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Variations in seawater mixing and ice concentration as main drivers for changes in methane over the Arctic seas: satellite data

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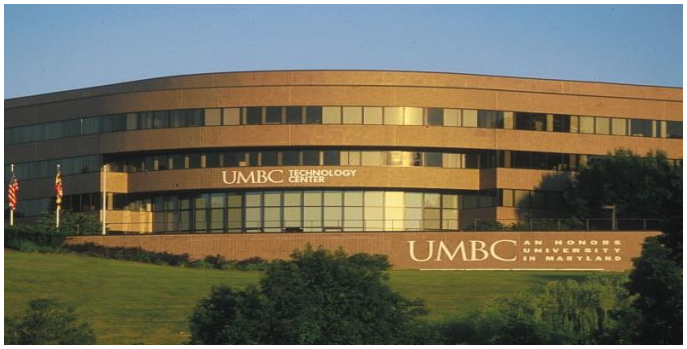
Abstract

Spectrometers using the outgoing long-wave IR (thermal) radiation of the Earth in sun-synchronous polar orbits provide a wealth of information about Arctic methane (CH_4) year-round, day and night. Their polar night data are unique. The report analyzes concentrations of methane obtained by the AIRS and IASI spectrometers in conjunction with microwave satellite measurements of sea ice concentration and ECCO model for the seawater mixed layer depth. The data were filtered out for cases of sufficiently high temperature contrast in the lower atmosphere. The focus is on the Barents and Kara Sea during autumn-early winter season between 2003 and January 2020. These seas underwent dramatic decline in the ice cover during last 17 years. This shelf zone is characterized by huge reserves of oil and natural gas (~ 90% methane), as well as presence of sub-seabed permafrost and methane hydrates. Seasonal cycle of atmospheric extra-methane (surplus over Atlantic) has a minimum in early summer and a maximum in early winter in accordance with changes in the depth of mixed layer. During last 17 years both summer and winter concentrations were increasing, but with different rates. In winter the Kara Sea methane was growing faster than that over Atlantic. The seasonal cycle amplitude tripled from 2003 to 2019. In the same time the fraction of ice-free sea surface quadrupled. If the current Arctic sea cover would decline further and open water area would grow then further increase of methane concentration over the ocean may be foreseen.



Biography:

Leonid Yurganov has been involved in remote sensing of greenhouse gases since 1969. He took part in validation of the first space-borne MOPITT instrument launched in 2000. Before that, working in USSR, he investigated carbon monoxide and methane near Moscow, in Antarctica and in the Arctic. After 2006 in the USA he published a set of papers on CO emission from forest fires in the Northern Hemisphere. During last 6 years his point of study is Arctic methane.

Speaker Publications:

1. Yurganov L., Muller-Karger F., Leifer I. Methane increase over the Barents and Kara Seas after the autumn pycnocline breakdown: satellite observations. Adv. Polar Sci. 2019, 30(4): 382-390. doi: 10.13679/j.advps.2019.0024.
2. Yurganov L. Degradation of sea ice in the Western Arctic facilitates methane transport from sub-seabed sediments to atmosphere: satellite data for 2003 - 2019. submitted to "Ice and Snow", 2020
3. Yurganov L, Leifer I. 2016. Abnormal concentrations of atmospheric methane over the Sea of Okhotsk during 2015/2016 winter. Cur Prob in Rem Sens of Earth from Space. 13(3): 231-234, doi: 10.21046/2070-7401-2016-13-3-231-234.

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