Applications of low-cost sensing technologies for air quality monitoring and exposure assessment: how far have they gone?

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In this presentation

- Low-cost sensors – paradigm change
- What new information will they provide?
- Are they performing?
- Utilization of the data they generate
- Sensor networks around the world
- Future?

What is a (low-cost) sensor?

Sensors should be cheap enough to be replaced rather than fixed, when they fail

A monitor which costs sever $k, and requires annual costly service (by the manufacturer) – is not a sensor

Whether they perform or not is concluded on statistical basis – in relation to the 'field'

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Australia – China Centre | for Air Quality Science and Management

Environmental Science & Technology

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The Changing Paradigm of Air Pollution Monitoring

Emily G. Snyder,*,† Timothy H. Watkins,† Paul A. Solomon,‡ Eben D. Thoma,† Ronald W. Williams,† Gayle S. W. Hagler,† David Shelow,§ David A. Hindin,∥ Vasu J. Kilaru,† and Peter W. Preuss⊥

Why do we want to use low-cost sensors?

To better understand and quantify:

City block scale

- spatial variation in pollutant concentrations

- source contributions

Indoor and outdoor

- personal exposure

The Government

To address community queries

In Australia

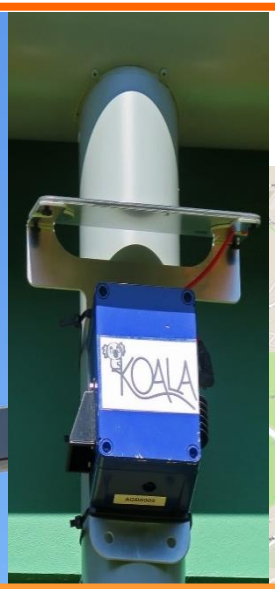
Australia Research Council Linkage Projects Grant 2017:
Developing and utilising advanced networks for air quality sensing and analysis

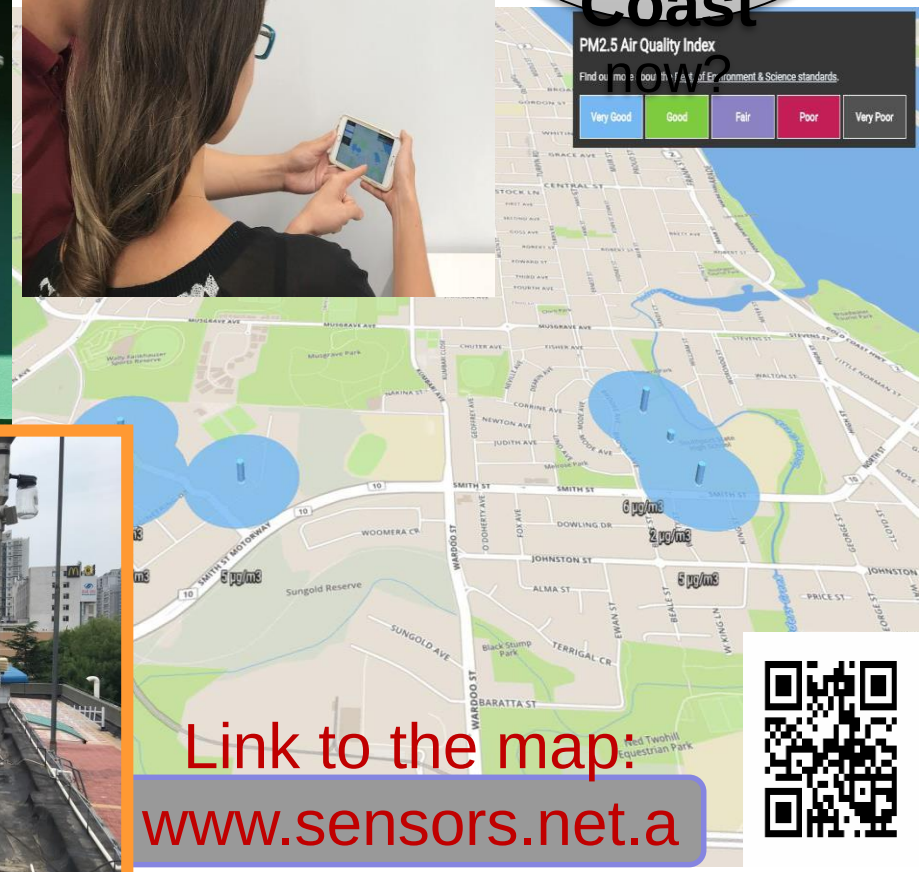
- *Brisbane*
- *Sydney*
- *Gold Coast*
- *Melbourne*
- *Adelaide*
- *Wollongong*

Several other smaller projects

Knowing Our Ambient Local Air-quali

What is the **air quality** on the **Gold Coast** now?





