OSA
Optical Society of America

FTS and ORS

Fourier Transform Spectroscopy

Optical Remote Sensing of the Atmosphere

Collocated Topical Meetings
and Tabletop Exhibits

February 3-6, 2003

Loews Le Concorde Quebec
Quebec City, Canada

The meeting organizers gratefully acknowledge the financial contribution from Ball Aerospace

In cooperation with the American Meteorological Society

Committees

FTS Technical Program Committee

- Dieter Hausamann, *German Aerospace Ctr. (DLR), Germany, Co-Chair*
- Robert McKellar, *Natl. Res. Council, Canada, Co-Chair*
- Glenn Kubiak, *Sandia Natl. Labs., USA**
- Mark Abrams, *FastMetrix Inc., USA*
- Peter Bernath, *Univ. of Waterloo, Canada*
- Peter Griffiths, *Univ. of Idaho, USA*
- Guy Guelachvili, *Univ. of Paris, France*
- Donald Jennings, *NASA Goddard Space Flight Ctr., USA*
- Neil Lewis, *Spectral Dimensions, Inc., USA*
- Jean-Pierre Maillard, *Observatorie de Paris, France*
- Gillian Nave, *NIST, USA*
- Makoto Suzuki, *NASDA/EORC, Japan*
- Jean Vander Auwera, *Univ. Libre de Bruxelles, Belgium*
- Raymond Winkel, *US Military Acad., USA*
- Manfred Winnewisser, *Ohio State Univ., USA*

*Denotes OSA Technical Council Representative

ORS Technical Program Committee

Organizing Committee

- Mitchell D. Goldberg, *NOAA, USA, General Chair*
- James G. Yoe, *NOAA/NESDIS, USA, General Chair*
- Raul J. Alvarez, *NOAA/ETL., USA, Program Chair*
- Allen Huang, *CIMSS Univ. of Wisconsin, USA, Program Chair*

Program Committee

- Steven Ackerman, *Univ. of Wisconsin, USA*
- Mark Allen, *Physical Sciences Inc., USA*
- George Aumann, *Jet Propulsion Lab., USA*
- Hal Bloom, *NOAA/NESDIS, USA*

- V. Mike Contarino, *U.S. Navy, USA*
- David Crosby, *American Univ., USA*
- David Emmit, *Simpson Weather Assoc., Inc., USA*
- Bruce Gentry, *NASA Goddard Space Flight Ctr., USA*
- Chris Hostetler, *NASA Langley Res. Ctr., USA*
- Timothy Kane, *Pennsylvania State Univ., USA*
- Philippe Keckhut, *CNRS, France*
- Larry McMillin, *NOAA/NESDIS, USA*
- Volker Wulfmeyer, *Natl. Ctr. For Atmospheric Res., Germany*
- William Smith, *NASA Langley Res. Ctr., USA*

*Denotes OSA Technical Council Representative

About FTS

Fourier Transform Spectroscopy

February 3-6, 2003

Fourier transform spectrometry is the spectroscopic technique of choice in all research areas that require high accuracy, sensitivity, and resolution, which continues grow in application and utilization. This is especially true for new research areas, to such as meteorology and chemical microscopy, where such attributes are mandatory. This FTS Topical Meeting is the only global conference on Fourier transform spectrometry covering the whole range of FTS technology and applications. Its scope will include laboratory spectroscopy, Earth and planetary remote sensing, and astronomy.

Meeting Scope

Topics To Be Covered:

- Instruments: New FTS concepts and designs; FTS in the submillimeter, infrared, visible, and ultraviolet; laboratory instruments; space-based instruments; astronomical instruments; new technologies for FTS; and imaging FTS.
- Analysis: New methods for photometry, lineshape determination, and improving frequency accuracy, as well as improvements in atmospheric retrievals of gases and particulates.
- Applications: Atomic and molecular spectroscopy, Raman FT spectroscopy, time-resolved Fourier transform spectroscopy, biological and in-situ spectroscopy, atmospheric remote sensing, earth remote sensing from space, planetary remote sensing, and spectroscopy of astronomical sources.

About ORS

Optical Remote Sensing of the Atmosphere

February 3-6, 2003

The meeting will address passive and active optical techniques used to monitor the Earth's atmosphere and provide information for such critical tasks as weather forecasting, storm tracking, transport prediction, ozone monitoring, and global climate assessment. Collocation with the Fourier Transform Spectrometry Topical Meeting is intended to facilitate fuller understanding of the science and technology of remote atmospheric measurements using optical methods.

