



CAMBIKE SENSOR

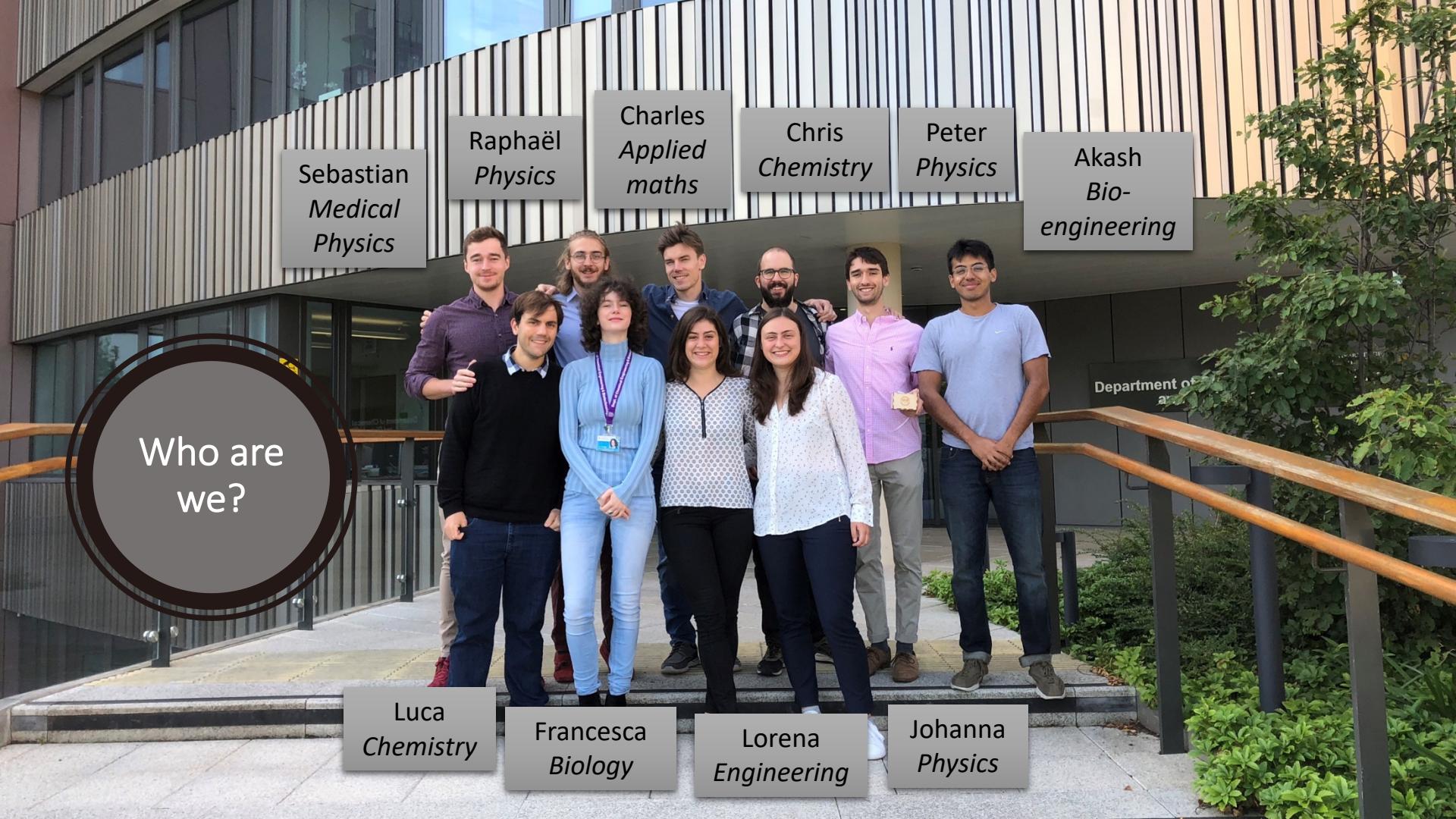


A cyclist's mobile sensor hub for big data citizen science.



Introduction

EPSRC Centre for Doctoral Training in
Sensor Technologies and Applications



Who are
we?

Luca
Chemistry

Francesca
Biology

Lorena
Engineering

Johanna
Physics

Sebastian
*Medical
Physics*

Raphaël
Physics

Charles
*Applied
maths*

Chris
Chemistry

Peter
Physics

Akash
*Bio-
engineering*

Where to move for... Cycling

Tom Dyckhoff

@tomdyckhoff

Sat 9 Jun 2018 08.00 BST



47 | 50

Where to move for... cycling

Inspired by Bradley Wiggins? A Mamil in the making? This is where you should be parking your bike



▲ In Cambridge, 52% of citizens cycle at least once a week.' Photograph: Antonio Olmos for the Guardian

British Cycling lists [towns and cities](#) stretching from Plymouth to Edinburgh as best for cycle commuting; but for sheer numbers Cambridge is way ahead: 52% of its citizens cycle at least once a week, 31% five times; next is Oxford, at 33.5% and 12.6%; then York, at 27% and 10.6%. Nowhere else comes close - yet.

CambridgeshireLive NEWS IN YOUR AREA UNITED WHAT'S ON TRAFFIC & TRAVEL #WeHaveCamsCovered

JOBS MENTAL HEALTH PROPERTY MOTORS BUY/SELL DIRE

SCRIBE FIND A JOB SIGN IN SEARCH

21°C FAIR

News Cambridge News Cambridgeshire County Council

Cambridgeshire's roads are littered and it's trashing people's cars

Potholes are causing problems for Cambridgeshire's motorists

By Rachael McMenemy 05:00, 23 JAN 2018 UPDATED 10:34, 23 JAN 2018

11 SHARES 73 COMMENTS

Enter your postcode to see news and information near you

Community update: Crime statistics, local news & events and much more

Opinion Sport Culture Lifestyle More UK edition

imate change Wildlife Energy Pollution

Thousands of British children exposed to illegal levels of air pollution

Exclusive: More than 2,000 schools and nurseries close to roads with damaging levels of diesel fumes, joint investigation by Guardian and Greenpeace reveals

