

Karlsruhe FTIR group

T. Blumenstock, F. Hase, D. Dubravica, M. Frey, J. Gross, M. Kiel, Q. Tu

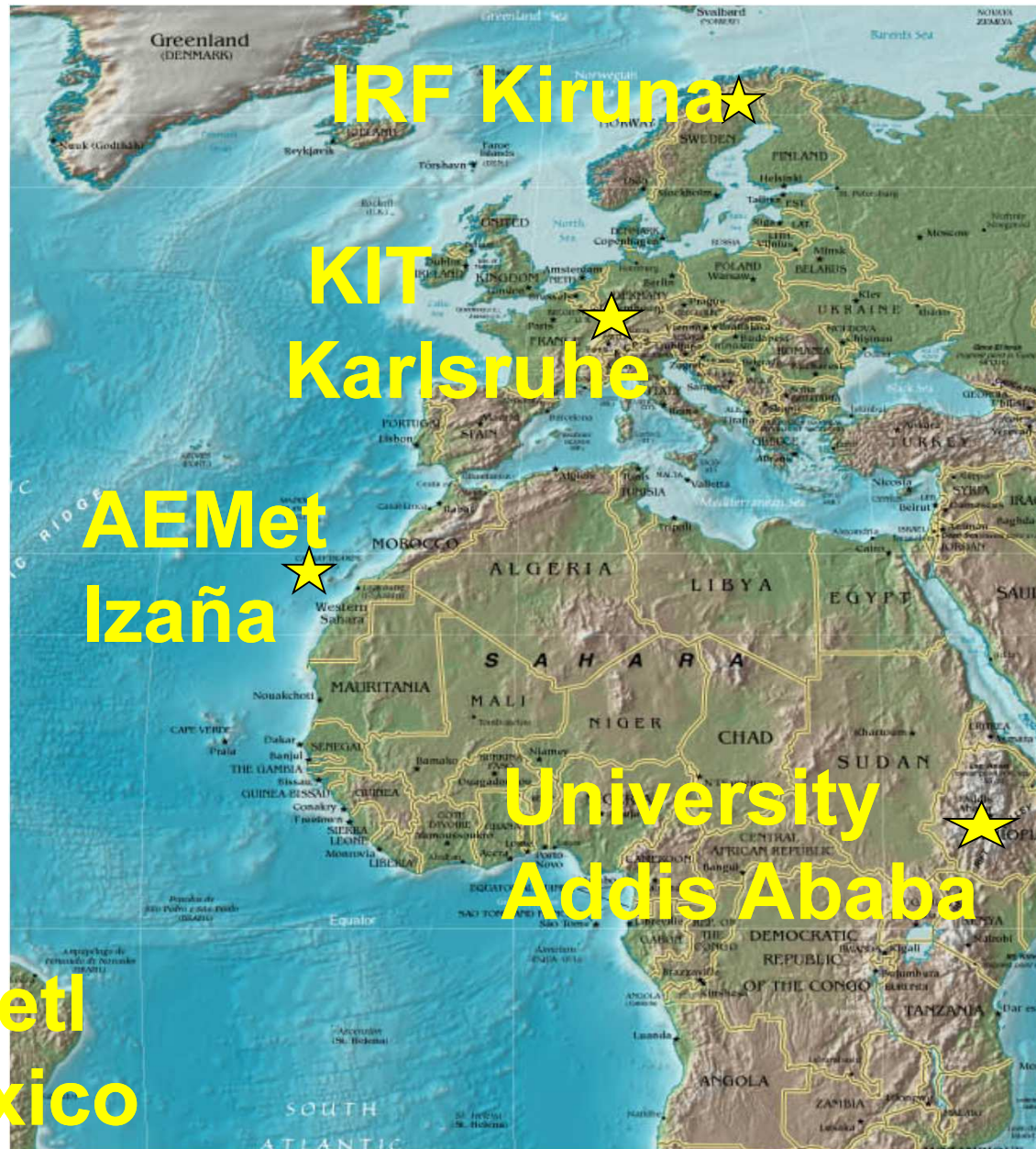


Plus ERC group MUSICA:
Matthias Schneider,
Sabine Barthlott,
Andreas Wiegele

- Susanne Dohe left
+ Qiansi Tu joined
the group

Mahesh Kumar Sha, Thomas Blumenstock, Frank Hase, Matthias Frey,
Jochen Gross, Gizaw Mengistu Tsidu in Berlin 2014 (from left to right)

Addis, Izana, Karlsruhe & Kiruna Site Reports



in cooperation with
or operated by

- Uwe Raffalski,
IRF Kiruna, (S)
- Omaira Garcia,
Emilio Cuevas,
AEMet Tenerife
I., Spain
- Gizaw Mengistu,
Addis Ababa
Univ., Ethiopia
- Michel Grutter,
Wolfg. Stremme,
UNAM, Mexico

Site report by
Michel Grutter



Altzomoni,
Popocatepetl
UNAM, Mexico

Karlsruhe site report

Frank Hase, Matthäus Kiel, Jochen Gross, Thomas Blumenstock



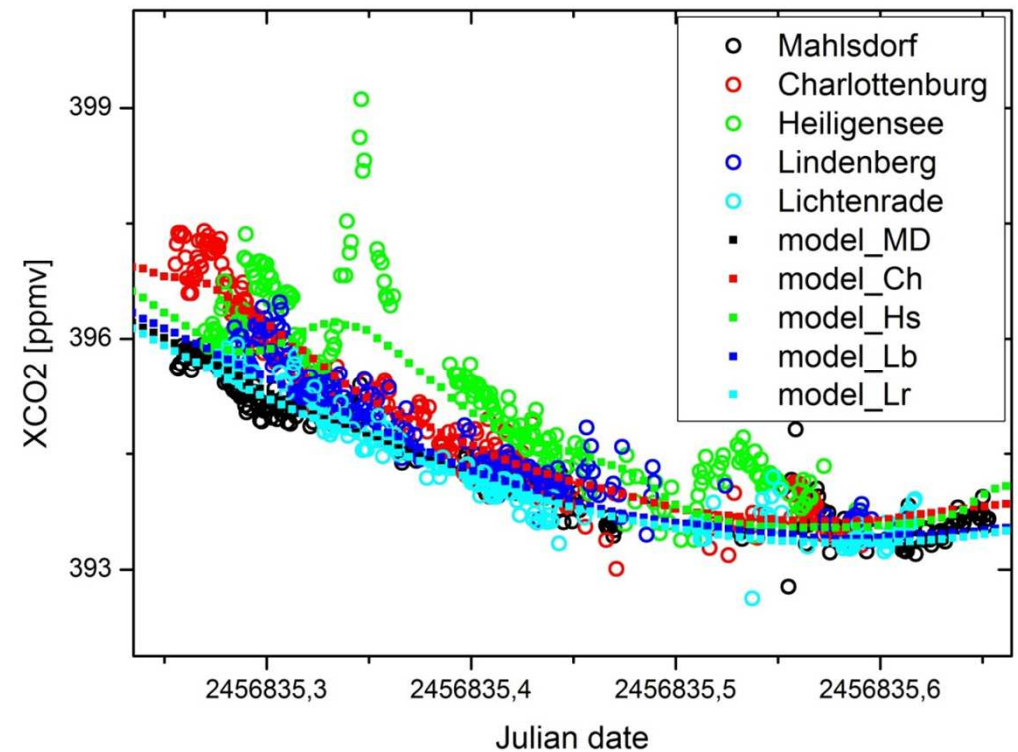
Matthäus' talk on Wednesday

- KIT Campus Nord,
- 49.1N, 8.4E, 111m a.s.l
- Bruker 125 HR
- BS: CaF_2 only
- Det.: InGaAs + InSb simultaneously
- Camtracker
- Remotely controlled
- Operational since Sept. 2009
- Laser broken in 4/2010, 2/2011, 2/2014
- 2014: 109 days of observation
- NIR & MIR comp. by M. Kiel
- TCCON affiliated since 2009
- Application for NDACC aff. coming up soon

Measurements of CO_2 with a table-top FTIR: Modified Bruker EM27 in Berlin



M. Gisi, F. Hase et al., AMT 2012
M. Frey et al., AMTD, 2015,
F. Hase et al., AMTD, 2015.



Berlin, June 27, 2014

Gizaw Mengistu Tsidu (group leader), Samuel Takele Kenea, Milkessa Gebeyehu, Gezahegn Sufa, Addis Ababa University, Addis Ababa, Ethiopia
Thomas Blumenstock, Frank Hase, KIT Karlsruhe, Germany



9.0° N, 39.0° E, 2443 m a.s.l.

