Citizen Science and the Science of Cities

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About Me

- GIS consultant for 10 years in the Middle East, the UK and all over Europe
  - Specialist in databases, software design, development and systems integration
- PhD in Geographical Information Science from University College London (UCL) in 2007
  - Founded in 1826, 30,000 students, 5000 staff
  - Ranked 5th in the world (QS 2014)
- Now Lecturer in Geographical Information Science
- Research interests – GIS and technology
  - Citizen Science
  - 3D GIS
  - GIS data quality and usability

Citizen Science and the Science of Cities

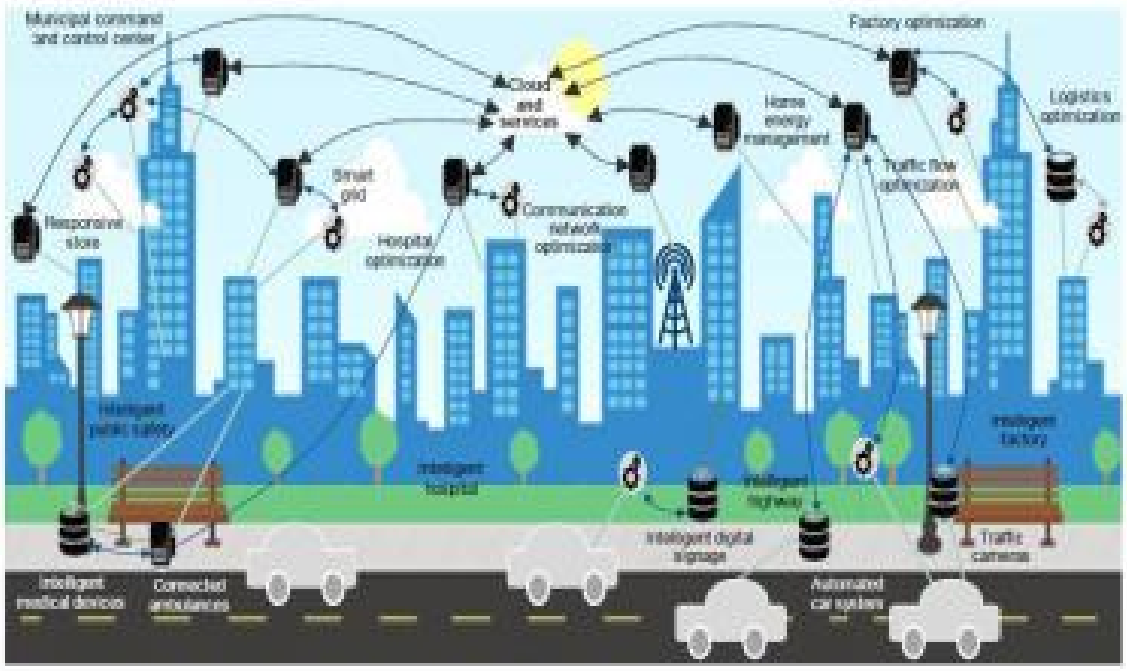
- Overview
  - **Introduction - Smart Cities**
  - Citizen Science and Extreme Citizen Science
  - Case Studies
    - Noise
    - Air Quality
  - Citizen Science and Smart Cities
    - Some Considerations

Smart Cities

Smart City

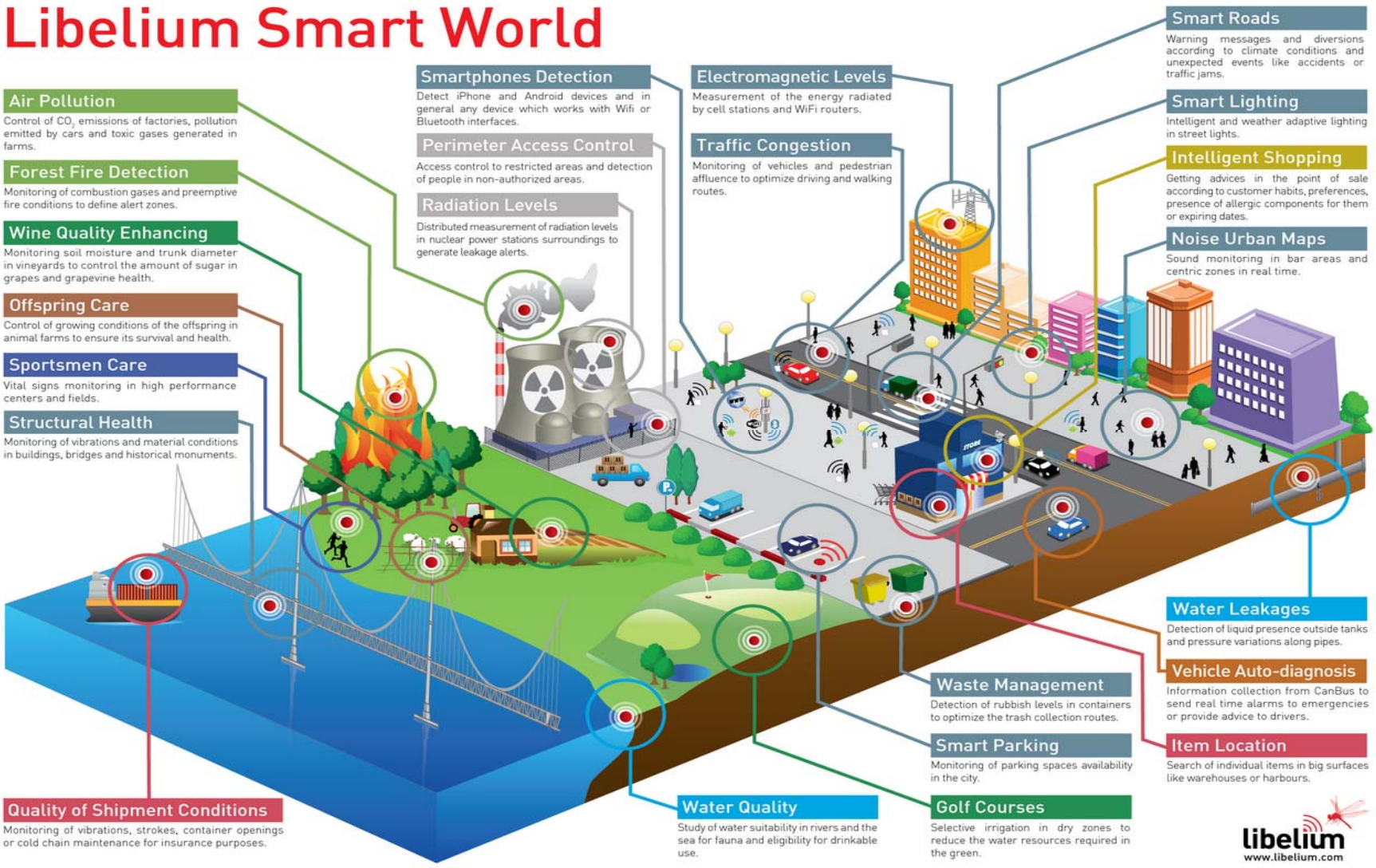
•An efficient, sustainable city with integrated information, active citizen participation and intelligent management

A City with a Digital Overlay



Source: IDC Government Insights, 2013

Smart Cities



Smart Cities

Where am I? > Home > News > Public Sector > Government

Budget 2015: George Osborne pledges £140m to develop Internet of Things, smart cities and driverless cars - Updated

By Danny Palmer

Follow @dannyjpalmer

18 Mar 2015

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The government will pledge funds to develop applications for the Internet of Things and smart cities, Chancellor of the Exchequer George Osborne has announced as part of the Budget.

