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Atmospheric Transport of Arid Aerosol from Desert Regions of Central Asia

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Investigation of atmospheric transport of arid aerosol from Central Asia was held within the ISTC project 3715. Particular attention was paid to the removal of aerosol from the Aral Sea region and its further transport, because aerosol and pollutants emission from Central Asia affect the airspace of the entire Asian continent. At the same time measurements of aerosols in the atmosphere of Central Asia are holding in a small number of stations, and currently available data are insufficient to define the initial conditions and/or verification of models of long-range transport.

To identify sources of pollution transported from Central Asia, in Kyrgyzstan measurement and sampling of air were organized: at the station on the northern slope of the Kirgiz Range, 30 km south of Bishkek, at an altitude of 1700 m above sea level (Bishkek Site, 42,683N; 74,694E), and on permanent alpine Teploklyuchenka lidar station in the Central Tien Shan at an altitude of 2000 m above sea level (Lidar Site, 42,467N; 78,533E). The chemical analysis of collected aerosol and soils samples was carried out.

Measurements of aerosol at these stations have been merged with the simulation of the trajectories of air masses in the study region and with the satellite (the Terra and Aqua satellites) observations of aerosol optical thickness in this region.

Satellite data for the region 43-47 N, and 58-62 E (Aral Sea) from April 2008 to September 2009 were analyzed. The moments were selected, when the value of aerosol optical thickness (AOT) was greatest (more than 0.5), and the transport from the Aral Sea region to the observation sites took place. For each of these days, the forward trajectories, which started at 6 points within the region, were calculated using the HYSPLIT model. The days, on which the trajectories reached the BISHKEK and LIDAR sites, were determined from the data obtained. Calculations on the basis of the RAMS model were performed for these days. These calculations were performed using a grid of 160*120*30 points. The obtained meteorological fields were used in the HYPACT model; the source of Lagrangian particles was located over the Aral Sea region.

As the result for 2008 11 days were detected when aerosol from the Aral Sea was actively transported to the observation sites. Comparative chemical analysis of aerosol samples at the stations of observation and soil samples from the Aral Sea region would confirm the presence of emissions and regional transport.

It should be noted that the main source of aerosol in Central Asia is Taklamakan desert. Average value and AOT variability over it several times higher than corresponding AOT values over the rest of the region. The greatest variability aerosol over Taklamakan observed from late March to mid-May. For example, on April 22, 2008 average of the AOT in cell 5° x 5° over the western part of Taklamakan – value reached 3,171. AOT virtually throughout the region positively correlated with AOT over Taklamakan desert. The most noticeable effect makes an aerosol of Taklamakan found in the south-east Kyrgyzstan, Tajikistan in the east and north of the Tibetan highlands. The impact of the Aral Sea area is restricted significantly less. In doing so, AOT in the central part of the region reveals a weak negative correlation with the AOT over the Aral Sea.