NIWA MIR-FTS program: Lauder & Arrival Heights site reports

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Lauder, New Zealand: 45S, 169E, 370m

Arrival Heights, Ross Island, Antarctica: 78S, 167E, 220m

Summary

- There is long-term, stable funding of both Lauder and Arrival Heights (AHTS) MIR-FTS measurements with continuing logistical support from Antarctica New Zealand (AntNZ).
- NDACC archiving of 10 species current to the end of 2018. All retrievals using SFIT4 and NDACC compliant retrieval strategies. Profiles submitted, but total column only for pre-2001 Lauder (NIWA002, Bruker 120M) and Arrival Heights Ozone datasets. NIWA006 data (May2018-present) are not currently submitted.
- The Lauder 120HR (NIWA001) was decommissioned in May 2019 after a 6-month MIR-measurement overlap (and intercomparison activity) with a Bruker 125HR (NIWA006). NIWA006 took over routine MIR obs in May 2018. Comparison of total column species abundances show good agreement for the majority of species. See a separate poster for details and results of this comparison.
- The Lauder MIR 125HR (NIWA006) and AHTS 125HR (NIWA004) have been operational over the past year with no prolonged downtime. Solar tracker robust and reliable. Both Brukers exhibit stable ILS. Both instruments are well aligned.

Main goals for the coming year:

1. Submit Lauder NIWA006 125HR data to the NDACC archive.
2. Continue to participate in NDACC IRWG activities.
3. Continue collaboration with other MIR-FTIR groups. (Erebus plume spectra, COF_2)
4. Mature programme now after serious rebuild (personnel, equipment and analysis). Time to look at research questions.

NDACC data archive data submission

SFIT4 & NDACC-compliant retrievals for all 10 species for both sites. HDF format.
(IRWG Uniform Retrieval Parameter Summary, Hannigan, 2012)…with tweaks…

NDACC Meta data files: both sites current up to 20180725

Lauder submissions, all 10 species:

NIWA002 Bruker 120M : 1990 – Oct 2001: Total column only.
NIWA001 Bruker 120HR: Oct 2001 – May 2018: Profiles
NIWA006 Bruker 125HR: Nov 2017 onwards: To be submitted after IRWG acceptance.

AHTS submissions, all 10 species:

NIWA005 Bomem DA2 (1992-1995): HNO_3 and HCl (total column).
NIWA003 Bruker 120M (1996- Feb 2016): profile, (except O_3, total column at the moment.)
NIWA004 Bruker 125HR (Dec 2014 – Dec 2018): profile. (except O_3: total column at the moment.)

Error analysis:

Uncertainty analysis available in NDACC database:

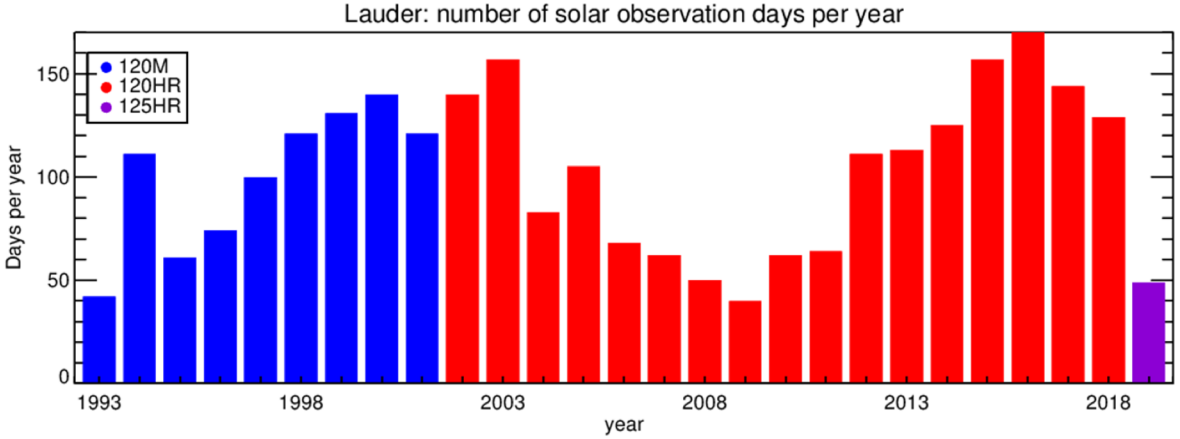
Full timeseries: HF, HCl, HCN, N_2O, $ClONO_2$, C_2H_6
Partial timeseries: CO, O_3, CH_4 (2016 onwards), HNO_3 (2018 onwards)

