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 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).

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


F.R.S.-FNRS contact group for High Resolution Molecular Spectroscopy, Febre, 26th, 2009, ULB, Bruxelles
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$_2$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

- Satellite data
  - Desearchiving
  - Channel selection
- Data Archive 100 To
  - Cloud detection
  - Spatio-temporal collocation
  - Quality control
- In situ Radiosoundings
  - Desearchiving
  - Quality control

GEISA SPECTROSCOPIC DATABASE

Radiative Transfer
- Direct Models
  - Clear sky or scattering medium
  - Nadir or limb
- Inverse Models
  - Bayesian inference
  - Neural Networks
  - Clustering

Model/observation bias computation
Instruments monitoring

Scientific Themes
- Thermodynamics
- Clouds
- Greenhouse gases
- Continental surfaces
- Aerosols
- etc...

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

F.R.S. - FNRS contact group for High Resolution Molecular Spectroscopy, Febr. 26th, 2009, ULB, Bruxelles
GEISA and GEISA/IASI System Overview
THE GEISA-2008 SYSTEM

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

Three SUB-DATABASES

- Line transition parameters database
  50 molecules (103 isotopic species)
  over 3,700,000 entries between 0 and 35,877 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
(For each sub-database)
Extraction of GEISA-08 between 599 & 3001 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, CCl\(_4\), N\(_2\)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

<table>
<thead>
<tr>
<th>Molecular species related with IASI Trace Gas Retrievals to be added</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCN</td>
</tr>
<tr>
<td>NH(_3)</td>
</tr>
<tr>
<td>HCOOH</td>
</tr>
<tr>
<td>C(_2)H(_4)</td>
</tr>
<tr>
<td>CH(_3)OH</td>
</tr>
</tbody>
</table>

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

F.R.S.-FNRS contact group for High Resolution Molecular Spectroscopy, Febr. 26th, 2009, ULB, Bruxelles
A database on refractive indices of basic atmospheric aerosol components:
  • Acids
  • Water ice
  • Water droplets
  • Water soluble components
  • Thin films
  • Solid Substances

A Database on atmospheric aerosols from LITMS *(Rublev, 1994)*

The software package and database OPAC (Optical Properties of Aerosols and Clouds) *(Hess et al., 1998)*

The Global Aerosol Data Set: GADS *(Köpke et al., 1997)*
The GEISA spectroscopic database: Current and future archive for Earth and planetary atmosphere studies


Laboratoire de Météorologie Dynamique, Institut Pierre Simon Laplace, Ecole Polytechnique, Route de Saclay, 91128 Palaiseau, France

Laboratoire Inter-Universitaire des Systèmes Atmosphériques, Faculté des Sciences et Technologie, 63 avenue du Général de Gaulle, 34090 Créteil, France

Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique, Observatoire de Paris-Meudon, 5 place Jules Janssen, 92195 Meudon, France

Institut Pierre Simon Laplace, Université Pierre et Marie Curie, 4 Place Jussieu, 75252 Paris, France

Groupe de Spectrométrie Moléculaire et Atmosphérique, Université de Reims-Champagne, 51682 Reims, France

Remote Sensing Technology Institute, German Aerospace Center (DLR), Oberpfaffenhofen, D-82234, Germany

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA

Laboratoire de Physique Moléculaire pour l'Atmosphère et l'Atmosphère et l'Urbain, Université Pierre et Marie Curie, 5 rue Cujas 75200 Paris, France

Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

Department of Meteorology, University of Reading, 2 Earley Gate, Whiteknights, Reading RG6 2AU, UK

Service d'Atmosphères, Institut Pierre Simon Laplace, Université Pierre et Marie Curie, 4 Place Jussieu, 75252 Paris, France

Service de chimie Quantique et Photochimie, Université Libre de Bruxelles, 1050 Bruxelles, Belgium

Laboratoire de Dynamique, Interactions et Rayonnement, Université Pierre et Marie Curie, 4 Place Jussieu, 75252 Paris, France

Rutherford Appleton Laboratory, Chilton, Didcot, Oxon.

Rutherford Appleton Laboratory, Chilton, Didcot, Oxon.

Institute of Molecular Physics at Russian Research Center Kurchatov Institute, Moscow, Russia

Received 23 July 2004; accepted 15 December 2004.

