Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01665, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01665
EGU General Assembly 2008

A photoacoustic system for measuring ammonia exchange between the biosphere and atmosphere

A. Pogány (1), Á. Mohácsi (3), L. Horváth (2), Z. Bozóki (3), G. Szabó (1)

(1) Department of Optics and Quantum Electronics, University of Szeged, Hungary, (2) Hungarian Meteorological Service, Budapest, Hungary, (3) Research Group on Laser Physics of the Hungarian Academy of Sciences, University of Szeged, Hungary (zbozoki@physx.u-szeged.hu / Fax: +36 62 544658/ Phone: +36 62 544518)

Measuring ammonia fluxes between the biosphere and atmosphere is important due to the impact of ammonia on atmospheric chemistry and on the ecological nitrogen balance. For long term, reliable flux measurements the ammonia concentration in ambient air has to be measured with sub-ppb accuracy, while the measuring instrument has to be simple, robust and capable of automatic operation. We present here a diode laser based photoacoustic system, which fulfills these requirements.

We have developed an ammonia monitoring instrument using near infrared photoacoustic spectroscopy. The main parts of our system are a telecommunication type diode laser as a light source, an acoustically optimized cell containing the gas sample with a hearing aid microphone attached to it for the detection of the photoacoustic signal, a membrane pump to maintain continuous gas flow through the cell and an integrated electronic unit for overall control of the system such as laser driving and signal processing. Furthermore, in order to reach the requested sub-ppb sensitivity, a preconcentration unit is integrated into the system. From the sampled ambient air, ammonia is chemisorbed in the preconcentration unit. After a sampling period, chemisorbed ammonia is released into the measuring photoacoustic cell by heating the preconcentration unit. The air sampling, the thermal desorption of ammonia and the subsequent concentration measurement take altogether approximately half an hour and is controlled by the system's electronics.

The photoacoustic system was calibrated in the lower ppb range with the help of an AMANDA instrument, and was installed in a robust housing, appropriate for field measurements. The two instruments were run parallel in our laboratory and also under field conditions for several days. Remarkably good agreement was found between the ammonia concentration readings of the two systems.

Additional advantages of the photoacoustic system are its excellent selectivity (i.e. no measurable interference from common atmospheric components), its wide dynamic range (more than four orders of magnitude), compact design, robustness and capability of long term automatic operation without recalibration.

The presented photoacoustic system can easily be adapted for flux measurements with the gradient method as well. For this purpose the system is modified to have three gas inlets. Each inlet, having its own preconcentration unit samples air from different heights simultaneously. After simultaneous sampling, the amount of ammonia sampled with the preconcentration units can be measured sequentially with the same photoacoustic cell. The calculated fluxes are average values for the sampling period. Flux measurements with the system are currently under progress.

This research was funded by the Hungarian OTKA Foundation (TS49872), the Hungarian Ministry of Education (NKFP-3/021/2005) and the NITROEUROPE EU-VI Framework Program.