

THE MAIN RESULTS OF THE STUDY

1. Comparison of the simulated results with the results of empirical studies and observation data

The model calculations of the global distribution of Joule heating in the stratosphere due to the solar wind induced electric currents demonstrated reasonable results, which must be checked by a direct comparison with the corresponding experimental data. It was a main aim of this task. The comparison between the model and experimental data were made for several observational points in the Northern hemisphere located in latitudinal range $60^\circ - 75^\circ$ N in three longitudinal sectors: $0^\circ - 40^\circ$ E; $100^\circ - 120^\circ$ E and $200^\circ - 220^\circ$ E.

The data of atmospheric temperature obtained by both methods was compared for four isobaric surfaces: 50, 70, 100 and 850 hPa. A special attention was given to the seasonal peculiarities of the temperature variations. Therefore the following periods were chosen for the analysis: February, March, August, November and December of 2001. It means that all seasons: winter, equinox and summer were included in this study. The real values of space parameters (density, velocity of the solar wind, values of vertical Interplanetary Magnetic Field (IMF) component B_z were provided for the model calculations. According to the special algorithm included in the atmospheric model the location of the magnetopause of the Earth magnetosphere was determined with subsequent determination of the electric field value induced by the solar wind distributions and the Joule heating of the atmosphere produced by these electric fields.

The model calculations of the atmospheric thermal regime with taking into account factor of Joule heating due to the solar wind disturbance were made for the latitudinal range $60^\circ - 90^\circ$ N.

2. The results of comparison of the model and experimental values

The most close resemblances between these two data sets was obtained for the points located in the longitudinal range: $0^\circ - 40^\circ$ E. Figure 1 shows relations between the model and experimental values of atmospheric temperature at isobaric surface 50 hPa for station Arkhangelsk ($\varphi = 64.6^\circ$ N, $\lambda = 40.5^\circ$ E). The upper panel of Figure 1 shows temporal variation of the experimental (curve 1) and the model (curve 2) values of T (50hPa) during February and March of 2001.

The middle panel shows correlation between these two data sets. One can see very close resemblance between model and experimental values, which is expressed by high correlation coefficient between them ($r = 0.77$).

The lower of Fig. 1 shows correlation between the same parameters but taken for August 2001 (summertime). Correlation coefficient between two data sets appeared to be a bit lower ($r = 0.61$) but it was still statistically meaningful.

Figure 2 shows results of comparison of the same data sets T (50 hPa) for Archangelsk in November – December 2001. The upper panel shows temporal variations of experimental (curve 1) and model parameters during period under consideration. The lower panel shows correlation between them, which appeared to be statistically meaningful ($r = 0.61$). It is worthy to note that no statistical smoothing was not used for the data, presented at Figure 1 and 2. Finally Figure 3 shows similar data for Arkhangelsk but taken for isobaric surface 850 hPa.

Once again temporal variations of both parameter is shown for February – March 2001 (upper panel) as well as correlation between model and experimental values of atmospheric temperature. It is evident that the difference between two datasets increased considerably due to a number of factors

Situation in the Western part of the Arctic was analyzed by using data of station Fairbanks ($\varphi = 64.8^\circ$ N, $\lambda = 212.2^\circ$ E).

Figure 4 (upper panel) shows temporal variations of atmospheric temperature at isobaric surface 50hPa during November – December 2001. As previously, curve 1 marks experimental values of

T (50 hPa) while curve 2 marks model values T (59 hPa). The second panel of Figure 4 shows correlation degree between experimental and model values of stratospheric temperature. As one can see, this correlation has evident tendency to be negative, i.e. the model values of T (50 hPa) exceeded the corresponding experimental values. However during summer (August) this dependence became positive and statistically meaningful ($r = 0.61$) due to increases conductivity of ground surface. We explain this effect by great seasonal changes of electro conductivity of the ground surface in Fairbanks: in winter it is a permafrost soil with very low degree of conductivity. In this the stratosphere is warmed by electric currents induced by the solar wind even under quite conditions in the disturbance of the solar wind. In this case electric current could not flow through ground surface whose conductivity is very low. Values of the conductivity of ice during low temperature in Arctic can be lower than the conductivity of stratosphere. This situation is different in Archangelsk where ground surface remains to be a good conductor even in winter. Unfortunately our model in its current configuration does not take into account this effect.

