Geophysical Research Abstracts
Vol. 21, EGU2019-5250, 2019
EGU General Assembly 2019

A compact QCL absorption spectrometer for mobile, high-precision methane measurements aboard drones

Béla Tuzson, Jonas Ravelid, Badrudin Stanicki, Manuel Graf, Liu Chang, Philipp Scheidegger, Herbert Looser, and Lukas Emmenegger

Empa, Air Pollution/Environmental Technologies, Duebendorf, Switzerland (bela.tuzson@empa.ch)

Deploying unmanned aerial vehicles (UAV) as mobile platforms for measuring atmospheric trace gases can provide valuable information about the spatial and temporal variability on a scale and in a level of detail that is not attainable with measurements from traditional stationary monitoring networks. Methane, in particular, is of special interest. Besides of being the second most abundant anthropogenic greenhouse gas after carbon dioxide, it also plays a crucial role in the Earth's atmosphere chemistry.

We report on the development of a lightweight, open-path direct absorption spectrometer for the measurement of atmospheric methane concentration. The spectrometer is based on a single-mode quantum cascade laser (DFB-QCL) emitting around 7.83 μm. The absorption signal is enhanced by using a ring-shaped, segmented multi-pass cell with an optical path-length of 10 m. This novel cell design has demonstrated low optical noise, increased stability against mechanical distortion and a compact footprint [1]. Ongoing validation measurements indicate excellent performance with a measurement precision at the low parts-per-billion (ppb) level. The overall instrument weights 1.6 kg (excluding battery) and has an average power consumption of about 15 W. A system-on-chip FPGA data acquisition module allows fully autonomous operation [2]. The spectrometer is equipped with additional sensors for pressure, temperature, and relative humidity as well as a GPS receiver. Therefore, it is possible to use the measurement device aboard any drone regardless of their specific communication protocol and as such a universally applicable sensor for other applications beyond UAV based platforms.

References:

[1] M. Graf, L. Emmenegger, and B. Tuzson, *Opt. Lett.*. 43, (2018).

[2] C. Liu, B. Tuzson, P. Scheidegger *et al.*, *Rev. Sci. Instrum.* 89, (2018).

Acknowledgements:

This project has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie grant agreement No 722479. We acknowledge financial and technical support by Thomas Paul and Deran Maas from ABB, Baden-Dättwil, Switzerland.