HCHO - Motivations

- Reactive/short-lived intermediate resulting from the oxidation of many important VOCs (e.g. isoprene) and methane
- Precursor of tropospheric ozone
- Source of secondary organic aerosols

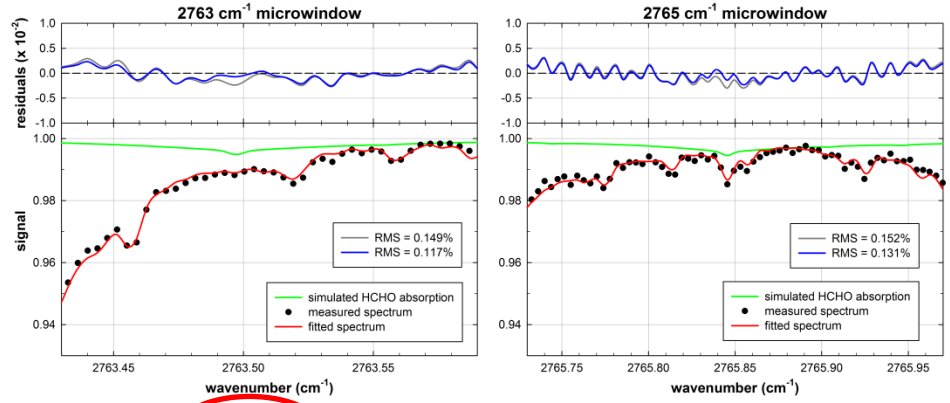
- Support to the NIDFORVal S5-P validation effort (ID28607; C. Vigouroux & G. Pinardi)

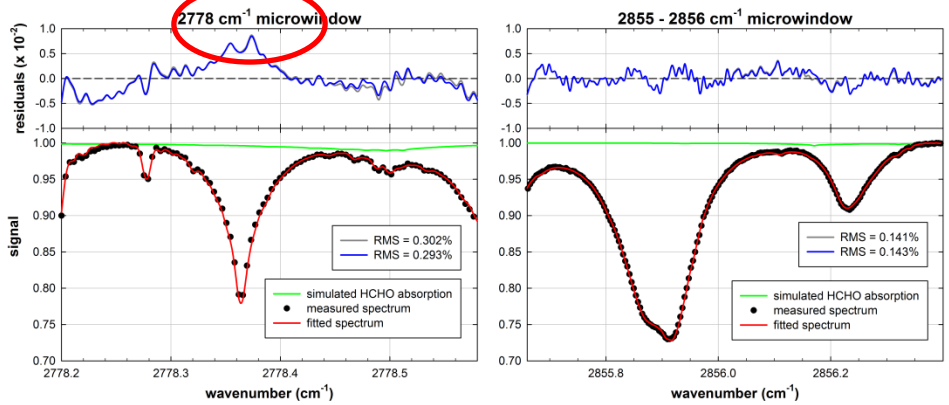
HCHO microwindows

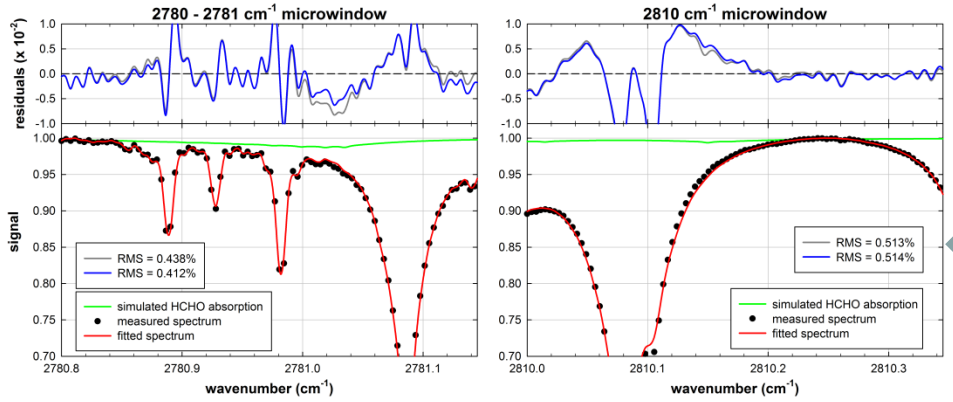
Microwindow (cm^{-1})	Notholt (1997)	Jones (2009)	Vigouroux (2009)	Franco (2015)
2763 (Meier)			X	X
2765 (Meier)			X	X
2778	X	X	X	X
2780	X	X	X	X
2810			X	
2855			X(*)	

More than recommended, the pre-fitting of H_2O and HDO appears to be mandatory!
(*) now used in the preliminary adjustment of HDO and removed from the second run

Vigouroux (2009)

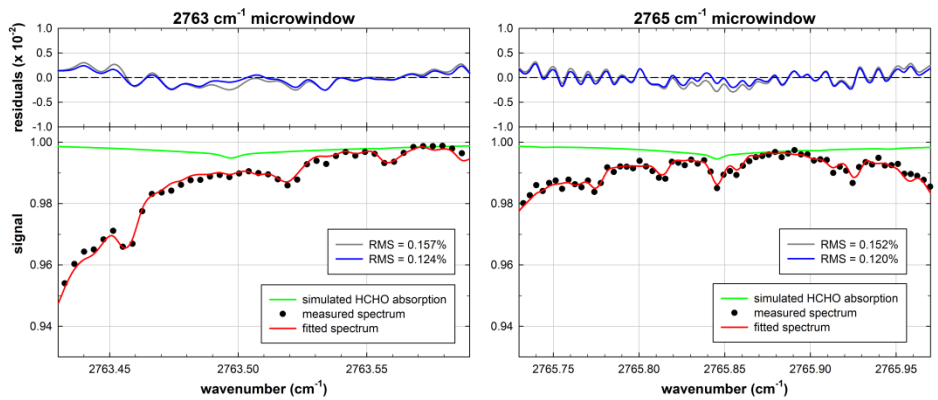


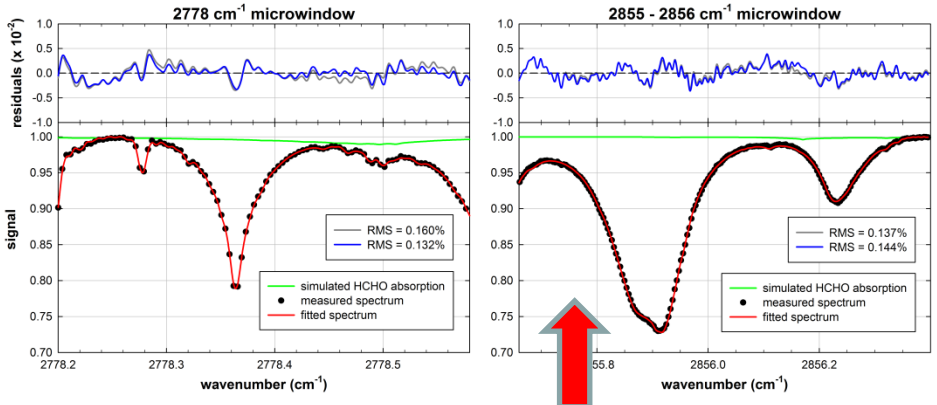




Jungfraujoch observation!!

Franco (2015)



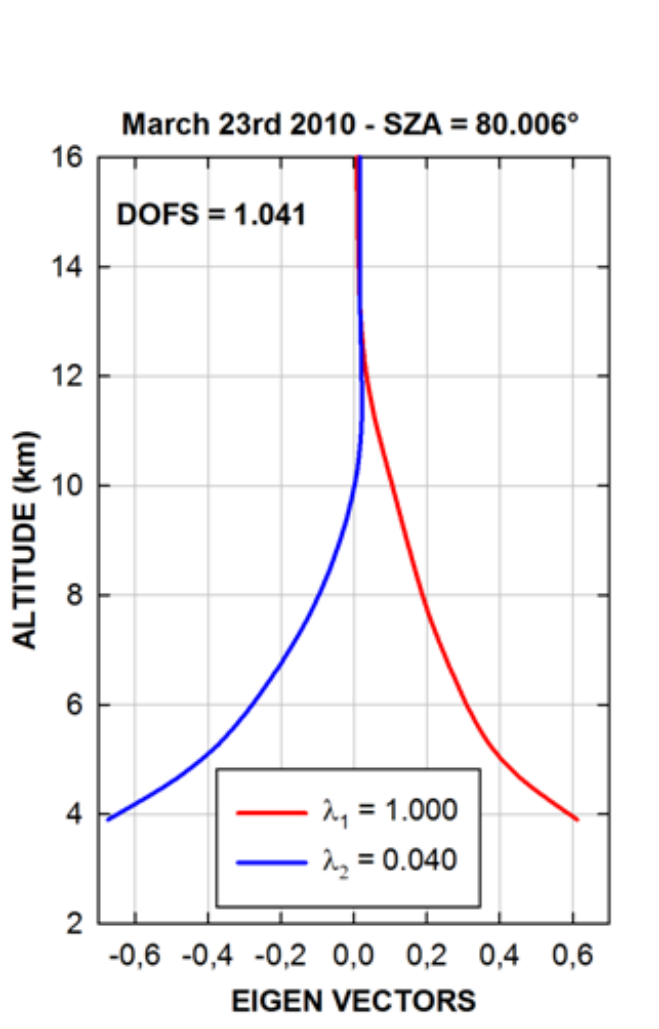


Very weak HCHO absorption (green line), but critical to adjust the HDO interference

Poor residuals, degradation of the 2778 window residuals. Not needed for Jungfraujoch, neither for fitting of HCHO (DOFS) or for constraining interferences.

Information content (Jungfraujoch)

- Limited information content (DOFS of ~1)
- Sensitivity up to the tropopause (i.e. ~11 km)
- For **REUNION** (St Denis), a typical DOFS of 1.1 is achieved, with sensitivity up to ~20 km
- For both sites, comparison with parallel MAX-DOAS measurements proved successful => confidence in the retrieved columns for a weak absorber



Université de Liège

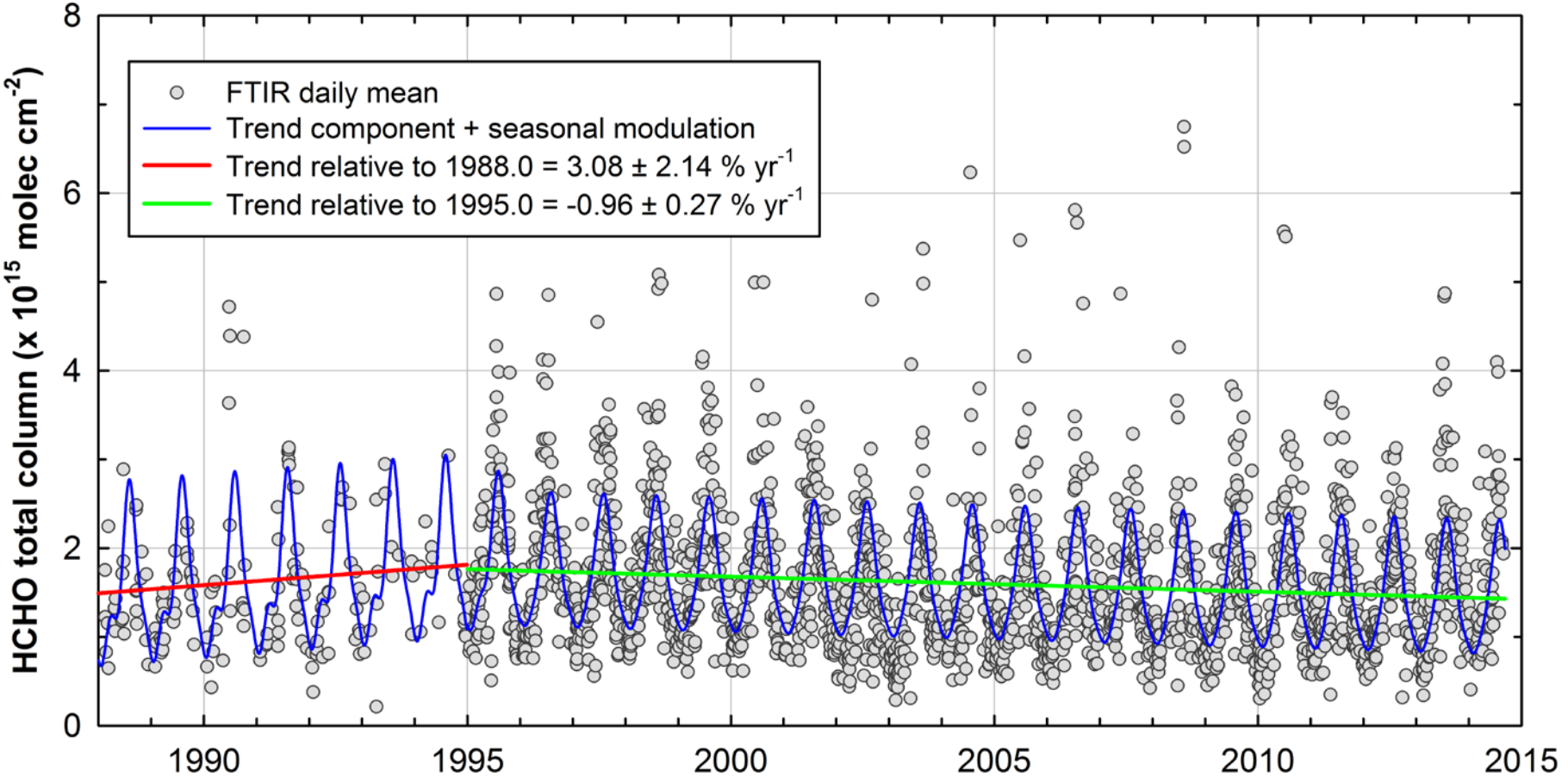
Error budget – Unpolluted site

Table 2. Impact of major sources of systematic and random uncertainties on typical individual HCHO total column retrievals from FTIR solar spectra above the Jungfraujoch station. These uncertainties have been calculated on the basis of all individual solar spectra recorded during the year 2011, with the exception of the measurement noise, the smoothing and the model parameters contributions that have been estimated according to the OEM formalism of Rodgers (2000) on the basis of a representative subset of solar spectra.

Error source	Error (%)	Comments
Assumed variability	49.7	WACCM variability relaxed, commensurate with ACE-FTS variability down to 6 km
Systematic errors		
Line intensity HCHO	9.7	Assuming ±10 % uncertainties in HCHO line strengths
Air-broadening coefficient HCHO	8.0	Assuming ±10 % uncertainties in HCHO air-broadening coefficients
Line intensity interfering gases	5.2	Assuming the maximal HITRAN 2008 uncertainties
ILS	2.5	±10 % misalignment and instruments bias
Forward model	1.0	Retrieval algorithm-related
HCHO a priori profile	3.0	Assuming HCHO a priori profiles derived from ACE-FTS, GEOS-Chem and IMAGES
Total Systematic Error	14.2	Evaluated at 8% for Reunion
Random errors		
Temperature profile	5.0	Assuming the NCEP profile uncertainty pattern (see text)
H_2O and HDO a priori profiles	10.1	Changes by a factor 2 in a priori slope
SZA	0.7	Assuming ±0.1° bias
Measurement noise	14.7	
Smoothing	10.2	
Model parameters	2.1	
Total Random Error	21.3	Evaluated at 18% for Reunion

Université de Liège

Long-term trend (Jungfraujoch)



Agreement between the FTIR instruments verified using close-in-time measurements

Université de Liège

Tentative conclusions

- Strategies have been optimized for two very different sites (Reunion & Jungfraujoch), providing essentially total columns which have been successfully compared to MAX-DOAS (and model) measurements
- Since most all other NDACC sites are characterized by intermediate atmospheric conditions (humidity, altitude…), the windows selected here should be appropriate (best combination to be identified)
- However, we would like to give a try to the wide-window shown/used by Geoff before drawing “definitive” conclusions (impact on information content/DOFS? Error budget?)

- Note also that the adoption of HITRAN2012 for the Jungfraujoch retrievals had dramatic effects on the retrieved columns (-49±25% !!). This results from cumulative effects associated with changes to the line parameters of HCHO (-9±6%), CH4 (-11±5%) and CO2 (-27±16%), ruining the FTIR/MAX-DOAS agreement