

Title:

Urban air quality in street canyons with avenue-like tree planting

Authors & affiliations:

Christof Gromke^{1,2}, Bodo Ruck²

¹ *WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland*

² *Institute for Hydromechanics, Karlsruhe Institute of Technology, Germany*

Abstract:

Traffic pollutant dispersion in urban street canyons with avenue-like tree planting have been studied in wind tunnel experiments and by RANS simulations employing different turbulence closure schemes. Tree planting configurations varying in stand density, crown porosity and tree arrangement have been investigated in different street canyon geometries subjected to winds approaching from various directions.

The results show that avenue-like tree planting lead to overall increases in traffic pollutant concentrations and lower wind speeds in street canyons when compared to their tree-free references. Maximum relative increases in concentrations of 80% for perpendicular wind, and of 300% for oblique wind, have been measured at the building facades in the wind tunnel. Tree density and crown porosity have significant impact on the pollutant concentration level in the case of perpendicular approaching wind, but not for oblique wind directions. The numerical simulations generally overestimate the pollutant concentrations and underestimate the wind speeds measured in the wind tunnel. However, qualitative agreement in the sense of similar concentration distribution patterns and flow regimes is evident.

Finally, based on the wind tunnel results and dimensional analysis, a relationship has been derived, linking tree planting characteristics and peak pollutant concentrations. This relationship allows to estimate maximum pollutant concentrations in street canyons and can be used by town planners and decision-makers in a design state to assess the implications of avenue-like tree planting on pollutant concentration levels.

References:

- CODASC Concentration Data of Street Canyons, internet database, www.codasc.de.
- Gromke, C., Ruck, B. (2009) On the impact of trees on dispersion processes of traffic emissions in street canyons, *Bound-Lay Meteorol* 131, 19-34.
- Gromke, C., Buccolieri, R., Di Sabatino, S., Ruck, B. (2008) Dispersion modeling study in a street canyon with tree planting by means of wind tunnel and numerical investigations - Evaluation of CFD data with experimental data, *Atmos Environ* 42, 8640-8650.
- Gromke, C., Ruck, B. (2007) Influence of trees on the dispersion of pollutants in an urban street canyon - experimental investigation of the flow and concentration field, *Atmos Environ*, 41, 3387-3302.