

Assessing Spectroscopic Parameter Archives for the Second Generation Vertical Sounders Radiance Simulation: Illustration through the GEISA/IASI database

N. Jacquinet-Husson, N.A. Scott, A. Chédin, R. Armante, K. Garceran,
Th. Langlois

ARA - Atmospheric Radiation Analysis - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://ara.lmd.polytechnique.fr/

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 long term, global, climatology of the earth-atmosphere state; temperature and moisture; cloud characteristics, including their microphysical properties; greenhouse gases, mainly CO₂, 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*).

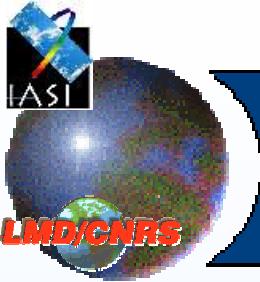
The [Laboratoire de Météorologie Dynamique \(LMD\)](#) is a Laboratory of the French [Centre National de la Recherche Scientifique \(CNRS\)](#), of the [Ecole Polytechnique](#), of the [Ecole Normale Supérieure](#), of the [Université Pierre et Marie Curie \(Paris 6\)](#), and belongs to the [Institut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

Done

Environnement Simon Laplace

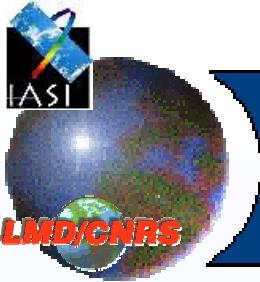
**Laboratoire de Météorologie Dynamique
Atmospheric Radiation Analysis Group
Ecole Polytechnique
91128, Palaiseau, France**

<http://ara.lmd.polytechnique.fr>

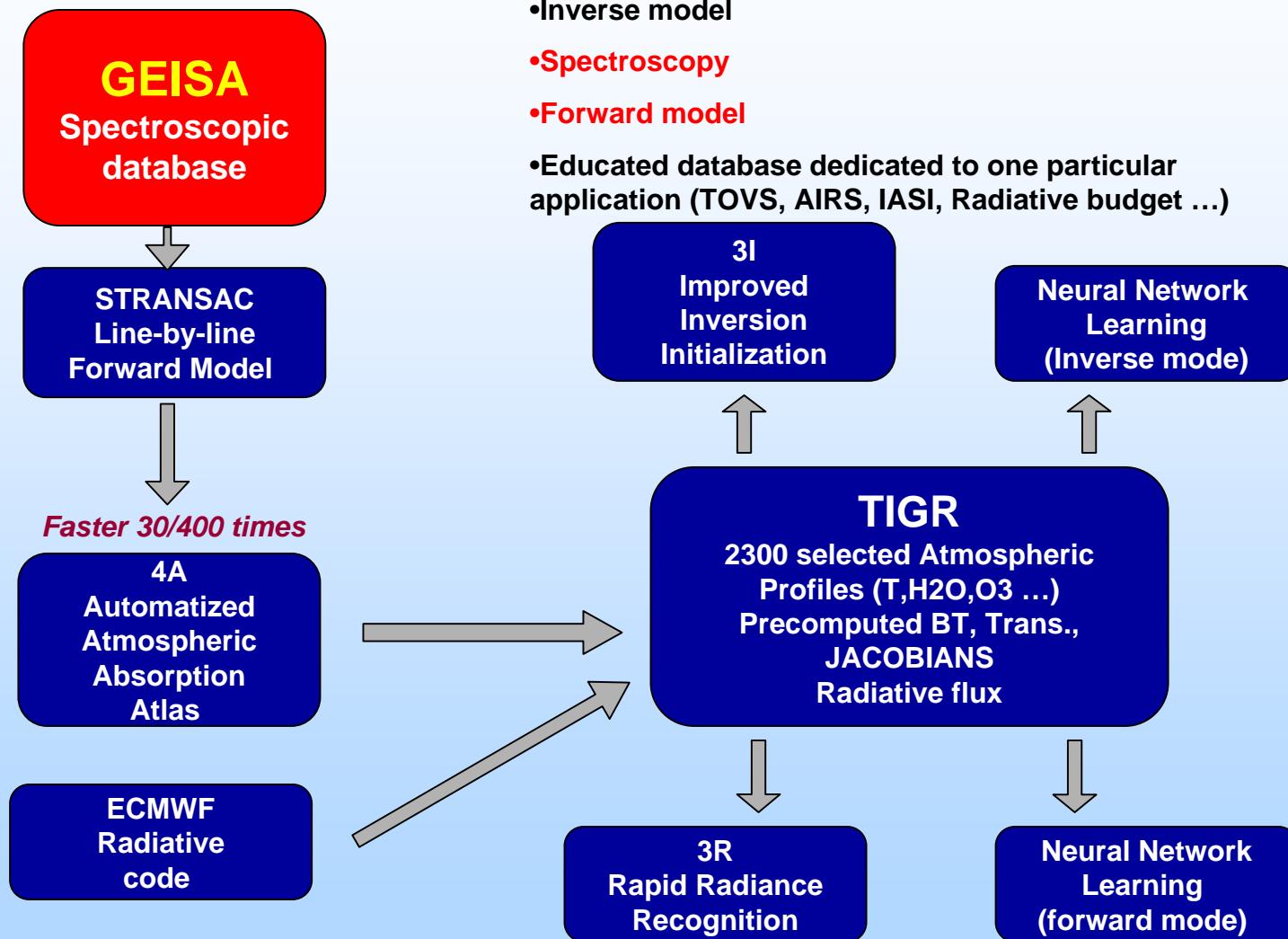


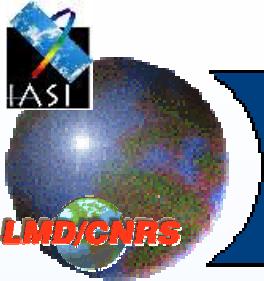
I

GEISA-03 and GEISA/IASI-03 OVERVIEW



The GEISA spectroscopic database in the ARA/LMD tools





The GEISA-2003 system

Gestion et Etude des Informations Spectroscopiques Atmosphériques
Management and Study of Atmospheric Spectroscopic Information

Three SUB-DATABASES

- Line transition parameters database
 - 42 molecules (96 isotopic species)
 - 1,668,371 entries between 0 and 35,877 cm⁻¹
- Absorption cross-sections database
 - IR: 32 molecular species (mainly CFC's)
 - UV/Visible : 11 molecular species
- Aerosol data archive and softwares

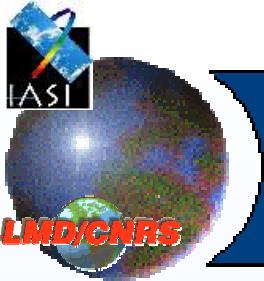
ASSOCIATED MANAGEMENT SOFTWARES (For each sub-database)