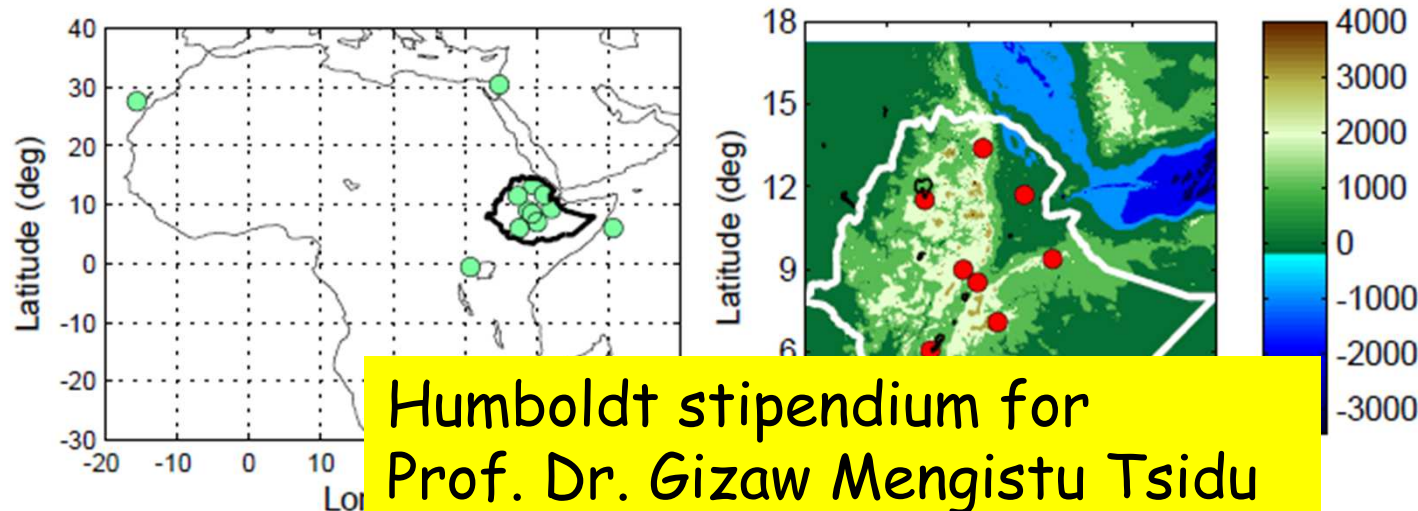
Experimental:

- ✓ Operated by Dr. Gizaw Mengistu Tsidu & his group: Samuel Takele Kenea et al.
- ✓ Set up of Bruker 120/125M in May 2009
- ✓ MCT (PV) + InSb detector
- ✓ Spectral resolution: 0.00775 cm⁻¹
- ✓ Measurements started in May 2009
- ✓ Regular cell measurements since then
- ✓ InSb detector broken in July 2009
- ✓ Scanner failed in Oct. 2009
- ✓ Check up in Nov. 2009
- ✓ Fully operational since Nov. 2009
- ✓ Laser & scanner failure in 2011
- ✓ Service visit by Gregor Surawicz in 2012
- ✓ Liquid nitrogen supply failed in 2014



Days of observation:

- ✓ Operational since Nov. 2009
- ✓ Break in 2011/12
- ✓ 2009: 35 days
- ✓ 2010: 85 days
- ✓ 2011: 27 days
- ✓ 2012: 27 days
- ✓ 2013: 40 days
- ✓ 2014: 22 days
- ✓ 2015: 53 days
- ✓ Total: 289 days

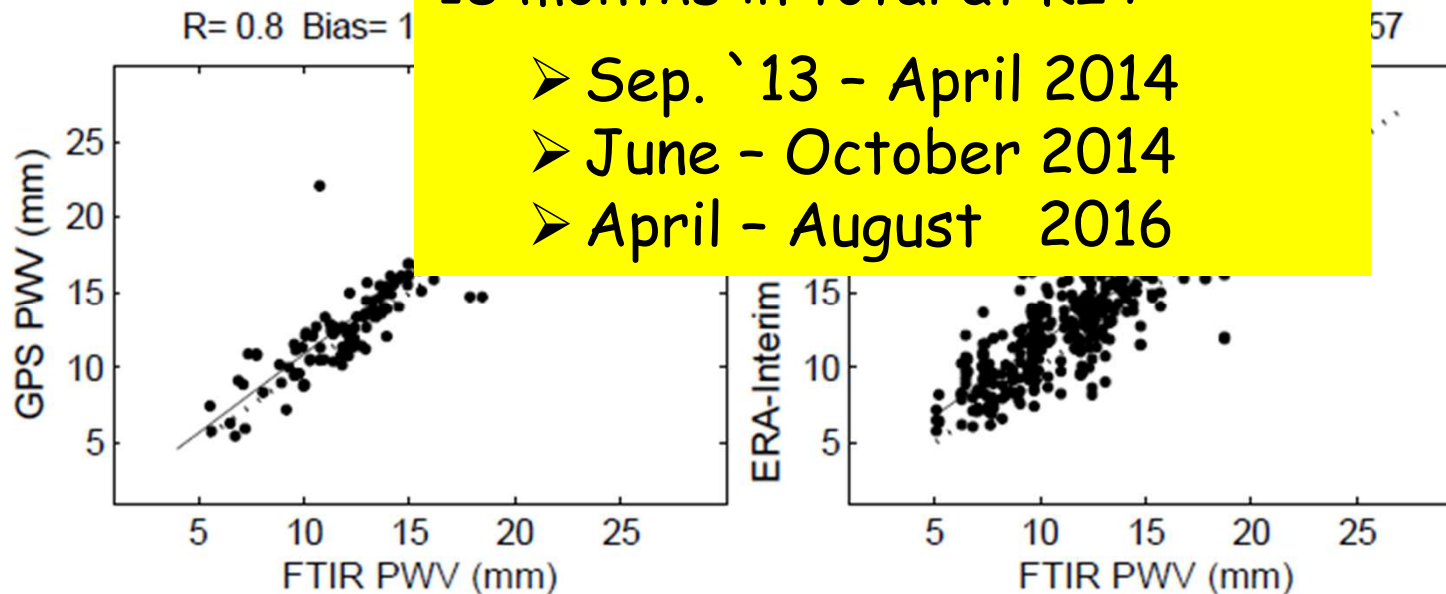


GPS ground receiver sites in Ethiopia

Humboldt stipendium for Prof. Dr. Gizaw Mengistu Tsidu 18 months in total at KIT

- Sep. '13 - April 2014
- June - October 2014
- April - August 2016

G. Mengistu Tsidu et al., Observations of precipitable water vapour over complex topography of Ethiopia from ground-based GPS, FTIR, radiosonde and ERA-interim re-analysis, AMTD, 7, 9869-9915, 2014.



Kiruna site report

IMK-ASF team, Karlsruhe, GER;
Uwe Raffalski, IRF Kiruna, S;
Yutaka Matsumi, Nagoya Univ., J



Data analysis:

PROFFIT

Data analysis &
archiving in progress

Data base:

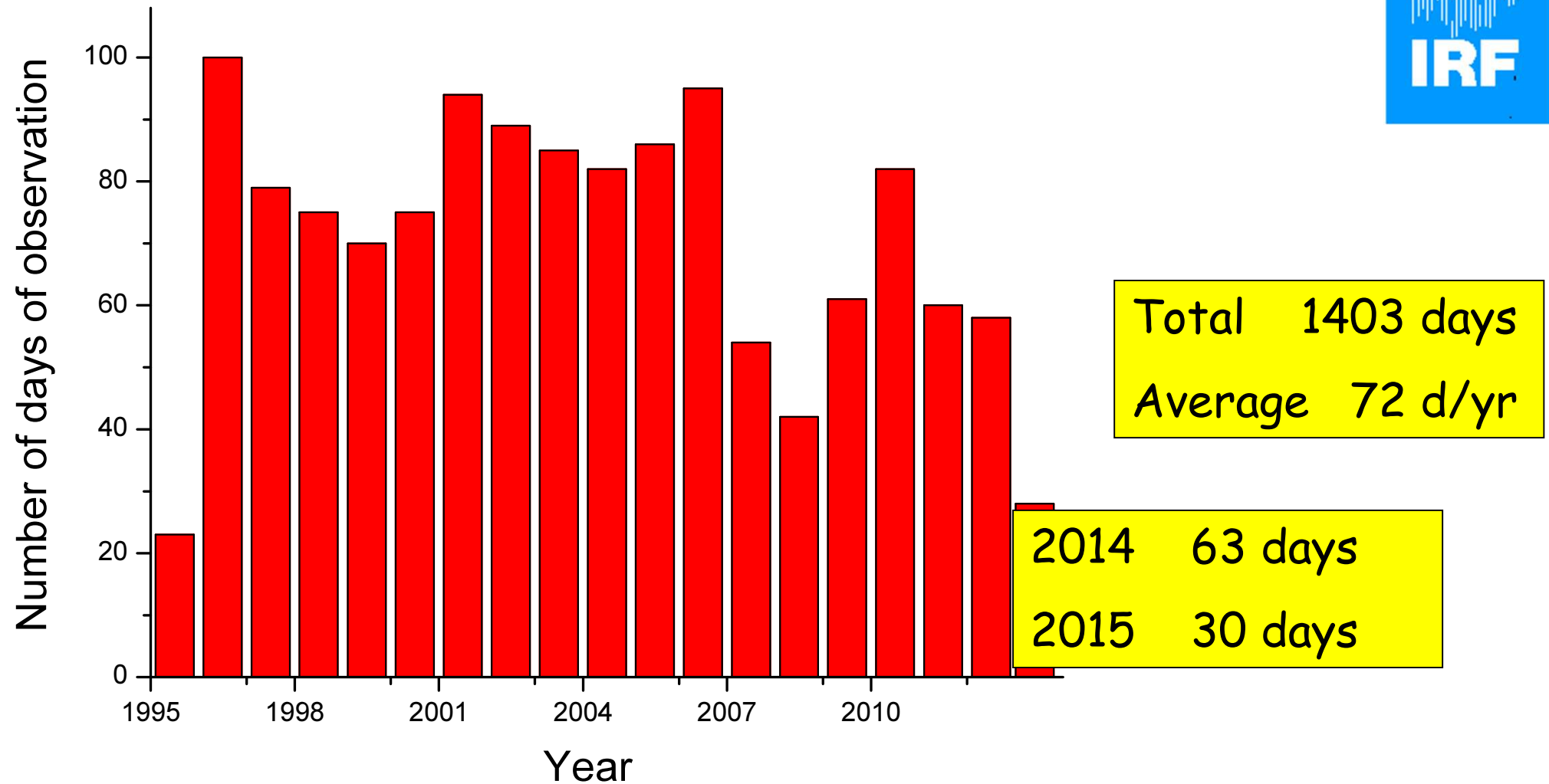
NASA data: 1996 - end of 2007

HDF data: 1996 - end of 2012

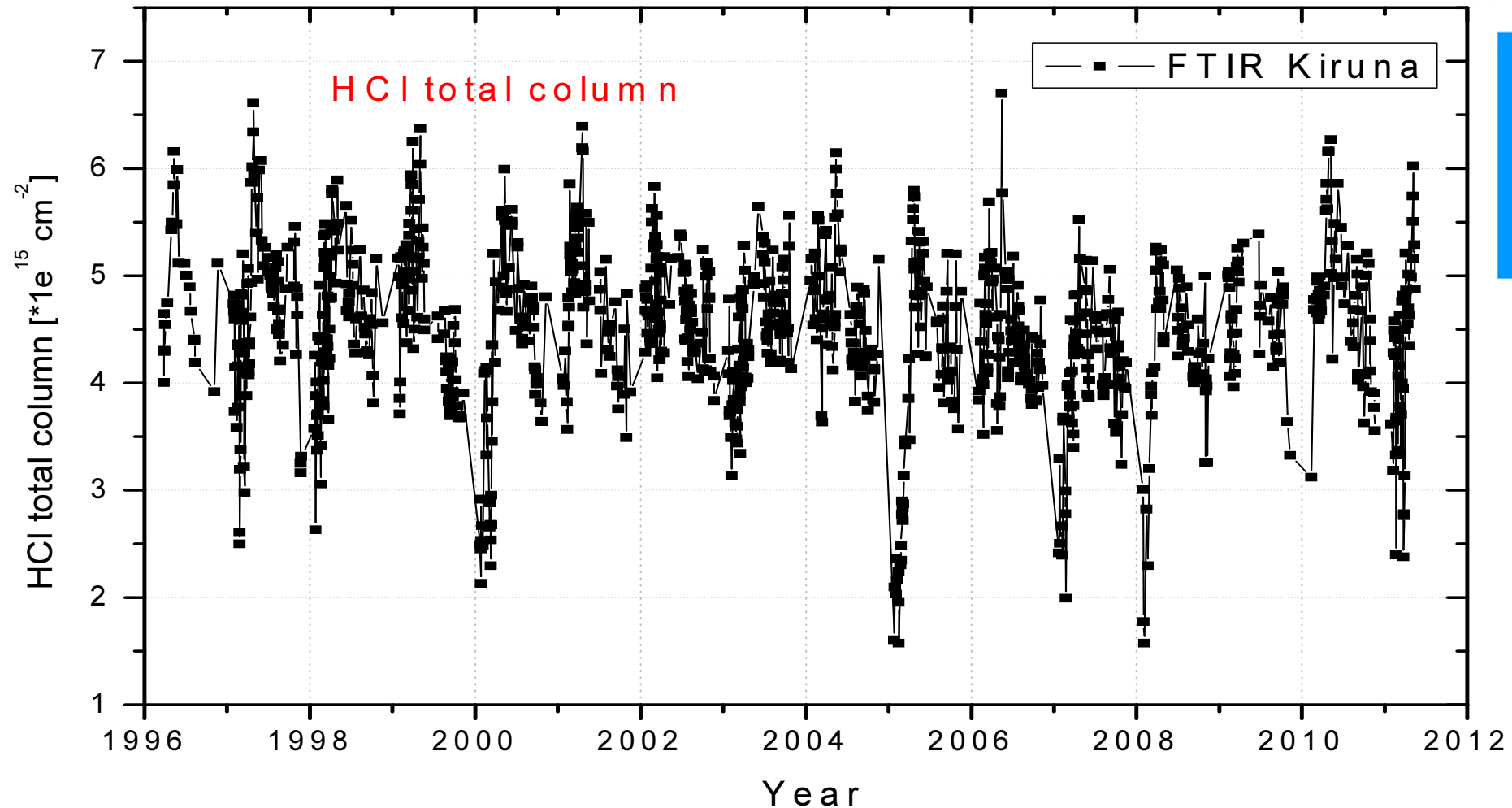
Species: O_3 , HCl, HNO_3 , N_2O , CH_4 , $ClONO_2$, HF, C_2H_6 , CO, HCN, NO_2 , NO

- Regular cell measurements since 1996
- Remote control since 2004
- Upgrade to 125 HR in July 2007
- Camtracker software in 9/2010
- Laser broken in 1/2010 & 4/2012 & 10/2014!
- Scanner motor (encoder) failed in 2008 & 2010 & 2013
- New PC (XP => Win7) in March 2014

Observation statistics Kiruna

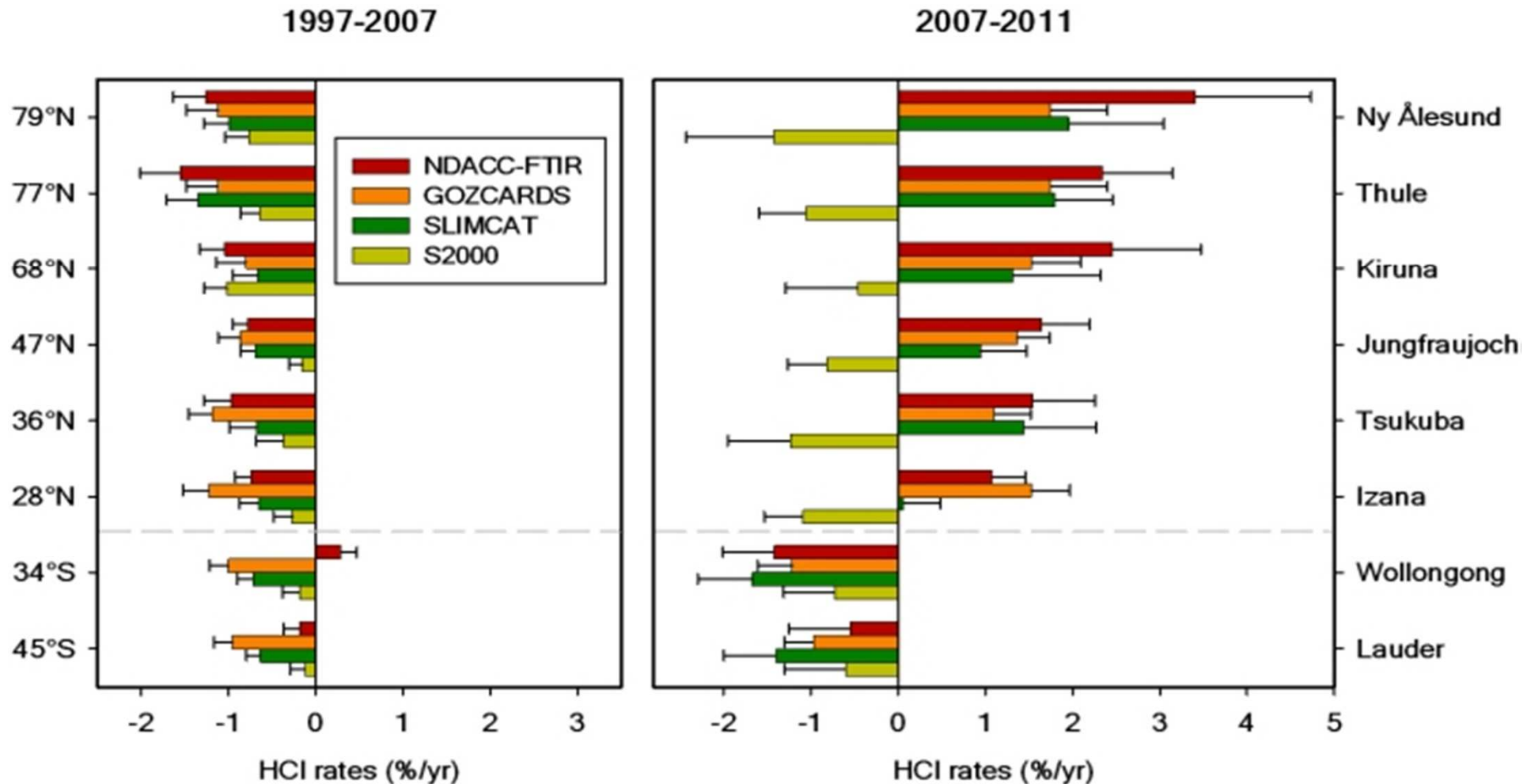
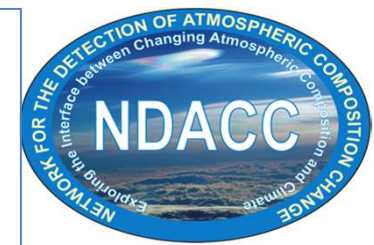


Kiruna - time series of HCl



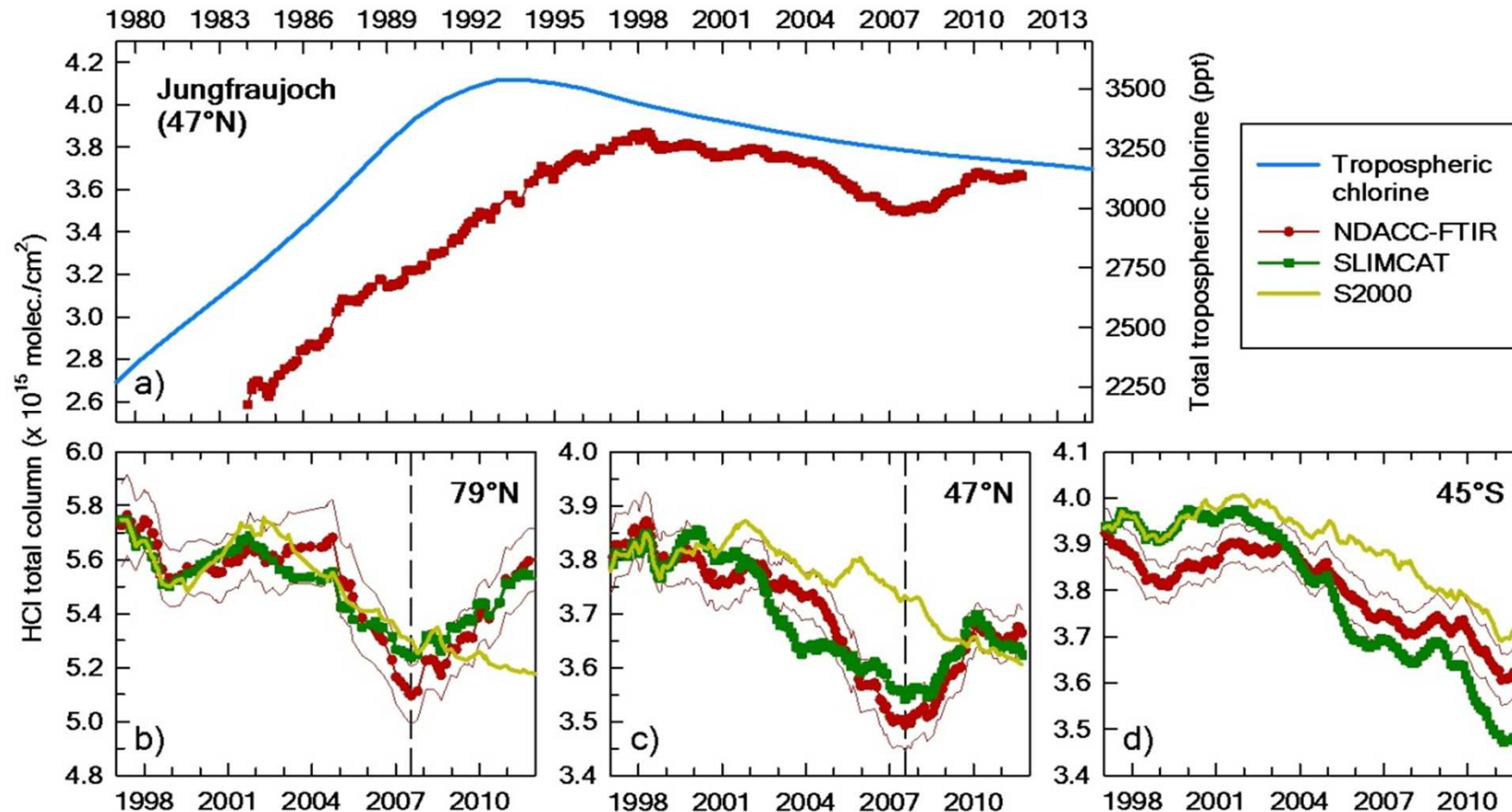
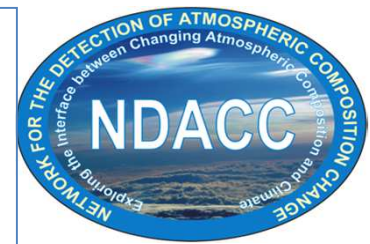
1. Chlorine activation in 1997, 1998, 2000, 2005, 2007, 2008 & 2011
2. Negative trend from 1996 to 2009 [Kohlhepp et al., ACP 2011 & 2012]
3. Increase since 2008 [Mahieu et al., Nature, 2014]

HCl trends



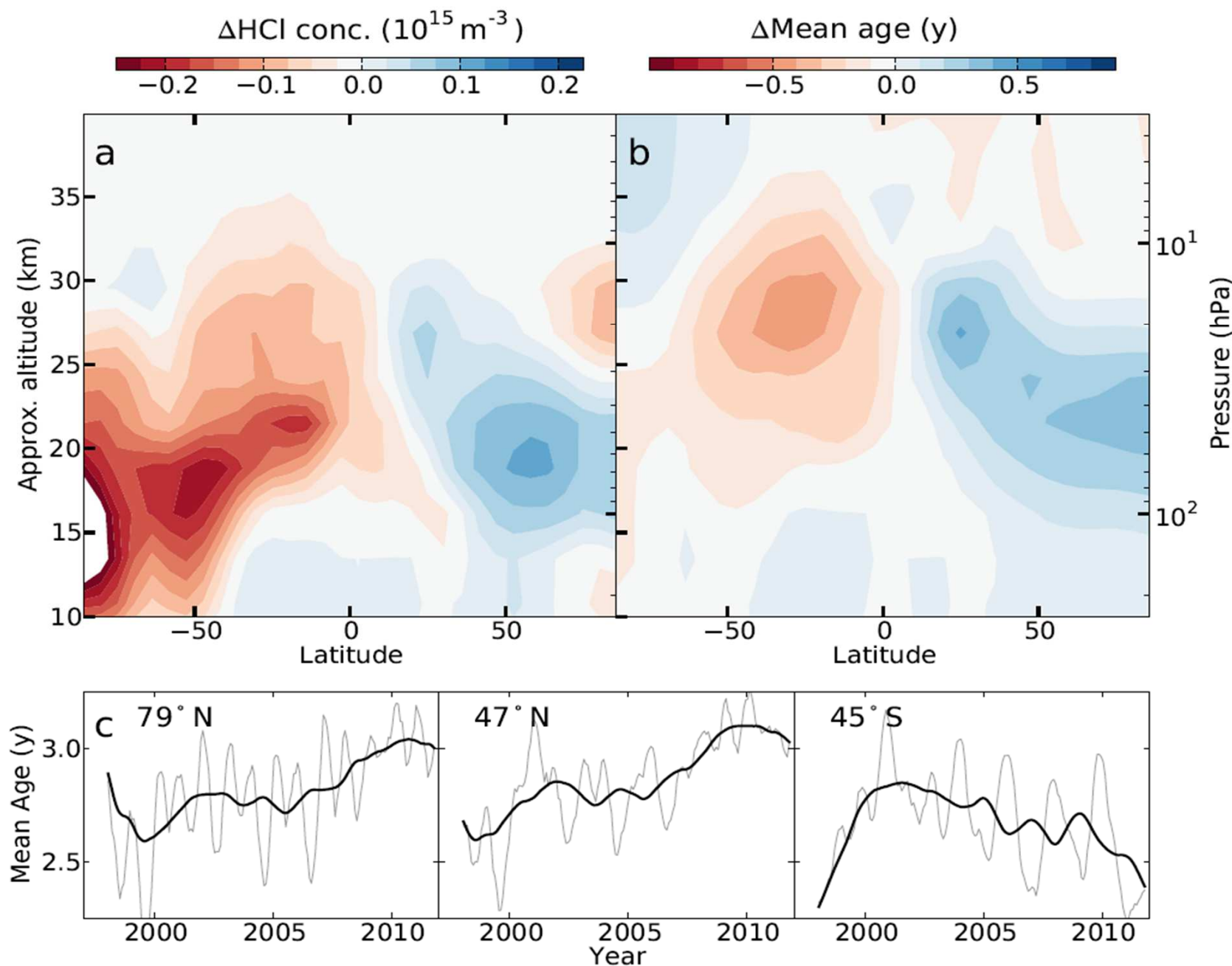
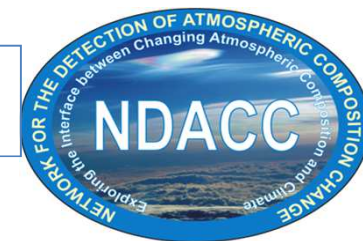
Mahieu, E. et al.: Recent northern hemisphere hydrogen chloride increase due to atmospheric circulation change, *Nature* 515, 104-107, 2014 .

HCl trends



Mahieu, E. et al.: Recent northern hemisphere hydrogen chloride increase due to atmospheric circulation change, *Nature* 515, 104-107, 2014.

HCl increase 2007 - 2011



Mahieu, E.
et al.:
Nature
2014, 515,
p. 104-107.

The Izaña site report

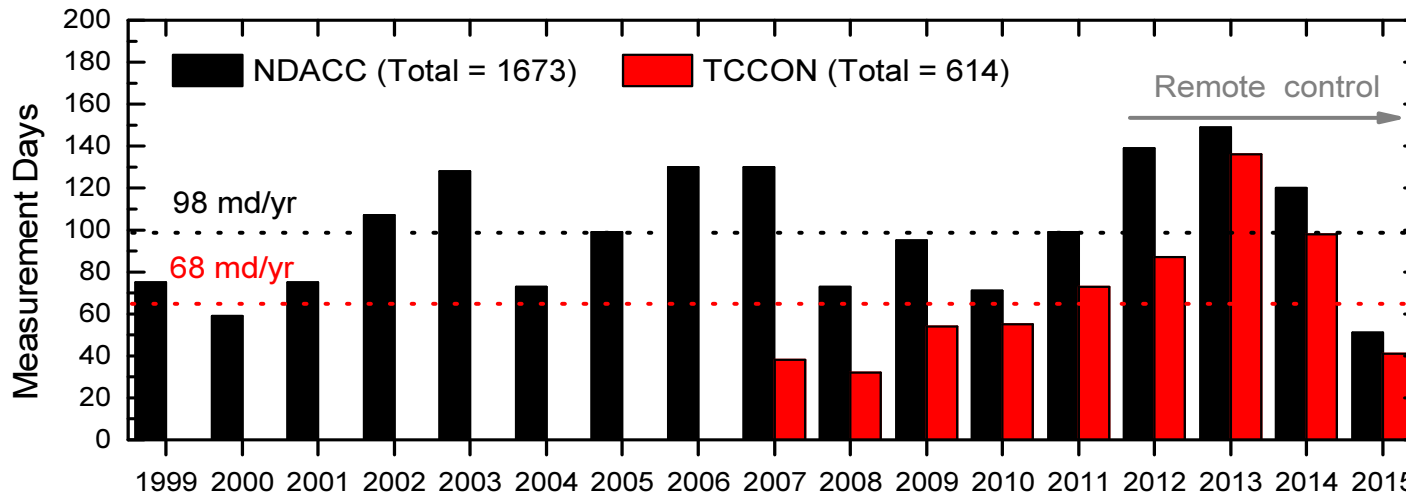
M. Schneider, T. Blumenstock, F. Hase: IMK-ASF, KIT, Germany

O. García, *E. Sepúlveda, M.E. Sanromá: CIAI, AEMET, Spain*



Some facts&News

Data recording activities:



Database archive

O₃, CH₄, CO, NO₂: until 12/2014

Other species: until 10/2012

On-going projects:

- **MUSICA** (MUlti-platform remote Sensing of Isotopologues for investigating the Cycle of Atmospheric water), ERC, 2011-2016.
- **VALIASI** (VALidation of IASI level 2 products), EUMETSAT Research Fellowships 2011, 2013-2017.
- **NOVIA** (Towards a Near Operational Validation of IASI level 2 trace gas products), MINECO (Spain), 2013-2015.
- Contributing to European projects/activities NORS, InGOS...

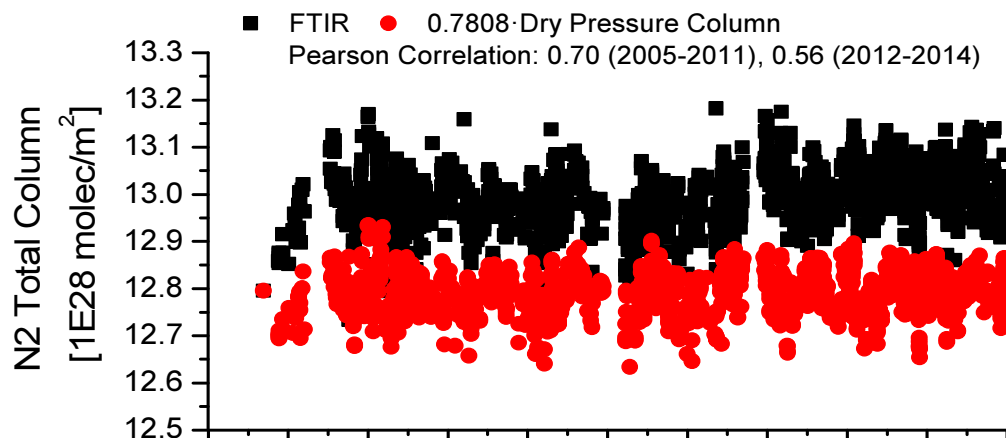
-> Please see Sabine's poster about MUSICA updates

