2.088 17O-excess of atmospheric nitrous acid in urban area: quantification of its sources.

Early Career Scientist

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Abstract:

Nitrous acid (HONO) is an important trace gas in the atmosphere because it plays an important role in tropospheric cycling of hydrogen oxides and nitrogen oxides due to the photolysis reaction. The sources of atmospheric HONO, however, are not well understood, especially during the daytime and need to elucidate the existing “unknown” sources, as well as estimating formations rates of the “known” sources precisely. The HONO sources can be divided into two categories: direct emission and secondary formation. The former includes vehicle or industrial exhausts, biomass burning and soil microbial activities, while the latter indicates photochemical/chemical reactions of atmospheric NO, NO_2 or nitrate (NO_3^-). In order to estimate the relative importance of direct emission and secondary formation, we used ^{17}O-excess of atmospheric HONO as tracer; $\Delta^{17}O$ values of HONO produced via secondary processes should have positive values owing to part/all of oxygen atoms originate from ozone, while $\Delta^{17}O$ value in directly emitted HONO should be zero because its oxygen atoms derive from H_2O or O_2.
In this study, automated systems for time-interval air sampling equipped with 6 four-stage-filter-packs were used to collect atmospheric samples every 4 hours, and verify diurnal variations in $\Delta^{17}O$ value of atmospheric HONO. The $\Delta^{17}O$ value of HONO was determined by combining sensitive determination method on isotopic compositions of NO_2^- with filter-pack method in which HONO was collected as NO_2^- on alkaline (K_2CO_3) impregnated filters.
Periodical sampling of atmospheric HONO was carried out at two sites; Nagoya and Sapporo, Japan. The daily mean $\Delta^{17}O$ values of HONO ranged from +15‰ to +17‰

through the observation periods. The $\Delta^{17}O$ values of HONO showed large diurnal variation; maximum value was observed around noon, while minimum value was found at night. The increasing $\Delta^{17}O$ values observed after sunrise result from sunlight induced rapid production of HONO via secondary formation.