The new TCCON-Observatory at Garmisch (47.5 °N, 11.1 °E, 734 m a.s.l.)

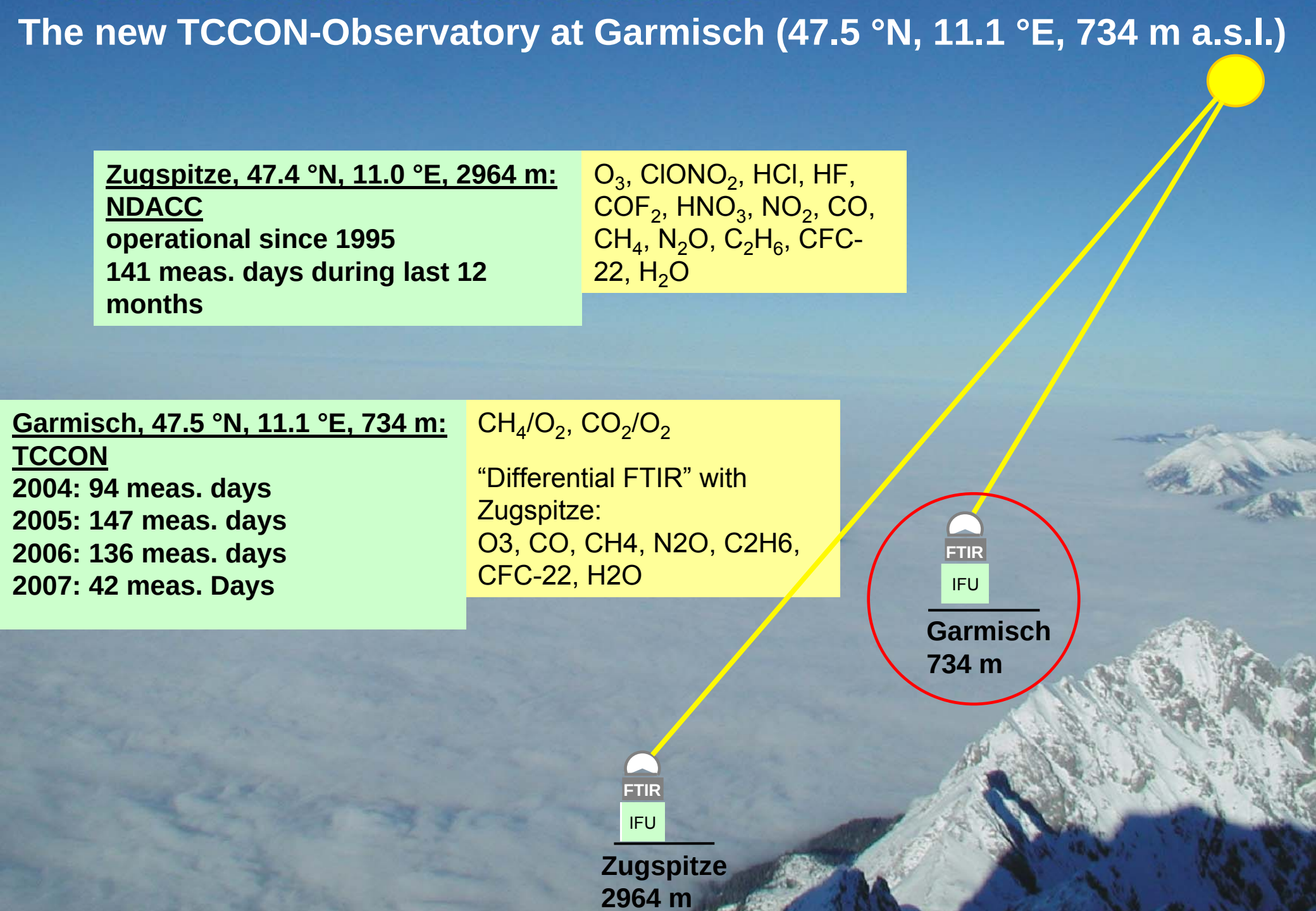
Zugspitze, 47.4 °N, 11.0 °E, 2964 m:
NDACC
operational since 1995
141 meas. days during last 12 months

