Estimation of Equivalent Black Carbon Spatial Distribution in WTimpact (Poster)

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Air pollution is in most cases measured by costly, stationary instrumentation at rather few locations. Only few institutes, notably federal and state, are traditionally able to collect high quality pollution data. Once the air quality management problems become more complex, the need for enhanced air quality and exposure monitoring capabilities become more apparent. This is the case with regard to higher spatial resolution and person-based monitoring.

The parameters regulated in the European Union do not include pollutants which are trusted to be associated with adverse health effects: Black Carbon [1], ultrafine particles, and/or specific species. De-centralized measurements using citizens' efforts might therefore fill in some of the gaps in the current air quality observation systems.

The number of community-based air quality observations has been rising over the past years, with several projects being launched on the European scale (e.g., CITI-SENSE, http://www.citi-sense.eu, or CITIZEN SENSE, http://www.citizensense.net). We acknowledge that much focus has been placed on exploring the interaction with citizens (recruitment, awareness campaigns, do it yourself / DIY tool boxes), and the integrated display of many kinds of different atmospheric observations. Nevertheless, we also observe a gap between the (low) quality of community-based observations and the (high) expectations of the scientific community towards related data usability. We are currently not aware of an air quality Citizen Science project that would have pursued a consequent development chain from i) a sensor undergoing a rigid quality assurance based on atmospheric science standards, ii) a seamless and user-friendly data collection framework and display system, iii) an urban-scale real-time air pollution prognosis, iv) a unique visualization, and v) data products that have been designed using the expertise of top scientists.
For the above-mentioned research chain gaps, we propose within the WTimpact project a novel method for using citizen science as a mean for improving the state of the art. WTimpact low cost air quality measurement set will consist of portable micro-aethalometer (AethLabs model MA200, San Francisco, USA), PM sensor (SDS021), and a GPS module (Navilock model NL-8004U, Berlin, Germany). Portable micro-aethalometer will be used to measure equivalent black carbon (eBC) mass concentration with one second time resolution. The GPS device will be used to log the eBC mass concentration and position and the GPS position will be recorded in one second time resolution. A single board computer will be used for data transfer to a Smartphone and data will be send further to a central database in real time. Visualisation tools for verification of spatial data done by the volunteers will be developed. The visualisation will be embedded in interactive browser-based software. The design process of the software will address different levels of products. These are visualisations on smartphones for supporting volunteers while taking data, and to visualise the same data within a larger context, e.g. with forecast data and measured data from other volunteers. Data are delivered continuously to a server embedded in the TROPOS IT-infrastructure. The server software collects and archives incoming data in a database, pre-processes data (e.g. quality assurance), provides graphs and maps for individual sensors and merged data for all sensor units. Visualisation of measurements and prognostic data will be made accessible to the volunteers and the public by internet. Web-based visualisation is instrumental in interacting with the volunteers, allowing timely feedback on technical sensor problems or pollution hot spots. Furthermore, the volunteers will receive a feedback on their personal exposure, an important aspect to motivate them.

Three field-phases will be carried out by TROPOS in 2019 with 90 volunteers in total. In total five sets of low-cost air-quality measurement technology will be used.

WTimpact establishes the basis for future Citizen Science activities on local air pollution observations beyond the project runtime.

It will be the first time that the development, implementation, and proof-of-concept of an infrastructure for personalized measurements, subsequent data processing and visualization will be validated via active participation of Leipzig citizens and TROPOS scientist.

References

[1] WHO: Health effects of black carbon. Eds. Janssen, N.A.H. et al., World Health Organization, Regional Office Europe, Copenhagen, 86 p., 2012.