Application of 3D regional transport model for study of methane formation mechanisms over large industrial area (Saint Petersburg)

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Combining atmospheric transport model [1] with multiyear methane measurements (high precision methane concentrations [2] and methane column content [3]) allows to obtain high quality information about methane distribution in troposphere and its variability. A 3-D regional transport model of high spatial resolution ($\Delta y=0.25^0$ = 27 km along longitude, $\Delta x = 0.5^0$ (~18-32 km) along latitude) is developed, adjusted and applied for study of methane budget mechanisms formation and emission assessment over industrial Saint-Petersburg area (55-65^0 N; 20-40^0 E). The vertical structure of the model is 10 unevenly spaced layers inside the boundary layer (up to 1 km) and 10 one-km layers in the above troposphere. Time step is 5 min for the gas transport calculations. The wind fields for the troposphere above PBL are updated from the 6-hourly ECMWF databases. The methane surface boundary fluxes are prescribed on the base of published data about methane emissions from North mires and methane fluxes from urban area of St.-Petersburg [4,5].

The multiyear series of observations are used, obtained by spectroscopic (1996-2001) and gas chromatographic methods (1987-2003). The applied model allows to assimilate both indicated above kinds of methane measurements.

The model was run for different seasons for periods of ground based (Voeikovo) and column (Petrodvorez) measurements, for instance, Figure 1 demonstrates geographical distribution of surface layer methane concentration and Figure 2 presents total methane column field for the same day over St.-Petersburg region.

Developed approach allows to estimate the input of natural and anthropogenic methane fluxes and long range atmospheric transport into regional methane budget formation and to explain the anomalies of methane content connected with current weather conditions.

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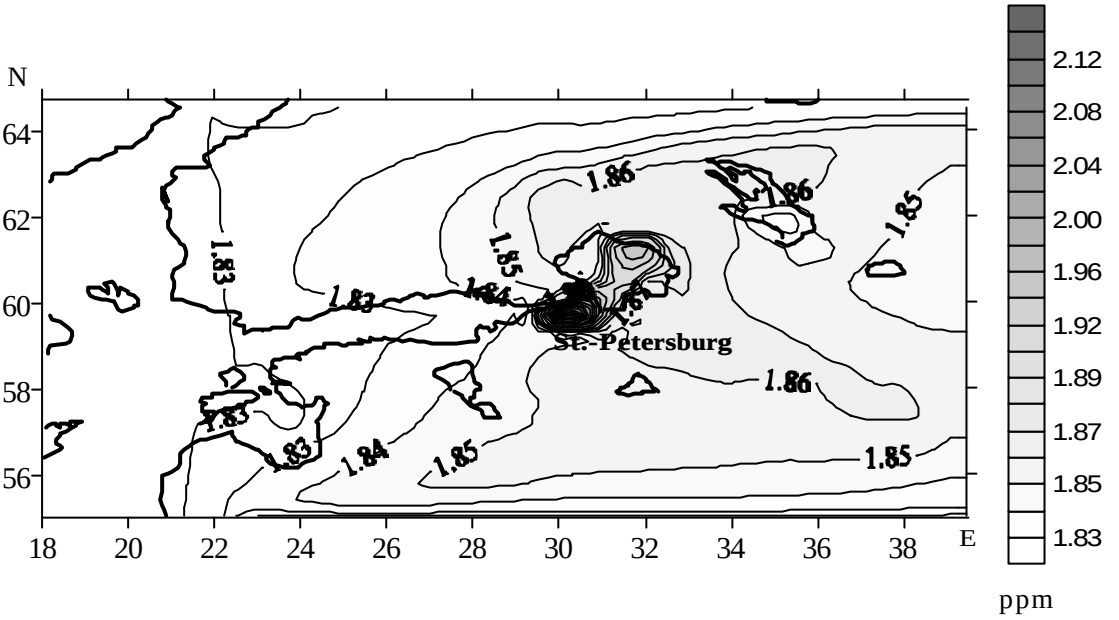

Fig. 1 Geographical distribution of methane concentration (ppm) at the altitude h ~ 15 m for 4 February, 1996

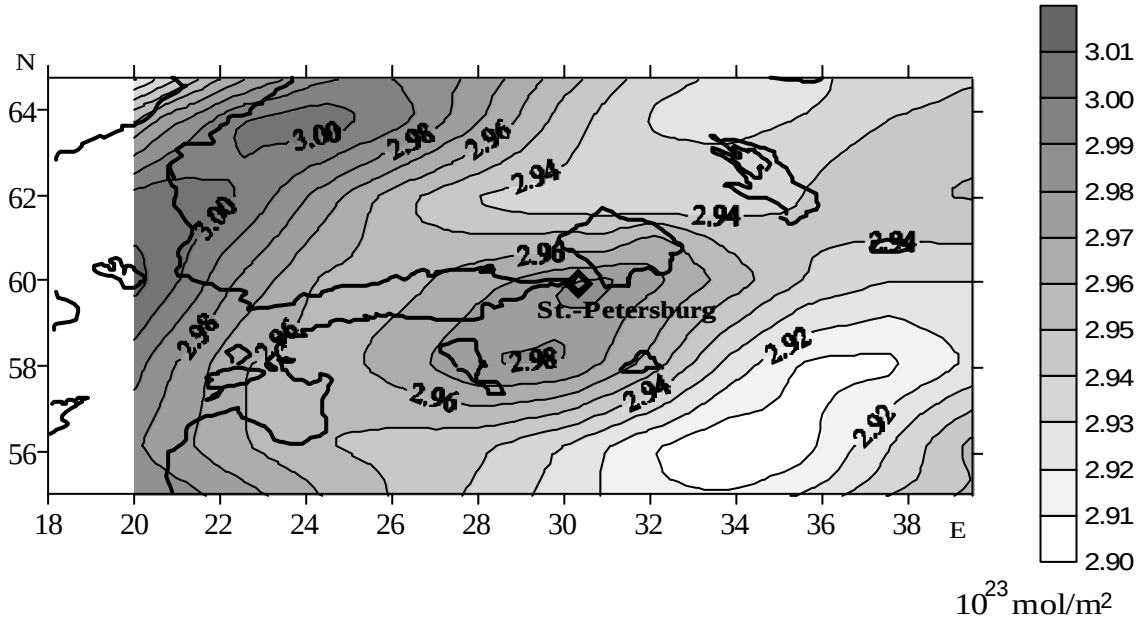

Fig. 2 Geographical distribution of methane column content (mol/m^2) up to 11 km for 4 February, 1996