The funding forms part of what the Treasury describes in the Budget document as "strategic science and innovation investments to make the UK a global leader in emerging markets and technologies".

A total of £40m will be set aside for "for demonstrator programmes, business incubator space and a research hub to develop applications for Internet of Things technologies in healthcare and

Further reading

- Internet of Things, analytics, mobile and cloud 'very much part of the agenda' for Ministry of Defence

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MEPs: Future privacy policy will be continually updated 'like a smartphone'

- Government will regret 'demonising CIO role', says former HMRC CIO
- Data protection authorities 'facing considerable resource challenges' due to digital boom
- Heathrow third runway 'like having a dial-up connection to the Internet of Things' says Mayor of London

Smart Cities

GIS LOUNGE

Front Page | What is GIS? | GIS Career | Learn GIS | Maps | GIS Data | Software | Spatial Analysis | Resources

How Spatial Big Data Underpins Smart Cities

BY GIS CONTRIBUTOR GIS INDUSTRY

Han Wammes, the Business Development Manager Geospatial Information Management at 1Spatial, writes about how cities can collect and harness the necessary information to create a smart city. In this piece, Wammes makes the case that "everything happens somewhere and only when you know where everything is can you create the connections that make cities smart. Underpinning any smart city program is trusted geospatial information; one single source of reliable, location-specific data."

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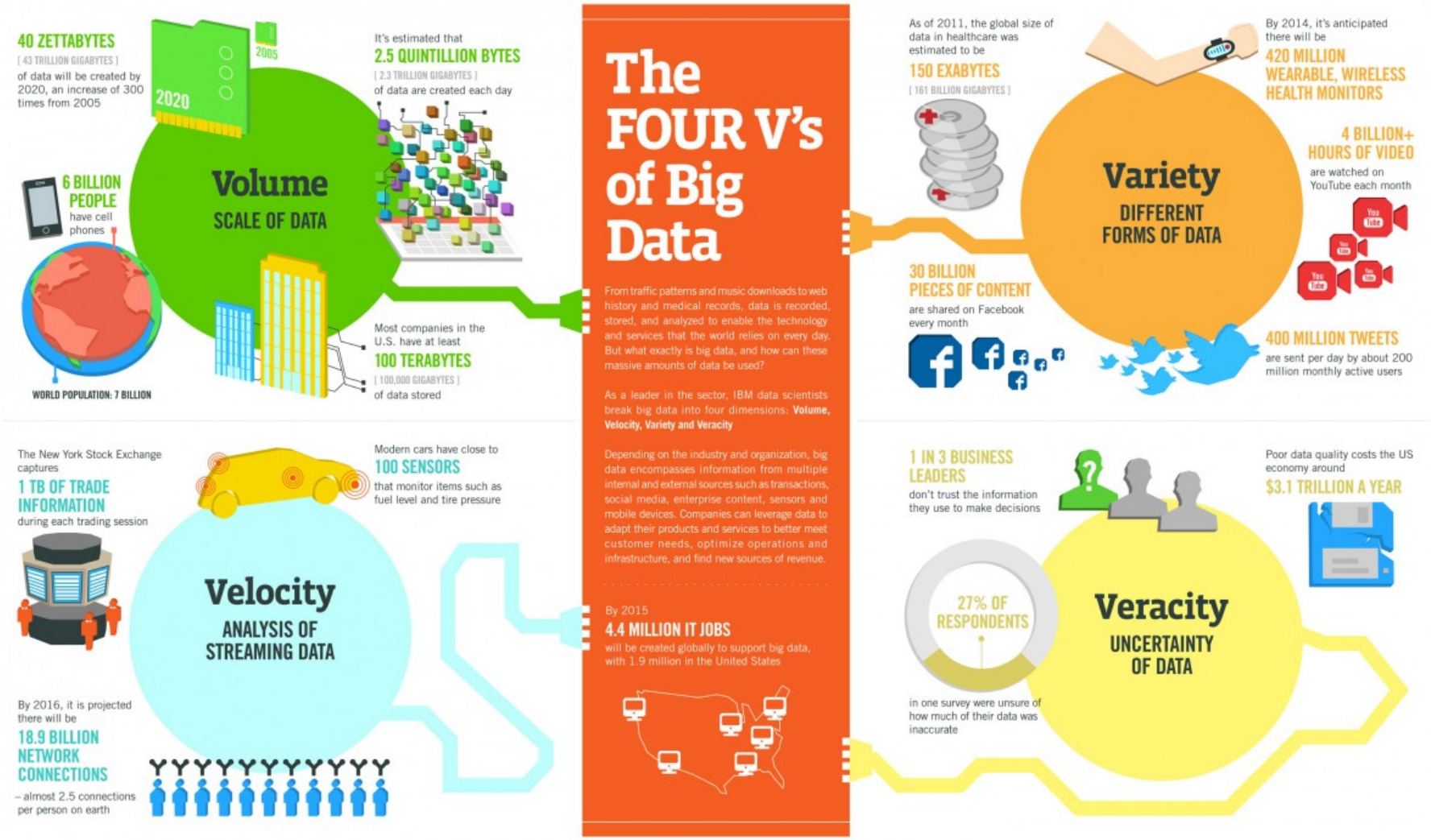
Governments, local councils, utility companies and dog owners; everyone could benefit from their city becoming smarter. Mayors and local councils recognise that a smart city is crucial for a city's development and improvement in the 21st century. The UN reports that 54% of people worldwide live in a city, half of these in cities which have fewer than 500,000 people. So how can these stakeholders collect and harness the necessary information to create a smart city? Everything happens somewhere and only when you know where everything is can you create the connections that make cities smart. Underpinning any smart city programme is trusted geospatial information; one single source of reliable, location-specific data.

