Geophysical Research Abstracts
Vol. 21, EGU2019-5667, 2019
EGU General Assembly 2019

Quantifying methane emissions from coal mining shafts in Silesia, Poland, using an active AirCore system

Truls Andersen (1), Wouter Peters (1,2), Marcel de Vries (1), Bert Kers (1), Jaroslaw Necki (3), Justna Swolkien (3), Anke Roiger (4), and Huilin Chen (1)

(1) University of Groningen, Energy and Sustainability Research Institute Groningen, Center for Isotope Research, Netherlands (t.andersen@rug.nl), (2) Meteorology and Air Quality, Wageningen University and Research Center, Wageningen, Netherlands., (3) Faculty of Physics and Applied Computer Science, AGH University of Science and Technology, Kraków, Poland., (4) Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany.

Atmospheric methane (CH4) is the second most abundant anthropogenic greenhouse gas (GHG) after carbon dioxide (CO_2), with the globally averaged mole fraction of 1859 $\pm$ 2 ppb in 2017, more than 2.5 times pre-industrial levels. A strong contributor to the annual European CH4 emissions comes from the black coal (anthracite) mines in Silesia, Poland, where large quantities of CH4 are emitted to the atmosphere via ventilation shafts of underground coal mines. However, coal-bed methane emissions into the atmosphere are poorly characterized, as they are dispersed over large areas and continue even after a mine's closure. As part of the Carbon Dioxide and Methane mission 0.5 (CoMet 0.5) and 1.0 (CoMet 1.0), a study of the Silesia coal mining region CH4 emissions took place in August 2017, and May 2018. We flew a recently developed active AirCore system aboard unmanned aerial vehicle (UAV) to obtain CH4 mole fractions downwind of five individual coal mining shafts. The flights were made between 150 and 300 m downwind of the shafts. Besides CH4 mole fraction measurements, we have also measured CO_2, CO, 13C and deuterium in CH4, atmospheric temperature, pressure, and relative humidity. Ground wind measurements were made to obtain horizontal wind speeds and directions. To quantify the shaft's emission rate, we employ two different techniques; a mass balance approach (MB), and a gaussian inversion (GI) technique. Fifteen UAV flights were performed downwind of the coal mining shaft Pniowek V during CoMet 0.5, and 59 flights downwind of the coal mining shafts Pniowek IV, Pniowek V, Borynia IV, Zofiowka V, and Brzeszcze IX during CoMet 1.0, flying perpendicular to the wind direction at several altitude levels, attempting to transect the plume. This effectively builds a 'curtain' of CH4 mole fractions in a two-dimensional plane. The preliminary estimates of the CH4 emission rates from the sampled shafts range from 1.9 to 15.3 kt/year using the mass balance approach, and between 3.0 to 18.5 kt/year using a Gaussian inversion method. The average difference between the mass balance and Gaussian inversion approach is 1.4 kt/year. These emission rates will be compared to detailed inventory values from the individual shafts.