Geophysical Research Abstracts
Vol. 13, EGU2011-2157, 2011
EGU General Assembly 2011

Impact of coal mining on elevated CH4 levels in near-ground regional atmosphere over southern Poland

Lukasz Chmura (1,2), Jaroslaw Necki (1), Adam Korus (1), Miroslaw Zimnoch (1), Janusz Rosiek (1), Michal Galkowski (1), and Kazimierz Rozanski (1)

(1) AGH - University of Science and Technology, Department of Environmental Phisics, Krakow, Poland (lchmura@novell.ftj.agh.edu.pl), (2) IMGW - Institute of Meteorology and Water Menagement

Methane is the second most important greenhouse gas. Its atmospheric concentration has been increasing steadily during the 20th century till late 1990s, when its level has stabilized at approximately 1850 ppb. The last several years saw renewed build-up of this gas in the global atmosphere. Causes of this recent increase are the subject of vigorous scientific debate.

Methane emissions associated with coal production (mining, storage, transport) constitute an important component of the global anthropogenic flux of this gas into the atmosphere. In regions of active coal mining methane emissions may lead to elevated concentrations of this gas in near-ground atmosphere. Restructuring of coal mining in some countries and shifts of major coal production centers results in transient character of global CH4 flux associated with this industry.

The region of southern Poland includes exceptionally large number of anthropogenic methane sources. Two major coal basins in Poland are located there: the Upper Silesian (USCB) and Lower Silesian (LSCB). The emissions of methane through ventilation shafts of mines in the USCB decreased from ca. 11.5x108 m3 in 1988 to 6.2x108 m3 in 2001. During the last decade the emissions have stabilized at the level of approximately 7x108 m3. This flux constitutes ca 32 % of the total methane flux to the atmosphere emitted from the territory of Poland. For LSCB, the corresponding CH4 flux dropped from ca. 0.27x108 m3 in 1992 to 0.02x108 m3 in 1998. By the end of 1998 all mines in LSCB were closed.

Apart of CH4 emissions associated with coal production, other sources of anthropogenic methane are also abundant in southern Poland. These include city gas networks supplying methane to large urban centers of this region. It has been estimated that aged networks are leaking at the rate of up to 5 % of the total gas consumption. Numerous landfills in the region, most of them not yet equipped with appropriate CH4 uptake installations, also contribute to substantial anthropogenic flux of this gas to the atmosphere.

To test the impact of emissions of anthropogenic methane in the region we launched a dedicated study aimed at characterizing spatial and temporal variability of CH4 mixing ratios in near-ground atmosphere. Measurements of CH4 mixing ratios were performed along latitudinal transects (ca. 50oN), typically extending from ca. 15oE to 20oE, covering the Upper Silesia and bordering regions. Occasionally, transects were extended to entire southern Poland. The measurement campaigns were performed repeatedly during the time period from 2004 to 2009. They included collecting air samples in flasks which were then analyzed in the laboratory using gas chromatography technique. Flask sampling was supplemented by in-situ, quasi-continuous measurements of CH4 mixing ratios using portable CH4 analyzer mounted on a car. The measured CH4 concentrations were compared with regional, free-tropospheric concentrations of methane obtained from high-altitude mountain station located ca 150 km south-east of the study area (Kasprowy Wierch, Tatra Mountains). Apart of measurements along the predefined transects, also measurements of diurnal variability of CH4 concentrations at selected sites of the study area were performed.

The results of the measurements clearly demonstrate that average methane concentration in near-ground atmosphere over Silesia region is elevated with respect to free-troposphere value (Kasprowy Wierch) by approximately 1500 ppb. Values of CH4 content lower than ca. 2000 ppb have never been observed during the survey in this region. Extremely high methane concentrations reaching ca. 20 ppm in winter and 10 ppm in summer were recorded in the near-ground atmosphere in vicinity (ca. 1 km) of the ventilation shafts of some mines.

ACKNOWLEDGEMENTS

Partial financial support of this work through statutory funds of the AGH University of Science and Technology (project No.11.11.220.01) is kindly acknowledged.