GEISA/IASI database general context

- Extraction of GEISA-03 between 599 & 3001 cm⁻¹
 - Individual spectral lines spectroscopic parameters sub-database
14 molecules (53 isotopic species): H₂O, CO₂, O₃, N₂O, CO, CH₄, O₂, NO, SO₂, NO₂, HNO₃, OCS, C₂H₂, N₂
 - IR absorption cross-sections sub-database (mainly CFC's)
6 molecular species: CFC-11, CFC-12, CFC-14, CCl₄, N₂O₅, 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 (IASI Sounding Science Working Group)

Total # entries: 702,550

Associated interest for AIRS



GEISA/IASI-03 line transition parameters sub-database content summary

2003 update

Molecule	Code	Isotopes	# Transitions
<u>h2o</u>	1	161-162-171-181-182	13278
<u>co2</u>	2	626-627-628-636-637-638-728-828-838	50840
<u>o3</u>	3	666-668-686-667-676	195102
<u>n2o</u>	4	446-447-448-456-546	18966
co	5	26- 36- 28- 27- 38- 37	3674
<u>ch4</u>	6	211-311-212 (<i>ch3d</i>)	121281
<u>o2</u>	7	66- 67- 68	435
<u>no</u>	8	46- 48- 56	29608
<u>so2</u>	9	626-646	22301
<u>no2</u>	10	646	71687
<u>hno3</u>	13	146	152586
<u>ocs</u>	20	622-624-632-623-822-634-722	19768
<u>c2h2</u>	24	221-231	2904
n2	33	44	120
Spectral range: 599 – 3001 cm ⁻¹			Total : 702,550

14 molecules

53 isotopic species



Fields of the format for line transition parameters in GEISA-03 (1)

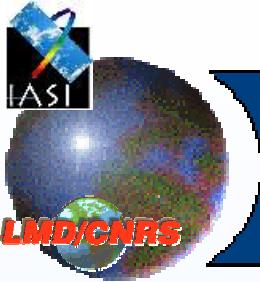
30 format
fields

A-J fields

Fortran format descriptor	F12.6	D11.4	F6.4	F10.4	A36	F4.2	I3	I3	A3
Field name	A	B	C	D	E	F	G	I	J

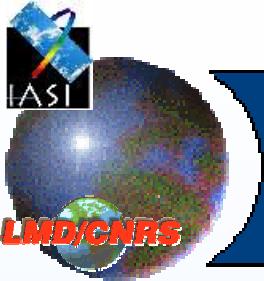
- (A) Wavenumber (cm^{-1}) of the line associated with the vibro-rotational transition.
- (B) Intensity of the line (cm molecule^{-1} at 296K).
- (C) Lorentzian air collision halfwidth ($\text{cm}^{-1} \text{ atm}^{-1}$ at 296K).
- (D) Energy of the lower transition level (cm^{-1}).
- (E) Transition quantum identifications for the lower and upper levels of the transition, as he following:
 - TRS1 upper state vibrational identification,
 - TRS2 lower state vibrational identification,
 - RN1 upper state rotational identification,
 - RN2 lower state rotational identification.
 - Blank fields (spaces) at this place match missing information.
- (F) Temperature dependence coefficient n of the halfwidth (value set to 0.75 if n not available).
- (G) Identification code for isotope.
- (I) Identification code for molecule.
- (J) Internal GEISA code for data identification.

GEISA management software specific



II

GEISA-03 line transition parameters update impact illustrations: H₂O, O₃



GEISA-03 line transition parameters sub-database

Updated molecules and spectral intervals

Molecule	Updated spectral intervals (cm ⁻¹)
H ₂ O	500 – 2819 9603 – 11399 13184 – 25232
CO ₂	436 - 2826
O ₃	600 – 3391
N ₂ O	872 – 1243
CH ₄	0 – 6184
O ₂	7665 – 8064 11484 - 15928
NO	1487 - 3799
NO ₂	2719 – 3074
NH ₃	0 - 5294
PH ₃	18 - 2479

Molecule	Updated spectral intervals (cm ⁻¹)
OH	29808 - 35877
HBr	17 – 396 2124 - 2790
HI	13 – 320 1951 - 2403
C ₂ H ₆	2975 - 2978
CH ₃ D	0 – 6184
C ₂ H ₂	605 - 3374
HOCl	1179 - 1320
CH ₃ Cl	1261 - 1646
COF ₂	1857 - 2001
HO ₂	0 - 908



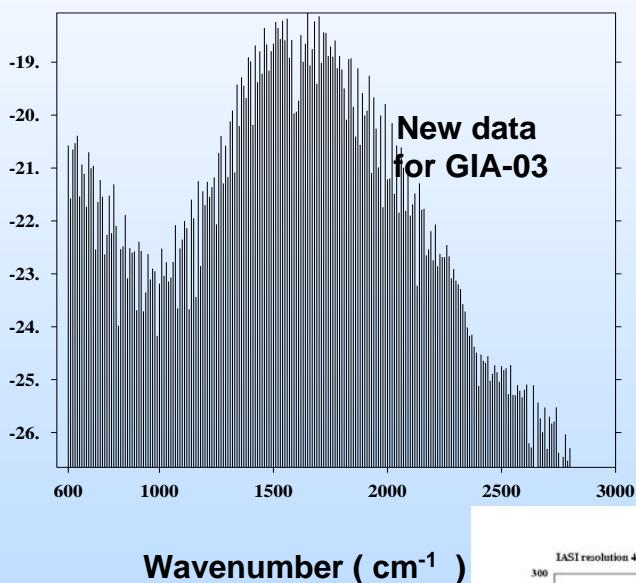
H_2O GEISA/IASI-03 update and alternative archive

Toth's (2000, 2002)

599.681 - 2819.848 cm⁻¹
(2003 update)

Log

intensity (cm.molecule⁻¹)

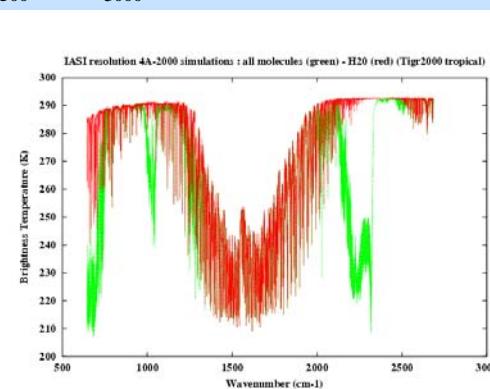
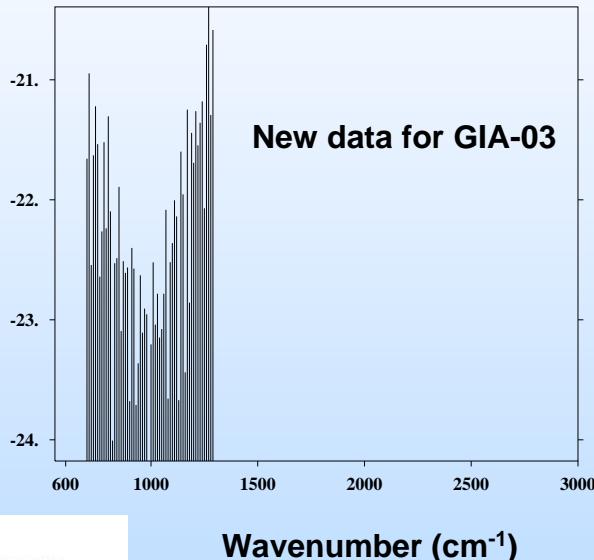