PARTNERS:

- Gold Coast 2018 Commonwe Corporation
- Department of Environment a
- Queensland University of Tec
- Griffith University
- Southport State High School

Link to the map:

www.sensors.net.a

In China

Over **30 000** sensors operating in China!

1500 in Beijing – Beijing Municipal Environmental Monitoring Centre

200 - Jinan taxi network

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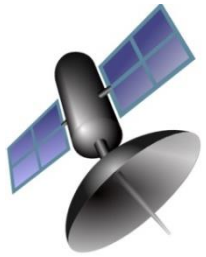
Developing a Global Platform on Air Quality and Health

A new WHO initiative to: '*generate better data on air pollution-related diseases and strengthened support to countries and cities through guidance, information and evidence about health gains from key interventions'.*

http://www.who.int/phe/health_topics/outdoorair/global_platform/en/

Initially: **ground based** monitoring, **satellite** and **transport model** data

Geneva January 2014



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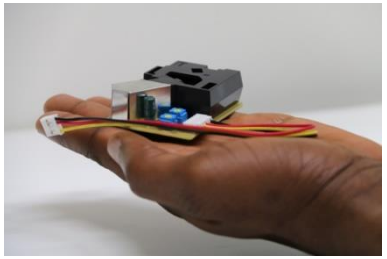
Inclusion of sensor data:

Geneva August 2015

Madrid March 2017



Challenges…

…before the new paradigm becomes the reality!

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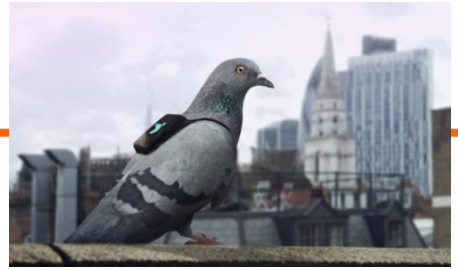
Is it the technology still a challenge ?



The technology is maturing

‘We demonstrate that, when tested appropriately and used with a full understanding of their capabilities and limitations, low cost sensors can be an unprecedented aid in a wide range of air quality applications, including the emerging field of citizen science’.

Jayaratne et al. **Low-cost $PM_{2.5}$ sensors: is the technology matured for widespread application?** *Under review*

The main challenges …

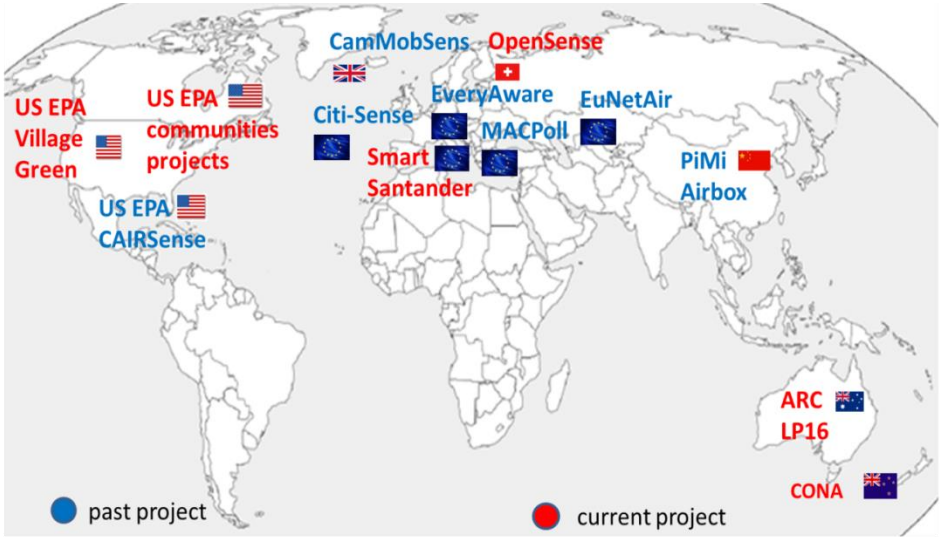
…are somewhere else!

