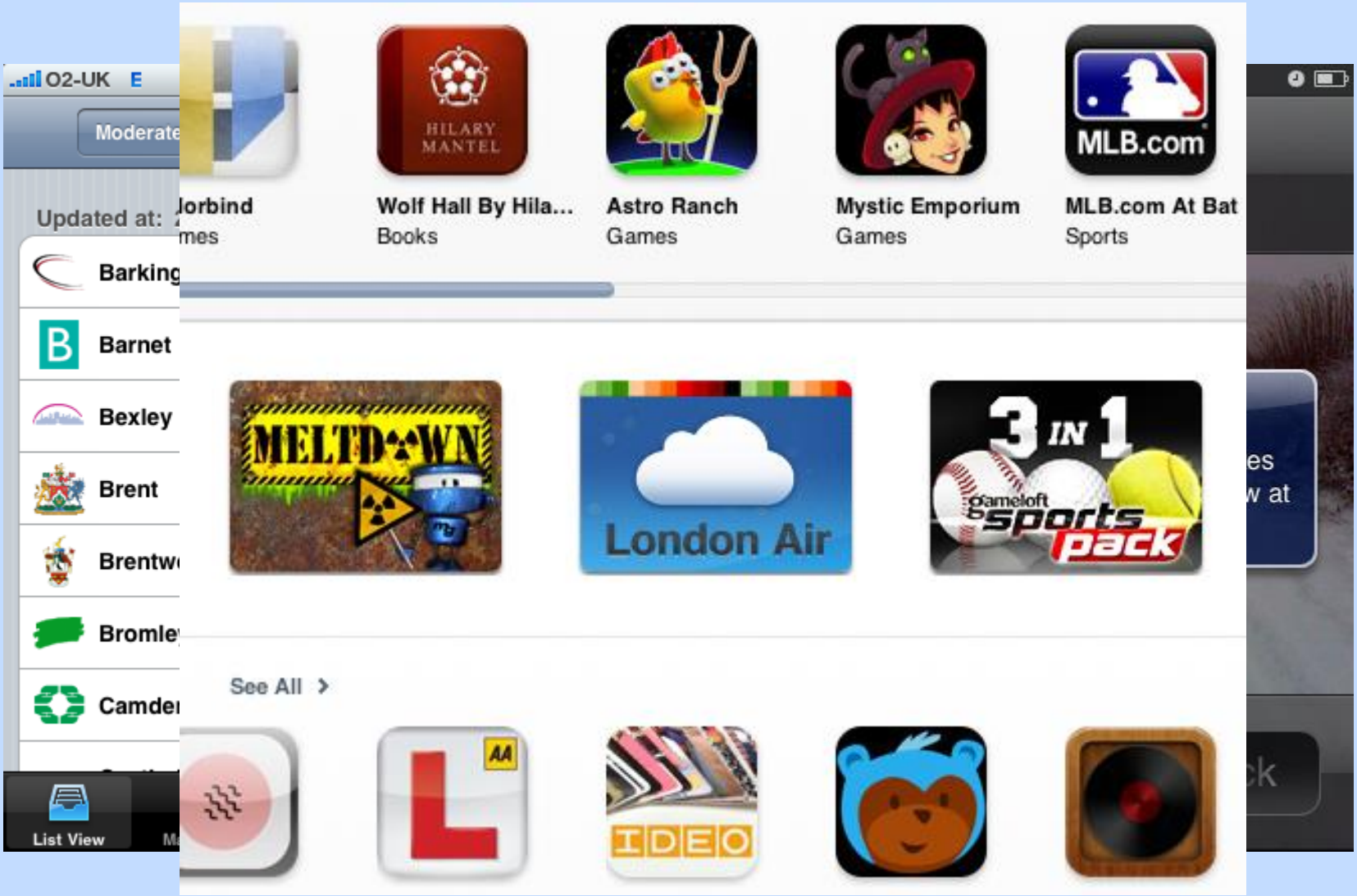
Canairy app – protecting outdoor workers

Andrew Grieve

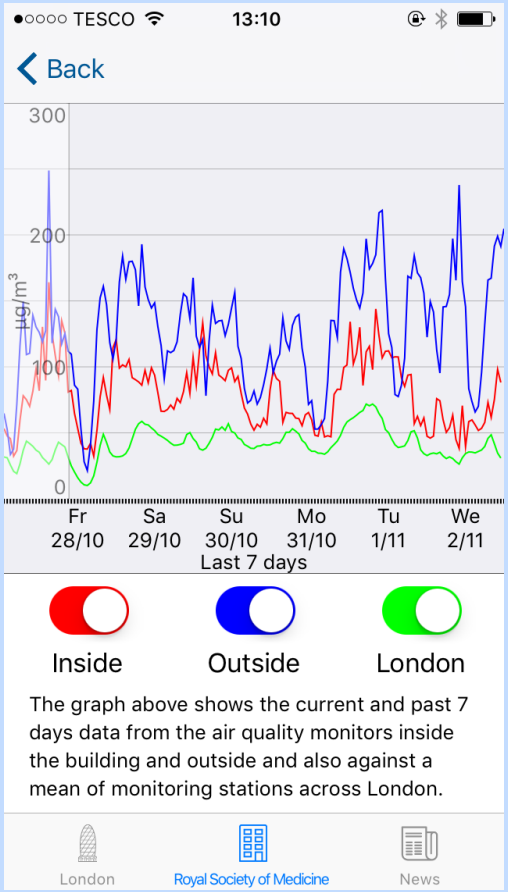
London Air Quality Network Conference – 25/06/19

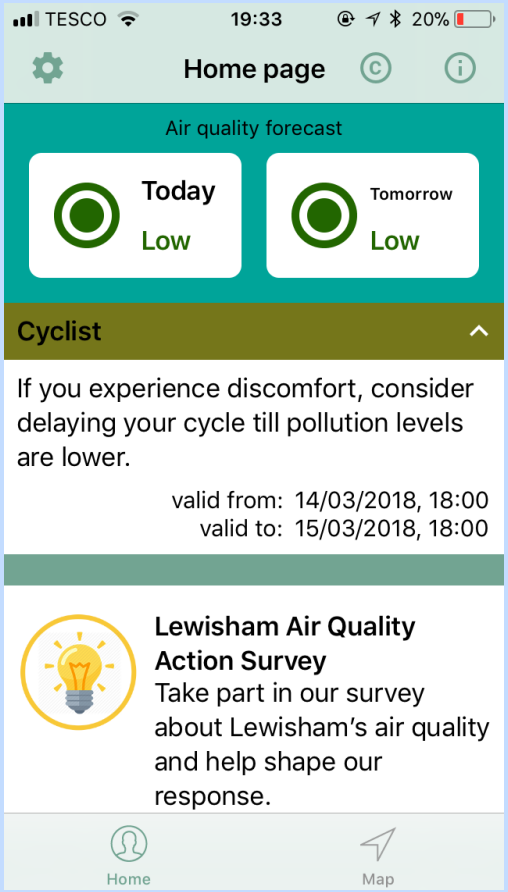
London & Sussex Air apps - 2010



CityAir - 2013

Many more...





ENGIE

Lewisham

UN environment

Apps as a research tool

Apps as a research tool

The Asthma Mobile Health Study, a large-sc observational study using ResearchKit

Yu-Feng Yvonne Chan[1,2], Pei Wang[1], Linda Rogers[3], Nicole Tignor[1], Micol Zweig[1], Steven G Nicholas Genes[1,2], Erick R Scott[1], Eric Krock[4], Marcus Badgeley[1], Ron Edgar[4], Samantha V Rosalind Wright[3,5,6], Charles A Powell[3], Joel T Dudley[1,7] & Eric E Schadt[1]

The feasibility of using mobile health applications to conduct observational clinical studies requires rigor we report initial findings from the Asthma Mobile Health Study, a research study, including recruitment, conducted entirely remotely by smartphone. We achieved secure bidirectional data flow between investig participants from across the United States, including many with severe asthma. Our platform enabled pr longitudinal, multidimensional data (e.g., surveys, devices, geolocation, and air quality) in a subset of us study period. Consistent trending and correlation of interrelated variables support the quality of data obt We detected increased reporting of asthma symptoms in regions affected by heat, pollen, and wildfires. this technology include selection bias, low retention rates, reporting bias, and data security. These issue realize the full potential of mobile platforms in research and patient care.

