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Some results of greenhouse gases and black carbon studies in the Arctic

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The review of field investigations of greenhouse gases and black carbon, executed by Arctic and Antarctic Research Institute in the Central Arctic and the Spitsbergen Archipelago is presented.
The study of the role of sea ice in CO_2 exchange in the Central Arctic is based on the estimations of total inorganic carbon in sea ice samples, collected at the drifting station “North Pole -35” (2007 – 2008). It was found that total inorganic carbon content in the main part of sea ice core is in the same proportion to salinity, as in seawater under ice cover. However, in the thin slush layer and upper part of ice samples it decreases due to destruction of calcium hydrocarbon and formation of $CaCO_3$ and CO_2. The value of CO_2 invaded to atmosphere from beginning of sea ice freezing in autumn to beginning of melting in summer is estimated as 20 mmol/m2. It is about 10% of maximal value of CO_2, which could be invaded to atmosphere in case of total destruction of hydrocarbon in sea ice of one-meter thickness. In turn, during summer melting water on upper surface of sea ice is strong undersaturated by CO_2. It leads to uptake of CO_2 from atmosphere. Our experimental data show that formation and consequent melting of sea ice in study area leads in total to uptake of carbon dioxide from atmosphere. The value of CO_2 uptake in annual cycle could be estimated as 30 mmol/m2.
Measurement of methane concentration in the atmospheric surface layer had been executed at the drifting ice station "North Pole - 39" (2011-2012) It was founded that monthly mean concentrations of methane in the Central Arctic were higher in all seasons compare to data of polar observatories Alert and Barrow. In the daily scale it was revealed the temporal variations of CH4 with frequencies typical for semi-diurnal tides and internal waves in the oceanic upper layer. It could be the indication of existence under-ice methane sources, because tides and internal waves usually leads to sea ice cover deformation and formation or closing of cracks, and respectively, to changes of intensity of gas exchange between atmosphere and the Arctic Ocean upper layer.
At the end the results of comprehensive studies of black carbon contamination influence on fast ice structure and surface albedo, executed near Sveagruva - coal mining center in the archipelago Spitsbergen in 2011, are presented together with some model results of temporal evolution of clean and contaminated ice.
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