-> Please see Omaira's poster about NOVIA updates

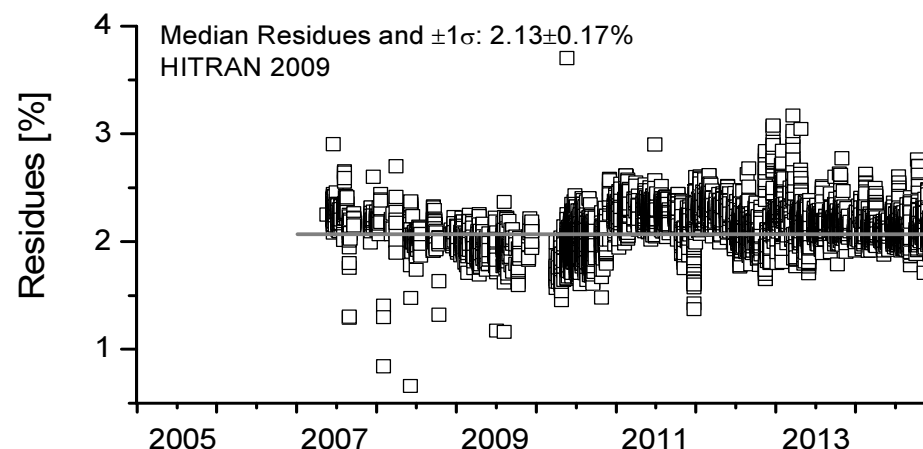
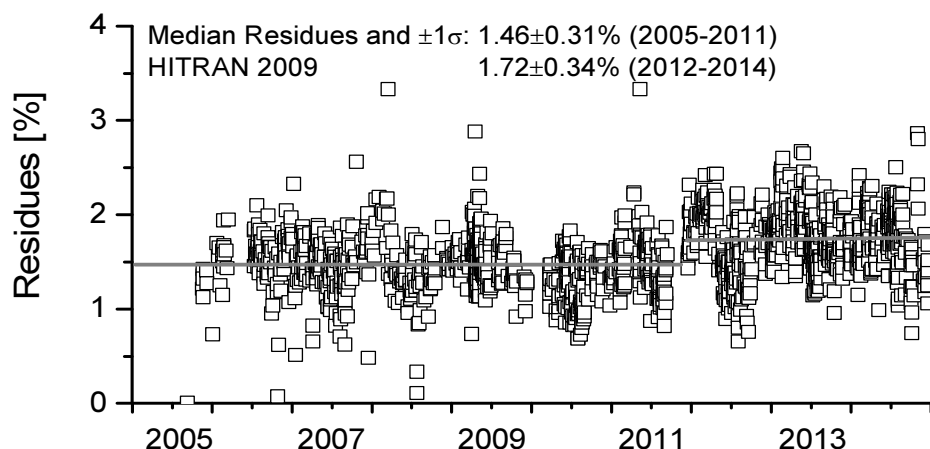
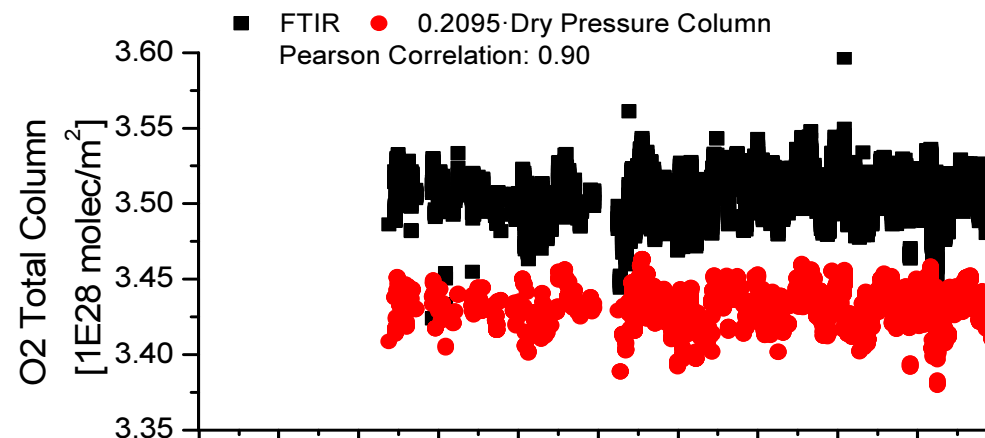
Technical News: No news, very stable instrument!!!!

Temporal Stability: Comparison between FTIR O2 and N2 Total Columns and Dry Pressure Columns at IZO

NDACC N2



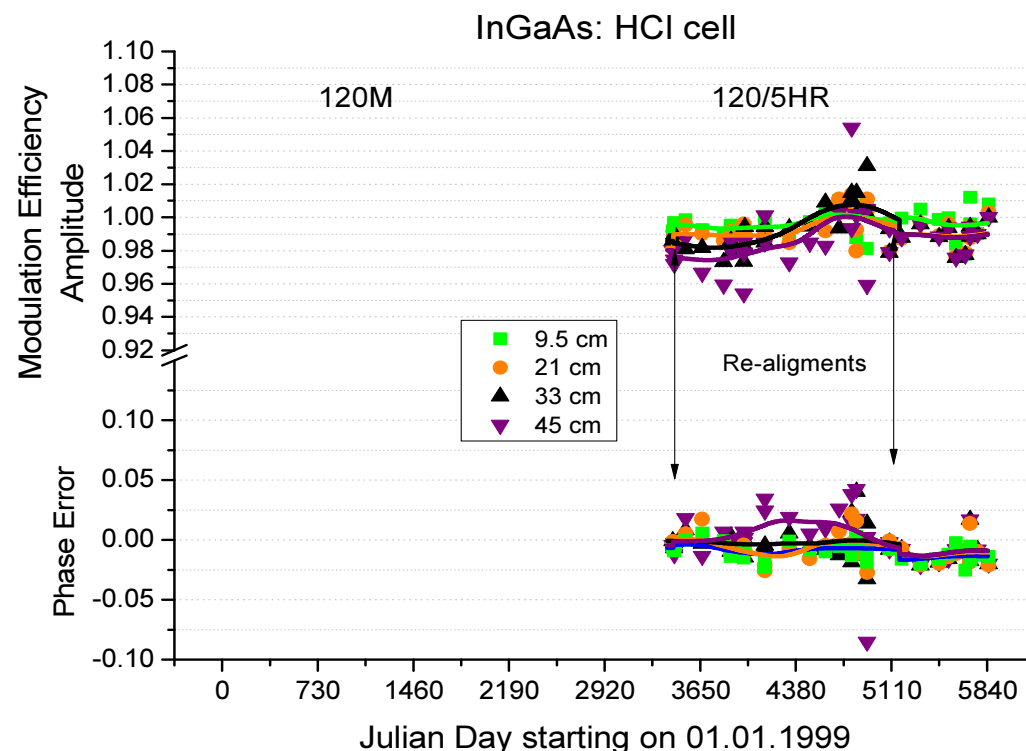
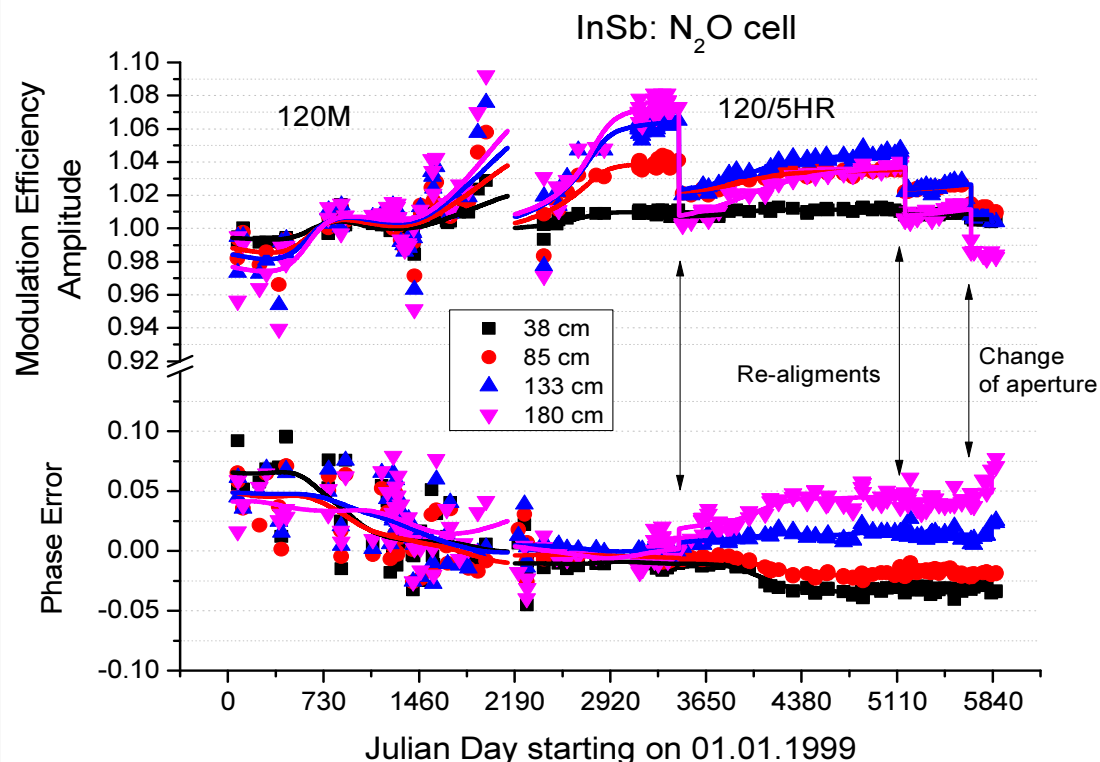
TCCON O2



Precision better than 0.35%!!!

