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 - Atmo	ospheric Ra	diation A	malysis - Mozilla Firefox	3				
<u>File</u> <u>E</u> dit	View Go	<u>B</u> ool	marks <u>T</u> ools <u>H</u> elp					
•	- 🛃 区		http://ara.lmd.polytechnique.fr/	✓ ○ Go G.				
R	A.LM	0	The ARA	• Group				
 Present Vertical Researce 	ation I soundin h themes	g	The Atmospheric Radiation Analysis group is spe evolution of the climate of the Earth from space bor sounders, in the infrared and the microwave domain	ecialized in the study of the variability and me observations made principally by vertical is.				
 Tools Geisa HFTP Publica 	• Tools 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 ₂ , in relation with the carbon cycle;							
 Oral Pu Acrony Contact 	iblication: ms ts	<u>s</u>	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					
 Links Intranet 	É.		spatio-temporal data bases (inverse problems, linear and non linear inference, neural networks, classification, pattern recognition, etc.).					
Last u Decer	update: 8t mber 200	h 4	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 <u>GEISA</u> « Gestion et Etude des Informations Spectroscopiques					
Copyrigh	t © 1995/	2005	Atmospheriques » (Study and management of atmospheric spectroscopic information).					
ARA/LN Re	1D, All R eserved.	ights	s The Laboratore 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 Surveyale Surveyale Marie Curie (Queie 6) and belance to the Institut					
			<u>Pierre-Simon Laplace (IPSL)</u> . It is also one of the French space laboratories working in cooperation with the <u>Centre National d'Etudes Spatiales (CNES)</u> .					

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

http://ara.lmd.polytechnique.fr



Done





IASI

The GEISA spectroscopic database in the ARA/LMD tools

Inverse model



ITSC-XIV: Beijing, China, 25-31 May 2005

Institut

aolace

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 subdatabase content summary

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
со	5	26- 36- 28- 27- 38- 37	3674
<u>ch4</u>	6	211-311-212 (ch3d)	121281
o2	7	66- 67- 68	435
<u>no</u>	8	46- 48- 56	29608
so2	9	626-646	22301
<u>no2</u>	10	646	71687
hno3	13	146	152586
ocs	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



2003 update

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

30 format

fields

Fortran format descriptor	F12.6	D11.4	F6.4	F10.4	A36	F4.2	13	13	A3
Field name	Α	В	С	D	E	F	G	I	J

A-J fields

- (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 (cm⁻¹ 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

Sciences de Environnement Finitionnement Sciences Scienco



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)		
H₂O	500 – 2819		
	9603 – 11399		
	13184 – 25232		
CO ₂	436 - 2826		
O ₃	600 – 3391		
N ₂ O	872 – 1243		
CH₄	0 – 6184		
O ₂	7665 – 8064		
	11484 - 15928		
NO	1487 - 3799		
NO ₂	2719 – 3074		
NH3	0 - 5294		
PH3	18 - 2479		

Molecule	Updated spectral intervals (cm ⁻¹)			
ОН	29808 - 35877			
HBr	17 – 396			
	2124 - 2790			
HI	13 – 320			
	1951 - 2403			
C2H6	2975 - 2978			
CH3D	0 – 6184			
C ₂ H ₂	605 - 3374			
HOCI	1179 - 1320			
CH3CI	1261 - 1646			
COF2	1857 - 2001			
HO2	0 - 908			



H₂O GEISA/IASI-03 update and alternative archive

Toth's (2000, 2002) 599.681 - 2819.848 cm⁻¹ (2003 update)

RAL/ EUMETSAT





(GIA: GEISA/IASI)



Sciences de territorinement Fervironnement Simon Laplace

ITSC-XIV: Beijing, China, 25-31 May 2005



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

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

IASI

aolace





O₃ GEISA/IASI-03 Update



Updated spectral interval : 600.179 - 3000.971 cm⁻¹





Spectroscopy impact on IMG O₃ Total column retrieval



LAS

Courtesy P.F. Coheur (ULB)

15





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



Wavenumber (cm⁻¹)

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 airbroadened half-widths and air pressure-induced frequency shifts of water-vapor absorption lines". JQSRT (in press).



Number of lines

GEISA/IASI-03 and HITRAN-04 H₂O STRANSAC-2000 **IASI** simulation







Wavenumbers (cm-1)



LAS



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 midlatitude-2)



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



hsnan

aplace

IASI 4A-2000 Simulation TIGR-2000 Tropical

2000 - 2180 cm⁻¹ spectral region







IV GEISA-03 distribution and access

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 An	alysis - Mozilla Firefox			
<u>File E</u> dit <u>V</u> iew <u>G</u> o <u>B</u> ookn	narks <u>T</u> ools <u>H</u> elp			ς.
🔷 • 🔿 - 🎅 🔕 😚 🗈	http://ara.lmd.polytechnique.fr/		 © 0 	Go C.
Presentation Vertical sounding Research themes Tools Geisa HFTP Publications	EISA and	d GEISA EISA/IASI Conter GEISA/IAS	I ACCESS	
Oral Publications Acronyms Contacts Links Intranet Last update: 8th December 2004 Convright © 1995/2005	On line DATABASE ACCESS	e current edition of the (ccessible. w user: if you are int licole.Jacquinet@Imd.polyt	GEISA system and associate erested, please contact Nic technique.fr)	d softwares are freely ole Jacquinet-Husson
ARA/LMD, All Rights	Li Enter usernan User Name:	ne and password for "Registratio	n" at http://ara.lmd.polytechnique.fr	
Keserved.	reai	sterme		ccess
	Password:			fevre
	Use Passo	vord Manager to remember this p	Dassword.	echnique entale 36 µ Cédex
	phone: +33.1.69 fax: +33.1.69.3	.33.48.02 3.30.05	phone: +33.1.69 fax: +33.1.69	9.33.45.51 33.30.05
	E-Mail Nicole. Jacquinet@Imd	polytechnique.fr	E-Mail Gilles.Lefevre@lmd.	polytechnique.fr
Waiting for ara.Imd.polytechnique.fr				



ACKNOWLEDGMENTS

to

CNES, EUMETSAT and ITSC-14

for their Encouragements and Supports