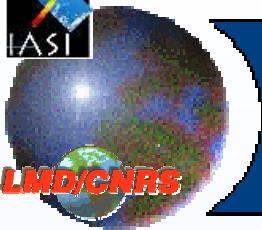
(GIA: GEISA/IASI)

RAL/ EUMETSAT

700.032 - 1299.980 cm⁻¹
(Alternative archive)

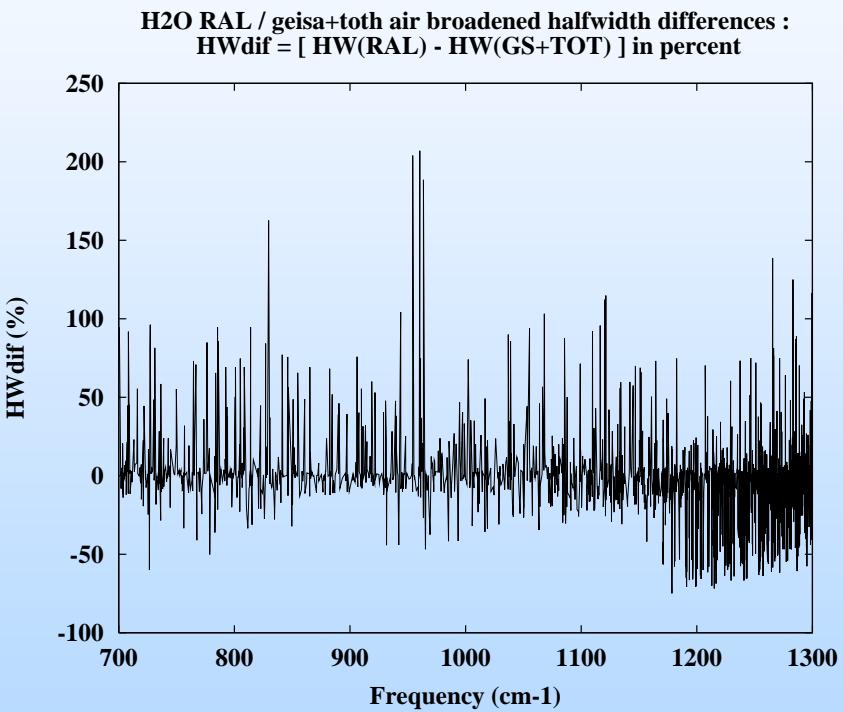
Log intensity (cm.molecule⁻¹)



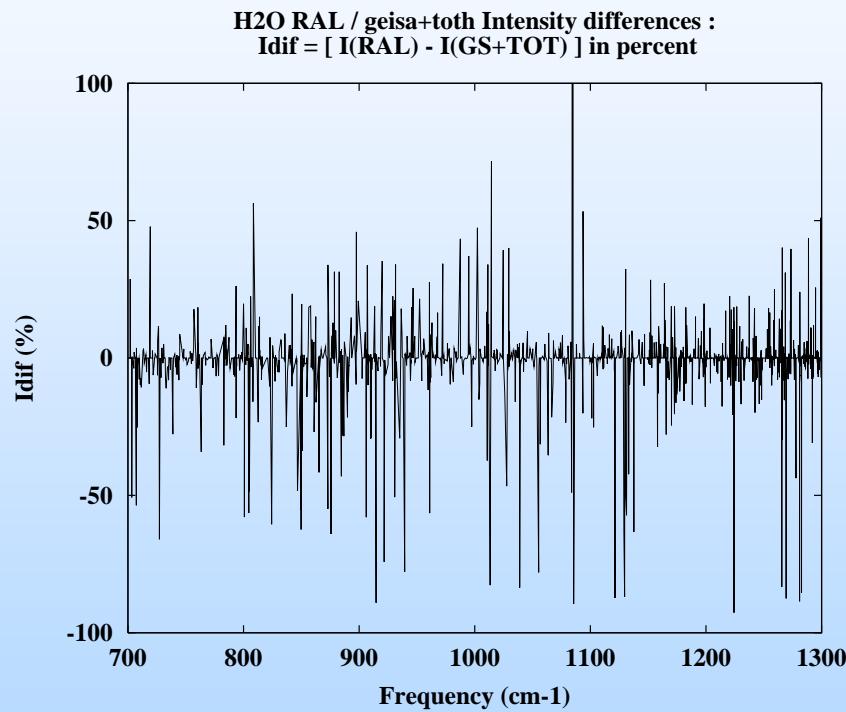


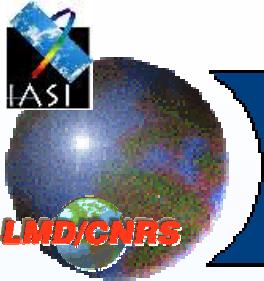
H₂O update in GEISA/IASI-03: TOTH VS RAL (1)

Halfwidths (%)



