



Community Planning Alliance

Tackling the National Health Emergency caused by Air Pollution

CPA Air Quality Workshop 2

Key Aim of the Series of Events:

Engage communities in discussions about how the Government (at all levels) aims to tackle air pollution and its consequences

Purpose of this specific session:

To consider the options for measuring and monitoring air pollution at a local level

8th February 2022 7:30pm





Aim / Purpose of Event

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Purpose of this specific Session:

- To consider the options for measuring and monitoring air pollution at a local level





Inspiring Communities to Measure and Monitor Air Quality in their Local Areas

**You wouldn't drink
dirty water.
So why are you still
breathing dirty air?**

150 years ago Greater Manchester got clean water.
Isn't it time we got clean air?



Supporting Greater Manchester's Clean Air Campaign

Click





Workshop 2: Agenda

- **Introductions and Welcome** – Marj Powner (Vice Chair, Community Planning Alliance)
- **Why Measure and Monitor Air Quality** – Professor Stephen Peckham (Director, Centre for HSS, University of Kent)
- **Building a Sensor Community** – Graham Turnbull (Clean Air for Sheffield)
- **Rural Air Quality Monitoring** – Mike Josephs (Hope Valley Air Quality Network)
- **Q&A – supported by Peter Fleming** (Air Quality Addict)
- **Next Steps**
 - Responses to the CPA Air Quality Survey
 - Information about Webinar 3 – currently being planned

Click



Air quality, health, the environment and planning: why we need to measure and monitor air quality

Professor Stephen Peckham

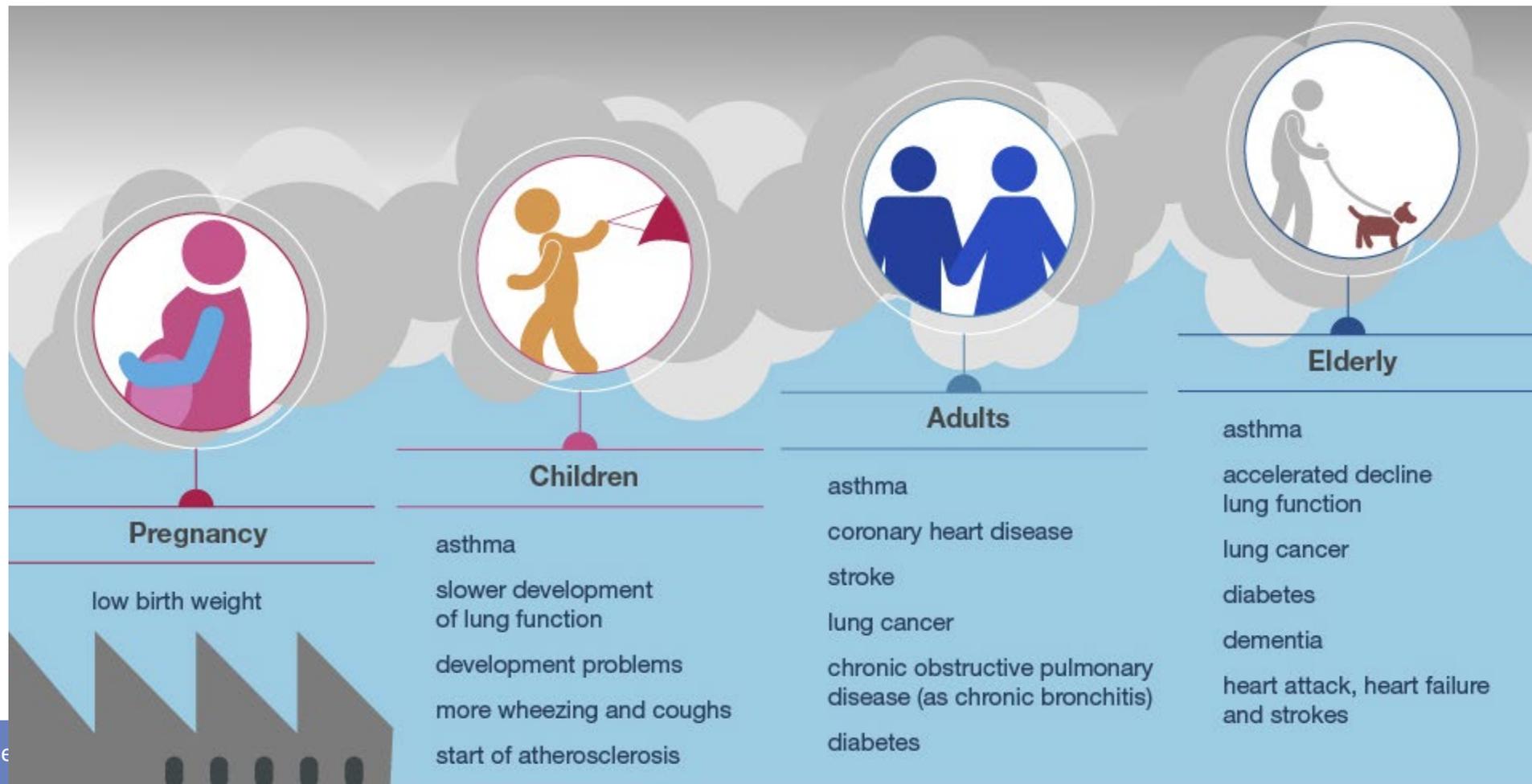
CENTRE FOR HEALTH SERVICES STUDIES



EXCELLENCE
IN HEALTH
RESEARCH

Air quality and health: should we be worried?

- Good evidence of both long-term and short-term exposure harms to health across the life-course



Air quality and health: should we be worried?

- Good evidence of both long-term and short-term exposure harms to health across the life-course
 - A 10 $\mu\text{g}/\text{m}^3$ increase in 24h NO_2 has been associated with increases in all-cause/cardiovascular/respiratory hospital admissions and mortality
 - Short-term exposure to the levels of PM_{10} in 2002 led to 6,500 deaths and 6,400 hospital admissions being brought forward that year
 - Prof Holgate's analysis linked emissions causally to Ella Kissah-Debrah's death
- World Health Organisation limits are significantly lower than English limits:
 - NO_2 - 10 $\mu\text{g}/\text{m}^3$ annual mean/25 $\mu\text{g}/\text{m}^3$ 24-hour mean (England - 40 $\mu\text{g}/\text{m}^3$)
 - $\text{PM}_{2.5}$ - 5 $\mu\text{g}/\text{m}^3$ annual mean/15 $\mu\text{g}/\text{m}^3$ 24-hour mean (England - 25 $\mu\text{g}/\text{m}^3$)
 - But acknowledged that these are not limits below which there are no harmful health effects and for particulate there is no safe minimum $\mu\text{g}/\text{m}^3$ level

Not forgetting the environment

- The impacts of nitrogen deposition may be a far more immediate than climate change
- Nitrogen is the '*elephant in the room*' of nature conservation
- Reactive nitrogen pollutants (oxidised nitrogen – NO_x NO₂) emitted to the atmosphere are transferred to land and water bodies, either in gaseous form (dry deposition) or in precipitation (wet deposition)
- Increasing degradation of waterways
- Nitrogen deposits threaten biodiversity
- Clear guidelines on detriment for Habitats Assessment
- But environmental degradation also has a health impact

Air quality monitoring

- Current monitoring framework:
 - Overall air quality measurement is poor—over 600 active AQMAs
 - DEFRA recognises problems in 38 towns and cities and on major roads
- What's monitored and why?
 - Most local authorities only monitor NO₂ and PM₁₀
 - Limited PM_{2.5} and O₃
 - Mainly Diffusion tubes (NO₂) only limited measurement of PM and O₃
- Where is it monitored?
 - AQMAs, busy roads and some other areas
- Accuracy/usefulness
 - DTs offer limited poor quality monthly data
 - Insufficient higher quality measurement with hourly or real time data

Air quality assessment: a broken system

- An inadequate monitoring framework
 - regulatory frameworks covering air-quality management and planning decisions are separate
 - responsibilities split between different departments at both central and local government levels
 - local authorities only required to prepare a plan if in breach of current national limits
 - government has refrained from requiring action
 - NPPF is only advisory – its guidance only
- Current English limits for PM, NO₂ and O₃ do not protect our health:
 - little real time monitoring to identify repeated short-term exposure
 - no attention really paid to pedestrian exposure as guidance says:
- DEFRA guidance states that:
- The achievement or likely achievement of an air quality objective ... shall be determined by reference to the quality of air at locations:
 - (a) which are situated outside of buildings or other natural or man-made structures above or below ground; and
 - (b) where members of the public are regularly present.**

National Air Quality Strategy objectives

- Progressively cut public exposure to PM pollution and halve the population living in areas with concentrations of PM_{2.5} above WHO guideline levels (10µg/m³) by 2025 (WHO level is now 5µg/m³).
 - aims to reduce emissions of PM_{2.5} against the 2005 baseline by 30% by 2020, and 46% by 2030.
 - reduce emissions of nitrogen oxides against the 2005 baseline by 55% by 2020, increasing to 73% by 2030. (WHO have slashed the safe annual average

However:

- Targets have not been set as legal limits in Environment Act 2021 (Secretary of State only required to set air-quality targets – especially for PM_{2.5})
- Only duty is still that LA is to prepare a plan for AQMAs
- Overall air quality measurement and data collection centrally is poor– currently over 600 AQMAs are active but DEFRA recognises problems mainly in 38 towns and cities and on some major roads.