Izaña ILS times series: NDACC (199-2014) and TCCON (2007-2014)

LINEFIT 14.5



NDACC ILS time series: Fit of a single very broad N_2O window (2173.20-2210.00 cm^{-1}): improvement of sensitivity at higher OPD

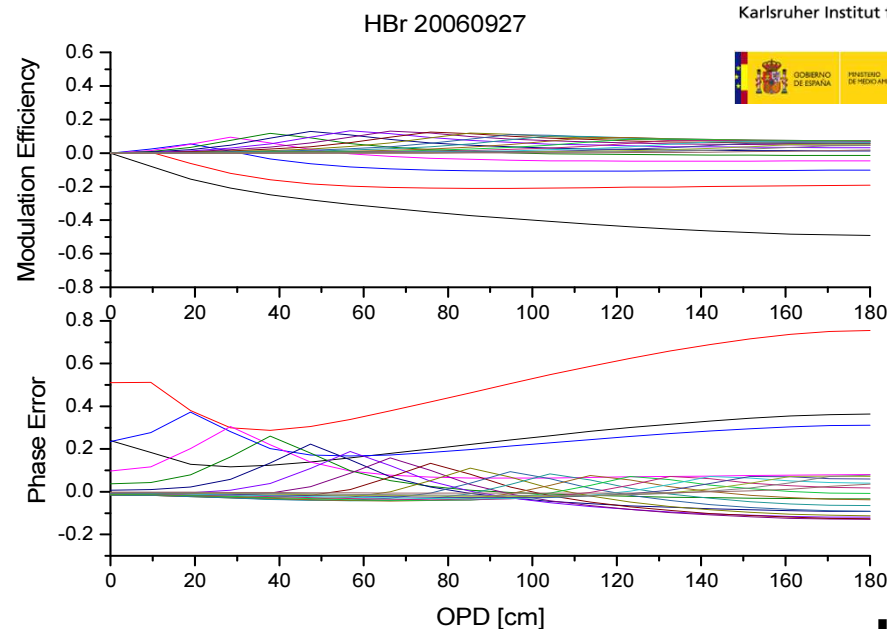
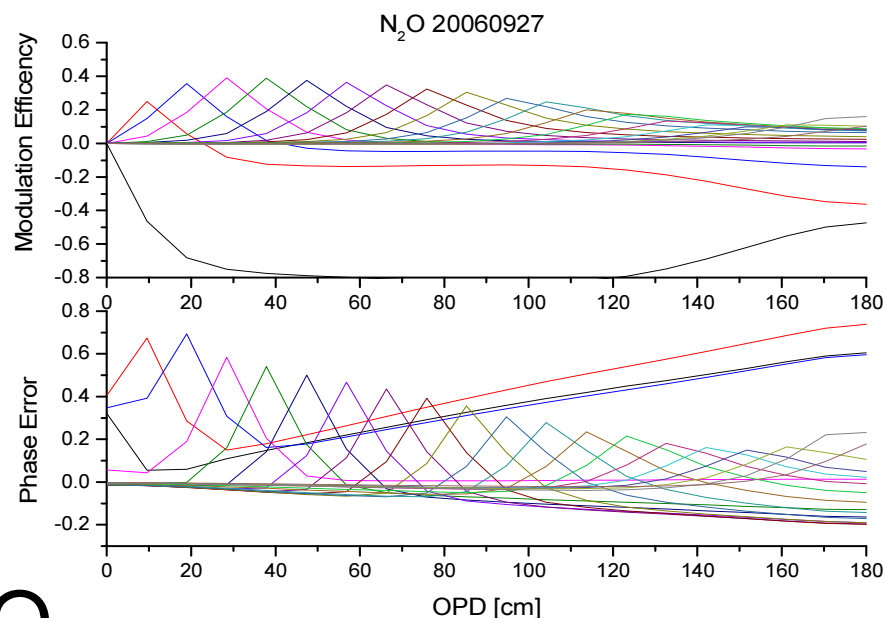
TCCON ILS time series: Fit of 13 HCl microwindows (5683-5780 cm^{-1})

