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Diode laser based photoacoustic instrument for ammonia concentration and flux monitoring

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A diode laser based near infrared (1532 nm) photoacoustic ammonia monitoring instrument was combined with a preconcentration unit in order to reach sub-ppb detection limit with a compact, automatic measuring instrument. The system has no measurable cross-sensitivity to common atmospheric gases, most importantly to water vapor and carbon dioxide. The minimum detectable amount of ammonia is 2.9 ng, which means a minimum detectable concentration of 0.5 ppb with a 30-minute measurement time. The instrument was calibrated with the widely accepted, wet-chemical AMANDA instrument, and was tested in several inter-comparison campaigns with various instruments. Results of the inter-comparison campaigns show that the instrument is highly reliable even under harsh field conditions and accurate enough for environmental ammonia concentration monitoring.

The instrument can be operated with three sampling inlets and thus can be used for ammonia flux measurements with the gradient method. The instrument was successfully tested in a flux measurement campaign on an agricultural field near a cattle farm, the purpose of which was to quantify ammonia load to the field originating from the cattle farm, taking advantage of the wide dynamic range of the instrument. In a second campaign, long term flux measurements were carried out for several months above semi-natural grassland, where the stability of the instrument was tested. In this campaign, ammonia emission was observed during the day (with a typical maximum of about 220 μgN/m^2·h) and deposition during the night (-10 μgN/m^2·h on average), and the measured flux values were within the theoretically estimated range.