The UN said in its recent report [1] "cities are where the battle for sustainable development will be won or lost". So how are cities beginning to manage this transformation? Many are starting with isolated, manageable

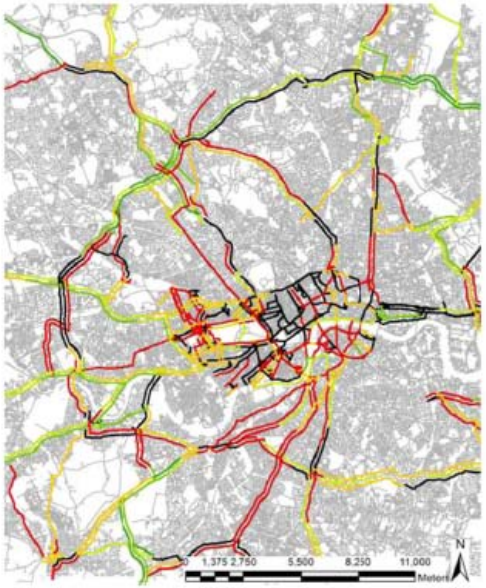
Smart Cities and Big Data



Sources: McKinsey Global Institute, Twitter, Cisco, Gartner, EMC, SAS, IBM, MEPTEC, QAS

Smart Cities: Sensors and Big Data

- Using Automatic Number Plate Recognition to measure journey time across a city



Citizen Science and the Science of Cities

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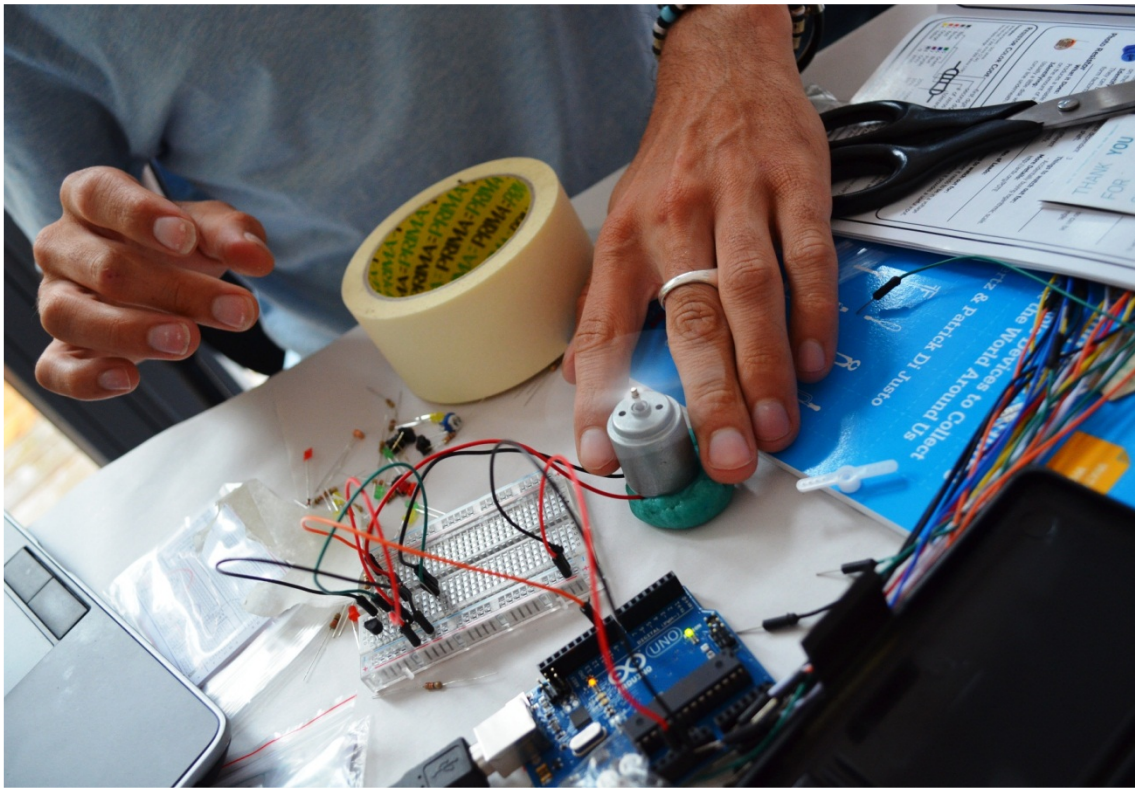
  - Case Studies
    - Noise
    - Air Quality
  - Citizen Science and Smart Cities
    - Some Considerations

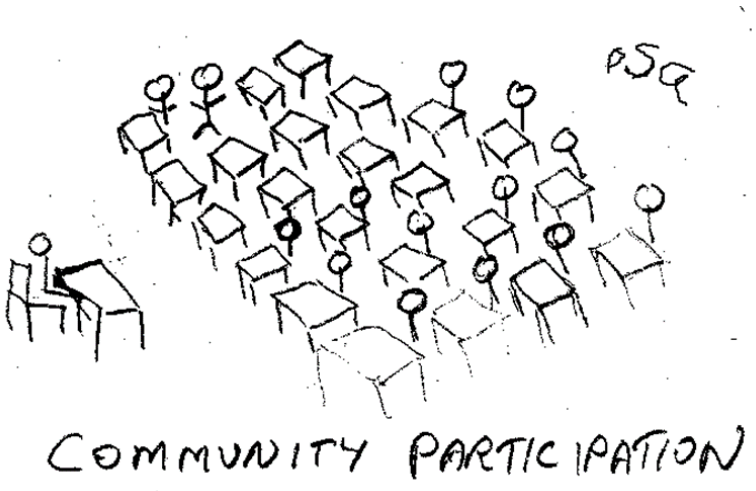
Citizen Science

- Citizen Science is a form of research collaboration involving members of the public in scientific research projects to address real-world problems (Wiggins and Crowston 2011)
- “The scientific activities in which nonprofessional scientists volunteer to participate in data collection, analysis and dissemination of a scientific project” (Cohn 2008; Silvertown 2009).



Levels of Citizen Science

Level 4 'Extreme'	• Collaborative Science – problem definition, data collection and analysis
Level 3 'Participatory science'	• Participation in problem definition and data collection
Level 2 'Distributed Intelligence'	• Citizens as basic interpreters
Level 1 'Crowdsourcing'	• Citizens as sensors



Citizen Science and ‘Extreme’ Citizen Science

	‘Normal’ Citizen Science	‘Extreme’ Citizen Science
Users	Educated, usually with some domain knowledge	Everyone, regardless of level of literacy
Location	Wealthy, populated and popular	Everywhere
Role	Data collection and entry	Shaping the problem, analysing the data
Mode of work	Crowdsourcing	Collaborative and participatory science

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Case Study: Noise

- Noise – some facts
  - Noise is subjective and defined as ‘unwanted sound’, as such one person’s noise is another person’s sound. The World Health Organization (WHO) recommends an annual average night exposure not exceeding **40 decibel (dB)**
  - Sleepers that are exposed to night noise levels above 40dB on average throughout the year, corresponding to the sound in a quiet street, can suffer mild health effects like sleep disturbance and insomnia.
  - Above 55dB long term average exposure, similar to the din of a normal conversation, noise can get to trigger elevated blood pressure and heart attacks.