Three billion smartphones were in use worldwide in 2015, a figure expected to double by 2020 (ref. 1). Smartphones have replaced standard mail and landline phones for many people, creating a need to leverage mobile devices for research historically conducted by phone and mail. Mobile technology may also offer advantages over traditional data collection and management processes in research.

ResearchKit (Apple; Cupertino, CA, USA), an open source framework for mobile research can (i) obtain electronic informed consent, (ii) administer and collect questionnaires, (iii) actively and passively collect biometric data, (iv) provide reminders and notifications, and (v) reliably transmit and secure data in a central repository in compliance with regulatory requirements. Several research institutions and Sage Bionetworks (Seattle) collaborated with Apple to build the first mobile health applications using ResearchKit to demonstrate the feasibility of conducting research via this platform, and to provide an open source template to build third-party research apps[2–5]. To this end, we developed the Asthma Health Application (AHA) and conducted the Asthma Mobile Health Study (AMHS).

As many as half of the 25 million Americans with asthma lack optimal asthma control, contributing to $56 billion in annual disease costs[6]. A smartphone platform enabling large-scale, continuous collection of clinical, environmental, and passive biometric data may provide valuable insights for asthma research and clinical care. Our prospective observational mobile health study focused on assessing the following primary objectives: (i) feasibility of smartphone-based recruitment; (ii) characteristics of a stud the ResearchKit platform; (iii) user engag terns; and (iv) user data sharing prefere and utility of self-reported data collecte ing correlation with trusted external sou expected patterns. Lastly, we evaluated t of AHA use in a subset of participants.

RESULTS

Study enrollment, user experience, a

After its Apple App Store release on Ma downloaded 49,963 times over the first were from United States. Only US resi study. Figure 1 describes the AHA enro key sub-cohort definitions (see Supplem prehensive description of study sub-coh the geographic distribution of the study p users, out of 8,524 completed the enroll were asked to complete a series of intake comorbidities, and asthma history over enrollment. Participants were also asked surveys to log symptoms, presumed trigg ence for the duration of the study. In addi weekly surveys to capture participants' h and quality of life over the previous 7 d. F

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Received 15 April 2016; accepted 13 February 2017; published online 13 March 2017; doi:10.1038/nbt.3826

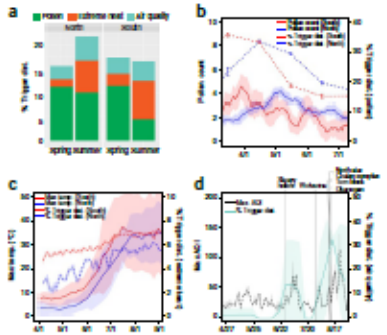


Figure 4 Geographic and seasonal trends in asthma triggers for Robust users. (a) The percentages of users reporting pollen, extreme heat or air quality as an asthma trigger (y axis) for southern (red) and northern (blue) regions of the contiguous US in the spring (March–May) and summer (Jun–Aug) respectively (based on $n = 545$ Robust users). (b) The percentage of users reporting pollen as an asthma trigger (solid) and the monthly pollen level (dashed) for southern (red) and northern (blue) regions of the US (based on $n = 64$ Robust users). (c) The percentage of users reporting extreme heat as their asthma triggers in southern and northern US regions for the spring and summer months (based on $n = 545$ Robust users). (d) The percentage of users reporting air quality as an asthma trigger for Washington state wildfires (solid, left y axis) and daily PM2.5 concentration (dashed, right-axis) in the same area (based on $n = 37$ Robust users). In (b–d), the shaded regions represent the ± 1 s.d. interval bands.

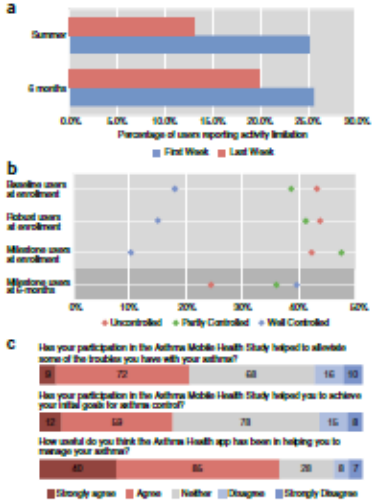


Figure 5 Positive impact of the app on user group. (a) The percentage of users reporting activity-limitation in their first week versus their last week in the summer (top, based on $n = 331$ Robust users) and in the entire 6-month study period (bottom, based on $n = 1,926$ Robust users). (b) The percent distribution of GINA control for all cohorts at enrollment (top three) and after 6-months of study participation (bottom). (c) Feedback and Milestone survey results based on data from Milestone users.

retention patterns, we focused on a subset of 537 users from the Robust user cohort, who were enrolled in the study for more than 90 d and who provided data for all the co-variates considered in the analysis. Both univariate and multivariate survival analyses of these 537 users, found earlier entrance into the study, (hazard ratio = 2.01 (95% CI, 1.73–2.33)) for each month following AHA launch, and increasing age, (hazard ratio = 0.978 (95% CI, 0.969–0.987)) for each additional year, significantly associated with greater likelihood of daily survey participation (Fig. 2d,e, Supplementary Fig. 2a and Supplementary Table 4a,b).

We also investigated the 'individual response rate', defined as the number of days with at least one daily survey question completed divided by the number of days enrolled through September 9, 2015, for each user. For the 537 users considered in the above retention analysis, the average individual response rate was 31%, with 104 of these users having an individual response rate >50% (Supplementary Fig. 2b). Increasing age and earlier study entry month were also associated with higher individual response rate (Supplementary Table 4c).

Relationship between baseline asthma control and prospectively collected data

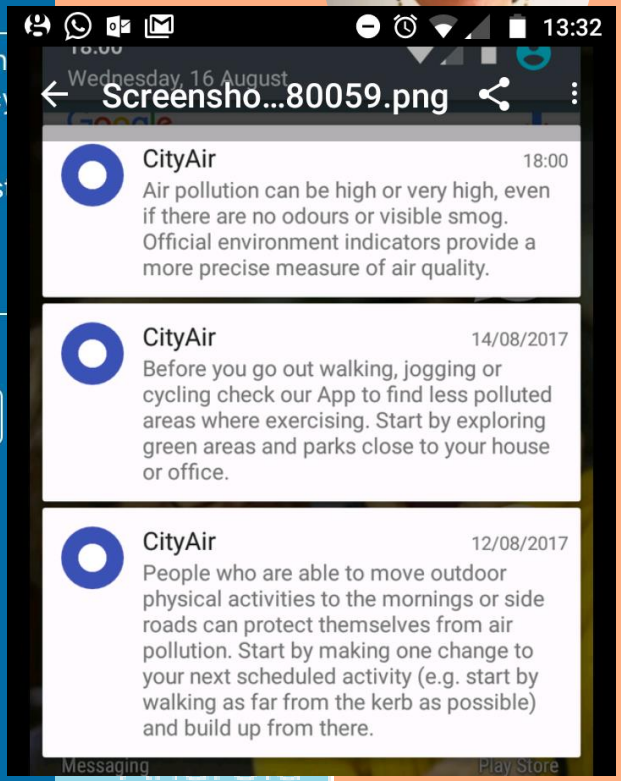
Participants completed intake questionnaires assessing asthma control upon study enrollment and then prospectively reported daily and nightly asthma symptoms, quick-relief inhaler usage, controller medicine usage, and peak flow measures over the course of their participation in the study. Patients' daily survey responses for the aforementioned four parameters were all found to be significantly associated with the GINA control levels calculated based on intake questionnaires from Robust users reporting daily (Kruskal–Wallis test; $H(2) = 471.94$, $P < 2.2^{-16}$, $n = 2,295$) and nightly symptoms (Kruskal–Wallis test; $H(2) = 232.23$, $P < 2.2^{-16}$, $n = 2,295$), quick-relief inhaler usage (Kruskal–Wallis test; $H(2) = 677.12$, $P < 2.2^{-16}$, $n = 2,295$), and controller medicine usage (Kruskal–Wallis test; $H(2) = 63.73$, $P = 1.4^{-14}$, $n = 2,285$) (Fig. 3a–d and Supplementary Fig. 3).