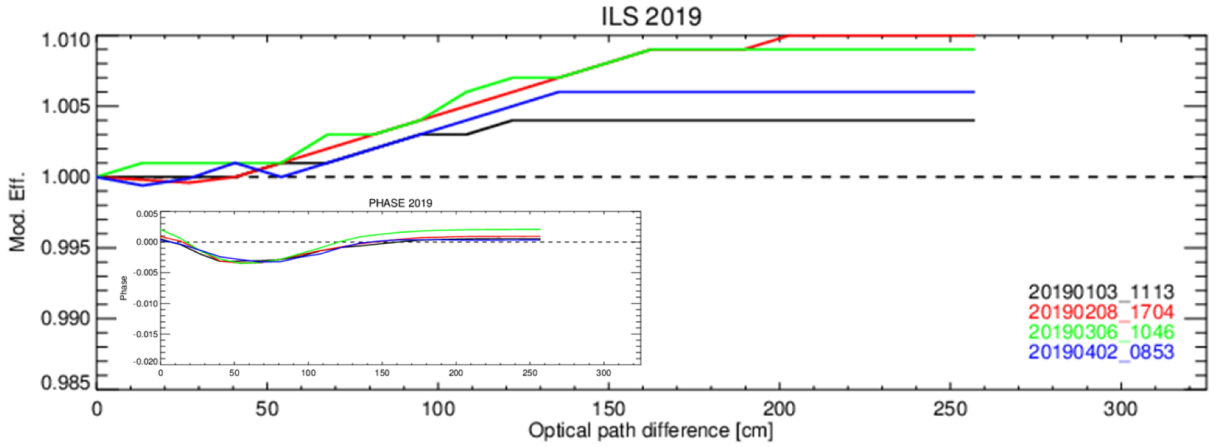
Other species available on request: H_2CO (Lauder only), NO_2, and OCS

CAMS27: monthly submissions of CO, CH_4 and O_3 for both sites.

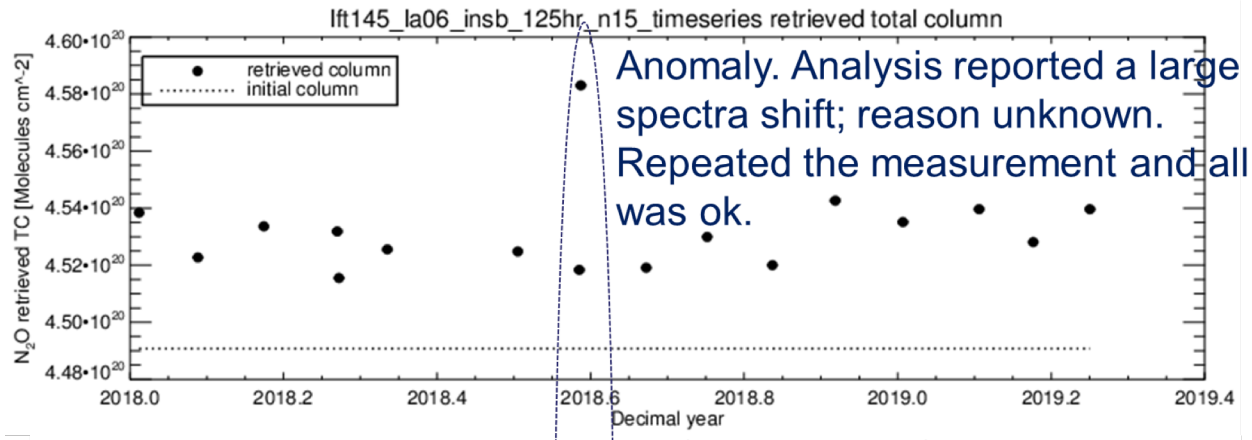
Instrument performance over the past year:

- ILS is monitored monthly on NIWA006 (Bruker 125HR) using N_2O cell #15 and analysis with Linefit-14.5. Over the past year the ILS has been stable. Results also indicate good alignment
- Installation of firmware v2.485 in the Lauder 125HR was found to have bugs, we resorted back to v2.4.
- Doubling of observations due to new scheduling software.

