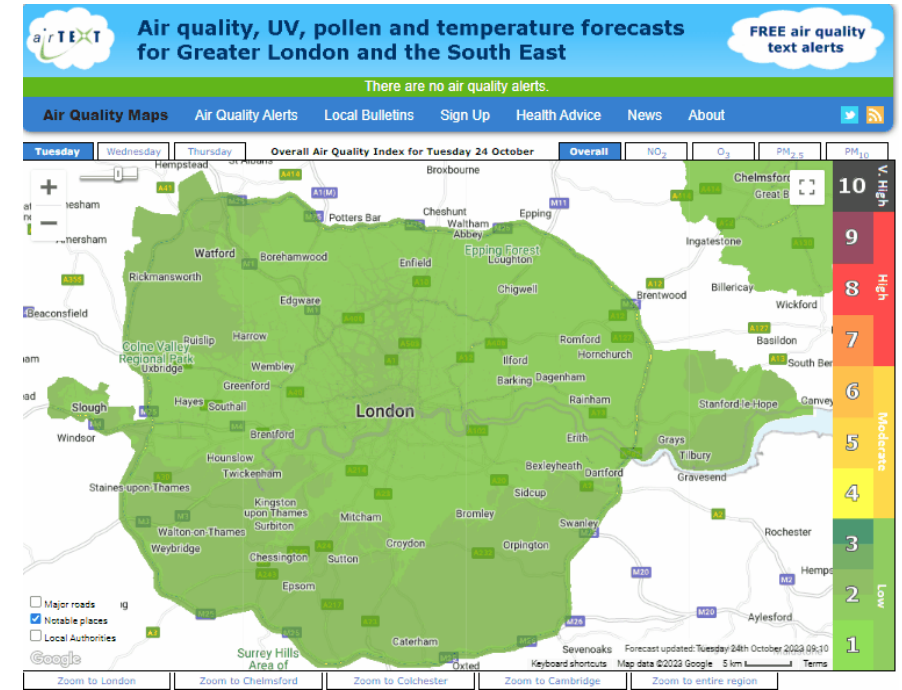
Online applications of ADMS-Urban model output

Examples of online applications developed by CERC that are based on or include ADMS-Urban model output:

- Forecasting systems
- Scenario tools
- Analysis tools
- Health impact tools



- **airTEXT** is a free service for the public providing air quality alerts by SMS text message, email and voicemail and 3-day forecasts of air quality, pollen, UV and temperature across Greater London and the South East.
- ADMS-Urban runs twice a day to provide high resolution daily forecasts of NO_2 , O_3 , PM_{10} and $\text{PM}_{2.5}$, using the Government's 10-point Daily Air Quality Index and adjusted using measurements.



airTEXT – Creating forecast and maps

- Uses ADMS-Urban’s spatial splitting option
- Runs ADMS-Urban spatial splits in parallel in the cloud to provide quick and efficient results
- Creates high resolution maps and zone forecast data
- Uses CAMS background data, DTN met data and HFC airport runway data

