

# Spectroscopic database GEISA-08 : content description and assessment through IASI/MetOp flight data

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## The ARA Group

The Atmospheric Radiation Analysis group is specialized in the study of the variability and evolution of the climate of the Earth from space borne observations made principally by vertical sounders, in the infrared and the microwave domains.

Its main research themes relate to the collection of a long term, global, climatology of the earth-atmosphere state: temperature and moisture; cloud characteristics, including their microphysical properties; greenhouse gases, mainly CO<sub>2</sub>, in relation with the carbon cycle; aerosols (volcanic, dust, smoke, etc.) infrared characteristics in relation with the earth radiative budget; continental surface infrared emissivities, in relation with the interaction between the surface and the atmosphere. The group is also deeply involved in statistical analysis of large spatio-temporal data bases (inverse problems, linear and non linear inference, neural networks, classification, pattern recognition, etc.).

The group has developed numerous tools in spectroscopy of the atmospheric gases, forward and inverse radiative transfer modelling, etc. In particular, the group develops and maintains the spectroscopic data base [GEISA](#) « Gestion et Etude des Informations Spectroscopiques Atmosphériques » (*Study and management of atmospheric spectroscopic information*).

The [Laboratoire de Météorologie Dynamique \(LMD\)](#) is a Laboratory of the French [Centre National de la Recherche Scientifique \(CNRS\)](#), of the [Ecole Polytechnique](#), of the [Ecole Normale Supérieure](#), of the [Université Pierre et Marie Curie \(Paris 6\)](#), and belongs to the [Institut Pierre-Simon Laplace \(IPSL\)](#). It is also one of the French space laboratories working in cooperation with the [Centre National d'Etudes Spatiales \(CNES\)](#).

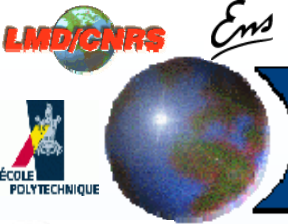


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# OUTLINE



## *General Context*



## *GEISA and GEISA/IASI System Overview*



## *GEISA-08 line transition parameters sub-database*

1) Database update summary

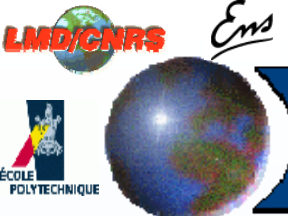
2) Evaluation of the impact of H<sub>2</sub>O spectroscopic archive differences using IASI 4A/STRANSAC Radiative transfer simulations

3) Evaluation of the impact of H<sub>2</sub>O spectroscopic archive differences using IASI Metop Flight Data and 4A/STRANSAC Radiative transfer simulations



## *Concluding Comments*



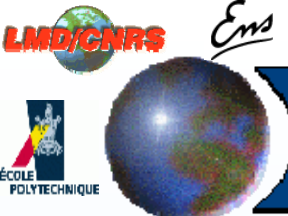


# GENERAL CONTEXT

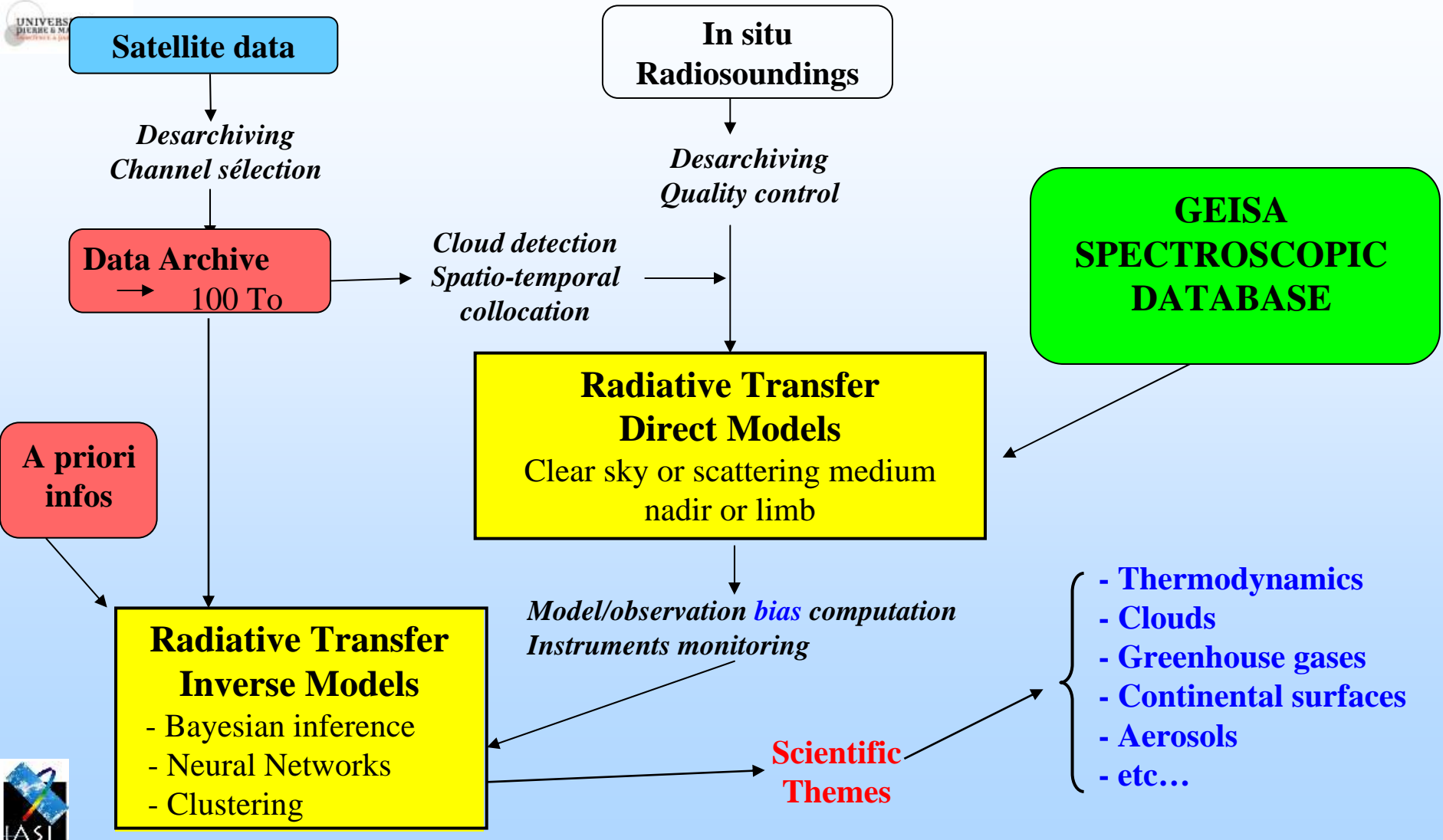


- ❖ The **ARA** (Atmospheric Radiation Analysis) group at **LMD** has been engaged, during the past three decades, in the development of **GEISA**, a computer-accessible spectroscopic database, designed to facilitate accurate and fast forward calculations of atmospheric radiative transfer using a line-by-line and (atmospheric) layer-by-layer approach.
- ❖ The performance of the second generation vertical sounding, high-resolution, sophisticated infrared spectroscopic instruments, such as **AIRS** in the USA and **IASI** in Europe, highly depends on the accuracy in the spectroscopic parameters of the optically active atmospheric gases, since such data constitute an essential input in the forward models that are used to interpret the recorded spectral radiances.





