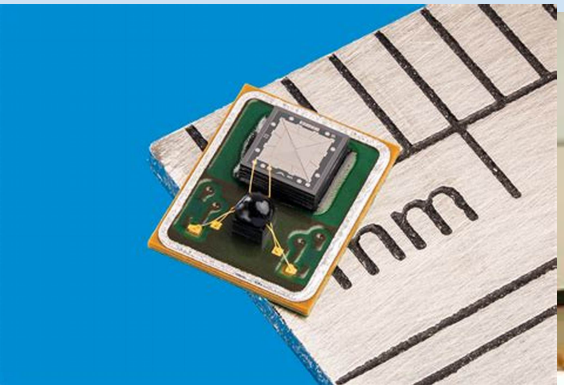

GENEVA
TSINGHUA
INITIATIVE
UNIVERSITÉ
DE GENÈVE
LOGAIR
Open & collaborative air quality monitoring

Introductions

Emmanuel Kellner

- Studied micro-engineering
- Now, Sustainable development & Innovation
- At University of Geneva & Tsinghua

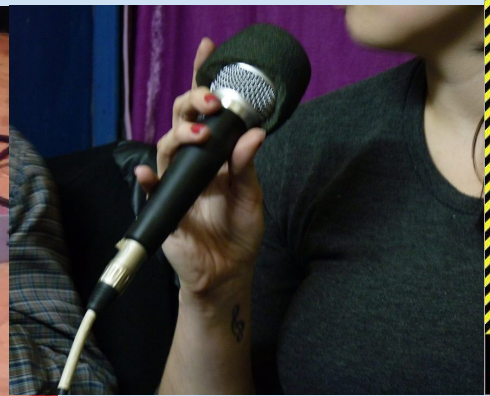


Introductions

Julieta Arancio

- Studied environmental sciences
- Now, phd in open science hardware
- From Buenos Aires, Argentina, in Geneva

<3 open source!



Introductions: You!

- Name
- Hometown
- Background
- Why are you here?
- What would you like to do?

The challenge

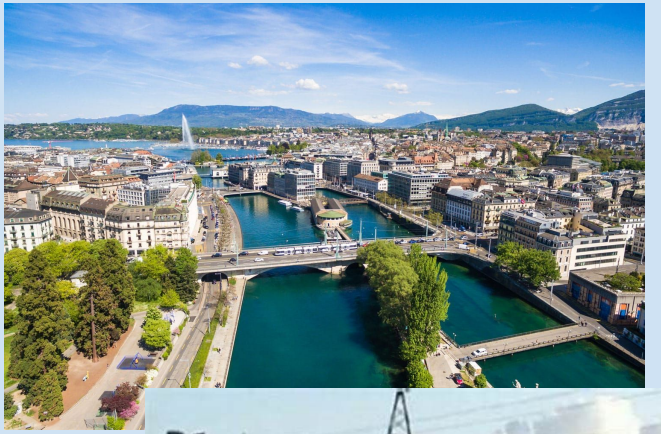
We combine bike sharing services with low-cost air quality monitoring to **map Geneva air quality** during daily commutes and **plan cleaner routes** within the city, while generating useful **public environmental data**.

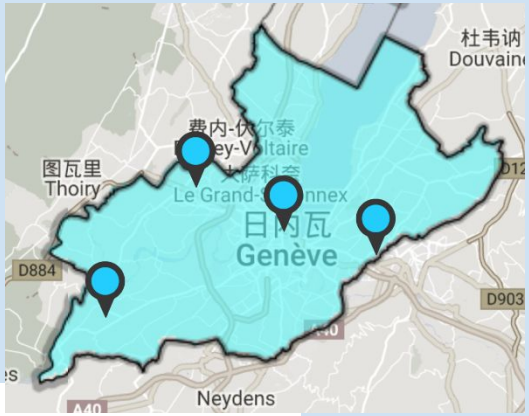
This talk

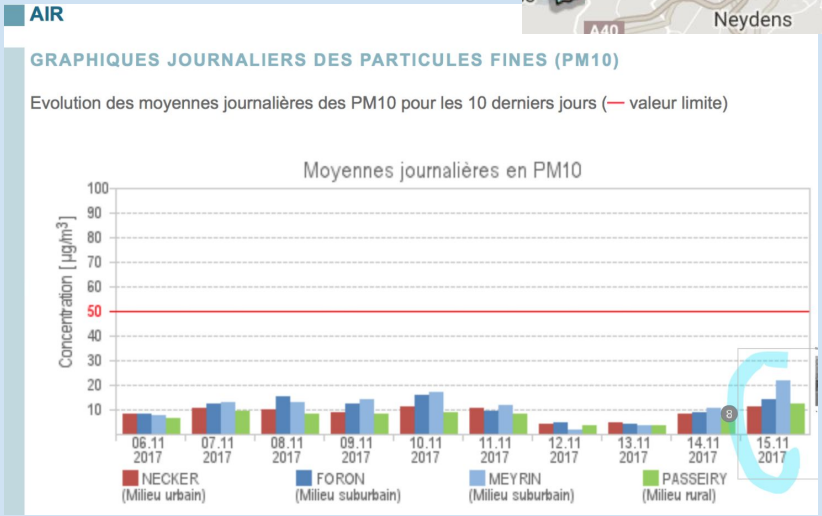
- ➔ Air pollution, what, why, how?!
- ➔ Open science and open hardware
- ➔ The LogAir device
- ➔ Assembling a LogAir device
- ➔ Getting data

Air pollution: what, why, how?

Why mapping air pollution?