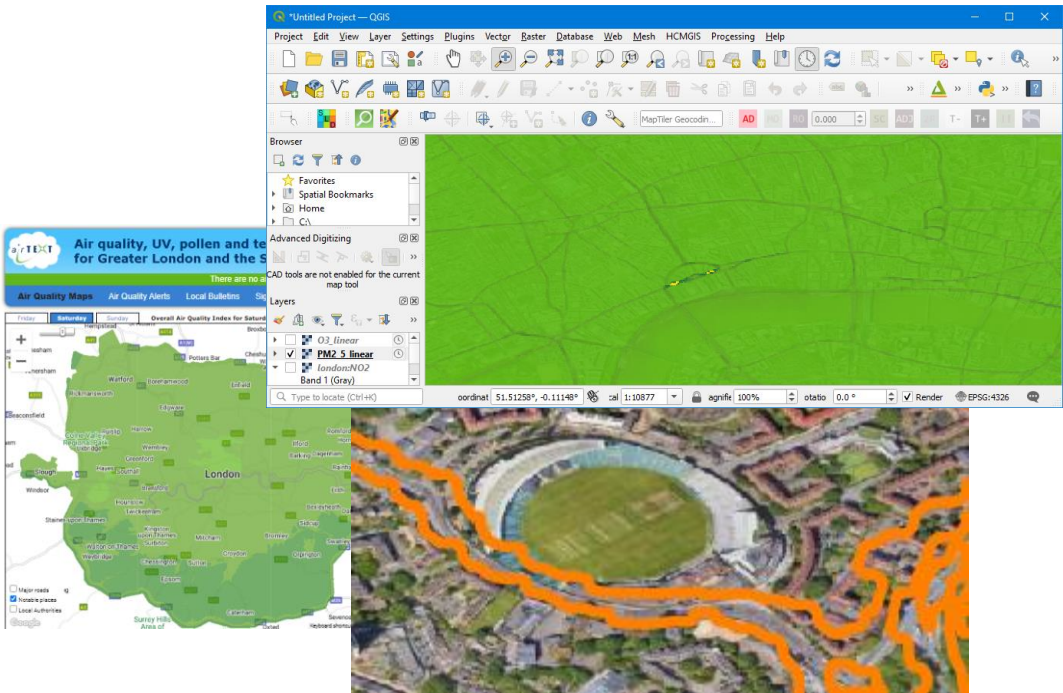



airTEXT – Serving maps

airTEXT uses GeoServer to:

- Host high resolution floating-point GeoTIFF data
- Provide data over the internet without having to download or store the entire dataset
- Serve data that can be viewed in web pages and analysed in GIS software

GeoServer: An open source third party server that allows users share geospatial data using open standards

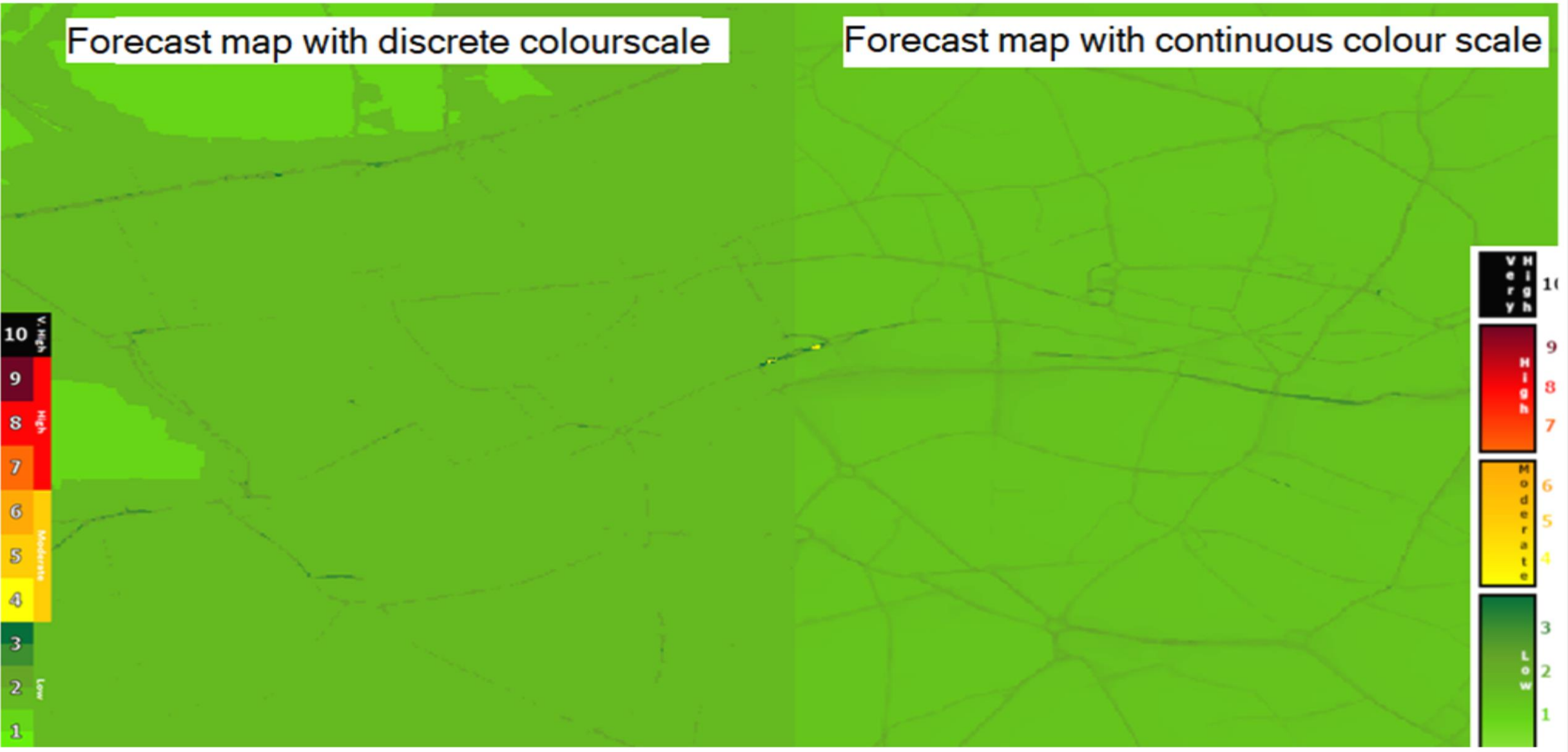


| | | | | |
|--|---|--|--|---|
|  <p>Creating the forecast and maps</p> |  <p>Providing forecast maps</p> |  <p>Providing zone forecasts</p> |  <p>Sending alerts</p> |  <p>Website</p> |
|--|---|--|--|---|