How to sustain operation of sensor networks?

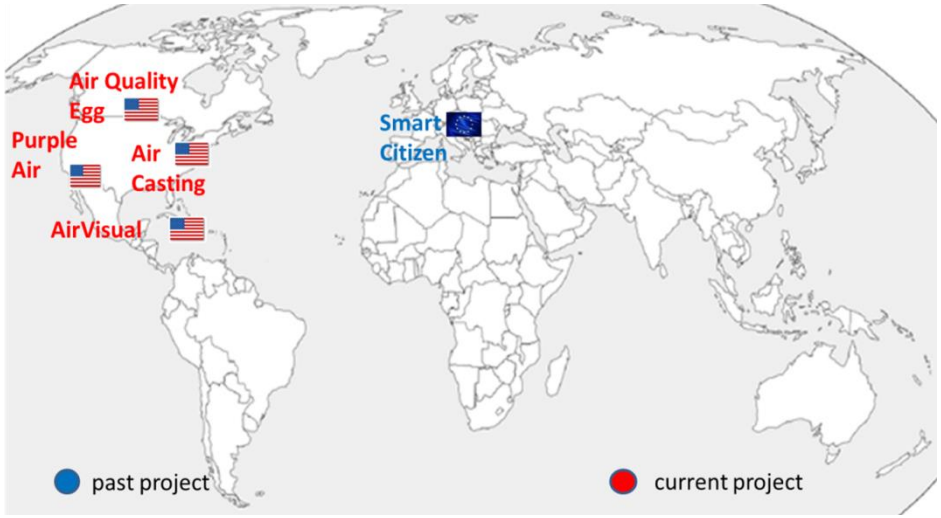
How to use the data?

Large projects on low-cost sensors for AQ monitoring

Government funding



Crowd funding/commercial



Morawska et al. Applications of low-cost sensing technologies for air quality monitoring and exposure assessment: how far have they gone? *Environment International,* 116: 286-299, 2018.

What really is the niche for sensors?

How much more information will we obtain from tens of thousands of sensors, compared to high resolution satellite data?

Maybe wearable sensor to account for indoor exposures and behaviours are more important to raise awareness?

Conclusions

There has been a **huge interest** and a lot of work conducted to explore low cost sensors

Most of the work has been on the **technology itself**

Next step: from the concept to the information flow (sustained operation or focused campaigns) – **still to happen**

Whether:

- we first define the questions to be addressed by application of low-cost sensors, or
- go ahead, deploy them, and then look at the data

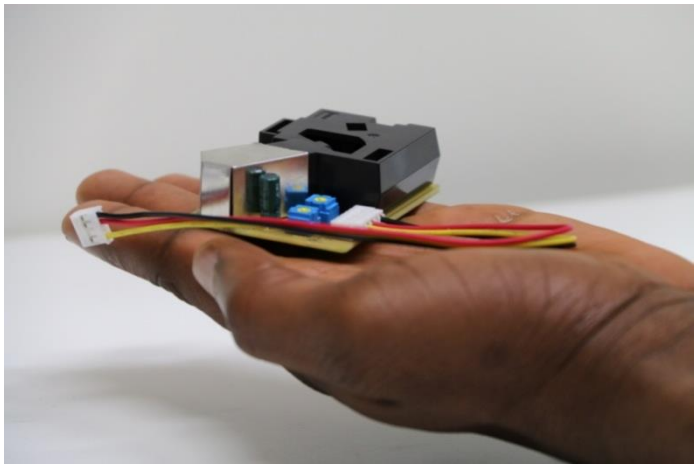
…the information **will drive improvements** in air quality!

What do sensors measure?

Gaseous pollutants:
CO, CO_2, NO, NO_2, O_3, SO_2,

Particulate matter mass:
$PM_{2.5}$, PM_{10}

Chemical composition:
some HC and VOCs;



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