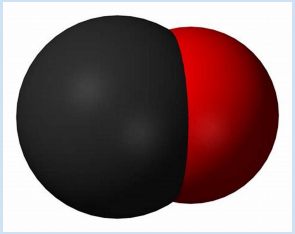


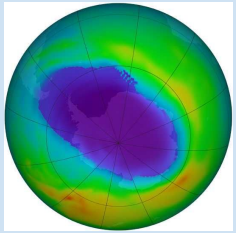


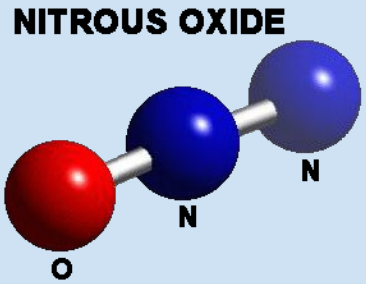


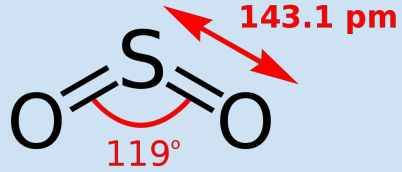
What is air pollution?

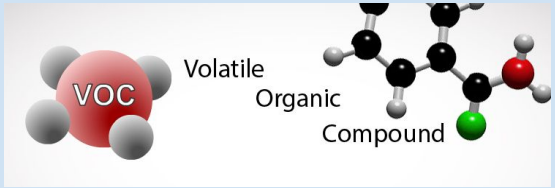
- PM2.5 & PM10
- Carbon Monoxyde (CO)
- Ozone (O3)
- Nitrous oxides (NOx)
- Sulfur Oxides (SOx)
- VOCs (benzene, formaldehyde…)
- …