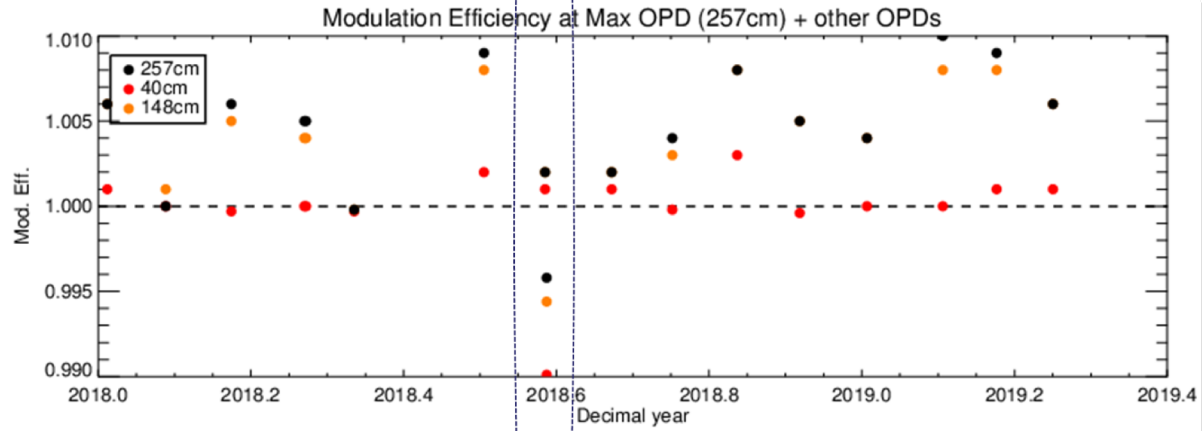


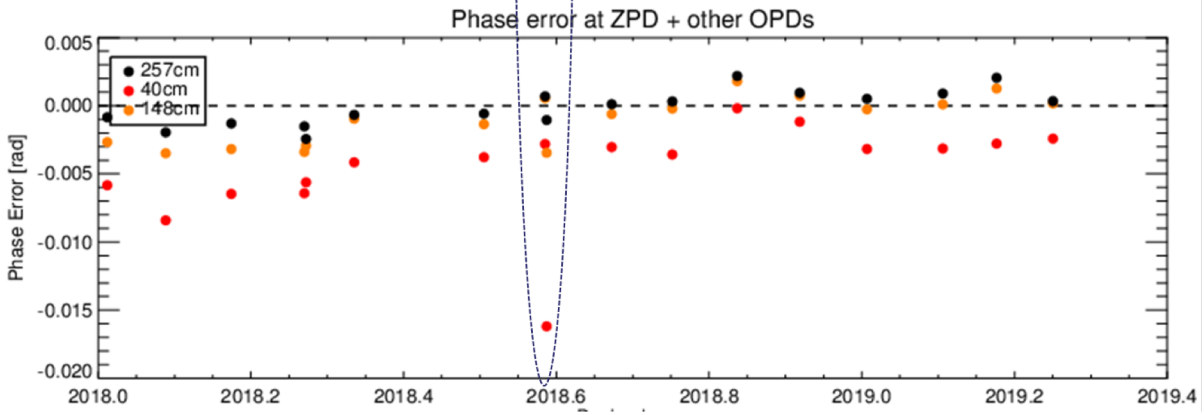


Lauder 125HR ILS N_2O cell



Anomaly. Analysis reported a large spectra shift; reason unknown. Repeated the measurement and all was ok.

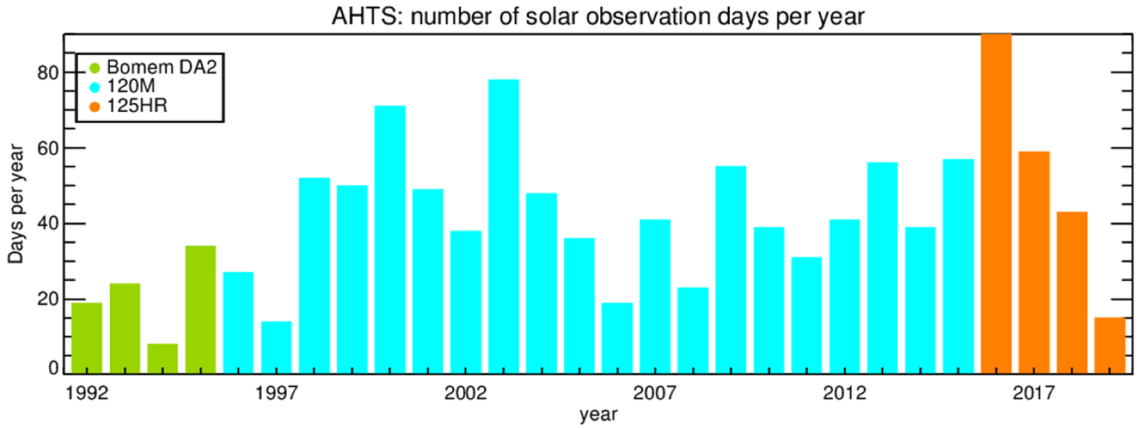


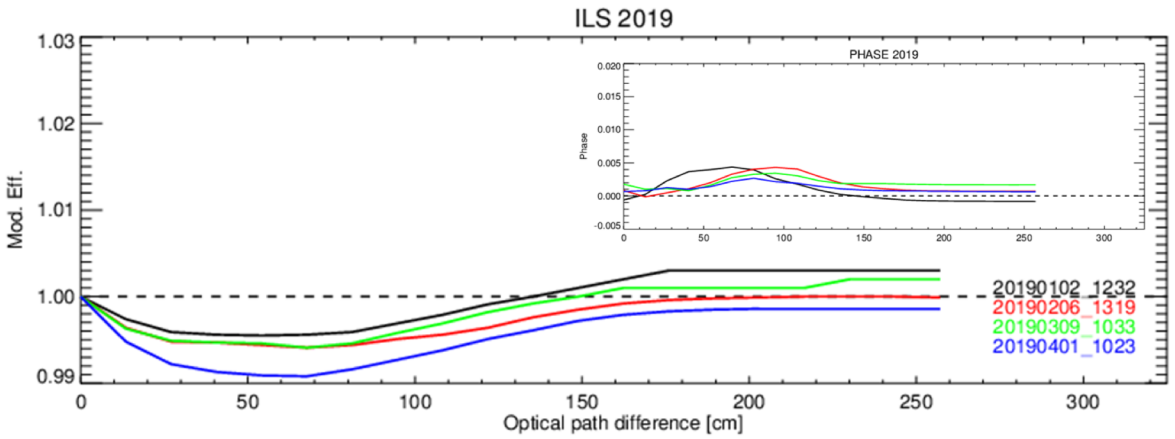


Instrument performance over the past year:

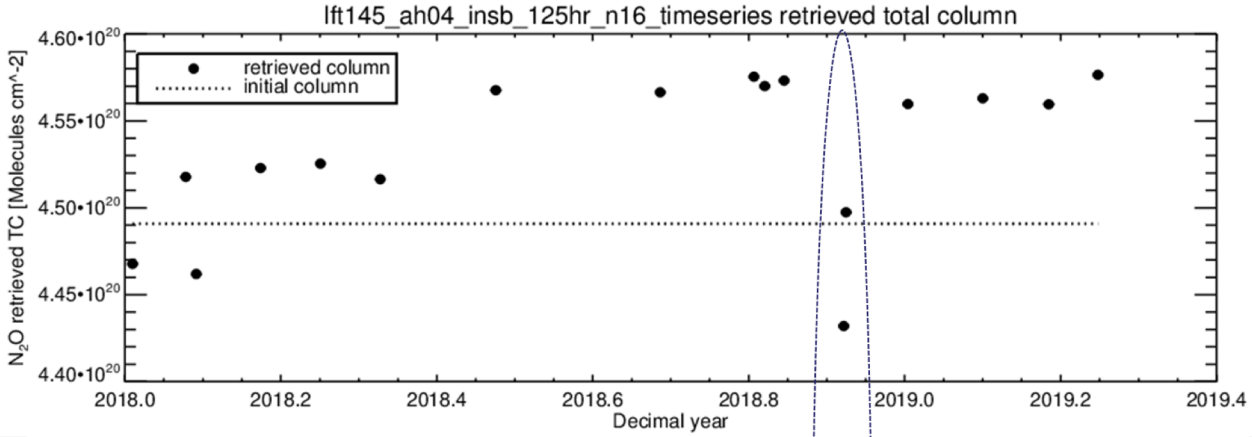
- The AHTS Bruker 125HR was installed in December 2014. N_2O Cell #16 is measured routinely (monthly). Analysis uses Linefit-14.5. ILS has been stable and is well aligned.