Of those in the Robust user cohort, 1,621 voluntarily submitted at least one peak flow measurement during the study period. As expected, patients with well-controlled asthma, and who were male and tall, had higher average peak flows throughout the study period (Fig. 3e). Those with uncontrolled asthma at baseline reported peak flows 42 liters/min lower than their well-controlled counterpart after adjusting for height and gender ($n = 183$).

We examined concordance of reported asthma symptoms, rescue inhaler use, and peak flow measurements using time series of daily survey responses from Robust users. Consistent with clinical expectation, we detected a positive correlation between daily or nightly symptoms and rescue inhaler use ($n = 979$ and $n = 761$, respectively), whereas these same variables were negatively correlated with peak flow values ($n = 235$ and $n = 173$, respectively) (Supplementary Fig. 4).

Adherence to preventative recommendations during poor air quality days

Adherence to preventative recommendations during poor air quality days



Adherence to preventative recommendations during poor air quality days

Environment International 124 (2019) 216–225

Contents lists available at ScienceDirect

Environment International

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The effect of evidence and theory-based health advice accompanying smartphone air quality alerts on adherence to preventative recommendations during poor air quality days: A randomised controlled trial

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ARTICLE INFO

Handling editor: Xavier Querol

ABSTRACT

Although poor air quality can have a negative impact on human health, studies have shown suboptimal levels of adherence to health advice associated with air quality alerts. The present study compared the behavioural impact of the UK Air Quality Index (DAQI) with an alternative message format, using a 3 (general population vs. at risk individuals) X 2 (usual DAQI messages vs. behaviourally enhanced messages) factorial design. Messages were sent via a smartphone application. Eighty-two participants were randomly allocated to the experimental groups. It was found that the enhanced messages (targeting message specificity and psychosocial predictors of behaviour change) increased attendance to make permanent behavioural changes to reduce exposure, compared to the control group ($V = 0.33$). This effect was mediated by a reduced perception of not having enough time to follow the health advice received ($b = -0.789$, BCa CI [−2.588, 0.503]). It was also found that higher worry about air pollution, perceived severity, perceived efficacy of the recommended behaviour and self-efficacy were predictive of self-reported behaviour change at four weeks. In response to a real moderate air quality alert, among those with a pre-existing lung condition, more respondents in the intervention group reported to have used their preventer inhaler compared to the control group ($V = 0.40$).

On the other hand, the two message formats performed similarly when intentions were collected in relation to a hypothetical high air pollution scenario, with all groups showing relatively high intentions to change behaviours. This study expands the currently limited understanding of how to improve the behavioural impact of existing air quality alerts.

1. Background

According to estimates from the World Health Organization released in 2014, in 2012 around 3.7 million people died prematurely in the world as a result of exposure to ambient air pollution (World Health Organization (WHO), 2014). Findings from epidemiological and toxicological research have highlighted the negative effects of short- and long-term exposure to air pollution on both premature mortality and morbidity from cardiopulmonary disease (for an overview, see (Kelly and Fussell, 2015)). A recent study conducted in London found that single day exposure to traffic-related pollutants was associated with increased hospitalisations for adult cardiovascular and paediatric respiratory problems (Samoli et al., 2016). In the UK, monitoring networks measure the levels of different air pollutants and these measurements are usually provided by the Department for Environment, Food & Rural Affairs (DEFRA) in the form of daily air quality indices

Abbreviations: KCL, King's College London; MRC HPRU, National Institute of Health Research, Health Protection Research Unit; PHE, Public Health England; DEFRA, Department for Environment, Food & Rural Affairs; DAQI, Daily Air Quality Index; COM-B, Capability, Opportunity, Motivation – Behaviour Model

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https://doi.org/10.1016/j.envint.2019.01.052
Received 26 September 2018; Received in revised form 17 December 2018; Accepted 2 January 2019
Available online 14 January 2019

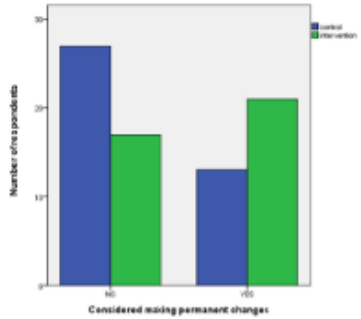


Fig. 3. Proportion of respondents in the control (n = 13, 32%) and intervention groups (n = 21, 55%) who considered making permanent changes in their daily travel route and/or exercise time or location. See Table 4.

4.1. Intentions to adhere to advice associated with a hypothetical high air pollution scenario

Our findings showed that the message format did not seem to have an impact on adherence intentions for the hypothetical high air pollution scenario, as respondents in both control and intervention groups reported relatively high intentions to follow the advice received. However, it is worth considering that initial high intentions do not necessarily translate into future behaviour (Webb and Sheeran, 2006).

Our study also showed that respondents in the control group were more willing to wear a mask (which is not a behaviour recommended by the UK DAQI), compared to the intervention group. Recent evidence suggests that many commercially available masks do not provide adequate protection (Cherrie et al., 2018). A plausible explanation for these results may be related to the fact that the advice associated with the UK DAQI has little message specificity compared to the more detailed recommendations provided in the intervention group (which clearly identified appropriate behaviours). This vagueness of recommendation might have led to the intention to adopt behaviours based on participants' personal beliefs rather than the health advice received. The implications of this may be really important depending on what type of not advised behaviour individuals adopt. Future studies should test the advantages of adopting highly specific messages.

4.2. Behaviour changes at 4 weeks

At four weeks, more respondents in the intervention group were reported to have considered making permanent changes to their daily travel route, exercise location or exercise time compared to the control group. A mediation analysis showed that the variable that mediated this effect was perception of having enough time to follow the health advice received, which was positively affected by the intervention. In group) or an alternative behaviourally targeted message format (intervention group). The latter included health advice characterised by higher message specificity and sent in conjunction with additional messages targeting specific psychosocial factors found to be associated with higher adherence.

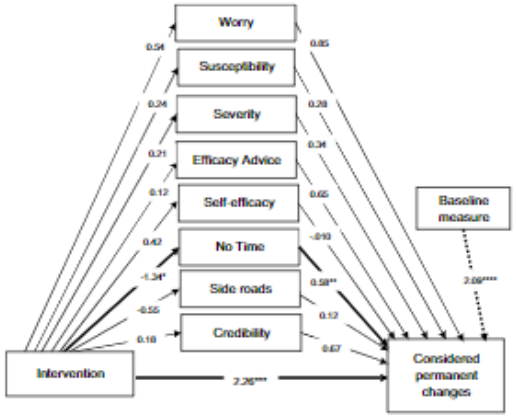


Fig. 4. Mediation analysis (model 4) showing the mediating effect of perception of time on considering permanent behavioural changes. Multiple mediation model of the intervention (intervention vs. control) on the outcome measure. This model aims to identify and explain the processes that underlie an observed relationship between an independent variable and a dependent variable through the inclusion of several hypothetical mediator variables (in this case, worry, perceived susceptibility, perceived severity, perceived efficacy of the advice, self-efficacy, perception of not having time to follow the advice, belief that taking side roads will make the journey longer, and message credibility).
Effect size measures for indirect effects are not available for models with dichotomous outcomes. The coefficients reported represent the direct effect, the effect of the independent variable on each mediator (i.e., a paths) and the effect of each mediator on the dependent variable (b paths) and are standardised. The values reported in the results section correspond to the indirect effect (i.e., a path * b path). All analyses have used 1000 bootstraps.
Significant indirect effects are represented in bold. Baseline measurements were included in the model as covariate and experimental groups coded as a dummy variable (Control = 0; Intervention = 1).
*$p = 0.0059$; **$p = 0.0132$; ***$p = 0.0111$; ****$p = 0.0113$.