Air quality and planning guidance

- National Planning Policy Framework
 - *“Development should, wherever possible, help to improve local environmental conditions such as air and water quality,...”* (Para 174)
 - *“Opportunities to improve air quality or mitigate impacts should be identified”* (186)
- IAQM guidance for planning air quality assessment: *the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant*
- Air quality monitoring framework for planning decisions

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

How useful are air quality assessments?

- LPAs tend to give less weight to air-quality issues:
 - *“air quality is a low priority”* – quote from a planning officer
- directive objectives provide sufficient health protection or future protection:
 - *The air quality standards are long-term benchmarks for ambient pollutant concentrations which **represent negligible or zero risk to health, based on medical and scientific evidence** ...* (Quote from an air quality assessment)
- From a health perspective air quality is simply used as a proxy
- Most assessments are based on modelling often using diffusion tube readings as the basis for such models:
 - modelling depends on accuracy of baseline measurements
 - Models are also reliant on initial traffic trip modelling
- Developers can simply redistribute pollution
- Make general statements regarding the benefits of mitigation

Better monitoring is necessary

- Detailed local monitoring is necessary as:
- Road transport is a major source, generally accounting for:
 - 31% of nitrogen oxides, 18% of PM₁₀ and 19.5% of PM_{2.5} emissions
 - Ozone is a secondary pollutant produced by road traffic and other combustion sources.
- But it accounts for more than 64% of air pollution at urban monitoring sites
- It has been estimated that:
 - 21% of PM_{2.5} emissions and 33% of PM₁₀ emissions are from non-exhaust sources
- We need to know about patterns of pollution levels - especially where people live, work and are regularly exposed to emissions

So what needs to be done?

- Localised real-time monitoring to understand patterns of emissions
 - Monitor where people regularly pass by
 - Monitor patterns of emissions
- Local Plans need stronger statements about air quality and health impacts and more attention paid to evidence
- Planning committees need to consider health more centrally in their decision-making:
 - The focus on the impact on AQMAs and the annualised average objective limits means that health impacts are not adequately considered
 - Require health impact assessments
- Planning committees should require mitigation strategies to be:
 - Based on good evidence of impact
 - Demonstrate benefit

Some useful/interesting information

Mills, A. and Peckham, S., 2019. [Garbage in, gospel out?—Air quality assessment in the UK planning system.](#) *Environmental Science & Policy*, 101, pp.211-220

Mills, A. and Peckham, S., 2021. [Annual NO2 as a Predictor of Hourly NO2 Variability: Do Defra UK's Heuristics Make Sense?.](#) *Atmosphere*, 12(3), p.385

National Institute for Health and Care Excellence (2019) [Air pollution: outdoor air quality and health](#) Quality standard [QS181]

Peckham S (2022) [Assessing air-quality impacts in planning decisions in England: should we focus more on health?](#) *Town Planning Review* 93(1), 61-82 /doi.org/10.3828/tpr.2021.6

Williams, M., Evangelopoulos, D., Katsouyanni, K. and Walton, H., 2019. [Personalising the Health Impacts of Air Pollution: Summary for Decision Makers.](#) *Environmental Research Group King's College London*

Public Health England publications:

Plans and evidence - <https://www.gov.uk/government/news/public-health-england-publishes-air-pollution-evidence-review>

[Estimation of costs to the NHS and social care due to the health impacts of air pollution](#)



Clean Air Sheffield

Building a sensor.community

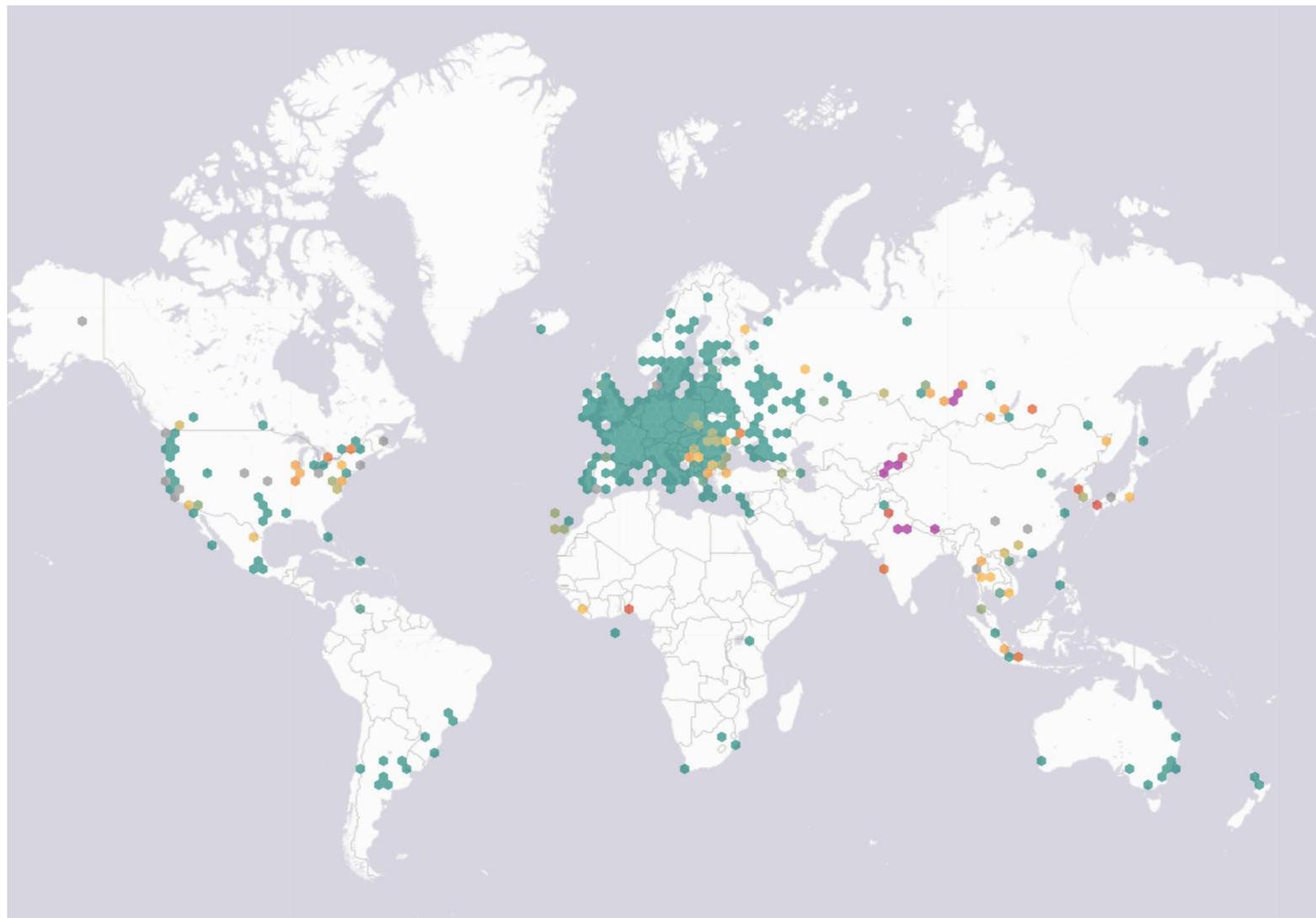
Graham Turnbull - February 8, 2022





sensor.community

- Sensor.Community Airrohr Project (“Air Pipe”)
- Part of a global project
- >14,000 PM2.5 monitors in 69 countries
- £40 for parts
- Not for everyone





Steps

1. Get the parts
2. Flash the firmware
3. Make the electrical connections
4. Secure parts together
5. Configure / Connect to Wi-Fi
6. Register online
7. Put inside an enclosure
8. Put it outside and plug it in



