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An attempt to profile the vertical distributions of trace gases and aerosol particles in the surface layer

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Dispersion and transport processes of gaseous molecules and aerosol particles that are emitted near the surface are strongly influenced by meteorological conditions within the surface layer. For instance, during daytime positive buoyancy flux at the surface creates a thermal instability and thus generates additional or even major turbulence, which may result in an effective vertical mixing of trace gases and aerosol, whereas during nighttime negative buoyancy inhibits turbulent mixing, thus vertical transport is slower at night than during the day. Most of the available observational studies of atmospheric trace constituents are ground-based campaigns which will not be adequate to reveal their spatiotemporal variations near the surface layer. Airborne-based campaigns are powerful approach to examine the spatiotemporal variations of atmospheric trace constituents in the free troposphere, but will be inadequate to expand the assessing heights into the surface boundary layer because of minimum safe altitude. We want to overcome the shortcomings posed by the poor understanding of the influence of vertical mixing near the surface, and the lack of altitude resolved measurements of the chemical composition in the surface boundary layer. We are developing a new methodology to reveal the vertical distributions of trace gases and aerosol particles and to investigate their variations with the meteorological parameters. In this presentation, we introduce the preliminary results from the simultaneous measurements using lidar, sodar and tethered balloon profiling, which were conducted at Kyoto University Middle and Upper Radar site (34.9 N, 136.1 E) in Shiga Prefecture, Japan, during the summer of 2011.

Keywords: aerosol, trace gases, surface layer, tethered balloon, vertical distributions