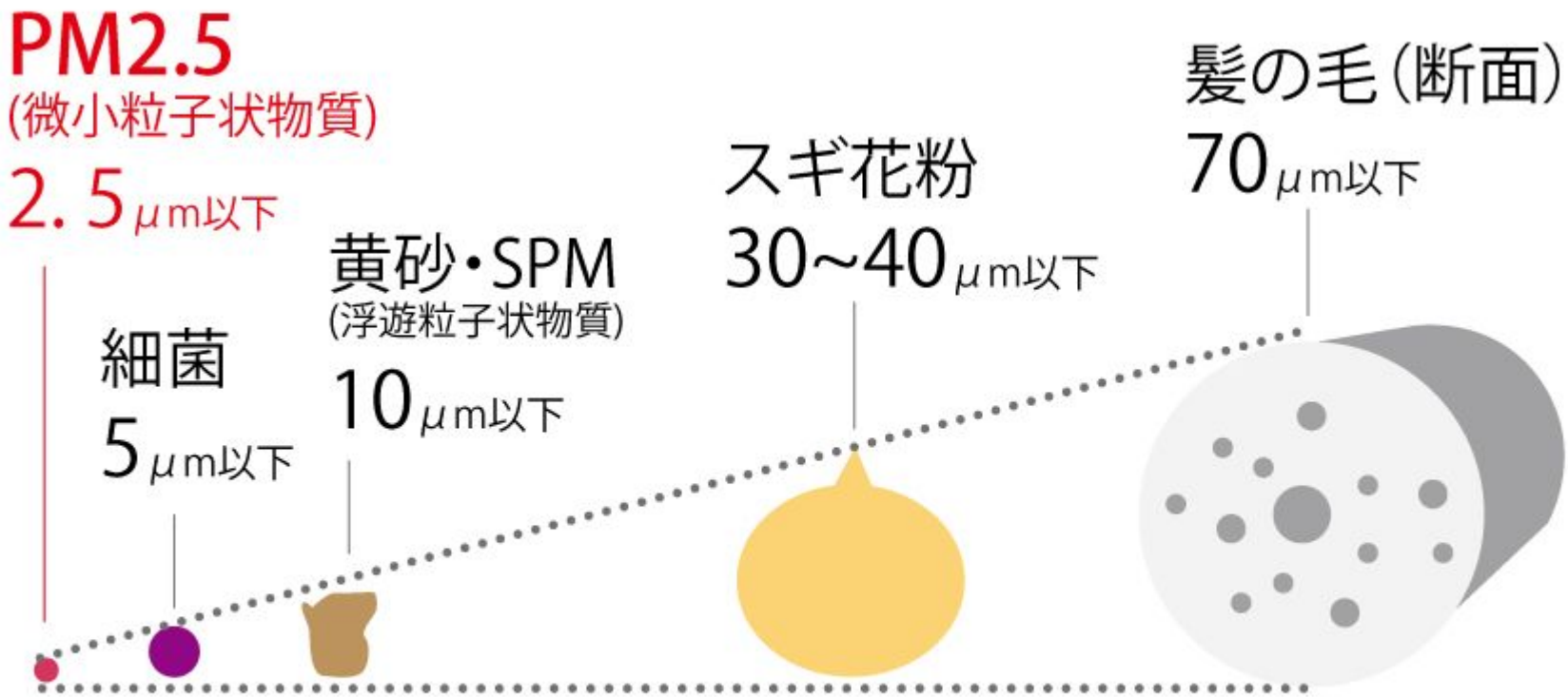








PM 2.5 & PM10



出典:米国EPA・大阪府環境農林水産業
「微小粒子状物質(PM 2.5)」に関する資料より

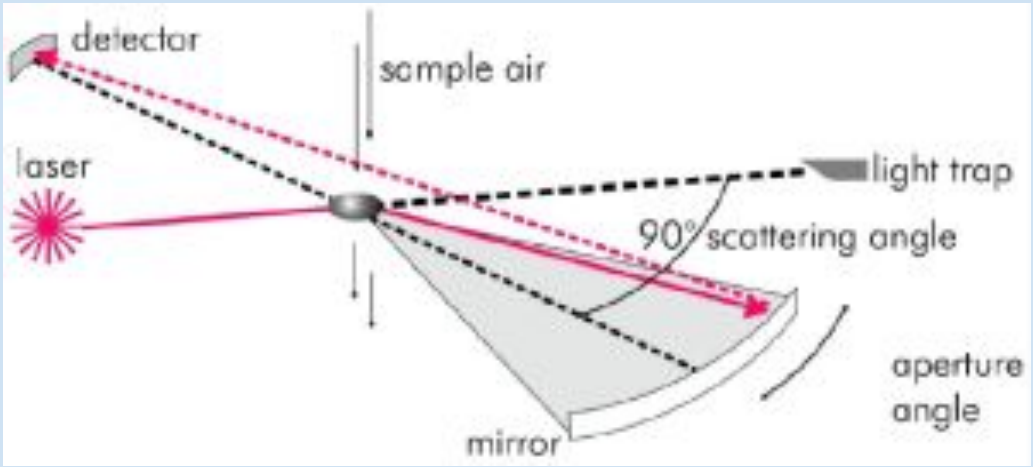
Origins of pm2.5 & pm10

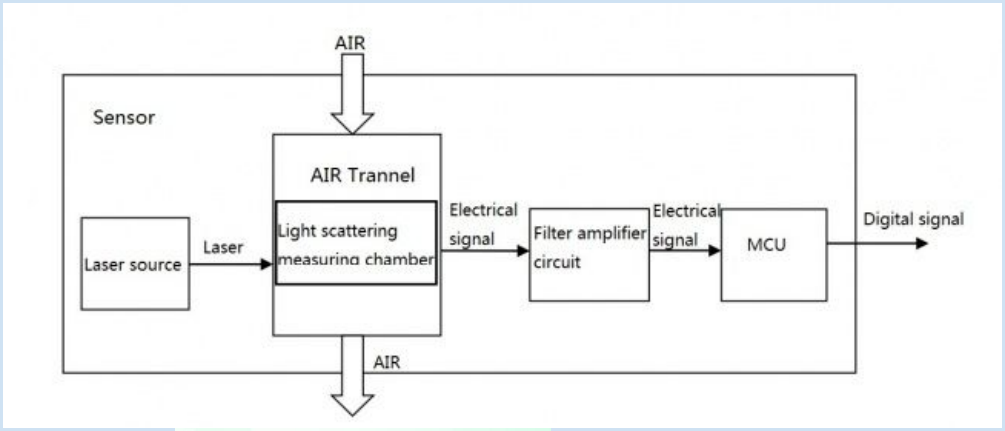
Why measure PM2.5 & PM10?

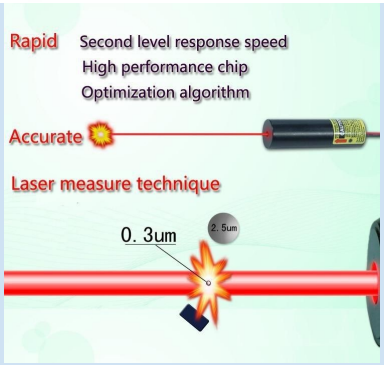
- Dangerous!
  Responsible for 1 over 7 premature death
  In Switzerland
- Everyone knows them
  But not that well
- We can measure them
- It is invisible

HOW TO MEASURE PM2.5 & PM10

- Optic method: IR laser scattering

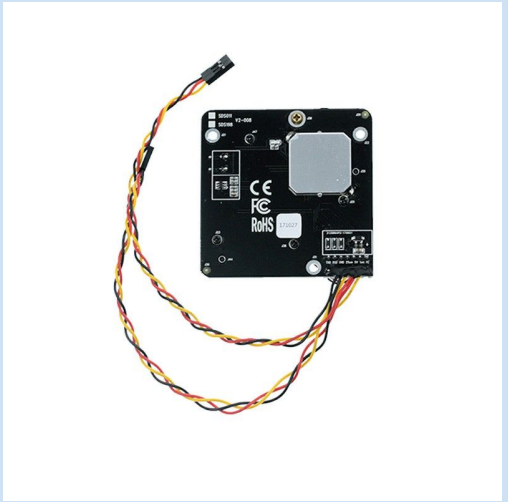






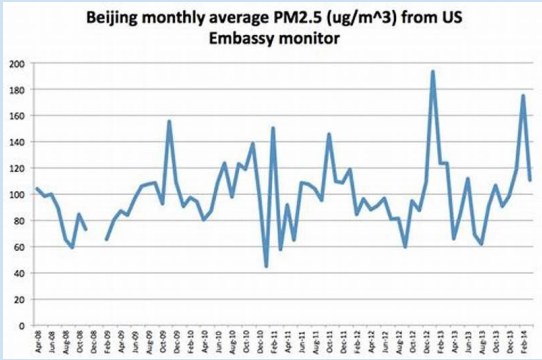
OK, BUT HOW!?

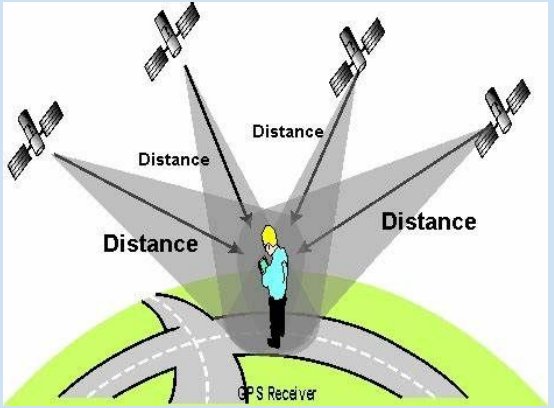
- No need to know how it works to use it!
  (but better to understand a bit, to trust the data)
- Many products exist. Find one that works for you.
  If you cannot find one, **make it**!



How to MAP air pollution

- Simple!
  - Get PM2.5 & PM10 value
  - Get GPS position
  - Write all that to a file!
- How to measure PM2.5? Ask internet?
- How to get position? Ask internet…
- How to log that to a file? Ask internet!