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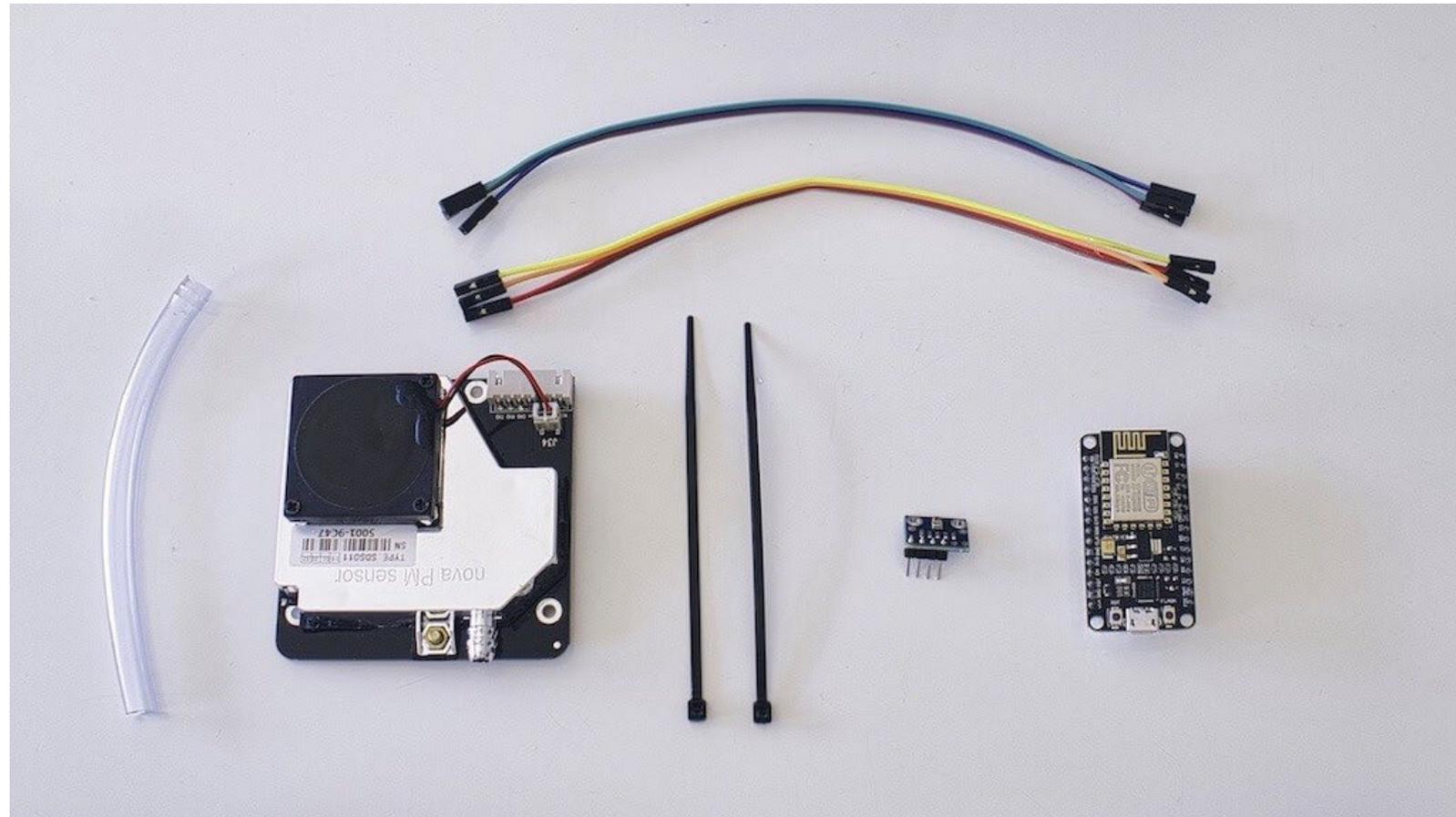
Airrohr Sensor

1. Get the parts

- SDS011 Particulate Matter Sensor
- ESP8266 Node MCU V3 CH340
- Optional BME280 weather sensor
- 6mm ID / 9mm OD tubing
- Small cable ties to secure components
- Larger cable ties to attach to house
- Dupont or JST cables
- Micro-USB cable up to 5m*
- An enclosure of sort

Suppliers:

- eBay
- Amazon
- AliExpress

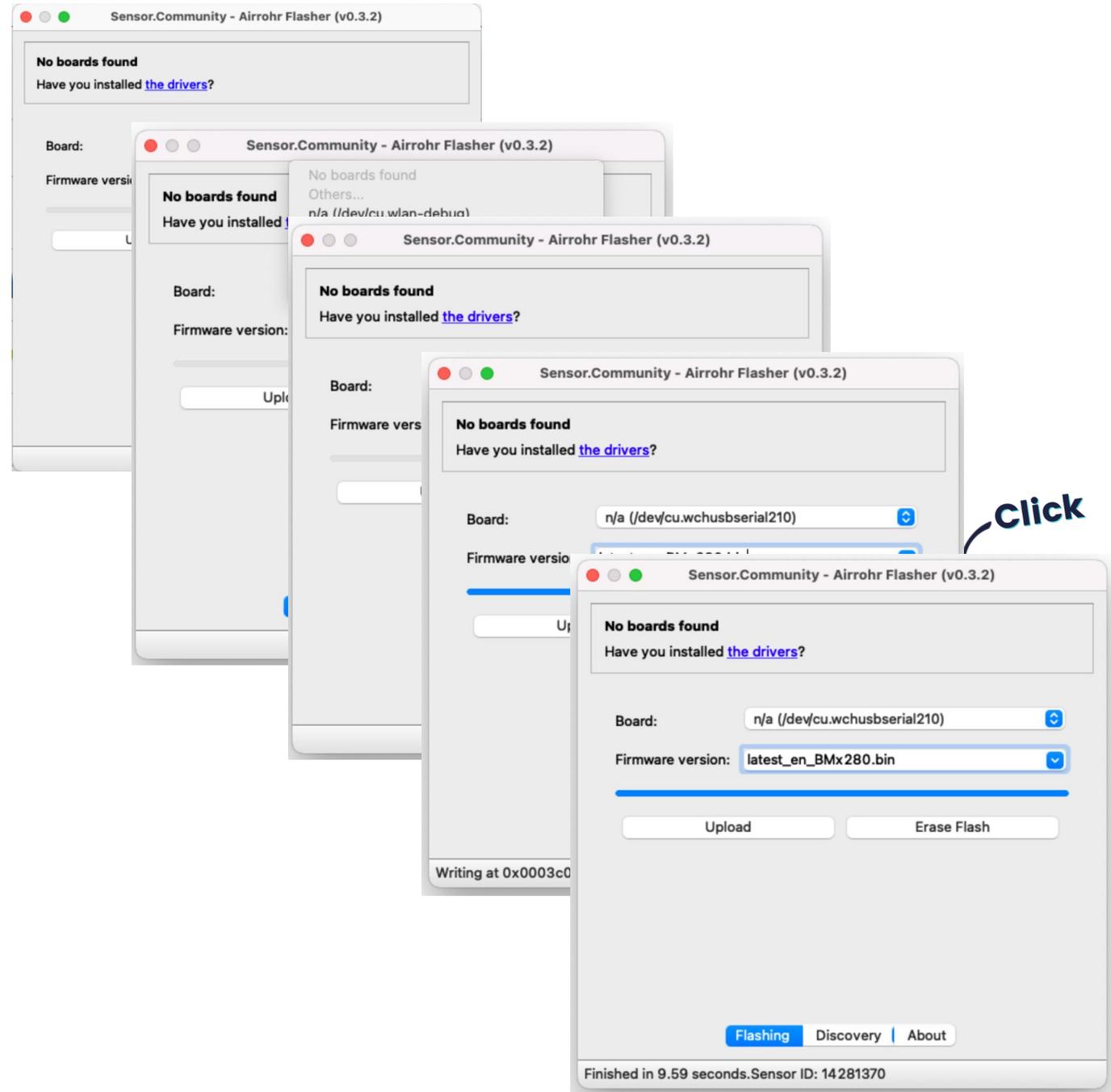




Airrohr Sensor

2. Flash the firmware

- Download the free flashing tool (Mac, Linux and Windows) available from sensor.community
- Install USB drivers if necessary (link in the tool)
- Select the board from the pull down menu
- Select the firmware language / version
- Connect board to PC with <1m USB data cable
- Flash firmware onto board (10 seconds)
- When finished, a **SENSOR ID** is provided in this example **14281370**
- Disconnect board from USB before continuing