Case Study: Noise

- DEFRA Road Noise Map, WC1E 6BT, from http://services.defra.gov.uk/wps/portal/noise (15th February 2014)

Case Study: Noise

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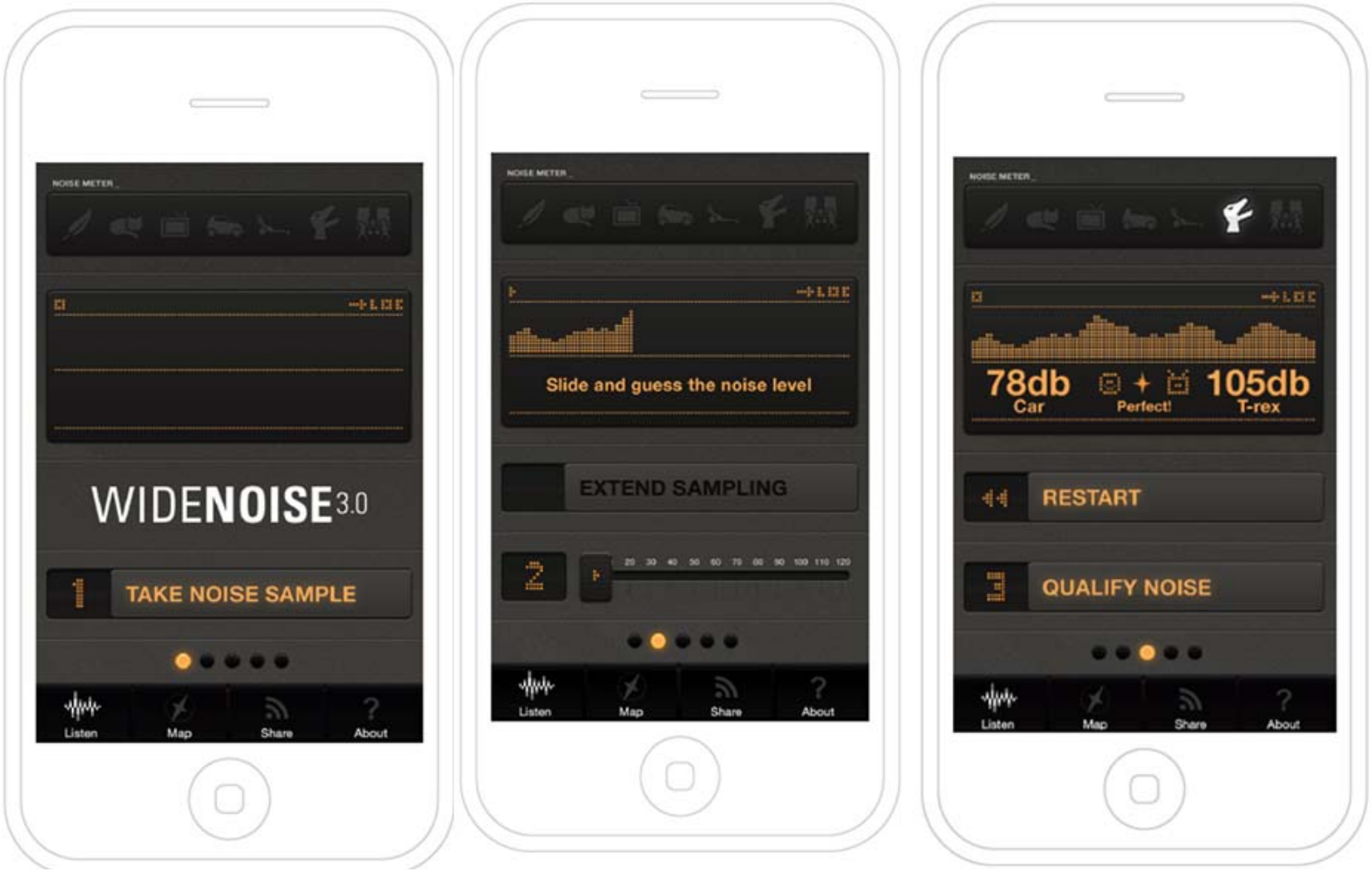