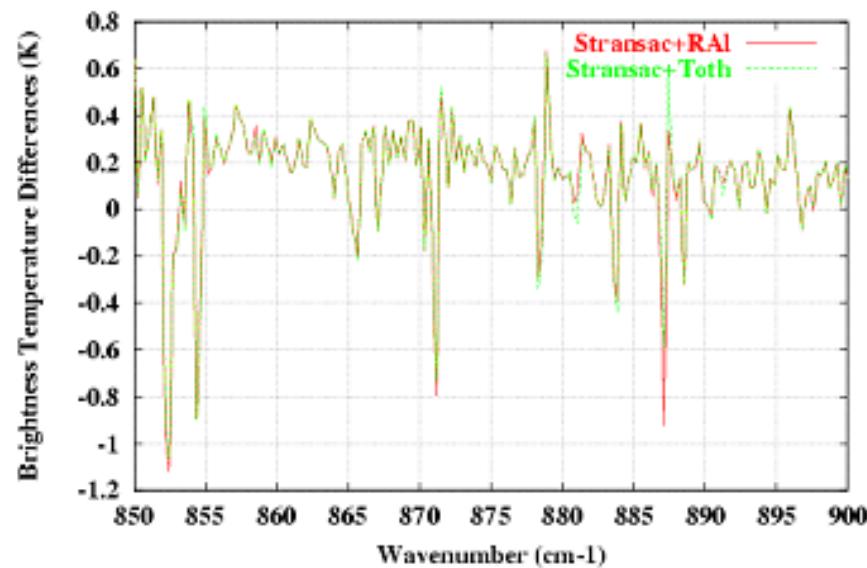
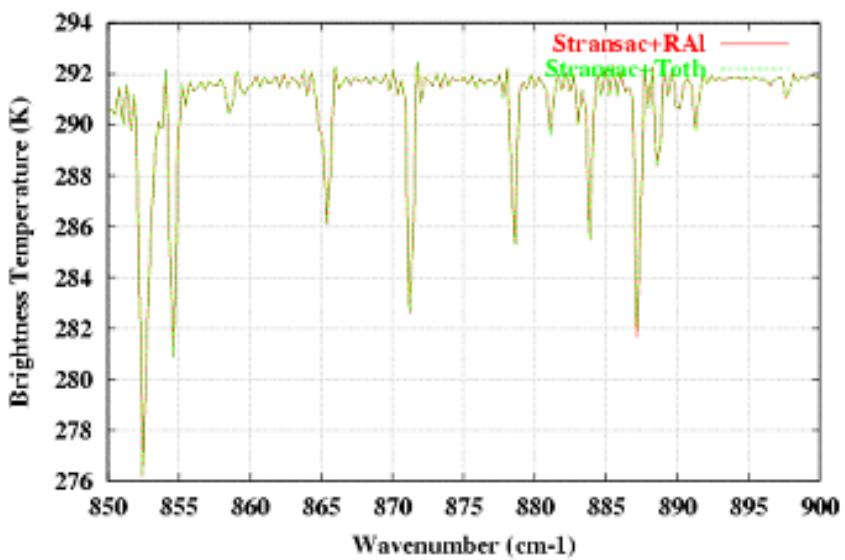
Intensity (%)





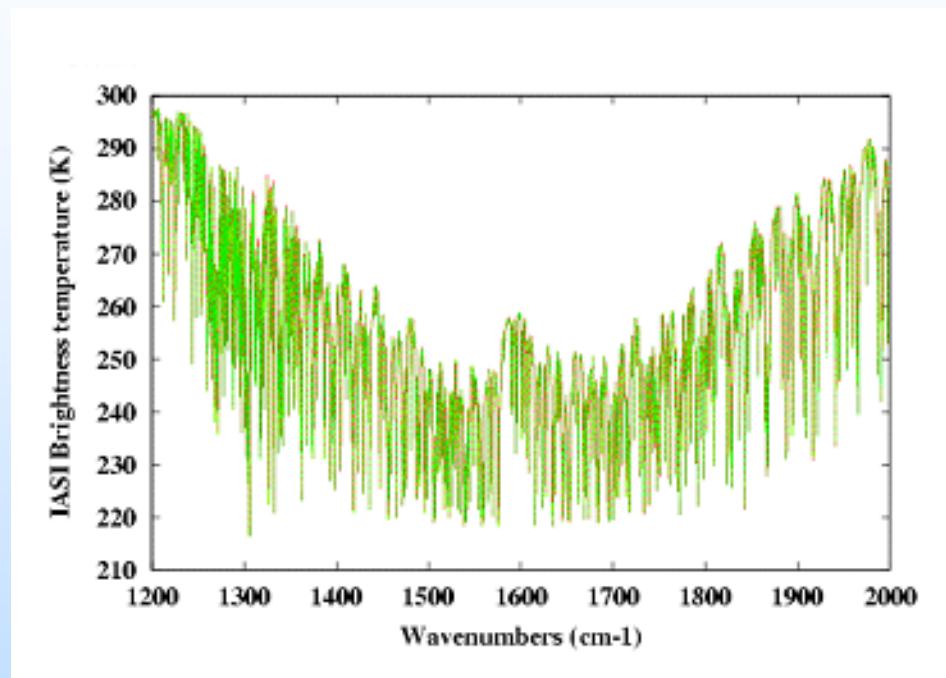
IASI Stransac-2000 simulations with RAL or TOTH's H₂O spectroscopy (2)

CAMEX (HIS) 29/09/94



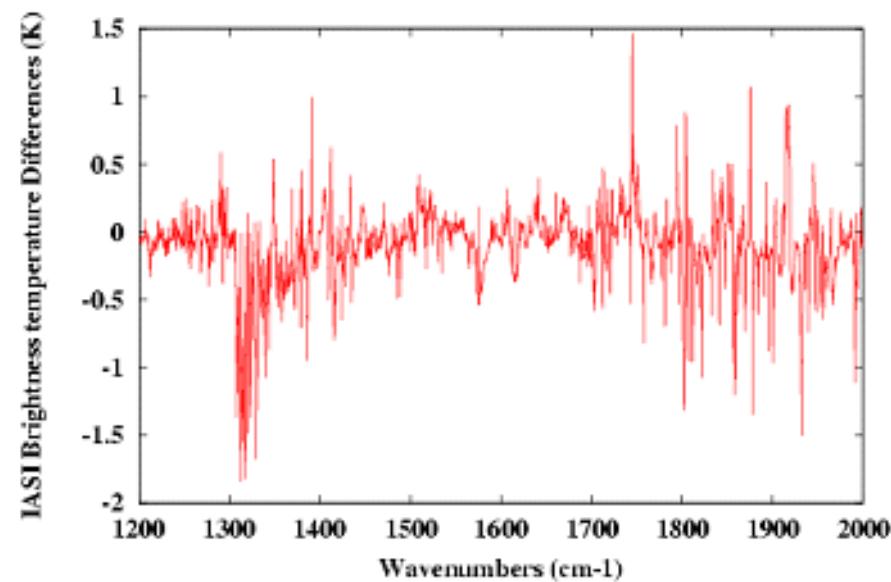


IASI Stransac-2000 simulations with RAL or TOTH's H2O spectroscopy



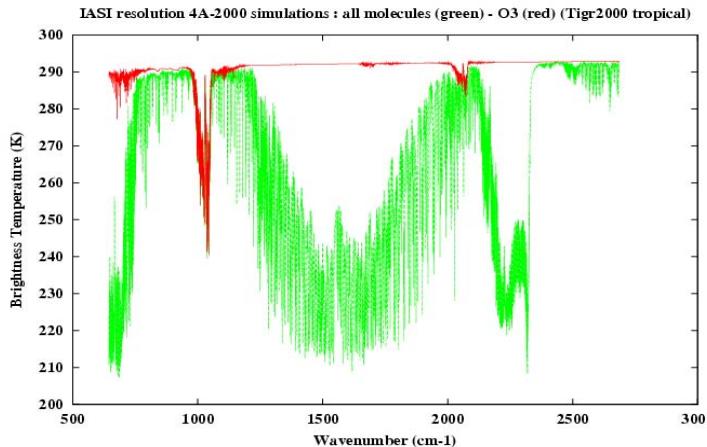
Stransac + Toth _____
Stransac + RaL _____