airTEXT – Serving maps

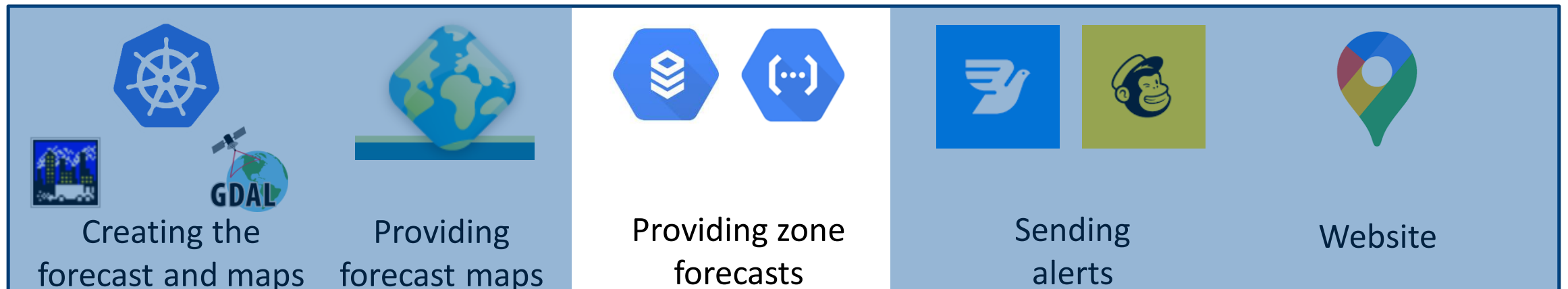
Forecast map with discrete colourscale

Forecast map with continuous colour scale



airTEXT – Zone forecasts

- Combines the spatially split results
- Calculates zone forecasts using the model results
- Stores the zone forecasts in a database
- Provides access to the forecasts to authorised users by web API



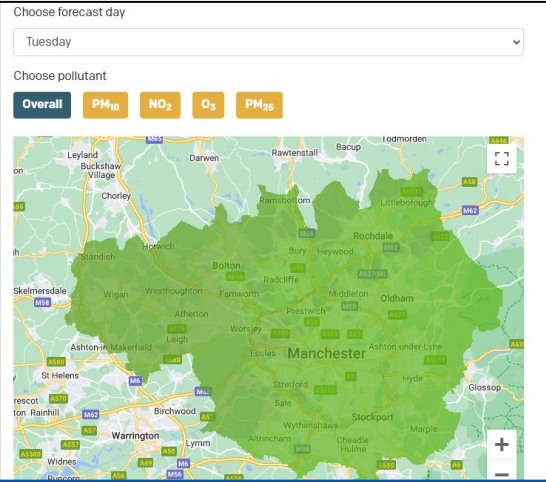
airTEXT – Sending alerts

- When an alert level is reached, i.e. >10% of a zone is Moderate or above:
 - Subscribers for that zone will receive an alert via voicemail, SMS or email
 - Alerts are available by API
 - Alerts are sent using third-party platforms, MessageBird and MailChimp

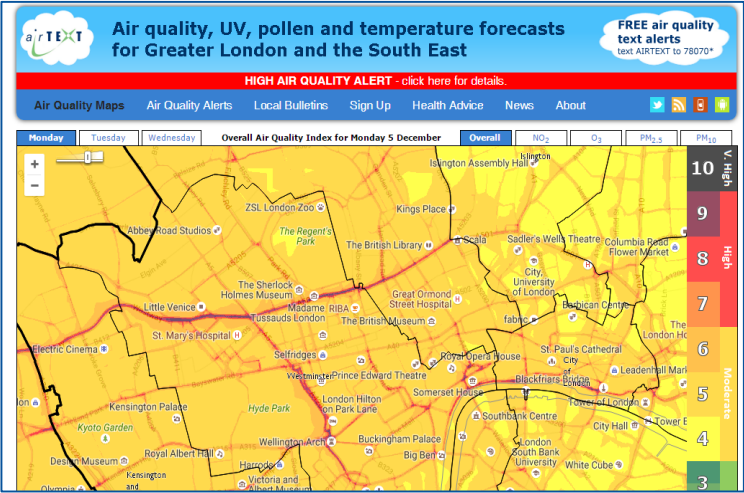
MODERATE air pollution forecast for Friday. Health effects are unlikely to require action. If unwell, contact GP. Unsubscribe www.airtext.info



