General comments

The primary aim of the experiment was measurements of microphysical, chemical, and optical parameters of aerosol particles over the territory of Western Siberia. We consider this work as a complex experimental study of atmospheric parameters, which allow refinement of the data available and acquisition of lacking data on the composition and state of the atmosphere. Overall estimation of radiative effects of aerosols with the use of the data obtained is not among the main tasks of this work (it is planned to be made in future). Nevertheless, the paper shows the experience that the authors have in the use of empirical data for radiative calculations and comparison with ground-based measurement data from previous experiments of 2010–2012.

Hence, the following change was made in the text of the paper:

Comment 1. In the abstract, as the primary objective of the Complex Aerosol Experiment, measurements of microphysical chemical, and optical properties of aerosol particles in the surface air layer and free atmosphere were pointed. In Chapter 2 (p. 5774, line 4) this objective is changed to "to study radiative characteristics of the atmosphere". Choose one formulation, please.

The aims of this work have been formulated more accurately.

In Abstract, we have deleted the paragraph

"Numerical calculations were compared with measurements of downward solar fluxes on the Earth's surface, performed in the clear-sky atmosphere in summer periods in 2010–2012 in a background region of the boreal zone of Siberia. It has been shown that, taking into account the instrumental errors and errors of atmospheric parameters, the relative differences between model and experimental values of direct and global solar radiation fluxes do not exceed, on the average, 1% and 3%, respectively. "

In chapter 1 (Introduction), the paragraph

"Since the primary objective of the Experiment was to study radiative characteristics of the atmosphere, below we describe the equipment used to measure atmospheric admixtures being major contributors to the radiative forcing."

has been changed to

"Below we describe the equipment used to measure atmospheric admixtures being major contributors to the radiative forcing."

Comment 2. One of the tasks of investigations was stated as study and analysis of the influence of vertical variability of optical parameters of tropospheric aerosol on radiative effects of aerosol under

typical conditions of Western Siberia (p. 577, lines 1-3). No analysis of the effects of vertical variability of optical parameters of tropospheric aerosol on radiative effects of aerosol can be found in the text.

In chapter 1, the item

"– study and analysis of the influence of vertical variability of optical parameters of tropospheric aerosol on radiative effects of aerosol under typical conditions of Western Siberia."

has been deleted from the list of tasks of the Experiment.

Comment 3. Although the Experiment was aimed at the study of the radiative characteristics of atmosphere, only a small part of the paper concerns radiative effects. Nothing is said about the aerosol radiative forcing over the territory of Western Siberia and its seasonal behavior. This chapter should be extended.

The comprehensive study of radiative effects (dependence of radiative parameters on stratification of aerosol parameters, seasonal variability of the aerosol radiative forcing, etc.) is not among the main tasks of this work, because the complexity and huge amount of materials on this subject require an independent study. Therefore, we consider unreasonable expansion of this chapter whining this paper.

Comment 4. The results of observations, presented in the paper, refer mostly to year 2013. But comparison between the measured and calculated fluxes was made for 2010-2012. Please explain how the results of the Intensive Observational Periods in 2013 were applied in radiative calculations for 2010-2012.

We included the results of our radiative experiments of 2010–2012 in this paper as an example of the use of empirical data in radiative calculations and comparison with ground-based measurement data

Hence, we have added the following paragraph in Introduction:

Analysis of the data obtained will promote formation of the set of input parameters for radiative calculations; their use allows more accurate estimation of the contributions of different atmospheric components into formation of the radiative budget of the Earth on the regional scale. The results obtained on the basis of data of the complex experiments carried out at IAO SB RAS in 2010–2012 can be considered as an example of the joint use of empirical data and numerical simulation of solar radiation.

