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The transfer of the stratospheric aerosol of volcanic origin over Western Siberia in 2008-2017, according to the lidar observation data

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It is important to study the impact of volcanic eruptions on the atmosphere and climate change, therefore an analysis of the observations data is ongoing. During the ten-year period from 2008 to 2018, the lidar observations of stratospheric aerosol have been carried out in Tomsk. The measurements were carried out by elastic scattering at a wavelength of 532 nm.

We observed the layers of volcanic aerosol arose during the eruptions of Kasatochi, Cleveland, and Okmok in 2008, Sarychev in 2009, Eyyafyadlayukudl in 2010, Grimsvotn and Nabro in 2011, Shiveluch in 2017.

Within a few weeks after the eruptions, the volcanic aerosol was observed as separate peaks. Then within about 1-2 months, a diffuse layer of eruptive aerosol was formed. This aerosol was concentrated at altitudes of 15-20 km with a peak at 18 km, regardless of the geographic location of the volcano.

The origins of the observed layered structures was analyzed using the trajectory method. The isentropic trajectories of air masses were calculated, the initial points of which were located at different altitudes above the volcanoes at the time of their eruptions. The trajectories were obtained with the help of the program package developed by us, using the stratosphere assimilated data of UK MetOffice on wind velocities, and also using the HYSPLIT package and GDAS data.

There is a model of stratospheric aerosol, which represents the averaged data from long-term satellite observations [1]. The maximum of the observed aerosol peak according to our lidar data corresponds to the maximum of aerosol filling according to this model.

However, the model is statistical. We found that during the warm period from May to September in 2012-2016, the aerosol scattering in the stratosphere was virtually absent. At that time, the stratosphere was not outraged by volcanic erution products.

It follows that in the absence of volcanic activity, the background state of the stratosphere is the absence of an optically active aerosol fraction and, accordingly, the absence of aerosol scattering.

When there is aerosol filling of the stratosphere, we investigated transport processes in the stratosphere and found that the aerosol can be transported from equatorial latitudes, where the tropical reservoir described by Hitchman et al. (1994) is located and this transfer is carried out along isentropic trajectories.

Along isentropic trajectories, a volcanic aerosol was transferred after the eruption of the Nabro volcano in Tomsk and Vladivostok.

But the same aerosol can also be transported from the northern latitudes to Tomsk. According to lidar data, the aerosol is spatially inhomogeneous.

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