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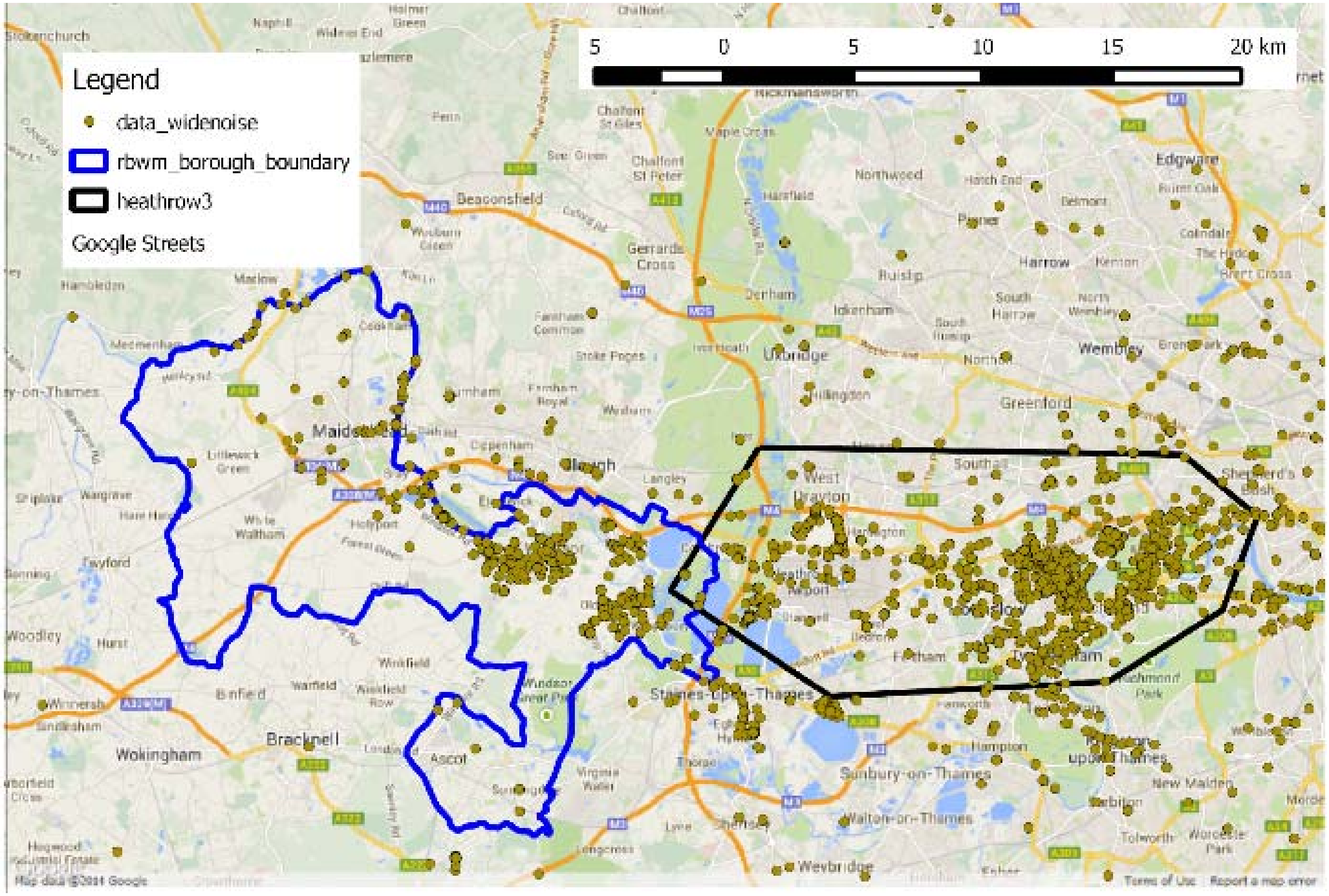
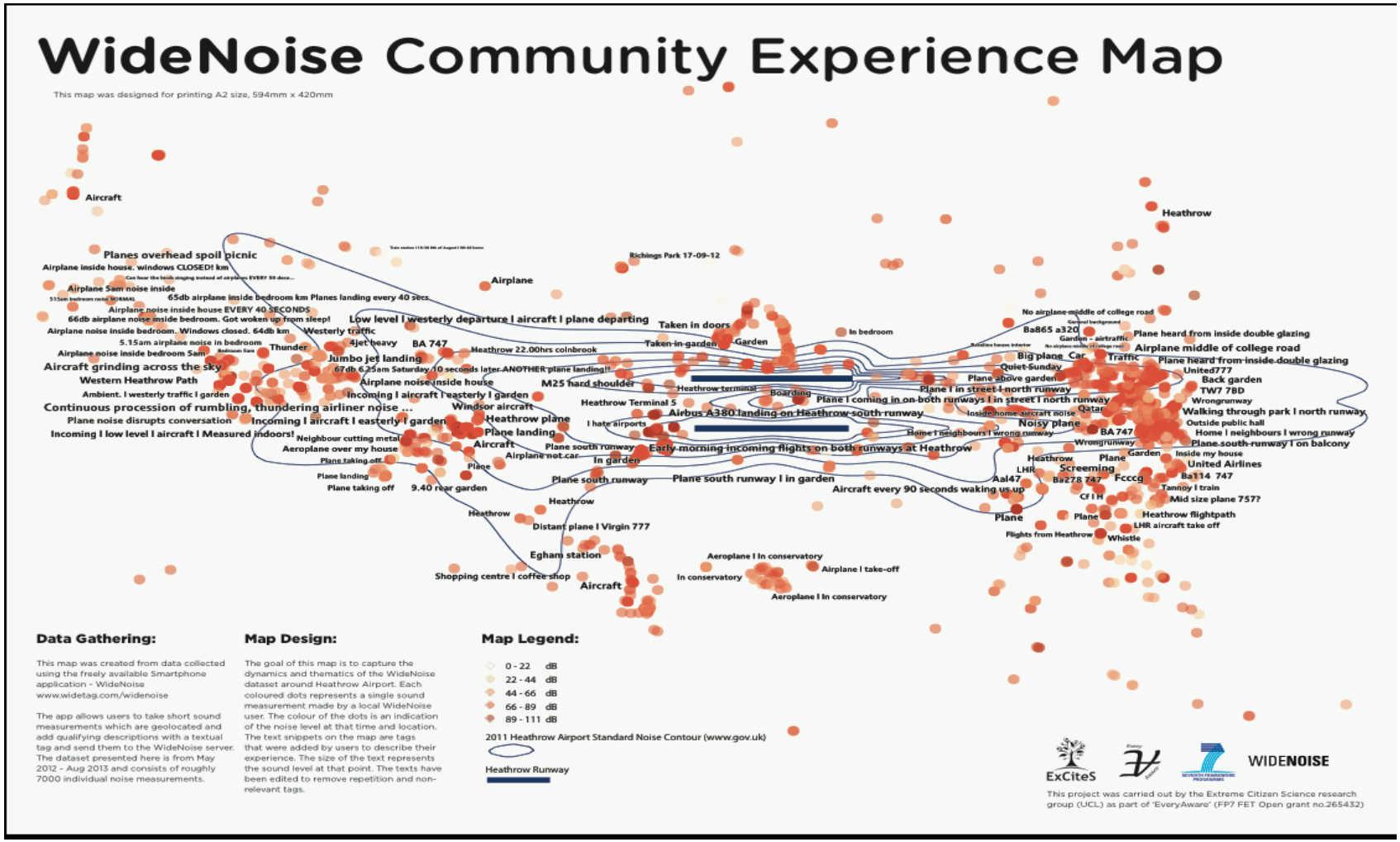