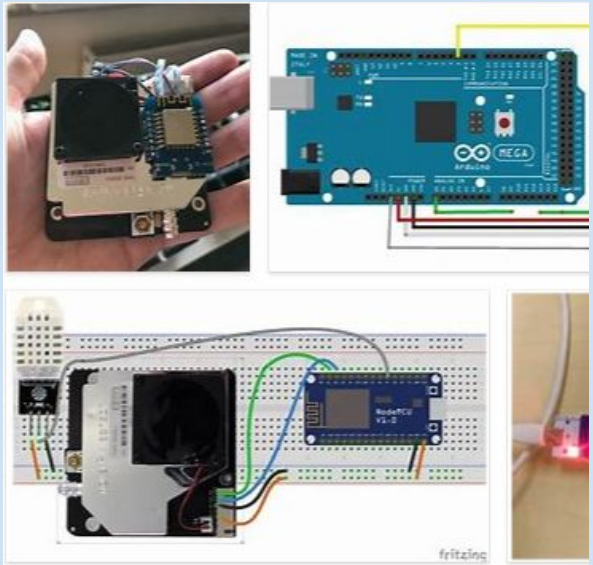
OPEN SCIENCE & OPEN HARDWARE

STANDING ON THE SHOULDERS OF GIANTS

Find people already using what you need!