Mc Clatchey Tropical

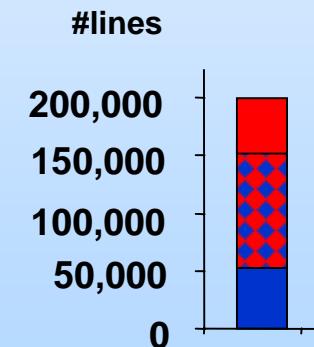
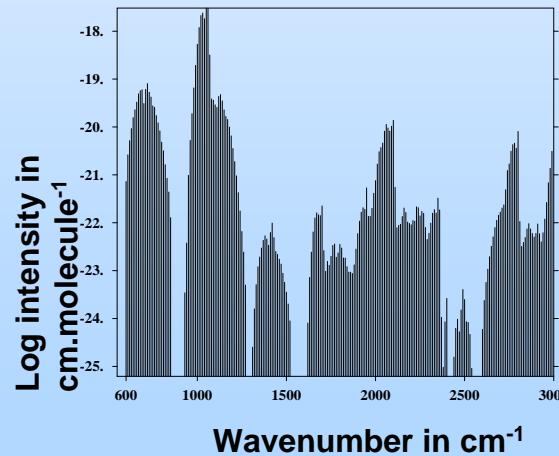




O₃ GEISA/IASI-03 Update

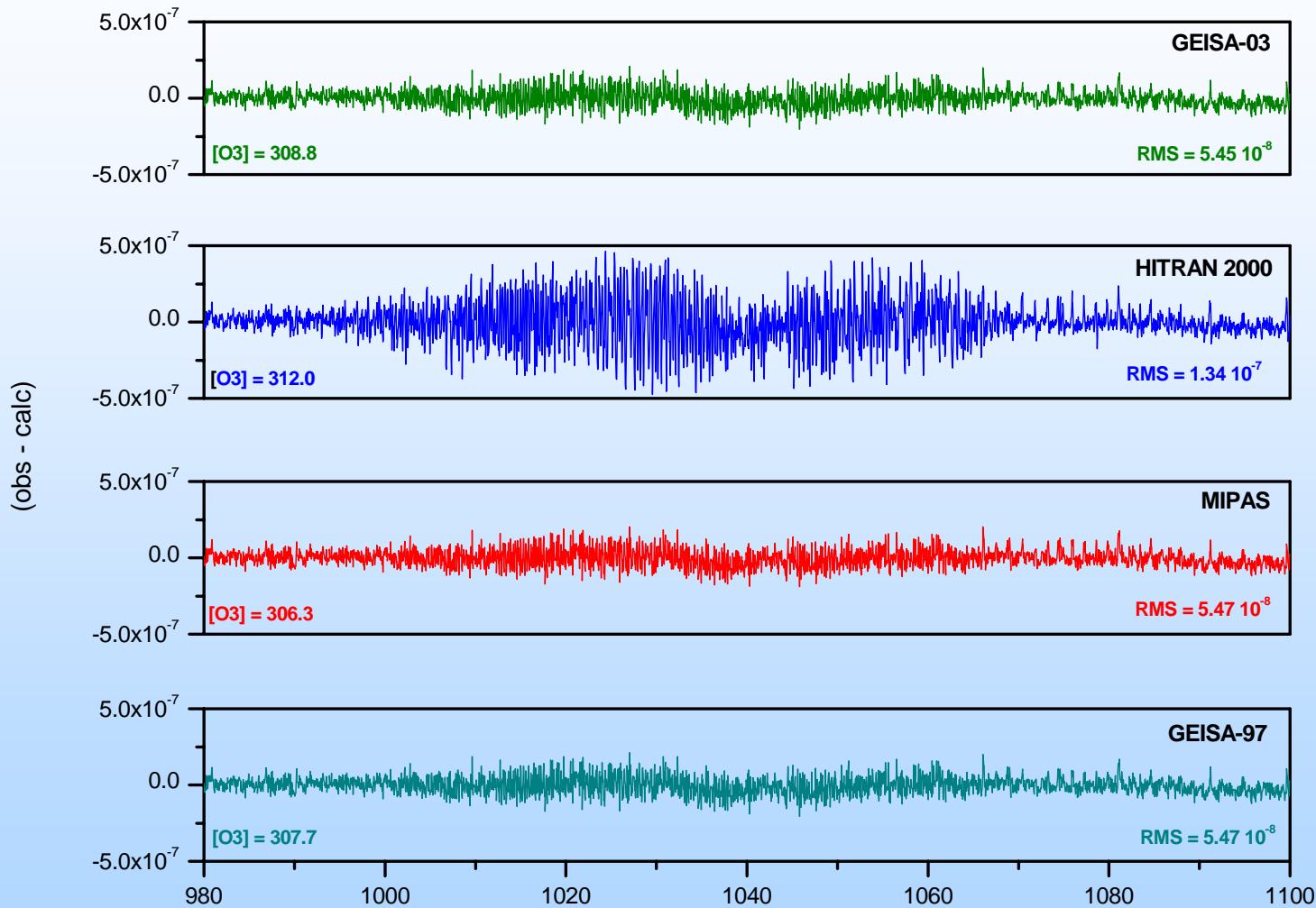


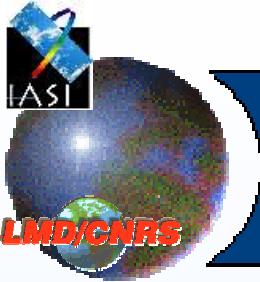
Updated spectral interval : 600.179 - 3000.971 cm⁻¹



- █ Data kept from GEISA-97
- █ GEISA-97 data updated
- █ New data added since GEISA-97