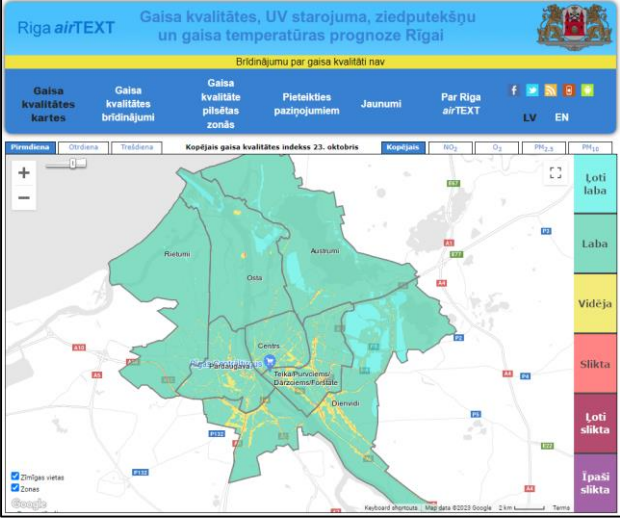
Forecast services – online platforms



Clean Air for Greater Manchester (since 2019)
www.cleanairmg.com



London airTEXT (since 2007)
www.airtext.info



Riga airTEXT (since 2018)
www.rigaairtext.lv



NEW!

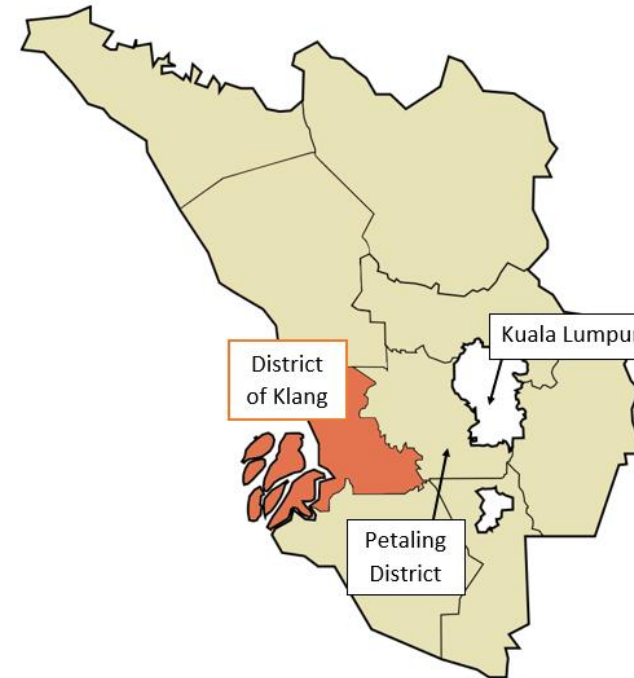


Launching March 2024



RESPIRE-2 (Malaysia)

- An example of the forecasting system for specific health research (in development)
- An early warning system to reduce haze-induced asthma events
- Uses ADMS-Urban to provide street-scale Air Quality forecasts linked to coarse resolution CAMS global forecasts
- Includes NO_2 , PM_{10} , $\text{PM}_{2.5}$, O_3 & SO_2
- A mobile phone app will provide online alerts
- Working with University of Edinburgh, Universiti Malaya and Universiti Kebangsaan Malaysia



Alert



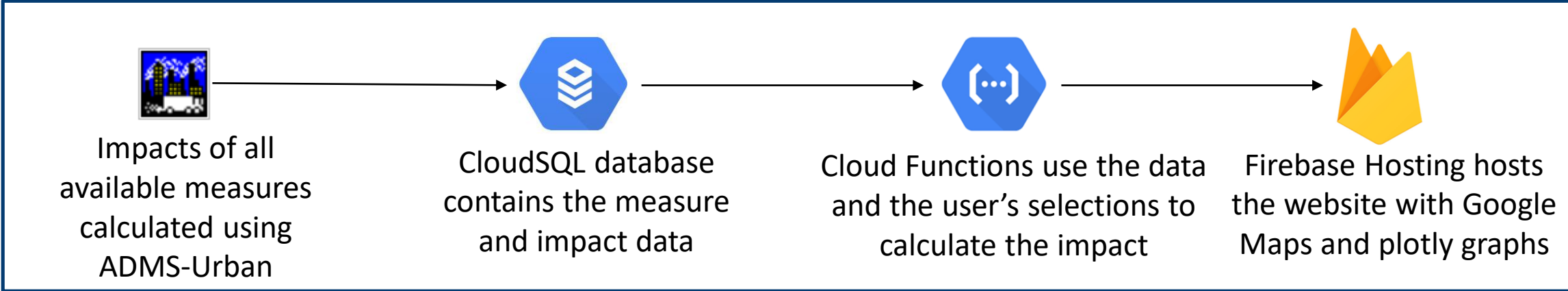
Action

Impact on Urban Health (IoUH) web tool

- Estimates impact of AQ measures on pollution concentrations at locations across Lambeth and Southwark
- Interface allows user to make measurable changes to impact measures and view effect at various locations

