Back in the Depot: AERO-TRAM Measurements Completed

Climate Data from the Tram: Project for the Scientifically Precise Measurement of Air Quality in the Region of Karlsruhe Is Completed – Cooperation of KIT and VBK

Since 2009, AERO-TRAM has covered a distance of about 200,000 km, corresponding to a trip five times around the earth. During 6228 measurement drives in the local tram network, the tram equipped with numerous instruments collected data on pollutant concentration. A result: As soon as the tram leaves the city center of Karlsruhe and enters the surrounding municipalities, nitrogen oxide concentration decreases by about 70%. Recently, the project of climate researchers of Karlsruhe Institute of Technology (KIT) in cooperation with Karlsruher Verkehrsverwaltung GmbH (VBK, Karlsruhe Transport Authorities) was completed.

Fine dust, nitrogen dioxide, ozone: Air quality in conurbations constantly is the subject of intense discussions. However, adequate countermeasures can only be developed, if precise scientific data are available. Having completed their AERO-TRAM project, scientists of the Troposphere Research Division of KIT’s Institute for Meteorology and Climate Research (IMK-TRO) have a comprehensive dataset, on the basis of which air pollution in the Karlsruhe city cen-
Climate data from the tram: AERO-TRAM in a video:
https://www.youtube.com/watch?v=vWiBm1KCFzM (in German only)

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“For the first time in Germany, we continuously measured highly resolved spatial distributions of particles and nitrogen oxides produced by e.g. road traffic or combustion processes with a tram system in a conurbation over a long term,” Bernhard Vogel says. These particles are smallest suspended particles (aerosols), such as carbon black or dust, which originate from a number of natural and anthropogenic sources and may influence cloud formation.
High nitrogen oxide and particle concentrations were measured in the city center of Karlsruhe, above all at main traffic junctions, such as Mühlburger Tor/Kaiserallee. AERO-TRAM measurements also revealed that both concentrations decrease rapidly when entering the pedestrian area (Kaiserstrasse, Marktplatz). Nevertheless, average concentration values here are above those in the urban surroundings. It was also found that particle number and nitrogen oxide concentrations are largely independent of the wind direction. At low wind speed, these concentrations are 50% higher on the average than in case of strong winds.

Compared to the particle numbers, nitrogen oxide concentration decreases much more rapidly when leaving the city center and entering the surroundings. For nitrogen oxide, this decrease was found to be 70%, while particle concentration dropped by 50% only. “We also found a rural area, where particle numbers increased again and reached values comparable to the urban area. But here, nitrogen oxide values did not increase. Such hot spots cannot be detected with widely distributed measurement stations,” Vogel emphasizes. The scientists attributed these high particle numbers to industrial emissions at five to ten kilometers distance. Due to these results, a subsequent experiment was initiated in this region (http://www.imk-aaf.kit.edu/156.php) to analyze chemical particle composition in detail. This campaign is still being evaluated.

About AERO-TRAM

The largely automated long-term measurement of concentrations of the trace gases ozone (O\textsubscript{3}), nitrogen monoxide (NO), additional nitrogen oxides (NO\textsubscript{x}), carbon monoxide (CO), carbon dioxide (CO\textsubscript{2}), and water vapor (H\textsubscript{2}O) as well as of the total particle number and particle size distribution in the area of Karlsruhe was the objective of the project. Since 2009, a tram provided by the Karlsruhe Transport Authorities (VBK) was operated on lines S1/S11 and S2 going from the surroundings of Karlsruhe through the city center into the surroundings again. Air quality was measured in north-south direction through the Rhine valley, from Hochstetten to Bad Herrenalb and from Spöck northeast of Karlsruhe to Rheinstetten in the southwest.

In 2011, AERO-TRAM won the federal innovation competition “365 Places in the Land of Ideas.”

More information: http://www.aero-tram.kit.edu (in German only)

Karlsruhe Institute of Technology (KIT) pools its three core tasks of research, higher education, and innovation in a mission. With about 9,300 employees and 25,000 students, KIT is one of the big institutions of research and higher education in natural sciences and engineering in Europe.

**KIT – The Research University in the Helmholtz Association**

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