

南鳥島における大気中CO₂濃度および炭素・酸素安定同位体比の連続観測 Continuous measurements of atmospheric CO₂ and its $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ O at Minamitorishima Island

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The Minamitorishima (MNM; 24°17' N, 153°59' E) station is uniquely located to monitor background air at northern mid latitudes; the site is located on a remote coral island in the western North Pacific, about 1,950 km southeast of Tokyo. The Japan Meteorological Agency has been making long-term continuous observations of atmospheric concentrations of major greenhouse gases at MNM. For a better understanding of mechanisms governing the observed CO₂ variation, systematic measurements of atmospheric CO₂ and its $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ have been carried out at MNM by analyzing discrete flask air samples taken at the site since 2011. The existing measurement program was enhanced by initiating continuous measurements of CO₂ and its $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ using a laser spectroscopy (Off-Axis Integrated-Cavity Output Spectroscopy) in March 2018.

Sample air is drawn from an air intake mounted on a tower at 20-m height above the ground surface, and introduced into a continuous isotope analyzer (Model CCIA-48, Los Gatos Research) after removing water vapor and aerosol particles. The analyzer is calibrated hourly for the concentrations of each CO₂ isotopologue, using 3 air-based CO₂ standard gases with isotopic ratios of industrial CO₂ and different total CO₂ concentrations. The isotopic ratios of these standards were determined by a mass spectrometer, and the concentrations of each CO₂ isotopologue of the standards were obtained from the isotopic ratios. The total CO₂ concentration and its $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ of sample air are calculated from the measured concentrations of each isotopologue.

The obtained CO₂ isotopic data are scattered, and the precisions of the $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values measured by this analyzer estimated from hourly measurements of a target gas, which is dried natural air compressed into a 48-L gas cylinder, are about 10 times and 5 times worse than those achieved by our mass spectrometer, respectively. However, the daily mean values of atmospheric $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ show day-to-day variations in concert with those of the total CO₂ concentration and prominent seasonal variations. The daily mean $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ show systematic difference from the isotopic values obtained from flask sampling on the same day. However, since the differences are almost constant, the nature of the variations are very similar in both cases.

In this presentation, results of the preliminary analyses of the daily mean CO₂, $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ data obtained from the continuous measurement will be presented. From comparison with the flask sampling results, the effectiveness of the continuous measurement will also be discussed.

Acknowledgements

We would like to thank A. Kudo and C. Abe for their technical support for our measurements. This research was supported by a grant for the Global Environmental Research Coordination System from the Ministry of the Environment, Japan.

キーワード：二酸化炭素、安定同位体比、南鳥島、連続観測

Keywords: Carbon dioxide, Stable isotopic ratio, Minamitorishima Island, Continuous measurement