Project "Smart Air Quality Network (SAQN)"
International workshop on assessing fine-granular modelling and
measurement of particulate matter
04 – 05 December 2018
Helmholtz Zentrum München

Discussion Summary

Topics for mid-term meeting SAQN:
1. Comparison of first results with the project program and conclusions
2. Correlation of our project with similar projects worldwide - requirements
3. Conclusions for improvement of the project program in the second half of the project

1. Comparison of first results with the project program and conclusions

Additional task set up - application of numerical simulations by GRAMM/GRAL to
- Provide information about optimum measurement network infrastructure
- Compare with measurement results of the available LÜB and new network
- Close gaps in the new network for personal air pollution exposure
- Detect hot spots of air pollution
- Predict air pollution

Corresponding emission inventory for small-scale numerical simulation of air quality
- Spatial resolution – availability of traffic counting data, miss-match roads, anonymization of household heating systems, availability household heating data
- Temporal resolution – traffic and residential heating emissions
- On-line availability – traffic counting data

2. Correlation of our project with similar projects worldwide - requirements

Application of numerical simulations by GRAMM/GRAL
- Air quality prediction
- Integration of measurements and numerical simulations on the small-scale

Integration of satellite sounding and numerical simulation (downscaling to street level)

Prediction of air quality in urban area on the basis of semi-empirical scheme (street increment): two-way meso-micro scale coupling for meteorological parameters and air pollutants

LES modelling in urban areas (PALM)

Application of UAVs for 3D spatial distribution of air pollutants and meteorological parameters

3. Conclusions for improvement of the project program in the second half of the project

Objectives:
- SOPs for new sensors and networks: operation, data platforms and algorithms
- Development of a new, corresponding QA/QC procedures: on site calibration, mobile reference instruments, automated data inter-comparison
- Cooperation with more partners as Bayerische Zentrum für Angewandte Energieforschung e.V., Technical University Graz, Aristotle University Thessaloniki, Düsseldorf University of Applied Sciences (HSD), MAN Energy Solutions SE
- Application of the project results in real life: continuous operation of new small-scale monitoring network and numerical simulations under responsibility of a certain institution (e.g. HMGU/EPI - cohorts, Stadt Augsburg, …)
- Prototype instrumentation including data management for personal exposure of air pollutants (pollen and fungi in the future): involvement of people without and with certain disease, data transmission and collection including GPS- and health sensor data
- Real cooperation with the environmental medicine: HMGU/EPI, UNIKA-T, practice - medical doctors
- Detection of new emission hot spots
- Demonstration of data quality: inter-comparison of sensors, development of QA/QC strategies
- Model evaluation on high temporal and spatial resolution

Conclusions:
- Improved cooperation between partners: integration of measurements and numerical simulations
- Measurement evaluation strategy with small-scale numerical simulations calibrated with LÜB data
- Methodologies for calibration of small-scale numerical simulations on the basis of spatially high-resolved measurement network
- Air quality prediction
- Smart phone APP for health protection
- Invitation of new partners for sensor and numerical simulation / modelling inter-comparison

Topics for workshop in general:
1. Publication of workshop results
2. General conclusions and new working ideas
3. Objectives of future cooperation
4. Objectives of joint research and research initiatives resulting in research proposals for financial support

1. Publication of agenda, abstracts and presentations

- Agreements
- Content
- Publication agency

2. General conclusions and new working idea

- Personal exposure determination becomes possible. Which chemical compounds of particles originate which disease? Which air pollution episode originates which diseases?
- Air pollution detection or air pollution measurement?
- Next steps to integrate new monitoring networks into available networks which are under responsibility of state agencies consider: new data determination, new responsibilities for measurements, new data collection, new role of data analyses / management software (final data are not from single sensors)
- Monitoring techniques and modelling of air quality are currently developed for high temporal and spatial resolution – this requires application of data assimilation algorithms, corresponding emission inventories and corresponding chemical reaction schemes
- New conclusions about sources of air pollutants and for emission reduction measures become possible
- Guidelines for new measurement techniques are necessary: sensor operation, QA/QC procedures, application of algorithms, long-term operation
- People can buy air pollution sensors – this brings science into society, user requirement should be collected, application of new guidelines: data collection, operation and analyses as well as integration with other information like GPS
- Legal responsibilities for new networks and data from new sensors should be defined, contributions to actual political debates and questions are possible and required (position of monitoring stations, personal exposure etc.)