Spectroscopy impact on IMG O₃ Total column retrieval



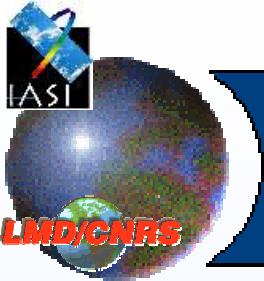


III

GEISA/IASI-03 and HITRAN-04 Archive Differences:impact illustration

HITRAN-04 *JQSRT, in press*

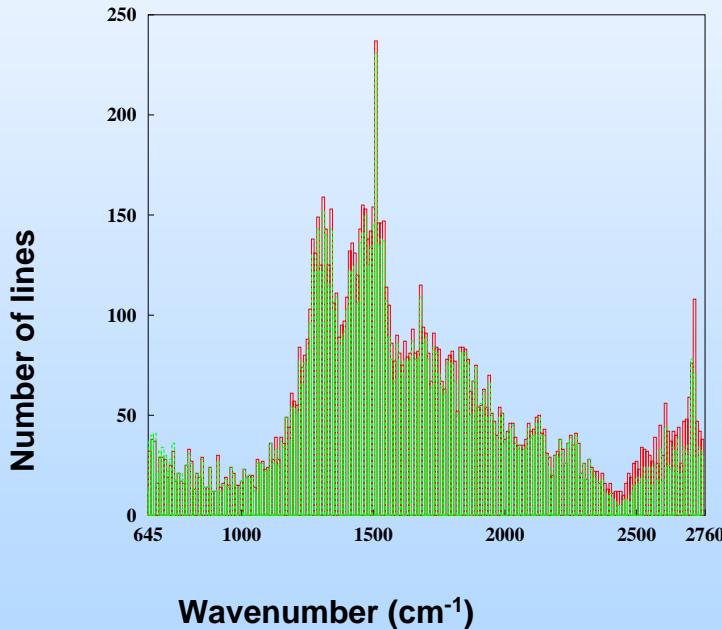
GEISA/IASI-03 *JQSRT, Vol. 95,4, 1 November 2005*



GEISA/IASI-03 and HITRAN-04 H₂O archives in the IASI spectral range (1)

HITRAN-04

GEISA/IASI 03 and HITRAN 04



Toth:

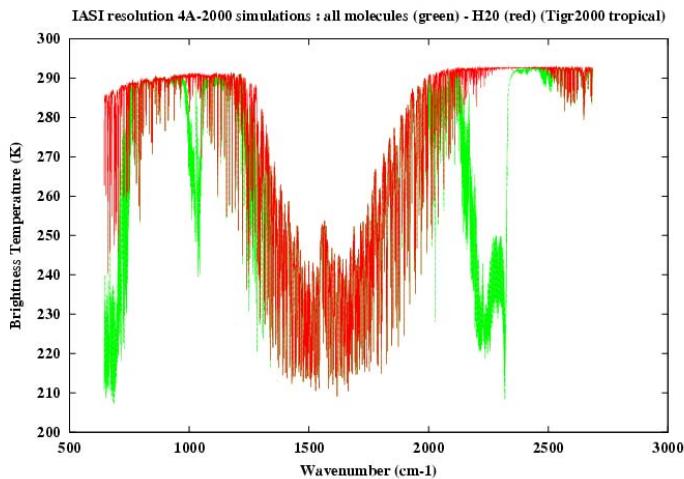
“Linelist of water vapor parameters from 500 to 8000 cm⁻¹: includes new measurements and analysis of air-broadening parameters”. JQSRT (in press).

Jacquemart et al:

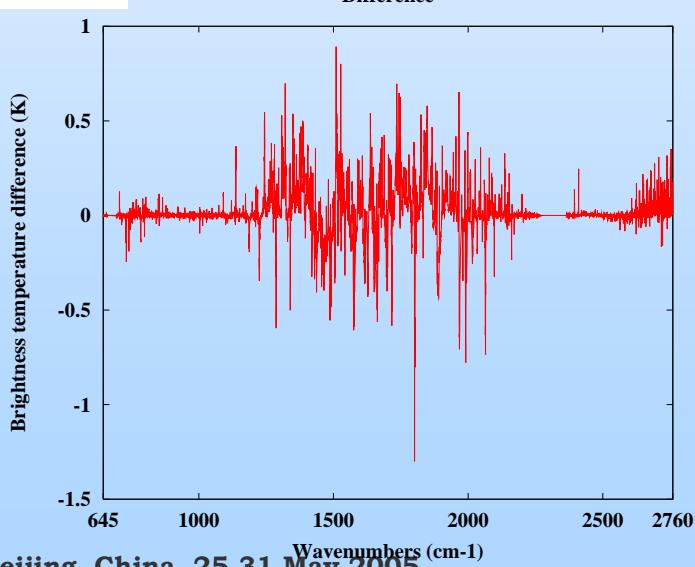
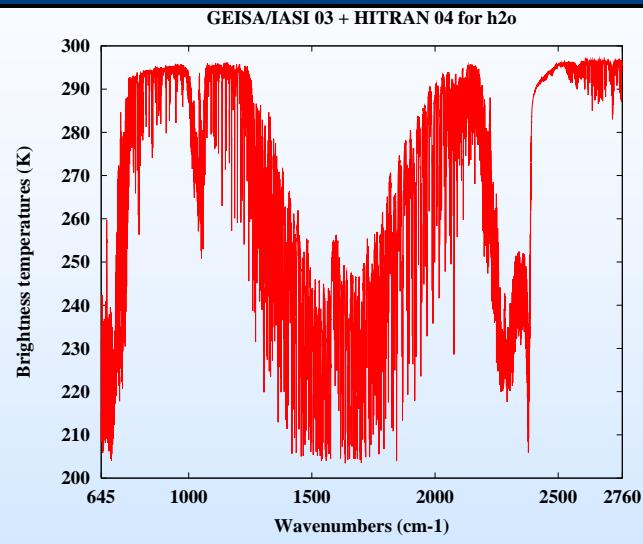
“Semi-empirical calculation of air-broadened half-widths and air pressure-induced frequency shifts of water-vapor absorption lines”. JQSRT (in press).