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**GEISA/IASI EFFECTIVE USE**

**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)]

\[\text{Related to}\]

- IASI Level 1 Cal/Val activities@ CNES

F.R.S.-FNRS contact group for High Resolution Molecular Spectroscopy, Febr. 26th, 2009, ULB, Bruxelles
GEISA-08 line transition parameters sub-database

Database update summary
EVOLUTION GEISA SINCE 1978:
line transition sub-database
GEISA and GEISA/IASI-08 Line Transitions Records

255 Characters record 30 Parameters

(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 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.
(F) Temperature dependence coefficient \(n\) of the halfwidth.
(G) Identification code for isotope.
(I) Identification code for molecule.

Extended format length

<table>
<thead>
<tr>
<th>Parameter</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>E4</th>
<th>F</th>
<th>G</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field length</td>
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<td>11</td>
<td>6</td>
<td>10</td>
<td>25</td>
<td>25</td>
<td>15</td>
<td>15</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Fortran descriptor</td>
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<td>1PD11.4</td>
<td>0PF6.4</td>
<td>F10.4</td>
<td>A25</td>
<td>A25</td>
<td>A15</td>
<td>A15</td>
<td>F4.2</td>
<td>I</td>
<td>I3</td>
<td>A3</td>
<td>I2</td>
<td>I1</td>
</tr>
</tbody>
</table>

(K) Molecule number as in HITRAN
(L) Isotope number as in HITRAN
(M) Einstein A-coefficient
(N) Self broadening pressure halfwidth (HWHM) (cm\(^{-1}\)atm\(^{-1}\)) at 296K
(O) Air pressure shift of the line transition (cm\(^{-1}\)atm\(^{-1}\)) at 296K
(P) Accuracy indices for wavenumber, intensity and halfwidth
(Q) Uncertainty indices
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(R)</td>
<td>Temperature dependence coefficient ( n ) of the air pressure shift</td>
</tr>
<tr>
<td>(A')</td>
<td>Estimated accuracy (cm(^{-1})) on the line position</td>
</tr>
<tr>
<td>(B')</td>
<td>Estimated accuracy on the intensity of the line in (cm(^{-1})/molecule.cm(^2))</td>
</tr>
<tr>
<td>(C')</td>
<td>Estimated accuracy on the air collision halfwidth (HWHM) (cm(^{-1})atm(^{-1}))</td>
</tr>
<tr>
<td>(F')</td>
<td>Estimated accuracy on the temperature dependence coefficient ( n ) of the air broadening HW</td>
</tr>
<tr>
<td>(O')</td>
<td>Estimated accuracy on the air pressure shift of the line transition (cm(^{-1})atm(^{-1})) @296K</td>
</tr>
<tr>
<td>(R')</td>
<td>Estimated accuracy on the temperature dependence coefficient ( n ) of the air pressure shift</td>
</tr>
</tbody>
</table>

(N')  | Estimated accuracy on the self broadened (HWHM) (cm\(^{-1}\)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 (cm\(^{-1}\)atm\(^{-1}\)) @296K |

(T')  | Estimated accuracy on the self pressure shift of the line transition (cm\(^{-1}\)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 |

---

**Water specific**

Standardized parameter missing values for GEISA-08 as a whole
FROM GEISA-03 TO GEISA-08

30 updated molecular species

- H₂O
- CO₂
- O₃
- N₂O
- CH₄
- O₂
- NO
- SO₂
- NO₂
- PH₃
- HNO₃
- OCS
- H₂CO
- C₂H₆
- CH₃D
- C₂H₂
- C₂H₄
- HCN
- C₃H₈
- C₂N₂
- C₄H₂
- HC₃N
- N₂
- CH₃Cl
- H₂O₂
- H₂S
- HCOOH
- SF₆
- C₃H₄
- ClONO₂