Canairy – the app for outdoor workers

Canairy

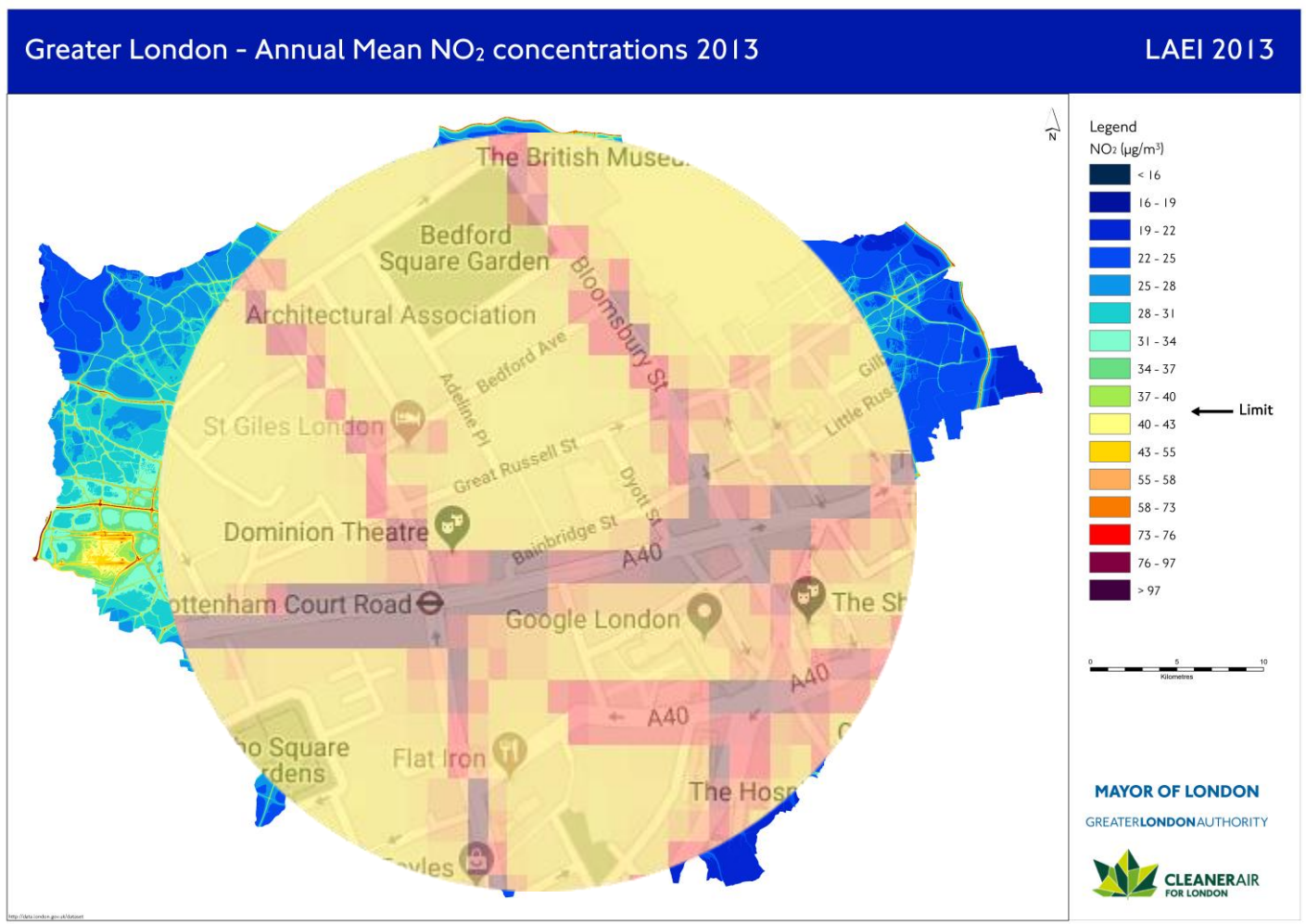
Canairy

- Build evidence base
- Information & advice for workers
- Intelligence for employers
- Data for BSC and KCL

Canairy


21:58
Map
14:32
Logs
Start
14:45
µg/m³
00:00
04:00
08:00
2.5µm P
10µm P
TESCO
21:41
Thursday 18 October
CANAIRY
NO2 Exceedance
Your exposure in the last hour exceeded WHO guidelines.
Head into the app to learn more.

Canairy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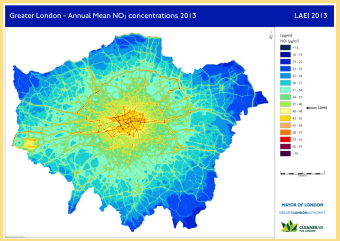
LAEI 2013
Legend
NO2 (µg/m3)
< 16
16 - 19
19 - 22
22 - 25
25 - 28
28 - 31
31 - 34
34 - 37
37 - 40
40 - 43
43 - 55
55 - 58
58 - 73
73 - 76
76 - 97
> 97
Limit
Kilometres
MAYOR OF LONDON
GREATERLONDONAUTHORITY
CLEANERAIR FOR LONDON
Bedford Square Garden
Architectural Association
Bloomsbury St
Bedford Ave
Adeline Pl
St Giles London
Great Russell St
Dyott St
Dominion Theatre
Bainbridge St
A40
Google London
Flat Iron

Canairy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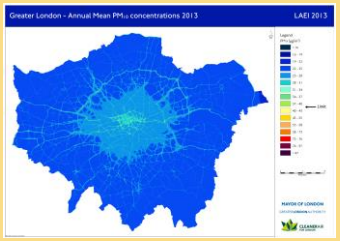
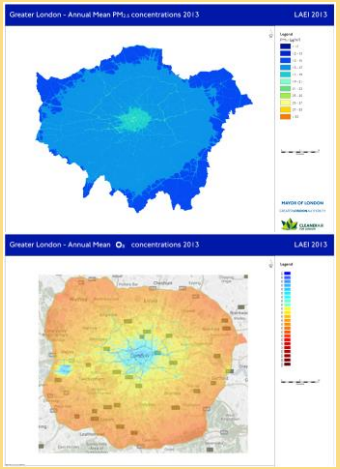
LAEI 2013


