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Aerosol Layers Formation by Mesoscale Circulation

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In the atmospheric boundary layer (ABL) mesoscale-circulation structures such as boundary layer roll vortices — ordered helical vortices with horizontal axes (Etling and Brown,1993) — affect the characteristics of turbulence, play a significant role in mixing processes and processes of aerosol emission and transport, facilitate the formation of aerosol layers in the ABL.

Dust emission related to the mesoscale circulation and convection in ABL was discussed in (Ponomarev,1998; Gorchakov et al.,2003; Cakmur et al.,2004; Takemi et al.,2006; Marsham et al.,2008; Klose and Shao,2012). According to estimates, total amount of aerosol emission and transfer due to the secondary airflows in the form of horizontal roll vortices should not be neglected on long timescales.

For analysis of roll characteristics the two-scale model has been used. Such a model consistently represent longitudinal vortices generation and let us focus direct on the investigation of the horizontal roll vortices without any mistakes and uncertainties when choosing parameterization schemes, subgrid scale model tolerance. Having applied obtained velocity fields the transport parameters of particles with various size distributions and the conditions of the generation of aerosol layers have been examined. These aerosol layers are observed by lidar sounding from the aircraft (Golitsyn et al.,2003).

Reasonably good correspondence between numerical simulation results obtained by mesoscale numerical weather prediction system WRF-ARW, in particular the eddy-resolving model WRF-LES and the WRF-Chem model, and the findings of the two-scale model is received. Validation of modelling results has been done using satellite data. Observed semi-desert areas were located near the Komsomolsky settlement in Kalmykia Republic, Russia (the Caspian lowland) in July 2007, where the complex expedition of field measurements organized by A.M. Obukhov Institude of Atmospheric Physics during the summer period was carried out.

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