Urban aerosol flux measurements in Innsbruck, Austria

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Air quality in the greater region of Innsbruck and eastern North Tyrol is affected by large traffic volumes along some of Europe's most important international road transport flows over the Alps. In order to quantify this potentially large anthropogenic impact on air quality, and help validate bottom-up emission inventories, the Innsbruck Air Quality Study (iNNAQS) aimed at measuring reactive trace gas and aerosol fluxes at an urban location in Innsbruck (Austria).

Aerosol flux measurements by eddy covariance were carried out during the iNNAQS second intensive observation period from July 2015 to September 2015 in downtown Innsbruck 38 m above ground level. The eddy covariance setup included a CSAT sonic anemometer (Campbell Scientific, USA) for measuring the 3D wind speed and direction, a condensation particle counter (CPC 3772, TSI, USA) for total aerosol number measurements, and an electrical low pressure impactor (ELPI+, Dekati, Finland) for size-resolved aerosol number measurements. Depending on the local wind patterns of the Inn valley, the flux measurements were influenced by different parts of the city of Innsbruck.

Total aerosol number fluxes and exchange velocities derived from the CPC measurements showed a typical diurnal cycle: At night, the net vertical transport of particles was close to zero. In the morning hours, turbulent transport developed and a clear increase of exchange velocity with a maximum of 0.9 cm s^{-1} was observed (Figure 1). During the day the median exchange velocity was 0.5 cm s^{-1} before the emission of particles decreased again in the evening to negligible net fluxes. Only sporadic aerosol deposition events were observed.

While the total aerosol number fluxes as measured with the CPC were clearly dominated by particle emission, preliminary results of the size-resolved aerosol number flux measurements indicate that bi-directional aerosol fluxes are possible. Particle size fractions with diameters smaller than 300 nm typically show emission, whereas larger particle size fractions show net deposition at the same time. Such a change of the flux direction depending on particle size has been reported previously for aerosol flux measurements in other urban environments (e.g. Deventer et al., 2015).

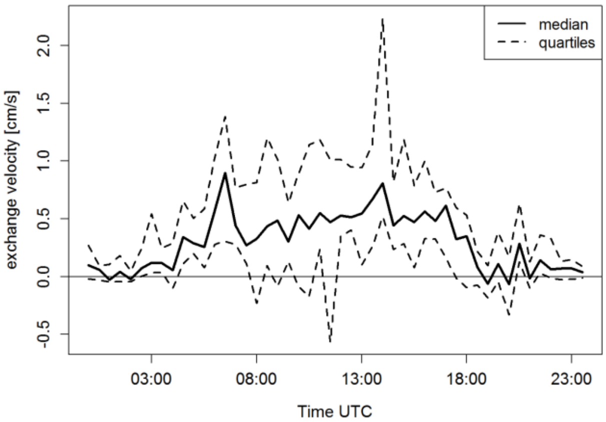

Figure 1. Diurnal cycle of median particle exchange velocity measured during iNNAQS.

Urban aerosol flux measurements are still scarce, and the iNNAQS data set contributes to an improved understanding of aerosol sources and sinks in the city of Innsbruck. Moreover, the presented data set promises additional insight into chemistry-transport interactions due to the measurement site's unique setting in the complex terrain of an Alpine valley, and the combination with turbulent flux measurements of reactive trace gases such as volatile organic compounds and nitrogen oxides.

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Deventer, M.D., El-Madany, T., Griessbaum, F., and Klemm, O. (2015) One-year measurement of size-resolved particle fluxes in an urban area. *Tellus B* **67,** 25531, doi:10.3402/tellusb.v67.25531.