Greater London - Annual Mean PM_{10} concentrations 2013
LAEI 2013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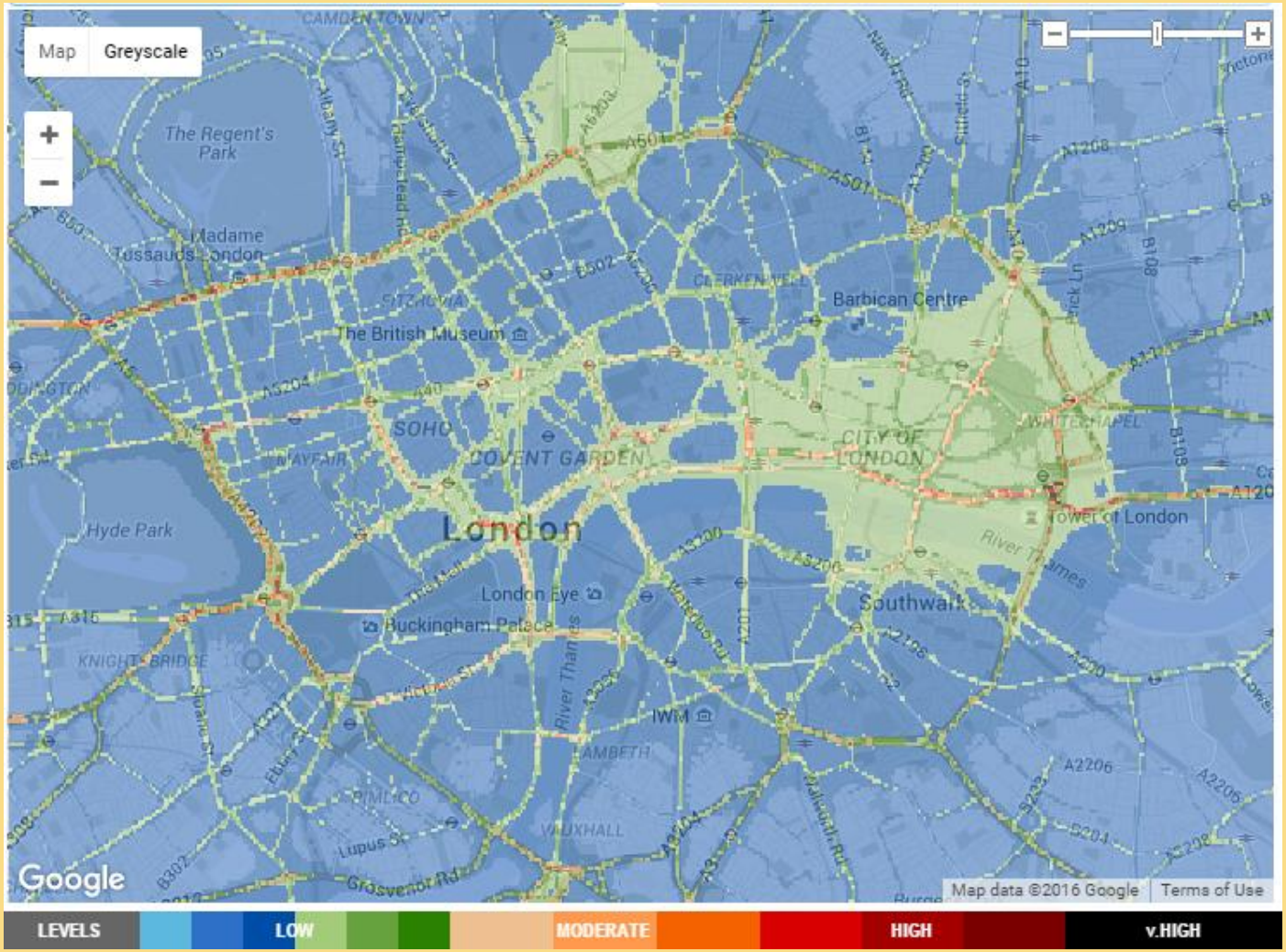
LAEI 2013
Greater London - Annual Mean O_3 concentrations 2013
LAEI 2013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SOHO
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London
London Eye
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Southwark
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IWM
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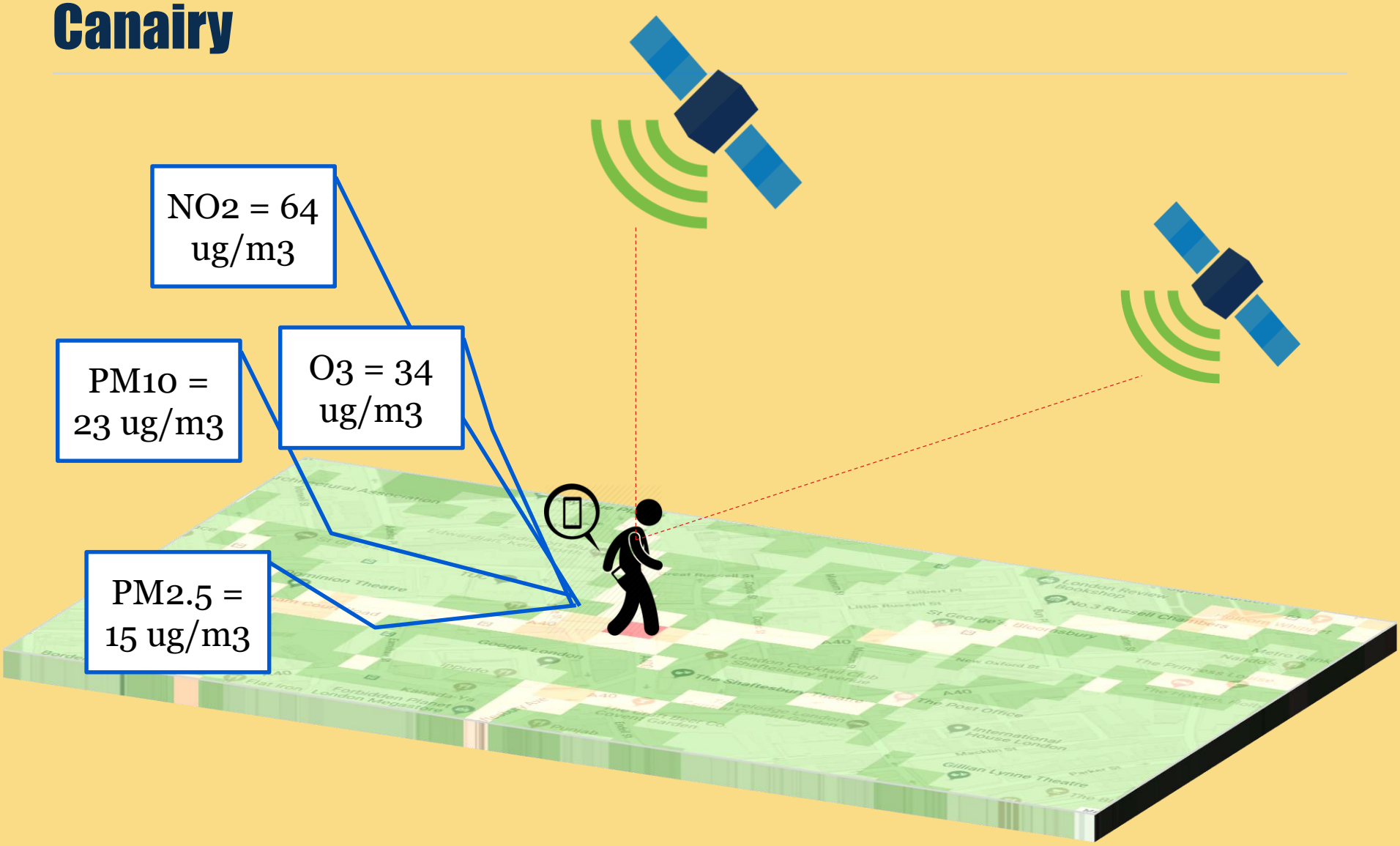
Terms of Use
LEVELS
LOW
MODERATE
HIGH
v.HIGH

Canairy



Canairy


LLADIUM
UK THEATRES
CLEAN AIR
PROTECT OUR WORKERS WHO PROTECT
STOP
A DIRTY JOB
NOT
DIRTY AIR
time to breathe
THE DAILY AIR

