



Tropospheric trace gas concentrations using infrared spectroscopy from space

International workshop held at the

*Laboratoire Interuniversitaire des Systèmes Atmosphériques
(LISA, Universités Paris – 7 and Paris – 12, CNRS UMR 7583)*

Nov. 30 – Dec. 1, 2006

Meeting report

Prepared by Jean-Marie Flaud and Johannes Orphal

1. Opening and Aim of the Workshop.

The international workshop “Tropospheric trace gas concentrations using infrared spectroscopy from space” held at the “Laboratoire Interuniversitaire des Systèmes Atmosphériques” (LISA) in Créteil from Nov. 30 to Dec. 1, 2006, was proposed in the frame of the ACCENT-TROPOSAT 2 project, in order to provide an opportunity to exchange experience and foster collaborations between different European groups working in the field of infrared spectroscopy from space applied to the remote-sensing of tropospheric trace gases.

The number of participants (25) from 7 different countries (France, Belgium, Netherlands, Germany, UK, Canada, USA) clearly demonstrates the great interest and current development of this field. The presentations (16 oral contributions of 30 min each) covered both general aspects, such as spectroscopy and methods for data inversion and assimilation, and results from different infrared sensors, such as IMG, IASI, MOPITT, MIPAS, SCIAMACHY, ACE-FTS, and TES.

There are currently an increasing number of infrared satellite sensors, monitoring different tropospheric species such as O₃, CO, SO₂, HNO₃, and several minor constituents such as HCOOH,

H₂CO, C₂H₆, etc., both in Nadir and Limb geometry. At the same time there are several new missions being prepared or developed. The aim of this workshop was to give an overview of the current activities and to exchange new results, and most of all, to provide an opportunity for questions and discussions.

2. Scientific Presentations

After a welcome by Jean-Marie Flaud, both as representative of the AT2 Steering Committee and on behalf of the organizers, the workshop started with a first session (chaired by Jim Drummond) focusing on different results from infrared satellite instruments: IMG and the latest news of IASI (presented by Cathy Clerbaux, France), MIPAS (presented by Gabi Stiller, Germany), SCIAMACHY (by Michael Buchwitz, Germany) and TES (by Tony Clough, USA). After a coffee break, the second session (chaired by Tony Clough) covered more general aspects: spectroscopy issues (presented by Jean-Marie Flaud, France), synergistic use of ultraviolet and infrared observations (presented by Jochen Landgraf, Netherlands), a neural network approach for tropospheric ozone retrievals from IMG and IASI (presented by Solène Turquety, France), and stratospheric balloon experiments for validation of infrared Nadir spectra (presented by Sebastien Payan, France).

The second day started with the third session (chaired by Cathy Clerbaux), again with results from different infrared satellite instruments: CO from MOPITT (presented by Jim Drummond, Canada), CH₃OH from ACE-FTS (presented by Gaelle Dufour, France), organic species and PAN from MIPAS (presented by John Remedios, UK) and tropospheric NO_y and organic species from IMG and ACE-FTS (presented by Piet Coheur, Belgium). After a coffee break, the last session (chaired by Gabi Stiller) covered different aspects of retrieval: Optimal estimation, regularisation, and instrument calibration (presented by Tony Clough, USA), near-infrared retrieval of CO and CH₄ from SCIAMACHY (presented by Annemieke Gloudemans, Netherlands), aerosols from infrared Nadir spectra (presented by Michel Kruglanski, Belgium) and studies on a priori climatologies for retrieval of tropospheric ozone (presented by Maxim Eremenko, France).

3. Discussion Points

After each presentation, there was time for questions and discussions. The most important issues that were discussed during the workshop are:

- different retrieval methods
- role of the a priori information
- impact of systematic errors such as instrument calibration and spectroscopy

- use of data for higher level products
- future missions using infrared instruments

4. Conclusions and Recommendations

The general feedback from all participants was that the workshop was very interesting, in particular since all main aspects of tropospheric trace gas retrievals using infrared spectroscopy from space were covered, and since most of the groups actively involved in this research were present. Many results that were shown were recent or new, and in several cases, still unpublished.

As main conclusion, one can state that infrared spectroscopy is a very promising field for atmospheric research and provides significant new results for tropospheric chemistry. There is an increasing number of satellite instruments operating in the infrared that were launched recently or are currently in preparation, and without any doubt, this field of research will continue to grow in the future.

5. Contribution to the current aims of AT2 and ACCENT (see Appendix below)

Clearly, the exchange of ideas and presentation of recent results and methods is an activity that fits perfectly into the frame and aims of the ACCENT-TROPOSAT 2 Network of Excellence. The workshop organised at LISA was attended by 25 scientists from 7 different countries, and all groups involved in the “infrared” subgroup of AT2 task group 1 were represented. (For a detailed list of presentations and attendants, see Annexes below.)

