

Temporal characteristics of CH₄ vertical profiles observed over Surgut (Novosibirsk) from 1993 (1997) to 2014 in West Siberian Lowland

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We have carried out monthly flask sampling with aircraft over the boreal wetlands in Surgut and a pine forest nearby Novosibirsk, both located in West Siberian Lowland (WSL). Vertical profiles of methane (CH₄) concentration were measured up to about 7 km since 1993 at Surgut and 1997 at Novosibirsk. Temporal variation at each altitude of both sites exhibited increasing trend with stagnation during 2000-2006 as observed globally from ground-based measurement network (Figure). In addition to winter maximum as seen at other remote sites in northern mid to high latitudes, a maximum was observed in summer, particularly in lower altitudes over the WSL. Large CH₄ emissions from the wetlands in the WSL likely have exceeded zonal-mean CH₄ loss by reaction with OH radical during summer, leading to the summer maximum. Methane emissions from different parts of the Earth's surface, atmospheric transport, and chemical loss produce the vertical CH₄ gradient and its variability. The vertical gradient at Surgut has been decreasing; the annual mean CH₄ difference between 5.5 km and 1.0 km decreased from 63±9 ppb during 1994-2000 to 37±8 ppb during 2009-2013. On the other hand, no clear decline in CH₄ vertical gradient appeared at Novosibirsk. An atmospheric chemistry-transport model simulation captured the observed decrease in the vertical CH₄ gradient at Surgut, when CH₄ emission from Europe was decreased but increased from the regions south of Siberia, e.g., the populated Asian nations and tropical land. At Novosibirsk, the influence of the European emission was relatively small. Our results also suggest that the regional emissions around the WSL did not change significantly over the period of our observations. Long-term monitoring of CH₄ vertical profile over West Siberia enabled us to detect variation in its emissions from the WSL and the surrounding land regions.

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