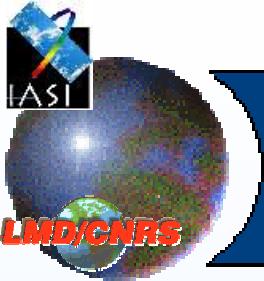


GEISA/IASI-03 and HITRAN-04 H_2O STRANSAC-2000 IASI simulation



Tropical TIGR-2000 atmosphere





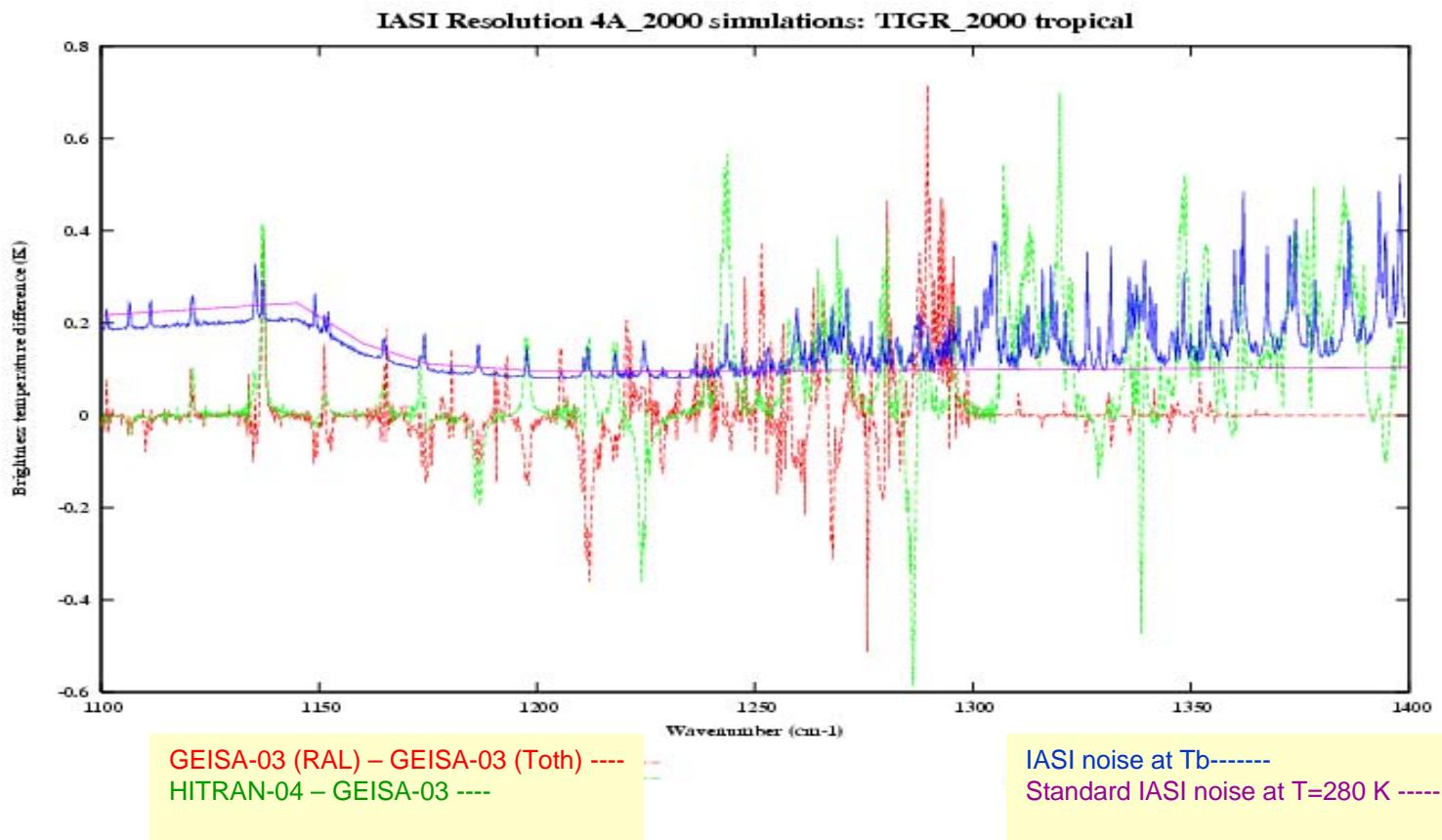
H₂O and CH₄ spectroscopy impact for IASI remote sensing

Evaluation of the impact of spectroscopic archive differences (HITRAN-04 and GEISA/IASI-03) on IASI direct radiative transfer simulations

- Two atmospheric TIGR profiles (mean of each of the 2 TIGR selected air-mass classes, i.e.: tropical and mid-latitude-2)
- 4A-2000
- Mean thermodynamic parameters for each air-mass

