A novel photoacoustic instrument for ammonia concentration and flux monitoring – results of field measurements

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We present a novel instrument for measuring concentration and surface-atmosphere exchange flux of ammonia. The instrument is based on near-infrared diode laser based photoacoustic spectroscopy combined with preconcentration sampling, and it operates with three sampling lines to enable simultaneous measurement of ammonia concentration at three different heights above canopy level, and thereby flux measurements using the gradient method [1]. In this presentation the practical applicability of the instrument is demonstrated through results of field measurement campaigns.

Long-term operation and applicability in concentration measurements has been evaluated during continuous measurements for two and a half years at Bugac, a semi-natural grassland site in the Hungarian Great Plain. Measured concentrations were around a few $\mu g \cdot m^{-3}$, with peaks of a few 10 $\mu g \cdot m^{-3}$. Typical diurnal and seasonal variation of ammonia concentration was observed, *i.e.*, higher concentrations were observed during daytime and during the vegetation period. The measured data were also compared to daily mean ammonia concentration measured at the K-puszta monitoring station of the Hungarian Meteorological Service approx. 30 km from Bugac, and good agreement was found between the two datasets.

Applicability for flux measurements have been demonstrated during shorter measurement campaigns in agricultural areas with higher ammonia concentrations. Results of two measurement campaigns are presented here. The first campaign has been carried out in autumn 2008 in Poland, near a cattle farm, where the ammonia plume of the farm was examined, as well as deposition flux of ammonia was quantified [3]. Background concentration of ammonia was around 2 $\mu g \cdot m^{-3}$ with peaks up to 60 $\mu g \cdot m^{-3}$ in case of wind blowing from the direction of the farm. Deposition fluxes were found to be in the range of 0-90 $ng \cdot m^{-2} \cdot s^{-1}$, with gradients showing clear diurnal variation according to changing atmospheric stability. The second measurement campaign was carried out in spring 2009 in Denmark, in an agricultural landscape over a fertilized winter wheat field [2]. During this campaign high ammonia concentrations were observed, together with strong emission of ammonia (fluxes in the range of a few 100 $ng \cdot m^{-2} \cdot s^{-1}$) due to the application of the fertilizer.

[1] A. Pogány, Á. Mohácsi, S. K. Jones, E. Nemitz, A. Varga, Z. Bozóki, Z. Galbács, T. Weidinger, L. Horváth, G. Szabó, *Atmospheric Environment* **2010**, *44*, 1490-1496.
[2] A. Pogány, T. Weidinger, J. Bieńkowski, Á. Bordás, Z. Bozóki, A. Eredics, A. Hensen, K. Janku, Gy. Kiss, A. Kraai, Z. Istenes, Á. Mohácsi, G. Szabó, K. Schelde, M. Theobald, *Geophysical Research Abstracts* **2010,** *12*, EGU2010-14742.
[3] A. Pogány, T. Weidinger, Z. Bozóki, Á. Mohácsi, J. Bieńkowski, D. Józefczyk, A. Eredics, Á. Bordás, A. Z. Gyöngyösi, L. Horváth, G. Szabó, *Időjárás* **2012,** Accepted for publication.