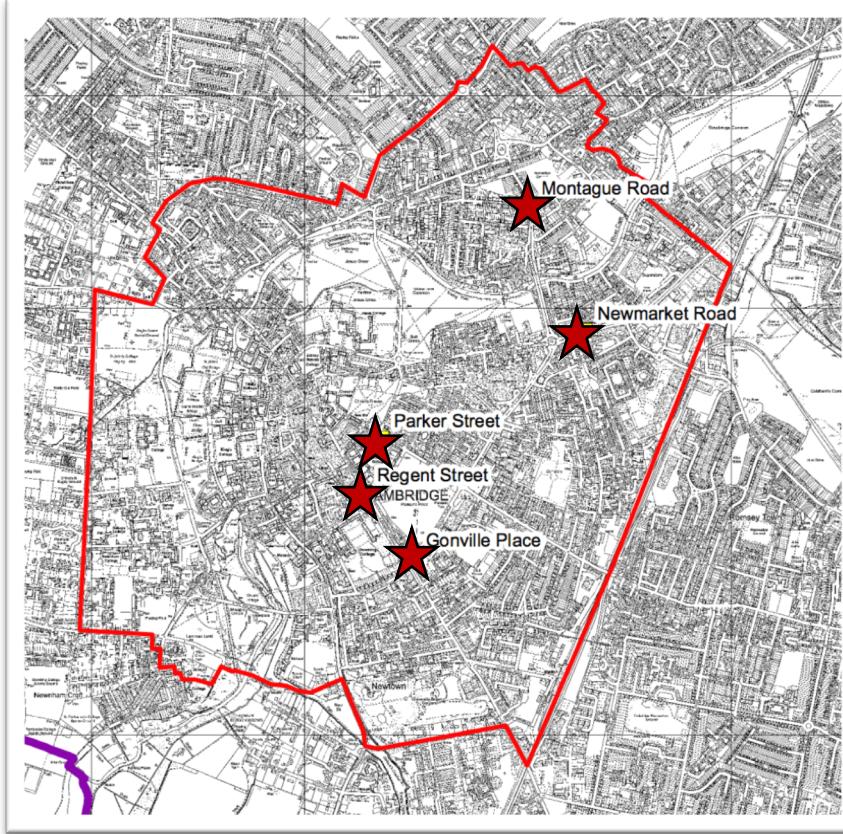
- Check whether your child's school is affected
- How have you been affected by air pollution?

most viewed

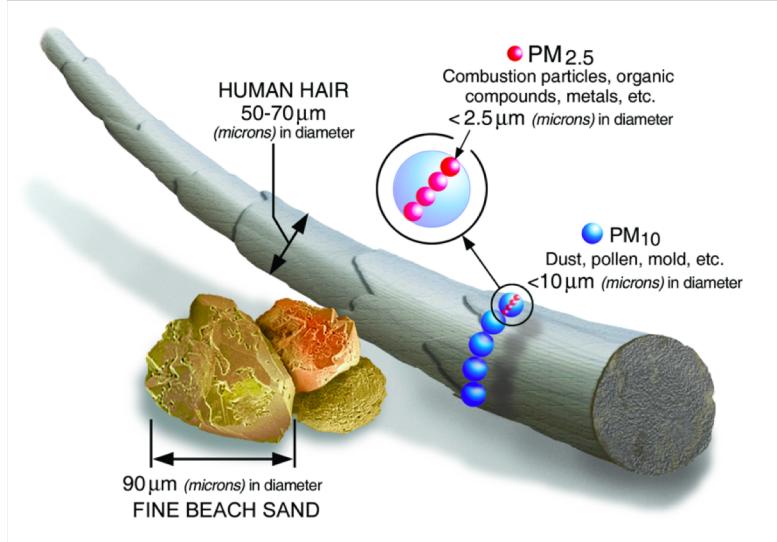
Live Dominic Raab becomes new Brexit secretary after David Davis resigns - politics live

Live Thai cave rescue: sixth boy rescued as mission to save others continues - live

Simon Pegg: 'I was lost, unhappy and an alcoholic'