3. Ozone measurements

The model experiments included calculations of ozone concentration distribution. Comparison of this model of O₃ distribution with reliable experimental values of ozone height profiles turned out to be a difficult problem due to scarcity of available experimental data. Figure 5 shows example of such comparison the measurements of O₃ concentration above Canadian Arctic station Resolute Bay ($\varphi = 74.7^\circ\text{N}$, $\lambda = 265.1^\circ\text{E}$) made in August 2001. The upper panel of Figure 5 shows correlation degree between the model and experimental values of O₃ density. A rather strong negative relation between two data sets is evident ($r = -0.7$). If consider relation between O₃ density and atmospheric temperature at isobaric surface 50hPa (height of the main O₃ maximum) we found that the model calculations show strong positive correlation between these parameters (middle panel Figure 5). However experimental data do not demonstrate such dependence (lower panel of Figure 5).

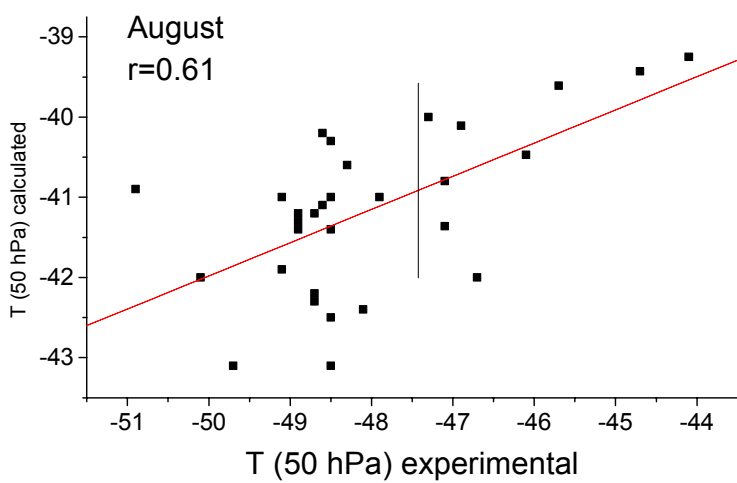
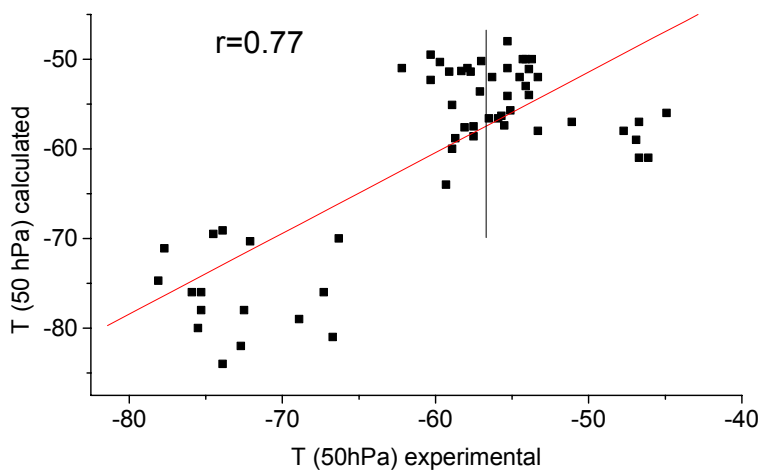
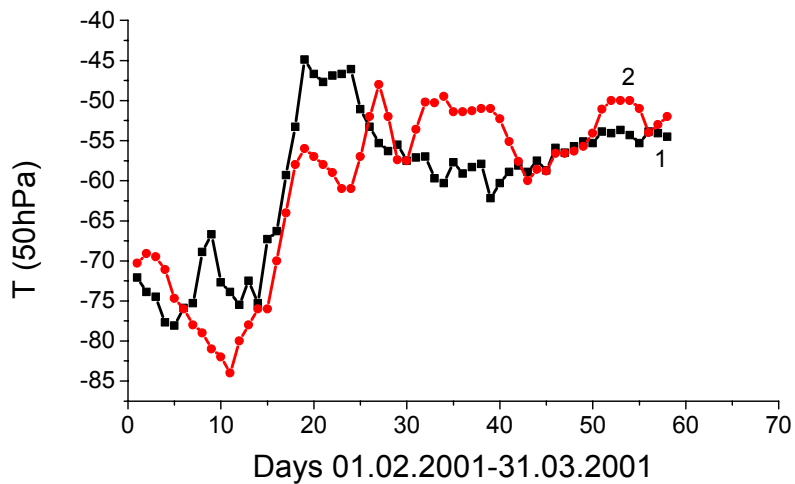


