SENSORDEVICES 2020

POLITECNICO
MILANO 1863

IARIA

Monitoring Outdoor Air Quality Using Personal Device to Protect Vulnerable People

Luca Rampini, Fulvio Re Cecconi

luca.rampini@polimi.it

Luca Rampini, PhD Candidate

Educational path:

- 2019 – present: PhD in Architecture, Built Environment and Construction Engineering, Politecnico di Milano

- 2018 – Visiting Student Researcher, UCLA

- 2015-2018 – Msc in Civil Engineering, Politecnico di Torino

- 2011-2015 – Bsc in Civil Engineering, Università degli Studi di Firenze

Research topic:

Artificial Intelligence technologies applied to the Built Environment and to enhance Building Asset Management.

SLow Onset Disaster (SLOD)

SLODs are **continuous**, **low intensity**, and **high frequency** events that represent a serious **risk for the health** of people.
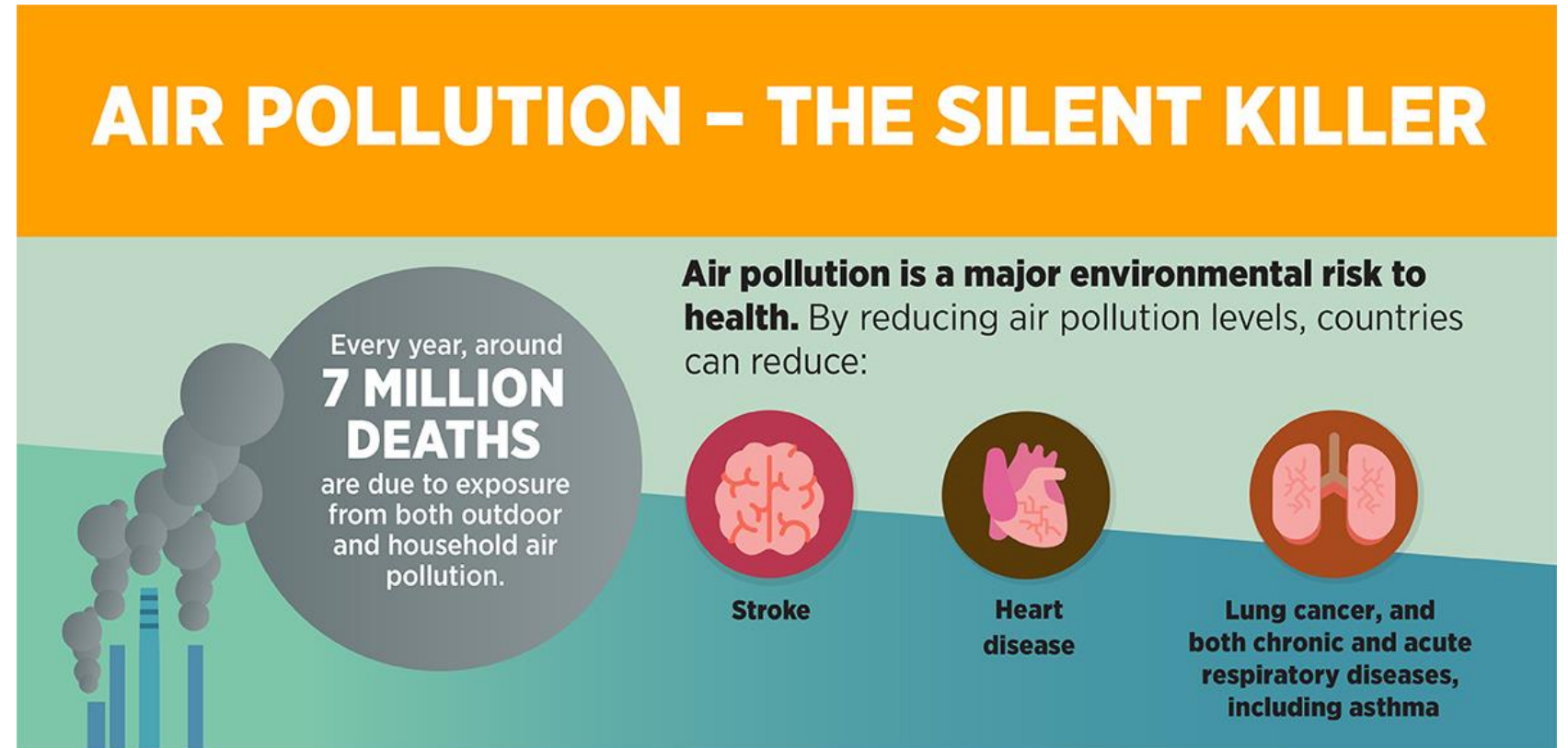
SLODs examples are:

- Air Pollution
- Heat Island

Air Pollution

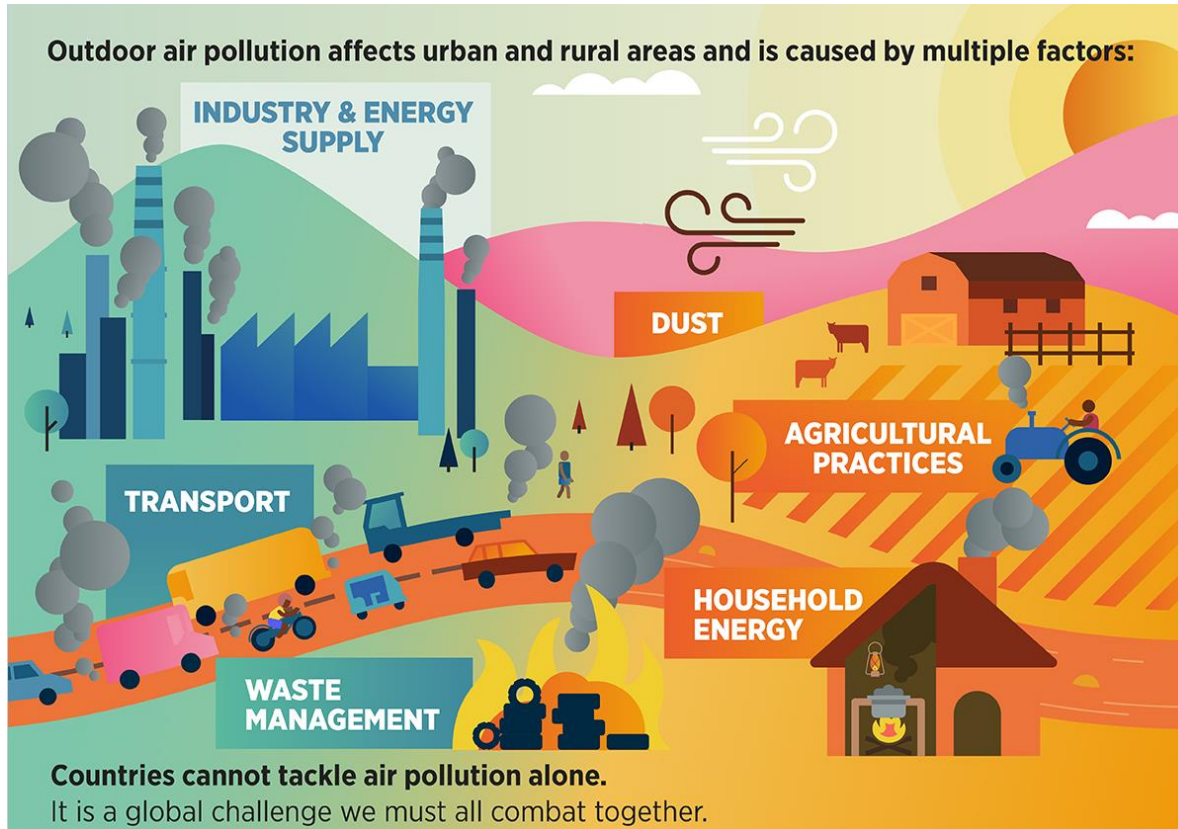Air Pollutions is charactherized by the presence of pollutants such as CO_2, PM, CO, O_3, and others.

To date, more than half of the world's population live in urban areas. Those parts of the world are the most affected by air pollution.