3. Objectives of future cooperation

- Sensor development and application for small-scale temporal and spatial resolution: correction algorithms, dedicated applications and sensor fusion, development of electro-chemical sensors and optical sensors for air pollutants and bioaerosols / Pollen / Fungi, development of Big Data algorithms
- Near-real time numerical simulations of air pollution and bioaerosols / Pollen / Fungi exposure: implementation of QA/QC procedures into measurement networks for small-scale temporal and spatial resolution
- Development of traffic management systems on the basis of information about personal air pollution exposure – measurements and numerical simulations: application of data assimilation algorithms
- General acceptance of new high-resolution monitoring networks for air quality determination and prediction, environmental medicine and health protection
- Integration of different measurement platforms, methodologies and parameters for high temporal and spatial resolution
- New applications of low-cost and middle-cost sensors – guideline developments

4. Objectives of joint research and research initiatives resulting in research proposals for financial support

- Sensor development for air pollutants, bioaerosols/Pollen/Fungi, meteorological parameters
- Determination of personal air pollution and bioaerosols / Pollen / Fungi exposure: handling interferences (humidity), temperature influence, sensor positioning, data checking and transfer, data assimilation, application of Big Data / Internet of Things / Open Source algorithms
- Development of network architecture for high resolution in space and time as well as operation strategies

- Guidelines for new sensors and networks: operation, QA/QC procedures
- Near-real time numerical simulations of air pollution and bioaerosols / Pollen / Fungi exposure and integration with monitoring data from the ground, UAVs and satellites
- Teaching people in sensor handling, air pollution and data application
- Development of business plans: who operates air pollution monitoring networks – future application of SAQN results, who is interested in air pollution and bioaerosols / Pollen / Fungi exposure and prediction, who is using these data (research, European, federal and local agencies, sensible persons, health protection, medical doctors) – GRIMM, Ainring, Germany; Aerosol Akademie, Ainring, Germany; Bosch, Stuttgart; Hawa Dawa, Munich; EnSense Co., Ltd., New Taipei City, Taiwan; Wuhan Cubic Optoelectronics Co., Ltd, Wuhan, China; HMGU; UNIKa-T

Plenary discussion, Wrap up and potential next steps towards future collaborations

An agreement for publication of the presentations at the workshop is given if no disagreement about this is sent to the project coordination team. Improved abstracts and presentations can be sent to Klaus Schäfer until Wednesday, 12 December. The publication of the workshop results should include the agenda, the names, institutions and e-mail addresses of the participants, the abstracts, the presentations (oral and posters) and this discussion summary. This publication should be on the project home page as pdf-file, a server of the project and in a publication series of KIT as publication agency.

Some important topics of discussion were:
The availability of emission data in European countries is very different (traffic amount, household heating, industry) and not the best one in Augsburg.
The practical aspects of new sensors and networks are in the focus now because these determine the development of the market.
A new picture of air pollutions becomes possible and necessary because it provides real hot spots and artefacts.
A new network, which will be developed in Augsburg with 50 scientific scouts, requires much more emission activity observations than now.
The very much increased possibilities to determine air pollution exposure can be realized by complete solutions only. This will include personal low-cost sensors also and means that science is going into the community.
Open data products, which will be developed, require adequate descriptions of these data and of the data quality.
Developing countries are very much interested in new sensors for air pollutants because these are cheaper and offer the possibility of emission source determination. But US and some national environmental agencies support also the development of new sensors and networks for air quality. This requires the development of test procedures for minimum requirements and certification as well as corresponding test beds. The JRC in Ispra is developing such guidelines already. Finally, German activities in this area should consider this. It should be checked if the development of a German test bed for new sensors is feasible – Augsburg or Düsseldorf could be a possibility and GRIMM is interested to provide reference instruments.

A next international workshop / symposium of the project is planned at the end of the project (first half of 2020).