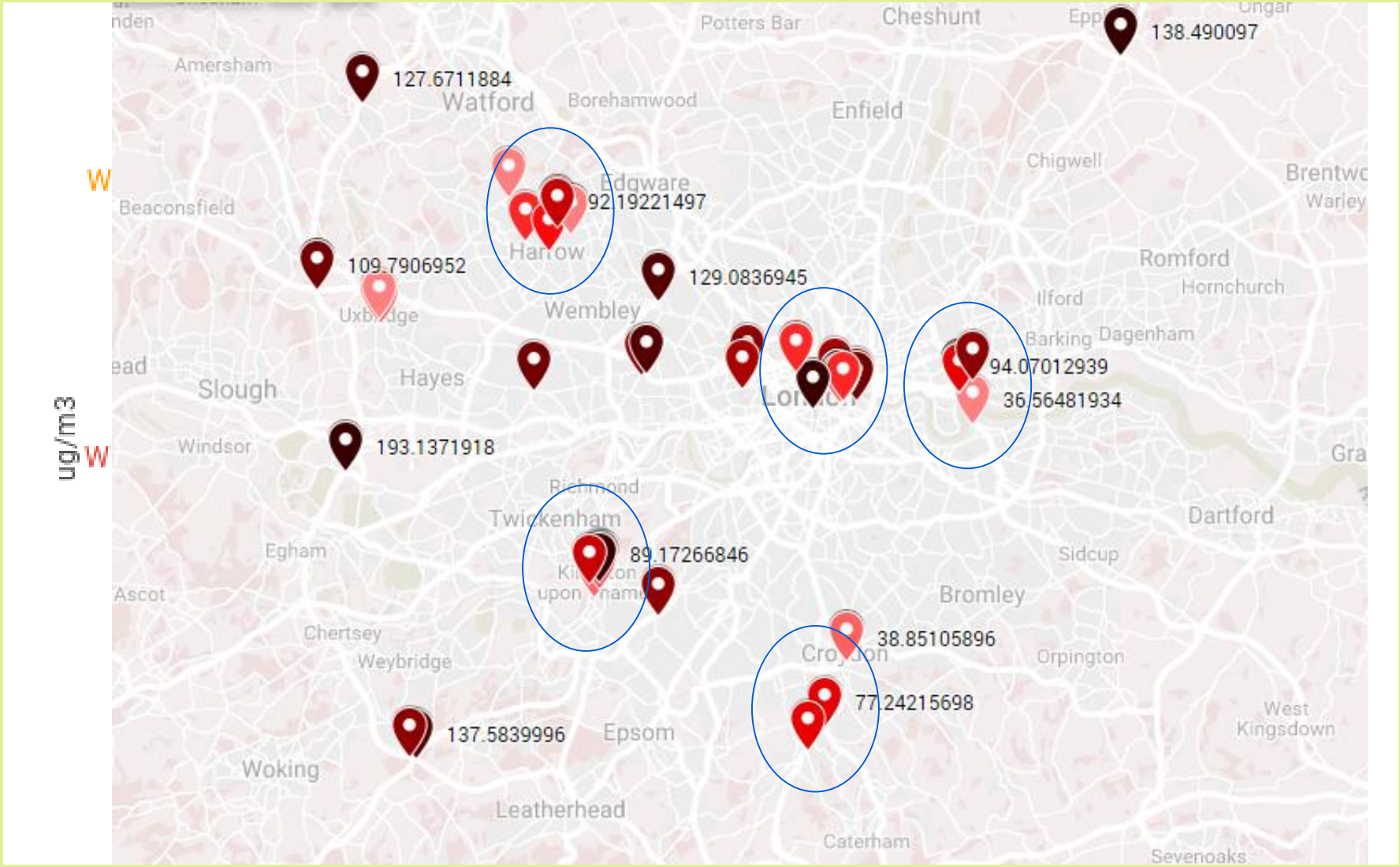
30+ Organisations

Canairy


ENABLING WORKS CONTRACT | SOUTH
Safety, Health, Wellbeing & Environment Strategy
Time to Breathe
for Outdoor Workers
Campaign
British Safety Council is launching Time to Breathe, a UK-wide campaign to raise awareness of the risks to outdoor workers from air pollution.
Download the British Safety Council's CANAIRY APP.
This is tool for London-based employers and workers to gather information to help reduce exposure of outdoor workers to poor quality air. It comes in both iOS and Android versions and is FREE to use.
Canairy
Pollution protection for outdoor workers
Register for free using the QR code or visit:
https://bit.ly/2HKAQT0
Check your Peak Flow to measure lung health
3 simple ways to book:
bookwhen
oh@csjv.co.uk
01273 013669
Safe at heart
SKANSKA
Working on behalf of
HS2
March
June
September
December
Silent Killers
Wellbeing medicals for all
Relaxation Tec
Safe at heart

Construction Company

Construction



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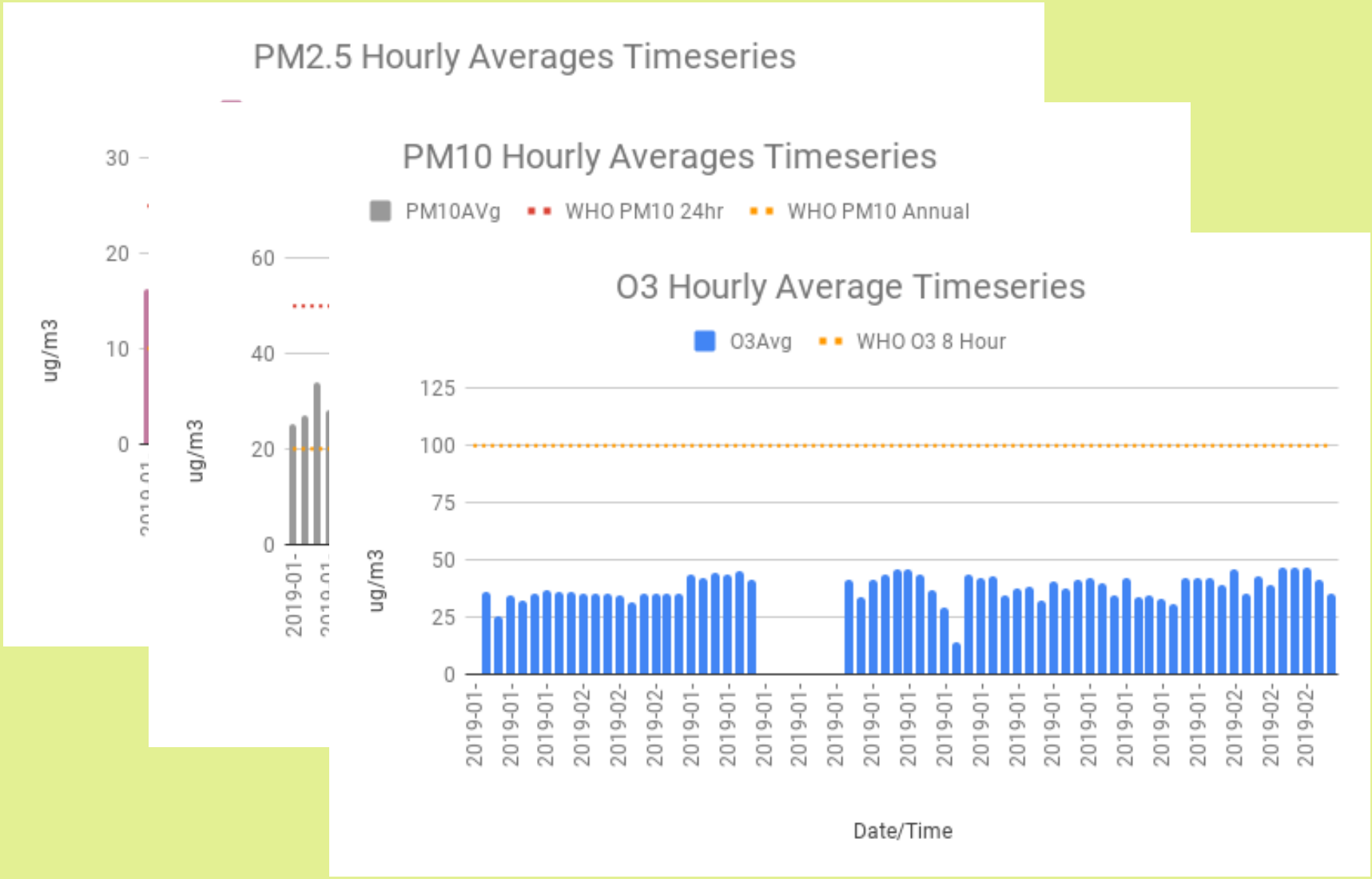
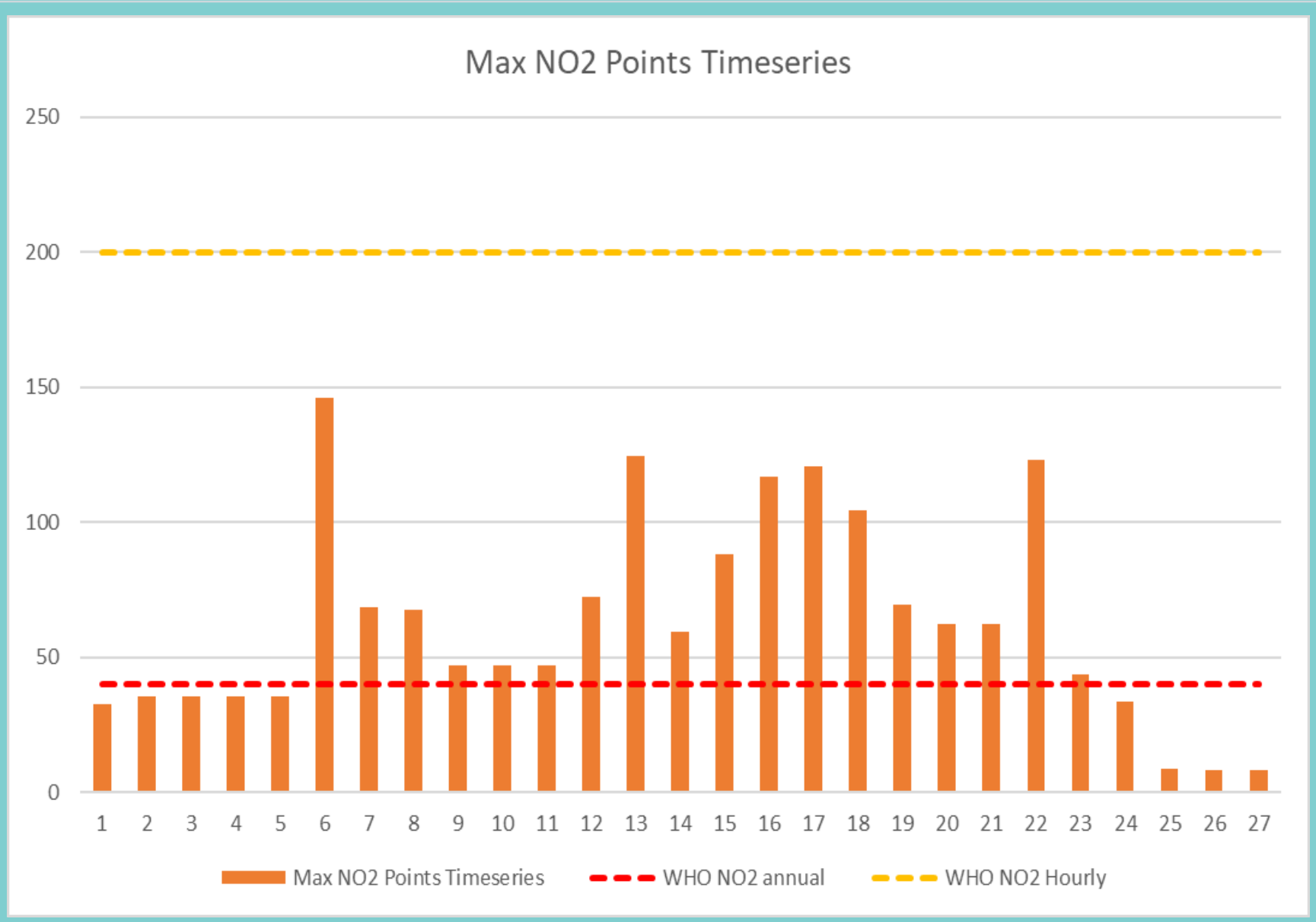


