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Methane emissions from coal mines ventilation shafts in Upper Silesia, Poland

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Atmospheric methane is the second most important anthropogenic greenhouse gas after carbon dioxide. On the global scale, methane emissions are reasonably well constrained but the contributions from individual sources are highly uncertain (Saunois, 2016). According to bottom-up estimates, methane emissions from underground coal mining excavation contribute 11% to all anthropogenic methane sources (Saunois, 2016). However, there is a lack of in situ measurement to verify these estimates. Here we present results from measurements of the methane mole fraction over the Polish part of the Upper Silesian Coal Basin (USCB). Methane mole fraction was measured using vehicles equipped with high precision laser-based instruments (Picarro G2201-i CRDS, Picarro G2301- CRDS). Basic meteorological data (wind speed, wind direction) and GPS location data were collected on the roof of the vehicles. In order to obtain emission estimates, we attempted to cross the plumes from the coal mine shafts using public roads approximately perpendicular to plume downwind from the source. When possible, the plumes were intersected several times at different distances in order to have a closer look at uncertainties. A Gaussian plume model was used to calculate the release rate from the methane single source.

In addition to methane mole fraction measurements, we collected air samples for isotopic characterization ($\delta^{13}C$ and δD) using isotope ratio mass spectrometry. We observed significant variation in measured methane isotopic composition over USCB (the results are in a range of -321 to -142 ‰ SMOW for δD and -31 to -58 ‰ VPDB for $\delta^{13}CH_4$). The results indicated a much larger variability of the isotopic composition of methane emitted from coal mines than assumed previously, which may complicate the distinction of methane emissions from different sources by isotopic characterization.

Keywords: Methane, Greenhouse Gases, Clime Change, Coal Mine Ventilation Shafts, Methane Isotopic Compositions

Reference:

Saunois, M., Bousquet, P., Poulter, B., et al., 2016a. The global methane budget, 2000–2012. Earth Syst. Sci. Data 8, 697–751. https://doi.org/10.5194/essd-8-697-2016. www.earth-syst-sci-data.net/8/697/2016/.

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