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Realisation of a laser photoacoustic detector of tropospheric methane

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Since 1997 the Groupe de Spectrométrie Moléculaire et Atmosphérique (Reims, France) has developed a photoacoustic (PA) cell based on differential Helmholtz resonance for infrared gas detection. This cell was used in conjunction with a near-infrared diode laser to detect methane. The main origin of this gas choice is the need of gas companies which are confronted to the leak problems on their gas distribution networks. The typical commercial methane detectors based on flame ionization present the main disadvantages to be non-specific to methane. Other pollutants such as C_2H_4, C_3H_8... may introduce false alarms.

In recent years diode lasers have been widely used for in-situ pollution monitoring. The PA sensor described here represents an effective spectroscopic technique for detection of ambient trace gases due to its intrinsically high sensitivity, large dynamic range and comparatively simple instrumentation. The detection limit of this technique is mainly determined by the characteristics of the laser used (output power, tunability, single mode emission...) and the PA cell sensitivity. The feasibility of methane detection has been demonstrated with near-infrared diode lasers and the system has been improved significantly so as to increase sufficiently the sensitivity for sub-ppm methane detection. The use of quantum cascade laser gives the possibility to improve the detection limit thanks to its high power and its emission in the methane fundamental bands. We will present the results obtained with the association of our PA cell and a quantum cascade laser emitting in the 7.9μm region for methane detection. The achieved detection limit is 3 ppb for a 1s time measurement. Flux measurements may be realized in order to obtain a continuous measurement of the tropospheric methane concentration.