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Carbon dioxide variability at Research Station "Ice Base Cape Baranova" during 2015 - 2019

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The Arctic region is one of the main areas of greenhouse gases sources due to large amount of biomass, carbon stocks in the soil and extensive wetlands. Large resources of previously inactive organic carbon may take part in atmospheric chemical reactions under melting permafrost conditions. In this case, carbon dioxide concentrations will increase in the atmosphere. Since 2015 Arctic and Antarctic Research Institute in cooperation with Finnish Meteorological Institute have been measuring the continuous concentrations of water vapor, methane, carbon dioxide and carbon monoxide at Research Station "Ice Base Cape Baranova" (79° 18´ N, 101° 48´ E, 30 m asl.) using cavity ringdown spectroscopy (CRDS) analyzer Picarro G2401. The sampling inlet is located at 10 m height.

Data preprocessing consists of deleting values obtained during power failures and 2 minutes after calibration. The values for wind directions corresponding to the transfer from diesel power station (90 - 145 °) and for wind speeds less than 3 m/s were also discarded because in this case polluted air may be distributed over the station homogeneously. After that data were adjusted taking into account the nearest calibration values by linear interpolation. The archive of carbon dioxide concentrations data averaged over each hour from October 2015 to December 2019 was used for further analysis.

CO_2 time series are characterized by a pronounced annual variation with concentration decreasing in summer months. The absorption by sea phytoplankton in the absence of sea ice cover causes the annual variability of carbon dioxide. Besides, the predominant presence of stable stratification of the atmospheric surface layer throughout the polar night contributes to accumulation of the gas in the surface layer in winter. The annual amplitude is 18–20 ppm approximately, which is consistent with the data of Alert and Barrow polar stations.

The analysis of the dependence of registered concentration distribution on the wind direction shows that the highest values are observed during the air-mass transfer from the south-western and northern directions. If the first case can be explained by the anthropogenic impact and presence of extensive wetlands in the summer, the reason for the second one requires a more detailed analysis. Applying the HYSPLIT trajectory model for cases of elevated values of greenhouse gas concentrations did not allow us to obtain an unambiguous answer. Although elevated values were observed, as a rule, when air masses transferred from the regions of Norilsk,

Yamal, the Kola Peninsula, and Lena estuary, however, there were cases of elevated concentrations during the transfer of air masses from the Arctic Ocean. This may be due to the action of any local sources, but their detection requires additional data analysis. The work had been executed in frame of CNTP Roshydromet 1.5.3.3.