# FROM SATELLITE OBSERVATIONS TO CLIMATE VARIABLES: a long process based on Radiative Transfer



Courtesy A. Chédin, Trattoria/CNES  
2-3 April 2008





42 co-authors  
16 Laboratories

# GEISA and

Journal of Quantitative Spectroscopy &  
Radiative Transfer 95 (2005) 429–467



53 co-authors  
27 Laboratories

Journal of Quantitative Spectroscopy &  
Radiative Transfer 109 (2008) 1043–1059

Journal of  
Quantitative  
Spectroscopy &  
Radiative  
Transfer  
www.elsevier.com/locate/jqsrt

## The GEISA spectroscopic database: Current and future archive for Earth and planetary atmosphere studies

### The 2003 edition of the GEISA/IASI spectra

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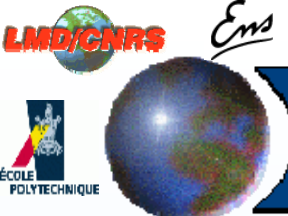
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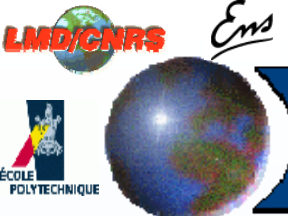
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# GEISA and GEISA/IASI System Overview





# THE GEISA-2008 SYSTEM



**G**estion et **E**tude des **I**nformations **S**pectroscopiques **A**tmosphériques  
Management and Study of Atmospheric Spectroscopic Information

## Three SUB-DATABASES

- **Line transition parameters database**  
48 molecules (102 isotopic species)  
over 3,200,000 entries between 0 and 35,877  $\text{cm}^{-1}$
- **Absorption cross-sections database**
  - IR: 39 molecular **species (mainly CFC's)**
  - UV/Visible : 11 molecular species
- **Aerosol data archive and softwares**

**ASSOCIATED MANAGEMENT SOFTWARES**  
each sub-database)

(For





# GEISA/IASI DATABASE GENERAL CONTEXT

- **Extraction of GEISA-08 between 599 & 3001  $\text{cm}^{-1}$** 
  - Individual spectral lines spectroscopic parameters sub-database  
*14 molecules (53 isotopic species):*  $\text{H}_2\text{O}$ ,  $\text{CO}_2$ ,  $\text{O}_3$ ,  $\text{N}_2\text{O}$ ,  
 $\text{CO}$ ,  $\text{CH}_4$ ,  $\text{O}_2$ ,  $\text{NO}$ ,  $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{HNO}_3$ ,  $\text{OCS}$ ,  $\text{C}_2\text{H}_2$ ,  $\text{N}_2$
  - IR absorption cross-sections sub-database (mainly CFC's)  
*6 molecular species:* CFC-11, CFC-12, CFC-14,  $\text{CCl}_4$ ,  
 $\text{N}_2\text{O}_5$ , HCFC-22
  - Microphysical and optical properties of Basic Atmospheric aerosol components sub-database (similar with the GEISA-03 one)
- **Continuous update**
- **Related with:**
  - CNES/EUMETSAT EPS mission
  - IASI measurement capabilities assessment
  - ISSWG

## Associated interest for AIRS

IASI : Infrared Atmospheric Sounder Interferometer

AIRS : Advanced InfraRed Sounder

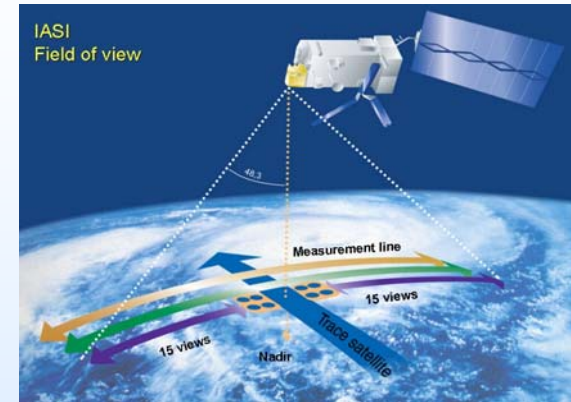
ISSWG : IASI Sounding Science Working Group

CNES : Centre National d'Etudes Spatiales, France

EUMETSAT : European organization for the exploitation of METeorological SATellites



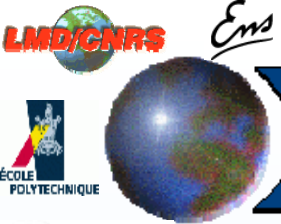
## IASI on METOP since October 19th 2006 launch



- **GEISA/IASI** used as the reference spectroscopic database
- **Validation achieved using 4A line by line Radiative Transfer Model** [Scott & Chédin, J.Appl.Met (1981); 4A/LMD <http://ara.lmd.polytechnique.fr>; 4A/OP co-developed by LMD and Noveltis with the support of CNES (2006)]



**Related to**  
**IASI Level 1 Cal/Val activities@ CNES**



# GEISA and GEISA/IASI interactive distribution

GEISA and associated facilities are implemented on the **Ether (CNRS/IPSL)** Products and Services Centre (CPS)

Effective January 2007

**Ether Products and Services Centre Facilities:**

<http://ether.ipsl.jussieu.fr>





# Welcome to the Ether website

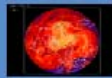
« L'harmonieux Ether dans ses vagues d'azur enveloppe les monts d'un fluide plus pur » Lamartine

This website offers various products of French activities in national and international projects. The access rights vary according to the products (see "Login Request"). [More information ...](#)

## Original products



IASI : french activities



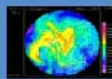
MIMOSA : Potential vorticity and temperature analysis and forecasts in Northern, Southern Hemisphere and Tropics



NDACC-FRANCE: Network for Detection of Atmospheric Composition Change



GEISA : spectroscopic data



REPROBUS : Chemistry Transport Model in Polar winters



ECCAD : data for emissions calculation



ARLETTY : temperature and pressure profiles calculation



Chemical Kinetics Database



ODIN-SMR : official data and specific production (O3, CO, ...)



GIRAFE : biomass burning plumes

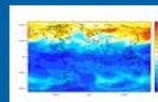


SOLSPEC : solar radiation spectrum data

## Other products



Select by Experiment



Models and Assimilations



Software

Ether Users : [LOGIN REQUEST](#) | [USER SPACE](#) | [ORDER TRACKING](#) | [USER RIGHTS](#)

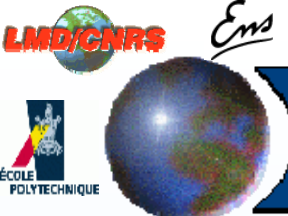


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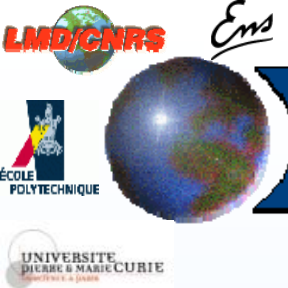




# GEISA-08 line transition parameters sub-database

## 1) Database update summary





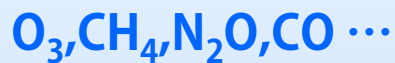
# Molecular species in the GEISA individual spectral lines sub-database



- Major Permanent constituents of EARTH's atmosphere :



- Minor permanent constituents of the EARTH's atmosphere :



- Trace molecules in the EARTH's atmosphere :



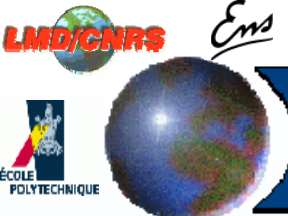
- Molecules present in the atmospheres of JUPITER, SATURN, URANUS, TITAN etc. :