Particulate matter

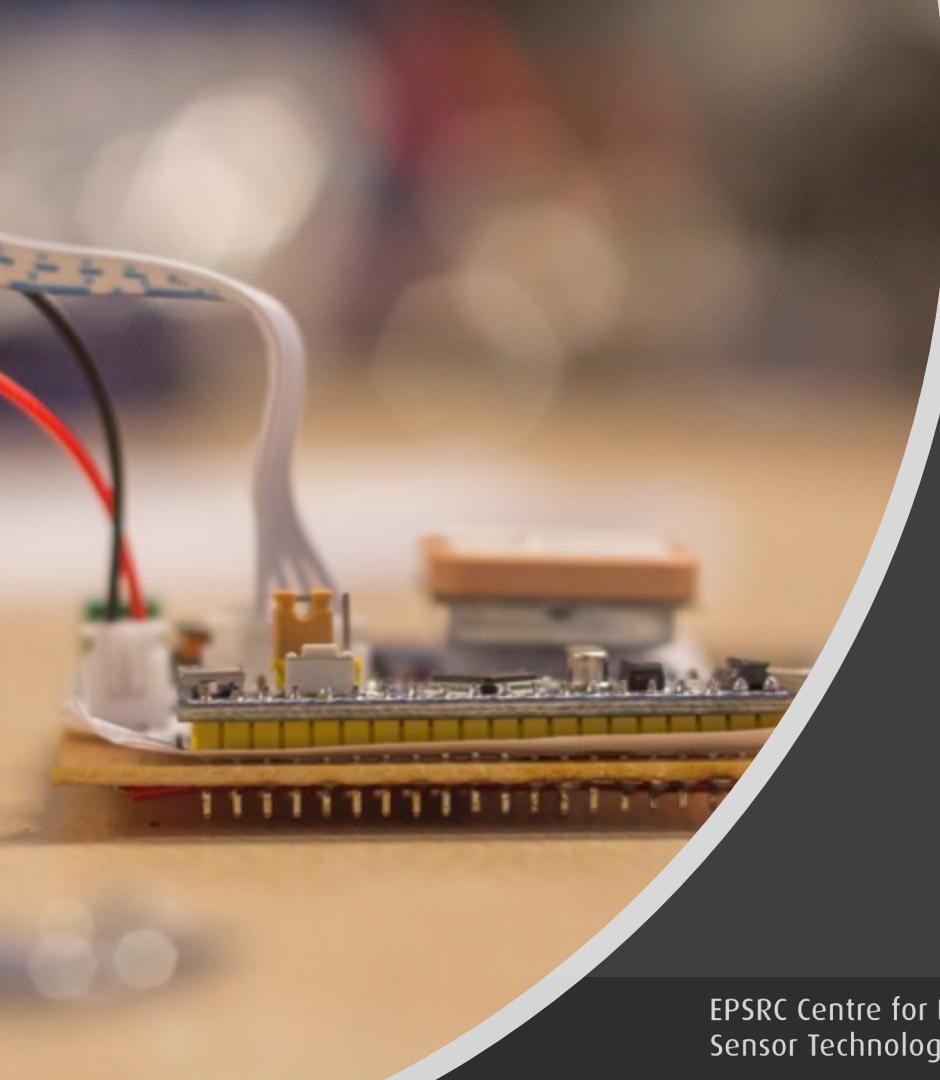


Cause of several lung and cardiovascular diseases

Outdoor PM levels are in the detection range of low-cost sensors

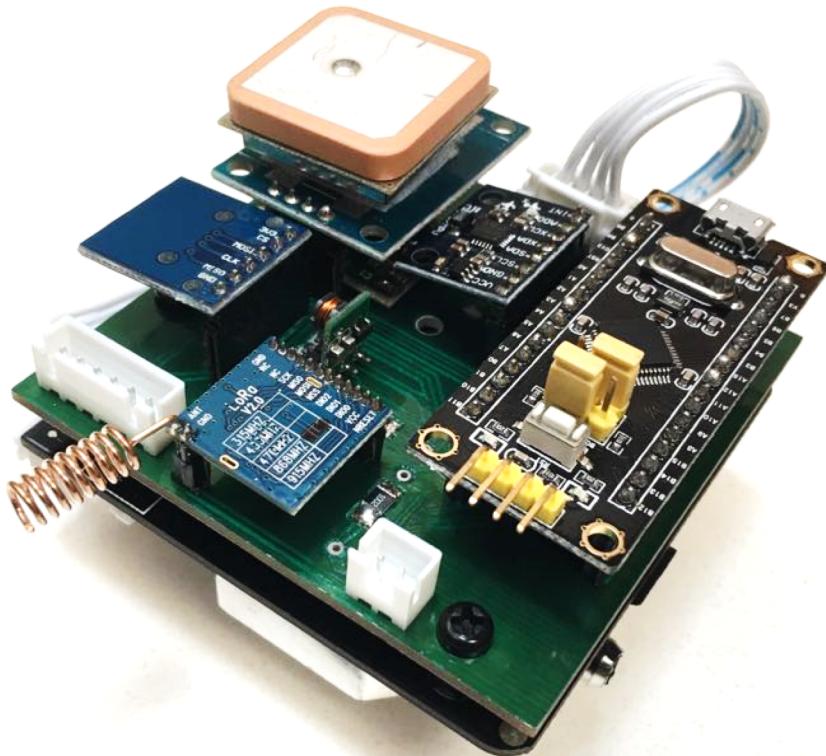
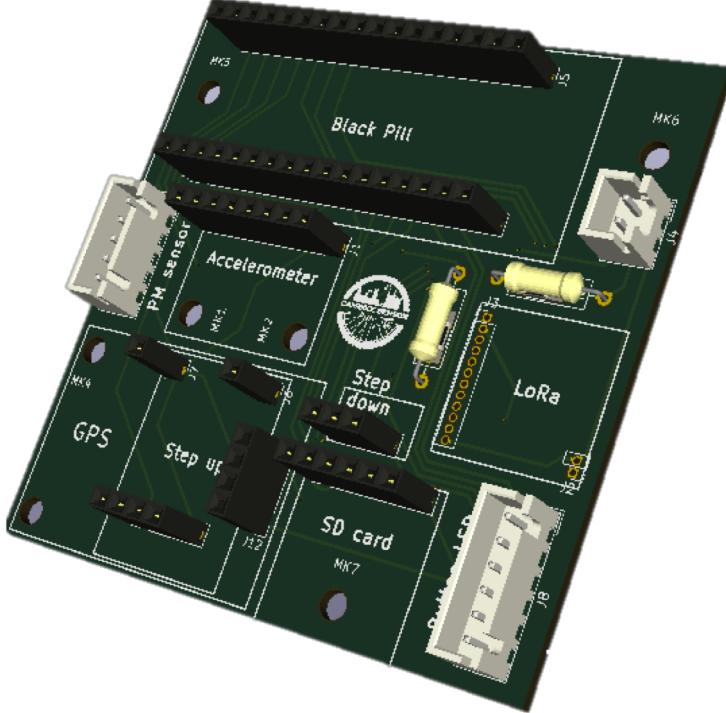
PM ₁₀	1	2	3	4	5	6	7	8	9	10
Band	Low	Low	Low	Moderate	Moderate	Moderate	High	High	High	Very High
$\mu\text{g}/\text{m}^3$	0-16	17-33	33-50	51-58	59-66	67-75	76-83	84-91	91-99	>100

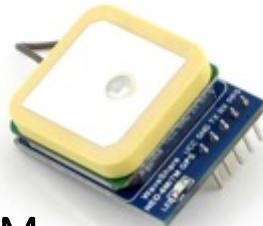
Image: <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>



The sensor hub

A modular device



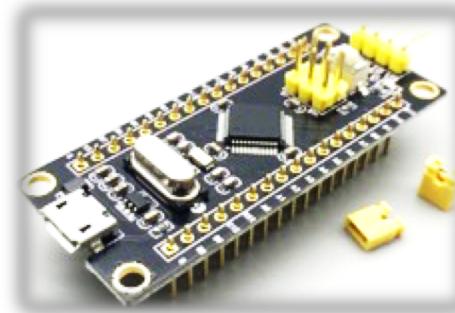
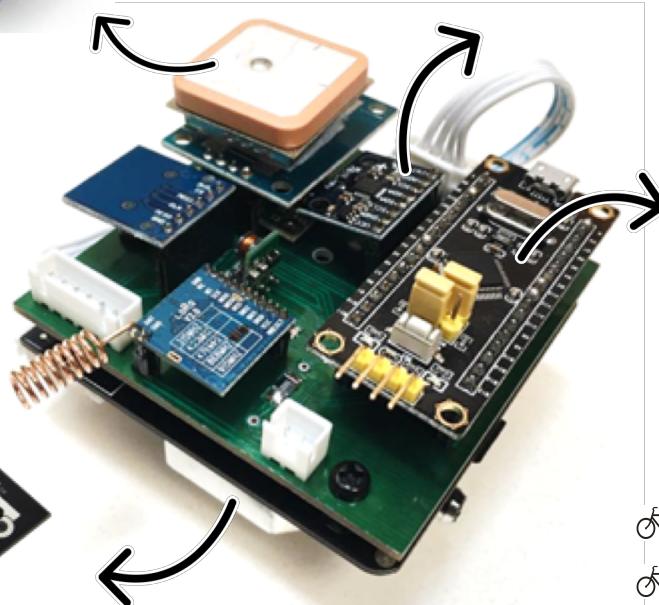
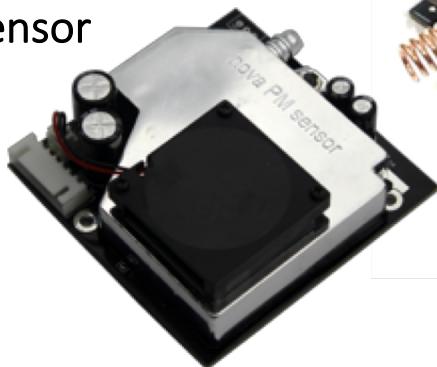