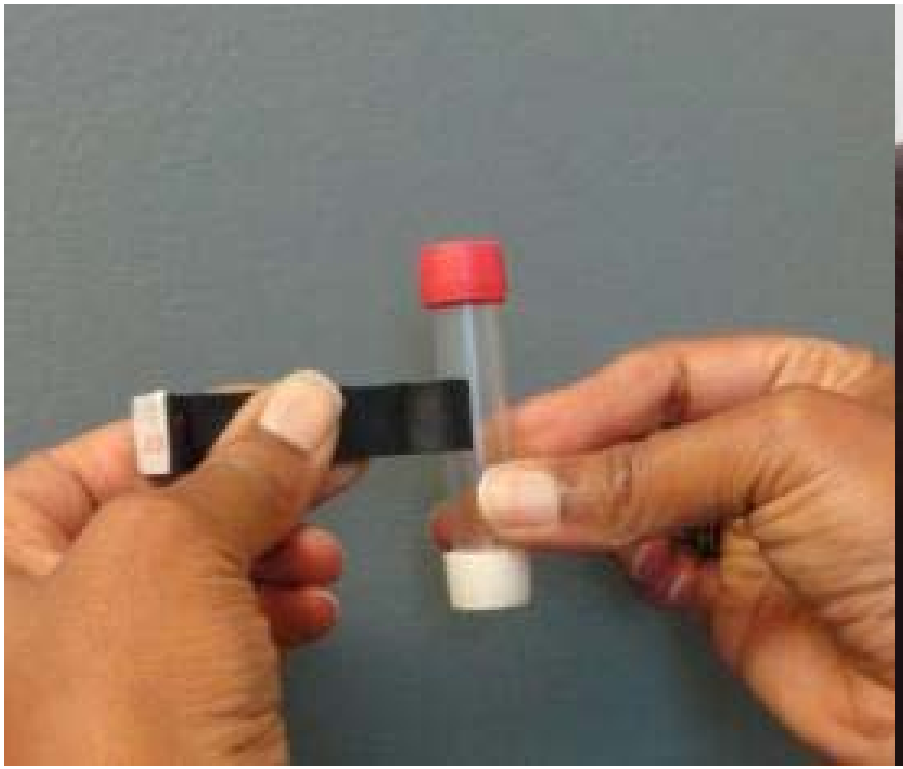
Case Study: Noise

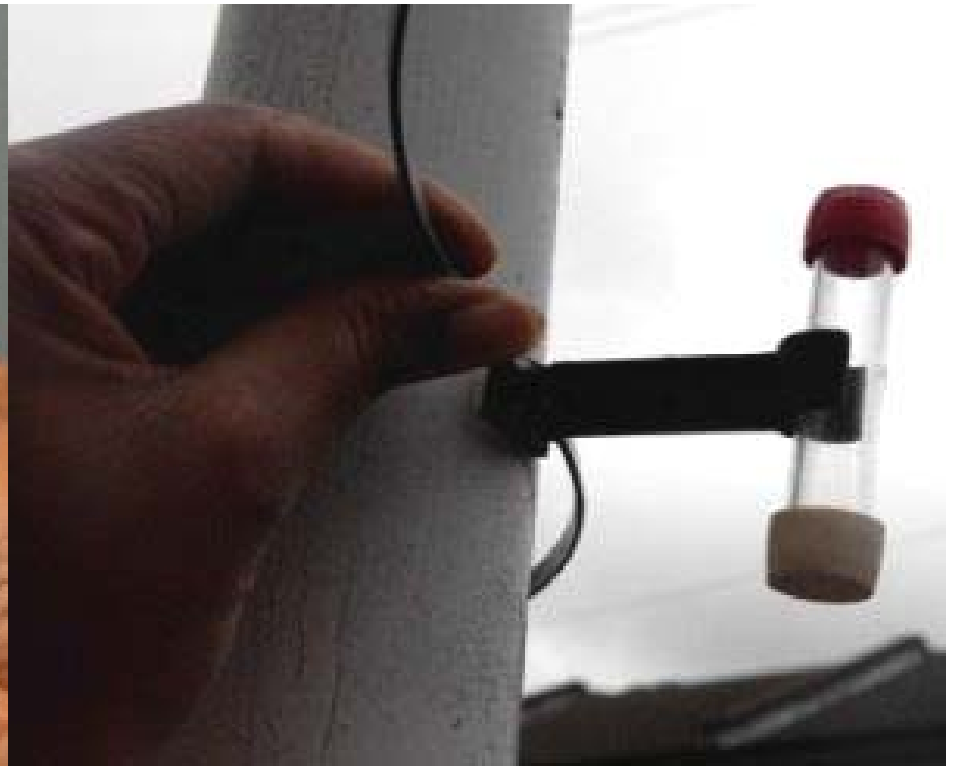


Case Study: Air Quality

- Air Pollution – Some Facts
  - Ozone pollution causes breathing difficulties, triggers asthma symptoms, causes lung and heart diseases, and is associated with about 21 000 premature deaths per year in 25 countries in the WHO European Region
  - Poor air quality is particularly an issue for children, those with heart or lung diseases, or the elderly
  - The available evidence is also sufficient to assume a causal relationship between exposure to PM and aggravation of asthma as well as cough and bronchitis symptoms.
  - Daily mortality and hospital admissions have been linked with short term variation of PM levels.

Case Study: Air Quality





Case Study: Air Quality

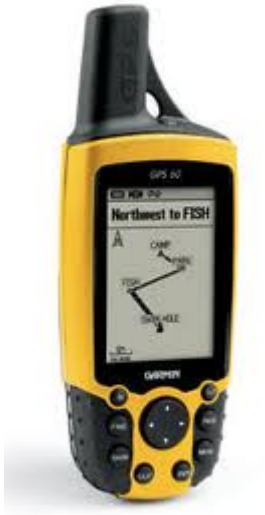
Surveyor Name:

Contact Details:

Details	Tubes Put Out	Tubes Taken In
Date		
Time (use 24 hour clock)		
Name of Road		
Location Description (e.g. residential street, park, high street).		
Site Characteristics (e.g. building/road works, traffic diversion)		
Tube Condition (e.g. tube found on the ground, dirt, insect or liquid inside tube).		

Figure 2.26: Nitrogen Dioxide Levels in Putney

Case Study: Air Quality



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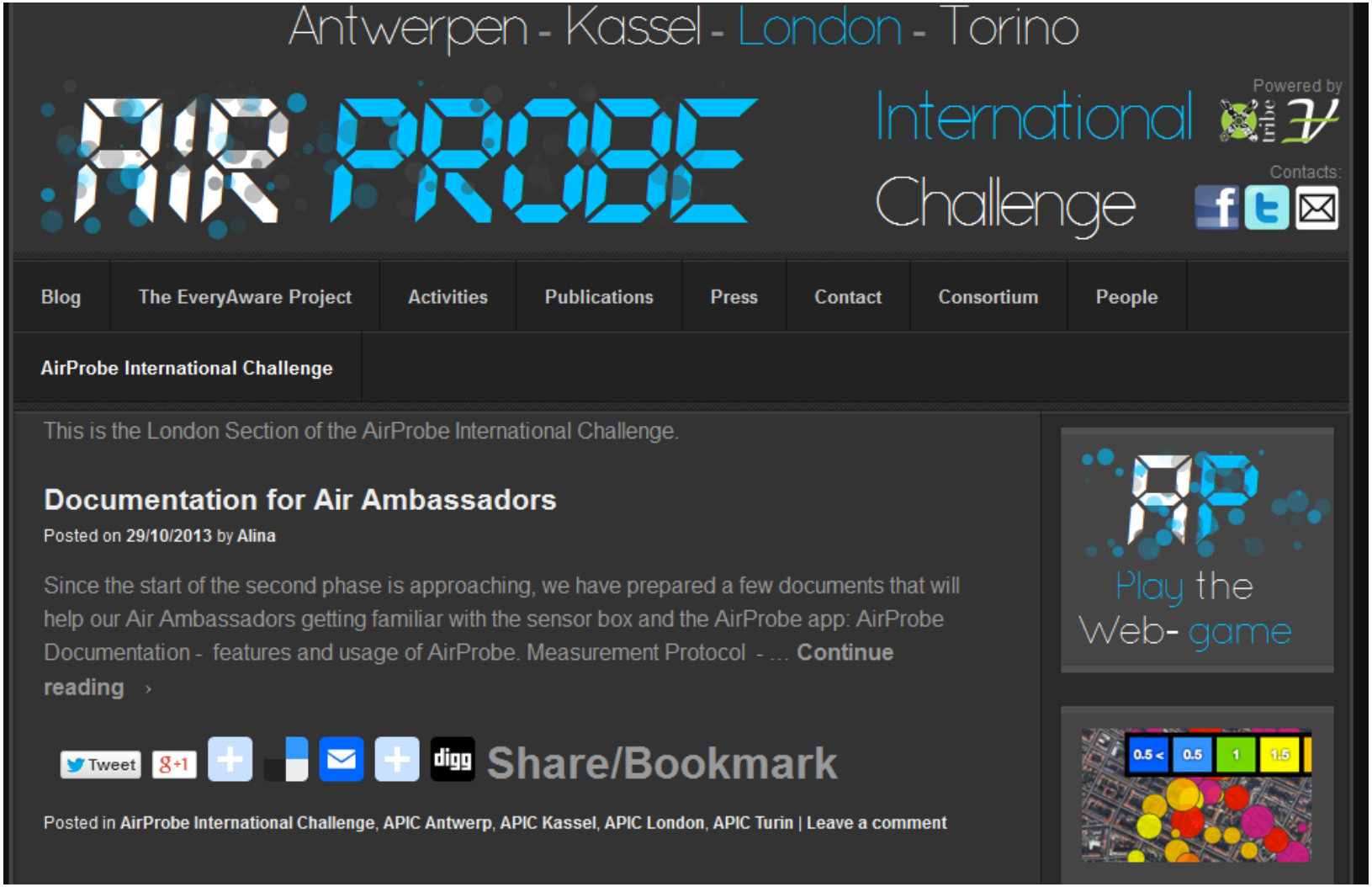
c. 5000 Euro