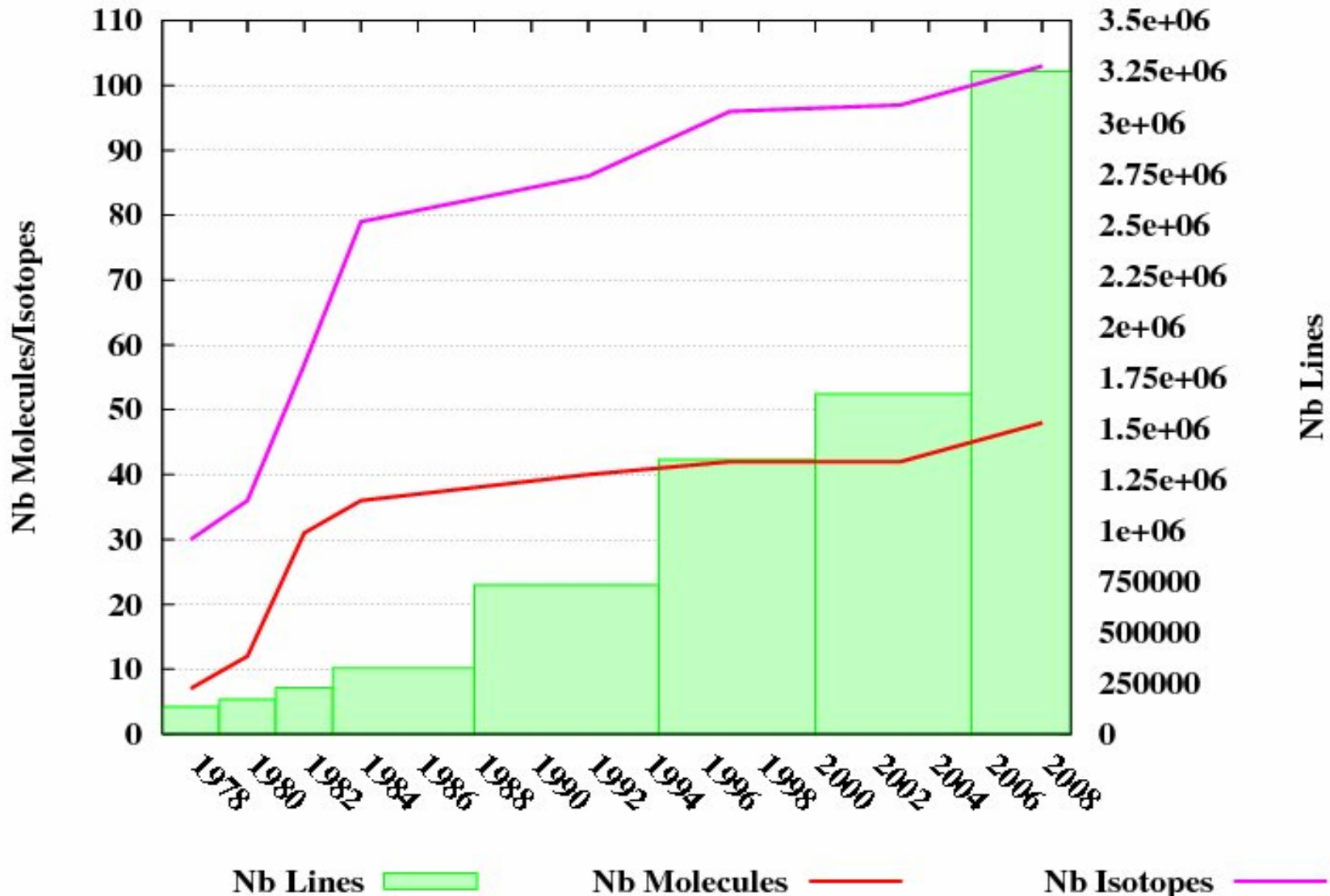
Spectral range: 0 – 35,877  $cm^{-1}$







# EVOLUTION GEISA SINCE 1978: line transition sub-database



# GEISA and GEISA/IASI-08 Line Transitions Records

255 Characters record

30 Parameters

- (A) Wavenumber ( $\text{cm}^{-1}$ ) of the line associated with the vibro-rotational transition.
- (B) Intensity of the line ( $\text{cm molecule}^{-1}$  at 296K).
- (C) Lorentzian collision halfwidth ( $\text{cm}^{-1} \text{atm}^{-1}$  at 296K).
- (D) Energy of the lower transition level ( $\text{cm}^{-1}$ ).
- (E) Transition quantum identifications for the lower and upper levels of the transition
- (F) Temperature dependence coefficient  $n$  of the halfwidth
- (G) Identification code for isotope.
- (I) Identification code for molecule.
- (J) Internal GEISA code for data identification.

*K-Q fields mainly HITRAN inter-compatibility related*

- (K) Molecule number as in HITRAN
- (L) Isotope number as in HITRAN
- (M) Einstein A-coefficient
- (N) Self broadening pressure halfwidth (HWHM) ( $\text{cm}^{-1} \text{atm}^{-1}$ ) at 296K
- (O) Air pressure shift of the line transition ( $\text{cm}^{-1} \text{atm}^{-1}$ ) at 296K
- (P) Accuracy indices for wavenumber, intensity and halfwidth
- (Q) Uncertainty indices

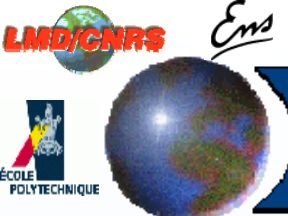
# GEISA and GEISA/IASI-08 Line Transitions Records (following)

- (R)** Temperature dependence coefficient  $n$  of the air pressure shift
- (A')** Estimated accuracy ( $\text{cm}^{-1}$ ) on the line position
- (B')** Estimated accuracy on the intensity of the line in ( $\text{cm}^{-1}/(\text{molecule}\cdot\text{cm}^{-2})$ )
- (C')** Estimated accuracy on the air collision halfwidth (HWHM) ( $\text{cm}^{-1}\text{atm}^{-1}$ )
- (F')** Estimated accuracy on the temperature dependence coefficient  $n$  of the air broadening
- HW**
- (O')** Estimated accuracy on the air pressure shift of the line transition ( $\text{cm}^{-1}\text{atm}^{-1}$ ) @296K
- (R')** Estimated accuracy on the temperature dependence coefficient  $n$  of the air pressure shift

*Water specific*

- (N')** Estimated accuracy on the self broadened (HWHM) ( $\text{cm}^{-1}\text{atm}^{-1}$ ) @296K
- (S)** Temperature dependence coefficient  $n$  of the self broadening halfwidth
- (S')** Estimated accuracy on the temperature dependence coefficient  $n$  of the self broadening HW
- (T)** Self pressure shift of the line transition ( $\text{cm}^{-1}\text{atm}^{-1}$ ) @296K
- (T')** Estimated accuracy on the self pressure shift of the line transition ( $\text{cm}^{-1}\text{atm}^{-1}$ ) @296K
- (U)** Temperature dependence coefficient  $n$  of the self pressure shift
- (U')** Estimated accuracy on the temperature dependence coefficient  $n$  of the self pressure shift