Figure 1

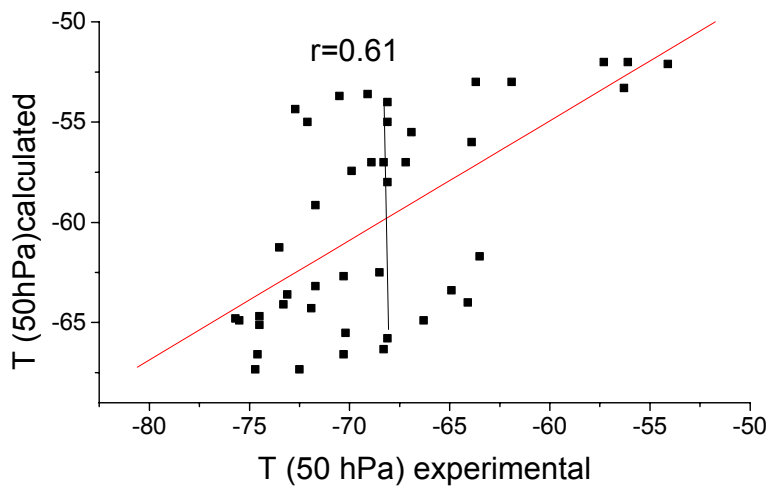
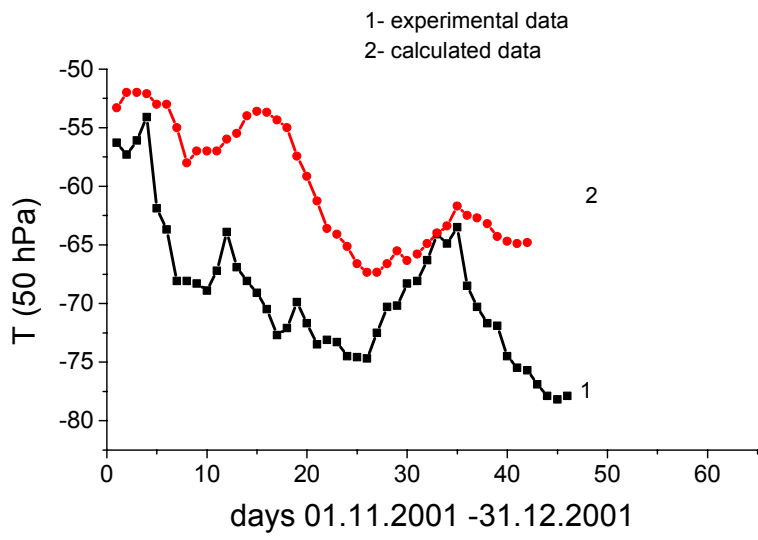


Figure 2

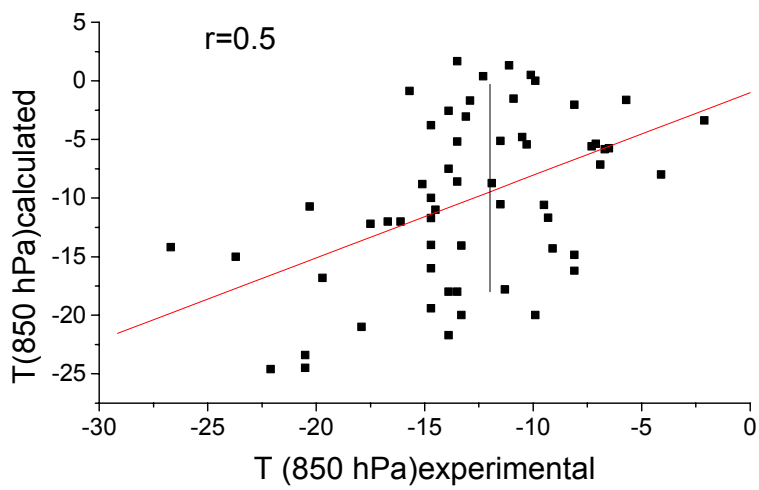
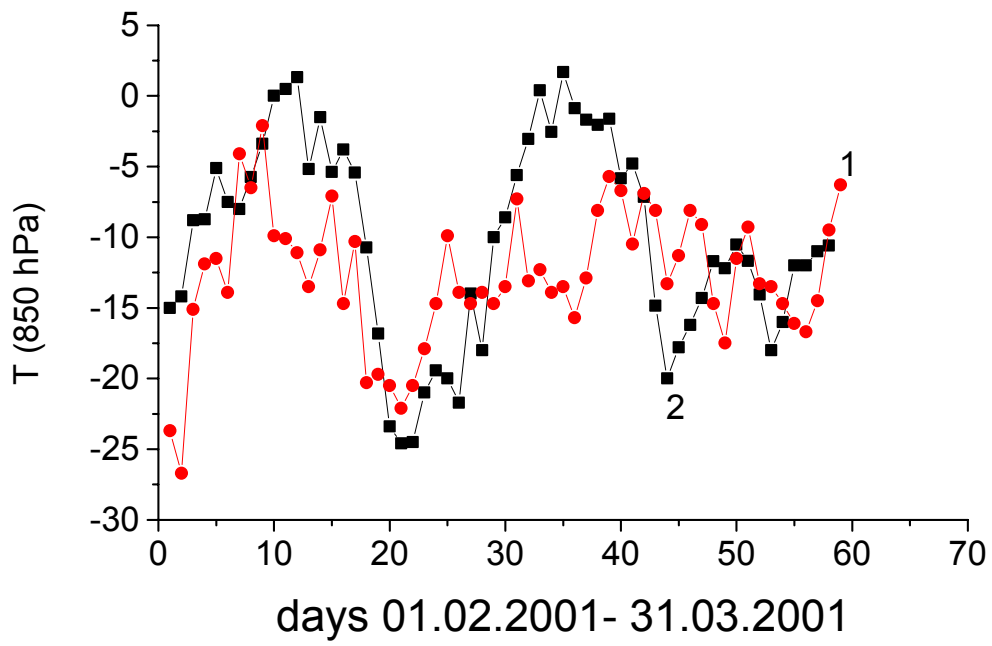


