



Commissioning of high precision in situ measurements of N₂O and CO at Cape Grim

CSIRO CLIMATE SCIENCE CENTRE
www.csiro.au

Zoë Loh, Paul Krummel, Elise-Andree Guerette, Darren Spencer and Ray Langenfelds



Quick Outline

- Description of instrument + set-up
- Justification
- Caveats

- For each species (CO and N₂O):
 - Comparison of data to existing GCMD measurements at Cape Grim
 - Water vapour correction
 - Sensitivity
- Potential issues

Instrument and set up details

- based on mid-IR cavity ring-down spectroscopy (CRDS) (Picarro Inc., G5310)
- $^{12}\text{C}^{16}\text{O}$ and $^{14}\text{N}^{14}\text{N}^{16}\text{O}$ analyser
- Tested at Aspendale labs: Oct 2018 – Feb 2019
- Installed at Cape Grim: early March 2019
 - Measuring from same 70 metre inlet as Loflo CO_2 analyser and both $\text{CO}_2 + \text{CH}_4$ Picarros
 - No sample drying
- Standards:
 - 40L Luxfer aluminium cylinders filled with whole air (chemically dried using $\text{Mg}(\text{ClO}_4)_2$).
 - Current Mid and High span standards were spiked with CO and N_2O of unknown isotopic composition
- GCWerks used for instrument control and data processing (not yet fully implemented)



Justification

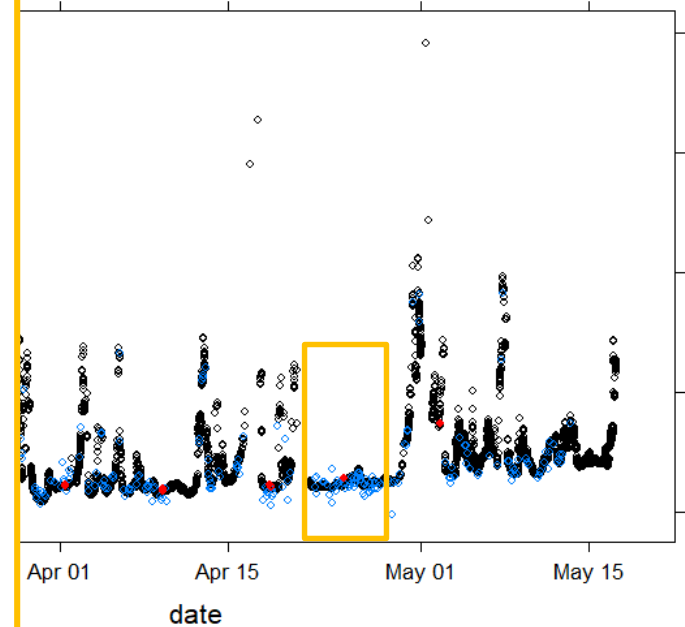
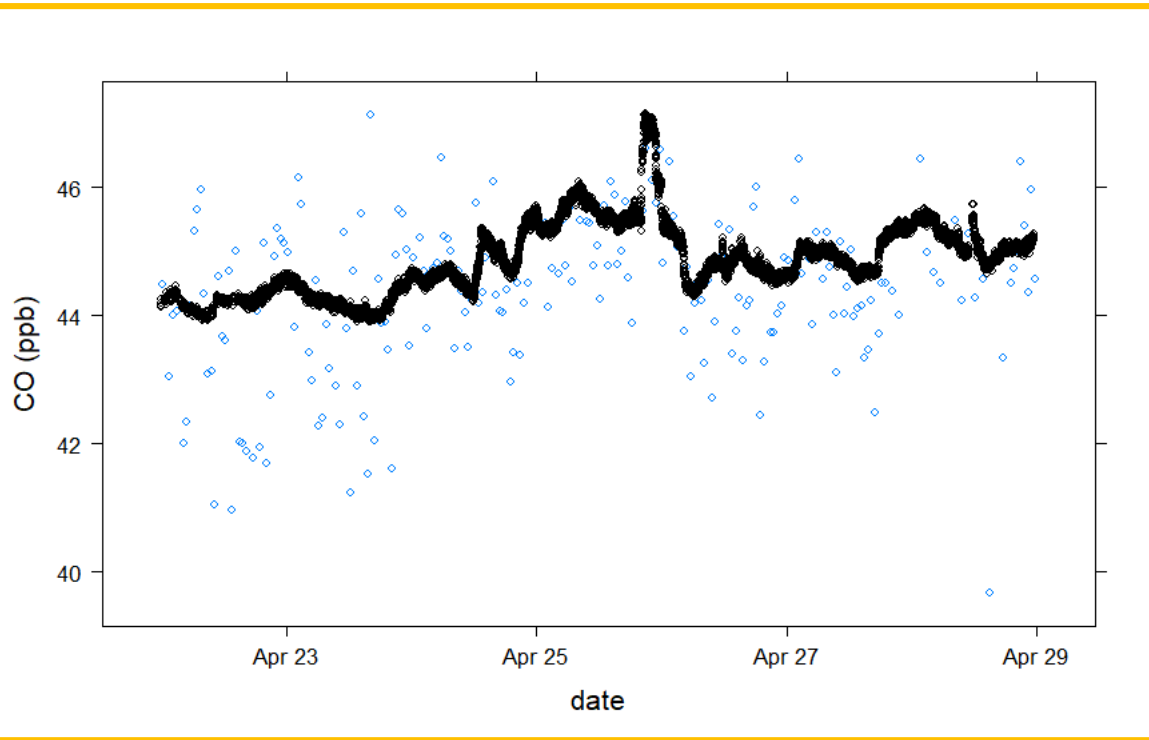
- Supplement existing GCMD CO and N₂O measurements
- Improved temporal resolution and precision

