Deployment of the 4AZ-MAXDOAS system at Chiba, Japan: the potential to investigate the spatial inhomogeneity of atmospheric components

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Ground-based observation data utilized for the model evaluation have been often obtained at sites, where target physical parameters, such as concentration of trace gas, are thought to be homogeneously distributed on a model grid spatial scale. However, the spatial distribution should depend on the physical parameter. More importantly, there tends to be the lack of sufficient test regarding the spatial homogeneity, particularly around sites, which are usually categorized as urban or suburban sites. Here, we present the new observation system, the 4-different-azimuth-viewing Multi-Axis Differential Optical Absorption Spectroscopy (4AZ-MAXDOAS) system. The continuous observation by the 4AZ-MAXDOAS system has been conducting in Chiba University, Chiba, Japan (35.63N, 140,10E) since November 2014, to investigate spatial distributions of atmospheric components such as nitrogen dioxides (NO_2), formaldehyde (HCHO), glyoxal (CHOCHO), and water vapor (H_2O) on a spatial scale of about 10 km. We found that daily 4AZ-MAXDOAS data for a 0-1 km layer show the significant spatial inhomogeneity, even for H_2O. However, the observed spatial inhomogeneity as well as the temporal inhomogeneity can be lowered by taking averages over longer time. We found that the differences among monthly-mean NO_2 volume mixing ratios for 4 different viewing directions were as small as ~2 ppbv. Similarly, those differences for HCHO, CHOCHO, and H_2O were estimated to be as small as ~1 ppbv, 60 pptv, and ~0.2%v, respectively. It is suggested that for measurements made at a single site, averaging data over time can lower effects of both spatial and temporal inhomogeneities on the estimate of the representative values for a grid adopted by a model and for a pixel measured by a satellite instrument.

Keywords: MAX-DOAS, NO2, HCHO, CHOCHO, H2O