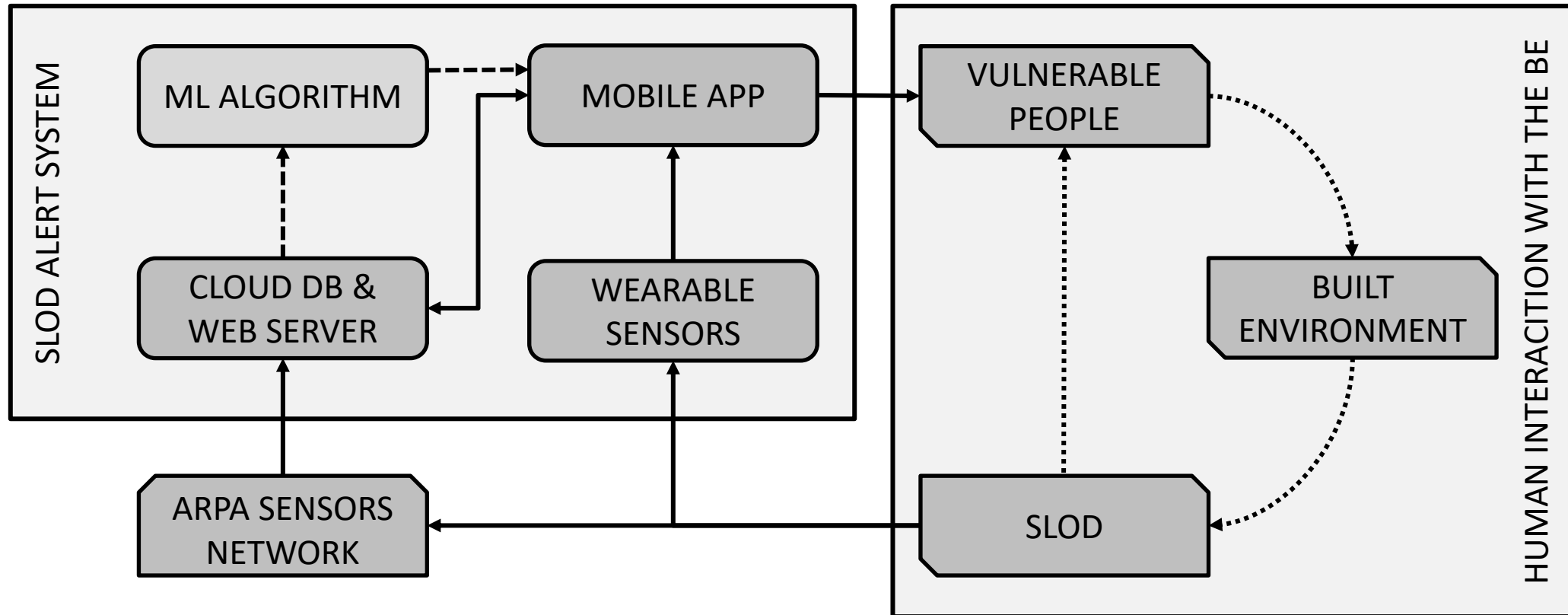

Source: WHO

Solutions

Long-term:

Outdoor air pollution affects urban and rural areas and is caused by multiple factors:

INDUSTRY & ENERGY SUPPLY

DUST

AGRICULTURAL PRACTICES

TRANSPORT

HOUSEHOLD ENERGY

WASTE MANAGEMENT

Countries cannot tackle air pollution alone.
It is a global challenge we must all combat together.

Source: WHO

Short-term:

• Alert System

Research Schema

Personal Device

Main board: Arduino One;

Sensors installed:

- **1 SparkFun Environmental Combo Breakout - CCS811/BME280**: this sensor measures Temperature, Relative Humidity (RH), Atmospheric pressure as well as pollutants' amount such as equivalent CO2 (eCO2) and Total Volatile Organic Compound (TVOC). The eCO2 output range is from 400 to 8192 ppm, whereas the TVOC output range is from 0 to 1187 ppb.

