**Title: TBD**

1. Introduction

1.1 Air pollution

**Gaseous – all major pollutants.**

**Aerosols and Particulate matter in the atmosphere.**

**Cycle in the atmosphere.**

**Typical concentrations.**

**Typical correlations between pollutants.**

1.1.1. Causes of air pollution

**Anthropogenic - traffic and industry.**

**Natural.**

1.1.2. Factors affecting ambient air pollution levels

**Meteorological factors.**

**Changes in emission rates of the sources.**

1.1.3. Health risks and damages related to air pollution

Serve as the main motivation for air pollution measurement.

1.2. Measurement of air pollution

**Purpose of measurement and evaluation -**Regulatory emission control, epidemiological studies, individual exposure, air quality plans.

**pollutant concentration Vs. air quality index.**

**Air quality stations.**

1.2.1. Standard measurement techniques

**(From David’s course) + low cost sensors**

1.2.2. Problems related to measuring air pollution

**Reliability of the measured values in different techniques.**

**High spatial and temporal variability of concentrations.**Substantial small-scale variations in space + **Sparse measurements.**

**Overcoming these issues.**

**---> modelling....**

1.3. Modelling of air pollution

**Forecasting in time (time series) and in space (spatial interpolation).**

**Statistical approach - Interpolation methods, LUR regression, machine learning techniques.**

LUR models need a large amount of in situ observations at strategic locations to represent the full spatial and temporal variability, and cannot be extended backward in time to satisfy the needs of long-term epidemiological studies

**Deterministic approach – atmospheric dispersion models/computational fluid dynamics models - Gaussian and Lagrangian models.**

**Applications – health alerts, source term estimation, emergency response.**

**---> In this work, we will....**

2. Literature review (previous work)

2.1. High resolution dispersion models

(Berchet, Zink, Oettl, et al., 2017)

(Berchet, Zink, Muller, et al., 2017)

2.2. Source term estimation

2.3. The use of micro-sensing units (MSUs) in estimating air pollution levels

**Gaseous MSUs.**

**PM MSUs.**

**Pros and Cons in comparison to the standard methods.**

3. Knowledge gaps

**Adequate spatial coverage.**

**Long measurement record.**

**MSUs performance evaluation.**

**Comprehension of the pollutant’s behavior in different atmospheric conditions.**

4. Research area

**TBD.**

**potentially**– perform a short-term measuring campaign in a small flat area with known pollution sources.

**Potentially –**use a dataset of measurements:

1.**Israel –** using some of these data as a test case. (Crowdsensing)

2. **Chicago -** Air pollution concentrations in Chicago city from a Wireless Distributed Environmentally Sensory Network (WDESN) operated by Chicago university.

5. Research objectives

**TBD.**

**Generally:**

**Specifically:**

6. Methods

**TBD.**

GRAL-GRAMME Lagrangian dispersion model.

Multi-objective evolutionary algorithms (MOEAs)(Hadka, 2012), Borg optimization(Hadka, 2013).

\*Other machine learning techniques to be used during the work

7. Research contribution

**TBD.**

Using unique data sets from different sources.

Taking advantage of the MSUs’ ability to cover much more space than AQM stations plus using the MSUs in a controlled short term experiment.

Using data from a long-term campaign of air quality measurements in Chicago. Campaign of high reliability, long term, use of Alpha sense. In addition to AQM.

New methods for evaluating low-cost sensors.

8. Research plan

**TBD.**

9. Initial results

Sensors evaluation (add a plot of diurnal cycle, if well represented).

10. Work schedule

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | Module | Description | Time period |
| 1 | Technical operation of low-cost sensors | Code writing, purchase and build a raspberry-pi toolkit of several sensors, build a database for data aggregation and sensors maintenance |  |
| Low-cost sensors evaluation and calibration (our lab's sensors) | Verify all sensors work well and adequately calibrated against AQM stations |  |
| Data preparation and cleaning of an external low-cost sensors' database | Use clustering techniques (?) to identify sensors which are adequate for the study. |  |
| Acquire modeling tools of air pollution dispersion | Learn how to use and operate the GRAL lagrangian model |  |
|  |  |  |  |