Accelerometer &
Gyroscope

GPS Neo 6M

- 🚲 Short cold start time
- 🚲 Robust antenna
- 🚲 Low interferences

Particulate
matter sensor



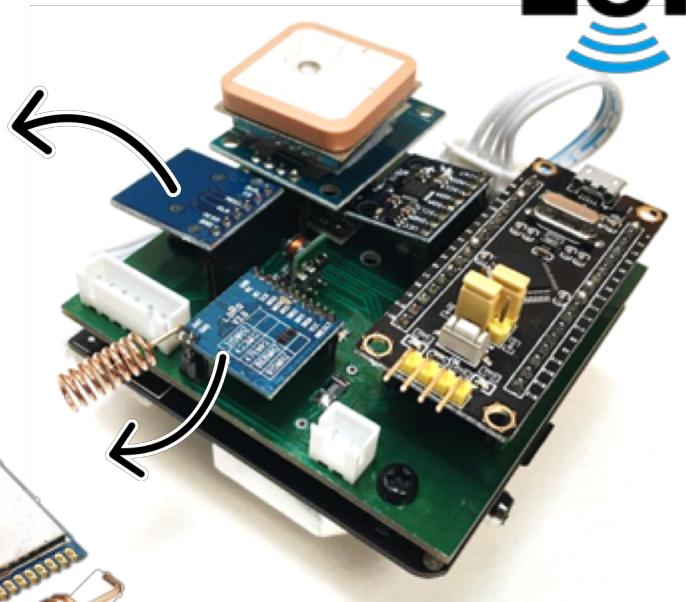
STM32 Black Pill
microcontroller

- 🚲 Low-cost (£ 1.5!)
- 🚲 Enough communication pins
- 🚲 More memory

SD card

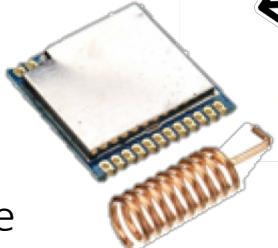


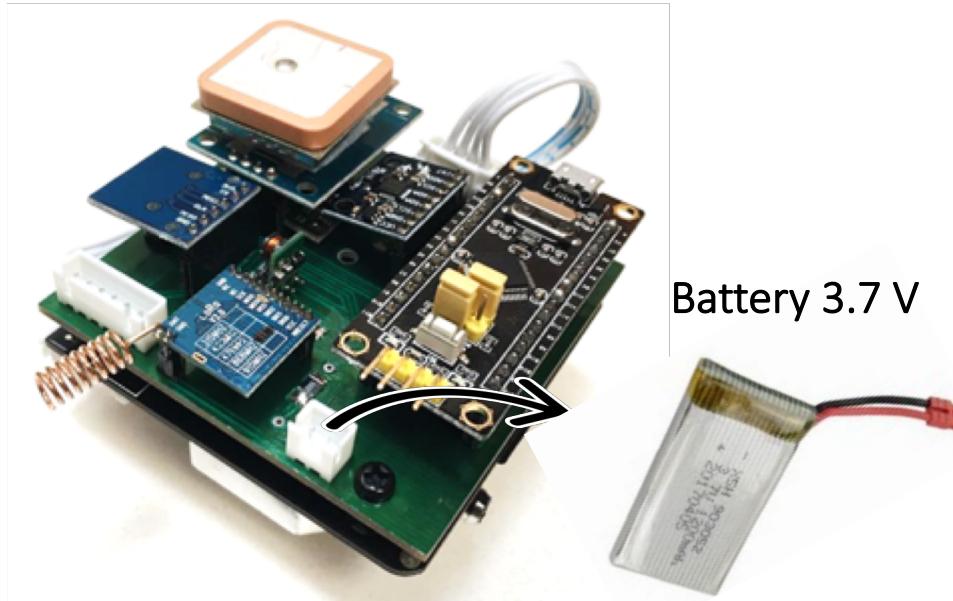
LoRa



LoRaWAN radio

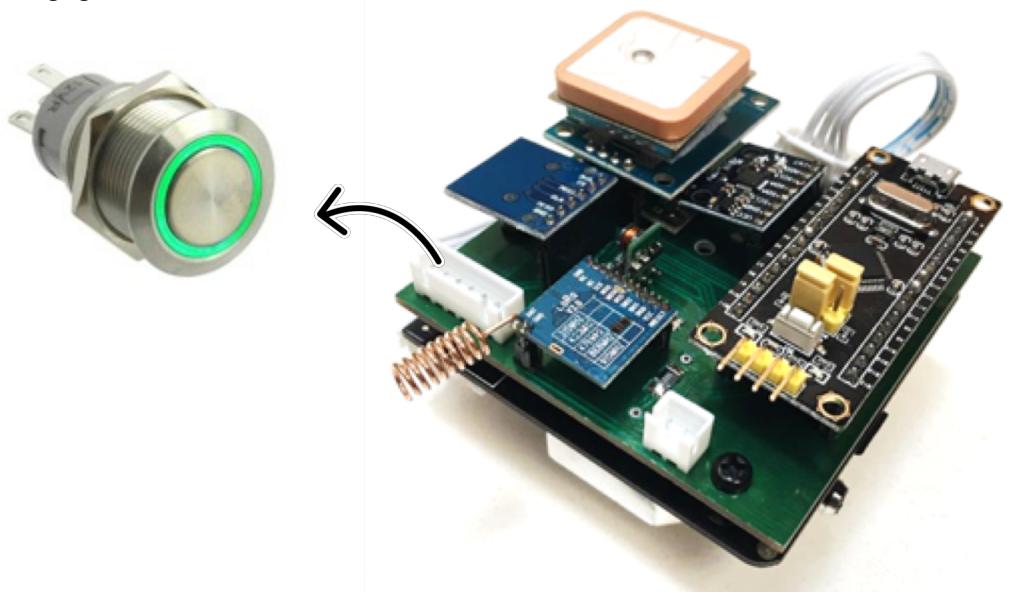
- Wireless
- 868 MHz
- 10 km range
- 1% duty cycle