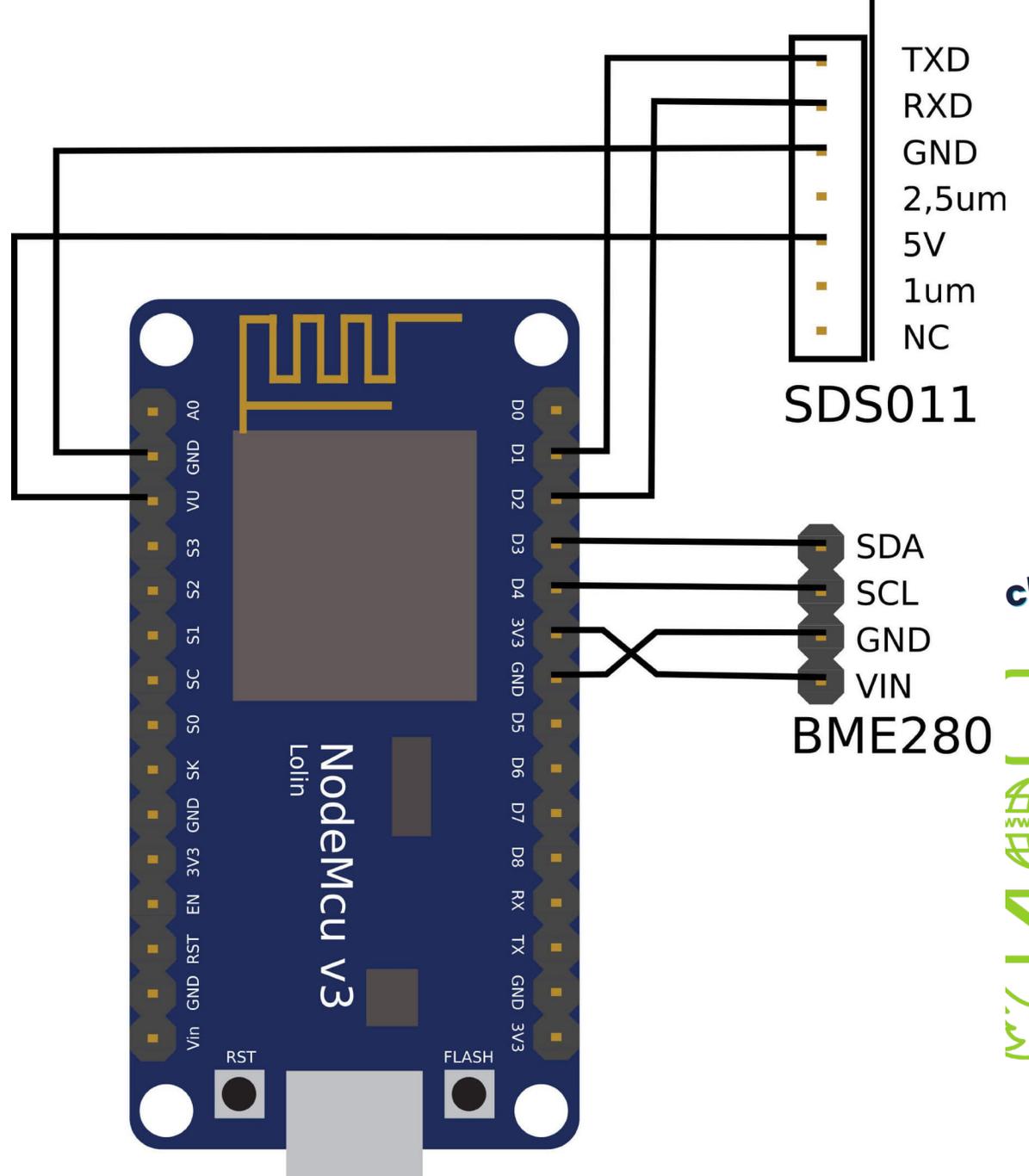




Airrohr Sensor

3. Make the electrical connections

- Connect the wires as shown
 - Use Dupont or JST cables
 - Used combined connectors for more secure connections
- Double check connections
- Power with micro-USB cable up to 5m



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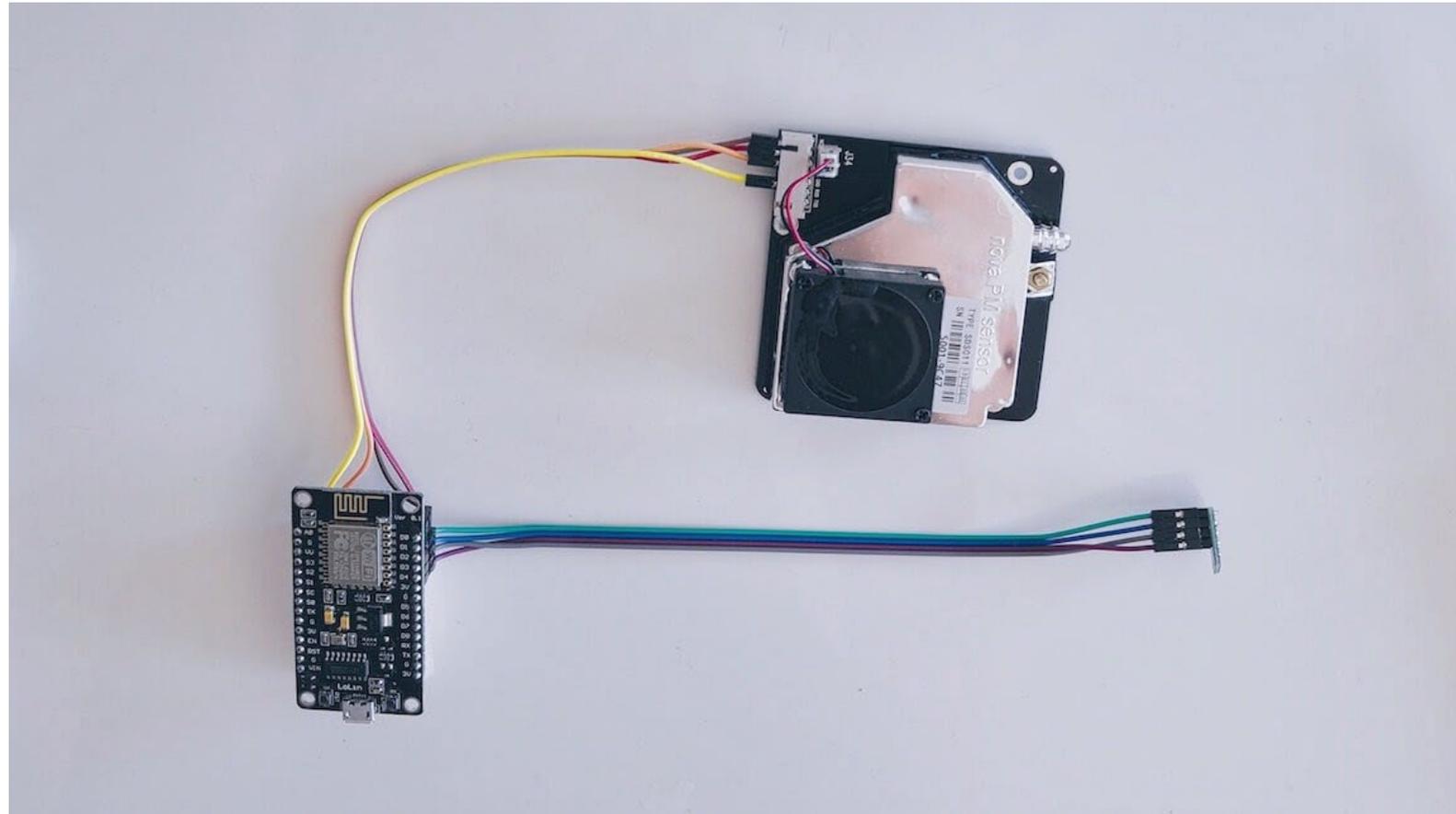




Airrohr Sensor

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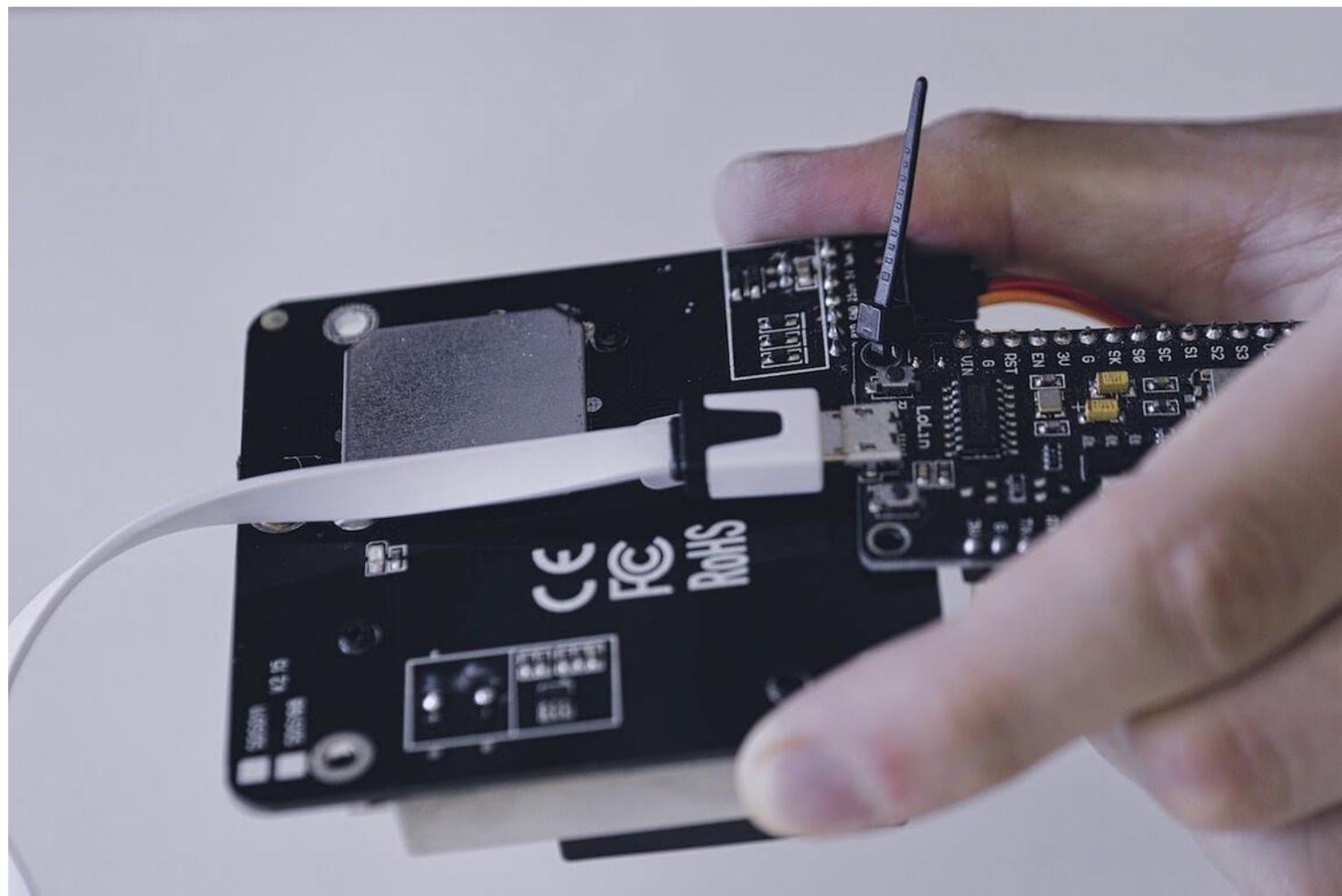