8 new molecular species

- CH₃Br
  - 794 – 1706 cm⁻¹
- CH₃OH
  - 0.02 - 33 cm⁻¹
  - 10 μm region
- NO⁺
  - 1635- 2530 cm⁻¹
- HNC
  - 0.22 - 12594 cm⁻¹
- C₆H₆
  - 642 – 705 cm⁻¹
- C₂HD
  - 451 - 580 cm⁻¹
  - 600 - 760 cm⁻¹
- CF₄
  - 594 – 1313 cm⁻¹
- CH₃CN
  - 870 – 1650 cm⁻¹
<table>
<thead>
<tr>
<th>MOL._ID</th>
<th>CODE</th>
<th>REF.</th>
<th>GEISA-08 UPDATED SPECTRAL RANGES</th>
<th>GEISA-08 # LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₂H₆</td>
<td>22</td>
<td>ULB</td>
<td>Bands : ( V_6, V_6 + V_1, 3V_4, V_6 + 2V_4, 2V_4 ) 22402 lines</td>
<td>28439</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J. Vander-Auwería N. Moazzen-Ahmadi</td>
<td>( 706.601510 - 3000.486000 ) cm⁻¹.</td>
<td></td>
</tr>
<tr>
<td>C₂H₂</td>
<td>24</td>
<td>LADIR LPMAA ULB</td>
<td>9 spectral regions 8225 lines</td>
<td>11340</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. Jacquemart J.Y. Mandin, V. Dana J. Vander-Auwería</td>
<td>( 3.8, 3.6, 2.5, 2.2, 1.9, 1.7, 1.5, 1.4, 1.3, 1.2, 1 \mu m )</td>
<td></td>
</tr>
<tr>
<td>C₂H₄</td>
<td>25</td>
<td>Institut Carnot de Bourgogne ULB</td>
<td>Band ( V_{12} ) 5400 lines</td>
<td>18378</td>
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<tr>
<td></td>
<td></td>
<td>M. Rotger, V. Boudon J. Vander-Auwería</td>
<td>( 1380.023905 - 1599.981903 ) cm⁻¹.</td>
<td></td>
</tr>
<tr>
<td>HCOOH</td>
<td>37</td>
<td>LISA ULB</td>
<td>Total replacement of the former GEISA contents 3 spectral regions</td>
<td>62684</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. Perrin J. Vander Auwería</td>
<td>( 10.018282 - 99.912896 ) cm⁻¹ 6808 lines</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( 940.197470 - 1244.413080 ) cm⁻¹ 49625 lines</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( 1723.862620 - 1889.333730 ) cm⁻¹ 6251 lines</td>
<td></td>
</tr>
<tr>
<td>MOL. ID</td>
<td>CODE</td>
<td>REF.</td>
<td>GEISA-08 UPDATED SPECTRAL RANGES</td>
<td>GEISA-08 # LINES</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
<td>------</td>
<td>----------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>C₂H₆ (INTERET ASTRO.)</td>
<td>22</td>
<td>ULB</td>
<td>J. Vander-Auwera, N. Moazzen-Ahmadi</td>
<td>Bands : ( \nu_3, \nu_6 + \nu_1 - \nu_4, 3\nu_4, \nu_6 + 2\nu_4 - 2\nu_4 ) 22402 lines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₂H₂</td>
<td>24</td>
<td>LADIR</td>
<td>D. Jacquemart, J.Y. Mandin, V. Dana, J. Vander-Auwera</td>
<td>9 spectral regions 8225 lines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₂H₄</td>
<td>25</td>
<td>Institut Carnot de Bourgogne</td>
<td>M. Rotger, V. Boudon, J. Vander-Auwera</td>
<td>Band ( \nu_{12} ) 5400 lines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLES OF DATABASE VALIDATION PROCESSES
Selected Spectroscopic Databases

Differences in contents and subsequent IASI radiative transfer modelling

**GEISA/IASI-03**

**GEISA/IASI-08 update with:**
- Toth R.A. « Linelist of water vapor parameters from 500-8000 cm\(^{-1}\) » *JQSRT (in preparation).*

**Spectral interval:** 10-2000 cm\(^{-1}\)

**HITRAN-04**

**HITRAN-06 update with:**
GEISA-08 line transition parameters sub-database

Evaluation of the impact of H$_2$O spectroscopic archive differences using IASI Metop Flight Data and 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; Chéruy et al. 1995]

STRANSAC [N.A. Scott, 1974]
line-by-line and layer-by-layer model in their latest version

F.R.S.-FNRS contact group for High Resolution Molecular Spectroscopy, Febr. 26th, 2009, ULB, Bruxelles
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 colocation'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 H₂O archives.

Two specific spectral regions have been selected:

- 800-900 cm⁻¹ and 1800-2000 cm⁻¹.

Whereas the first region don't show improvement in the spectroscopic parameters, the second seems to show a comparison 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\(^{-1}\) IASI Observations

Brightness temperature differences (K)

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

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

F.R.S.-FNRS contact group for High Resolution Molecular Spectroscopy, Feb 26th, 2009, ULB, Bruxelles
1800 – 2000 cm\(^{-1}\)
IASI Observations

Brightness temperature differences (K)

Wavenumber (cm\(^{-1}\))

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

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

F.R.S.-FNRS contact group for High Resolution Molecular Spectroscopy, Feb 26th, 2009, ULB, Bruxelles
GEISA Interactive Distribution
GEISA and associated facilities are implemented on the Ether (CNRS/IPSL) (CPS)