The screenshot shows the IoUH web tool interface. On the left, there are sliders for five measures: Increase Private Vehicle Electrification Rate, Increase Taxi Electrification Rate, Increase LGV Electrification Rate, Increase Bus Electrification Rate, and Increase ULEZ compliance rate for Private Vehicles. Below these are buttons for 'Lambeth' and 'Greater London', and an 'Apply measures' button. The central map shows a color-coded impact of NO_x concentration after impact (µg/m³) across the region. On the right, there is a 'Pollutant' selector (NO₂, NO_x, PM₁₀, PM_{2.5}), a 'Total/Change from baseline' selector (Total (µg/m³), Change (µg/m³), Change (%)), and a table of receptor impacts.

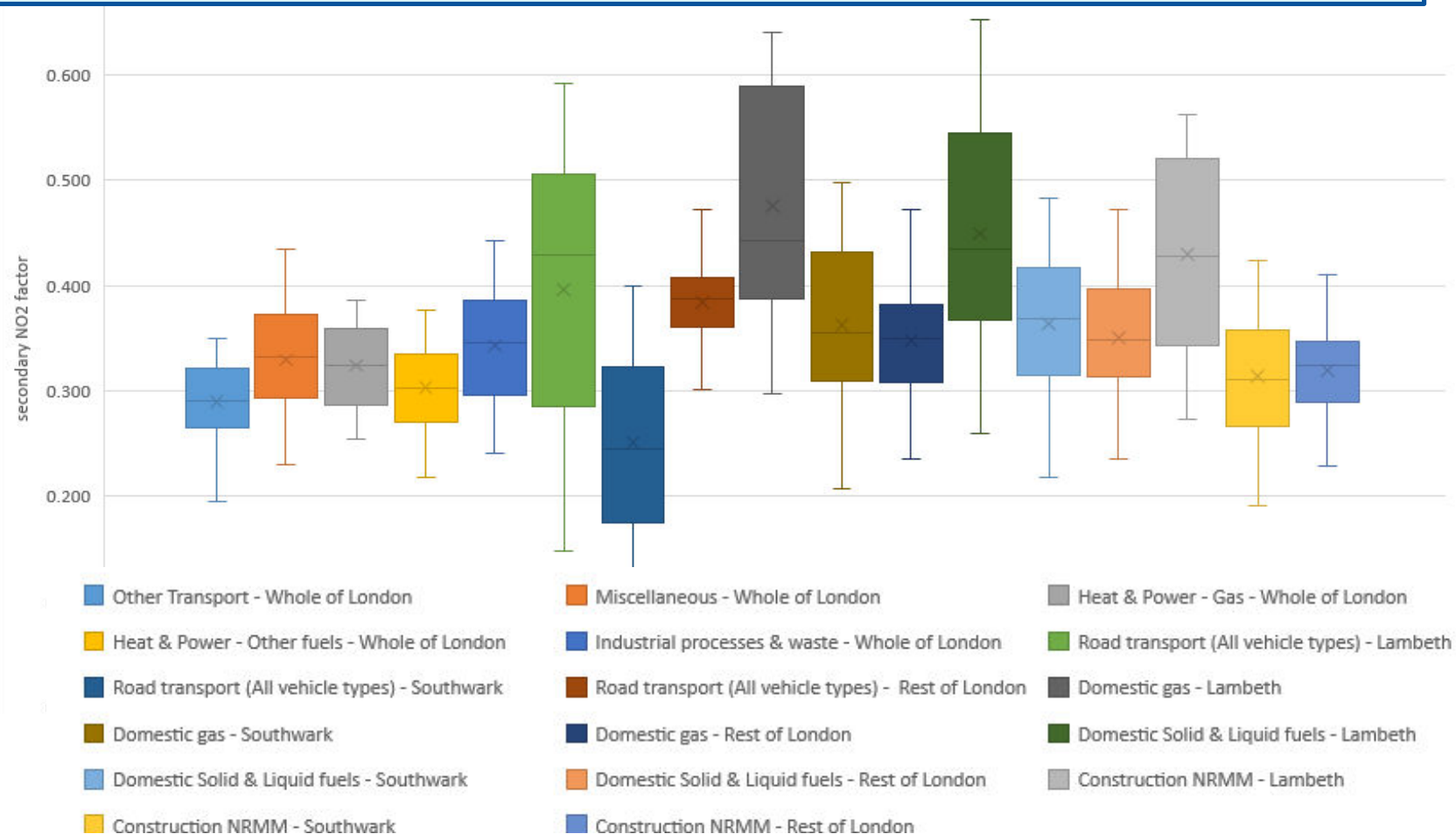
| Receptor | Baseline (µg/m ³) | With impact (µg/m ³) |
|-------------------------------|-------------------------------|----------------------------------|
| LB6 façade | 78.9 | 78.9 |
| DT25 façade | 78.7 | 78.7 |
| Tower Bridge Care Centre | 77.6 | 77.6 |
| The London Bridge Hospital | 75.3 | 75.3 |
| Grange Primary School | 71.5 | 71.5 |
| Guy's and St Thomas' Hospital | 70.7 | 70.7 |
| DT27 façade | 70.4 | 70.4 |
| SDT 39 façade | 67.6 | 67.6 |
| DT16 façade | 66.0 | 66.0 |
| LB4 façade | 63.2 | 63.2 |



