Quantifying CH4 coal mine emissions in Upper Silesia by passive airborne remote sensing observations during CoMet

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Methane (CH_4) is, after carbon dioxide (CO_2), the second most important anthropogenic greenhouse gas in our atmosphere. It also has an important role in future climate mitigation strategies due to its stronger greenhouse warming potential compared to that of CO_2, despite its relatively short atmospheric lifetime. Consequently, knowledge about CH_4 sources is essential to reduce its atmospheric abundance. For this reason, the CoMet (CO_2 and Methane) campaign was executed attempting to quantify emissions of one of the largest CH_4 emitting areas in Europe, the Upper Silesian Coal Basin (USCB, Poland), starting from single shafts over smaller clusters up to the entire basin, in May and June 2018. Methane emissions from that area, originating from various mining shafts distributed over around 60 x 40 km², reach over 500 ktCH_4/yr. During the campaign various platforms (aircraft, car, stationary) and instruments (active and passive remote sensing, in-situ, wind lidar, FTIR) were deployed to achieve that goal.

Here, we will focus on the passive airborne remote sensing MAMAP (Methane Airborne MAPper) observations, which use absorption spectroscopy to infer atmospheric CH_4 concentration gradients. These gradients were combined in a simple mass balance approach with wind information from three wind lidar stations deployed in the USCB to infer cross-sectional CH_4 fluxes through different flight tracks located downwind of multiple mining shafts. The computed fluxes were assigned to specific shafts, or small clusters of them, and compared to annually reported and hourly measured CH_4 emissions.

Averaged observed fluxes range between ~1 and 9 tCH_4/hr for single clusters derived from multiple overflights on different days. Associated errors (1-sigma) are in the range of 15 to 45% of the respective averaged fluxes and largely depend on the number of available flight tracks and atmospheric conditions, e.g. prevailing wind speed. In this presentation, one of such mining clusters will be discussed in more detailed, demonstrating the need for repeated overflights of emission sources and limitations of annually reported emissions as found in common greenhouse gas inventories.