Button LED

- 🚲 Status LED
- 🚲 Master switch



Step up

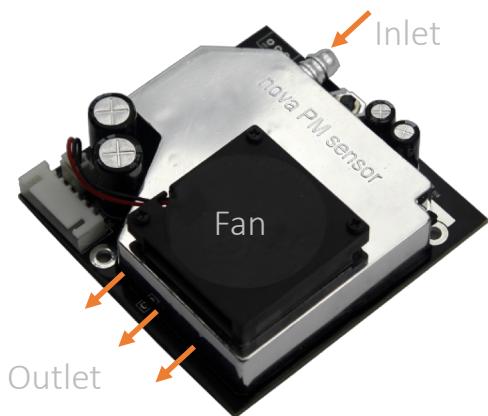
- 🚲 From 3.7 V to 5 V



Step down

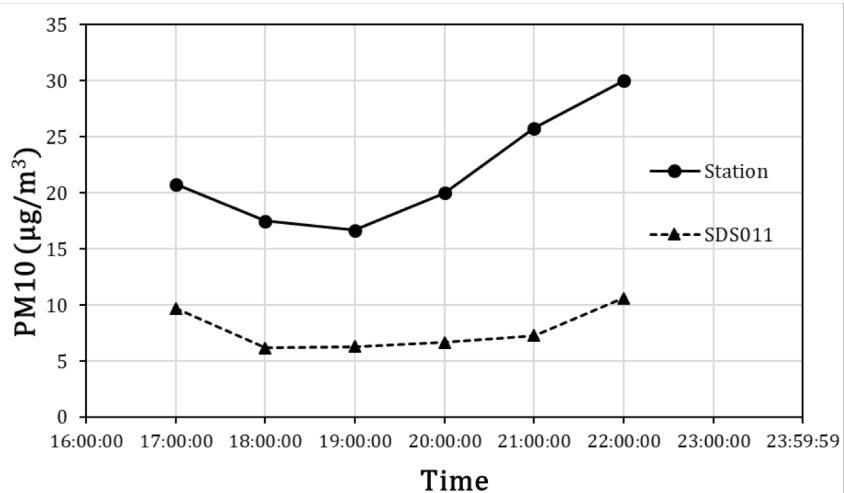
- 🚲 From 3.7 V to 3.3 V

Sensing particulate matter



SDS011: PM2.5 and PM10

- 🚲 Dynamic Light Scattering
- 🚲 0.3-1000 $\mu\text{g}/\text{m}^3$
- 🚲 No baseline (<0.1 $\mu\text{g}/\text{m}^3$ in a cleanroom)







Outreach

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Get citizens involved!

Educate



Participate



Make a difference



Avenues for Outreach

Media



Workshops



Networking



Distribution

Build it from scratch.

The screenshot shows a wiki page with the following content:

Main page [Discussion](#)

Main Page

Welcome to the CamBike Sensor documentation

CamBike Sensor is a student-led initiative from the University of Cambridge to track your bike. By encouraging Cambridge residents to track their bikes, we hope to promote engagement with issues relating to the quality of our air and roads.

Table of contents

- Assembly
- Data analysis
- Embedded software
- Laser cut casing
- The team
- FAQ

CamBike sensor

[\[edit\]](#)



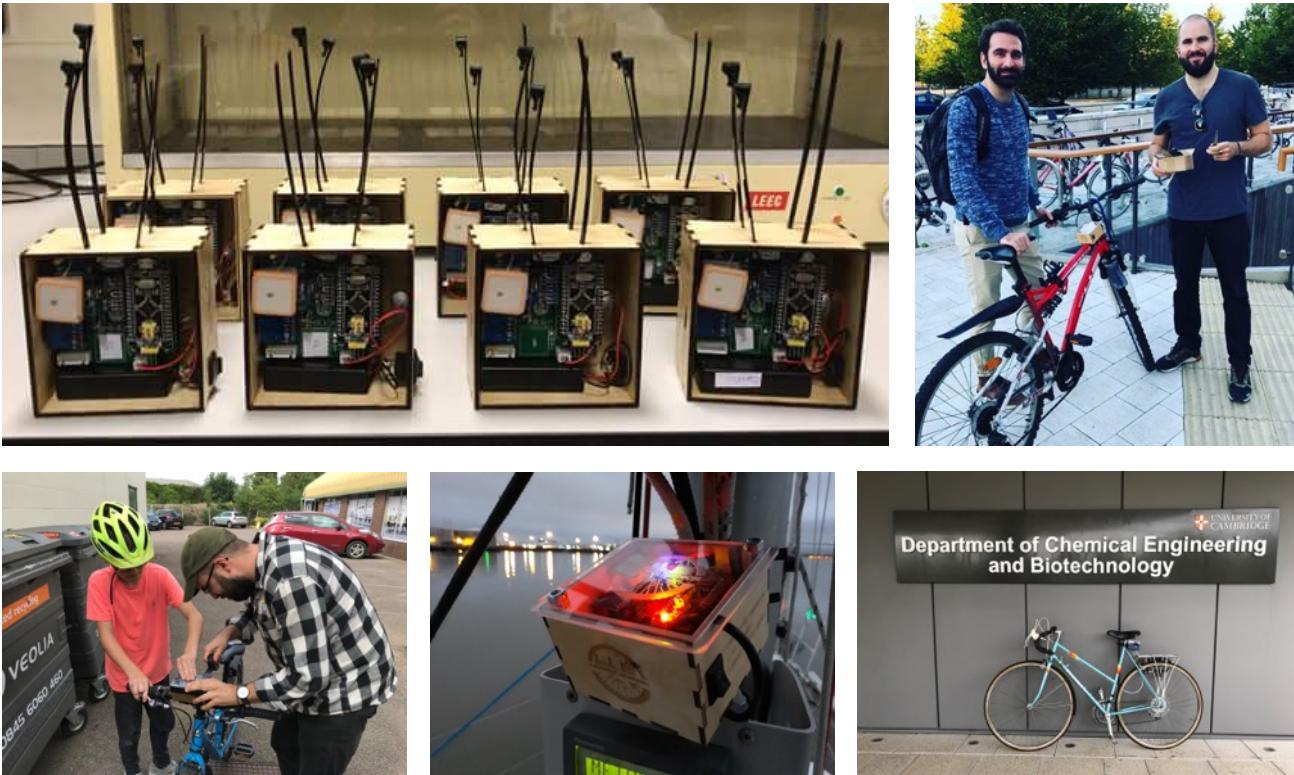
Get a kit from us.