IoUH web tool – derivation of secondary NO₂ factors

$$\text{Total NO}_2 \text{ concentrations} = \text{Primary NO}_2 \text{ (direct emissions)} + \text{Secondary NO}_2 \text{ (chemical reactions between NO and O}_3\text{)}$$

- Measures were modelled for x%, y% and z% reductions in source group emissions using ADMS-Urban chemistry to calculate source group and receptor specific Secondary NO₂ factors
- The tool calculates Total NO₂ concentrations for individual measures and in combination

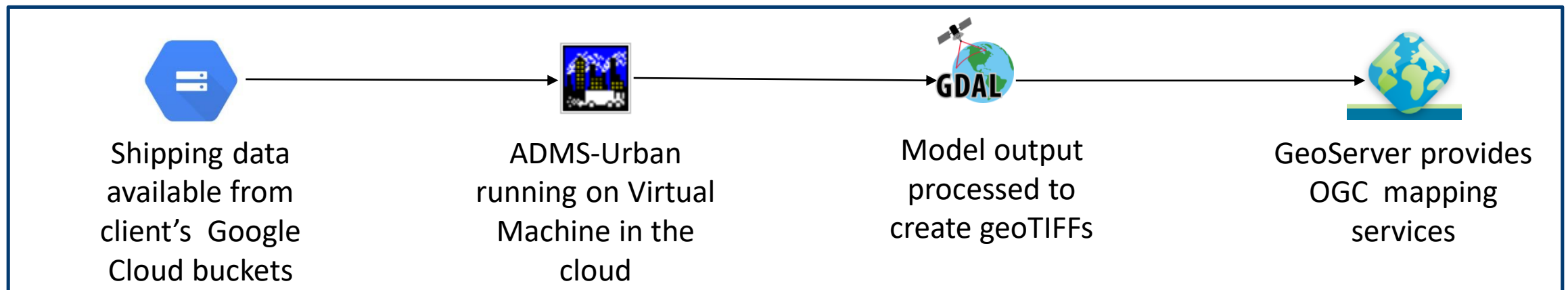


Near-real time port modelling

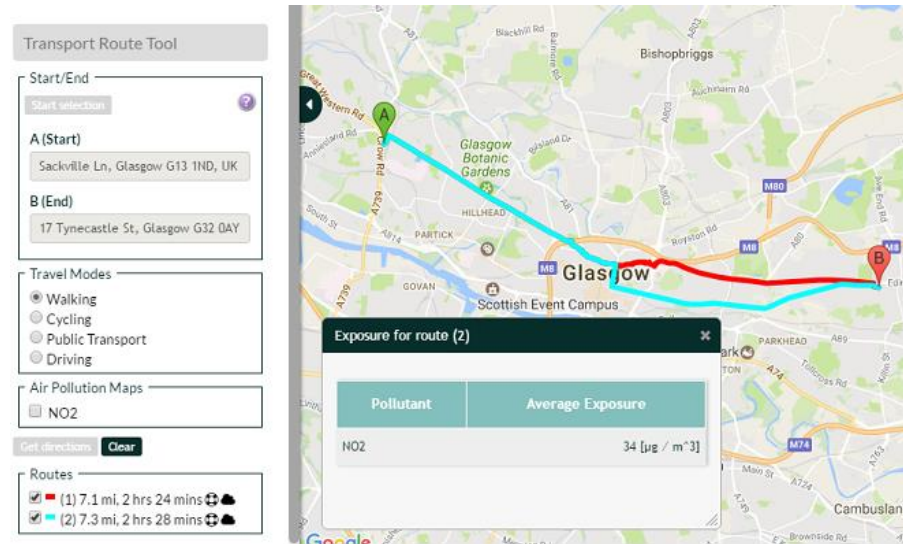
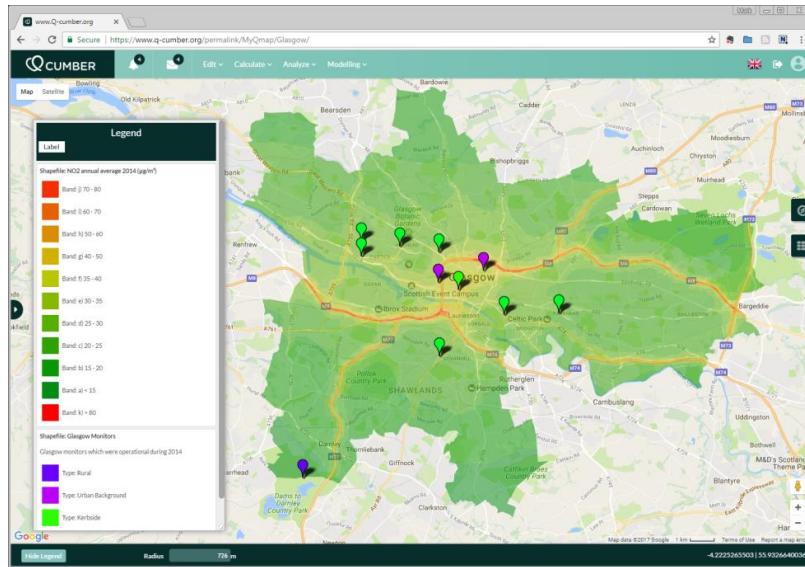
- Multiple projects providing near-real time air quality modelling outputs
- Using road traffic and shipping data for urban city and port areas
- Input shipping data made available on the Google Cloud by project partner Redshift
- CERC provides modelling and source apportionment using ADMS-Urban