Courier Company

Courier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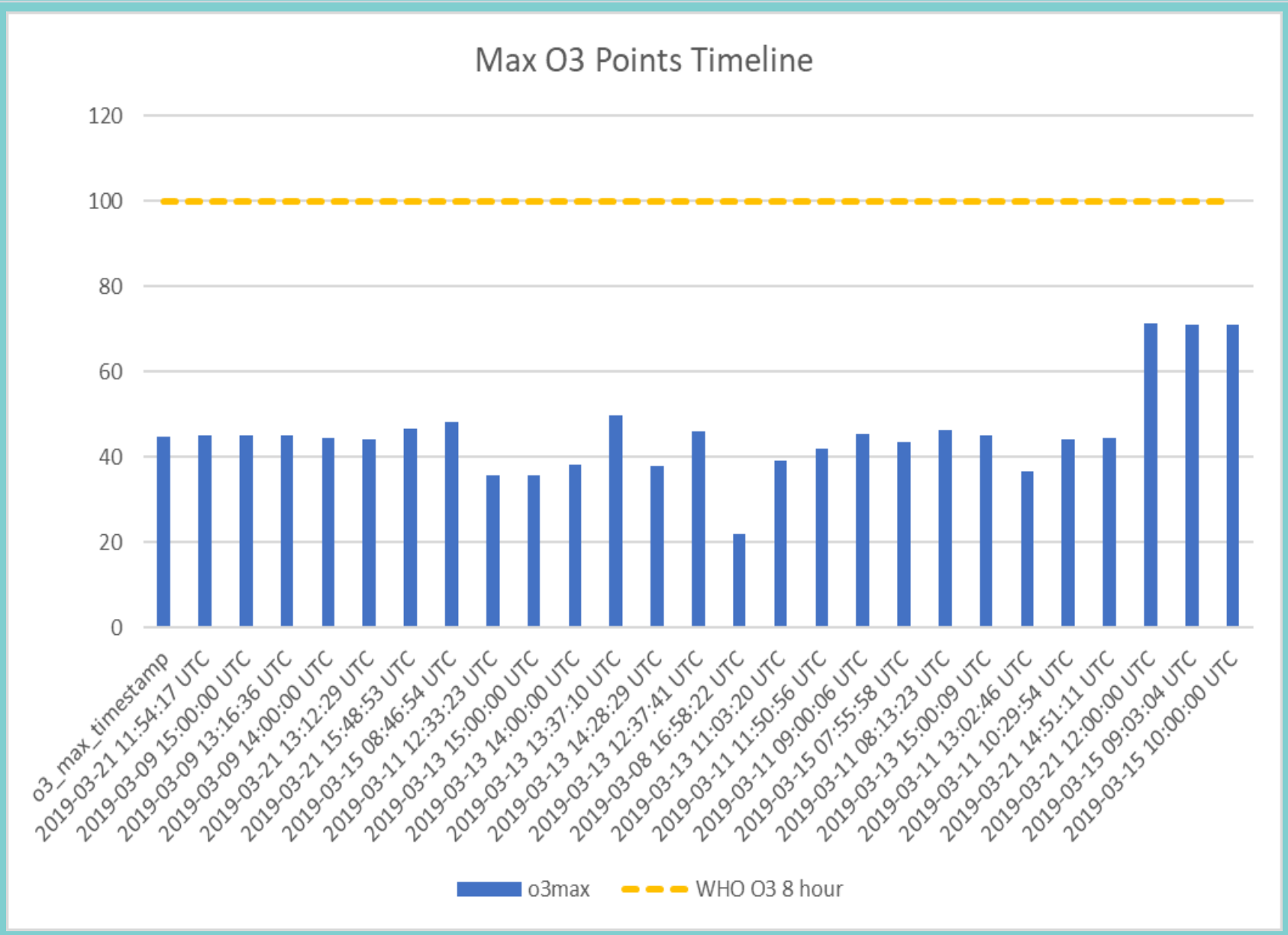
WHO NO2 Hourly