- **1 PM sensor SDS011**: this sensor detects PM in the air. The PM output range is from 0 to 999 μg/m3 and the humidity working range of the sensor is 0-70%.
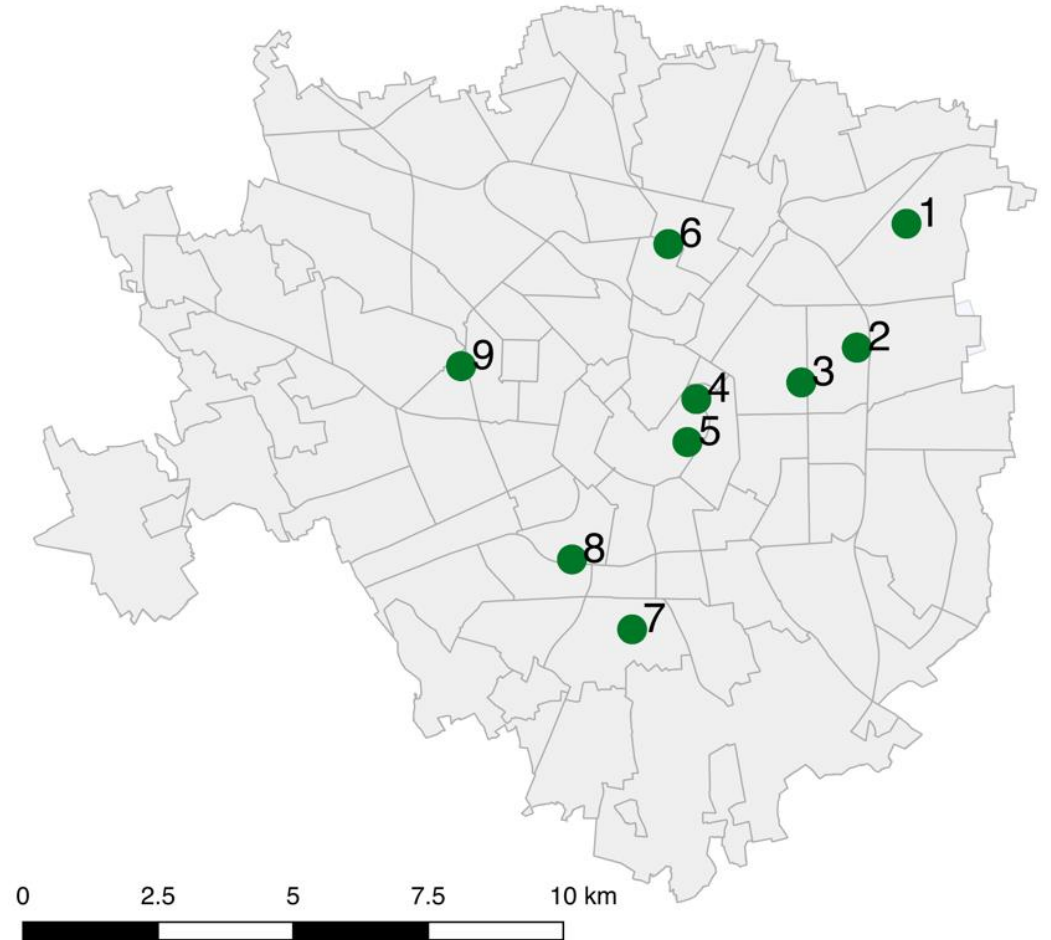
Software

Main screens:

1) Login
2) Data
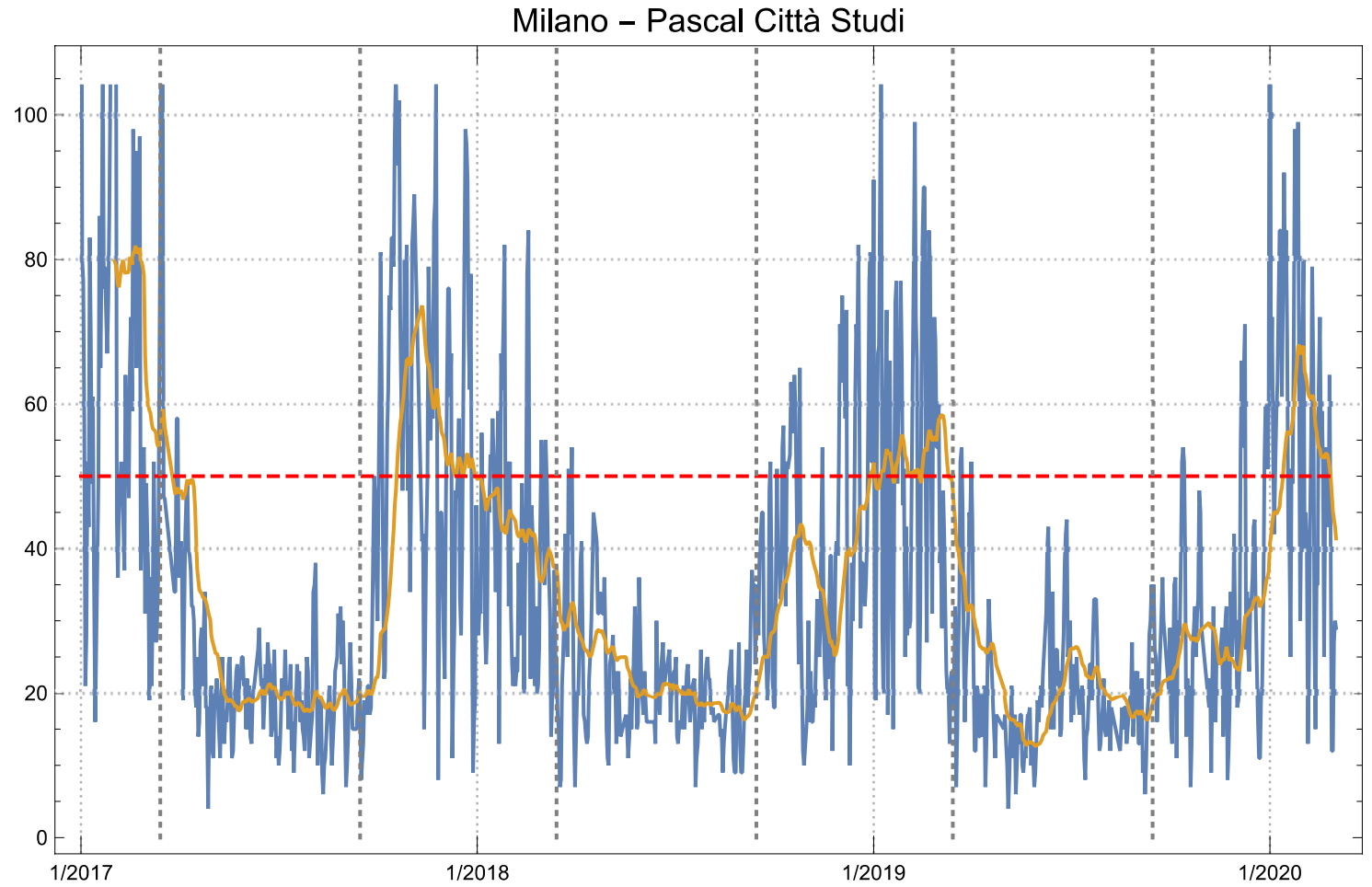3) Maps
4) Reports
5) Settings