Caveats of comparison to GCMD:

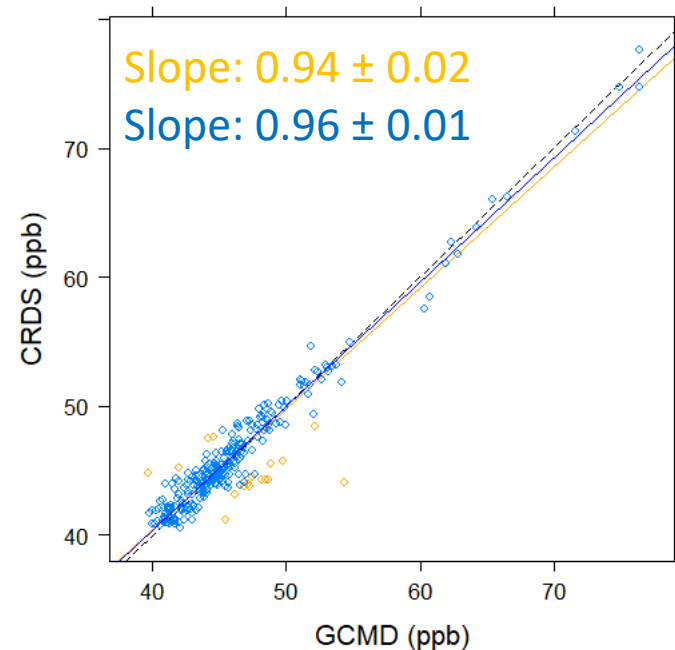
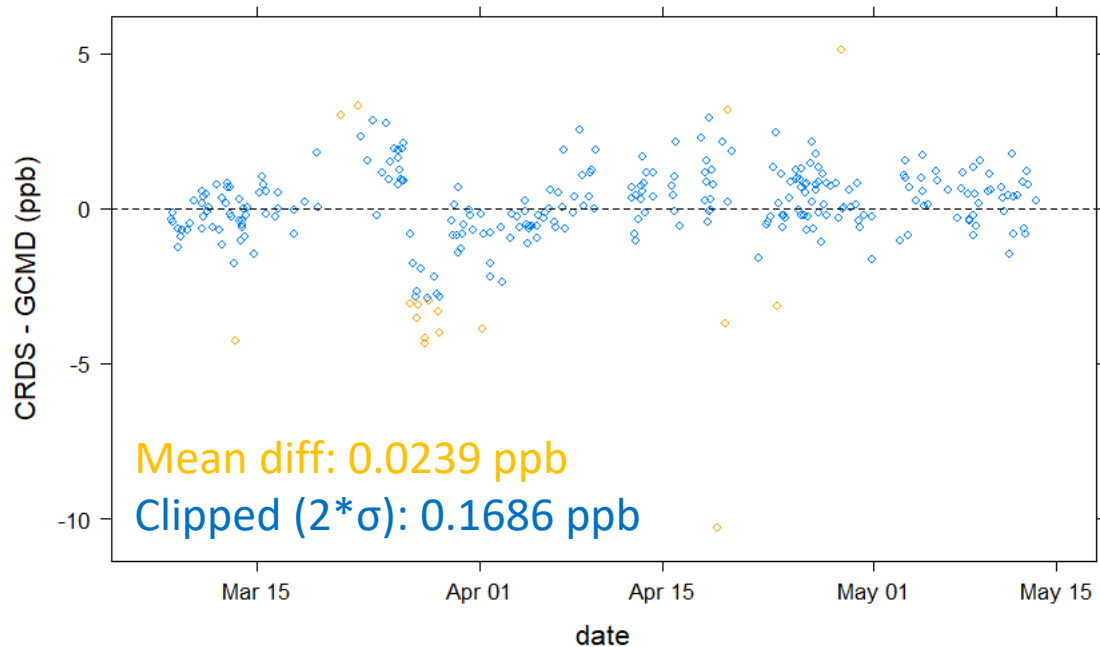
- GCMD currently measuring from 10 m mast
- GCMD non-linearity correction for CO is preliminary
- One point calibration applied to CRDS data
- Factory water vapour correction for CRDS data
- N₂O measurements are on different scales – GCMD is on SIO-16 while CRDS is on NOAA-2006A.