Courier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100
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60
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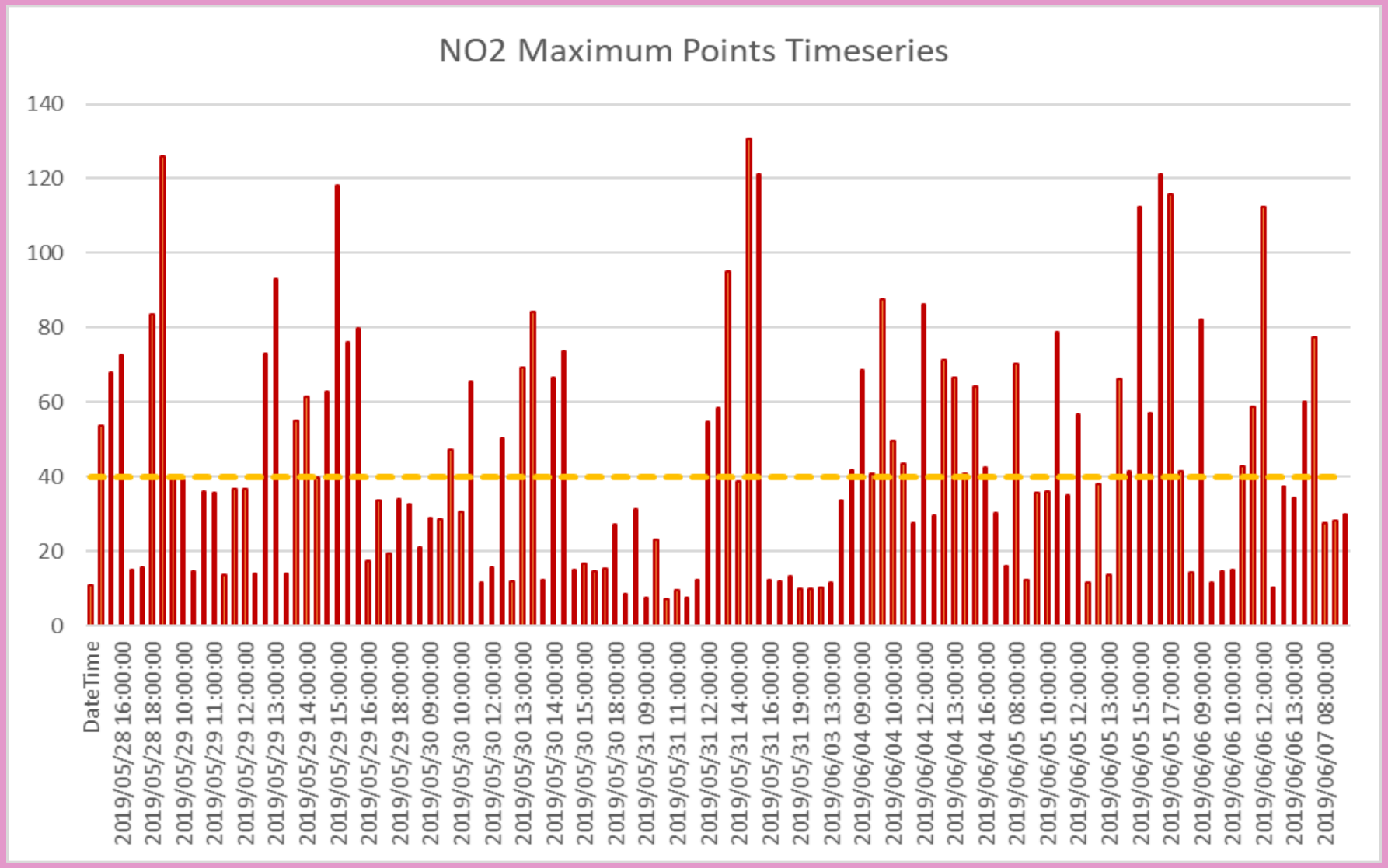
o3max
WHO O3 8 hour

Airport

Airport


NO2 Maximum Points Timeseries
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120
100
80
60
40
20
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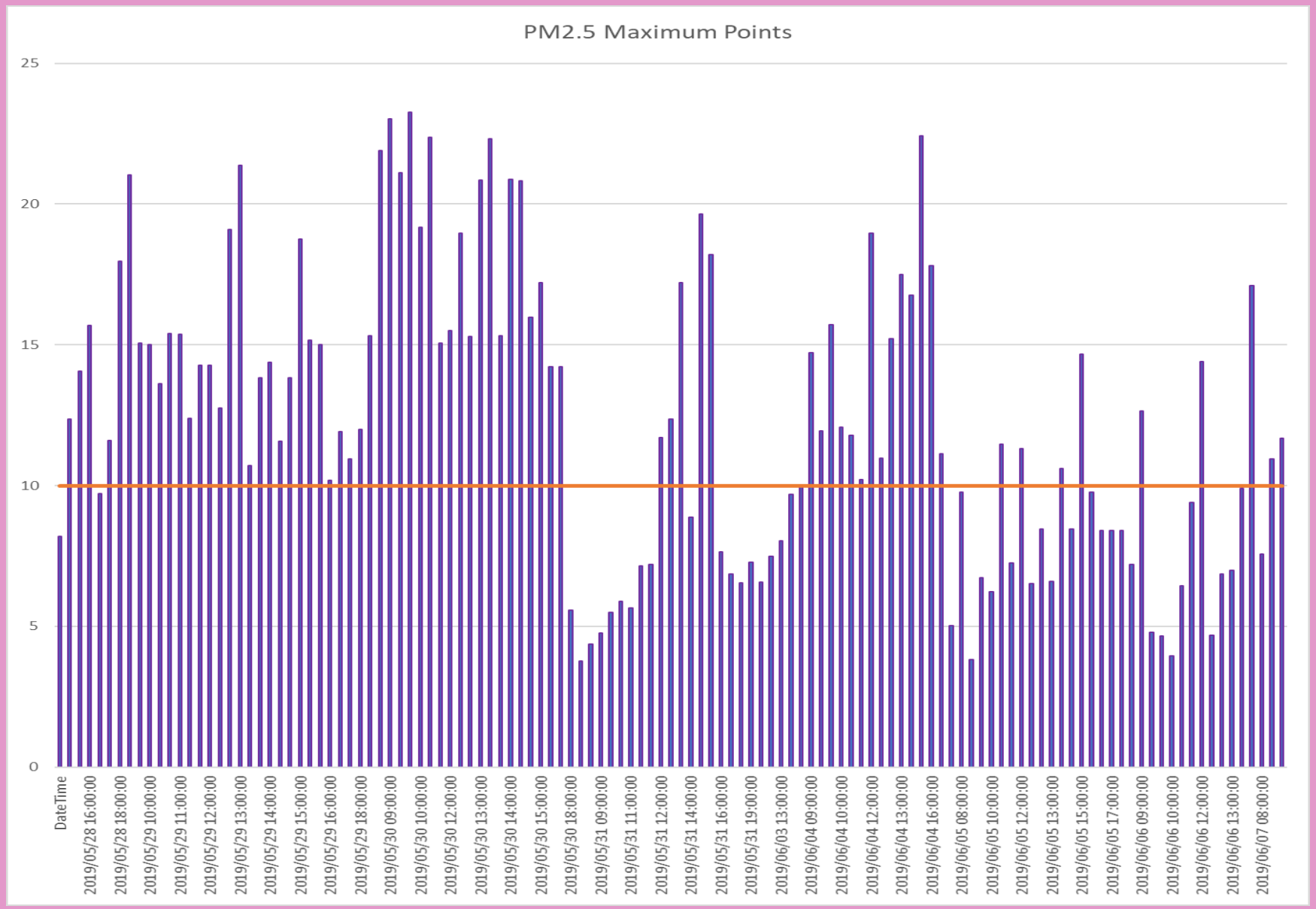
2019/06/06 13:00:00
2019/06/07 08:00:00

Airport


PM2.5 Maximum Points
25
20
15
10
5
0
DateTime
2019/05/28 16:00:00
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2019/06/07 08:00:00

Summary

Summary

- New type of data: Pollutant (avg+max) + Location + Time + Occupation
- Ability to track exposures over time
- New intelligence for Employees + Employers + Campaigners + Researchers
- Limitations: It's modelled data
- Advantages: Able to reach lots of people


The boroughs & BIDs & Businesses of the
London, Sussex, Essex & Hampshire air quality networks
ISLINGTON
CROYDON COUNCIL
Royal Kingston
BRENT COUNCIL
Camden
Ealing
Lambeth
GROSVENOR
ENFIELD Council
ROYAL GREENWICH
Hackney
h&f
THE LONDON BOROUGH OF HAVERING
Lewisham
Southwark Council
Redbridge
merton
THURROCK COUNCIL
WINDSOR AND MAIDENHEAD
TOWER HAMLETS
Reigate & Banstead BOROUGH COUNCIL
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New Forest
City of Westminster
CHICHESTER District Council
castlepoint
ADUR
Horsham District Council
Brighton & Hove City Council
SOUTHAMPTON CITY COUNCIL
EASTBOURNE
Leicester City Council
Hastings
Crawley
Wealden
inmidtown

Thank you

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