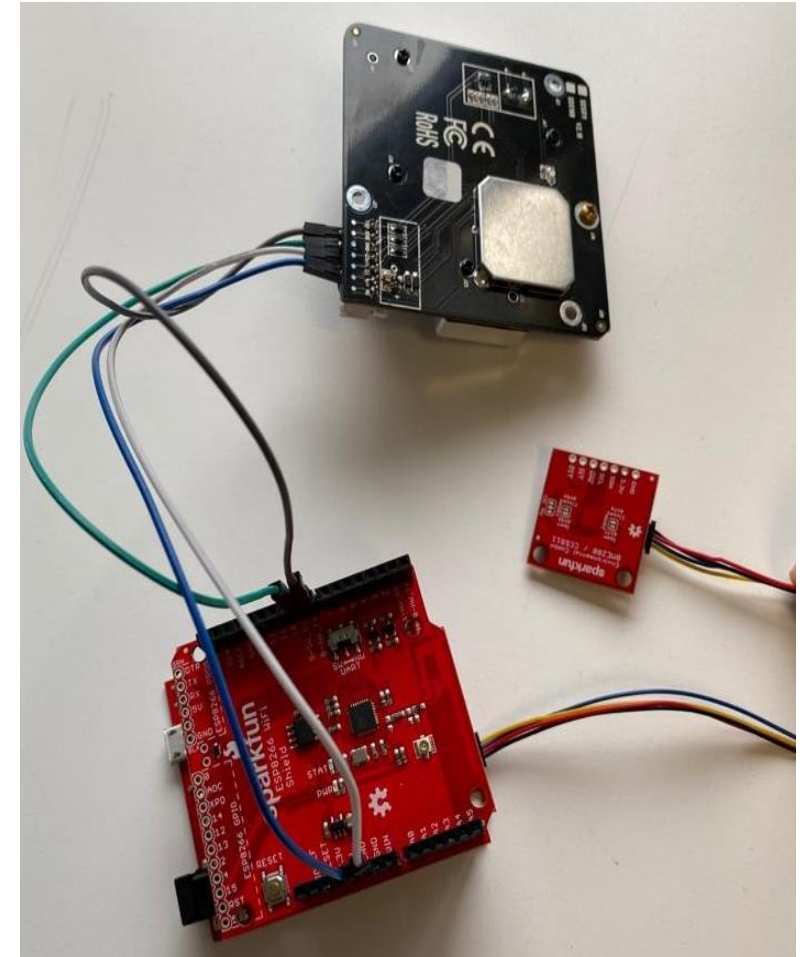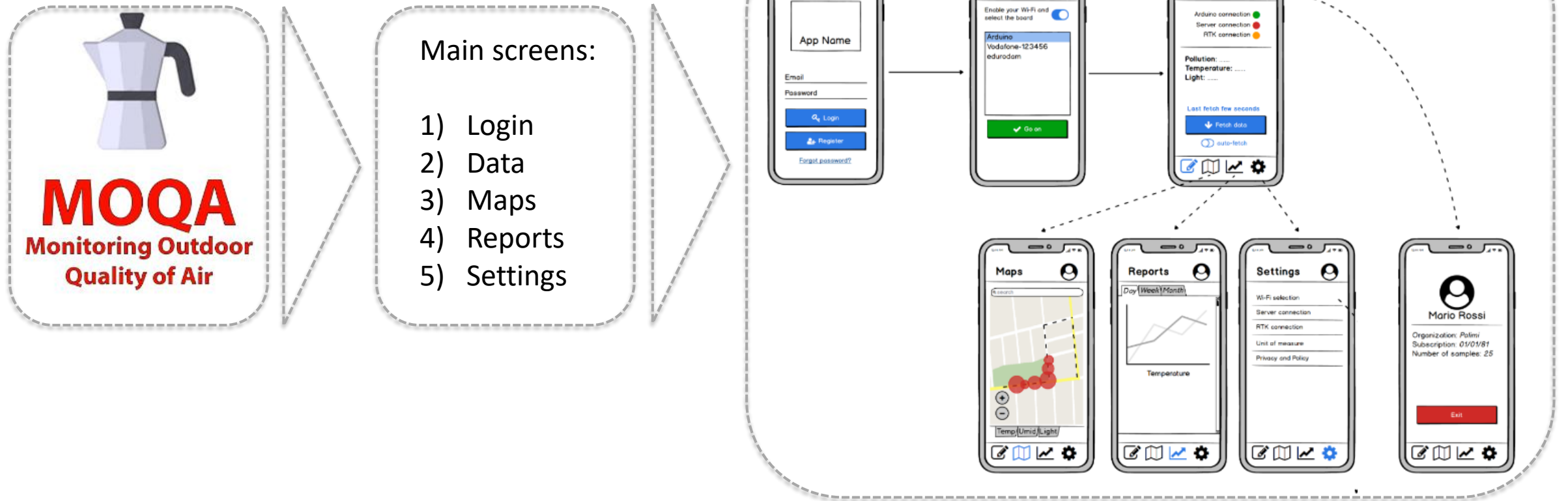
MILAN

