Mobile mapping and Eddy Covariance flux measurements of ammonia (NH_3) emissions with a portable Quantum Cascade Laser-based open-path sensor

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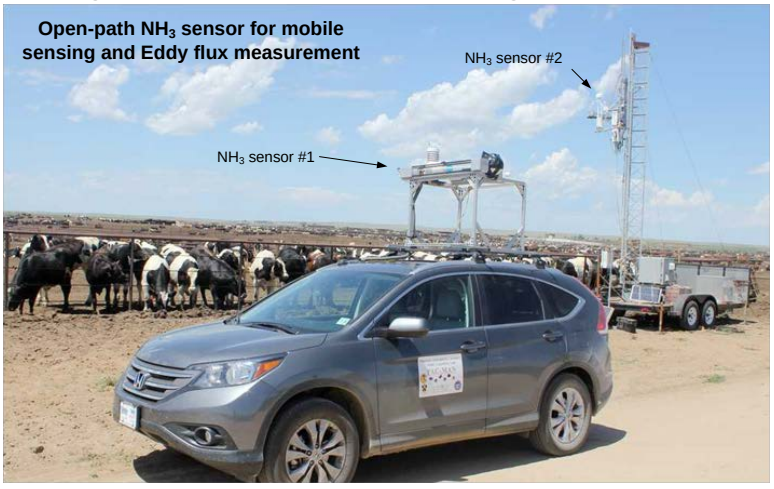
Ammonia (NH_3) is the dominant alkaline species in the atmosphere and an important compound in the global nitrogen cycle. There is a large uncertainty in NH_3 emission inventory from agriculture, which is the largest source of NH_3, including livestock farming and fertilizer applications. In recent years, an open-path sensor has been developed using a 9.06 μm Quantum Cascade Laser (QCL) (Corning Inc.) to provide high-resolution, fast-response and high-sensitivity NH_3 measurements [1]. A custom electronic box hosted a low noise laser current driver (QCL 500, Wavelength Electronics Inc.), a laser temperature controller (HTC 4000, Wavelength Electronic Inc.) and a data acquisition board (National Instrument Inc.) is used to control the sensor. It has a detection limit of 150 pptv NH_3 with a sample rate up to 20 Hz with low power consumption (~50 W). This NH_3 sensor has been integrated into a mobile platform mounted on the roof of a car to perform measurements of multiple trace gases for thousands of miles in the United States and China [2]. It has also been used with several other open-path sensors to perform direct flux measurement of NH_3 emission from a cattle feedlot using Eddy Covariance (EC) method [3]. The mobile sensing method provides high spatial resolution and fast mapping of measured gases. Meanwhile, the EC flux method offers accurate flux measurements and resolves the diurnal variability of NH_3 emissions. Ongoing work includes the miniaturization and integration of the sensor electronics into a digital signal processor (DSP) based embedded control system, which benefits the minimization of the power consumption and the improvement of instrument performance. Further research shall enable the potential incorporation of the sensors on different platforms into a large scale, multi-sensor network using existing wireless/wired communication technologies for real-time information exchange.



Sampling NH_3 with the mobile platform and EC flux tower at the same time

[1] Miller, D.J., *et al*, *Atmos. Meas. Tech.* (2014)
[2] Tao, L., *et al*, submitted to *Appl. Phys. B* (2014).
[3] Sun, K., *et al*, submitted to *Agr. Forest Meteorol.* (2014)