- Model results maps served by GeoServer hosted by project partner GSI
- More information available from last years UGM



Redshift Associates



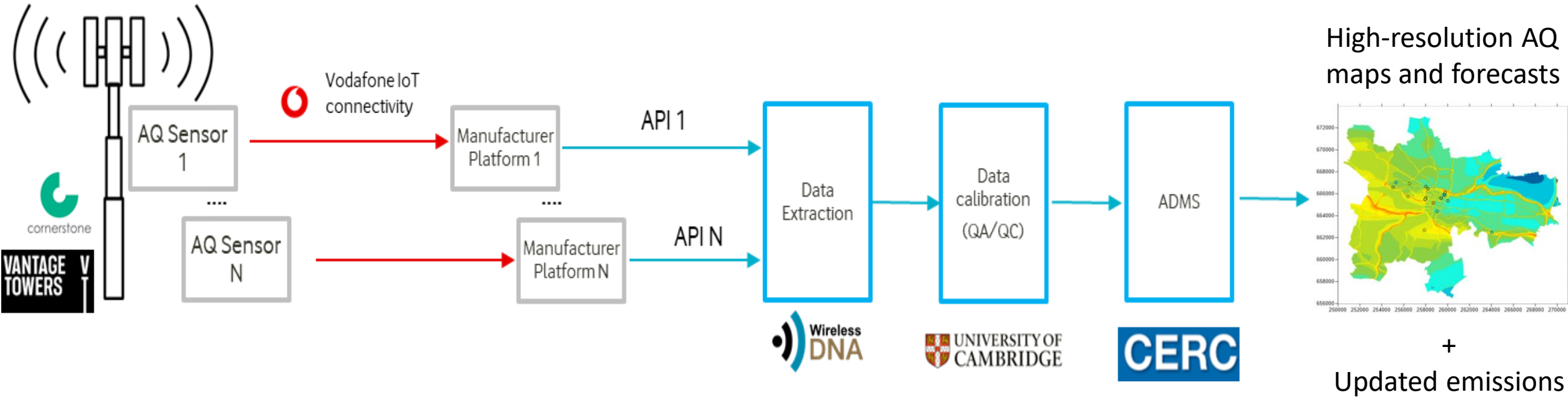
QCumber EnvHealth



- Decision-making tool by Algebrafor urban health and policy evaluation based in Glasgow
- Innovative open city data platform with crowd sourcing and environmental tools
 - Layers from ADMS-Urban modelling; smart AQ monitors; synthetic data
- Included transport route tool to view AQ exposure along each route

Glasgow – Network as a Sensor pilot

- Developing an operational system that automatically assimilates sensor concentration data with CERC’s ADMS-Urban dispersion model to deliver 10 metre resolution, calibrated, near-real-time pollution maps for Glasgow City Centre, and updated emissions based on measurements
- Includes an operational QA/QC system to produce calibrated sensor concentration data for 15 sensors in Glasgow for the following pollutants: NO_x, NO₂, O₃, PM₁₀, PM_{2.5} and CO₂.