Why?

- Critical area in Central Europe;

- Data available from open source repository (ARPA dataset).

ARPA data

Characteristics:

- Open access

- 2.5 million yearly records

- 9 air monitoring stations

Milano – Pascal Città Studi

Differences between Device's and ARPA data
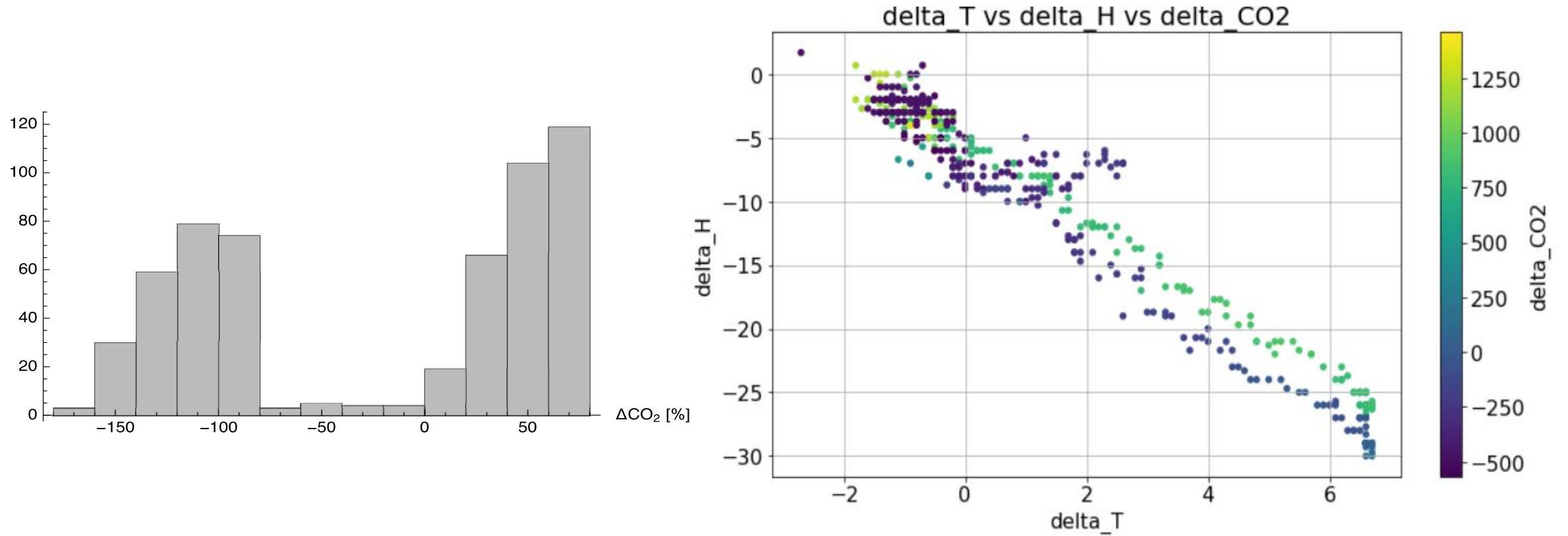
Layers:
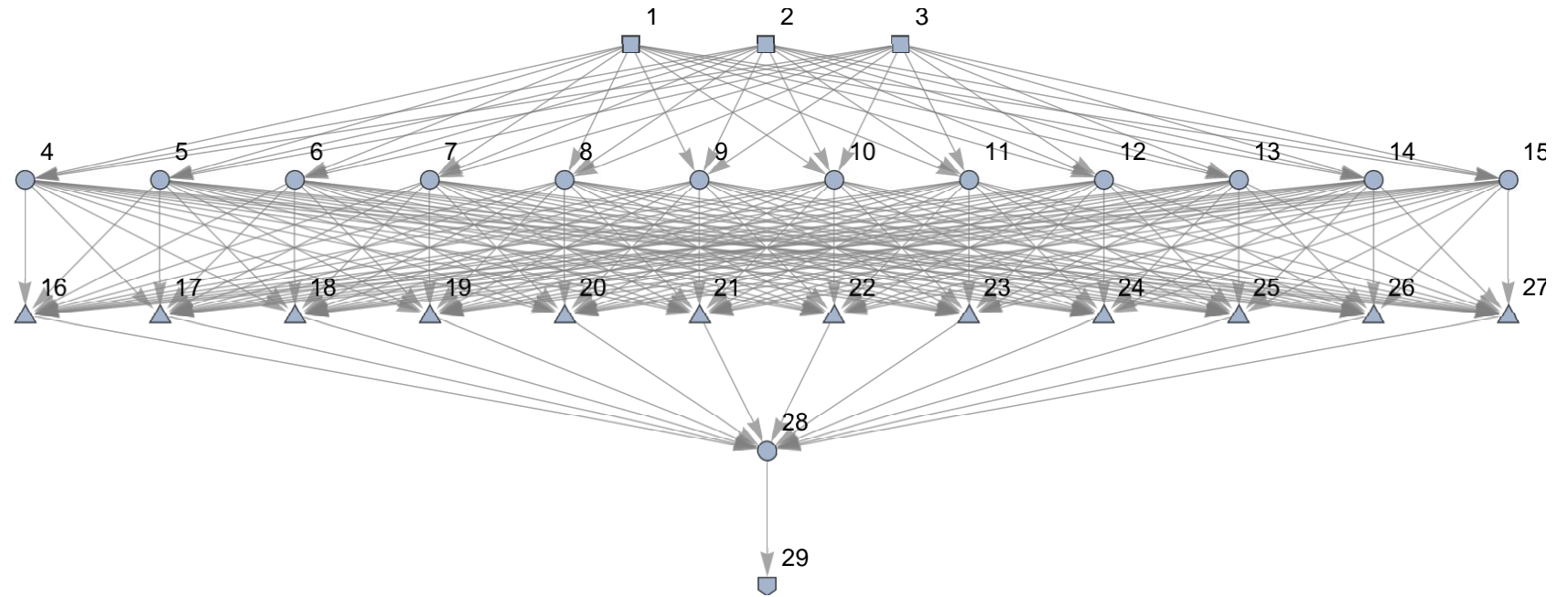
3 input

