ABSTRACTS (MASTER THESIS)

Development of high-range resolution lidar for observing aerosol spatial distributions including near ranges

**(Graduate School of Informatics,
Laboratory of Radar Atmospheric Science, RISH, Kyoto University)**

Fumiya Kitafuji

Atmospheric aerosols from nature and anthropogenic sources affect the global climate and local air quality related to human health. A lidar is suitable for observing the spatial distribution of aerosols and conventionally associated with wide-range measurements such as long-range transboundary air pollution. However, the incomplete overlap between the laser beam and field of view of the receiving telescope of the backscatter lidar significantly prevents observation in the near range. In this study, we develop a high-range resolution lidar for observing the detailed aerosol spatial distribution including the near range.

The constructed lidar system can observe aerosol profiles with a maximum range resolution of 18.8 cm by using a short-pulse laser and multispectral detector that can operate at a high sampling rate. Two methods were investigated to observe the near-field range. The first method includes tilting the laser beam axis toward the receiving telescope axis to observe a certain observation range. It is suitable for closed spaces such as the indoors because strong scattering from a hard target (e.g. wall) can be removed. The second method is implemented by slanting a part of the receiving optical axis by the use of several wedge prisms placed in front of the telescope. The advantages of this method are that the observation range in the near field may be modified flexibly. Moreover, the data acquisitions of both the near and far ranges can be achieved within the detector's dynamic range by adjusting the signal power using the wedge prisms. When the telescope diameter was 10 cm (F2) in the Galileo type and 15 cm (F5) in the Newtonian type, this lidar that it can acquire the signal with a statistical uncertainty of less than 10% was 2 m and 5 m, respectively.

Lidar observation on a flat-grassland

Simultaneous measurements between the in-situ instruments using the observation tower and scanning lidar were performed on a flat-grassland in the Miura peninsula in January 2019. We observed that inhomogeneous aerosol spatial distributions varied at a height within several meters under the weak wind condition during nighttime. Figure 1 shows an example of the observation result indicated the inhomogeneous vertical distribution of aerosol backscattering ratio. This is considered to be due to the formation of an aerosol layer caused by a temperature inversion layer under the weak wind conditions during nighttime.

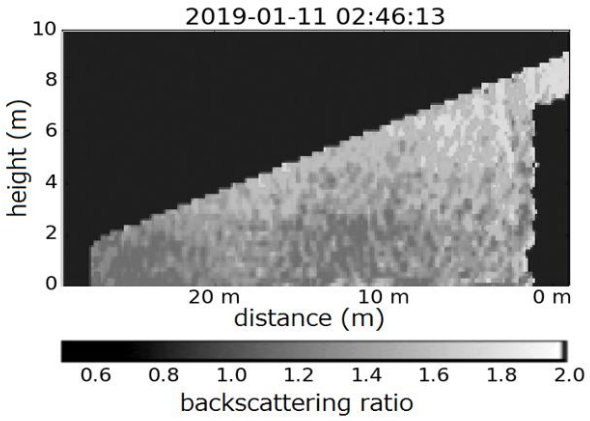

Figure 1. Backscattering ratio of vertical cross section obtained from lidar observation on a flat-grassland in the Miura peninsula at 2:46 JST on January 11, 2019. The vertical and horizontal range resolutions are 0.4 m.