

# **Pilot Observation of Atmospheric Nitrous Oxide using a Compact Mid-Infrared Laser in Comparison with Ongoing Long-Term GC Observation at JMA Ryori Station**

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## **Abstract**

Continuous observations of atmospheric greenhouse gases (GHGs) have been performed at stations of Japan Meteorological Agency (JMA) since late 1980s under the Global Atmosphere Watch programme of the World Meteorological Organization (WMO/GAW). Ryori station, located on the Pacific coast hill in the northeast part of Japan, has the longest history of continuous GHGs observation in Japan. Nitrous oxide (N<sub>2</sub>O) observation has been conducted since 1990 using ECD-GC. On the other hand, laser analyzers have rapidly evolved in recent years, by the benefit of high precision and easy operation. Aeris MIRA Ultra N<sub>2</sub>O/CO is a mid-infrared absorption spectroscopy based analyzer, which is small, power-saving, and inexpensive. We prepared a measurement system based on the laser-analyzer, and performed a pilot observation for about six months from Jun 2023 in comparison with the JMA GC measurements, for the purpose of scientific research and technical cross-validation between the laser and GC. In the laser observation, standard and reference gases were regularly measured for calibration and performance check. Reproducibility of N<sub>2</sub>O and CO mole fractions from the repetitive reference gas measurements were 0.09 and 0.31ppb, respectively, while those for GC were 0.86 and 0.45 ppb, respectively. Although MIRA Ultra outputs tend to show large temporal drifts, satisfactory high precisions were achieved. The laser observation shows clear N<sub>2</sub>O diurnal cycles due to some meteorological conditions such as large boundary layer height variation and land and sea breeze, while they are not clear in the GC observation. Synoptic scale variations like fast transport events from Eurasia are almost similarly seen for both laser and GC results. Mean difference of N<sub>2</sub>O mole fractions measured by laser and GC was less than 1 ppb on the same standard scale but seems to imply some sort of effect due to other atmospheric species in both laser and GC measurements.

## **Early Career Scientist**

NO, I am not an early career scientist.

## **IGAC Activities**

BBURNED: Biomass Burning Uncertainty: ReactionS, Emissions and Dynamics, Allin-Wayra: Small Sensors for Atmospheric Science, CCMi: Chemistry Climate Model Initiative, GEIA: Global Emissions Initiative, PACES: Air Pollution in the Arctic: Climate, Environment, and Societies