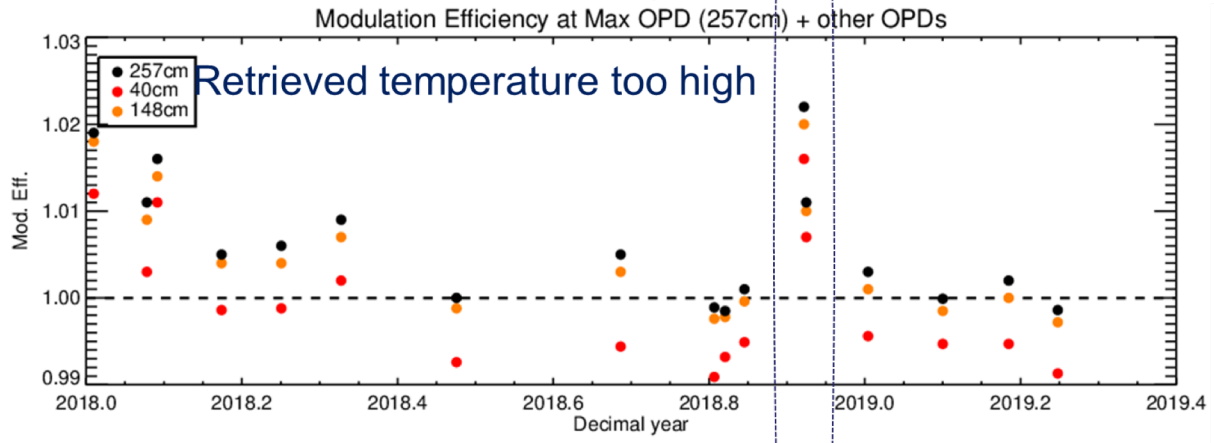
- Main power noise spikes affecting AHTS A3 spectra was diagnosed and significantly reduced.