Standardized parameter missing values for GEISA-08 as a whole

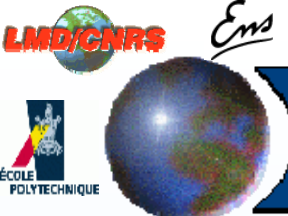


# FROM GEISA-03 TO GEISA-08: updated molecular species



MOI. ID	SPECTRAL RANGE/ BAND ID.	
	GEISA-03	GEISA-08 update
<b>H<sub>2</sub>O</b>	0.007- 25232.004 cm <sup>-1</sup>	500- 8000 cm <sup>-1</sup>
<b>CO<sub>2</sub></b>	436.123- 9648.007 cm <sup>-1</sup>	2200-7000 cm <sup>-1</sup> 4000-9000 cm <sup>-1</sup>
<b>O<sub>3</sub></b>	0.026- 4060.783 cm <sup>-1</sup>	1613- 4845 cm <sup>-1</sup> 6000- 7000 cm <sup>-1</sup>
<b>N<sub>2</sub>O</b>	0.838- 5131.249 cm <sup>-1</sup>	525- 10175 cm <sup>-1</sup>
<b>CH<sub>4</sub></b>	0.010- 9199.285 cm <sup>-1</sup>	750- 1350 cm <sup>-1</sup> 2850- 3150 cm <sup>-1</sup> 4800- 9200 cm <sup>-1</sup>
<b>O<sub>2</sub></b>	0.000- 15927.806 cm <sup>-1</sup>	0.7 μm region
<b>SO<sub>2</sub></b>	0.017- 4092.948 cm <sup>-1</sup>	1011- 1410 cm <sup>-1</sup>
<b>NO<sub>2</sub></b>	0.498- 3074.366 cm <sup>-1</sup>	780- 2940 cm <sup>-1</sup>
<b>PH<sub>3</sub></b>	17.805- 2478.765 cm <sup>-1</sup>	770-3601 cm <sup>-1</sup>
<b>HNO<sub>3</sub></b>	0.035- 1769.982 cm <sup>-1</sup>	Sub-millimeter U <sub>5</sub> -U <sub>9</sub> 2U <sub>9</sub> -U <sub>9</sub>  U <sub>5</sub> ; 2U <sub>9</sub> (U <sub>8</sub> +U <sub>9</sub> ); (U <sub>6</sub> +U <sub>7</sub> )





# FROM GEISA-03 TO GEISA-08: updated molecular species (following)



MOI. ID

SPECTRAL RANGE/ BAND ID.

	GEISA-03	GEISA-08 update
<b>H<sub>2</sub>CO</b>	0.000 - 2998.527 cm <sup>-1</sup>	1.573 μm
<b>C<sub>2</sub>H<sub>6</sub></b>	725.603 - 2977.926 cm <sup>-1</sup>	12 μm region
<b>CH<sub>3</sub>D</b>	7.760 - 3306.810 cm <sup>-1</sup>	3250-3700 cm <sup>-1</sup>
<b>C<sub>2</sub>H<sub>2</sub></b>	604.774 - 3374.223 cm <sup>-1</sup>	2.5 μm and 3.8 μm 1.5 μm region 0.83 μm region
<b>C<sub>2</sub>H<sub>4</sub></b>	701.203 - 3242.172 cm <sup>-1</sup>	1380- 1509 cm <sup>-1</sup>
<b>HCN</b>	2.870 - 18407.973 cm <sup>-1</sup>	14 μm (U <sub>2</sub> ; 2U <sub>2</sub> -U <sub>2</sub> )
<b>C<sub>2</sub>N<sub>2</sub></b>	203.955 - 2181.690 cm <sup>-1</sup>	203.872 - 266.320 cm <sup>-1</sup>
<b>C<sub>4</sub>H<sub>2</sub></b>	190.588 - 654.425 cm <sup>-1</sup> 605.5 - 651.4 cm <sup>-1</sup>	199.1 - 244.0 cm <sup>-1</sup>
<b>HC<sub>3</sub>N</b>	474.293 - 690.860 cm <sup>-1</sup> 20 μm (U <sub>6</sub> )	16 μm (U <sub>5</sub> )
<b>HOCl</b>	0.024 - 3799.249 cm <sup>-1</sup>	3- 309 cm <sup>-1</sup>
<b>N<sub>2</sub></b>	1992.628 - 2625.497 cm <sup>-1</sup>	4.3 μm
<b>CH<sub>3</sub>Cl</b>	674.143 - 3161.830 cm <sup>-1</sup>	650 - 2650 cm <sup>-1</sup>
<b>H<sub>2</sub>O<sub>2</sub></b>	0.043 - 1499.487 cm <sup>-1</sup>	0.043 - 1730 cm <sup>-1</sup>



# FROM GEISA-03 TO GEISA-08: updated molecular species (following)

MOI. ID

SPECTRAL RANGE/ BAND ID.

GEISA-03

GEISA-08 update

HCOOH 1060.962 - 1161.251 cm<sup>-1</sup>

10 - 100 cm<sup>-1</sup>  
940 - 1244 cm<sup>-1</sup>

SF<sub>6</sub> 940.425 - 952.238 cm<sup>-1</sup>

U<sub>3</sub>, U<sub>4</sub>, U<sub>4</sub>+U<sub>6</sub>-U<sub>6</sub>

C<sub>3</sub>H<sub>4</sub> 290.274 - 359.995 cm<sup>-1</sup>

290 - 360 cm<sup>-1</sup>  
592 - 673 cm<sup>-1</sup>

ClONO<sub>2</sub> 763.641 - 790.805 cm<sup>-1</sup>

500 - 1330 cm<sup>-1</sup>

27 molecular species updated

## 6 New Molecular Species

CH<sub>3</sub>Br 16 μm

CH<sub>3</sub>OH 0.02 - 33 cm<sup>-1</sup>  
10 μm region

NO<sup>+</sup> 1635- 2530 cm<sup>-1</sup>

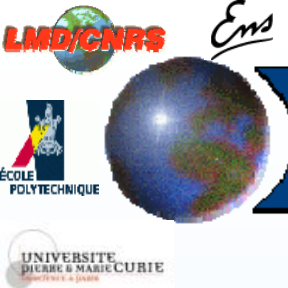
HNC 0.22 - 12594 cm<sup>-1</sup>

C<sub>6</sub>H<sub>6</sub> 642 -705 cm<sup>-1</sup>

C<sub>2</sub>HD 451 - 580 cm<sup>-1</sup>

600 - 760 cm<sup>-1</sup>





# FROM GEISA-03 TO GEISA-08: non-updated molecular species



MOI.

GEISA-03

=====

CO	3.414 - 8464.882 cm <sup>-1</sup>
NO	0.000 - 9273.214 cm <sup>-1</sup>
NH <sub>3</sub>	0.058 - 5294.502 cm <sup>-1</sup>
OH	.005 - 35877.031 cm <sup>-1</sup>
HF	41.111- 11535.570 cm <sup>-1</sup>
HCl	20.240 - 13457.841 cm <sup>-1</sup>
HBr	16.232- 9758.565 cm <sup>-1</sup>
HI	12.509 - 8487.305 cm <sup>-1</sup>
ClO	0.015 - 1207.639 cm <sup>-1</sup>
OCS	0.381- 4118.004 cm <sup>-1</sup>
GeH <sub>4</sub>	937.371 - 2224.570 cm <sup>-1</sup>
C3H8	700.015 - 799.930 cm <sup>-1</sup>
H <sub>2</sub> S	2.985- 4098.234 cm <sup>-1</sup>
COF <sub>2</sub>	725.006- 2001.348 cm <sup>-1</sup>
HO <sub>2</sub>	0.173- 3675.819 cm <sup>-1</sup>

15 Molecular species  
non updated



# Updates for 2008 Edition of GEISA/IASI line transition parameters sub-database *Preliminary non exhaustive list*

## Molecular species already archived in GEISA/IASI

<b>H<sub>2</sub>O</b>	500- 8000 cm <sup>-1</sup>	<b>LISA, JPL</b>
<b>CO<sub>2</sub></b>	2200-7000 cm <sup>-1</sup>	<b>JPL, LTS</b>
<b>N<sub>2</sub>O</b>	1900-6800 cm <sup>-1</sup>	<b>JPL</b>
<b>CH<sub>4</sub></b>	750-1350 cm <sup>-1</sup>	<b>ICB, JPL</b>
	2850-3150 cm <sup>-1</sup>	
<b>SO<sub>2</sub></b>	U <sub>1</sub> ,U <sub>3</sub>	<b>LISA</b>
	U <sub>1</sub> +U <sub>2</sub> -U <sub>2</sub>	<b>GSMA</b>
<b>HNO<sub>3</sub></b>	U <sub>5</sub> ; 2U <sub>9</sub>	<b>LISA</b>
<b>C<sub>2</sub>H<sub>2</sub></b>	604- 2254 cm <sup>-1</sup>	<b>LADIR</b>