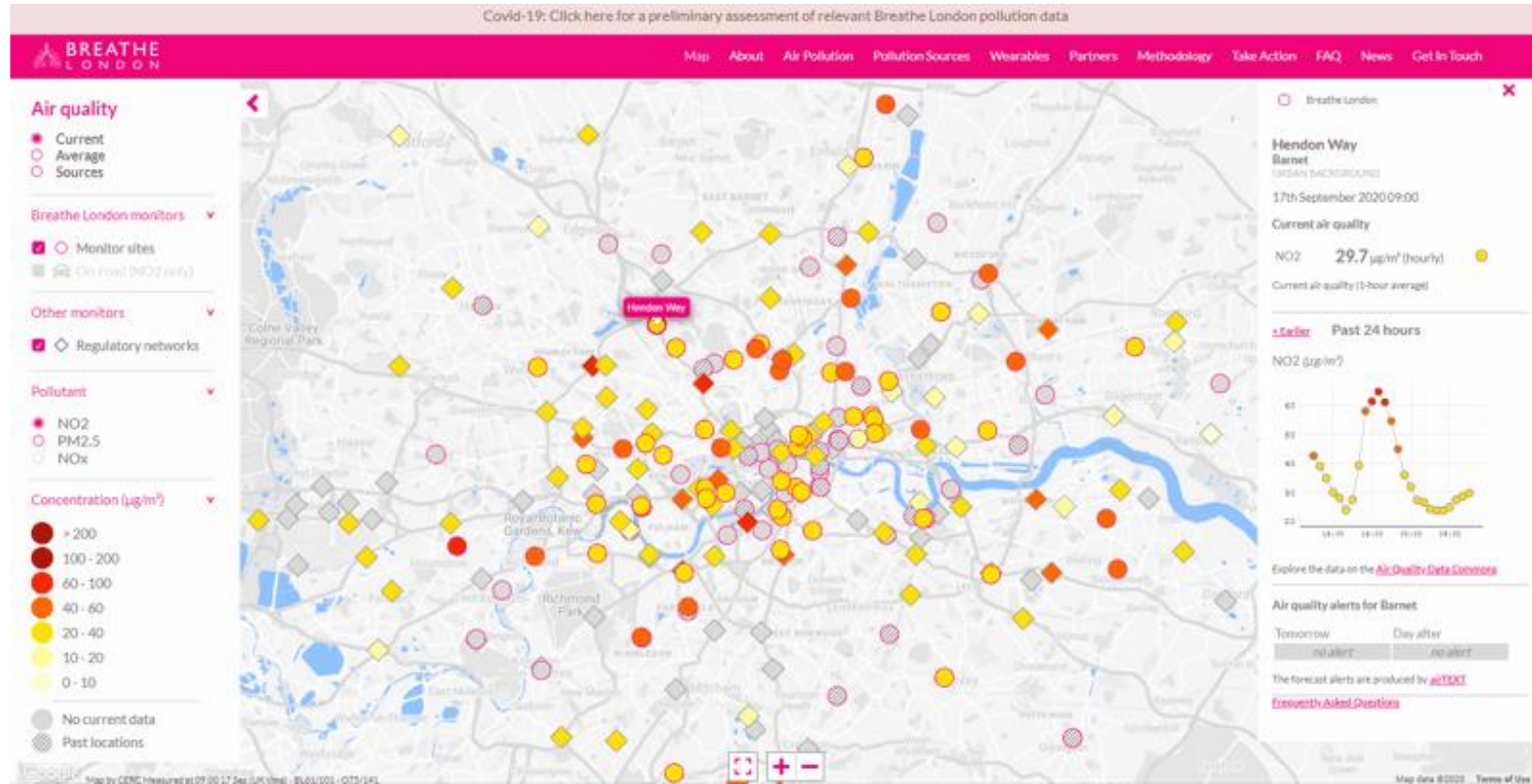


Thibault I, Jones R, Mills J, Popoola O and Stidworthy A, 2023: The suitability of a mobile communications network to deliver high-resolution air quality measurements. Envirotech Online, September 2023.



Breathe London Pilot project

- Website to show current and annual average air quality in London
- Using low-cost sensor measurements and ADMS-Urban modelling
- Included source apportionment using ADMS-Urban results
- On-road concentrations derived from receptors on Google StreetView cars



Summary

Combining ADMS-Urban and the internet has many advantages:

- Dissemination of ADMS-Urban output is easier
- Makes collaboration easier
- ADMS-Urban output can add value to internet based tools
- Running ADMS-Urban model runs can be faster, scalable and more efficient

Thank you for listening

Any Questions?