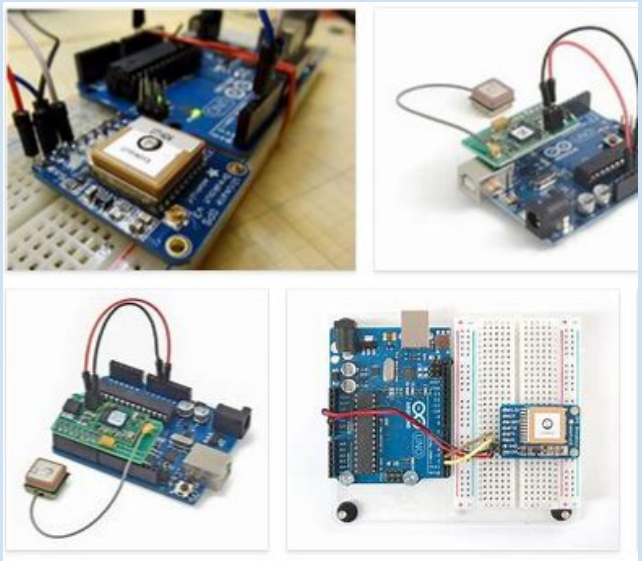
国内版 国际版

pm2.5 arduino



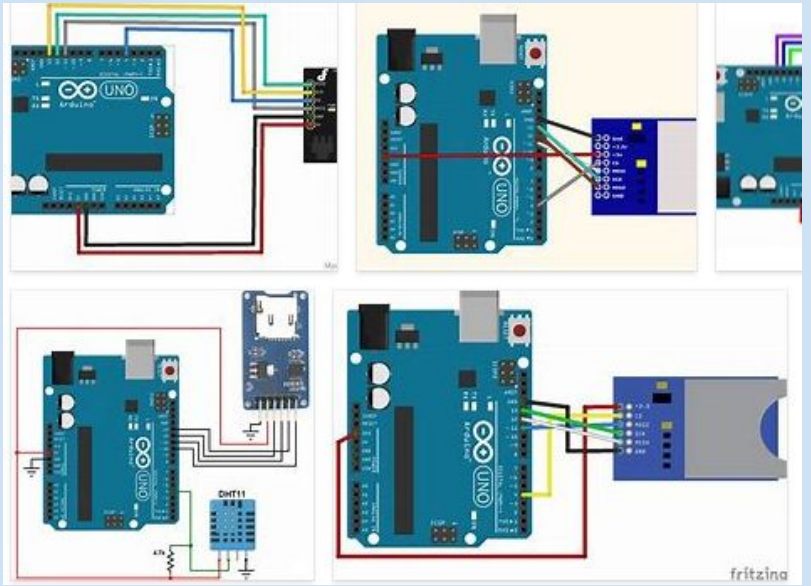
国内版 国际版

gps arduino



国内版 国际版

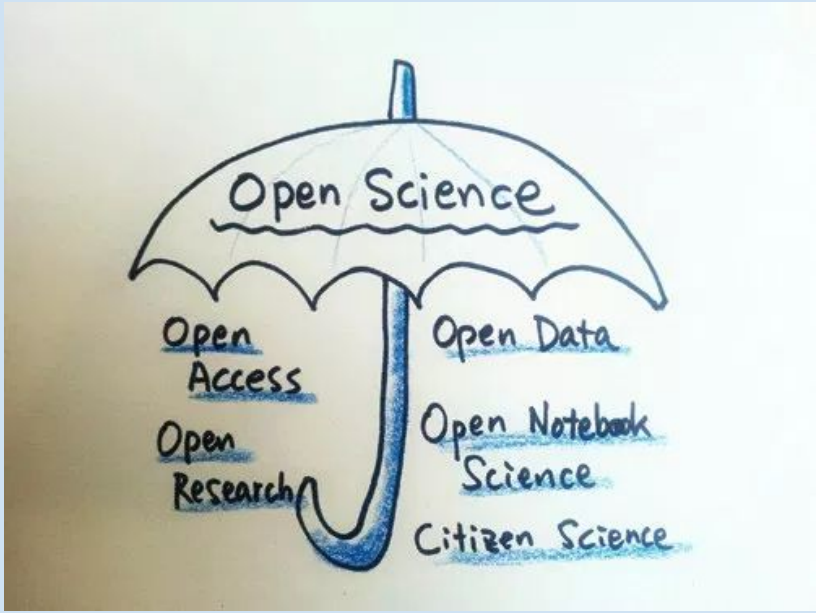
sd card arduino



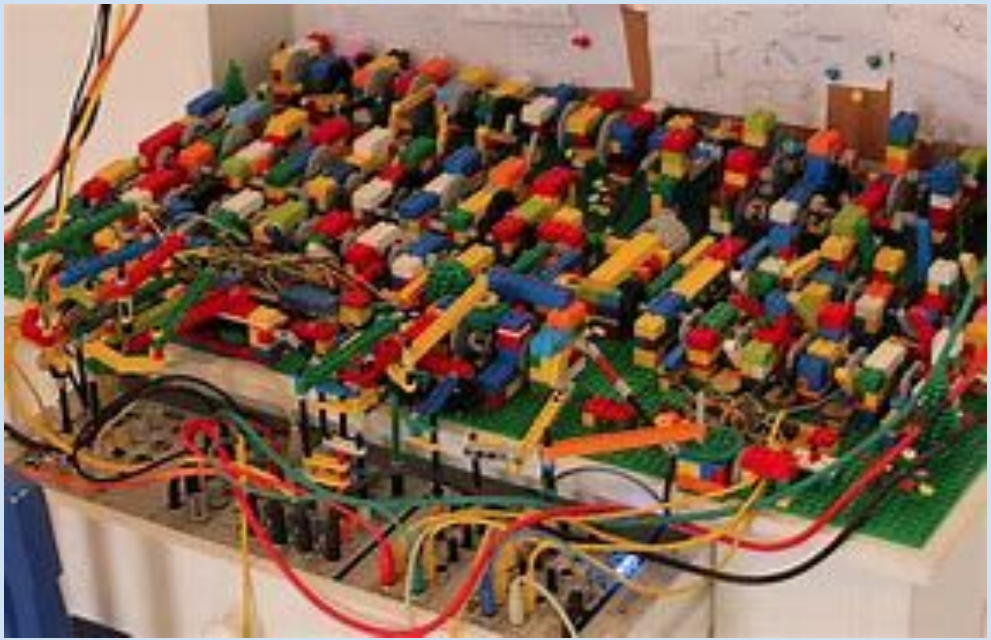
OPEN SCIENCE COMMUNITY

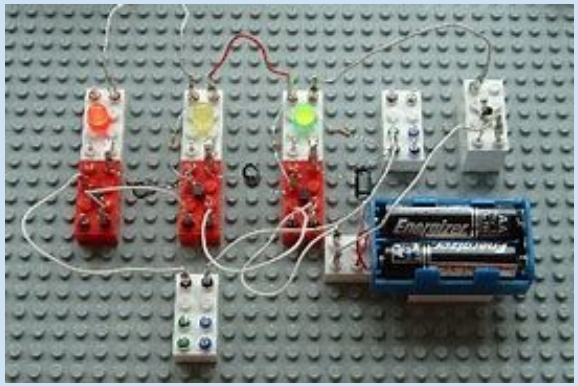
Many people have similar issues, try similar or different things… Find out what others use, why, and how, **don't reinvent the wheel!**

- **Documentation:** just like scientific papers, share your hypothesis, methodology, results
- **Open source, Open Hardware, Open Science:** be transparent, share so others can improve and share back!



PROTOTYPING: LEGO/IKEA MODEL

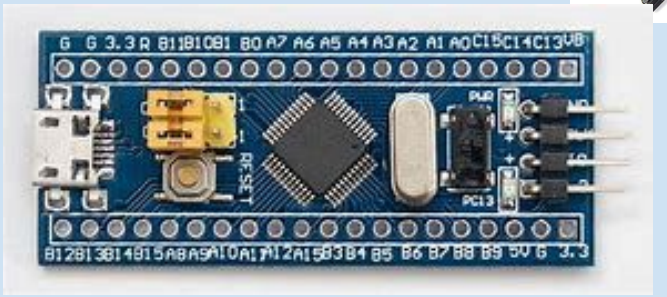


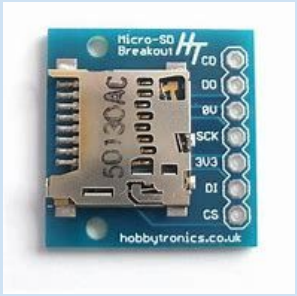


THE LOGAIR DEVICE

Components

- Microcontroller
- PM2.5/PM10 sensor
- Temperature/Humidity
- GPS
- SD-Card
- Lots of wires!





Microcontroller

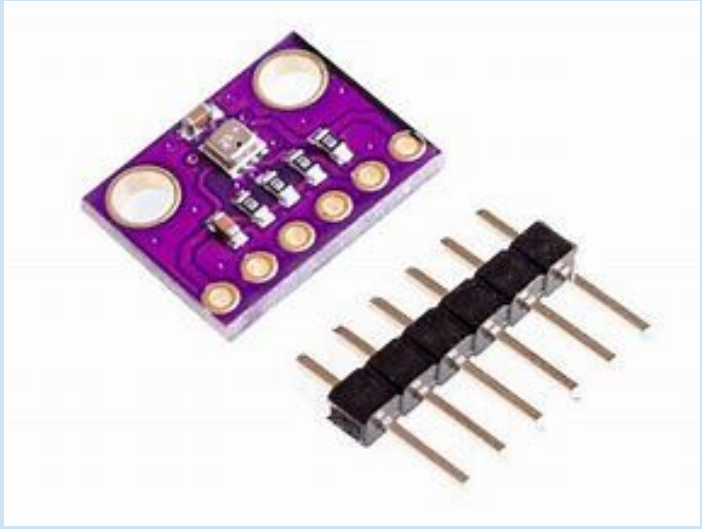
- Bluepill – STM32
- Cheap! 10RMB
- Powerful
  lots of input/outputs, fast
- Compatible Arduino (but cheaper ;))
  Do you know Arduino?

PM2.5 & PM10 SENSOR

- Plantower PMS7003
- (not so) cheap!
- Good quality
  cheaper sensors = random output
  more expensive sensors = too expensive!
- Arduino Libraries available!

TEMPERATURE & HUMIDITY SENSOR

- Why? Humidity change particle apparent size...
- BME280
- Cheap: 16RMB
- Good
- Not much to say…
- Arduino Libraries available!

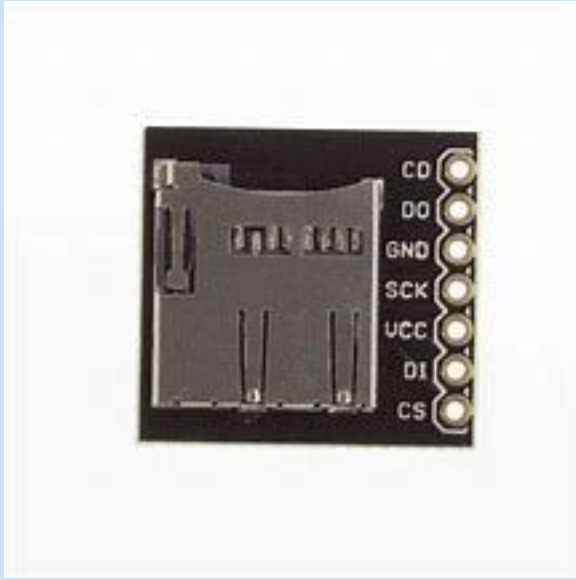


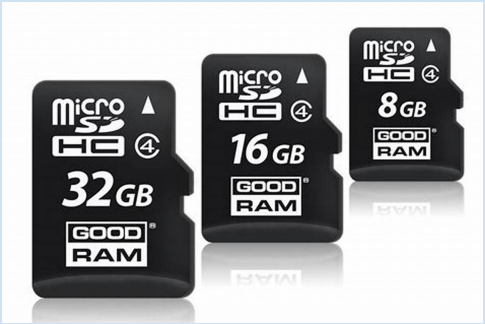
GPS RECEIVER

- MT3339
- Expensive: 130RMB
- But good signal!
  Mapping need correct position
  GPS signal is sometimes hard to get
- Arduino Libraries available!

SD CARD READER

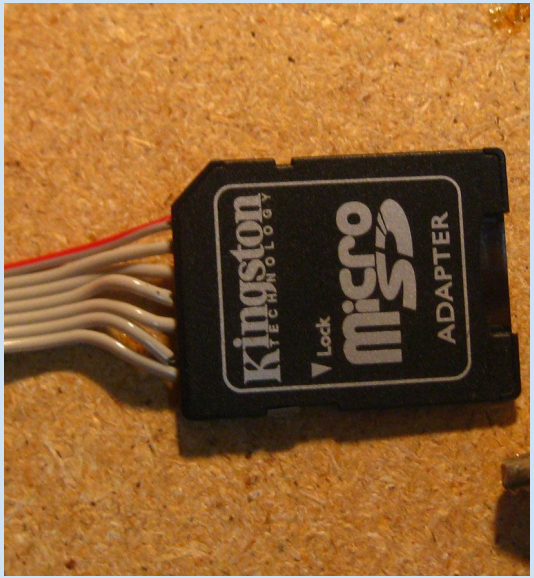
- Simple connection
- Cheap: 5RMB
- But…
- We didn’t receive those… Hack!

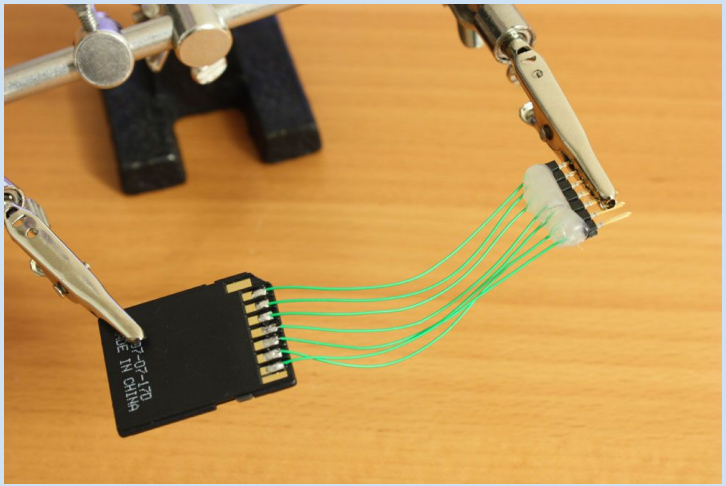




SD CARD READER HACK

- Simple connection
- Cheaper: 1RMB
- But… a bit messy





BLUETOOTH MODULE

Get your data… wireless!

To sum up...

	Component	Price
Microcontroller	Bluepill	10 RMB
PM2.5/PM10 sensor	SDS018	120 RMB
GPS	MT3339	130 RMB
Humidity & Temperature	BME280	15 RMB
SD card + breakout	No Name	20 RMB
Bluetooth module	HM10	
Total		**300 RMB**
Professional Solution		**2100 RMB**
+ pencil & paper		

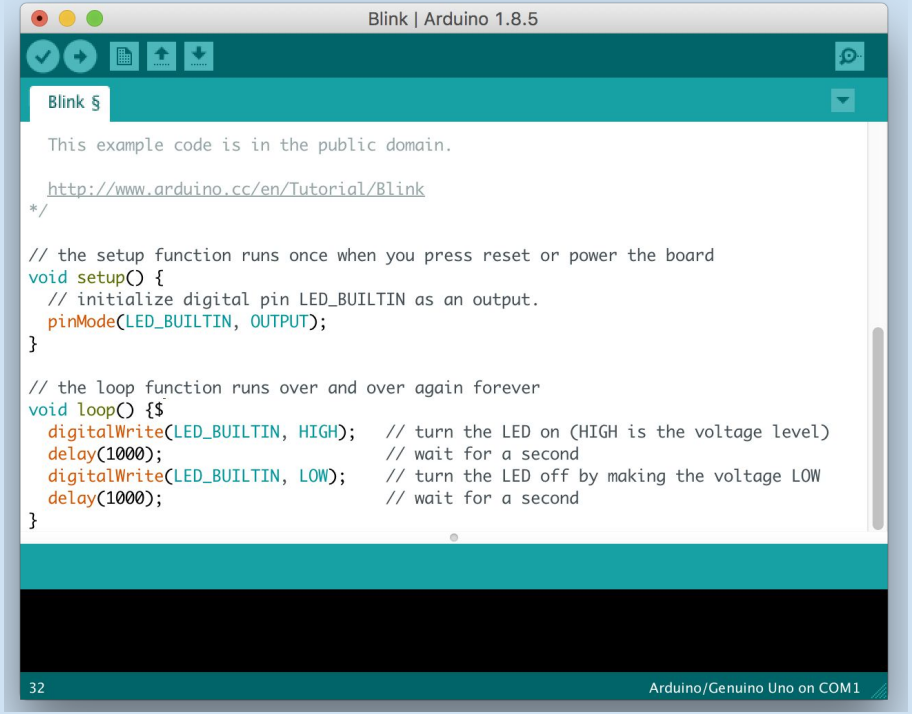
ASSEMBLING LOGAIR

Follow instructions at:

github.com/logair/akkamobility

SOFTWARE

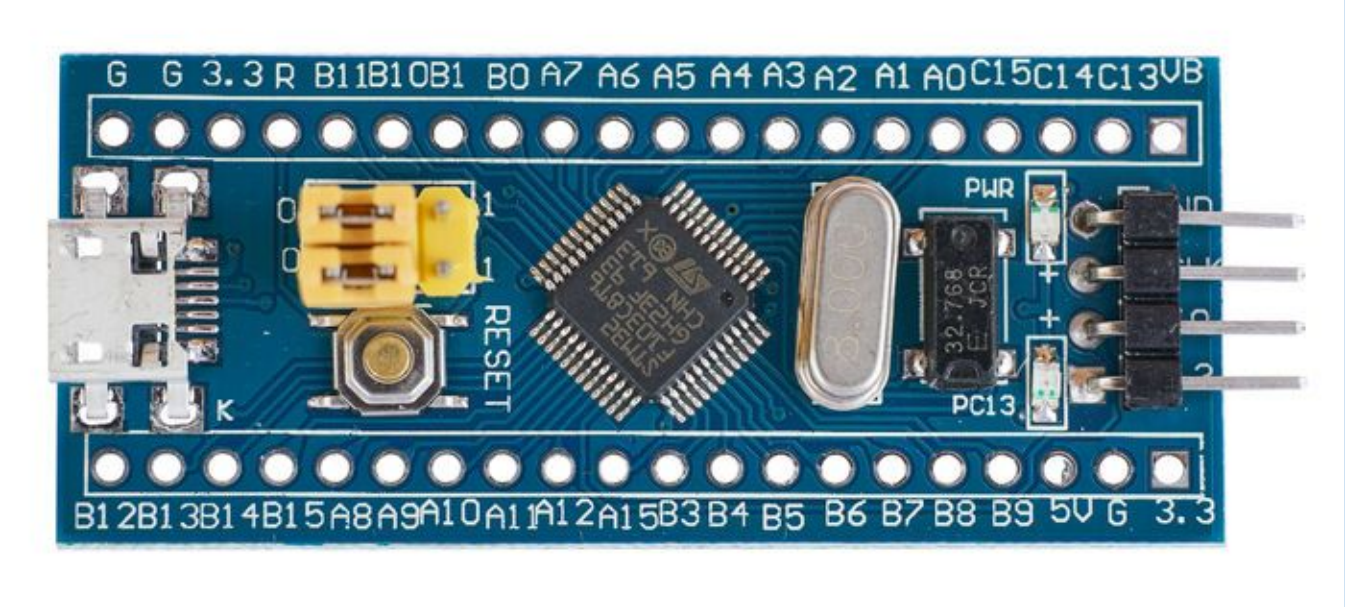
Get Arduino IDE



Configure libraries & board

BLUEPILL: THE BRAIN OF LOGAIR

- Pins have names and numbers
- They do different things: read signal, blink LED..



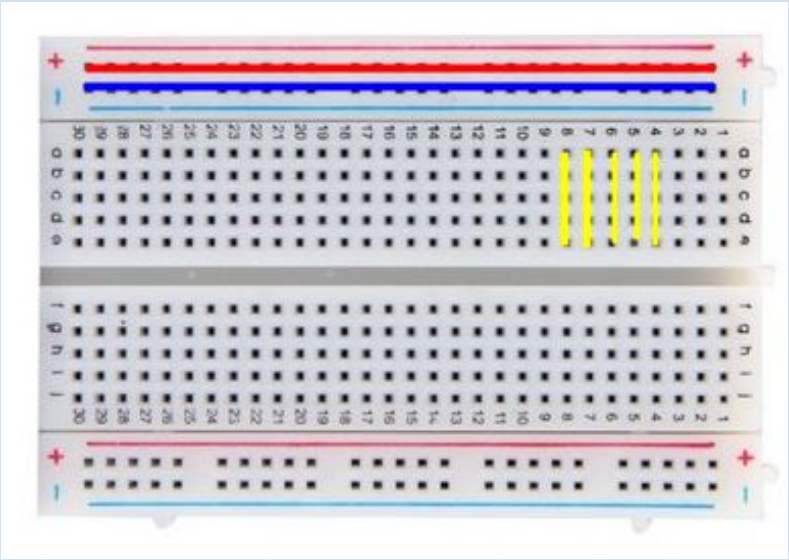
CONNECTING SENSORS TO THE BLUEPILL

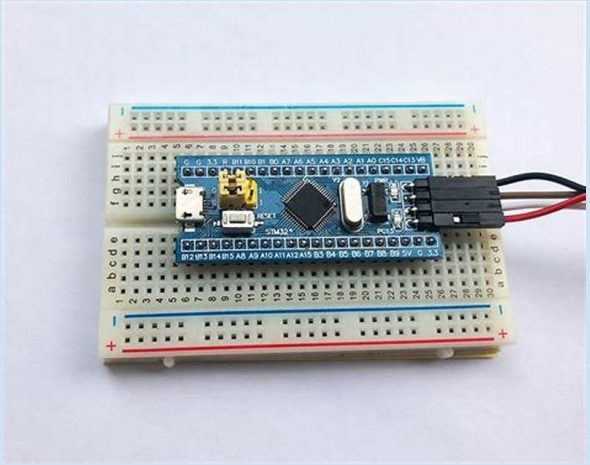
All sensors have:

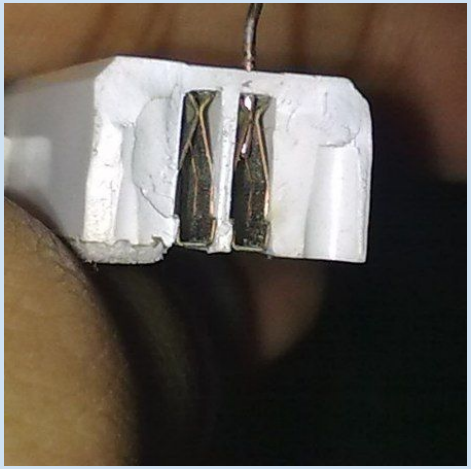
- Input: Power (5v or 3.3v or VCC) & Ground (GND)
- Digital outputs: TX, RX, others (like PM data, longitude, latitude, temperature, humidity, log a file, etc)

WIRING - PROTOTYPING

Use breadboards!