c. 500 Euro

http://www.everyaware.eu

Case Study: Air Quality



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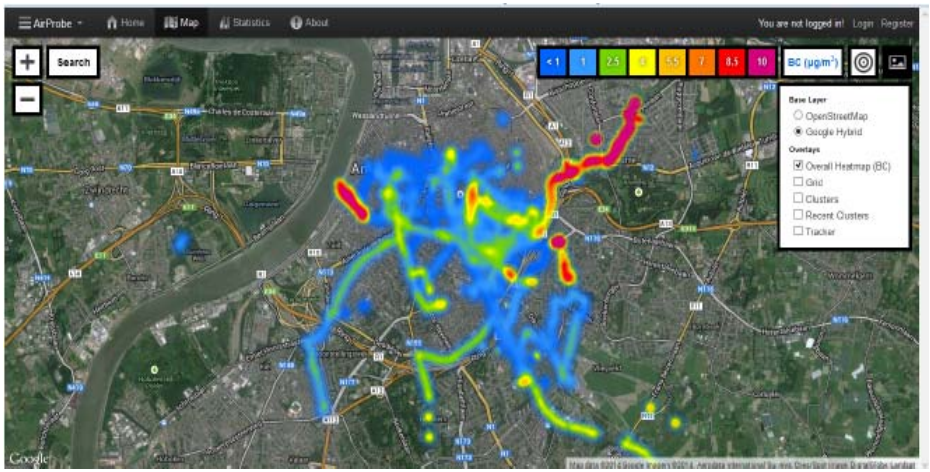
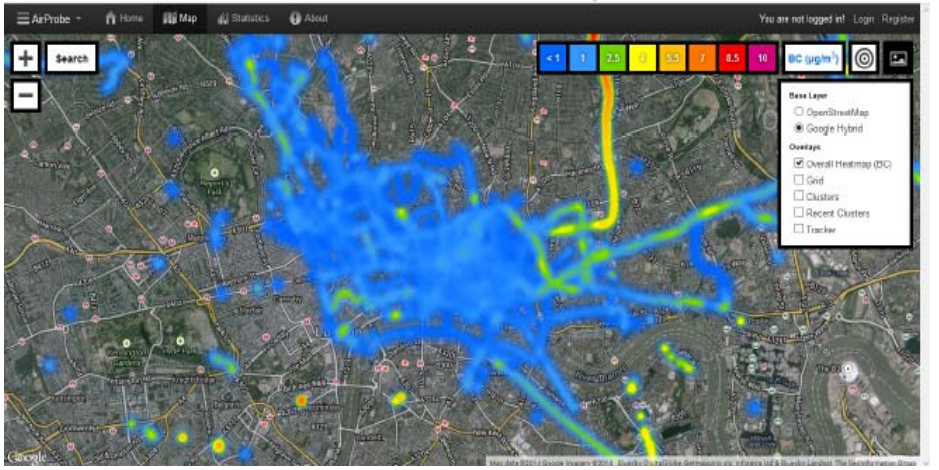


Base Layer
○ OpenStreetMap
● Google Hybrid
Overlays
☑ Overall Heatmap (BC)
☐ Grid
☐ Clusters
☐ Recent Clusters
☐ Tracker



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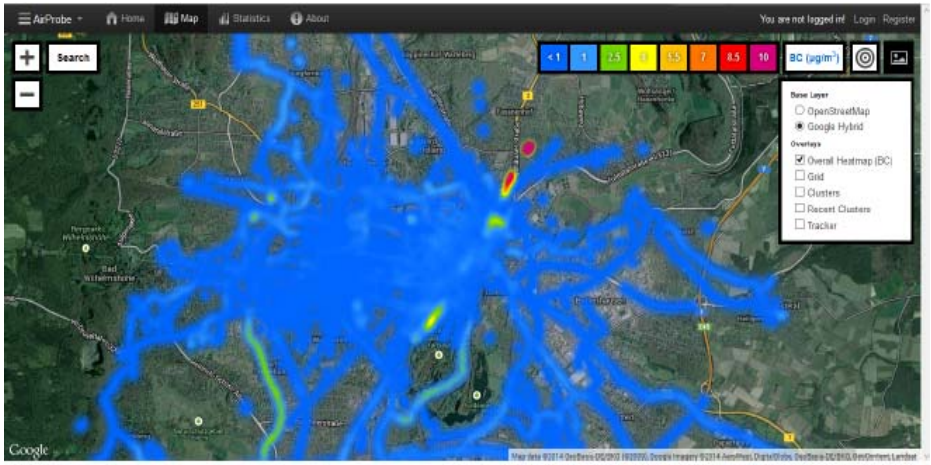

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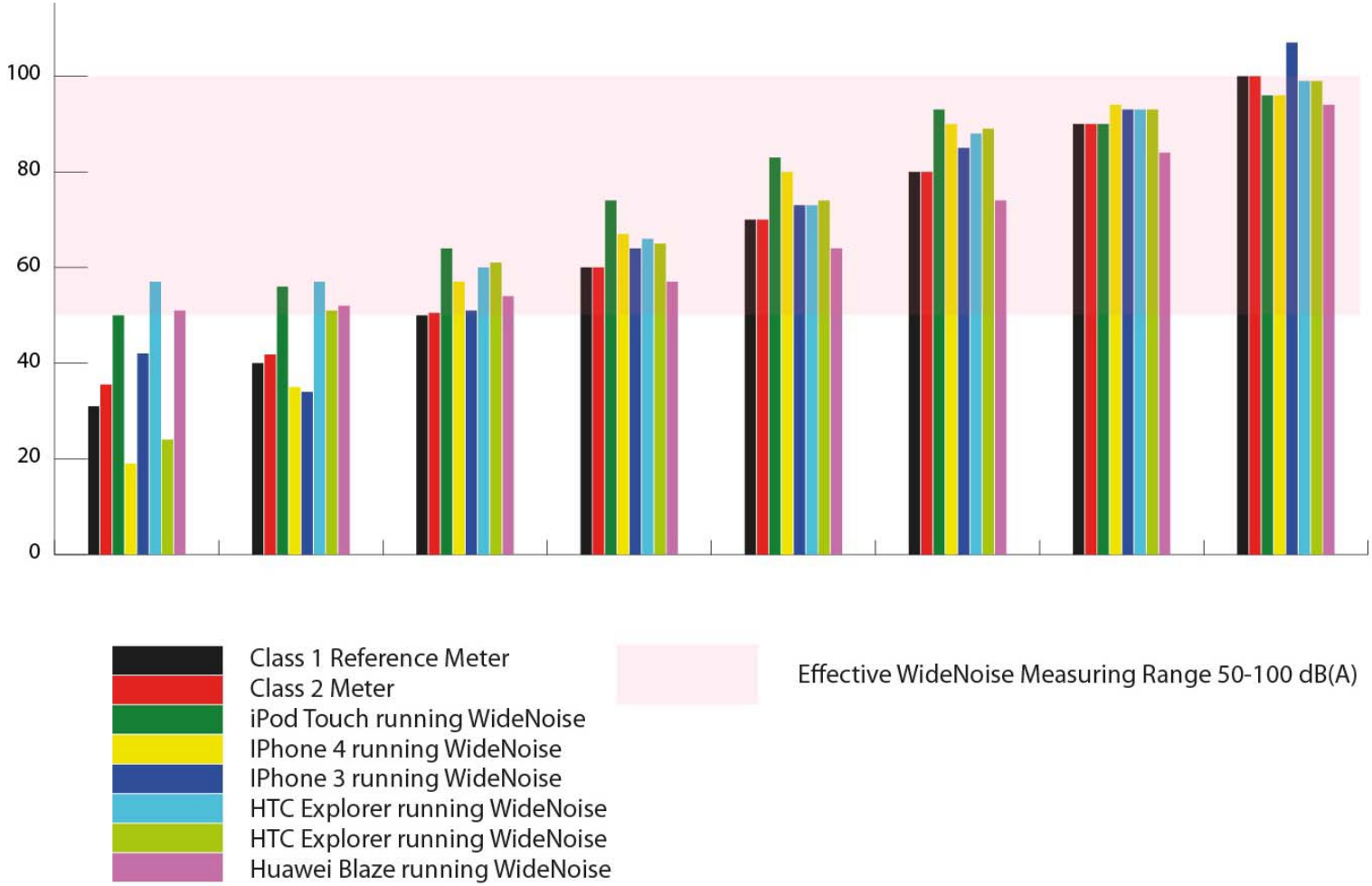
Citizen Science and Smart Cities