Put it on your bike.



Distribution to the public





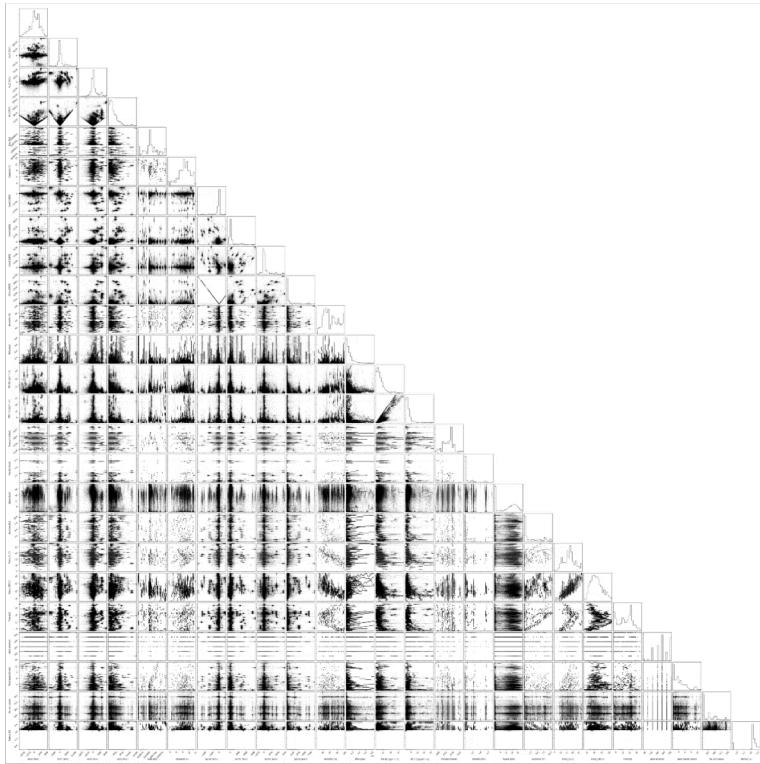
Results

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- 🚲 500 + uses
- 🚲 150 + hours of cycling
- 🚲 2 million + datapoints

Getting involved — cambikesensor.net/results/



🚲 Combined with archive weather data from DTG Weather Station

DIGITAL TECHNOLOGY GROUP

Cambridge Weather
At 01:54 - very humid, cool, calm, 10.0 C

Graphs: Today Yesterday

Maps: Lightning

The dials show the current Cambridge weather readings, as taken on the roof of our building by the DTG Weather Station. Also available as:

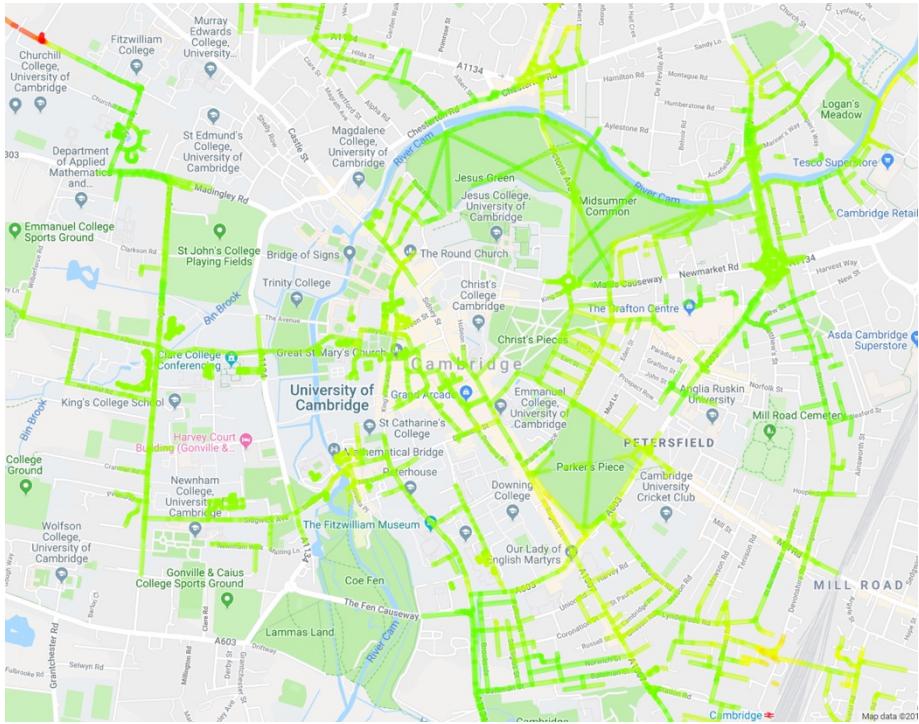
- Plain text
- RSS feed

Available on the iPhone

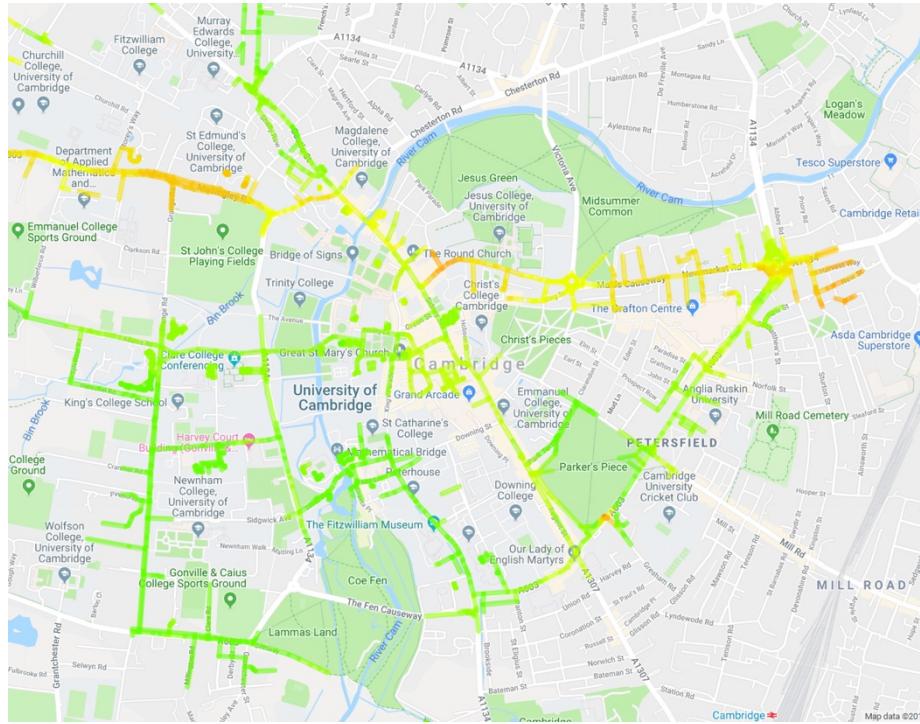
Archive data since 1995

- Daily: text or graphs
- Monthly: text or graphs
- All raw data: daily text files (tar.gz archive)
- All raw data: single CSV file (format)