Figure 3

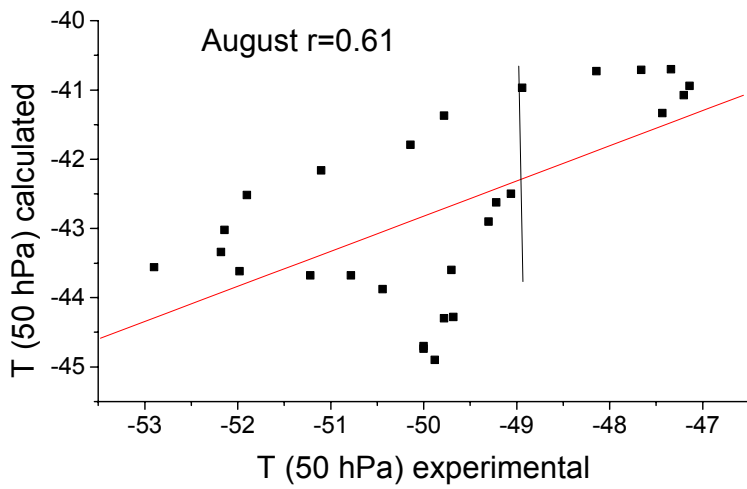
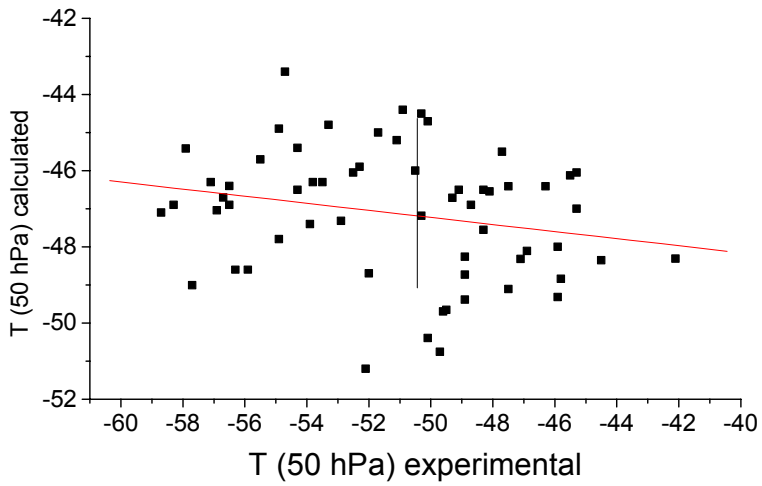
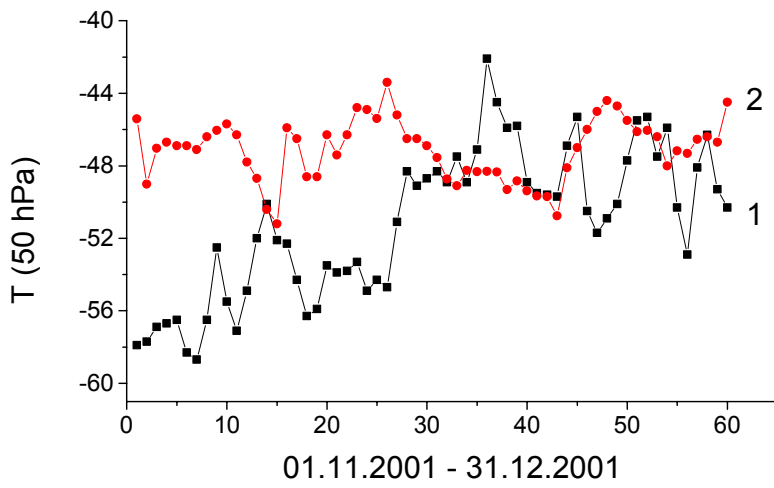


