In situ and ground-based remote sensing measurements of atmospheric CO$_2$ in New Zealand

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NIWA

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NIWA operates two GAW stations in New Zealand.
Different methods (NDIR, Solar FTS, Closed path FTS)
Operating on same scale
Comparisons
BARING HEAD
Site exposed to generally high wind speeds (7 to 40 ms\(^{-1}\)) from two direction (S or N)

Traditionally observing Steady Intervals (SI) with less than 0.2 ppm variability in 4 hours

4 day back trajectories during SI indicate air originating from a large area of Southern Ocean, mostly to the west.
Baring Head SI timeseries

Small seasonal cycle due to Oceanic dominance

Trend similar to that observed elsewhere

Tied to SIO and now NOAA CCL scales
1970–2009 Baring Head CO2 SI PICK

Baring Head steady intervals

SIO flasks comparison since 1978, evacuated flasks collected during SI.

NOAA Flasks comparison since 1999, auto-sampler collects during SI.
Annual mean differences between Baring Head SI and comparison flasks
• Working gas correction applied to early record for ref gases in N2 not air
• Note
R13. SUMMARY OF RECENT INTERNATIONAL PLANNING OF ATMOSPHERIC TRACE GAS MEASUREMENT STRATEGIES.

d) Develop and implement long-term measurements of total column Greenhouse Gases at a number of sites in WMO-GAW and its partner stratospheric network NDACC recognising the need for satellite calibration/validation and modelling.
Lauder

History of spectroscopic column measurement

Significant Cloud free periods

Total Carbon Column Observing Network (TCCON)

Ground based Solar absorption FT (Bruker 120)

In situ closed path FTS (Dave Griffith, Wollongong)
O₂ 1.27 micron band used for dry air mole fraction

HIPPO overflights used to calibrate to mole fraction CO₂ scale

Local Network of TCCON includes Wollongong and Darwin

To be used as primary validation data for GOSAT CO₂ retrievals

FTS airmass corrected column average dry air VMR, preliminary calibration $C=1.012$
Comparison of Solar FTS and Baring Head SI

Similar secular trends
Seasonal cycles are comparable
Some phase difference
Both methods appear to representing larger spatial scales
Not necessarily seeing the same footprint

FTS airmass corrected column average dry air VMR, preliminary calibration C=1.012
Closed cell Fourier Transform Spectrometer
(David Griffith, Wollongong, Aust)

Uses Reference gas on WMO mole fraction scale

Intake at 10m

To avoid local influences data plotted as monthly mean (and stdev) of hourly means (15:00-16:00) at winds over 5 ms$^{-1}$

IFTS has regional influences not visible in BHD data
Higher variability in summer/spring
Lower By ~1ppm in winter
Flask data measured by GC validate each in situ timeseries
Regional Carbon Modelling

Establish CarbonTracker Australasia

- Local grid 1x1 degree
- Global grid 3 x 2 degrees

Input to come from

- In situ measurement sites
- TCCON sites
- Ship and event sampling (CO$_2$ and pCO$_2$)
Summary

• Good agreement at this stage between solar FTS and SI Baring Head CO₂

• Indirect calibration with aircraft (maybe use Aircore in future?)

• In Situ FTIR easier to calibrate with known ref scales

• Multi species

• Low on user time and consumables

• Flasks integrated over measurement period seem initially to be useful for comparison.