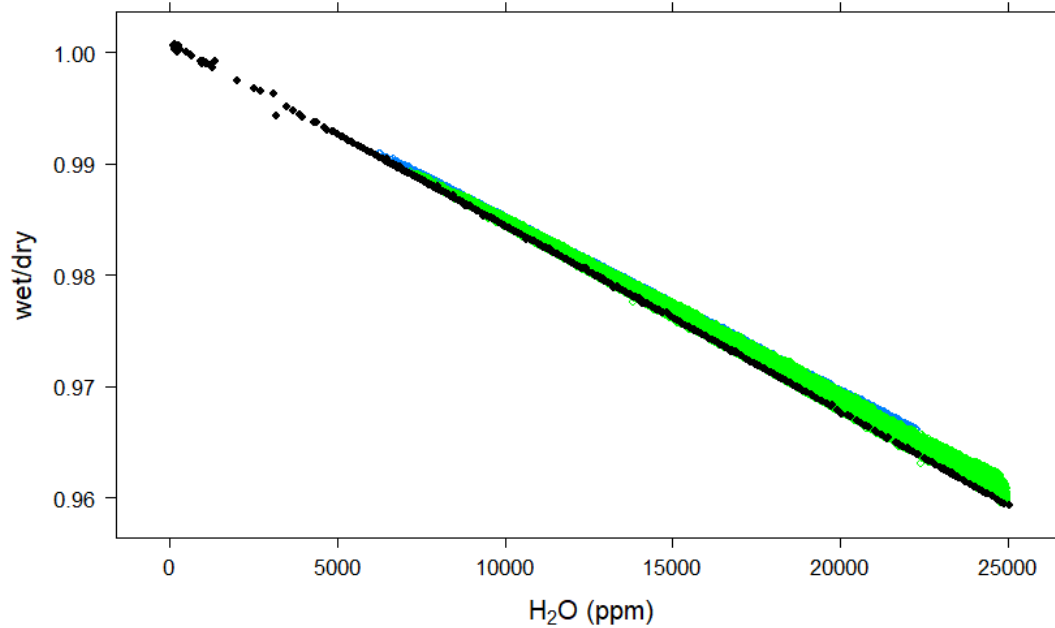
CO performance vs. GCMD (RGA)