## Molecular species related with IASI Trace Gas Retrievals to be added

HCN  
NH<sub>3</sub>  
HCOOH  
C<sub>2</sub>H<sub>4</sub>  
CH<sub>3</sub>OH

New PF 3.2 Version (courtesy of J.M. Flaud) to be considered

7 molecular species updated

# GEISA-08 line transition parameters sub-database

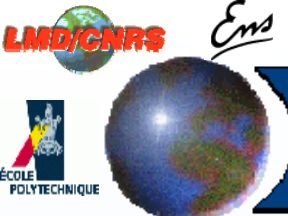
## 2) Evaluation of the impact of H<sub>2</sub>O spectroscopic archive differences using IASI 4A/STRANSAC Radiative transfer simulations

**4A** (Automatized Atmospheric Absorption Atlas);  
fast and accurate line-by-line radiative transfer model  
*[N.A. Scott and A. Chédin, 1981; Tournier et al. 1995; Chérut et al. 1995]*

**STRANSAC** *[N.A. Scott, 1974]*  
line-by-line and layer-by-layer model

in their **latest 2000 version**





# Selected Spectroscopic Databases



## Differences in contents and subsequent IASI radiative transfer modelling

### GEISA/IASI-03

Jacquinet-Husson N. et al. *JQSRT 95 (2005) 429-467.*

### GEISA/IASI-08 update with:

- Toth R.A. « Linelist of water vapor parameters from 500-8000  $\text{cm}^{-1}$  » *JQSRT (in preparation).*

<http://mark4sun.jpl.nasa.gov>

- Coudert L. H. et al. « The eight first vibrational states of the water molecule: measurements and analysis » *J.M.S. 228, 471-498 (2004)*; « The water molecule: line position and line intensity analyses up to the second triad » *J.M.S., in preparation.*

Spectral intervals: 600-800  $\text{cm}^{-1}$

1300-1500  $\text{cm}^{-1}$

1700-2000  $\text{cm}^{-1}$

### MIPAS Dedicated Spectroscopic Database Version PF 3.2

Flaud et al. *J. Atm. And Ocean Optics, 16 (2003) 172-182.*

### HITRAN-04

Rothman et al. *JQSRT 96 (2005) 139-204.*

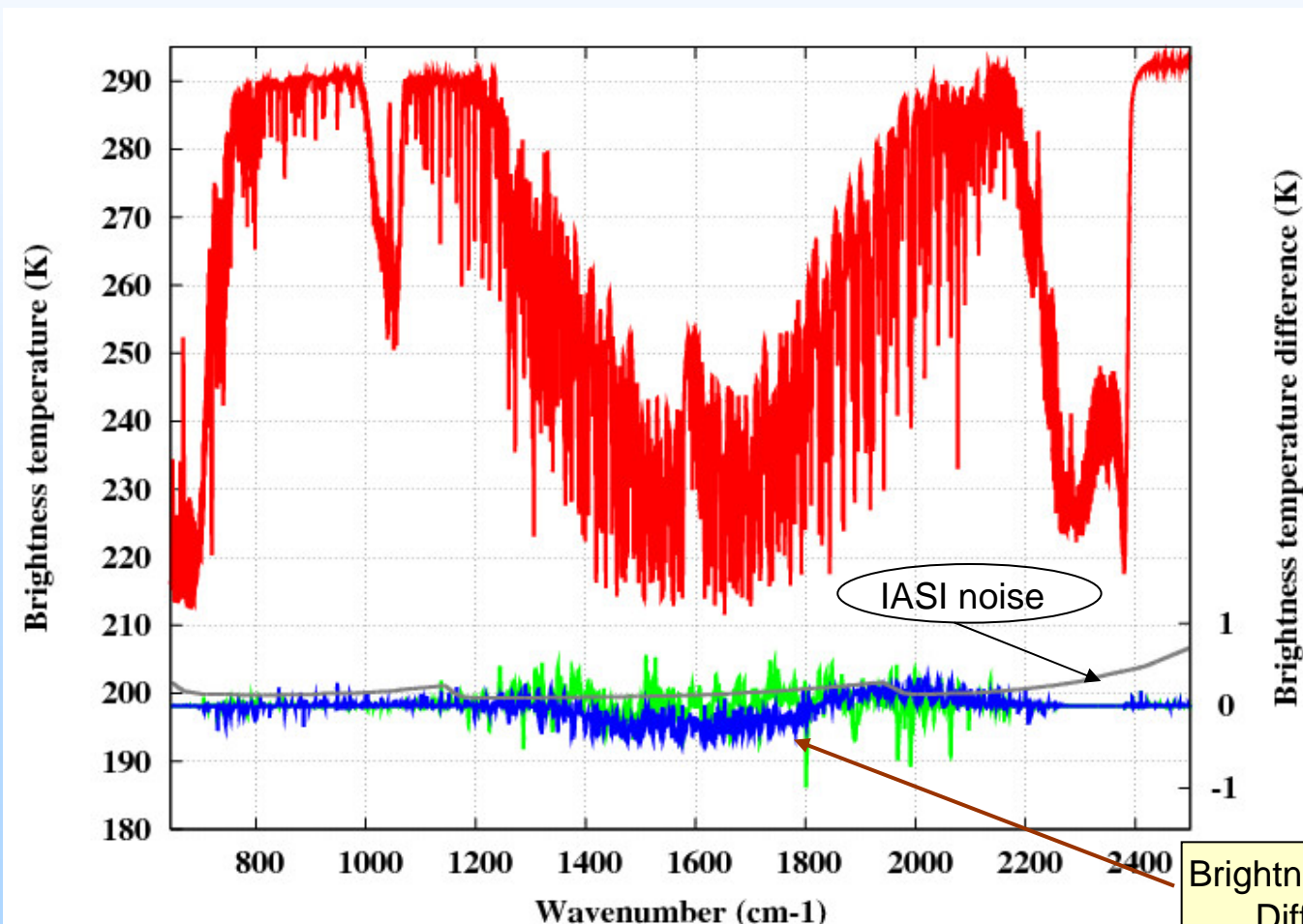
### HITRAN-06 update with:

Gordon et al. "Current updates of the water-vapor line list in HITRAN: a new "diet" for air-broadened half-width". *JQSRT 108 (2007) 389-402.*



