

Commissioning of High Precision *in situ* Measurements of N₂O and CO at Cape Grim

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To date, *in situ* measurements of atmospheric nitrous oxide (N₂O) and carbon monoxide (CO) at the Cape Grim Baseline Air Pollution Station have been made under the auspices of the Advanced Global Atmospheric Gases Experiment (AGAGE) utilizing a gas chromatography multidetector (GC-MD) system [electron capture (ECD) for N₂O and reduction gas (RGA) for CO], which measures a single ambient air aliquot once every 40 minutes.

In March 2019, CSIRO installed a new CO and N₂O analyser based on mid-IR cavity ring-down spectroscopy (CRDS) (Picarro Inc., model G5310) at Cape Grim to provide higher precision, higher frequency measurements of these two important atmospheric trace gases at this key global monitoring site.

Here we present results from tests performed in our Aspendale laboratories before deployment of the instrument, including characterisation of the instrument response to water vapour content in the sample. We also present the initial CRDS time series from Cape Grim, including comparison to GC-MD N₂O and CO measurements as shown in Figure 1. Importantly, the two techniques provide time series that are largely faithful to each other for both species. The N₂O precision from the CRDS instrument is notably superior to the GC-MD system. Data from the two instruments are on different scales (AGAGE GCMD data are on the SIO-16 N₂O scale while the CRDS data are on the NOAA-06A scale). Occasional divergence in the CO measurements reflect differences in intake height [70m for the CRDS and currently 10m for the GC-MD (normally 70m)] and known issues with the GC-MD. Data from both instruments are on the CSIRO94 CO scale.

Finally, we explore two challenges posed by the commissioning of this new instrument. Firstly, what is the best strategy to handle the propensity of CO to drift in the Luxfer aluminium cylinders we commonly use in the preparation of working standard and calibration cylinders for our continuous *in situ* analysers? And secondly, unlike the GC systems we use for cascading our calibrations, the CRDS instrument is sensitive to only the major isotopologue (¹²C¹⁶O and ¹⁴N¹⁴N¹⁶O). This potentially introduces error in the CRDS measurements at high mole fractions when high mole fraction standards have been prepared by ‘spiking’ clean air cylinder fills with CO of a different isotopic composition than is likely to be present in the well-mixed atmosphere.

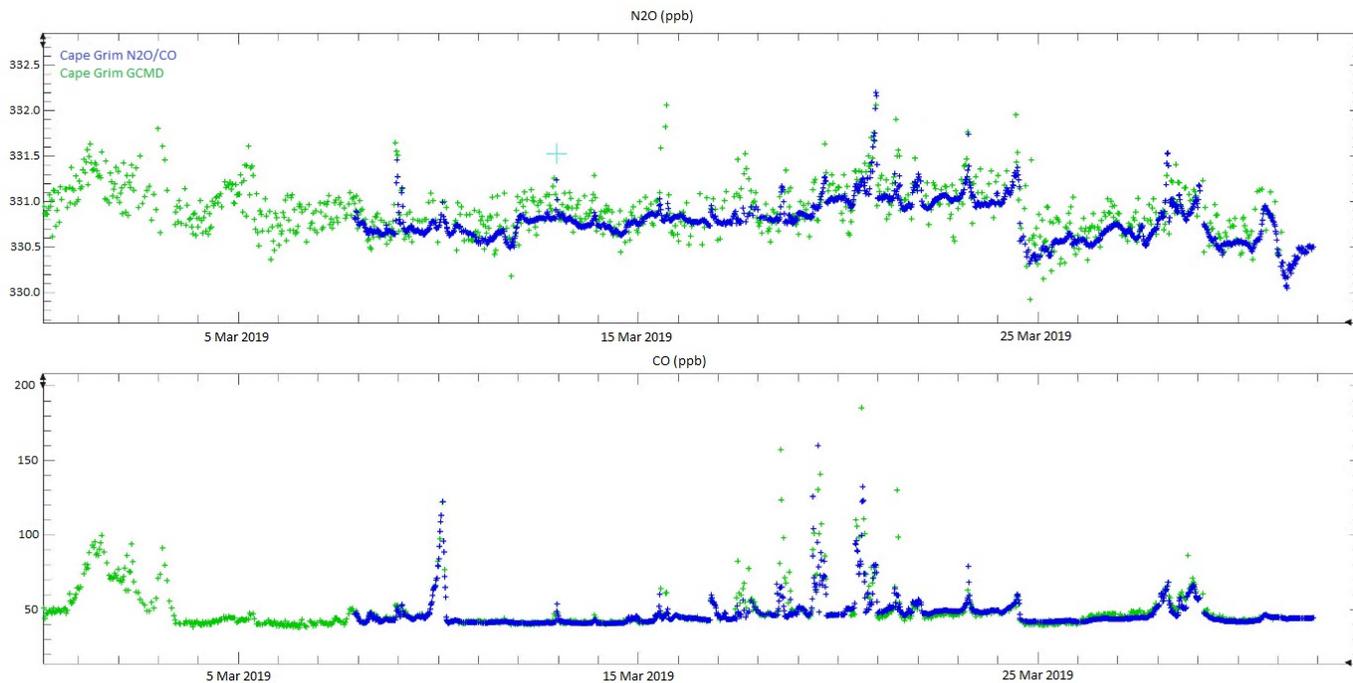


Figure 1. Time series of N₂O (upper panel) and CO (lower panel) at Cape Grim. Green data points are from the AGAGE GC-MD system, blue data points are from the Picarro G5310 system.