12 linear
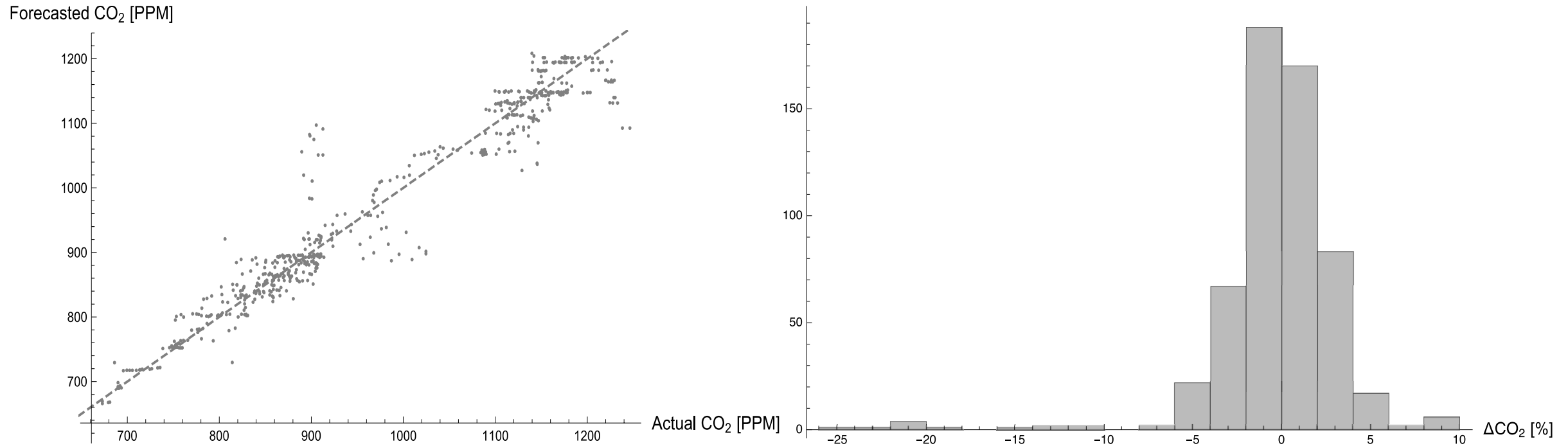
12 Hyperbolic tangent

1 linear

1 output

Pearson's correlation R_2: 97,59.

92,97% of the data fall in ΔCO_2 [-5%;+5%] interval.

Conclusions

- **SLODs** are a **danger** to the health and well-being of city dwellers
- It is **impossible** to **eliminate SLODs** in the **short term** so **alert systems** are needed to **suggest safer behaviour** to citizens.
- portable sensors coupled with mobile applications can be used effectively but must have **high measurement reliability**
- thanks to a **neural network**, it is possible to **improve** the **reliability** of low-cost sensors.
- The collected data will also allow a **better urban planning** to reduce the effects of SLODs in the **long term**.