# H2O Spectroscopy differences illustration

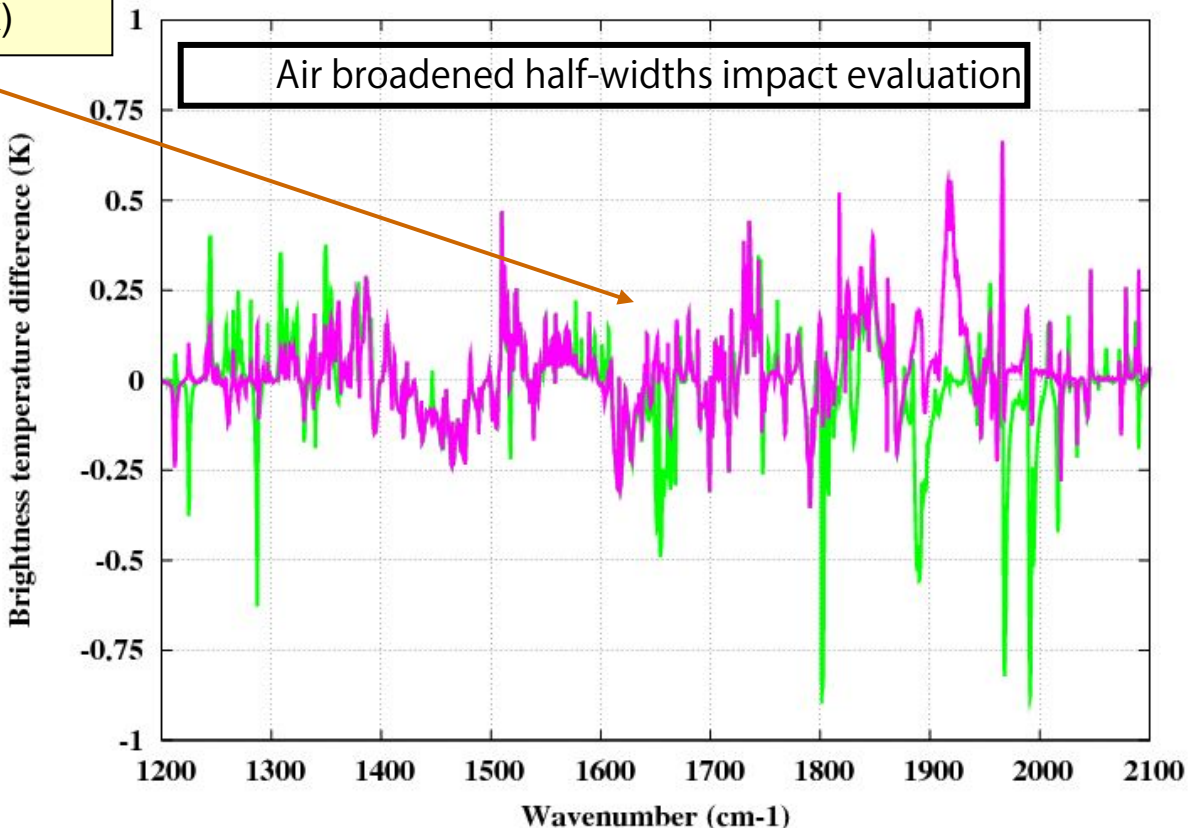
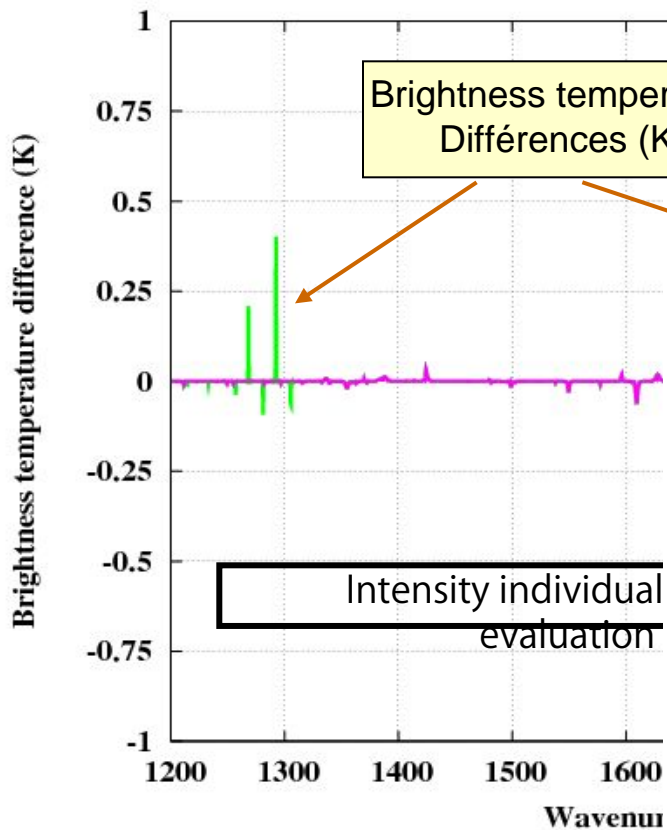
- ❖ IASI brightness temperature (K) simulation with **GEISA-03** (upper curve);
- ❖ Impact of replacement of **HITRAN-04** or **MIPAS PF3.2 H2O data** in GEISA IASI-03
- ❖ differences (K) in lower curves, with associated **IASI noise**.



Brightness temperature Differences (K)

# Individual impact of Spectroscopic parameters

**GEISA-03** IASI brightness temperature simulation differences (K), replacing H<sub>2</sub>O spectroscopy by **HITRAN-04** or **HITRAN-06** one





# GEISA-08 line transition parameters sub-database

3) Evaluation of the impact  
of H<sub>2</sub>O spectroscopic archive differences using  
**IASIMetop Flight Data** and 4A/STRANSAC Radiative  
transfer simulations

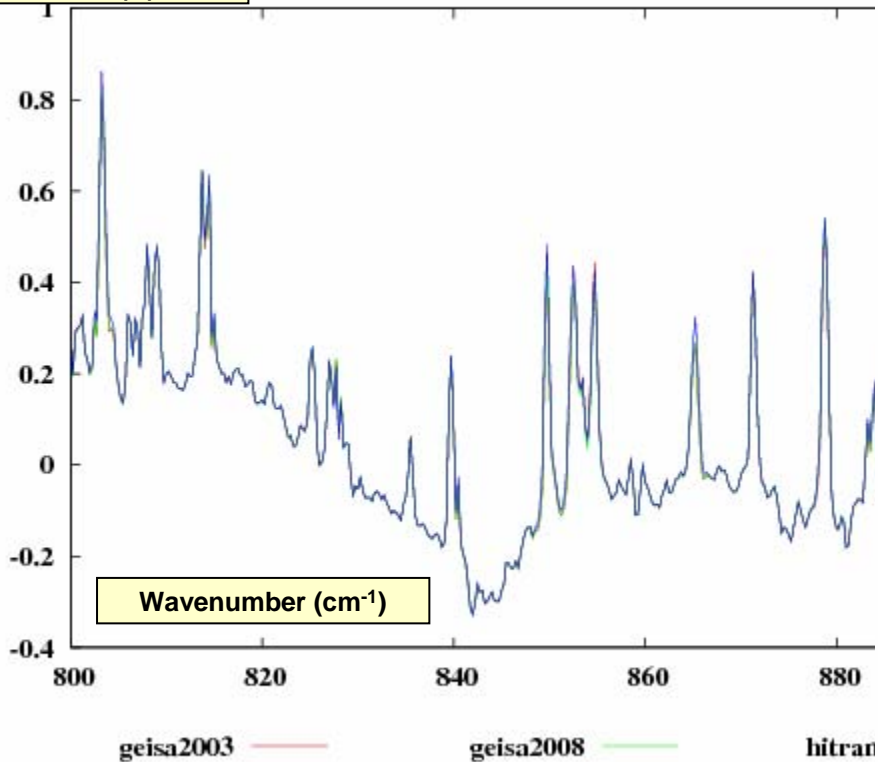
# Evaluation Process

- ✚ From the IASI level1b data (from Ether server), **a set of 69 IASI spectrums have been selected for the period of August 2007 to February 2008.**
- ✚ A collocation with the ECMWF radiosoundings have been made with a collocation's distance of : space = 100 km; time = less than 1 hour.
- ✚ **This dataset has been used to identify the quality of the update of GEISA-2008, in comparison with GEISA-2003 and HITRAN-2006 H<sub>2</sub>O archives.**
- ✚ **Two specific spectral regions have been selected:  
800-900 cm<sup>-1</sup> and 1800-2000 cm<sup>-1</sup>.**
- ✚ Whereas the first region don't show improvement in the spectroscopic parameters, the second seems to show a comparaison closest to the IASI observations with GEISA-2008.