Effective January 2007

Ether Products and Services Centre Facilities:

http://ether.ipsl.jussieu.fr
Welcome to the Ether website

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

**Original products**

- MISO: French activities
- GRISA: spectroscopic database
- ECAD: data for emissions calculation
- Chemical Kinetics Database
- GIRAFE: biomass burning plumes
- SOLSPEC: solar radiation spectrum data
- MINOSA: Potential vorticity and temperature analysis and forecasts in Northern and Southern Hemispheres and Tropics
- REPROBUS: Chemistry Transport Model in Polar waters
- ARLETTY: temperature and pressure profiles calculation
- CRBM/SNR: official data and specific production (CO₂, CO₃→)

**Other products**

- Select by Experiment
- Models and Assimilations
- Software

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

The current edition of the GEISA data is freely accessible.

<table>
<thead>
<tr>
<th>GEISA 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Individual lines (interactive access)</td>
</tr>
<tr>
<td>- Individual lines (FTP access)</td>
</tr>
<tr>
<td>- IR Cross-sections</td>
</tr>
<tr>
<td>- UV-VIS Cross-sections</td>
</tr>
<tr>
<td>- Aerosols</td>
</tr>
</tbody>
</table>

GEISA 2003

- Individual lines : Interactive access
- Individual lines : FTP access
- IR Cross-sections
- UV_VIS Cross-sections
- Aerosols

Questions?

- You will find the answers to the most current questions about our FAQ.
- For scientifical questions, please contact Prof. Nicole Jacquinet-Husson: Nicole.Jacquinet@iml.polytechnique.fr
- For online Web access questions, please contact the webmaster: Ether.webmaster@ipsl.jussieu.fr
Table 4
Update requirement index for selected molecules and spectroscopic parameters in major public spectroscopic databases

<table>
<thead>
<tr>
<th>Molecules</th>
<th>Line position</th>
<th>Line intensities</th>
<th>Line broadening</th>
<th>Line mixing</th>
<th>Continuum</th>
<th>Cross-sections</th>
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<tbody>
<tr>
<td>H$_2$O</td>
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<td>1</td>
<td>1</td>
<td>1</td>
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<td>CO$_2$</td>
<td>Y</td>
<td>Y</td>
<td>1</td>
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<tr>
<td>O$_3$</td>
<td>3</td>
<td>1?</td>
<td>1</td>
<td>1</td>
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<td>CH$_4$</td>
<td>2</td>
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<td>1</td>
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<tr>
<td>CO</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
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<tr>
<td>N$_2$O</td>
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<td>?</td>
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<td>2</td>
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<tr>
<td>HNO$_3$</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

O$_2$ and N$_2$ collision-induced spectrum

CFCs, HCFCs, N$_2$O$_3$

1” parameters that need to be improved; “2” and “3” second and third priority for improvement; “Y” no problem clearly identified; “?” the databases have to be checked. A blank corresponds to non-applicable information.
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 cm\(^{-1}\): refine the temperature dependence;
4. O\(_3\) in the 9.6 μm region: the spectroscopic parameters still need to be validated;
5. Some CO2 – Q branches: further improvement/tuning of the line mixing (15 μm region especially)
Conclusions from ISSWG-2.1

IASI Sounding Science Working Group Meeting
30 June 2008 - 2 July 2008, CNES, Paris, France

CNES and EUMETSAT have decided to extend the mandate of the ISSWG in order to foster the science with IASI, to seek expert advice for the calibration and validation and also on new applications with IASI.

Assessment of spectroscopy for IASI

- Comparison with HITRAN and GEISA, in particular for water vapour, and real IASI spectra, compared to simulations with ECMWF provided radiosondes, lead to the conclusion that in particular water vapour needs to be validated, and the continuum reinvestigated.

- In the discussion urgent areas to investigate were considered to be line coupling, (which should be independent of the data bases) and non LTE.

- IASI related spectroscopy problems with H2O and CO2 as first priority
ACKNOWLEDGMENTS

to

CNES, CNRS/INSU and EUMETSAT

for their Encouragements and Supports

THANK YOU FOR YOUR ATTENTION
FROM GEISA-03 TO GEISA-08:
updated molecular species