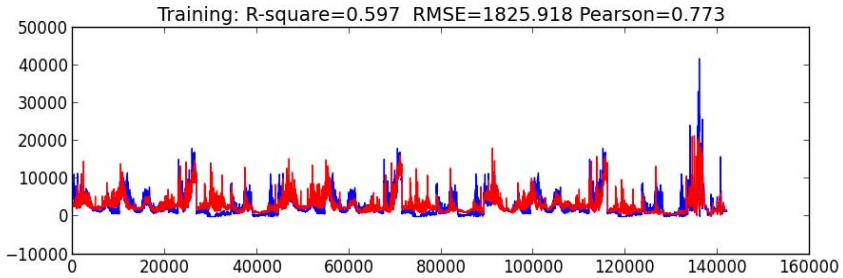
- Citizen Science gives you a personal view of your world and allows you to address local issues
  - In particular, it allows the combination of objective and subjective data
- But can the data also be aggregated and integrated with other Smart City datasets to provide an additional source of information?
  - It is not ‘big data’
- Citizen Scientists are perceived as untrustworthy
  - No ‘quality control’
  - Not professional

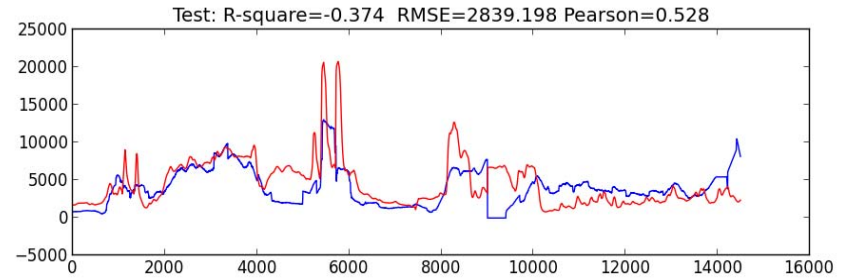
Citizen Science and Smart Cities: Positional Error

Citizen Science and Smart Cities: Calibration (Noise)

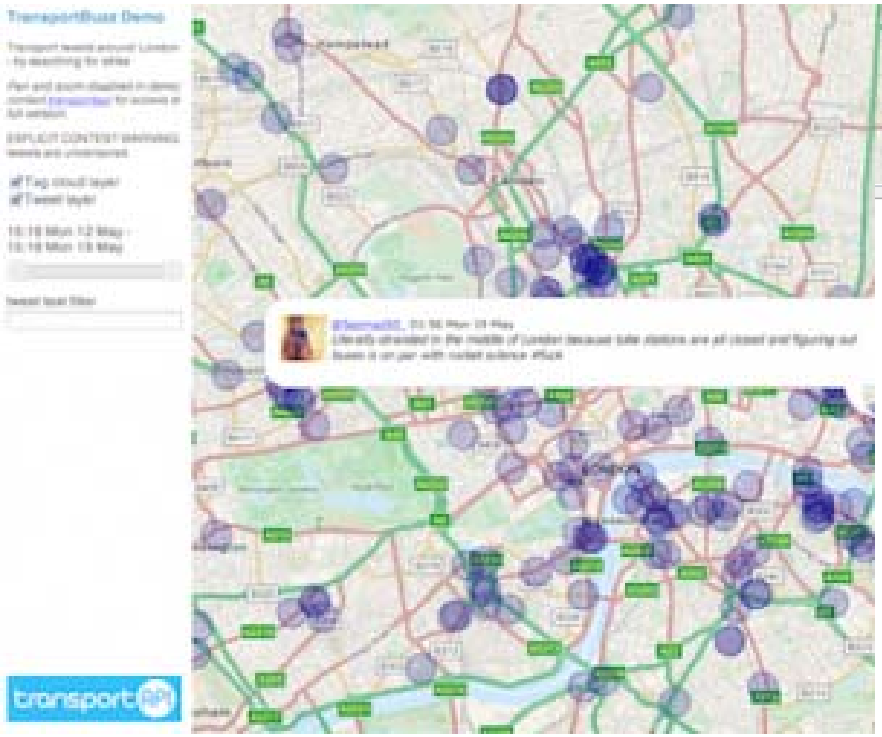


Citizen Science and Smart Cities: Calibration (Air Quality)





Citizen Science and Smart Cities: Metadata



Translate this page Spanish

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(UK) - UK-AIR: Air Information Resource - automatic and non automatic monitoring data

Spatial data set

Metadata Language English

Resource Language English

Metadata Date

2014-05-30T02:00:15

Metadata Point Of Contact

Ricardo-AEA, *E-mail*: Agnieszka.Griffin@ricardo-aea.com

Responsible Party

Author: The Department for Environment, Food and Rural Affairs, The Scottish Government, The Welsh Government and The Department of Environment - Northern Ireland, *E-mail*: emily.connolly@defra.gsi.gov.uk

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Resource Title

UK-AIR: Air Information Resource - automatic and non automatic monitoring

Spatial Data Theme

Environmental monitoring facilities (Environmental

Citizen Science and Smart Cities: Open Questions

- Is it really true that lots of low quality measurements can be as useful as a few high quality measurements?
- Can we interpolate noise and air quality information created by citizen scientists
  - Moving from personal exposure to a general map
  - Integrating with sensor data and ‘big’ data

Citizen Science and Smart Cities: Open Questions

- Who has the end use of the data, ownership and credit for the work?
- Are there issues of empowerment, inclusion/exclusion, marginalisation, participation?
- What makes people start to participate and continue to contribute?
- What is the importance of local knowledge and understanding in Smart Cities?

Citizen Science and the Science of Cities

Thank You

Any Questions?