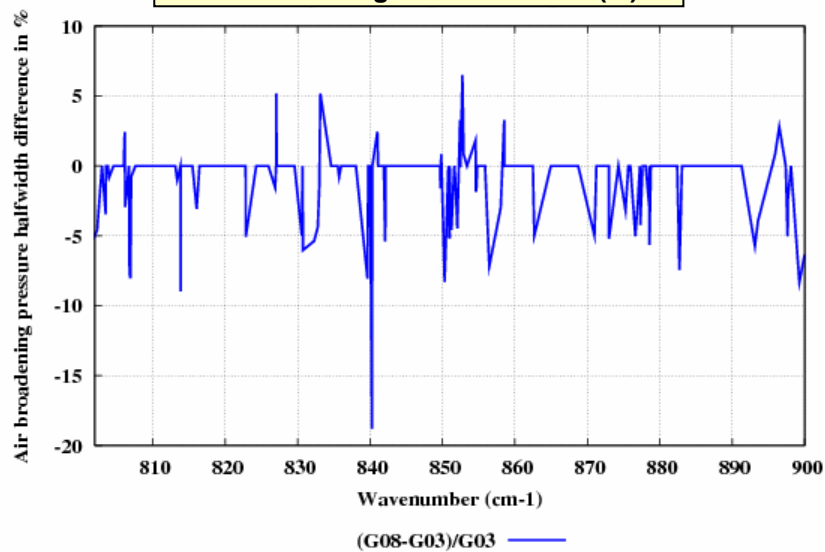
**These preliminary results have to be confirmed.  
Especially, the quality of the spectra have to be examined, and  
the number of collocations has to be increased.**

# 800 – 900 cm<sup>-1</sup> IASI Observations

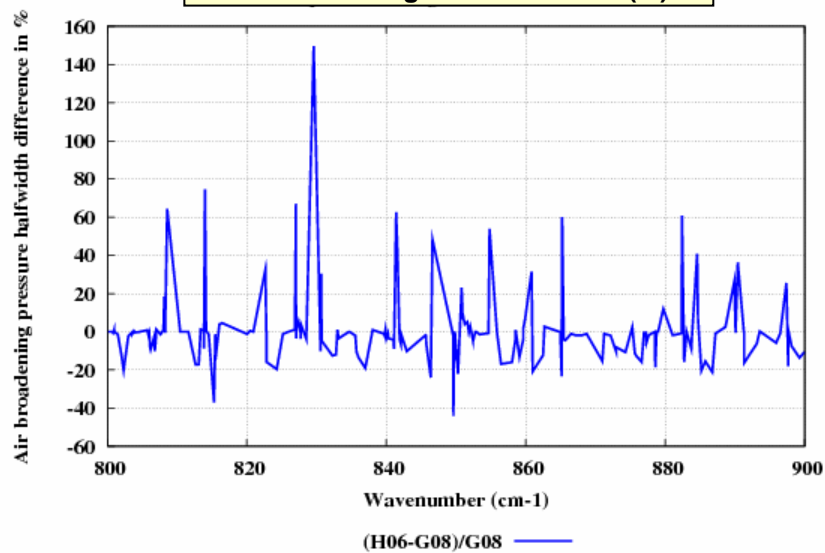
Brightness temperature  
 différences (K)



GEISA-03 vs GEISA-08  
 Air-broadening HW differences (%)

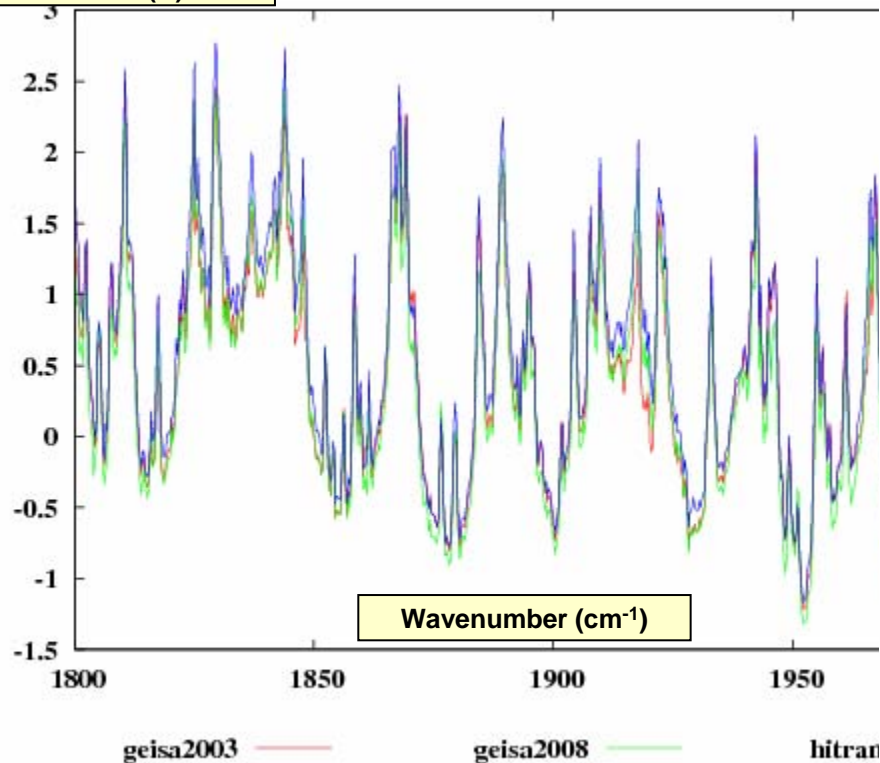


GEISA-03 vs HITRAN-06  
 Air-broadening HW differences (%)

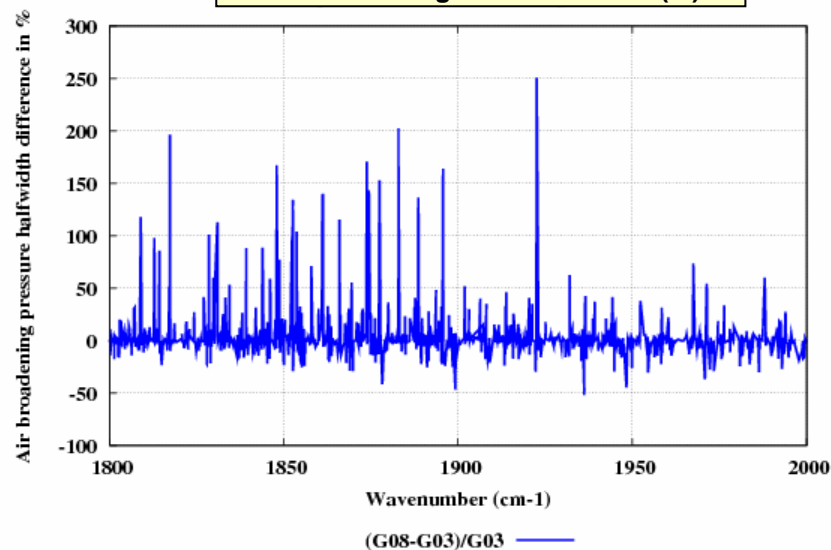


# 1800 – 2000 cm<sup>-1</sup> IASI Observations

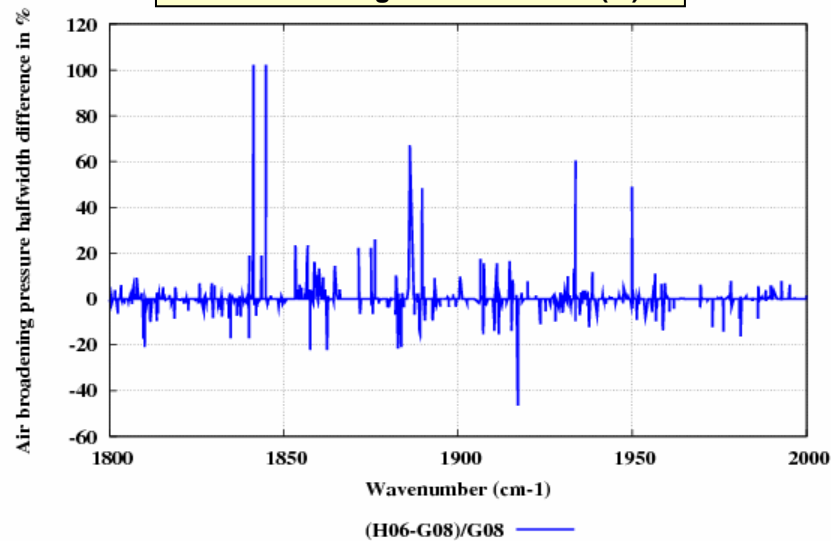
Brightness temperature  
 Différences (K)