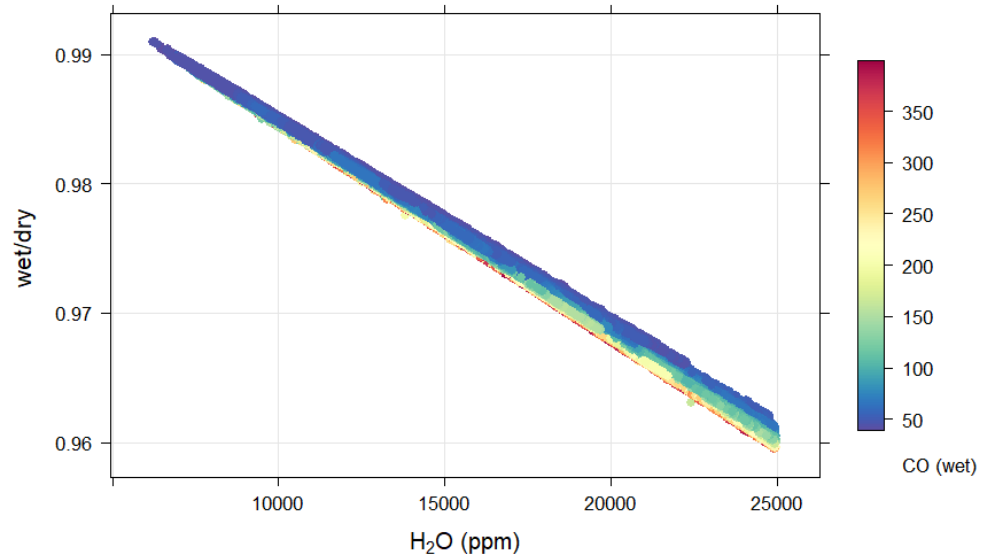
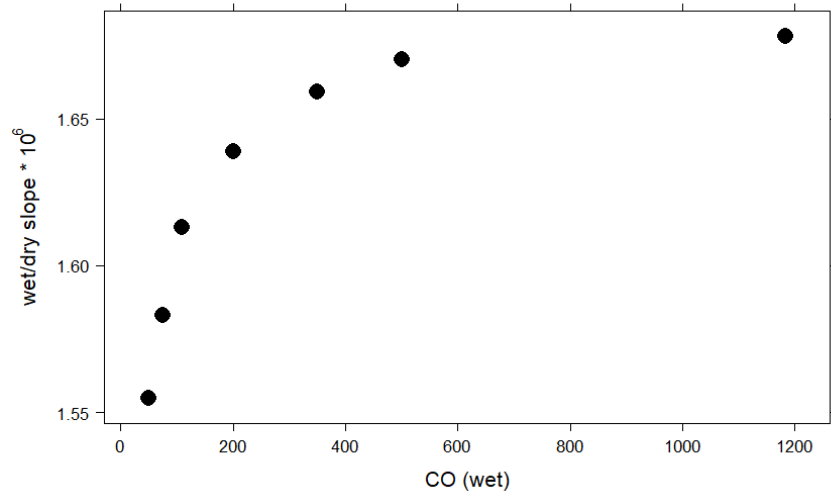
Time-matched 'baseline' comparison with GCMD