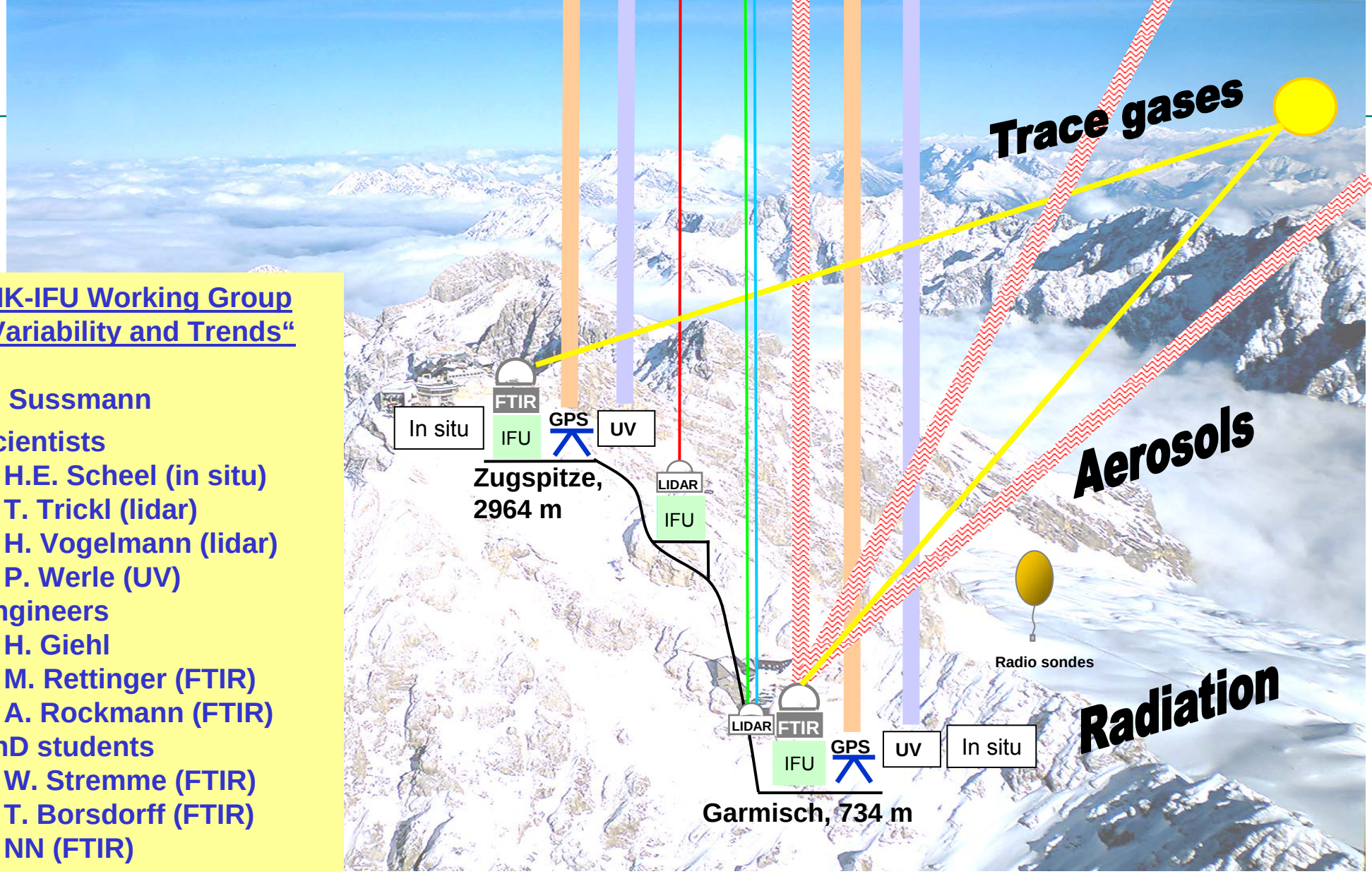
O_3, $ClONO_2$, HCl, HF, COF_2, HNO_3, NO_2, CO, CH_4, N_2O, C_2H_6, CFC-22, H_2O

Garmisch, 47.5 °N, 11.1 °E, 734 m:
TCCON
2004: 94 meas. days
2005: 147 meas. days
2006: 136 meas. days
2007: 42 meas. Days

CH_4/O_2, CO_2/O_2

"Differential FTIR" with Zugspitze:
O3, CO, CH4, N2O, C2H6, CFC-22, H2O





IMK-IFU Working Group „Variability and Trends“

R. Sussmann

Scientists

- H.E. Scheel (in situ)
- T. Trickl (lidar)
- H. Vogelmann (lidar)
- P. Werle (UV)