GEISA-03 vs GEISA-08  
 Air-broadening HW differences (%)

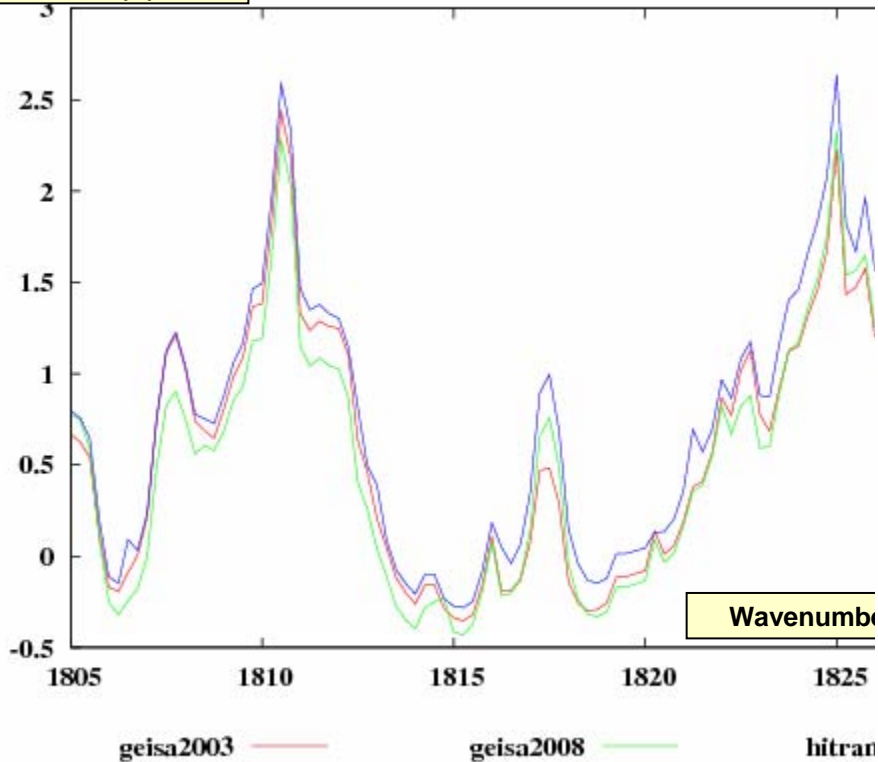


GEISA-03 vs HITRAN-06  
 Air-broadening HW differences (%)

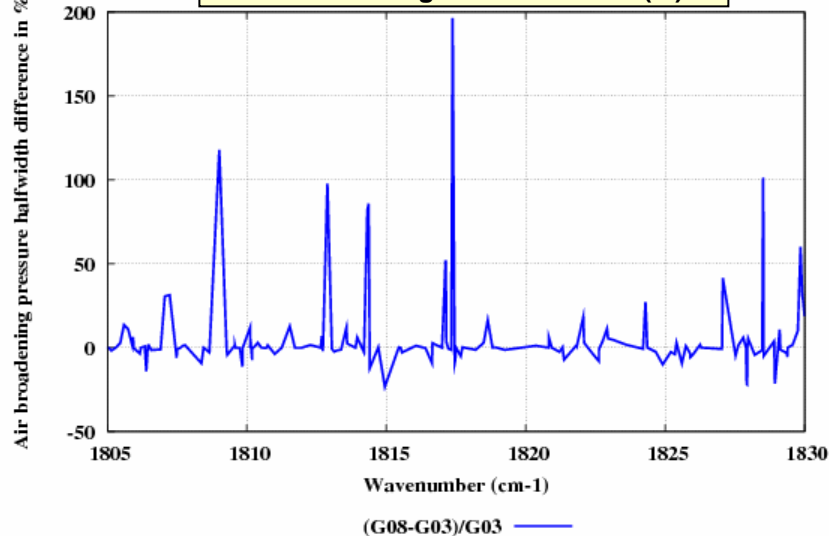


# ZOOM 1805 – 1830 cm<sup>-1</sup> IASI Observations

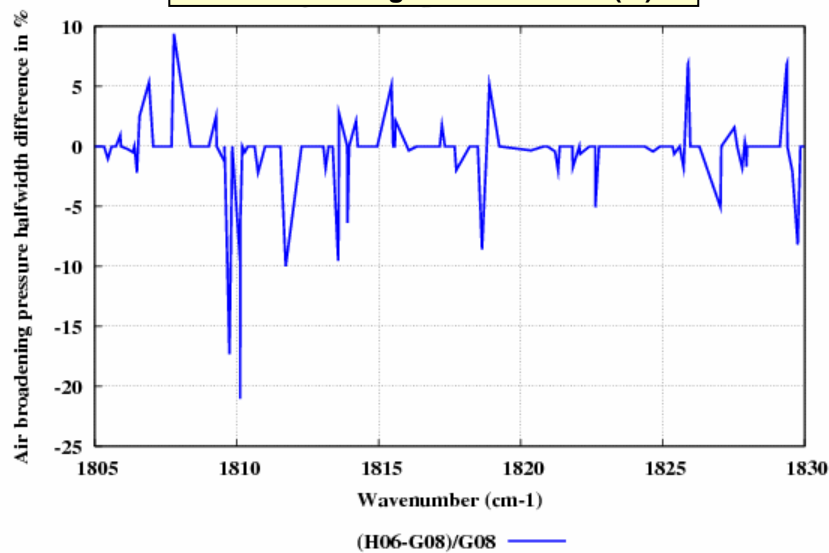
Brightness temperature differences (K)

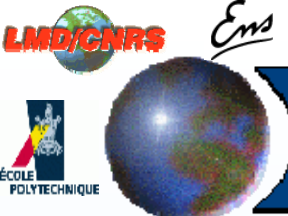


GEISA-03 vs GEISA-08  
 Air-broadening HW differences (%)



GEISA-03 vs HITRAN-06  
 Air-broadening HW differences (%)

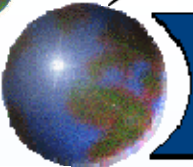




# Concluding Comments







# Remaining spectroscopy related problems

Some conclusions of validation exercises, using e.g. : the 4A-00/LMD Model, in the case of IASI radiative transfer modelling

1. **The water vapour spectroscopic parameters:** still need to be validated;
2. **The water vapour continuum:** more tuning to be done when more validation data (especially with high water vapor content) become available;
3. **The freons bands at 850 and 920  $\text{cm}^{-1}$ :** refine the temperature dependence;
4.  **$\text{O}_3$  in the 9.6  $\mu\text{m}$  region:** the spectroscopic parameters still need to be validated;
5. **Some  $\text{CO}_2$  – Q branches:** further improvement/tuning of the line mixing (15  $\mu\text{m}$  region especially)

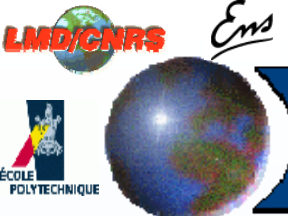
## Forward Models Error Sources

### Spectroscopy and RT model

- line inaccurate positions, line intensities, halfwidths, ...
- insufficient/missing information (absorbers, hot bands, heavy molecules cross sections, ...)
- line shape, continua, line coupling,...
- pressure shift
- NLTE

*Courtesy A. Chédin, Trattoria/CNES  
2-3 April 2008*





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**for their Encouragements and Supports**

THANK YOU FOR YOUR ATTENTION