Figure 4

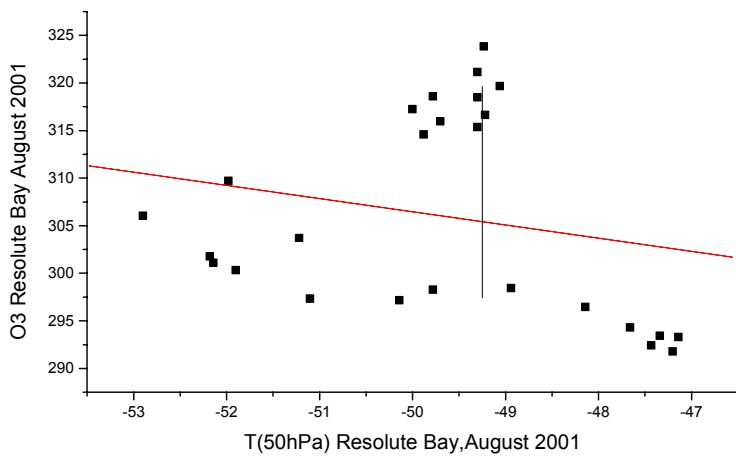
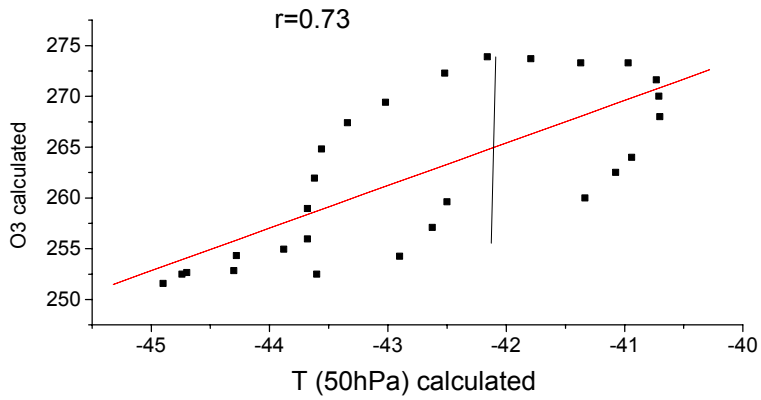
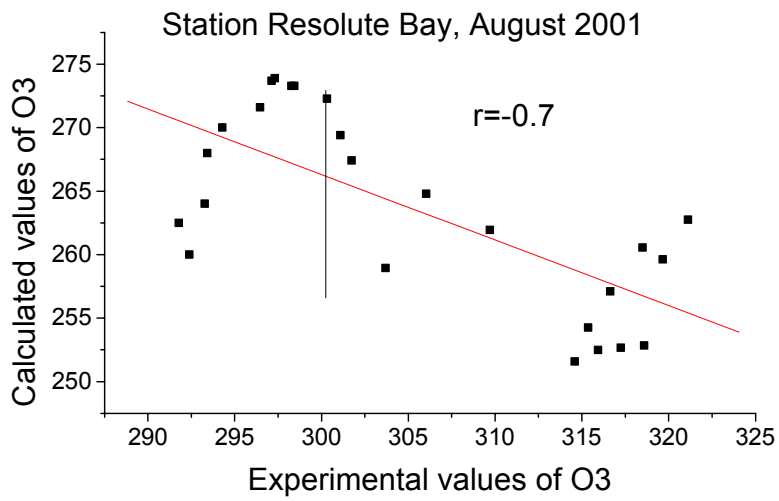


Figure 5