

Temporal variations of the atmospheric CO₂ concentration and d¹³C at Ny-Ålesund, Svalbard

*Daisuke Goto¹, Shinji Morimoto², Shigeyuki Ishidoya³, Shuji Aoki², Takakiyo Nakazawa², Akie Yuba¹

1.National Institute of Polar Research (NIPR), 2.Tohoku University, 3.National Institute of Advanced Industrial Science and Technology

Long-term measurements of the atmospheric CO₂ concentration and its carbon isotope ratio (d¹³C) have been used for partitioning CO₂ sinks into the terrestrial biosphere and the ocean. However, the CO₂ sinks estimated from d¹³C suffer with uncertainties in isotopic disequilibrium flux between the atmosphere and the ocean and between the atmosphere and the terrestrial biosphere (so-called isoflux). For a better understanding of the global carbon cycle, we have been carrying out the systematic observation of the atmospheric CO₂ concentration and d¹³C at Ny-Ålesund (78.93°N, 11.83°E), Svalbard since 1991 by weekly air sampling with subsequent analysis in NIPR. Here, we will present the observational results of CO₂ concentration and d¹³C for 1991–2013 and 1996–2013, respectively. The d¹³C data before 1996 were removed from our analysis due to experimental and sample quality problems (Morimoto et al., 2001).

The CO₂ concentrations show a clear seasonal cycle with peak-to-peak amplitude of about 17 ppmv, which reaches the maxima in late April to early May and the minima in late August, superimposed on a secular increase with an average rate of 2.0 ppmv/yr for the period of 1996–2013. On the other hand, the d¹³C decreases secularly at an average rate of -0.018 ‰/yr, and varies seasonally in opposite phase with the CO₂ concentration. We have also maintained atmospheric d(O₂/N₂) measurements at Ny-Ålesund since 2001 (Ishidoya et al., 2012). Using the atmospheric d(O₂/N₂) and CO₂ concentration records, the terrestrial and oceanic CO₂ sinks are estimated to be 1.7 ± 0.8 GtC/yr and 2.2 ± 0.7 GtC/yr, respectively, for the 13-year period (2001–2013). Using these values of CO₂ sinks and the d¹³C record, the average isoflux for the period of 2001–2013 is estimated to be 99 ± 28 Gt ‰/yr.

References

Ishidoya et al. (2012) Oceanic and terrestrial biospheric CO₂ uptake estimated from atmospheric potential oxygen observed at Ny-Ålesund, Svalbard and Syowa, Antarctica. *Tellus B*, 64, 18924, <http://dx.doi.org/10.3402/tellusb.v64i0.18924>.

Morimoto et al. (2001) Temporal variations of atmospheric CO₂ concentration and carbon isotope ratio in Ny-Alesund, Svalbard, *Mem. Natl Inst. Polar Res.*, Spec. Issue, 54, 71–79.

Keywords: atmospheric CO₂, carbon isotope ratio, O₂/N₂ ratio