<table>
<thead>
<tr>
<th>MOI. ID</th>
<th>SPECTRAL RANGE/ BAND ID.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GEISA-03</td>
</tr>
<tr>
<td>H₂O</td>
<td>0.007- 25232.004 cm⁻¹</td>
</tr>
<tr>
<td>CO₂</td>
<td>436.123- 9648.007 cm⁻¹</td>
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<tr>
<td>O₃</td>
<td>0.026- 4060.783 cm⁻¹</td>
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<tr>
<td>N₂O</td>
<td>0.838- 5131.249 cm⁻¹</td>
</tr>
<tr>
<td>CH₄</td>
<td>0.010- 9199.285 cm⁻¹</td>
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<tr>
<td>O₂</td>
<td>0.000- 15927.806 cm⁻¹</td>
</tr>
<tr>
<td>SO₂</td>
<td>0.017- 4092.948 cm⁻¹</td>
</tr>
<tr>
<td>NO₂</td>
<td>0.498- 3074.366 cm⁻¹</td>
</tr>
<tr>
<td>PH₃</td>
<td>17.805- 2478.765 cm⁻¹</td>
</tr>
<tr>
<td>HNO₃</td>
<td>0.035- 1769.982 cm⁻¹</td>
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## FROM GEISA-03 TO GEISA-08:
updated molecular species (following)

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<tr>
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<td>GEISA-03</td>
</tr>
<tr>
<td>H$_2$CO</td>
<td>0.000 - 2998.527 cm$^{-1}$</td>
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<tr>
<td>C$_2$H$_8$</td>
<td>725.603 - 2977.926 cm$^{-1}$</td>
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<tr>
<td>CH$_3$D</td>
<td>7.760 - 3306.810 cm$^{-1}$</td>
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<tr>
<td>C$_2$H$_2$</td>
<td>604.774 - 3374.223 cm$^{-1}$</td>
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<tr>
<td>C$_2$H$_4$</td>
<td>701.203 - 3242.172 cm$^{-1}$</td>
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<tr>
<td>HCN</td>
<td>2.870 - 18407.973 cm$^{-1}$</td>
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<tr>
<td>C$_2$N$_2$</td>
<td>203.955 - 2181.690 cm$^{-1}$</td>
</tr>
<tr>
<td>C$_4$H$_2$</td>
<td>190.588 - 654.425 cm$^{-1}$</td>
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<tr>
<td>HC$_3$N</td>
<td>474.293 - 690.860 cm$^{-1}$</td>
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<tr>
<td>HOCl</td>
<td>0.024 - 3799.249 cm$^{-1}$</td>
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<td>N$_2$</td>
<td>1992.628 - 2625.497 cm$^{-1}$</td>
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<td>CH$_3$Cl</td>
<td>674.143 - 3161.830 cm$^{-1}$</td>
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<tr>
<td>H$_2$O$_2$</td>
<td>0.043 - 1499.487 cm$^{-1}$</td>
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</tbody>
</table>

F.R.S.-FNRS contact group for High Resolution Molecular Spectroscopy, Febr. 26th, 2009, ULB, Bruxelles
FROM GEISA-03 TO GEISA-08: updated molecular species (following)

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**GEISA-03**

<table>
<thead>
<tr>
<th>MOI</th>
<th>Spectral Range (cm⁻¹)</th>
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</thead>
<tbody>
<tr>
<td>HCOOH</td>
<td>1060.962 - 1161.251 cm⁻¹</td>
</tr>
<tr>
<td>SF₆</td>
<td>940.425 - 952.238 cm⁻¹</td>
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<tr>
<td>C₃H₄</td>
<td>290.274 - 359.995 cm⁻¹</td>
</tr>
<tr>
<td>ClONO₂</td>
<td>763.641 - 790.805 cm⁻¹</td>
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</tbody>
</table>

**GEISA-08 update**

<table>
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<tr>
<th>MOI</th>
<th>Spectral Range (cm⁻¹)</th>
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<tr>
<td></td>
<td>10 - 100 cm⁻¹</td>
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<tr>
<td></td>
<td>940 - 1244 cm⁻¹</td>
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<tr>
<td></td>
<td>ν₃, ν₄, ν₄+ν₆-ν₆</td>
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<tr>
<td></td>
<td>290 - 360 cm⁻¹</td>
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<tr>
<td></td>
<td>592 - 673 cm⁻¹</td>
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<tr>
<td></td>
<td>500 - 1330 cm⁻¹</td>
</tr>
</tbody>
</table>

8 New Molecular Species

- CH₃Br
  - 16 μm
- CH₃OH
  - 0.02 - 33 cm⁻¹
  - 10 μm region
- NO⁺
  - 1635- 2530 cm⁻¹
- HNC
  - 0.22 - 12594 cm⁻¹
- C₆H₆
  - 642 -705 cm⁻¹
- C₂HD
  - 451 - 580 cm⁻¹
  - 600 - 760 cm⁻¹

30 molecular species updated

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