6. Close

The international workshop on “Tropospheric trace gas concentrations using infrared spectroscopy from space” was a real success, and the organisers would like to express their gratitude to the ACCENT-TROPOSAT 2 network for supporting this event.

Appendix 1 Participants and Affiliations

1.	Aben	Ilse	SRON	Utrecht, The Netherlands
2.	Barret	Brice	LA, CNRS	Toulouse, France
3.	Boynard	Anne	LISA/SA, CNRS	Créteil/Paris, France
4.	Buchwitz	Michael	IUP	Bremen, Germany
5.	Clerbaux	Cathy	SA, CNRS	Paris, France
6.	Clough	Anthony	AER	Lexington, MA, USA
7.	Coheur	Piet	ULB	Bruxelles, Belgium
8.	De Maziere	Martine	IASB-BIRA	Bruxelles, Belgium
9.	Drummond	James	Dalhousie University	Halifax, Nova Scotia, Canada
10.	Dufour	Gaëlle	LISA	Créteil, France
11.	Eremenko	Maxim	LISA	Créteil, France
12.	Flaud	Jean-Marie	LISA	Créteil, France
13.	George	Maya	SA	Paris, France
14.	Gludemans	Annemieke	SRON	Utrecht, The Netherlands
15.	Hadji-Lazaro	Juliette	SA	Paris, France
16.	Hurtmans	Daniel	ULB	Bruxelles, Belgium
17.	Kruglanski	Michael	IASB-BIRA	Bruxelles, Belgium
18.	Landgraf	Jochen	SRON	Utrecht, The Netherlands
19.	Orphal	Johannes	LISA	Créteil, France
20.	Payan	Sébastien	LPMAA	Paris, France
21.	Perrin	Agnès	LISA	Créteil, France
22.	Remedios	John	University of Leicester	Leicester, UK
23.	Stiller	Gabriele	IMK-FZK	Karlsruhe, Germany
24.	Turquety	Solène	SA	Paris, France
25.	Vandaele	Ann-Carine	IASB-BIRA	Bruxelles, Belgium

Appendix 2 Workshop Programme

Thursday, 30.11.2006

Session 1 (Chair: J. R. Drummond)

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|-------|--------------|---|
| 14:00 | C. Clerbaux | Current CO measurements in the thermal infrared (IMG, MOPITT, ACE)+ some highlights on volcanic SO ₂ detection |
| 14:30 | G. Stiller | Atmospheric processes in the UTLS as seen by MIPAS |
| 15:00 | M. Buchwitz | Three years of SCIAMACHY/WFM-DOAS tropospheric CO, CH ₄ , and CO ₂ |
| 15:30 | S. A. Clough | TES: Level 1B through Level 3, calibration, retrieval strategy, information content, error analyses, global maps, ... |

16:00 Coffee Break

Session 2 (Chair: S. A. Clough)

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| 16:30 | J.-M. Flaud | Spectroscopy Issues |
| 17:00 | J. Landgraf | Retrieval of Tropospheric Ozone: The Synergistic Use of Thermal Infrared Emission and Ultraviolet Reflectivity Measurements from Space |
| 17:30 | S. Turquety | Tropospheric ozone retrieval from high resolution IR measurements: IMG, IASI |
| 18:00 | S. Payan | Validation of IASI with IASI-Ballon (L1 and L2) |

20:30 Workshop Diner

Friday, 1.12.2006

Session 3 (Chair: C. Clerbaux)

09:00	J. R. Drummond	Results from the MOPITT experiment: Six years of continuous CO measurements
09:30	G. Dufour	Influence of continental emissions on upper-tropospheric methanol revealed from ACE-FTS satellite observations
10:00	J. Remedios	Infrared remote-sensing of organic compounds in the upper troposphere
10:30	P. F. Coheur	Tropospheric NO _y and organic species (ACE-FTS / IMG)

11:00 Coffee Break

Session 4 (Chair: G. Stiller)

11:30	S. A. Clough	On the role of radiance accuracy, radiance validation, and my perspective on the current status of Forward Model accuracy
12:00	A. Gloudemans	SCIAMACHY retrievals of CO and CH ₄ in the near-infrared
12:30	M. Kruglanski	Retrieval of methane and aerosol load from IASI spectra using ASIMUT
13:00	M. Eremenko	Tropospheric O ₃ from IASI

13:30 Lunch (Sandwiches, Desserts)