Airrohr Sensor

4. Secure parts together

- Use small nylon cable ties
- Connect board using hole at USB end
- Add air tubing to air inlet
- Secure the weather sensor to the air tube

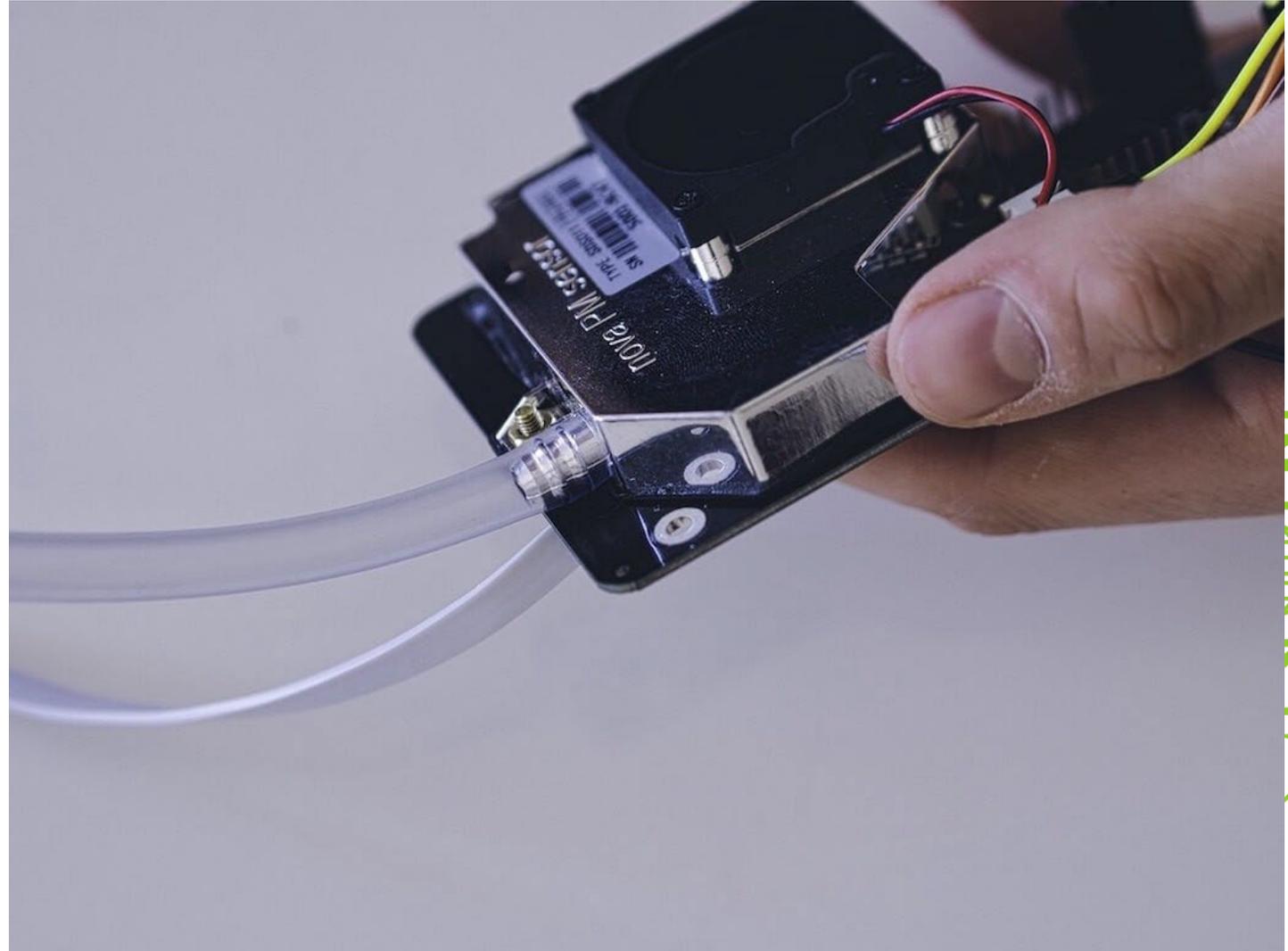




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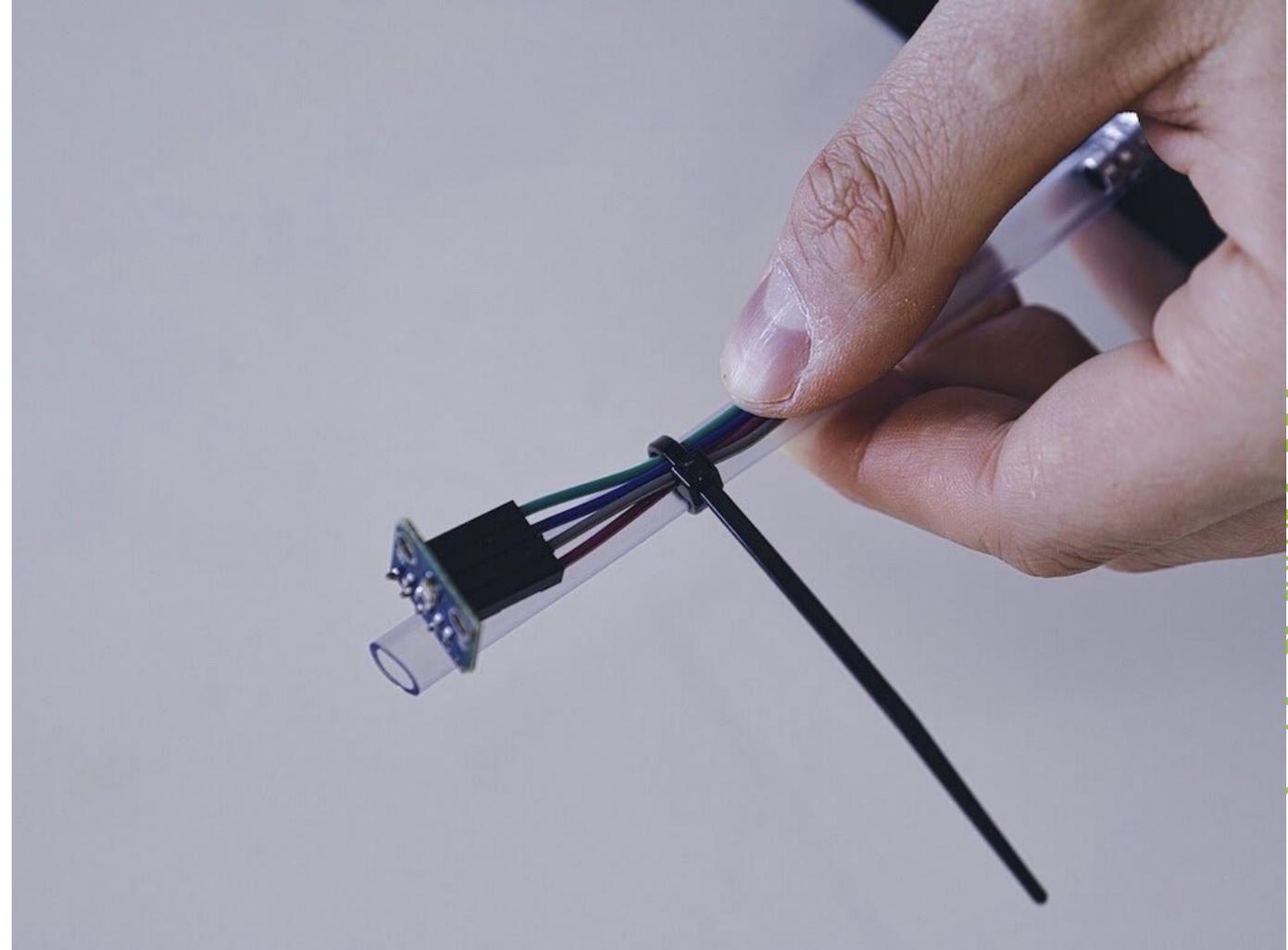