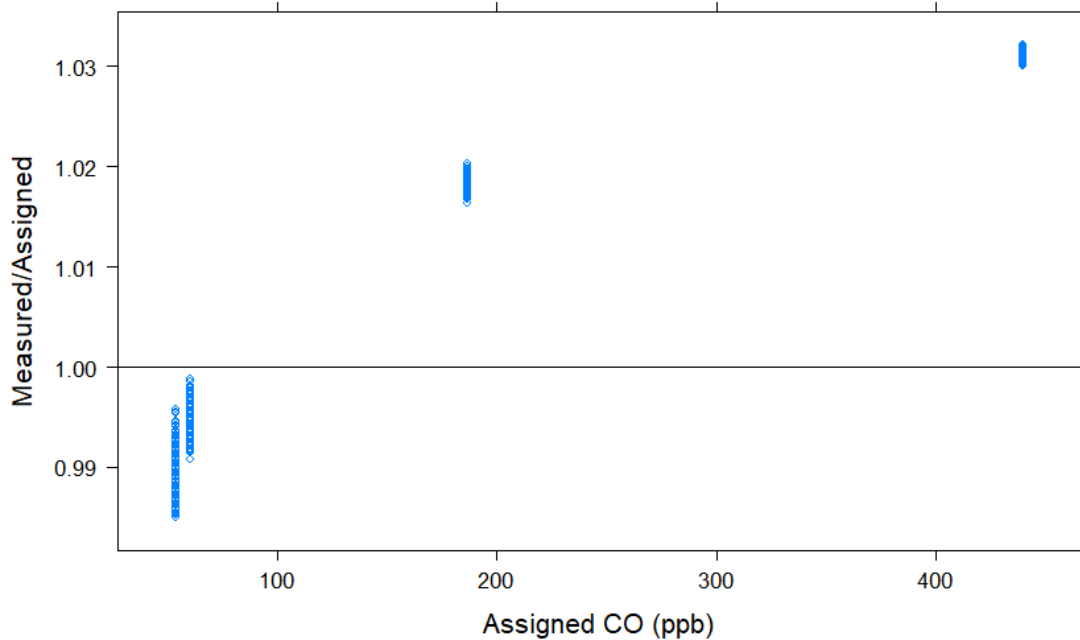
Water vapour correction



Water vapour correction depends on [CO]



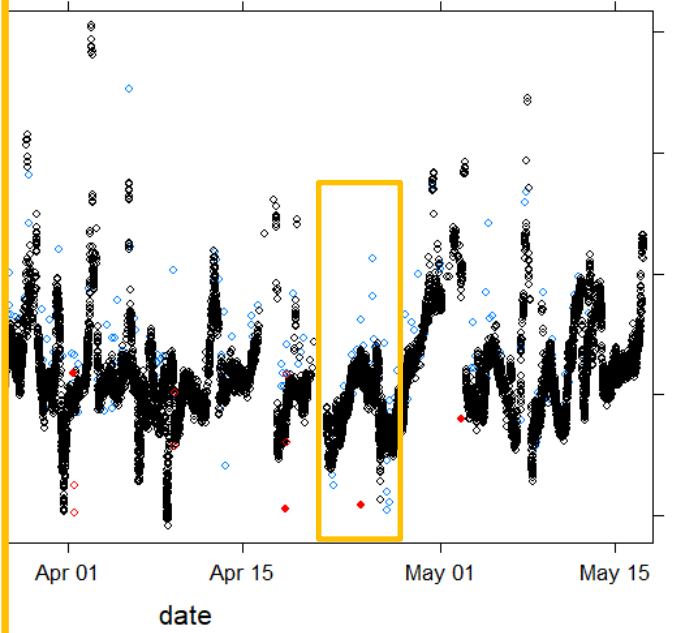
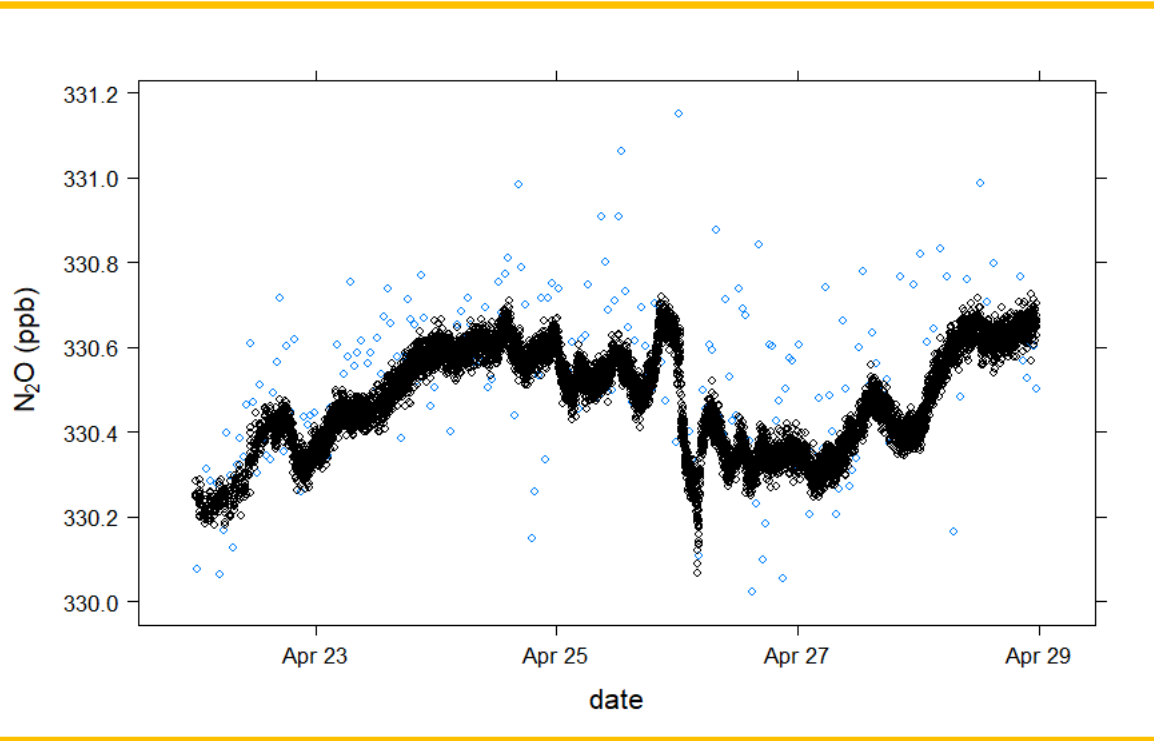
Sensitivity