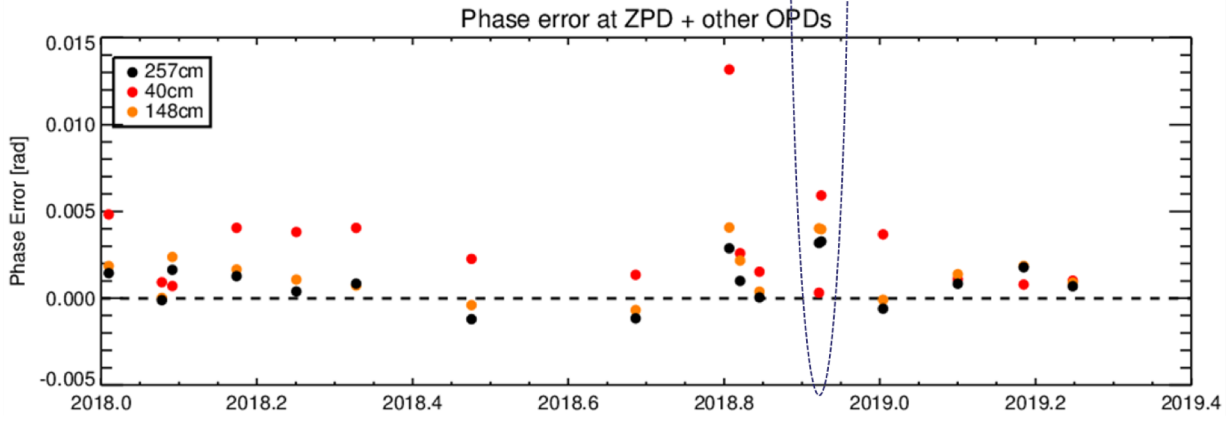




AHTS 125HR ILS N_2O cell

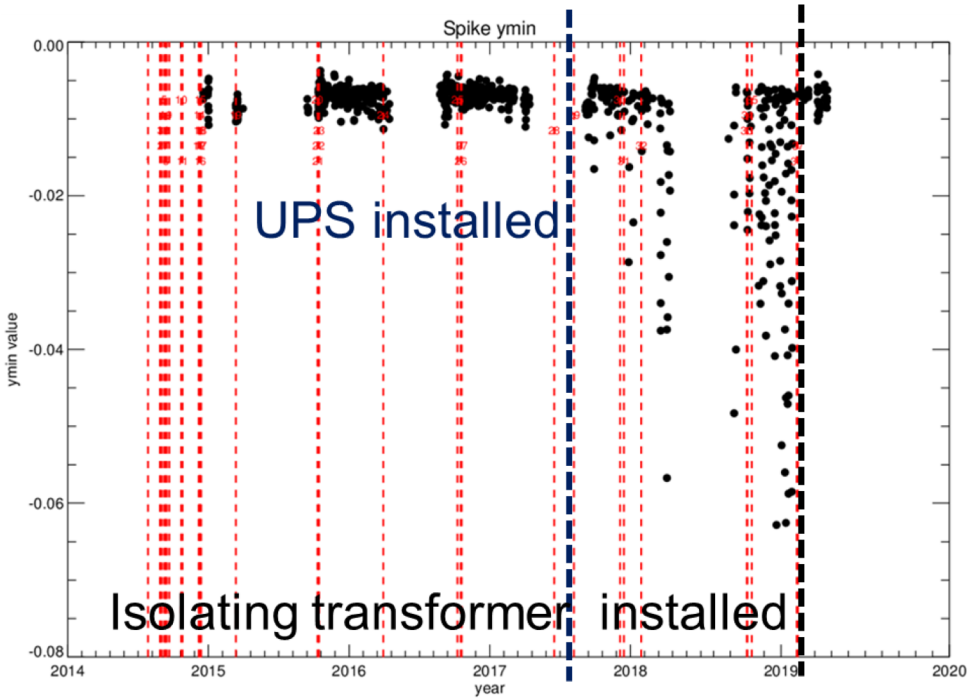


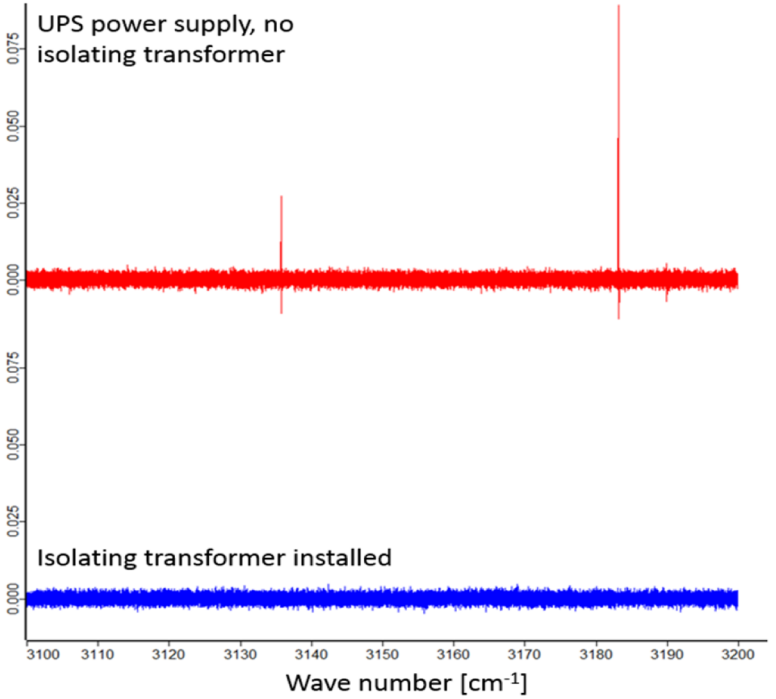




Noise spikes in the AHTS 125hr A3 spectra

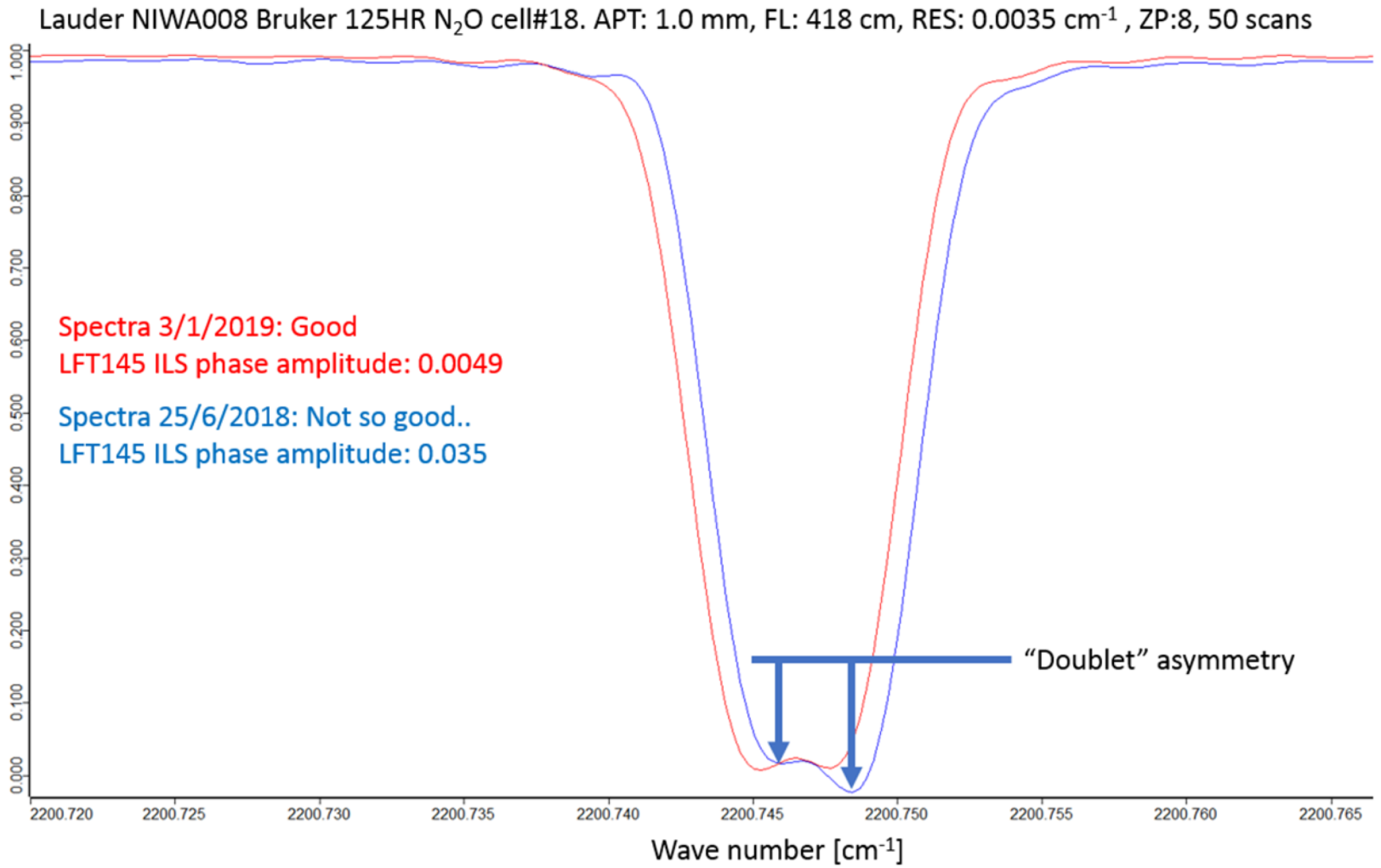
- Since 2018 there had been a steady increase the number of NDACC#3 (A3) filter spectra (~2400-3200cm^{-1}) with large YMIN (zero level) values.
- The onset of large YMIN values was correlated with the installation of a new uninterrupted power supply (UPS) unit at AHTS in August 2017.
- The UPS produced (easily visible) noise spikes in the 3100-3200cm^{-1} region, at frequencies closely aligned with high order harmonics of the mains power (60Hz).
- Installation of an isolating transformer (Feb 2019) between the UPS and the Bruker 125HR eliminated/significantly reduced the interference.





A heuristic indicator of ILS phase?

- For alignment purposes, the retrieved ILS phase amplitude from Linefit analysis of N_2O cell spectra is correlated with the 'doublet' asymmetry of the N_2O absorption line at 2200.74cm^{-1}.
- Generally…greater the asymmetry, greater the ILS phase error amplitude. This single unconvolved saturated line nearly resembles a boxcar and thereby generates nice ringing. (Thanks Frank!)



Technical transfer

Zhou, M., et al.: An intercomparison of total column-averaged nitrous oxide between ground-based FTIR TCCON and NDACC measurements at seven sites and comparisons with the GEOS-Chem model, Atmos. Meas. Tech., 12, 1393-1408.

Boynard, A., et al : Validation of the IASI FORLI/EUMETSAT ozone products using satellite (GOME-2), ground-based (Brewer–Dobson, SAOZ, FTIR) and ozone sonde measurements, Atmos. Meas. Tech., 11, 5125-5152.

Vigouroux, C., et al: NDACC harmonized formaldehyde time series from 21 FTIR stations covering a wide range of column abundances, Atmos. Meas. Tech., 11, 5049-5073.

Contribution to: WMO (World Meteorological Organization), Scientific Assessment of Ozone Depletion: 2018, Global Ozone Research and Monitoring Project–Report No. 58, 588 pp., Geneva, Switzerland, 2018.