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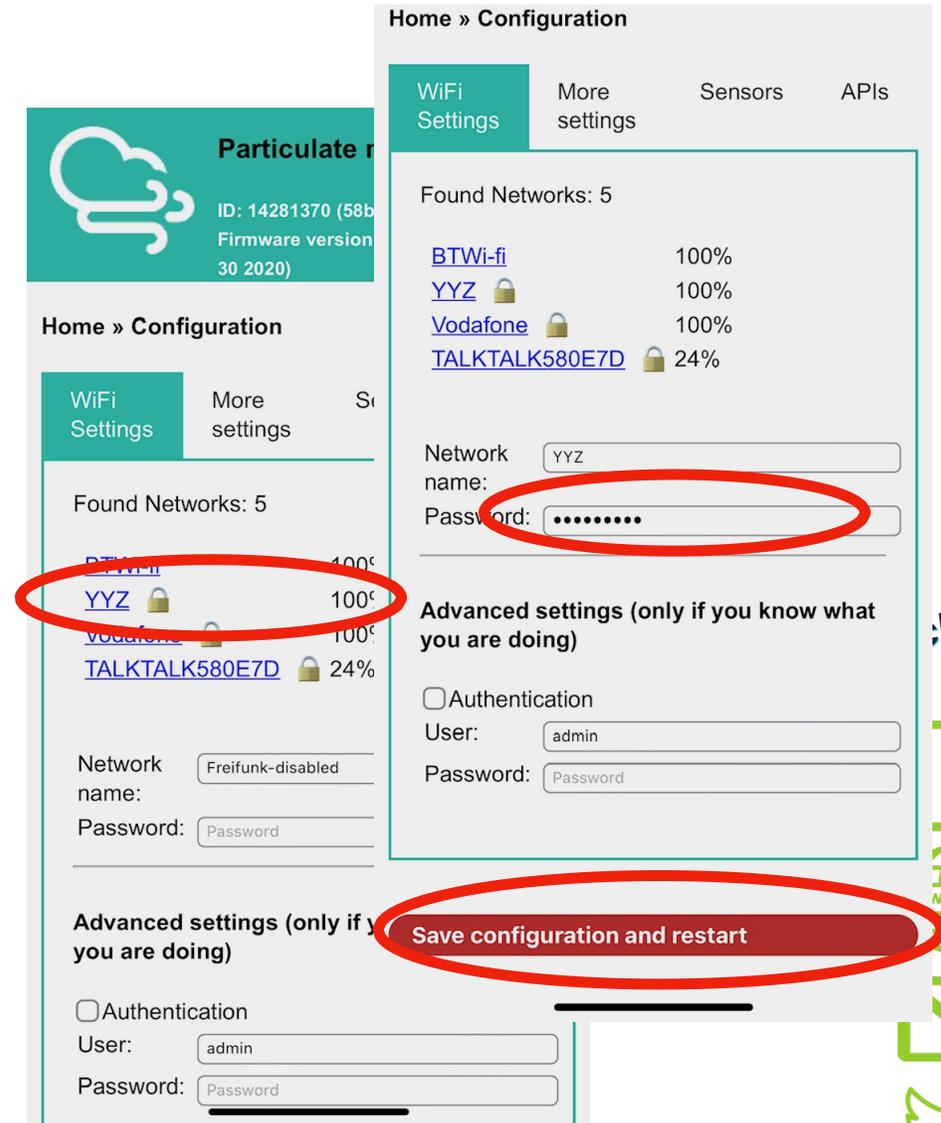
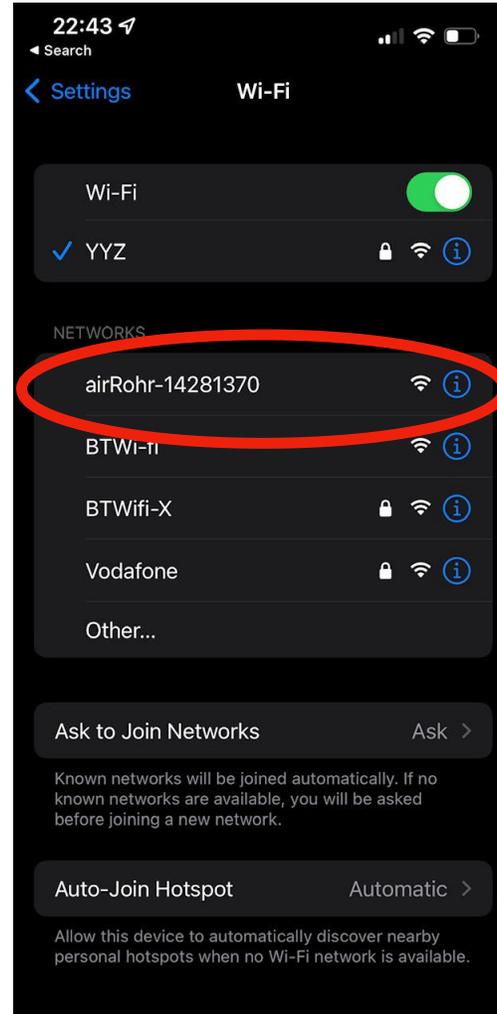




Airrohr Sensor

5. Connect to Wi-Fi / Configure

- When first powered up, acts as a Wi-Fi access point
- You connect to this Wi-Fi using your phone
- On iPhones configuration page will open automatically
- On others, you have to use a browser and enter **192.168.4.1**





Airrohr Sensor

5. Connect to Wi-Fi / Configure

- After your device is connected to Wi-Fi, it stops acting as a Wi-Fi access point
- You have to find its address on your home network (use free app called Fing)
- Bookmark it!
- Connect and check that the correct sensors are ticked
- Click **Save configuration and restart** if any changes made

Particulate matter sensor
ID: 5636844 (cc50e35602ec)
Firmware version: NRZ-2020-133/EN (Nov 29 2020)

Home »

- Current data
- Device status
- Active sensors map (external link)
- Configuration**
- Delete configuration
- Restart sensor
- Debug level

Back to home page

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Particulate matter sensor
ID: 5636844 (cc50e35602ec)
Firmware version: NRZ-2020-133/EN (Nov 29 2020)

Home » Configuration

WiFi Settings More settings **Sensors** APIs

- SDS011 (particulate matter)
- Honeywell PM (particulate matter)
- Sensirion SPS30 (particulate matter)
- DHT22 (temperature, humidity)
- HTU21D (temperature, humidity)
- BME280 (temperature, humidity, air pressure), BMP280 (temperature, air pressure)
- SHT3X (temperature, humidity)
- DNMS (LAeq)

correction in dB(A):
Correction in °C:

More Sensors

- DS18B20 (temperature)
- Plantower PMS(1,3,5,6,7)003 (particulate matter)
- BMP180 (temperature, air pressure)
- GPS (NEO 6M)

Save configuration and restart

Back to home page





Airrohr Sensor

5. Connect to Wi-Fi / Configure

- Connect to the sensor again to check readings
- You do that from the **Current data** section
- Check that you have readings for all values
- New readings every 145 seconds by default

Particulate matter sensor
ID: 5636844 (cc50e35602ec)
Firmware version: NRZ-2020-133/EN (Nov 29 2020)

Home »

- Current data**
- Device status
- Active sensors map (external link)
- Configuration
- Delete configuration
- Restart sensor
- Debug level
- Back to home page

Particulate matter sensor
ID: 5636844 (cc50e35602ec)
Firmware version: NRZ-2020-133/EN (Nov 29 2020)

Home » Current data

13 seconds since last measurement.

Sensor	Parameter	Value
SDS011	PM2.5	2.3 µg/m³
SDS011	PM10	10.8 µg/m³
BME280	temperature	-146.3 °C
BME280	air pressure	672.55 hPa
BME280	humidity	100.0 %
WiFi	signal strength	-81 dBm
WiFi	signal quality	38 %

Back to home page

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Airrohr Sensor

6. Register online

- Create account
devices.sensor.community
- Just need to enter your email and
choose a password.

Home Login Register English ▾

Register

Email Address

Password

please wait up to 30 min to receive the mail and check your spam folder

[Register](#)





Airrohr Sensor

6. Register online

- Provide the Sensor ID you saw when you flashed it (see Step 2.)
- Give it a name
- Say where you are putting it.
- Ensure Hardware configuration section matches sensors used ie. Usually SDS011 and BME280
- Can confirm exact location on map

Home My sensors Settings Password change Logout English

Sensor registration

Sensor ID

The numeric part of the sensoname only

Sensor Board

Normally this should be esp8266. Users of ESP32 boards, Raspberry PI or the Smogomierz sensor version need to change this accordingly. Also in these cases the Sensor ID is the numeric part of the name only.

Basic Information

Personal sensor name

Only the sensor ID will be published.

Street Street number Indoor Sensor

Postal code City Country

Additional Information

Publish exact location
Reveal exact sensor location in public data and archives.

Sensor level above ground (in cm)

Sensor location relative to the traffic

1 = on the garden side, very well shielded from all streets, 10 = the sensor is on a house wall directly on the street. With this value it is irrelevant how big the street is, it is only about where the sensor is attached to the house.

Short description of location

Hardware configuration

(click >>here<< to enable expert fields)

Sensor Type

Sensor Type

The more precise the data we have, the better we can evaluate the data and thus energize statements. The system can also try to make a geoposition out of the address, but we would be happy if you would specify the position with the map below.