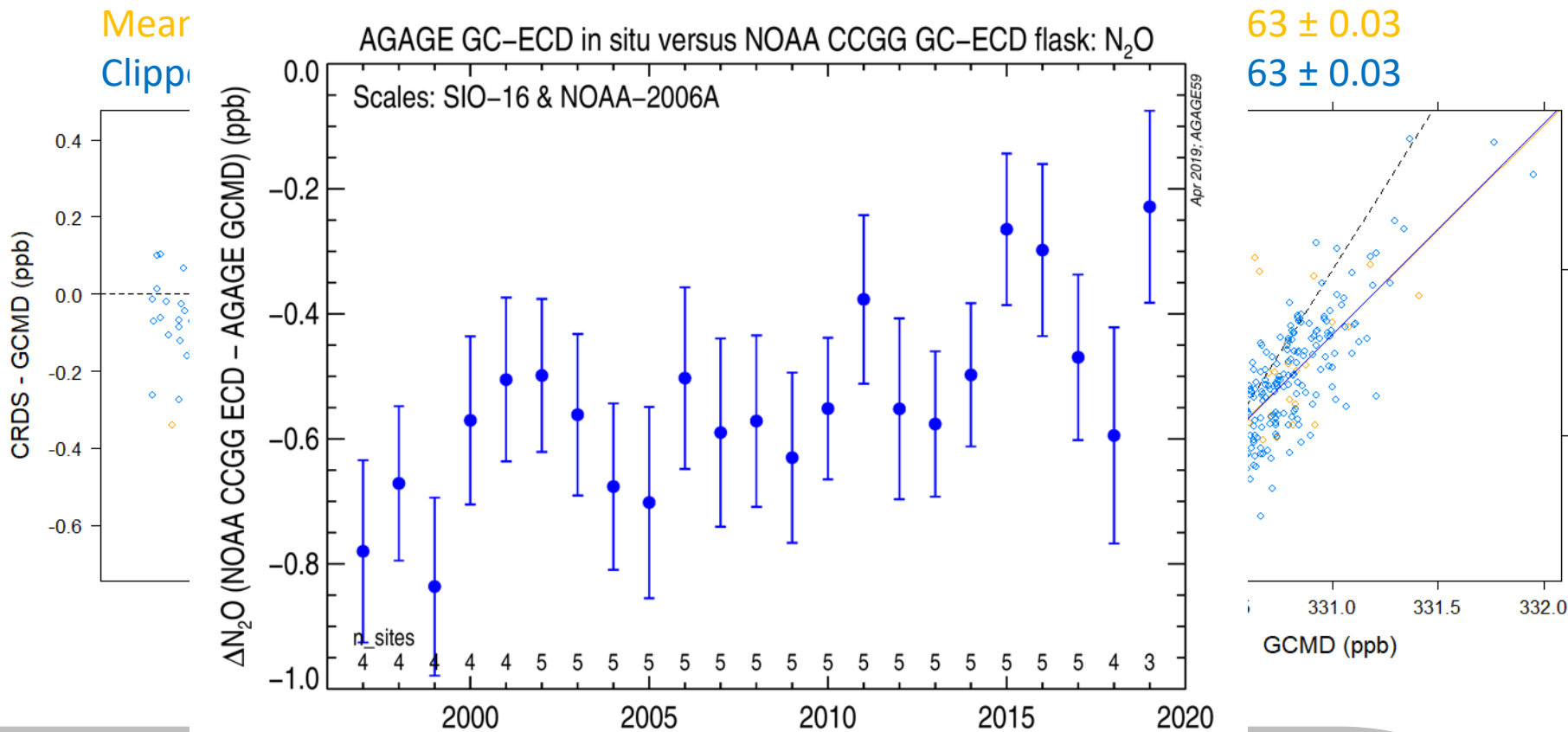
Non-linear response:

Isotopic composition?
Instrument curve fitting?

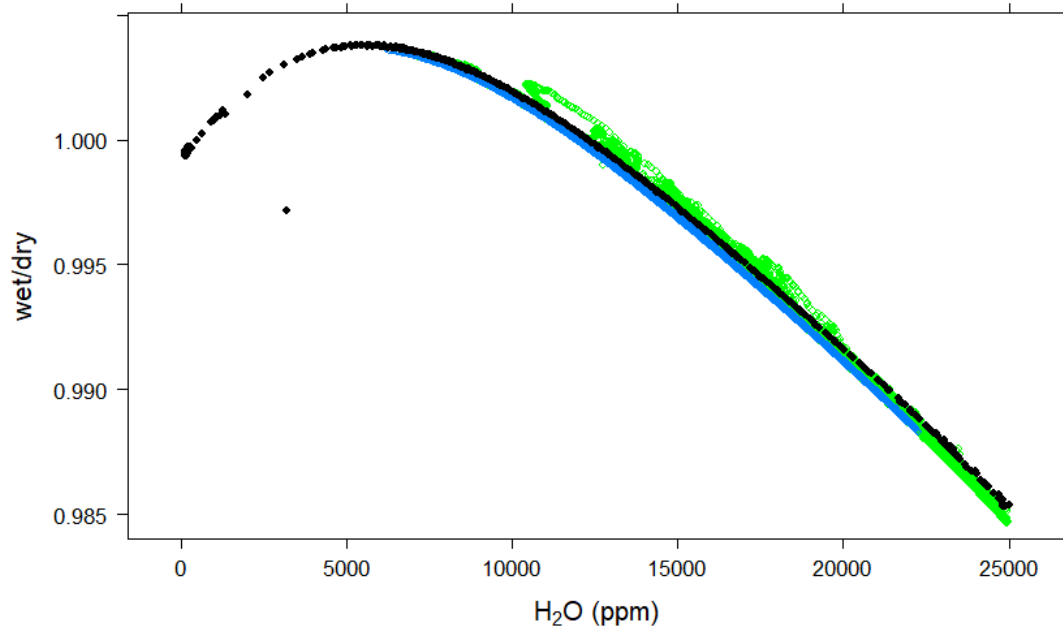
N₂O performance vs GCMD (ECD)



Time-matched 'baseline' comparison with GCMD



Water vapour correction



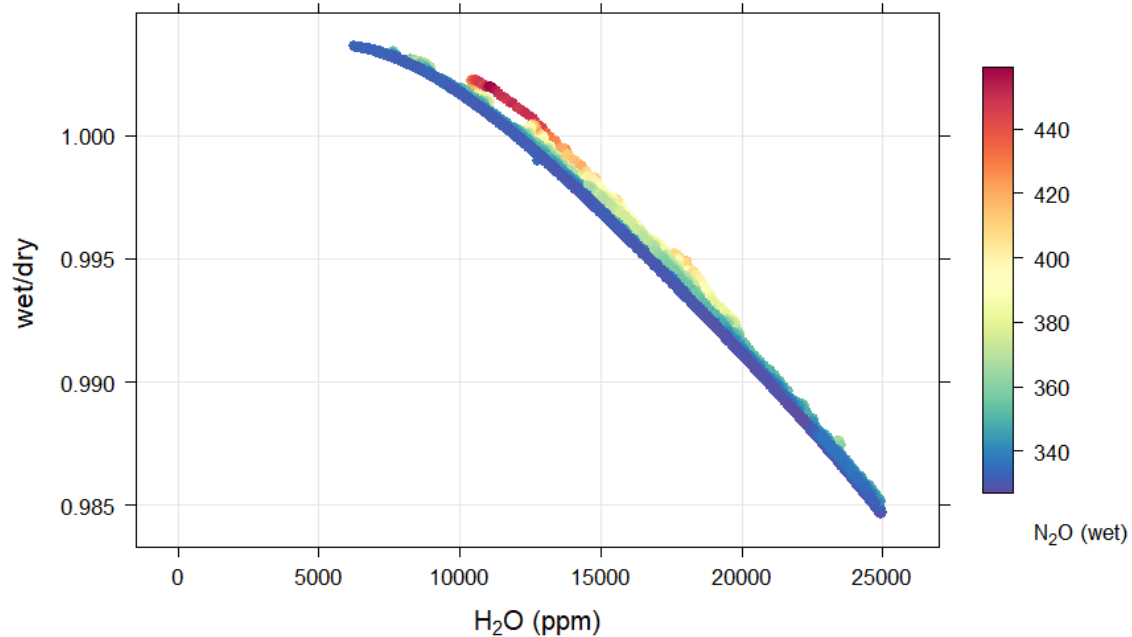
Water vapour correction depends on $[N_2O]$