IASI 4A-2000 Simulation TIGR-2000 Tropical

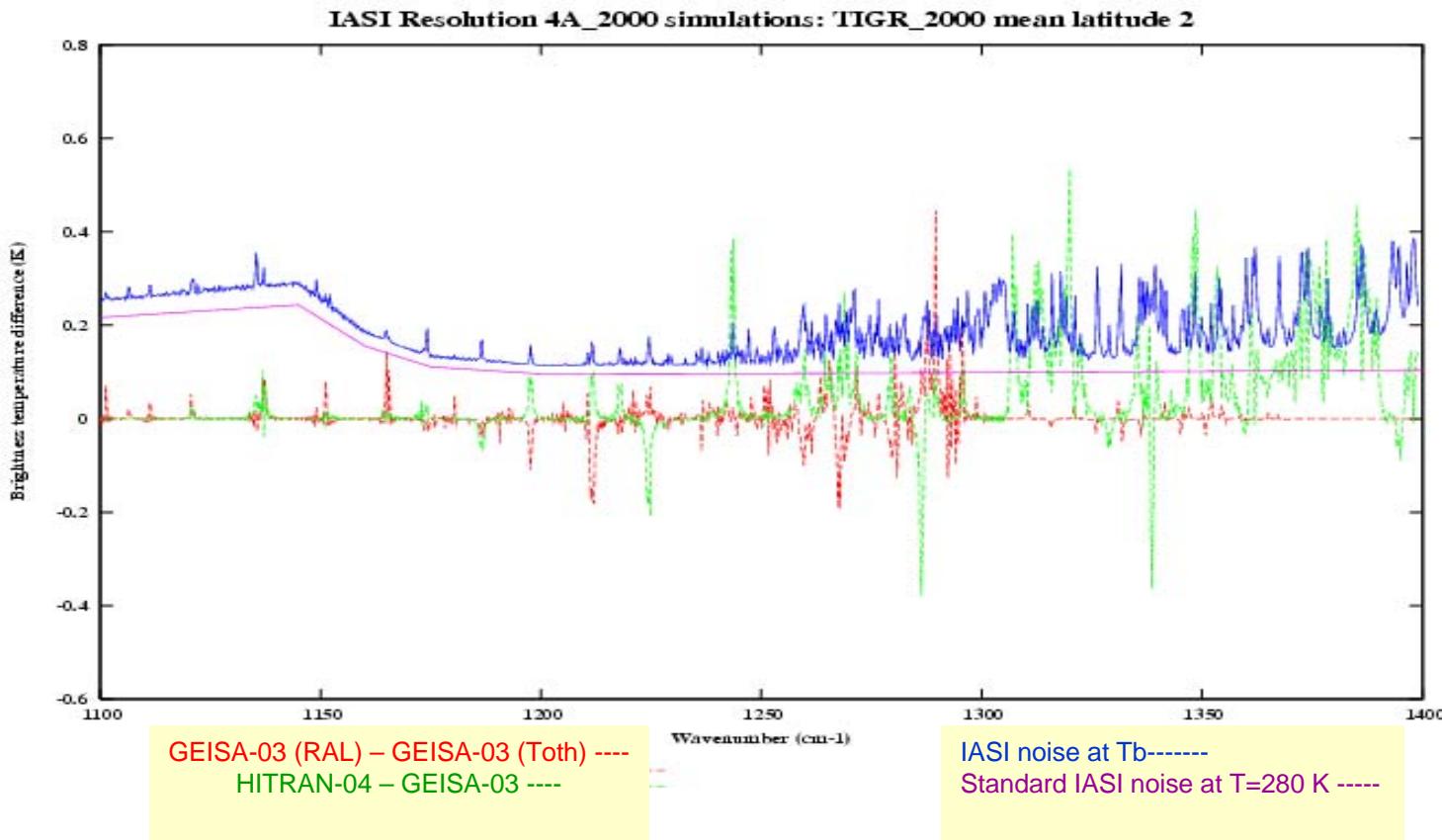
1110-1400 cm^{-1} spectral region

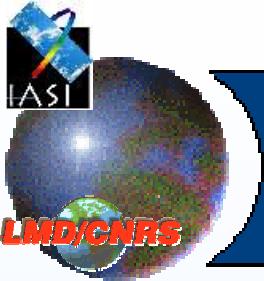




IASI 4A-2000 Simulation TIGR-2000 Mean Latitude 2

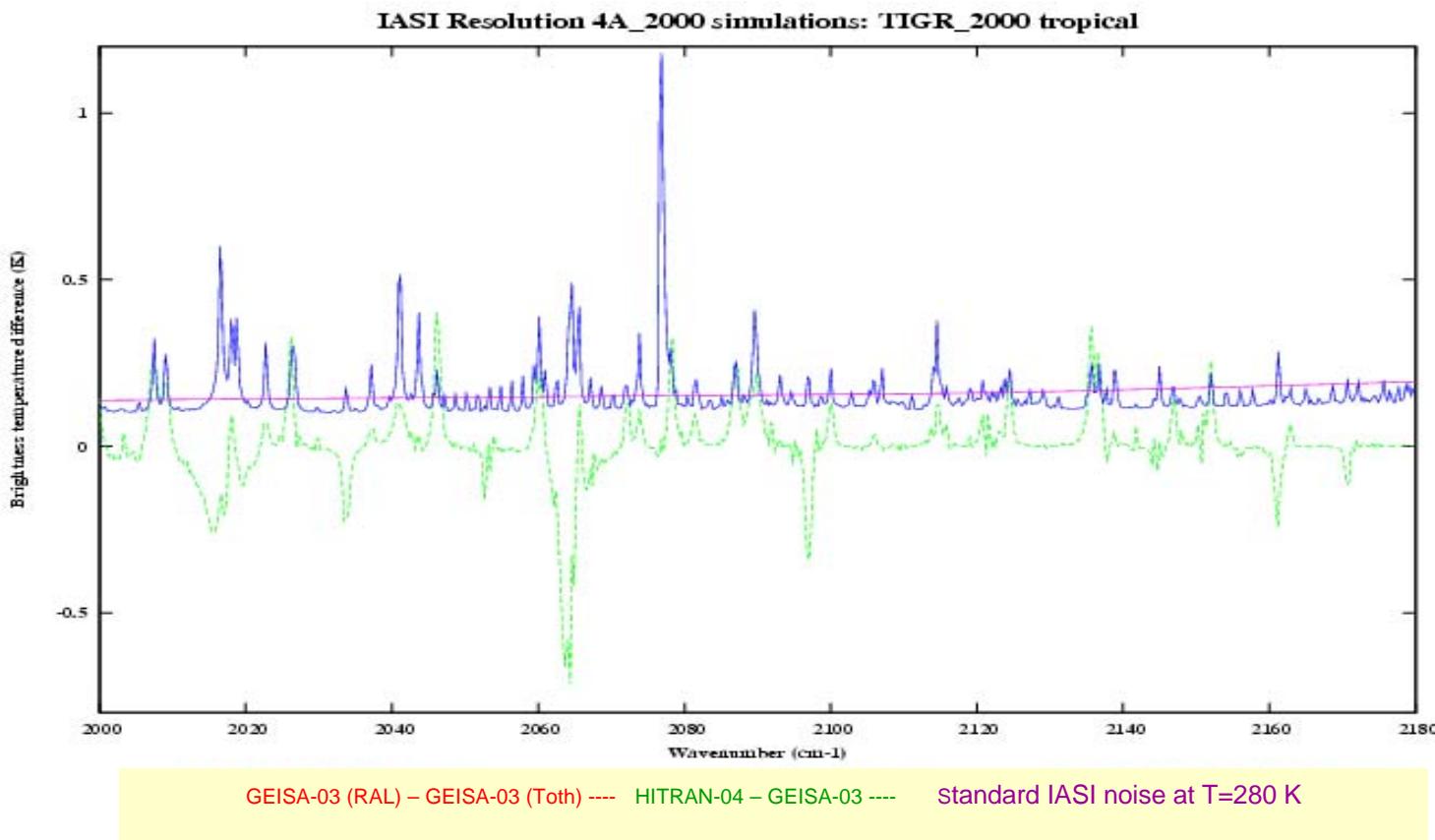
1110-1400 cm^{-1} spectral region

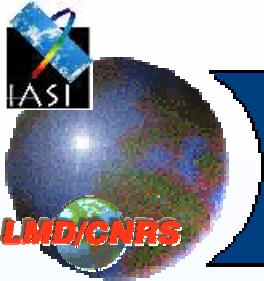




IASI 4A-2000 Simulation TIGR-2000 Tropical

2000 - 2180 cm⁻¹ spectral region





IV

GEISA-03 distribution and access

ftp :

- new GEISA-03 data for lines, cross sections and aerosols :
→ different formats available including the HITRAN-00 and HITRAN-04 formats for the line sub-databases

- associated management tools

Web:

- complete new technical documentation on the web site

<http://ara.lmd.polytechnique.fr>



GEISA and GEISA/IASI Operational Use (3)

First access

<http://ara.lmd.polytechnique.fr/registration>

ARA - Atmospheric Radiation Analysis - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://ara.lmd.polytechnique.fr/ Go

GEISA and GEISA/IASI

The GEISA/IASI database Content Database access

GEISA and GEISA/IASI access

On line DATABASE ACCESS

The current edition of the GEISA system and associated softwares are freely accessible.

New user: if you are interested, please contact Nicole.Jacquinet-Husson (Nicole.Jacquinet@lmd.polytechnique.fr)

Prompt

Enter username and password for "Registration" at <http://ara.lmd.polytechnique.fr>

User Name:

Password:

Use Password Manager to remember this password.

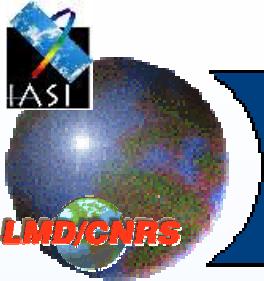
Cancel OK

phone: +33.1.69.33.48.02 phone: +33.1.69.33.45.51
fax: +33.1.69.33.30.05 fax: +33.1.69.33.30.05

E-Mail E-Mail

Nicole.Jacquinet@lmd.polytechnique.fr Gilles.Lefevre@lmd.polytechnique.fr

Waiting for ara.lmd.polytechnique.fr...



ACKNOWLEDGMENTS

to

CNES, EUMETSAT and ITSC-14

for their Encouragements and Supports