Engineers

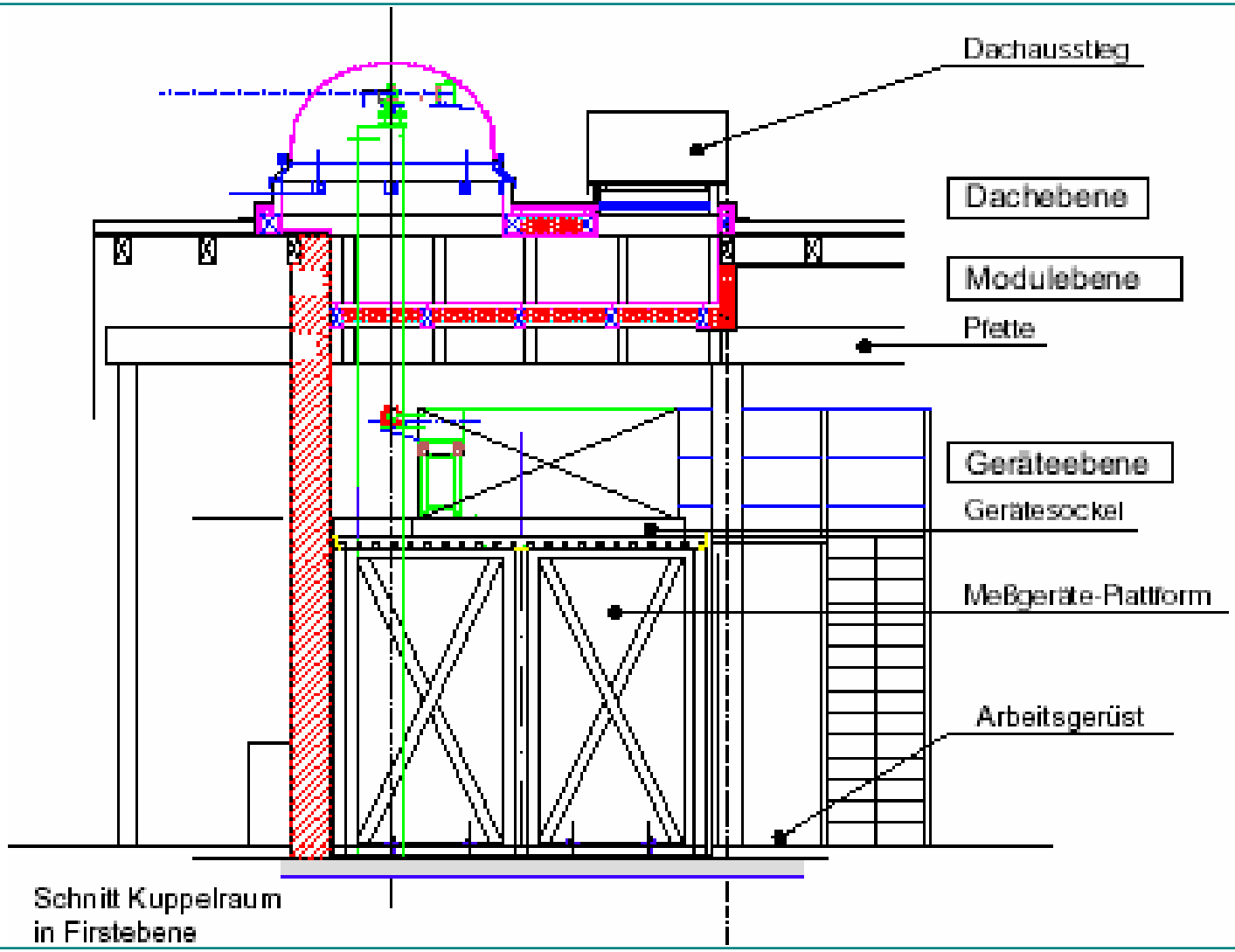
- H. Giehl
- M. Rettinger (FTIR)
- A. Rockmann (FTIR)

PhD students

- W. Stremme (FTIR)
- T. Borsdorff (FTIR)
- NN (FTIR)

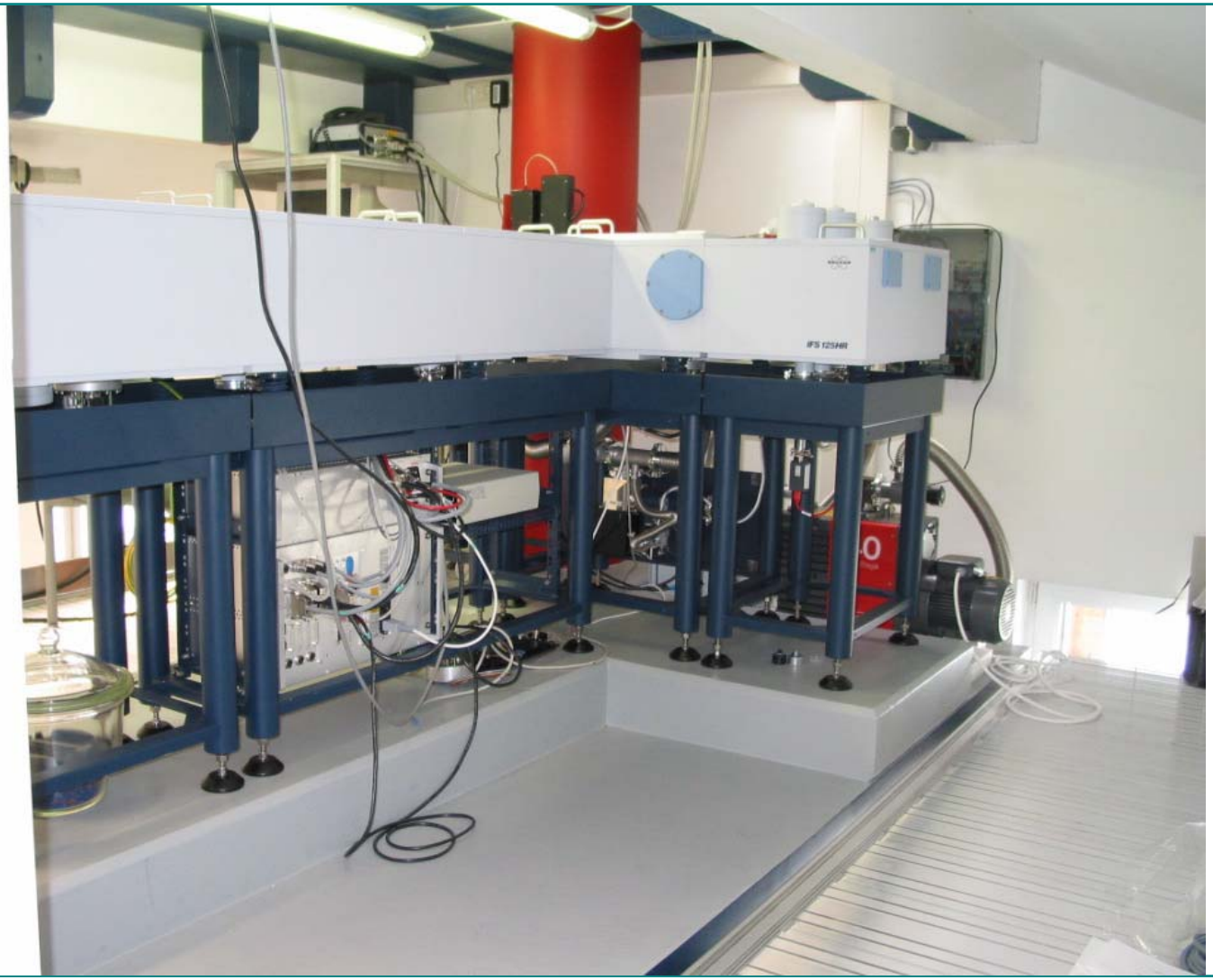
Garmisch FTIR: Dome, solar tracker

Garmisch FTIR: Instrument mount



Garmisch FTIR: Instrument mount

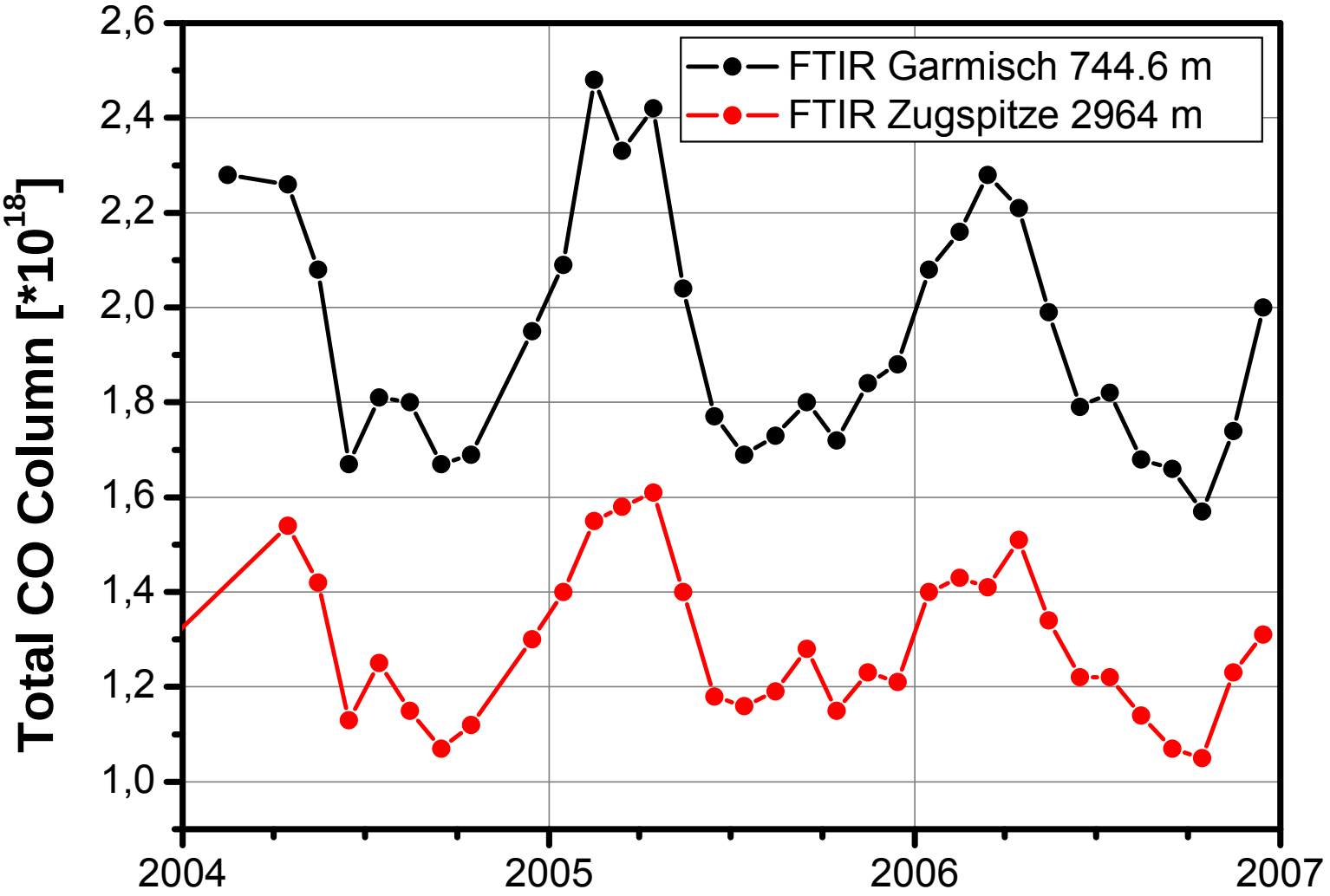
Garmisch FTIR: Bruker 125 HR, 250 cm OPD



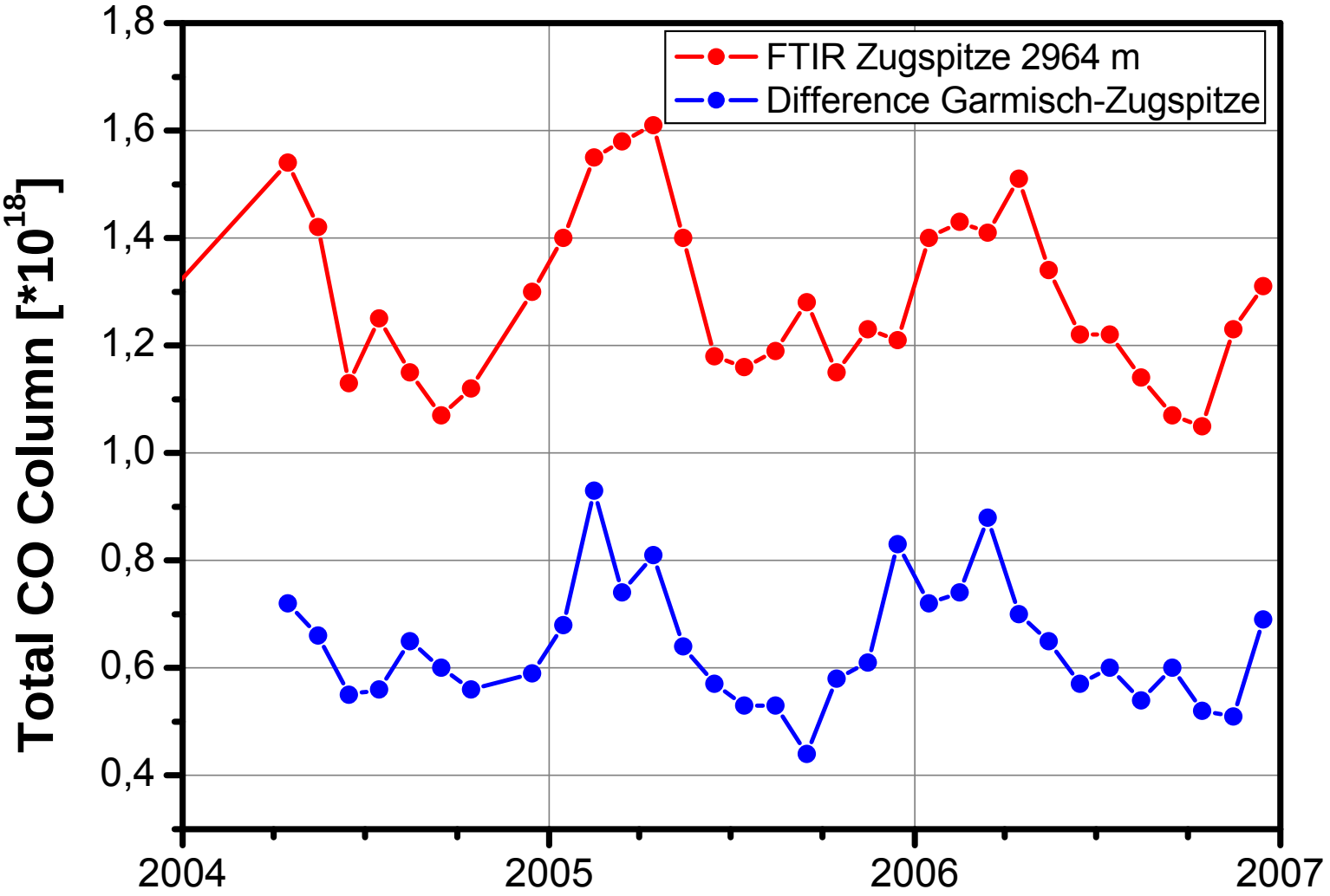
Measurements at Garmisch

Spectral region (cm^{-1})	Years	Resolution (cm^{-1})	Beamsplitter	Detektor
3750 – 8900	2006 – 2007	0.02	CaF2	InSb
4000 – 11500	2007 – ongoing	0.02	CaF2	InGaAs
11500 – 15800	2007 – ongoing	0.02	CaF2	Si-Diode
750 – 1250	2004 – 2007	0.0036	KBr	MCT
1850 – 2200	2004 – 2007	0.0036	KBr	InSb
1900 – 2650	2004 – 2007	0.0072	KBr	InSb
2400 – 3100	2004 – 2007	0.00513	KBr	InSb
3750 – 4370	2004 – 2007	0.0079	KBr	InSb

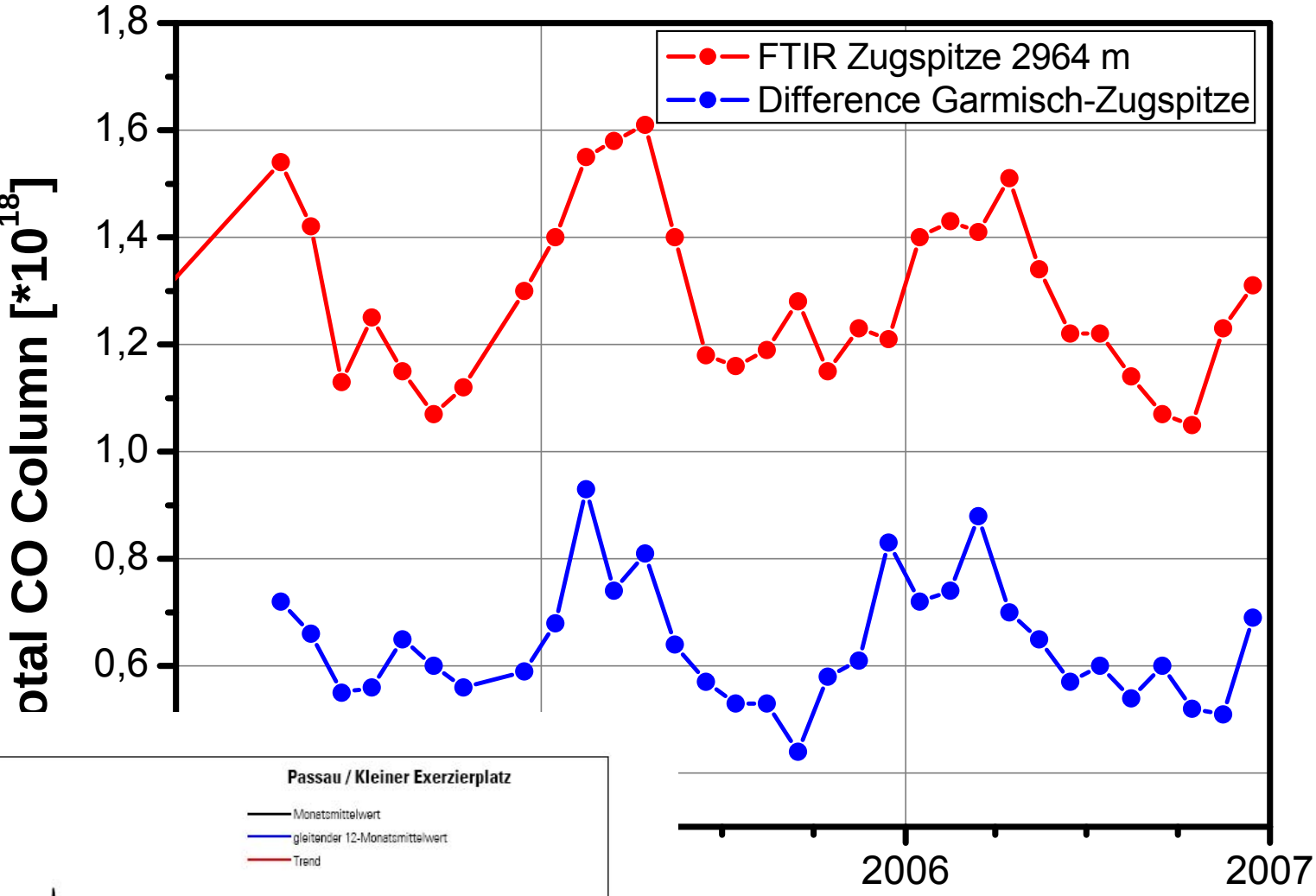
“Differential“ Garmisch-Zugspitze FTIR: CO



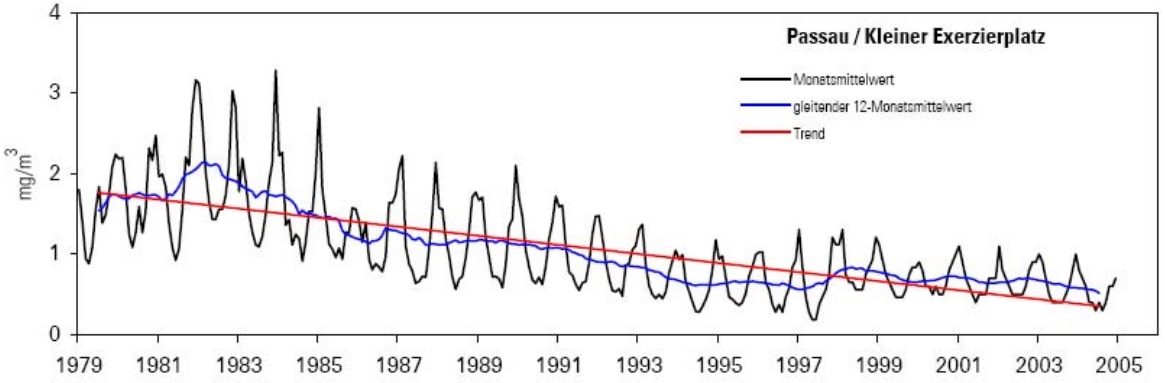
“Differential“ Garmisch-Zugspitze FTIR: CO



“Differential“ Garmisch-Zugspitze FTIR: CO



In situ CO



Sussmann

isch TCCON Site Report

TCCON adaptations - Time synchronization: done

Bruker spectrometer internal clock

firmware (rounding) problem: drift ~ 63 s / day
new firmware: drift ~ 20 seconds /day
new clock: drift ~ 2.5 seconds / day