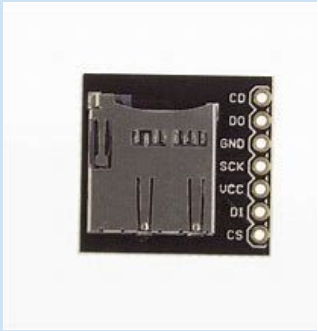


Check if it works, no soldering

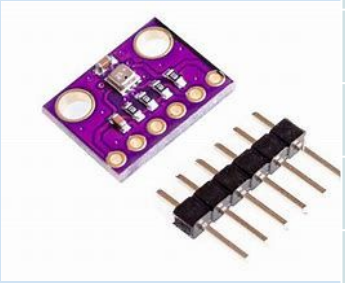
WIRING

PMS7003	BluePill
5V	5V
GND	GND
RX	B10
TX	B11

GPS	BluePill
GND	GND (G)
VCC	5V
TXD	A3
RXD	A2



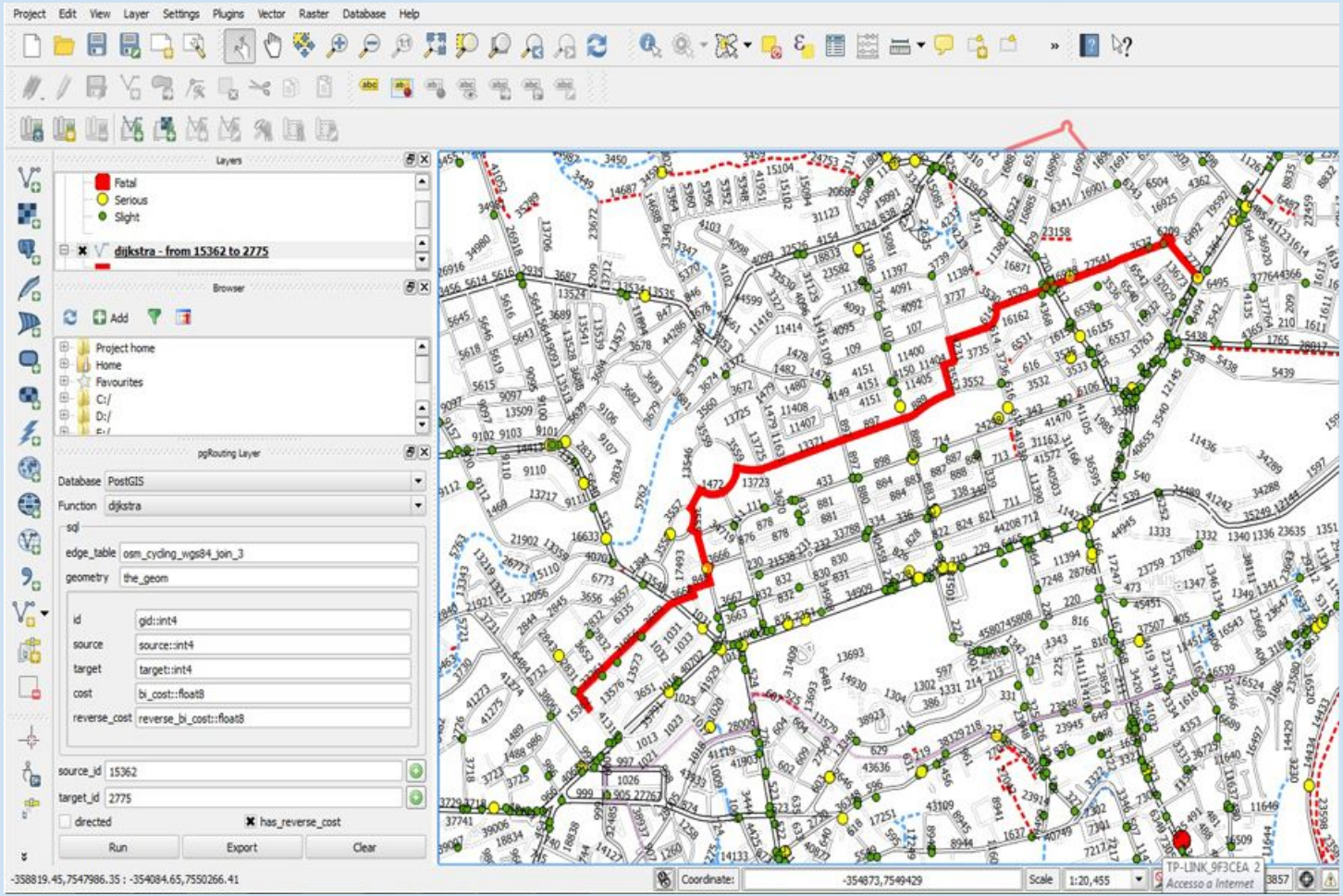
SD breakout	BluePill
3V3	3.3V
CS	B0
MOSI	A7
CLK	A5
MISO	A6
GND	GND (G)



BME280	BluePill
VCC	3.3V
GND	GND (G)
SCL	A5
SDA	A7
CSB	A4
SDO	A6

IT WORKS? LET'S SOLDER!

GETTING & MAPPING DATA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target_id 2775
directed
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Coordinate:
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Scale
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TP-LINK_9F3CEA_2
Accesso a Internet

MERCI :D

NOW... LET'S MAP!