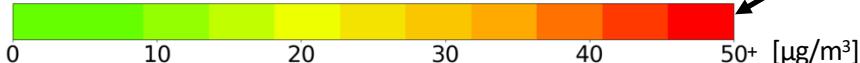
07:00 – 09:00



09:00 – 11:00



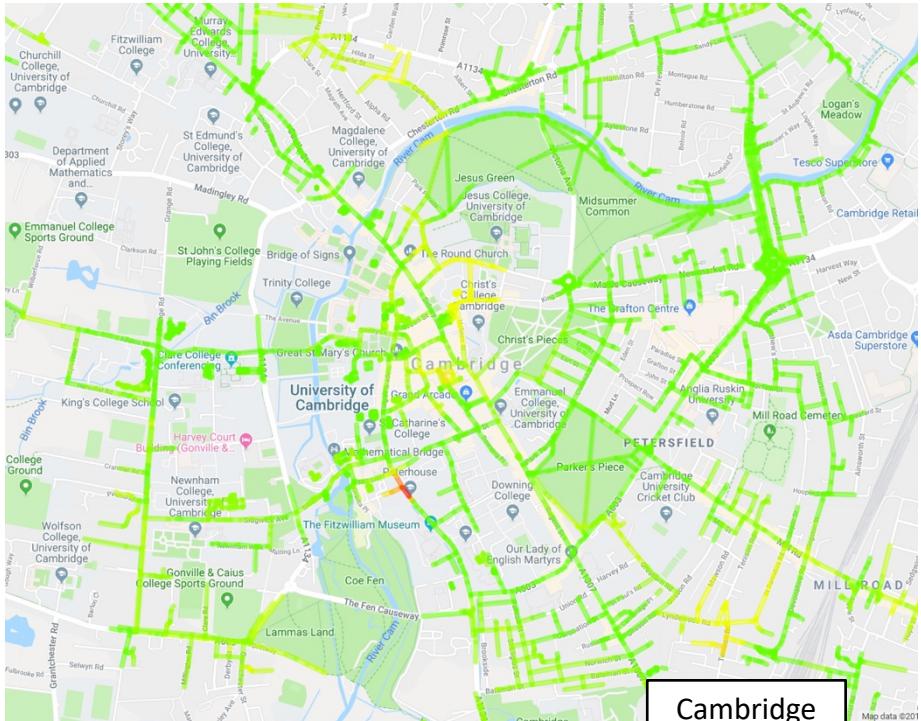
PM10



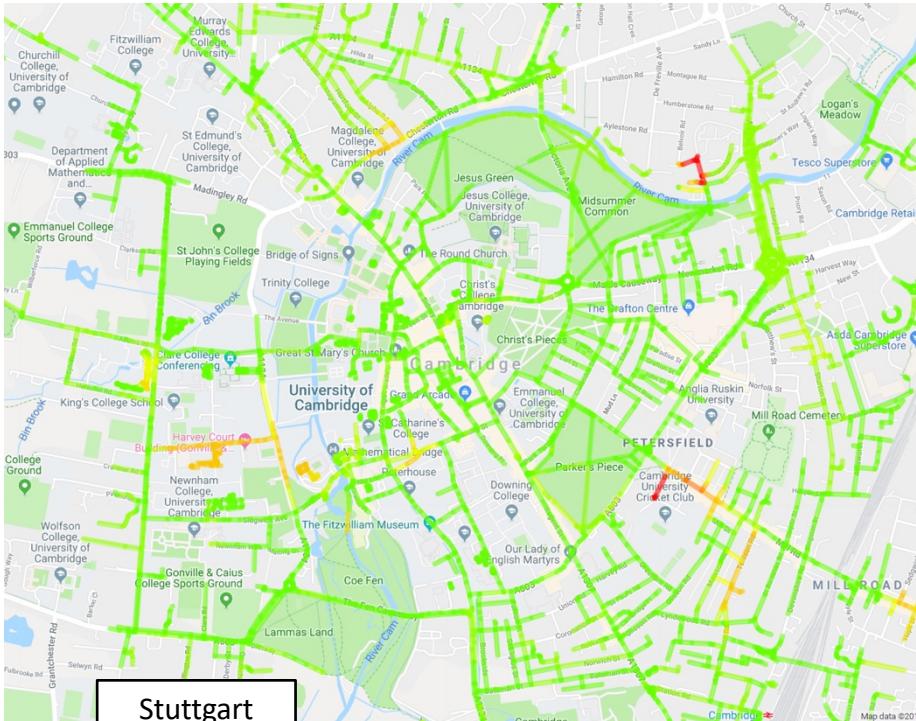
EU limit value

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11:00 – 13:00



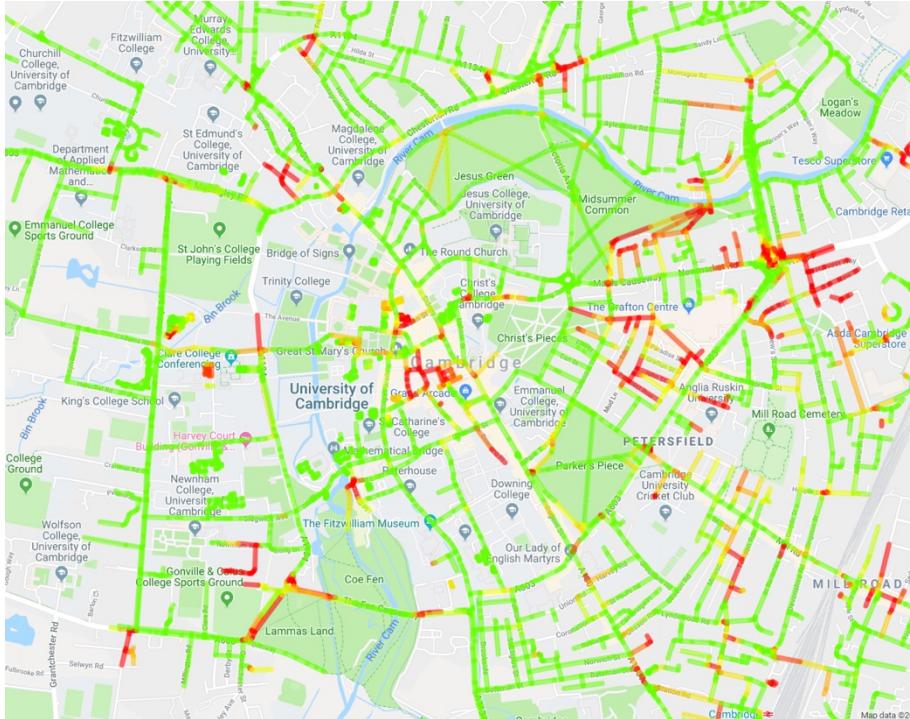
15:00 – 18:00



PM10

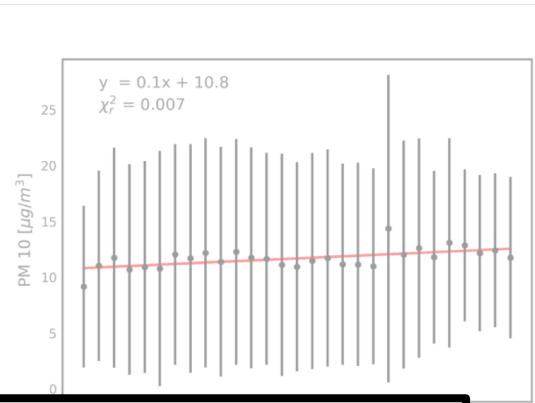
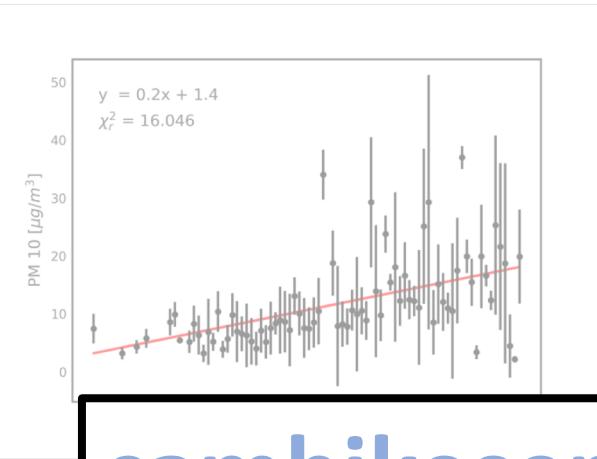


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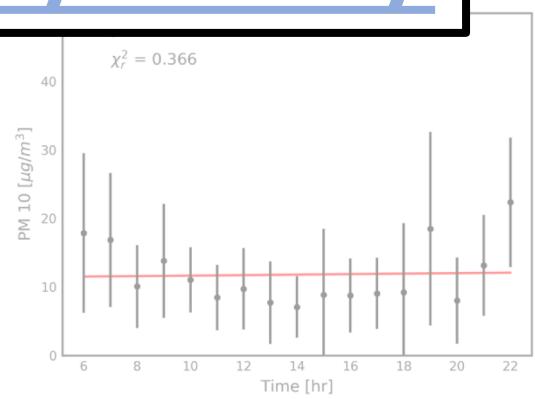
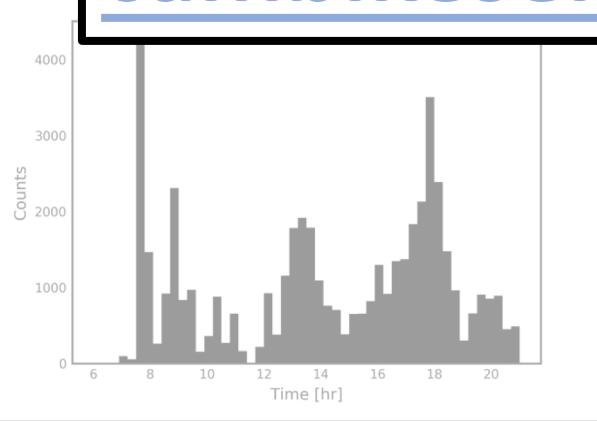


Cycle traffic

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cambikesensor.net/results/



Department of Chemical Engineering
and Biotechnology

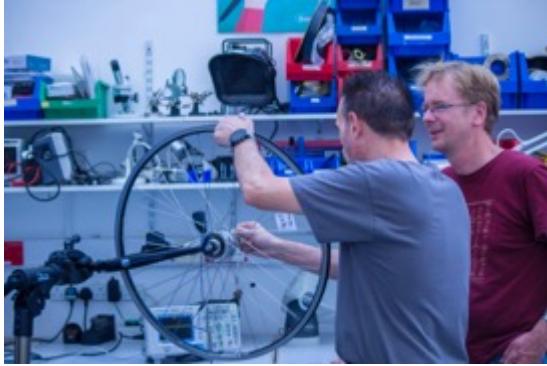


Looking to
the future

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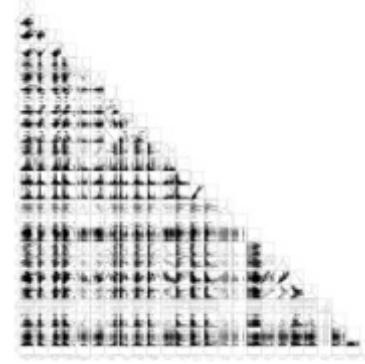
Developing the technology further



Power harvesting



Wireless transmission



From data to
information

Expanding our networks



Centre for
Global
Equality

Cultivator



Volunteer
community



'Global' coverage

Acknowledgments



Oliver Hadeler

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Clemens Kaminski

Michael Simmons

Axel Zeitler

Lee Smith

Karen Scrivener

Naomi & Jonathan Griffiths

Sebastien Cosnefroy

Peter Murray-Rust

Andrés Arcia-Moret

Andrew Stretton

Harvey Bewley

Anjali Das

Ward Hills

Kheng Boon Pek

Sophie Mower

Anantharaman Iyer

Lara Allen

...And all our volunteers!



cambikesensor.net

info@cambikesensor.net

#CamBikeSensor