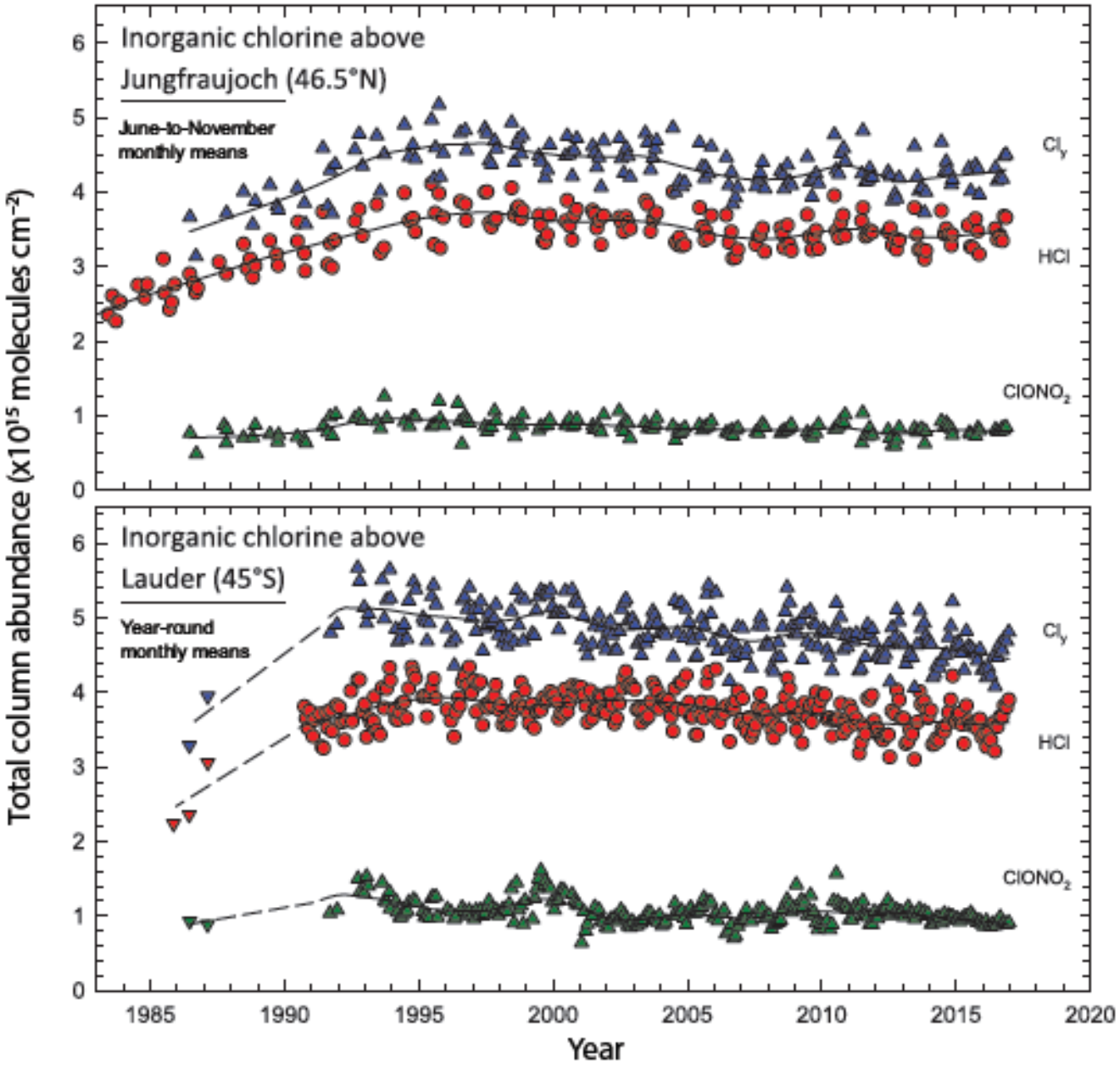


Figure 1-13 from 2018 Ozone assessment

Lastly: Roll the credits…

A big thanks to the following people who have provided invaluable assistance to us at Lauder:

- Corinne Vigouroux, Nicholas Jones, Bavo Langerock, Jim Hannigan, Manu Mahieu and Frank Hase.
- Susan Strahan (NASA)
- Roger Lin (NDACC archiving)
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- Gregor Surawicz (Bruker)

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NIWA Posters:

- An intercomparison of solar MIR-FTS measurements of atmospheric gases between a Bruker 120HR and a Bruker 125HR at Lauder, New Zealand (45S)

- NIWA360 solar tracker – 10 years on!

- Another autonomous cover design for solar trackers

Thank you.