In Chapter 4, the paragraph

“The comparison of numerical calculation results and values of downward solar radiation fluxes on the Earth’s surface measured in the clear-sky atmosphere during summer periods of 2010–2012 in a background region of boreal zone of Siberia shows that relative differences between the model and experimental values of the direct and total radiation, on the average, do not exceed 1% and 3%, respectively, when instrumental errors and uncertainties of atmospheric parameters are considered. It is also shown that the radiative cooling rates have a local maximum of about 3.5 K/day at an altitude of about 3 km in summer. The cooling rates are much lower in winter because of a sharp increase in the water vapor total content; the maximum within the troposphere are observed near the Earth’s surface (0–0.5 km) and are caused by high absorptivity of aerosol particles in this altitude range.”

has been changed to the following:

The comparison of numerical calculation results and values of downward solar radiation fluxes on the Earth’s surface measured in the clear-sky atmosphere during summer periods of 2010–2012 in a background region of boreal zone of Siberia shows that relative differences between the model and experimental values of the direct and total radiation, on the average, do not exceed 1% and 3%, respectively, when instrumental errors and uncertainties of atmospheric parameters are considered. At the same time, the difference between the model and measurement data only on the direct radiation attains 5%.

The estimates of the cooling rates have been deleted from the paragraph. We think that it is better to estimate the cooling rates with the use of data on the vertical variability of radiation-significant aerosol parameters and atmospheric gases within an independent study.

Specific comments

1. P. 5773, line 20. -The word “collected” is extra.

Extra word removed.

2. P. 5775, lines 9-10. -Are these centers or boundaries of size intervals? Please specify.

We indicate the centers of the intervals.

3. P. 5775, line 23. -“SP-9 multiwave sun photometer”. May be you meant “multiwavelength”?

correct sentence

1. SP-9 multiwavelength sun photometer for regular measurements of AOD in the 0.34–2.14 μm spectral range (16 spectral channels) and atmospheric column water vapor, as well as for retrieval of aerosol microstructure parameters (Sakerin et al., 2004, 2012);

4. P. 5776, line 1. - “microstructure parameters of particles sized from 0.1 to 10 m”. Standard AERONET product is aerosol size distribution in the radius range from 0.05 to 15 micrometers.

correct sentence

2. CIMEL CE 318 Sun-Sky radiometer of the AERONET global network for measurements of AOD in the 0.34–1.02 μm spectral range, water vapor content W, asymmetry factor of aerosol scattering phase functions, aerosol single scattering albedo, microstructure parameters of particles sized from 0.05 to 15 μm, and others (Holben et al., 1998; Dubovik et al., 1998, 2000; Dubovik and King, 2000).

5. P. 5776, lines

9-10. - “photoelectric particle counters from scattered radiation”. Please correct the

sentence.

Corrected - "photoelectric particle counters of scattered radiation".

6. P. 5776, lines 14-15. -Please specify, to what kind of concentration (number,

volume, asf) is proportional the angular scattering coefficient at 45 deg.

Line 13: “directed aerosol scattering coefficient”

change to

“angular aerosol scattering coefficient”

Line 14-15: “which is proportional to the concentration of submicron aerosols”

change to

“which is proportional to the volume concentration of submicron aerosols”

Line 16: “directed scattering coefficient”

change to

“angular scattering coefficient”

7. P. 5776, line 24. -Three-wavelength.

Line 23: “three-wave”

change to “three-wavelength”

8. P. 5776, line 23. -Check the reference.

Line 24: “Sakerin et al, 2004”

change to

“Kozlov et al, 2008b”

9. P. 5781, line 24. - Aerosol mass concentration does not depend upon wavelength. Correct, please.

«Figure 5a shows the total black carbon column up to altitudes of 7 km and aerosol mass concentration at a wavelength of 0.53 μm. These results are relatively close to springtime average values of 1.64mgm m–2 and 0.18,’

change to

“Figure 5a shows the vertical profiles of the mass concentrations of aerosol and black carbon in spring. The columnar concentrations determined from these profiles are close to the springtime average values of 1.64mg•m-2 and 0.18 mg•m-2 for aerosol and black carbon, respectively, “

10. P. 5784, line 2. -Change “revel” to level.

Corrected.

11. Figure 10. -Unknown units “mkm”.

Corrected - micrometer

Correct figure: