

Quantitative spectroscopy of several tropospheric or stratospheric molecules: recent updates performed in the GEISA database

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January 25-29, 2010

IASI, Annecy,

Excellent results achieved by IASI for trace gas retrievals.

- **CO, ozone, CH₄, CO₂** , are now measured
- **Ammonia (NH₃): NH₃ is now measured by IASI (Clarisse, Clerbaux, Dentener, Hurtmans, Coheur, Nature Geoscience, 2009.**
- **Tracking and quantifying volcanic SO₂ is possible.** L. Clarisse, P. F. Coheur, A. J. Prata, D. Hurtmans, A. Razavi, T. Phulpin, J. Hadji-Lazaro, and C. Clerbaux
- **O₃: Numerous papers** (Talks from Scannell, Dufour, Coman...& posters)
- **Nitric acid (HNO₃) Talk by Wespes et al.)**
- **Formic acid (HCOOH):** talk from Razavi et al.

Goal of this study

- To suggest **new molecules** which could – possibly ?? – be measured by IASI
- For this purpose, it is necessary to propose the best possible spectroscopic parameters

Spectroscopy ???

- High resolution spectra recorded in laboratory
- Well defined experimental conditions
- Accurate theoretical model used to reproduce the line intensities and positions

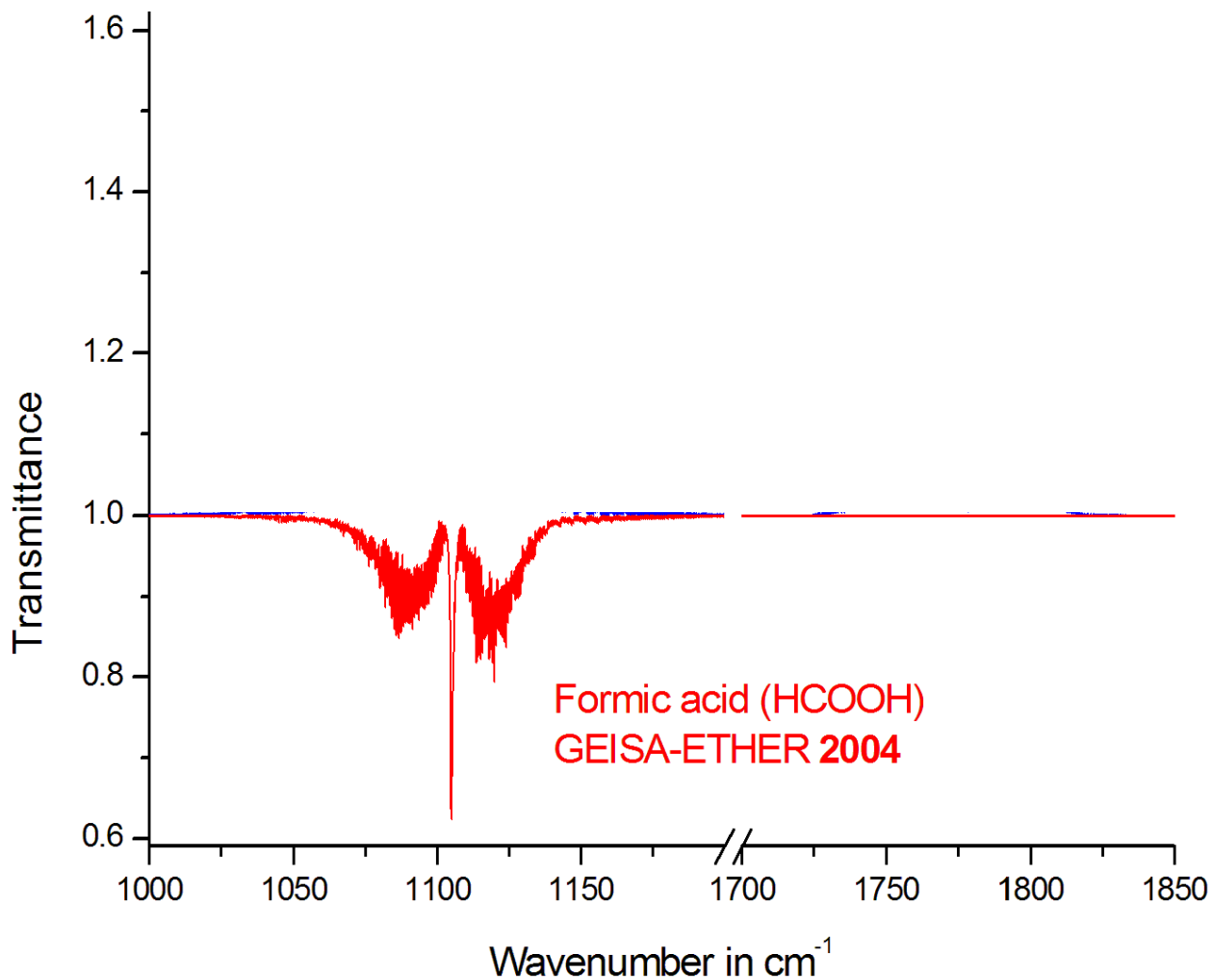
Formic acid (*trans*-HOOH)

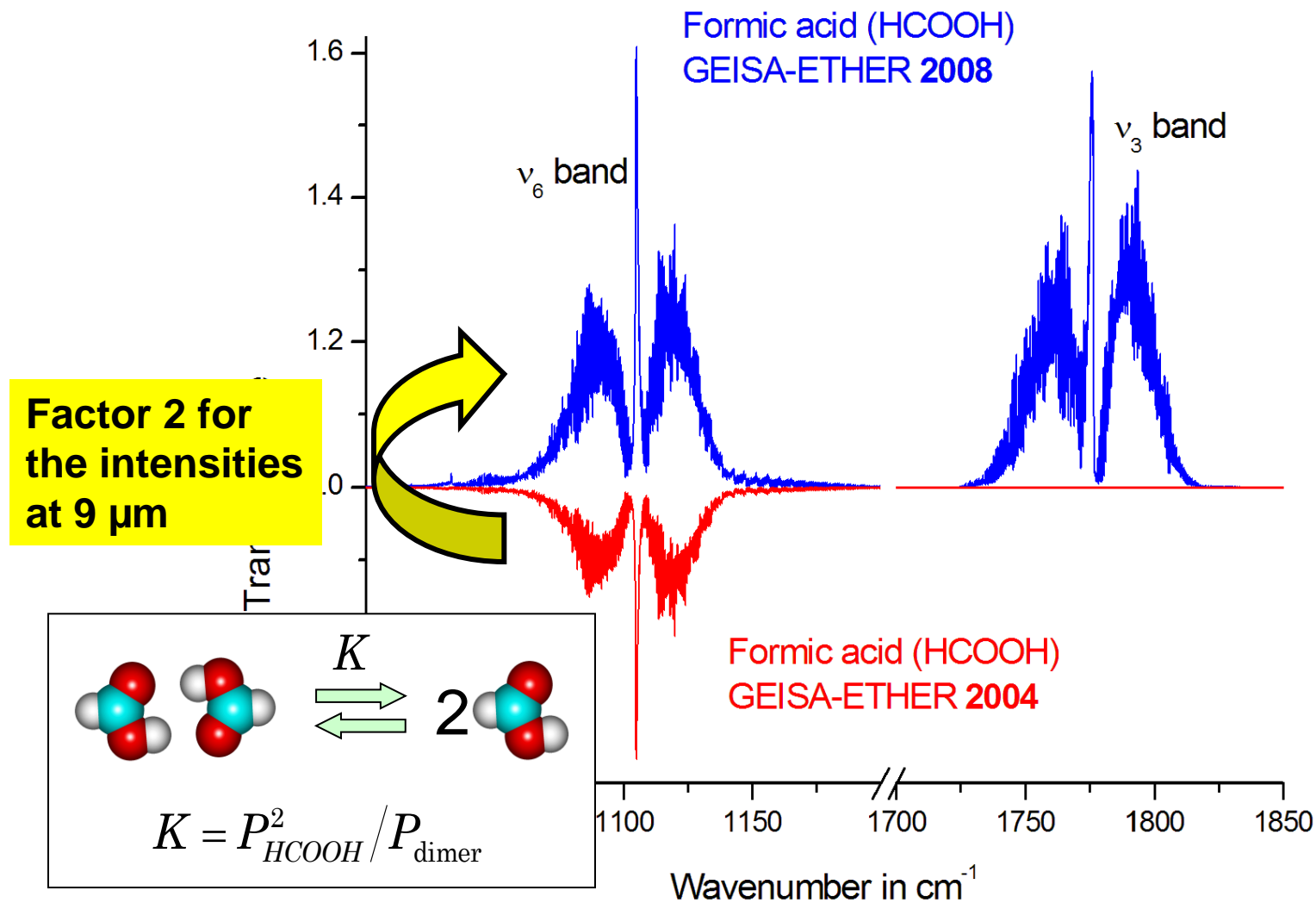
Thursday talk:

Razavi, Karagulian, Clarisse, Hurtmans,
Coheur, Clerboux, Stravrakov, Müller

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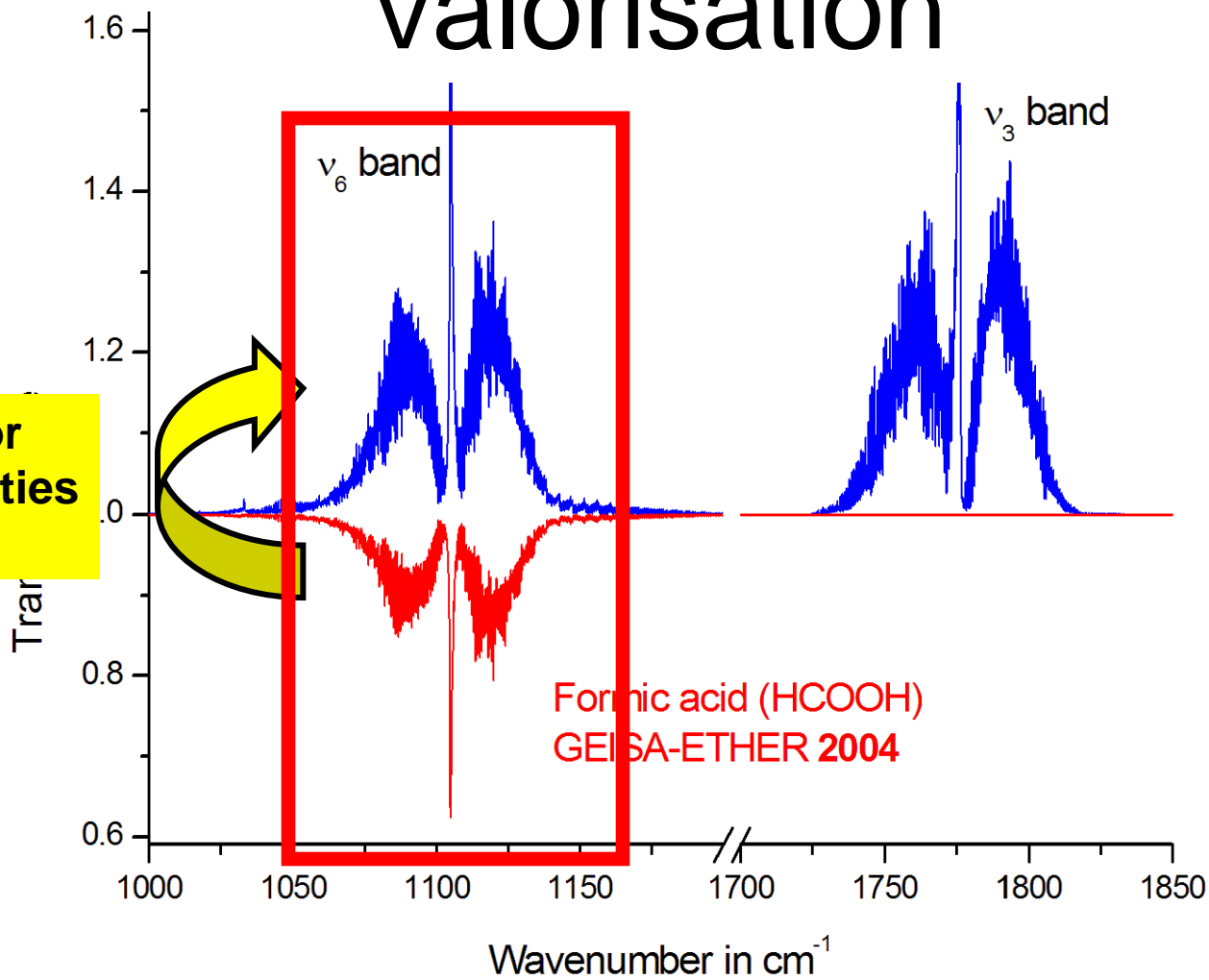
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Valorisation

Factor 2 for the intensities at 9 μm



Valorisation for the 9 μm band of HCOOH (ν_6 band)

- In the **new database** the **intensities** are about **two times stronger** than the previous one
- With this **new database** the **retrieved HCOOH are about two times weaker** than with the previous version
- The new database is now used by *Zander et al* \$ for the retrieval of formic acid above the **Jungfrauoch**
- Evaluation of **daytime**, **day to day variability**, **diurnal** and **seasonal modulation**, inter annual variations during the **1985-2007 period**.
- They perform a new **re-analysis** of the « **old** » **measurements** 1985-2006 using the **new spectroscopic database** (instead of the old one)

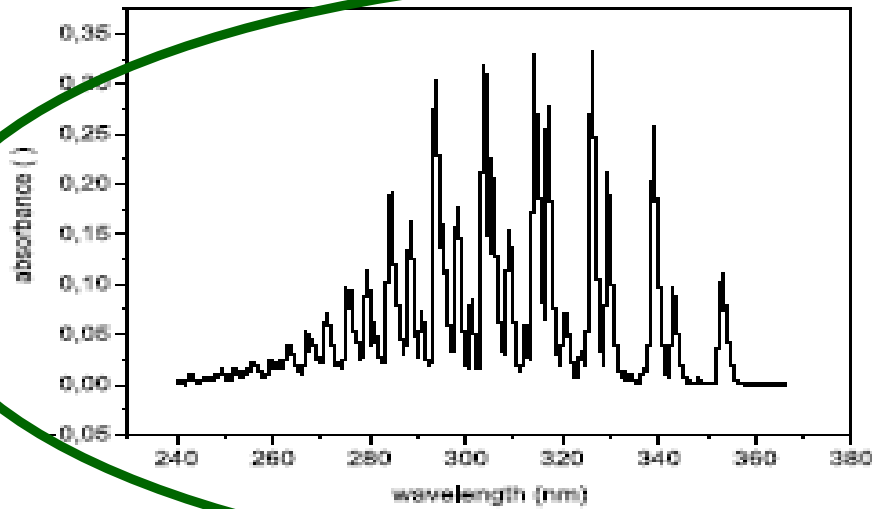
\$ Zander, Duchatelet, Mahieu, Demoulin, Roland, Servais, Vander Auwera, Perrin, Rinsland & Crutzen, *paper in preparation*

Formaldehyde (H_2CO)

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UV-VIS

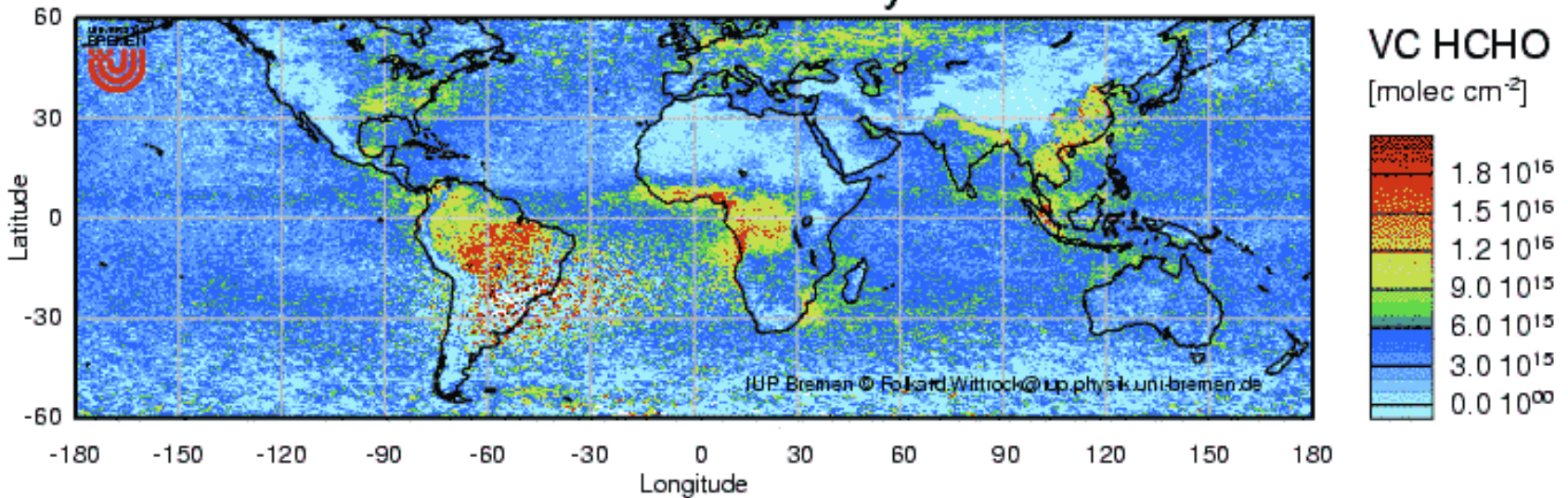


INSU
Formaldéhyde
(H₂CO)

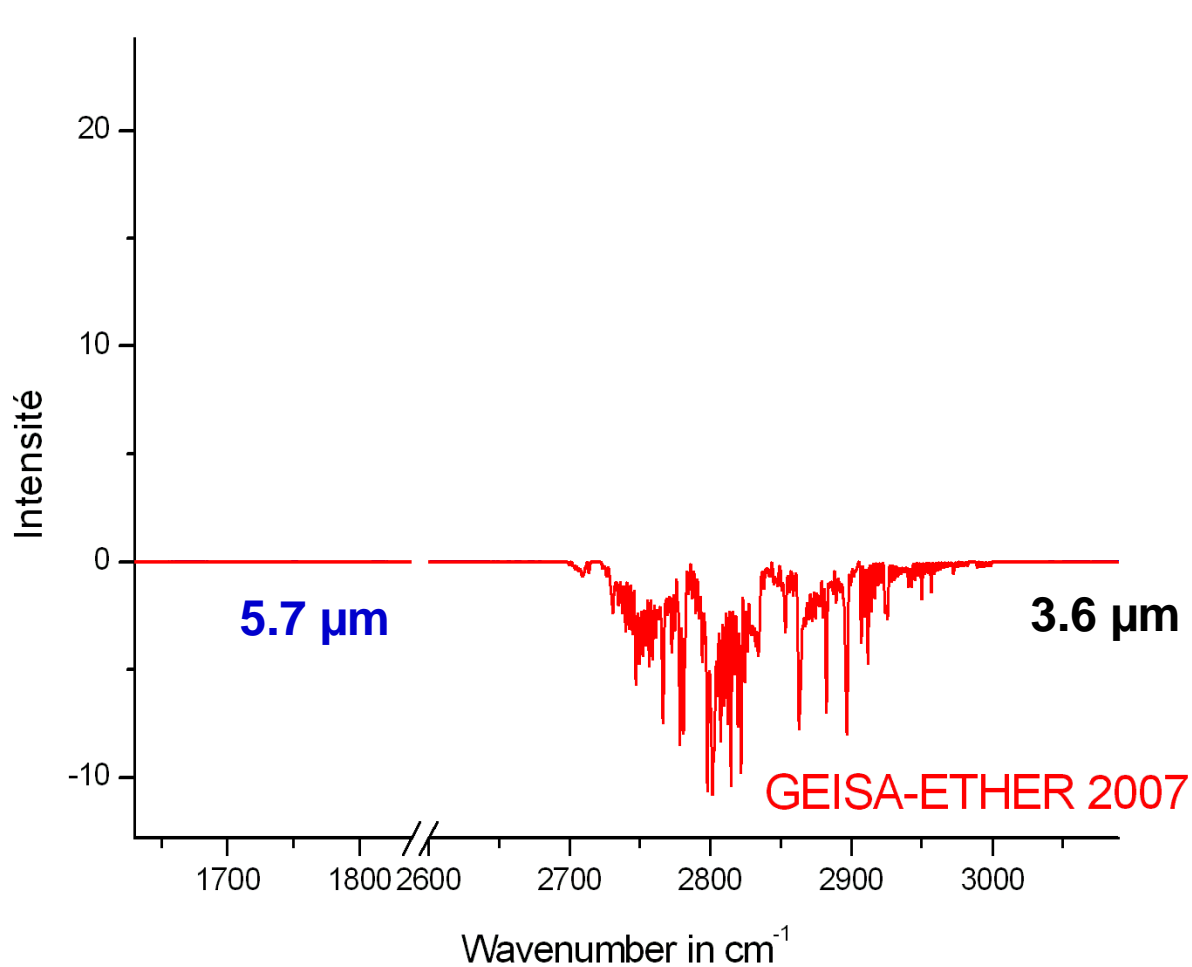
GOME & SCIAMACHY

Only the 'UV-VIS was used for satellite measurements of Formaldehyde

SCIAMACHY Formaldehyde 2005

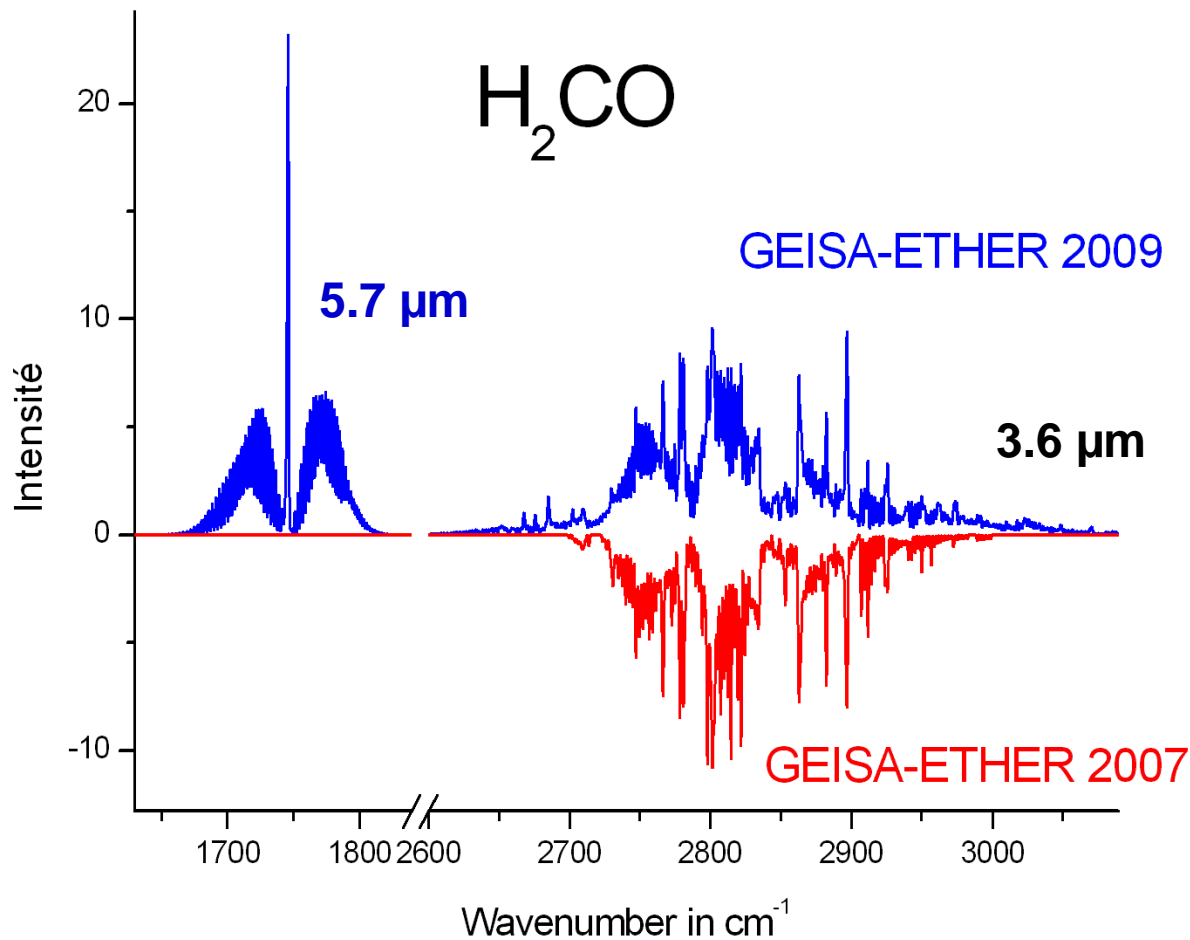


Formaldéhyde (H₂CO) in spectroscopic databases (infrared region)

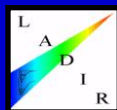


Formaldéhyde (H₂CO) in spectroscopic databases (infrared region).

After...



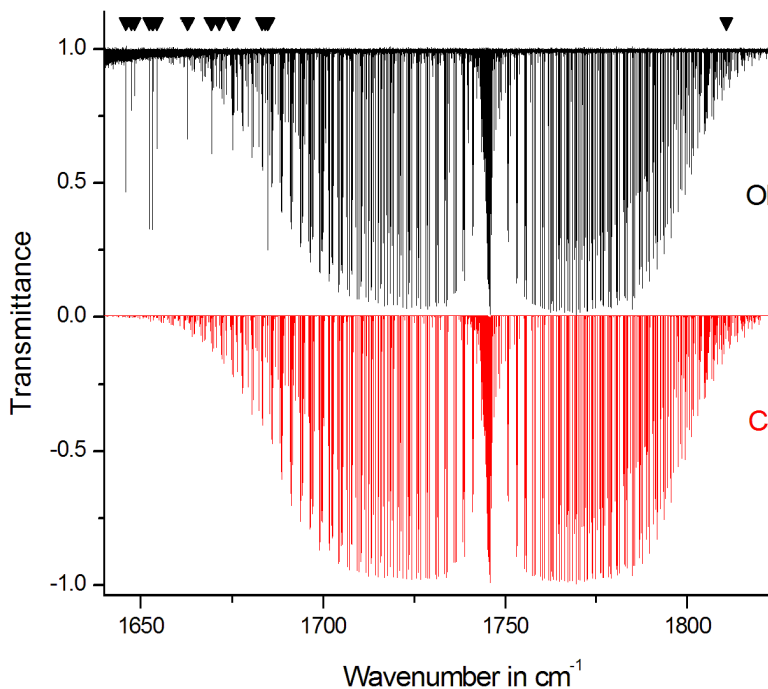
H₂CO: high resolution studies



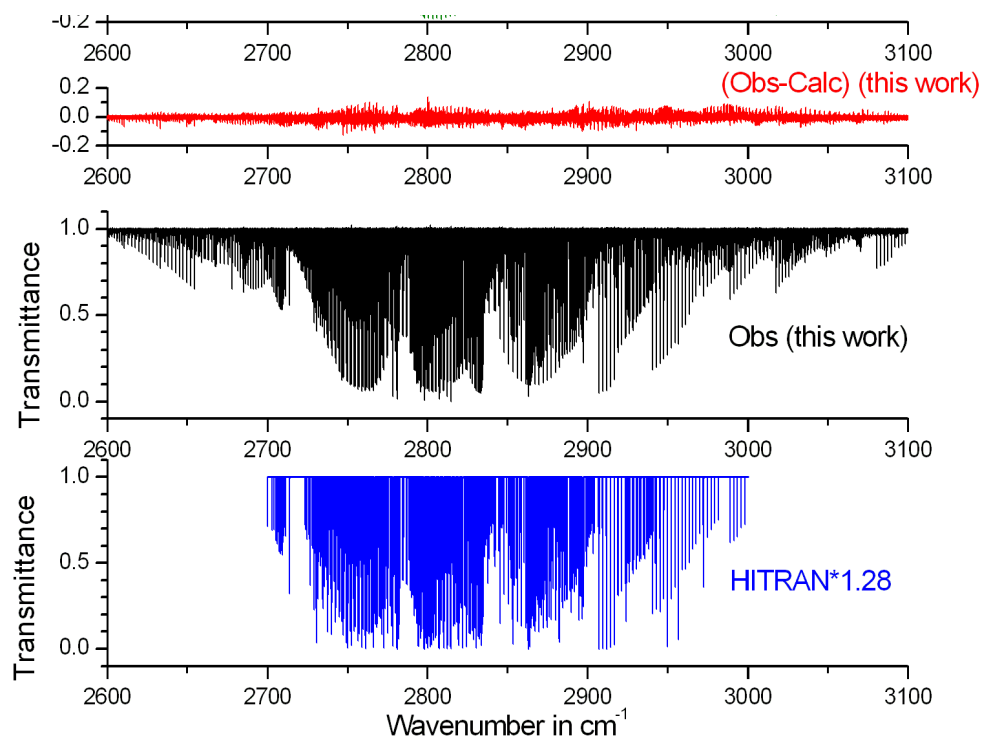
Experiment & Calculations



Bande ν_2 (5.7 μm)



Bandes ν_1 & ν_5 (3.6 μm)



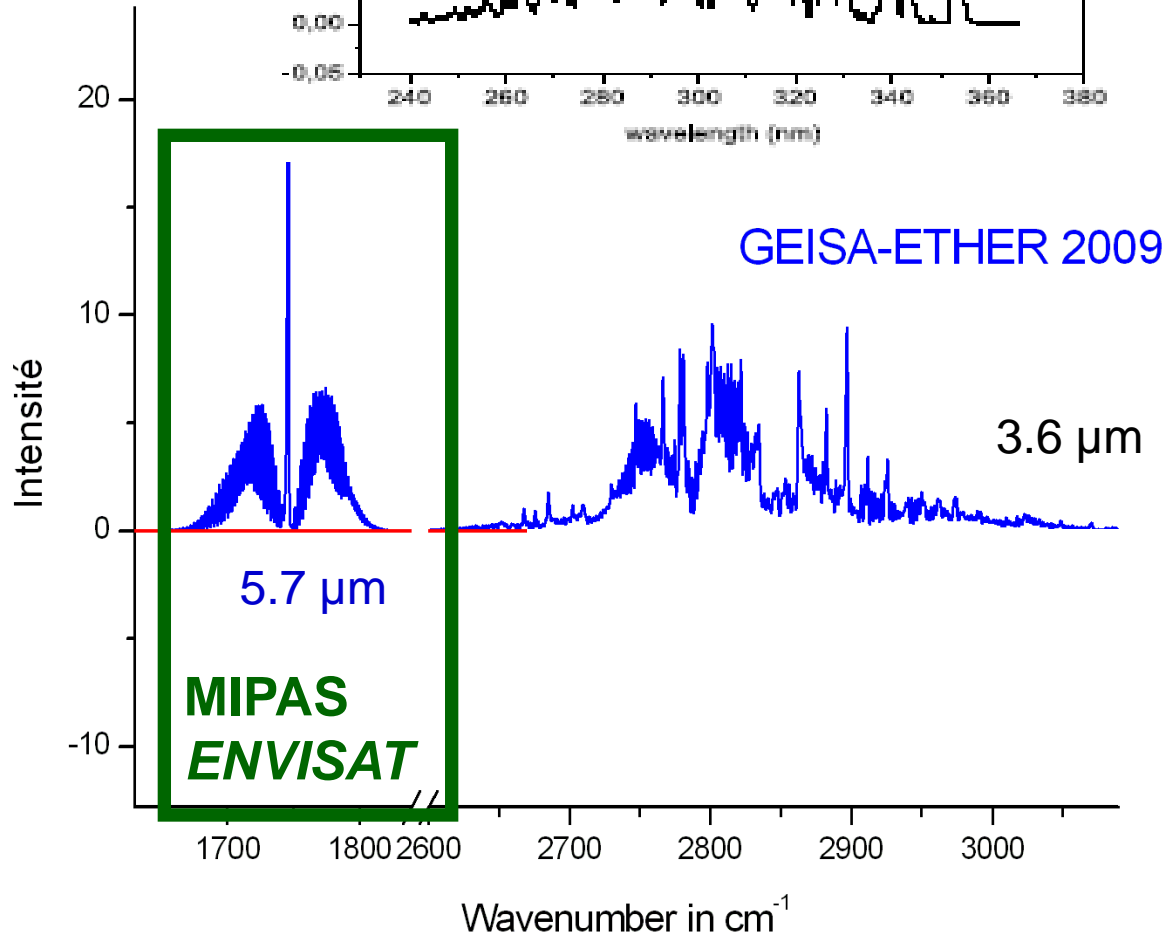
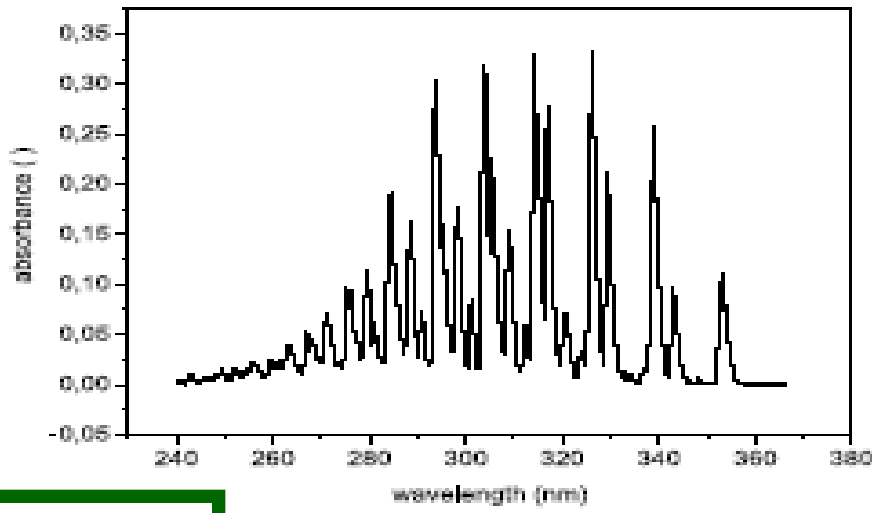
Formaldehyde (H_2CO)

Valorisation.....

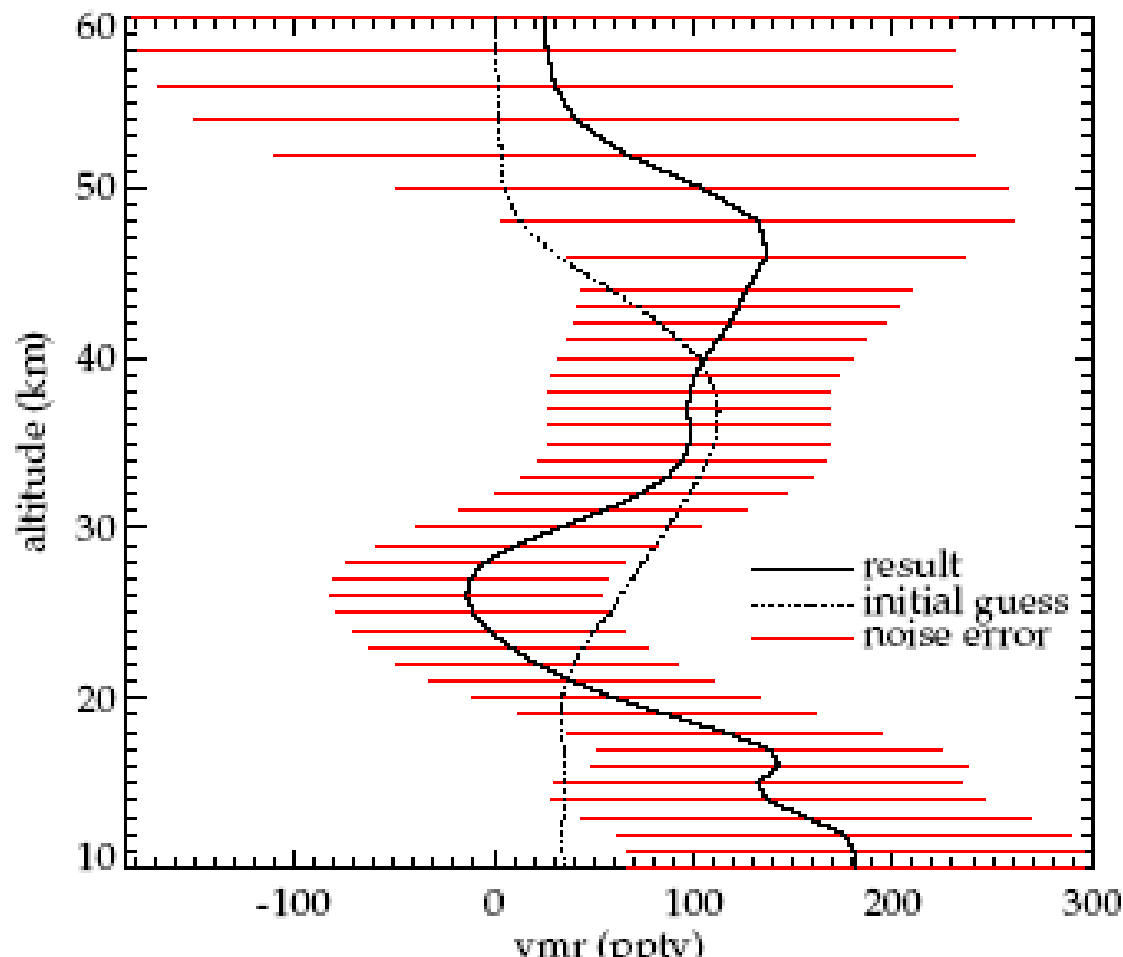
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UV-VIS:
GOME
SCIAMACHY



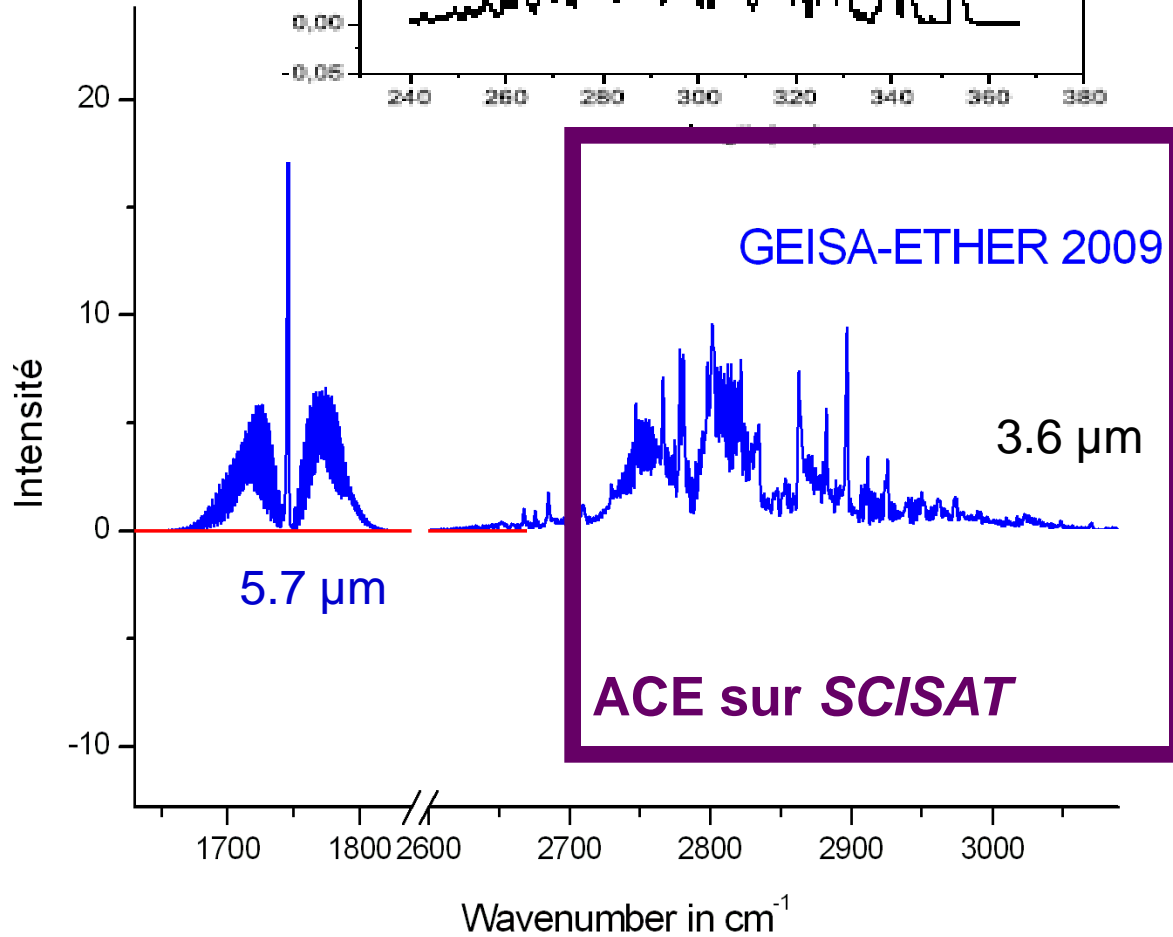
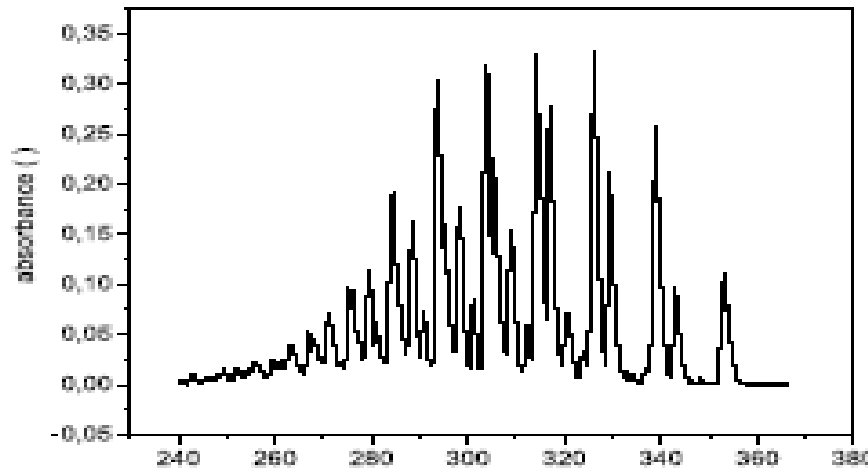
H₂CO retrievals by the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) instrument



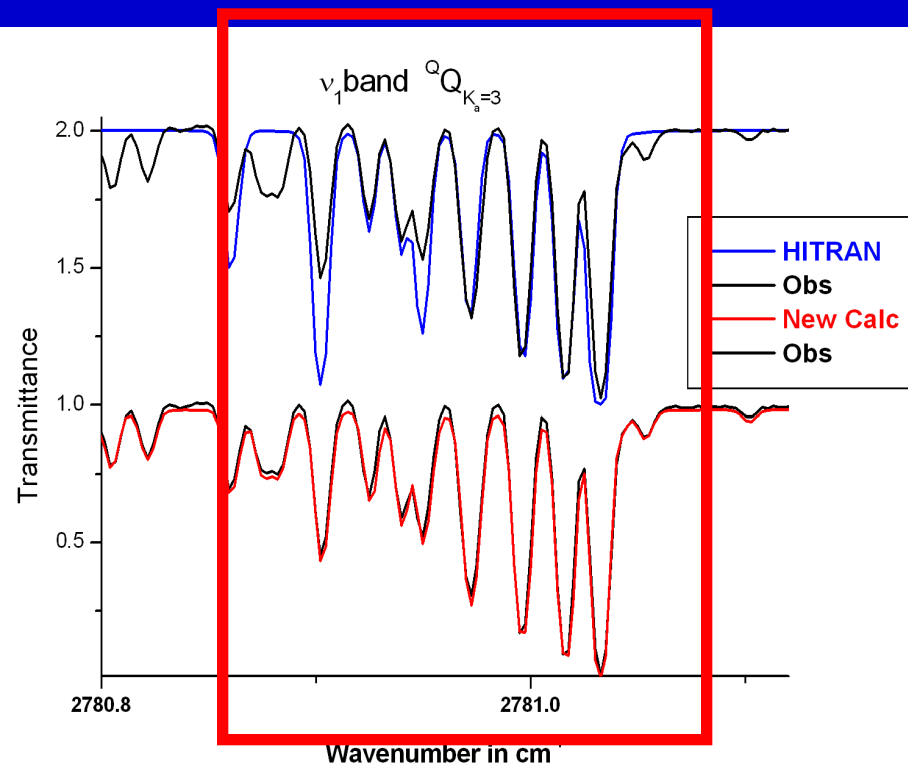
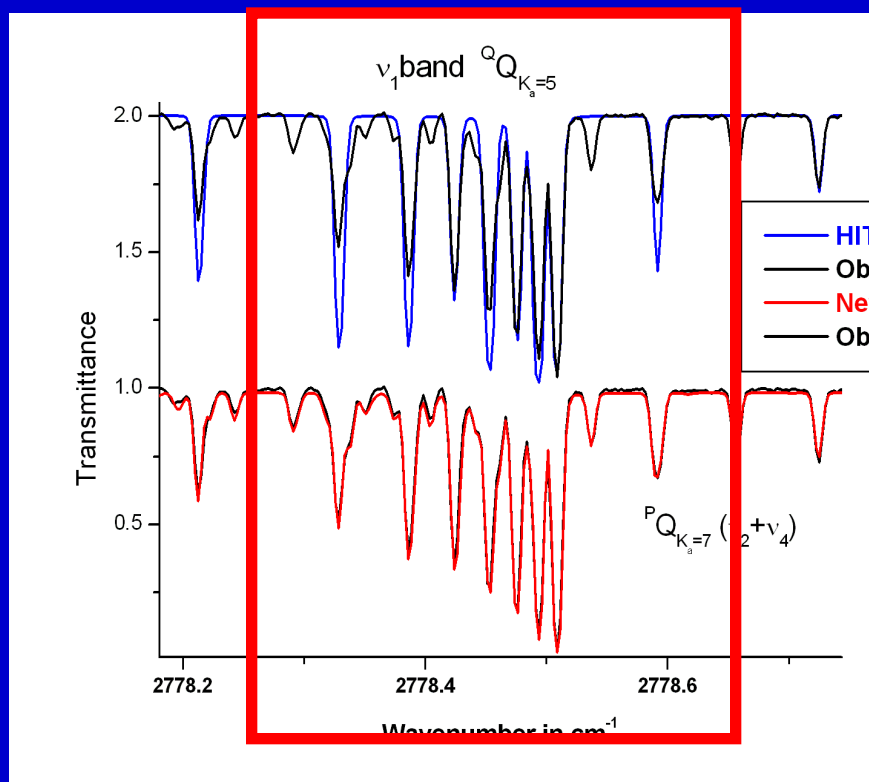
The **5.7 μm**
band used for
H₂CO
retrievals by
MIPAS on the
ENVISAT
satellite

Steck, Glatthor, von Clarmann, Fischer, Flaud, Funke, Grabowski, Höpfner, Kellmann, Linden, Perrin, and Stiller, **Retrieval of global upper tropospheric and stratospheric formaldehyde (H₂CO) distributions from high-resolution MIPAS-Envisat spectra**, *Atmos. Chem. Phys.*, 2008

UV-VIS:
GOME
SCIAMACHY



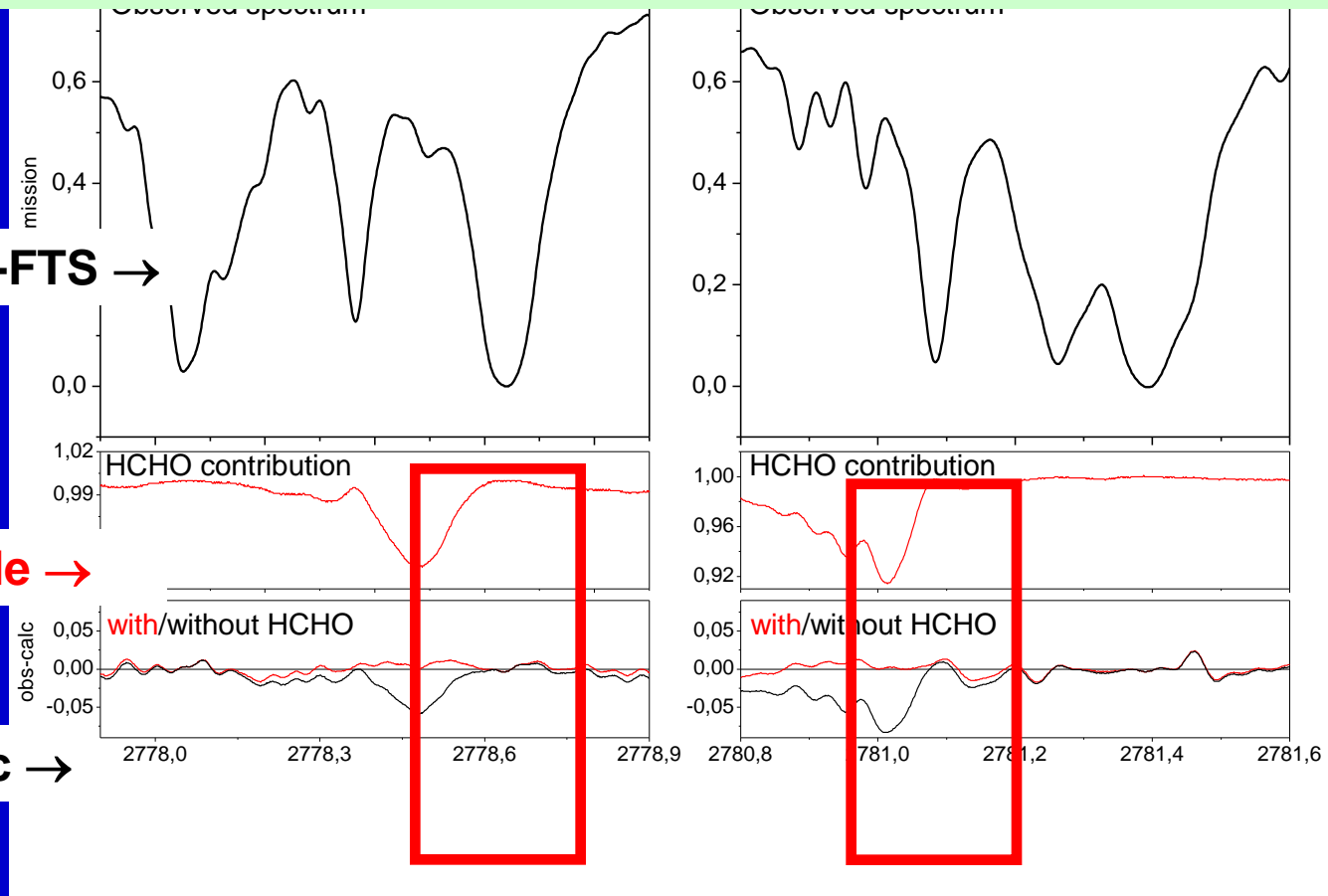
(Obs) Laboratory spectra at LADIR
(Calc) Calculations at LISA



These « Q » branches are now used by ACE-FTS on SCISAT satellite

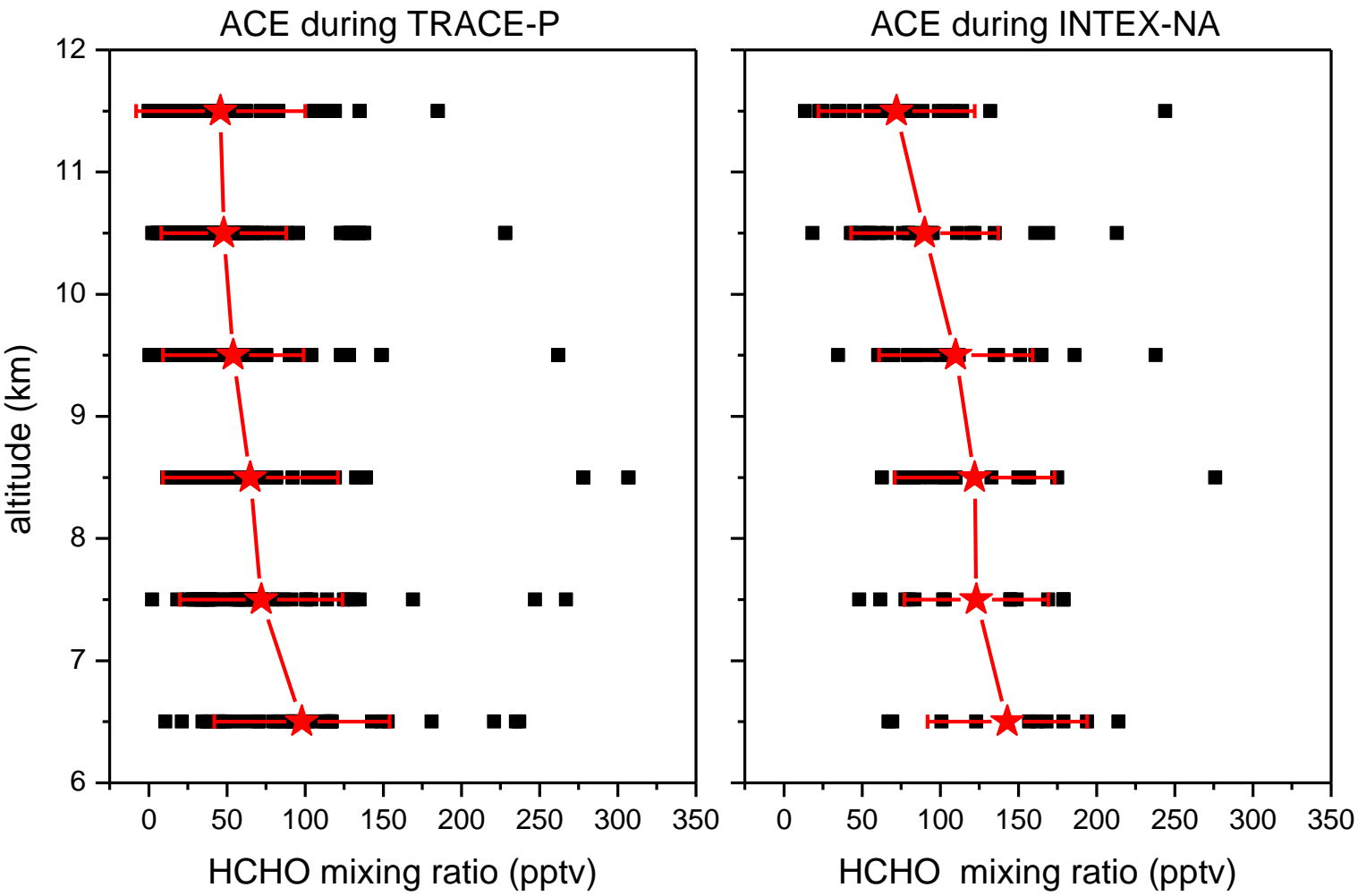
First validated measurements of formaldehyde in the 3.6 μm region by the ACE-FTS instrument on SCISAT

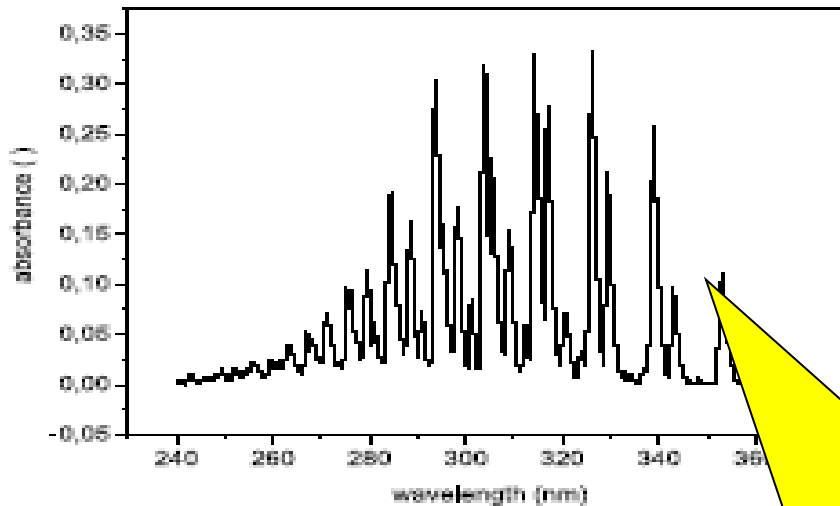
ACE-FTS →



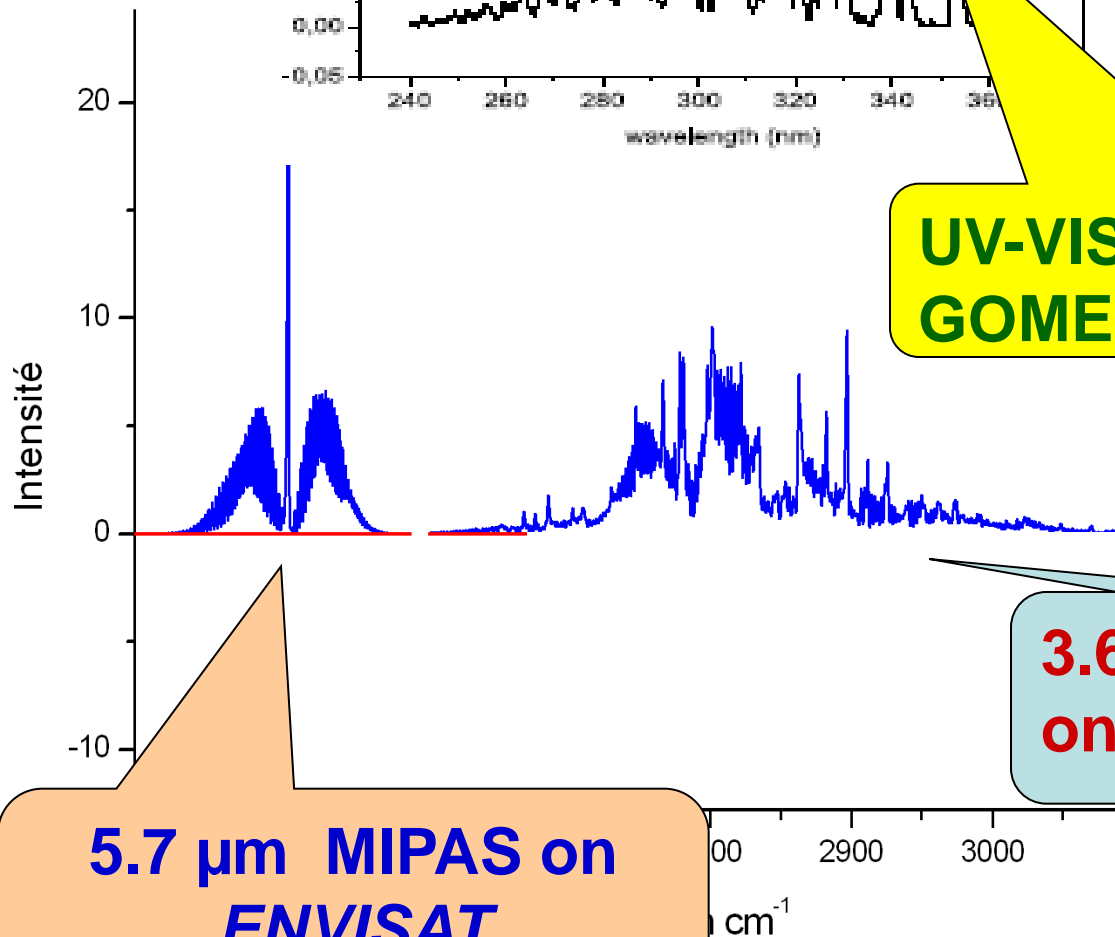
Formaldehyde →

Obs-Calc →



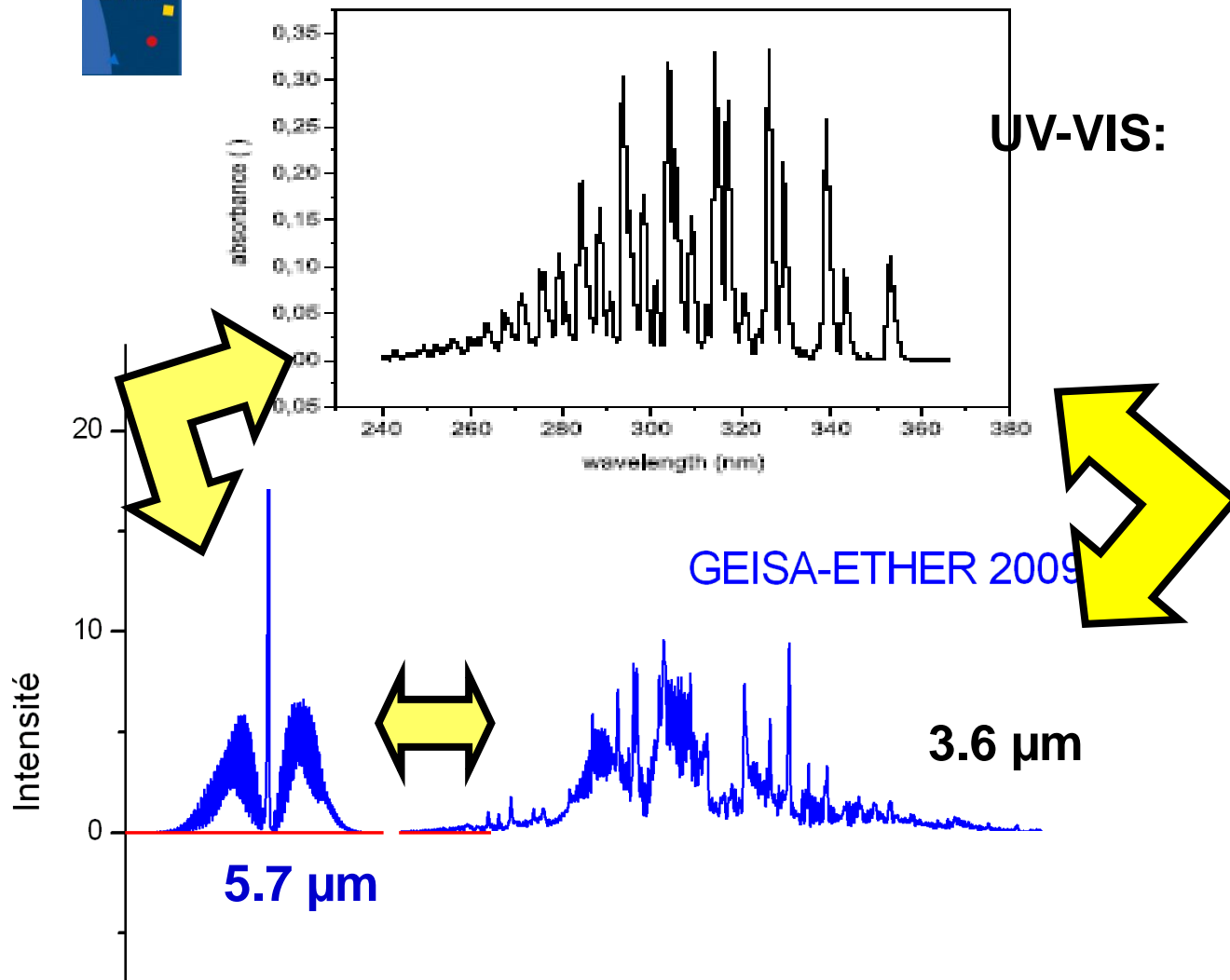


**UV-VIS:
GOME & SCIAMACHY**



**3.6 μm : ACE-FTS
on SCISAT**

**5.7 μm MIPAS on
ENVISAT**



GEISA-ETHER 2009

3.6 μm

5.7 μm

Intercomparaison and absolute band intensities measurements for formaldehyde

**Gratien, Picquet-Varrault, Orphal, Perraudin, Doussin and Flaud,,
J. Geophys. Research. 112, D05305, 2007**

Formaldehyde (H_2CO) & formic acid (HCOOH)

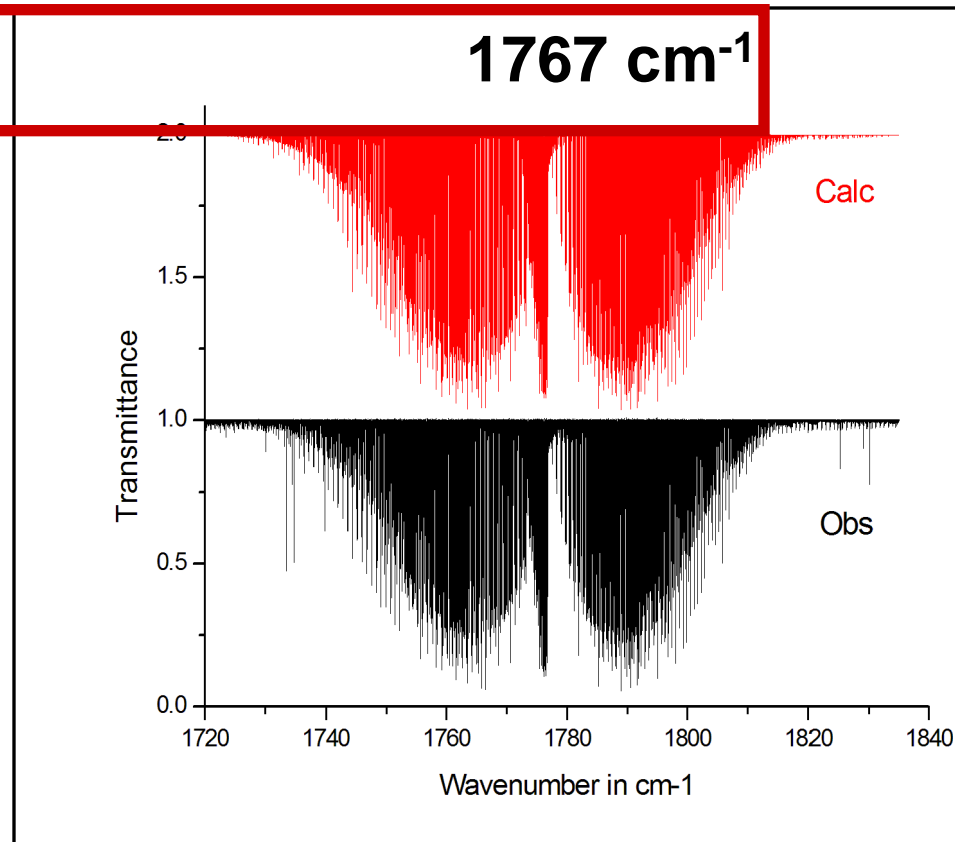
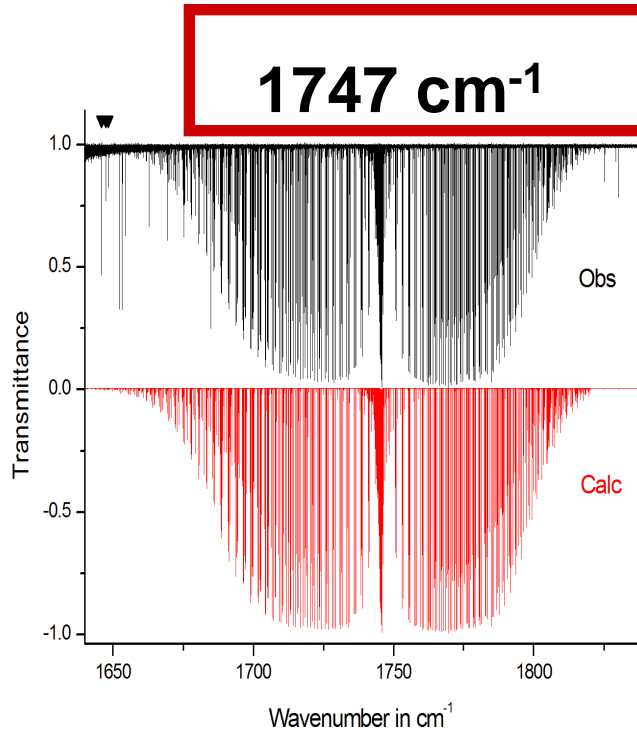
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Formaldehyde and formic acid

ν_2 band of H_2CO

ν_3 band of HCOOH



**Perrin, Jacquemart, Kwabie,
Lacome, J.Q.S.R.T. 110, 743-755
(2009)**

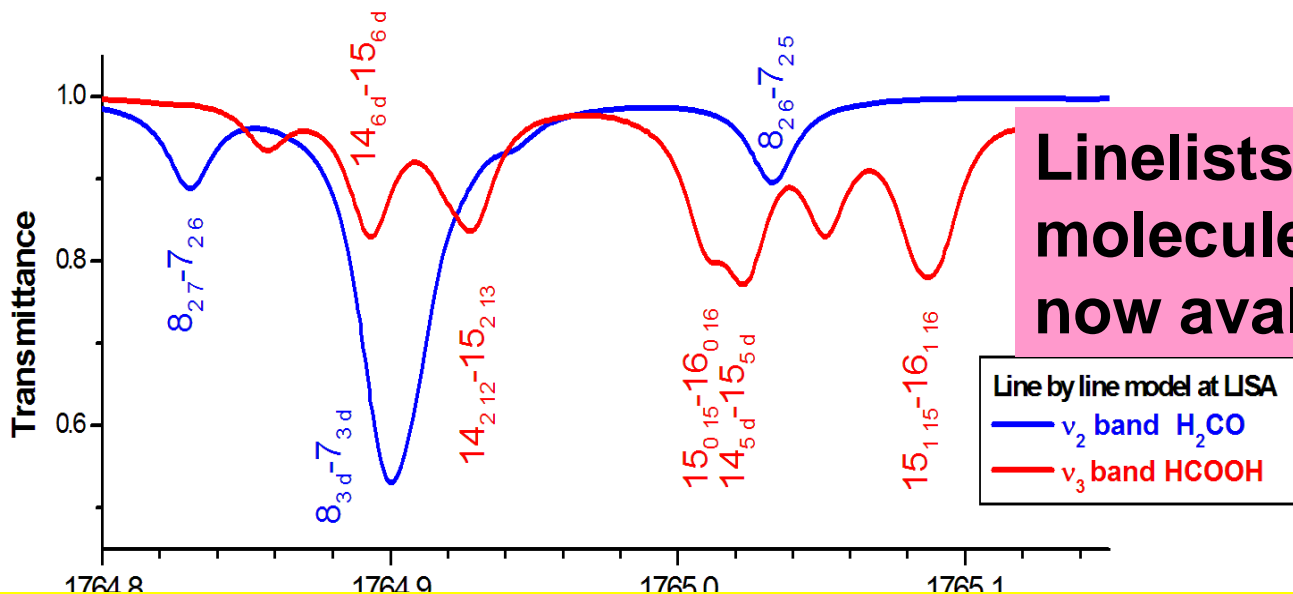
**Perrin, Auwera, Zelinger, J.Q.S.R.T. 110,
743-755 (2009)**

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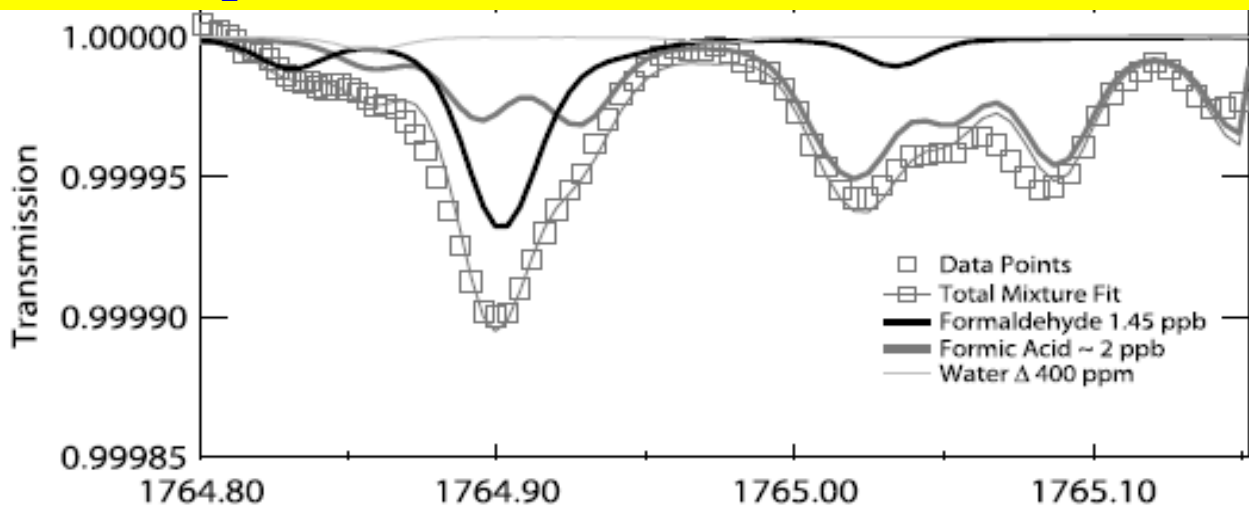
PARIS
DIDEROT

PARIS 12
VAL de
MARNE
CONNAISSANCE
ACTION



Linelists for both molecules are now available

$HCOOH$ and H_2CO can be retrieved simultaneously



Herndon, Zahniser, Nelson Jr., Shorter, McManus, Jiménez, Warneke, & de Gouw, "Airborne measurements of H_2CO and $HCOOH$ during the New England Air Quality Study 2004 using quantum cascade laser spectrometer », J. Geophys. Res. D112, D10S03, doi:10.1029/2006JD007600, 2007

Databases

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All our results (H_2CO , HNO_3 , HCOOH , ...) were communicated to



GEISA on Ether

<http://ether.ipsl.jussieu.fr/etherTypo/?id=977&L=0>

Nicole Jacquinet

An article is under preparation (Nicole Jacquinet Husson & co workers)

Our results were also communicated to

HITRAN: High resolution TRANsmission
molecular database



<http://cfa-www.harvard.edu/HITRAN/>

Thanks to the authors of this work

- **Formaldehyde (H_2CO) line lists:** D.Jacquemart, F.Kwabia-Tchana & N.Lacome (LISA & LADIR)
- **H_2CO cross sections measurements:** Gratien, Picquet-Varrault, Orphal, Perraudin, Doussin & J.M.Flaud (LISA)
- **H_2CO in ACE-FTS:** G.Dufour, Szopa, Barkley, Boone, Palmer, Bernath
- **H_2CO on MIPAS** Steck, N. Glatthor, T. von Clarmann, H. Fischer, J.-M. Flaud, B. Funke, U. Grabowski, M. Höpfner, S. Kellmann, A. Linden, A. Perrin, and G. P. Stiller
- **Formic acid ($HCOOH$):** J.Vander Auwera Didriche (ULB-Brussels)

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ECOLE d'été

SPECATMO

De la SPECTroscopie à l'ATMOsphère
mesures et modèles

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Finally, we would like to thank
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<http://pce.cnrs-orleans.fr/~specatmo/>

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Thank you !

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