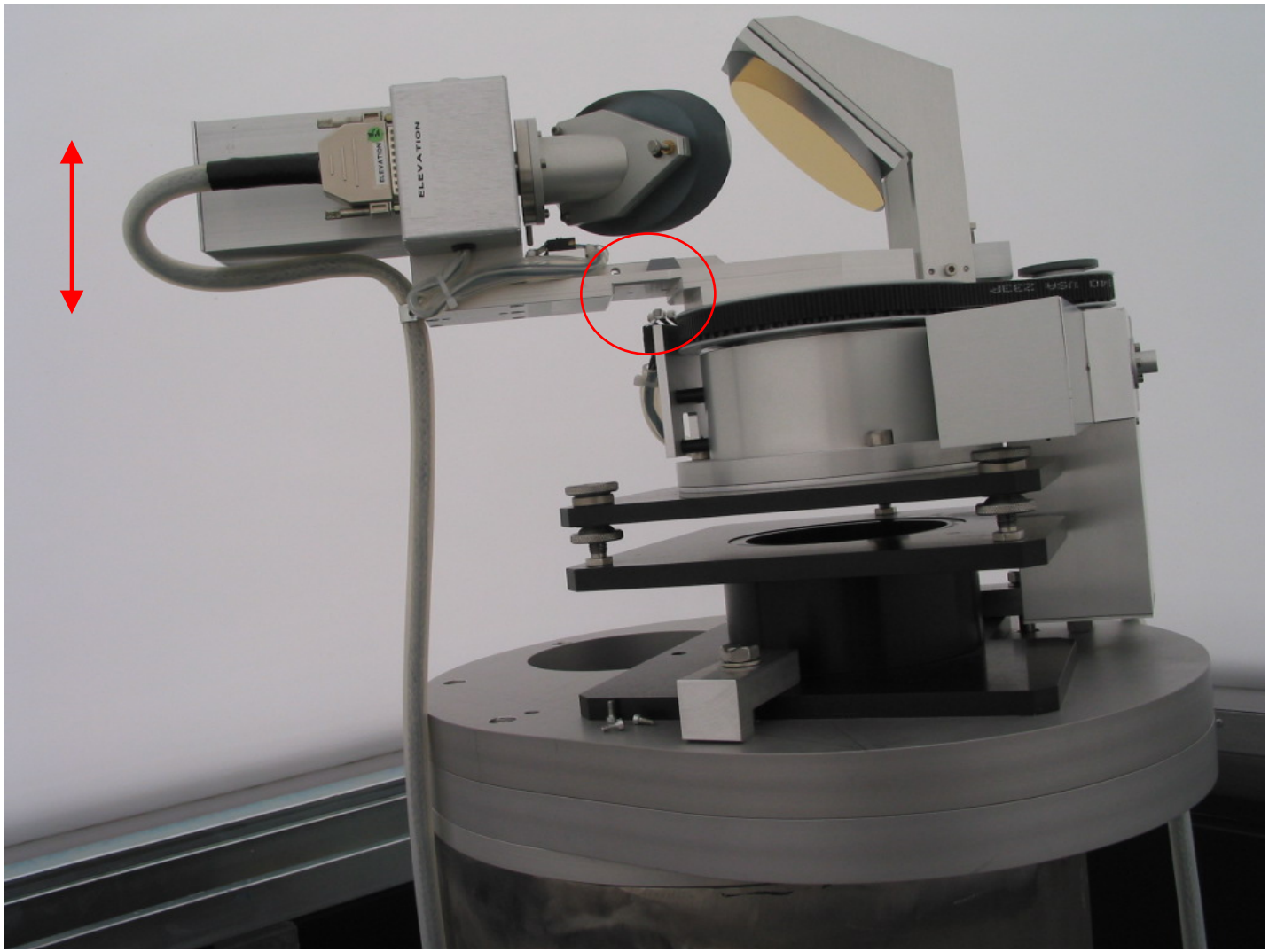
⇒ use SynchTime.exe to get OPUS-PC time before each measurement

⇒ synchronize OPUS-PC via GPS

(Hopf GPS-Funkuhr 6039)

accuracy 1 µs in GPS receiving mode
drift 0.01 s/day without satellites

Pointing accuracy problem: flexibility lead to ~ 2 mm move on aperture



Pointing accuracy problem: done

TCCON adaptations - gas cell

- **HCl cell (shipped by Paul Wennberg)**

TCCON adaptations - Detectors and related optics: currently installed

- MCT
- InSb
- InGaAs-Diode (Bruker D429/B) 4000 – 12800 cm^{-1}
- Si-Diode (Bruker D510/B) 9000 – 25000 cm^{-1}

Simultaneous operation of InGaAs and Si diode via

– dual channel acquisition electronics (Bruker E530/H, includes DC coupling)

– dichroic beam splitter:

Omega Optical Part# 1000 DCLP

- Cut on wavelength 10000 cm-1
- Transmission > 90% average, 85% min , 3300 – 7700 cm^{-1}
- Reflection > 95% average, 90% min , 12500 - 15500 cm^{-1}

45‘‘ wedge angle - is relatively small (?) -

adding 10 times the longest wavelenght (2,5 µm) to one side of the optics leads to:

(using effective dia 35mm (Ø = 25mm * √2 = 35 mm, 45° incidence)

$$wedge\ \ angle = \arctan \frac{10 * \lambda / n}{Durchmesse\ r} = \frac{25\,\mu m / 1.43}{35000\,\mu m} = 0.5 mrad = 103''$$

– Long pass filter for Si-Diode: Oriel Instruments Part# 51325; Ø = 1 inch; 3mm; cut on: 15500 cm^{-1} (no longer fabricated); wedge angle = 0, o.k.?

TCCON adaptations - Pressure sensors: Garmisch plan (to be done)

Hg barometer

Garmisch: Lambrecht 406 (2200 Euro)	accuracy: 0.25 hPa (?)
JPL: Princo Instruments Model 453:	accuracy: 0.30 hPa

p sensor

Garmisch: Lambrecht 8126 MIL (2939 Euro)	accuracy: 0.15 hPa (?) long-term stability: < 0.1 hPa/year (?)
JPL: Setra (Model 270)	Accuracy: 0.3 hPa

What is the quality control strategy?

E.g., German Wheather Service: replace p sensor if difference to Hg reaches 1 mbar for the first time

Acknowledgments

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EC-GEOMON
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