4th order polynomial fit

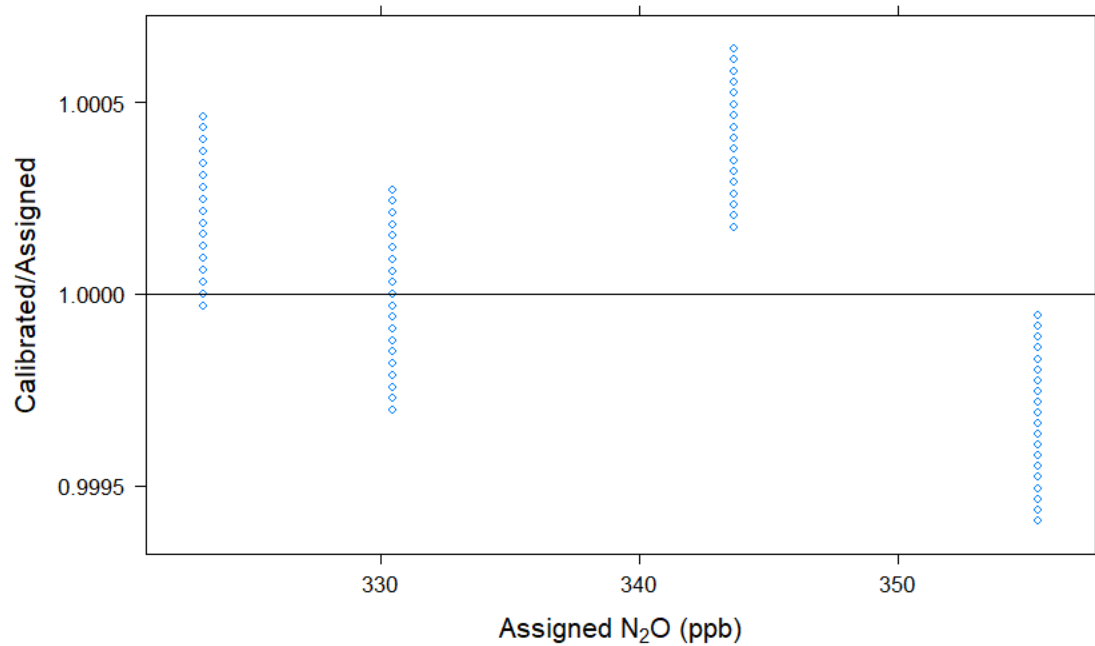
Little $[N_2O]$ variation at Cape Grim

→ Effect should be minimal

→ Fit using low span or working standard



Sensitivity



Potential issues

- Drifting CO standards
- Unknown isotopic composition of standards
- Water correction for both species is [] dependent
- Cross-sensitivity? (not assessed yet)

Does anyone here make routine measurements of ^{13}CO ?

Do you have a friend who makes measurements of ^{13}CO ?

Do you have a G5310?

COME FIND ME AT THE BREAK 😊

Thank you

CSIRO CLIMATE SCIENCE CENTRE
www.csiro.au