Latitude Longitude

Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA

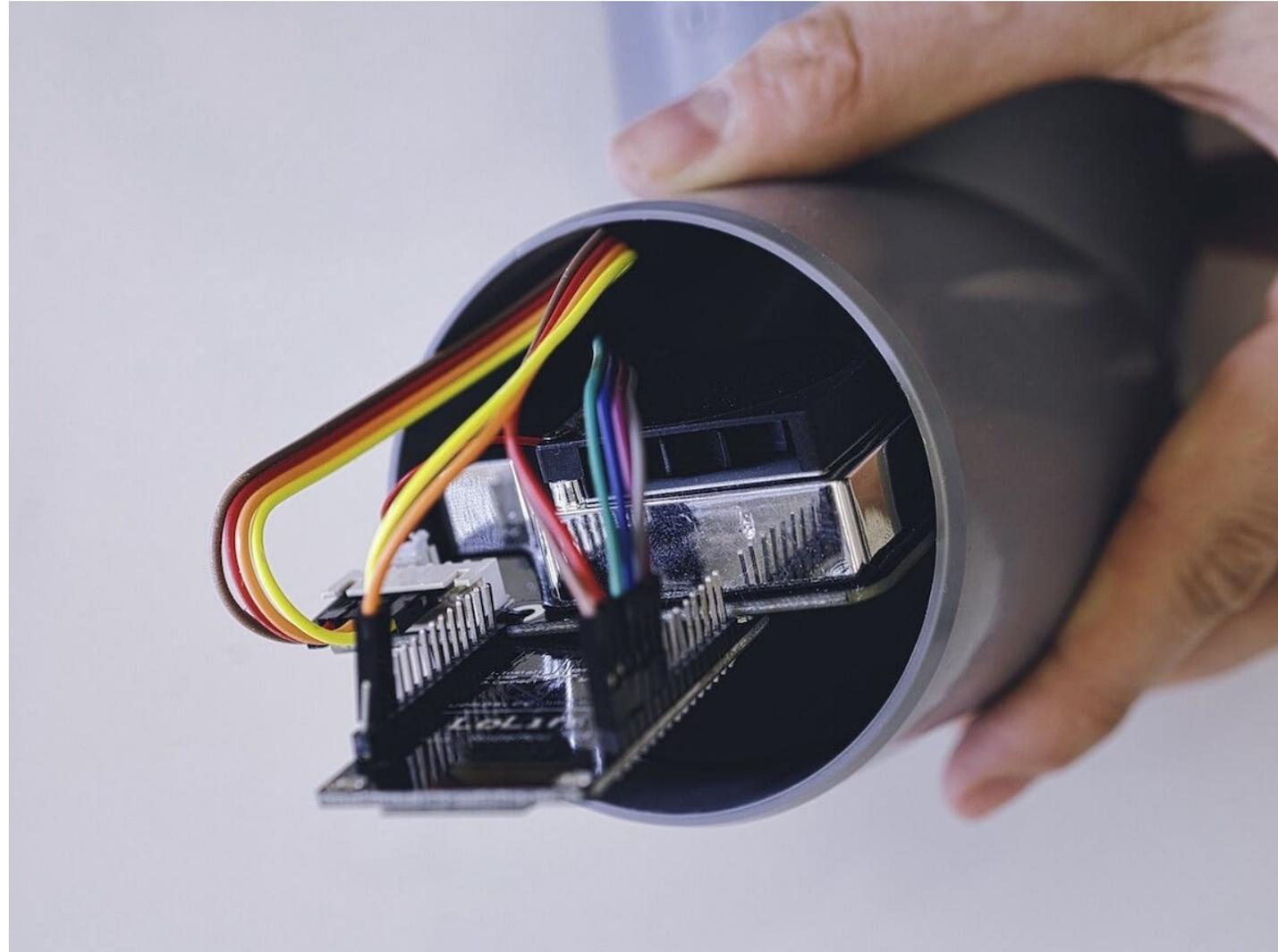


Airrohr Sensor



7. Put inside an enclosure

- Traditionally German drain pipe elbows are used
- DN75 (75mm diameter)
- Put the air line tubing end in first
- Whole assembly slides into one of the elbows
- Attach the other elbow
- Add insect mesh (highly recommended)





Airrohr Sensor

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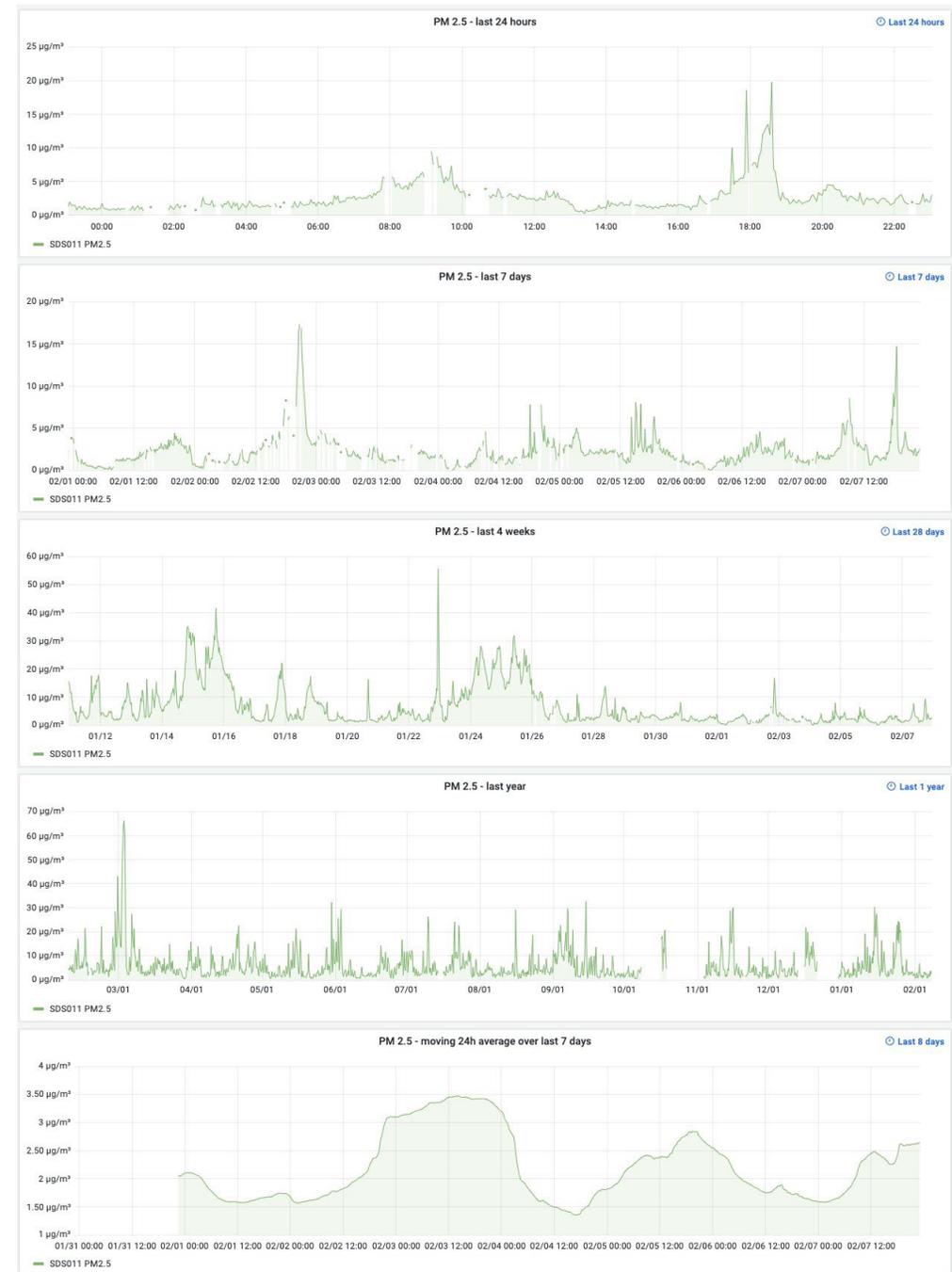