N₂O vs HBr cell measurements

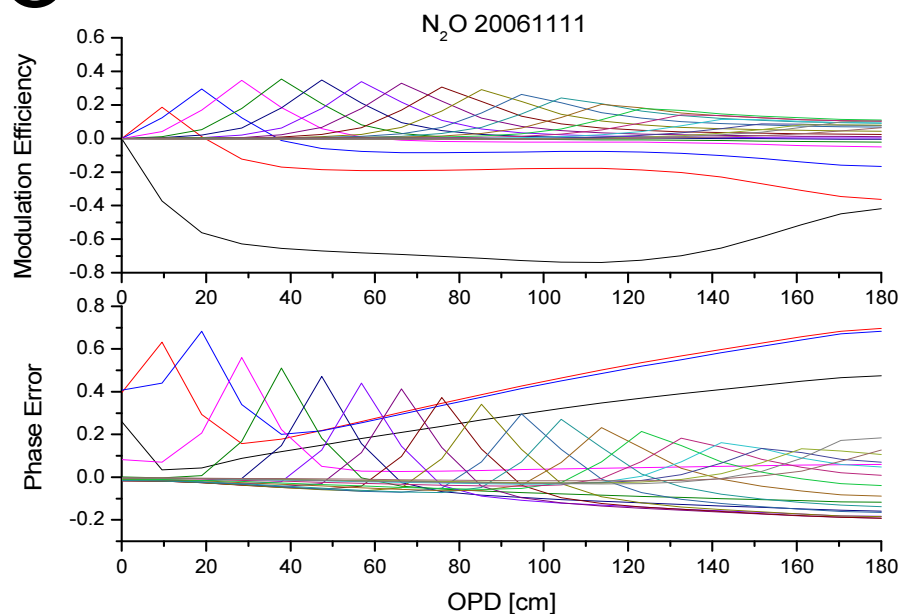
Averaging Kernels



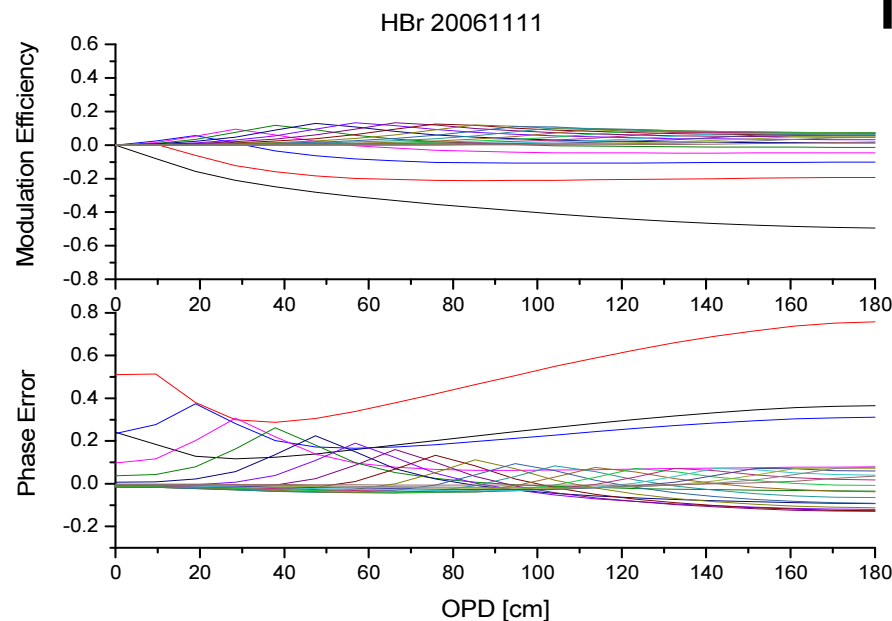
Karlsruher Institut für Technologie



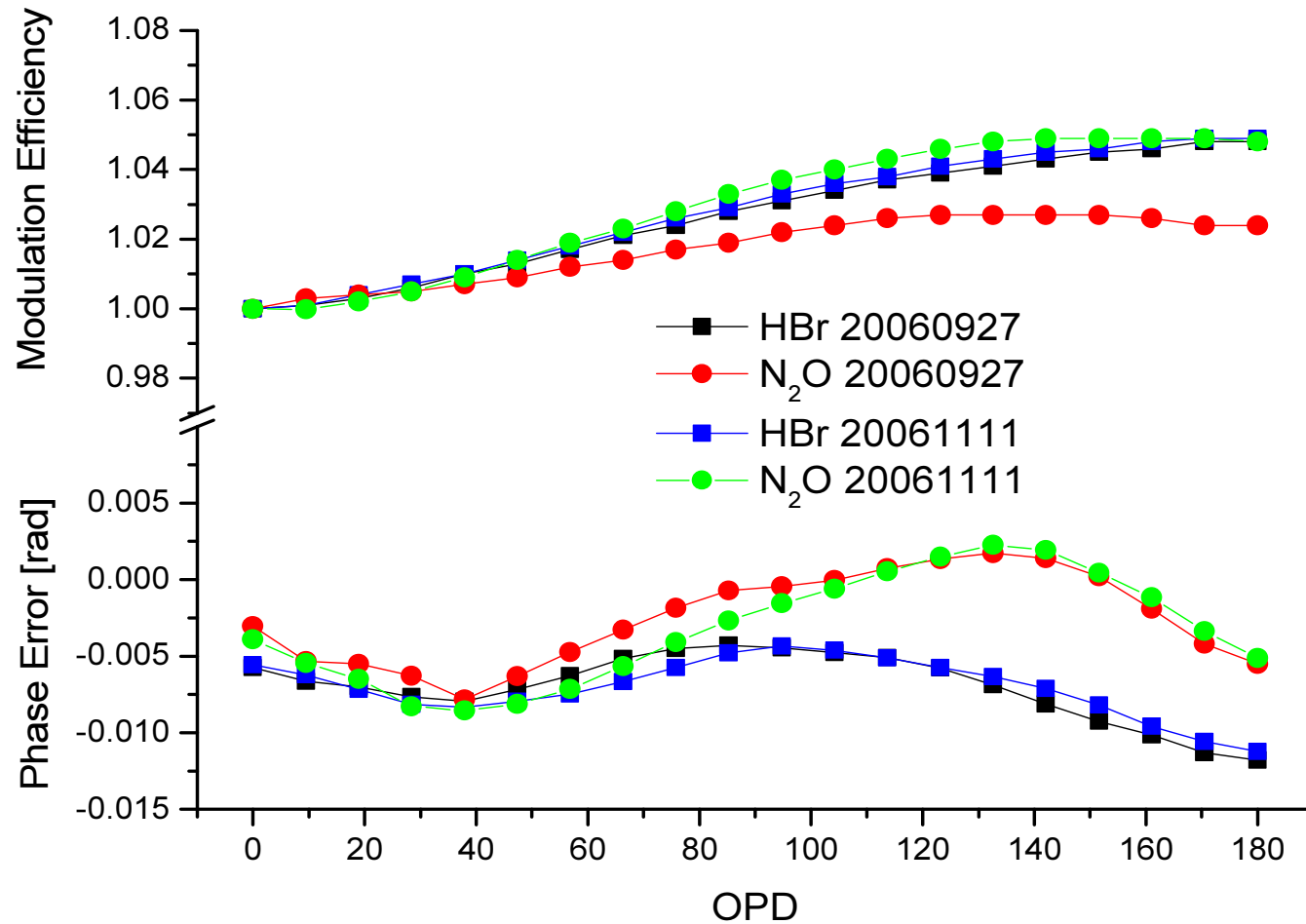
N₂O



HBr



N₂O vs HBr cell measurements



N₂O cell measurements show good sensitivity up to OPD 180 cm.

Publications 2014



1. Mahieu, E. et al.: Recent Northern Hemisphere **stratospheric HCl** increase due to atmospheric circulation changes, *Nature* 515, 104–107 (06 November 2014), doi:10.1038/nature13857, 2014.
2. Lacour, J.-L. et al.: Cross-validation of IASI/MetOp derived **tropospheric δD** with TES and ground-based FTIR observations, *Atmos. Meas. Tech. Discuss.*, 7, 11087-11135, 2014.
3. Mengistu Tsidu, G. et al.: Observations of **precipitable water vapour** over complex topography of Ethiopia from ground-based GPS, FTIR, radiosonde and ERA-Interim reanalysis, *AMTD*, 7, 9869ff., 2014.
4. Reuter, M. et al.: Satellite-inferred European **carbon sink** larger than expected, *ACP* 14, 13739ff., 2014.
5. Ostler, A. et al.: Multi-station intercomparison of column-averaged **methane** from NDACC and TCCON: impact of dynamical variability, *Atmos. Meas. Tech.*, 7, 4081-4101, doi:10.5194/amt-7-4081-2014 2014 .
6. García, O. E. et al.: Quality assessment of **ozone total column amounts** as monitored by ground-based solar absorption spectrometry in the near infrared ($> 3000 \text{ cm}^{-1}$), *Atmos. Meas. Tech.*, 7, 3071-3084, 2014.
7. Saad, K. M. et al.: Derivation of tropospheric methane from TCCON **CH₄ and HF total column** observations, *Atmos. Meas. Tech.*, 7, 2907-2918, doi:10.5194/amt-7-2907-2014, 2014.
8. Wiegele, A. et al.: The MUSICA MetOp/IASI **H₂O and δD** products: characterisation and long-term comparison to NDACC/FTIR data, *Atmos. Meas. Tech.*, 7, 2719-2732, doi:10.5194/amt-7-2719-2014, 2014.
9. Rokotyan, N. V. et al.: A posteriori calculation of **$\delta^{18}O$ and δD** in atmospheric water vapour from ground-based near-infrared FTIR retrievals of H₂¹⁶O, H₂¹⁸O, and HD¹⁶O, *AMT*, 7, 2567-2580, 2014.
10. Sepúlveda, E. et al.: Tropospheric **CH₄** signals as observed by NDACC FTIR at globally distributed sites and comparison to GAW surface in-situ measurements, *Atmos. Meas. Tech.*, 7, 2337-2360, 2014.
11. Dils, B. et al.: The Greenhouse Gas Climate Change Initiative (GHG-CCI): comparative validation of GHG-CCI SCIAMACHY/ENVISAT and TANSO-FTS/GOSAT **CO₂ and CH₄** retrieval algorithm products with measurements from the TCCON, *Atmos. Meas. Tech.*, 7, 1723-1744, doi:10.5194/amt-7-1723-2014, 2014.
12. Deng, F. et al.: Inferring regional sources and sinks of atmospheric **CO₂** from GOSAT XCO₂ data, *Atmos. Chem. Phys.*, 14, 3703–3727, doi:10.5194/acp-14-3703-2014, 2014.

Publications 2015

1. Hase, F. et al.: Use of portable FTIR spectrometers for detecting greenhouse gas emissions of the megacity Berlin - Part 2: Observed time series of **XCO₂** and **XCH₄**, AMTD, 8, 2767-2791, 2015.
2. Frey, M., F. Hase et al.: Use of portable FTIR spectrometers for detecting greenhouse gas emissions of the megacity Berlin - Part 1: Instrumental line shape characterisation and **calibration of a quintuple of spectrometers**, Atmos. Meas. Tech. Discuss., 8, 2735-2766, 2015.
3. Scheepmaker, R. A. et al.: Validation of **SCIAMACHY HDO/H₂O** measurements using the TCCON and NDACC-MUSICA networks, AMT, 8, 1799-1818, doi:10.5194/amt-8-1799-2015, 2015.
4. Barthlott, S. et al.: Using **XCO₂** retrievals for assessing the long-term consistency of NDACC/FTIR data sets, Atmos. Meas. Tech., 8, 1555-1573, doi:10.5194/amt-8-1555-2015, 2015.
5. Vigouroux, C. et al.: Trends of **ozone** total columns and vertical distribution from FTIR observations at eight NDACC stations around the globe, ACP, 15, 2915-2933, 2015.
6. Turner, A. J. et al.: Estimating global and North American **methane emissions** with high spatial resolution using GOSAT satellite data, Atmos. Chem. Phys. Discuss., 15, 4495-4536, 2015.
7. Heymann, J. et al.: Consistent satellite **XCO₂** retrievals from **SCIAMACHY** and **GOSAT** using the BESD algorithm, Atmos. Meas. Tech. Discuss., 8, 1787-1832, 2015 .
8. Schneider, M. et al.: Empirical validation and proof of added value of MUSICA's tropospheric **δD** remote sensing products, Atmos. Meas. Tech., 8, 483-503, doi:10.5194/amt-8-483-2015, 2015.

Addis, Izana, Karlsruhe & Kiruna Site Reports

Kiruna



Izaña



Thank you!

Altzomoni, Mexico



Karlsruhe



Addis Ababa

