

Measurement of CO₂ stable isotope ratio by mid-inferred laser absorption spectrometry; analysis of CO₂ cycle in urban

YUBA, Akie^{1*} ; TAKAHASHI, Kenshi² ; NAKAYAMA, Tomoki¹ ; MATSUMI, Yutaka¹

¹Solar-terrestrial environment laboratory, Nagoya university, ²Research Institute for Sustainable Humanosphere, Kyoto University

CO₂ concentration has been increasing from the range of 275 ppmv (parts per million by volume) to 285 ppmv in the previous industrial period to about 400 ppmv in 2013. IPCC reported that CO₂ has the most effective on the positive radiative force. The insight of CO₂ emission and absorption flux helps us to estimate the variation of radiative forcing and atmospheric environment. CO₂ concentration changed with the anthropogenic and biogenic emission and absorption. The stable isotope ratio of CO₂ ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) is associated with the CO₂ source such as combustion and biogenic respiration. The contribution of each CO₂ source in the urban area was estimated by using the stable isotope ratio of CO₂.

We conducted the continuous measurement for CO₂ concentration and stable isotope ratio of CO₂ using the mid-inferred absorption spectrometry which can obtain CO₂ concentration and its isotope ratio with high time resolution. The water vapor and stable isotope ratios of water vapor (δD and $\delta^{18}\text{O}\text{-H}_2\text{O}$) were measured to show the relationship between H₂O and CO₂ due to the isotopic exchange reaction. CO and NO_x concentrations were obtained as a tracer of anthropogenic emission. The measurement was conducted for two weeks in summer and winter. The seasonal variation of CO₂ source was shown according to the comparison of CO₂ concentration and stable isotope ratio. Especially, we focused on the contribution of biogenic process to CO₂ concentration variation in the urban area.

CO₂ concentration and stable isotope ratio of CO₂ in the summer showed the diurnal variation. On the other hand, those in the winter had no diurnal variation. CO₂ concentration variation in the winter was correlated with CO concentration variation. These results suppose that CO₂ concentration variation in the winter was mainly dominated by the anthropogenic emission and that in the summer was related with biogenic process as well as anthropogenic emission. We will discuss the relationship between stable isotope ratio and meteorological condition or water vapor isotope ratio to identify the detail of CO₂ source.

Keywords: CO₂ stable isotope ratio, Urban area, CO₂ cycle, mid-inferred laser absorption spectrometry