Different ways to access data

From one reading to all readings

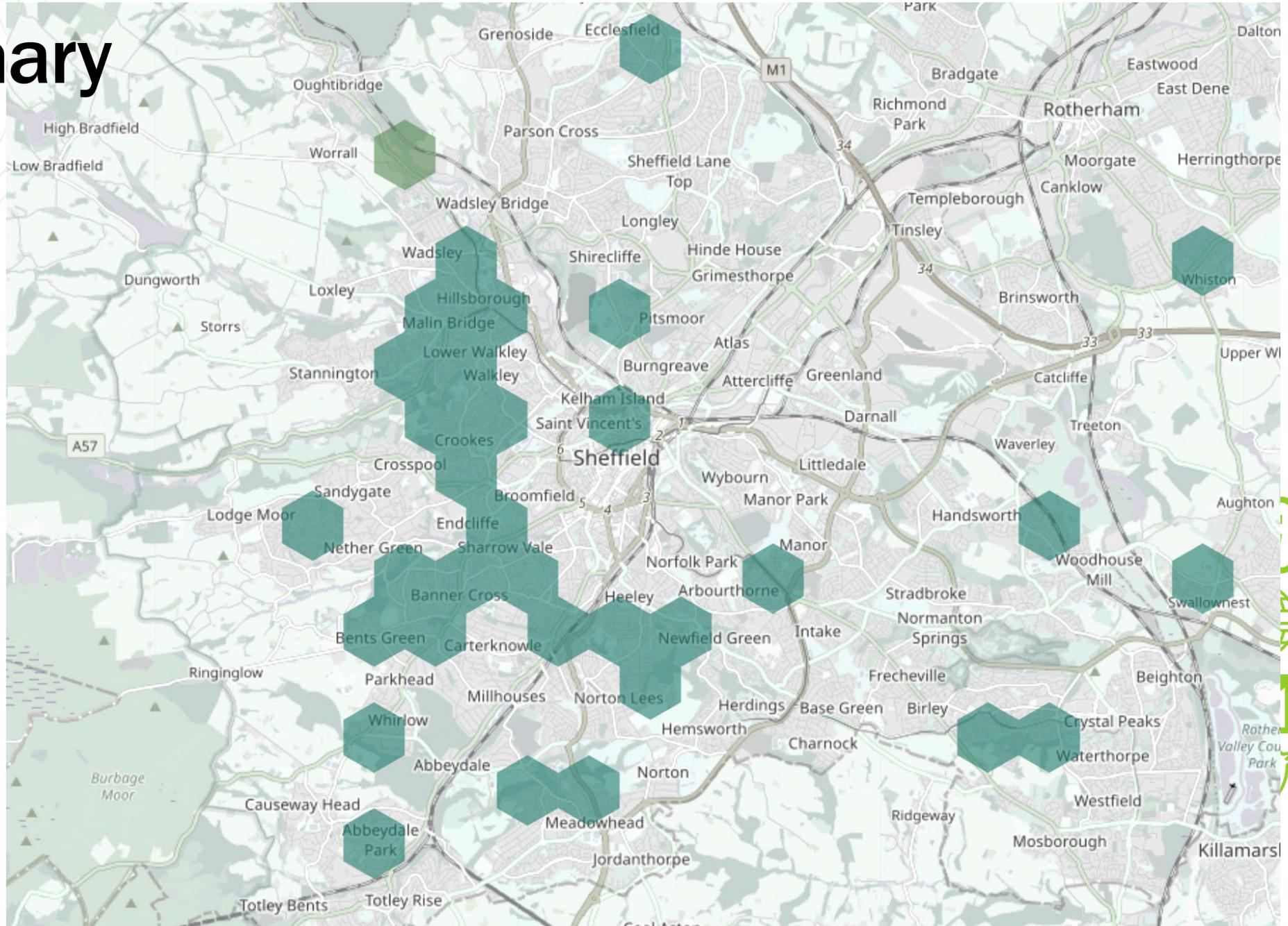
- The device itself via your own network for latest readings
- The colour coded map with clickable hexagons for actual reading and 24 hour history
- Some historical data via the platform
- APIs to get the data programmatically
- Send the data to your own database (eg. InfluxDB)





Summary

- £40 for parts
- Can order parts, kits or completed units from me
- Happy to support anyone looking to make their own





Thank you!
graham@cleanairsheffield.com
 [@cleanairsheff](https://twitter.com/cleanairsheff)
 Clean Air For Sheffield



Hope Valley Air Quality Network

In 2020 we deployed network of sensors in the Hope Valley, Peak Park to monitor Air Quality, temperature, humidity, pressure etc after learning of the Sheffield project

As before, these are visualized on the **Global Sensor Community** dashboard. This is an example of IoT enabling “Citizen Science”

These sensors rely on Wifi and a power source but require zero maintenance other than an occasional reset. Anyone anywhere can access this map and see what’s happening now or over the past year.

In the Peak Park we have begun to use this data to track down heavy polluters.

Cost: £600

Value: Huge.

Paid for by the National Park authority.



Global Sensor Community Dashboard

Hope Valley Air Quality Network

The initiative was undertaken in concert with the local climate action group and many of its members volunteered to be hosts to the sensors



Hope Valley Air Quality Network

In general comparisons we have found the Hope Valley has very good, clean air.

However when there are wildfires or moor burning events, the air quality is substantially impacted

We have begun to use the data we have collected to correlate with burning events such as this one in 2021.

March 24, 2021

PHOTO 1

Shatton Edge burn plume, March 5, 2021 - 14:30



Hope Valley Air Quality Network

On March 24 there were two very significant burns set on the grouse moors.

The image shows the wind direction was such as it would carry the smoke from the Ladybower burn into the Hope Valley and probably impact air quality in the Hope Valley villages.

Hope Valley air quality and the impact of burning on the Moor

March 24, 2021

MAP 1

Google Map showing the approximate locations of the burn sites based on the photos (1&2) and also indicating wind direction

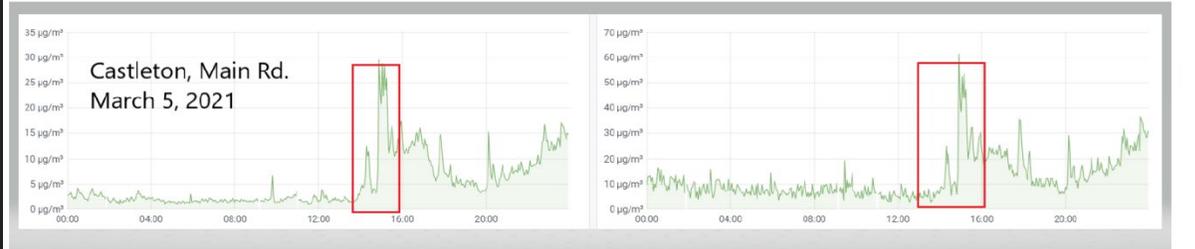


Hope Valley Air Quality Network

The data recorded by the Hope Valley AQ network tells a very clear story showing a surge in particulates starting mid afternoon and continuing most of the evening.

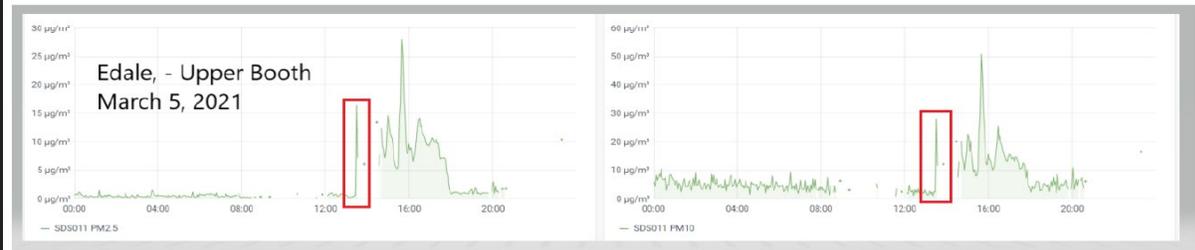
Castleton Village

CHART 4



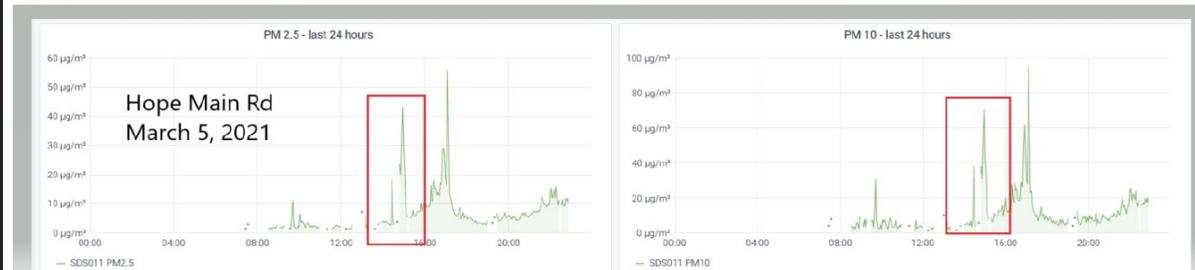
Edale

CHART 5



Hope Village

CHART 2



Hope Valley Air Quality Network: Next steps

- Because of the AQ project, people could see the value in having more data about visitor numbers and how it would help with planning and policy. But there is no consistent data collection about visitors, only some inferred data.
- Subsequently there have been several discussions with parish councils interested in developing a “Smart Village” project to collect more data
- The project to collect this data is now in development



Smart Village - The basics

We see this data as key to:

- Promoting the wellbeing of the community and those who visit us for work or leisure
- Understanding the volume of traffic in the area (where, when, speed, type)
- Providing evidence and rationale for resources and changes to the statutory authorities
- Understanding current transport use and identifying measures to moderate excessive vehicle movements by looking at integrated transport alternatives.
- Checking pollution and disturbance including noise / air / light / traffic
- Identifying inappropriate use of footpaths and identifying potential routes for trails /bridleways

In Closing

Thank you.

Feel free to contact me

Mike Joseph

qmick01@gmail.com



Thank you for listening