Meeting Scope

Topics To Be Covered:

- Global measurement of trace gases
- Developments in lidar measurements of aerosols and clouds
- Advances in laser development of lidar applications
- New results from the Earth Observing System
- New results from the Advanced TIROS Operational Vertical Sounder
- Advanced passive high spectral resolution infrared sounders
- Retrieval algorithms and signal processing
- Remote sensing for climate applications
- Fast radiative transfer models
- Laboratory spectroscopy of molecules of atmospheric interest
- Remote wind measurements
- Novel lidar instrumentation
- Lidar studies of tropospheric air pollution
- Measurements of atmospheric constituents
- Spaceborne atmospheric measurements
- Assimilation optical remote sensing data
- Hyperspectral instrumentation and applications

FTS Invited Speakers

The list of invited speakers during the FTS program includes a session code for easy reference:

Current developments in FTS: What is (and is not) in the book, Mark Abrams, *ITT Industries, USA* [FMB1]

Very-high-resolution studies of chiral molecules with a Bruker IFS 120 HR: The rovibrational spectrum of CDBrCIF in the range 600-2300 cm-1, S. Albert, *ETH Zurich, Switzerland* [FWD2]

Ultrafast multidimensional Fourier transform spectroscopy, N. Belabas, *Ecole Polytechnique, France* [FThA1]

The ACE (Atmospheric Chemistry Experiment) satellite mission: An overview, P.F. Bernath, *Univ. of Waterloo, Canada* [FTuD1]

Radiometric accuracy assessment of MIPAS on ENVISAT, M. Birk, *DLR, Germany* [FMC1]

The instrument lineshape, an imperative parameter for the absolute calibration of an FTS, M. Chamberland, *TELOPS Inc., Canada* [FWC1]

The MIPAS-Experiment on boards ENVISAT: Status and first results, H. Fischer, *IMK, Germany* [JMA1]

Laboratory FT Spectroscopy in support of MIPAS, J.-M. Flaud, *CNRS, France* [FWD1]

Photon games with three pieces of glass, G. Guelachvili, *CNRS, France* [FThA2]

Current status of IASI, an IR space FTS for atmospheric sounding, P. Hebert, *CNES, France* [FWB1]

Achieving kilometric absorption paths using intracavity laser absorption spectroscopy detected by FTS (FT-ICLAS): Development and applications, D. Hurtmans, *ULB, Belgium* [FWD3]

Bio-medical imaging applications of FTS, M. Jackson, *Ntl. Res. Council of Canada, Canada* [FThB1]

New methods of data processing in FTS equipment, J.A. Keens, *Bruker Analytik, Germany* [FWC2]

Current applications of FTS in astronomy, Jean Pierre Maillard, *Inst. d'Astrophysique de Paris, France* [FWB1]

Far infrared Fouier transform spectroscopy facility at the Canadian Light Source, Tim May, *Canadian Light Source, Canada* [FTuB2]

High sensitivity time-resolved Fourier transform spectroscopy: Quantitative spectroscopy with kilometric absorption paths, N. Picqué, *CNRS, France* [FTuA3]

The imaging FT Spectrometer FTIS, W. Posselt, *Astrium GmbH, Germany* [FMB2]

Design of the FTS for the ACE mission, Marc Andre Soucy, *ABB Bomem Inc., Canada* [FTuC1]

FTS studies of line shapes, P. Varanasi, *State Univ. of New York at Stony Brook, USA* [FTuA2]

A new perspective of quasilinear molecules, B. Winnewisser, *The Ohio State Univ., Columbus, USA* [FTuA1]

ORS Invited Speakers

The list of invited speakers during the ORS program includes a session code for easy reference:

Infrared remote sensing in the presence of clouds with AIRS-AMSU-HSB, Moustafa Chahine and Fred O'Callaghan, *Jet Propulsion Lab, USA* [JMA2]

High resolution airborne water vapour DIAL during IHOP, Gerhard Ehret, *DLR, Germany* [OTuB2]

Coherent Doppler wind lidar for the Japanese experimental module of the ISS, Toshikazu Itabe and Kohei Mizutani, *Comm. Res. Lab., Japan* [OWA1]

The NASA Earth Observing System (EOS) moderate resolution imaging spectroradiometer on-orbit characterization and status, Vincent V. Salomonson, *NASA Goddard Space Flight Ctr., USA* [OTuA1]

Publications

Technical Digests

The FTS and the ORS Technical Digests will be comprised of the camera-ready summaries of papers being presented during the meeting. At the meeting, each registrant will receive a copy of one Technical Digest of their choice. Extra copies can be purchased at the meeting for a special price of $45 USD.

Agenda of Sessions

FTS/ORS Agenda

FTS Agenda

Sunday, February 2, 2003

Time	Event
14.00 - 19.00	Registration Ballroom Foyer

Monday, February 3, 2003

Time	Event
7:30 - 17:00	Registration/Speaker and Presider Check-In *Ballroom Foyer*
7:30 - 8:30	Continental Breakfast *Ballroom Foyer*
8:15 - 8:30	Opening Remarks *Salle Borduas*
8:30 - 10:30	JMA: Joint Session Atmospheric Remote Sensing *Salle Borduas*
10:30 - 11:00	Coffee Break Salle Krieghoff
11:00 - 12:20	FMB: New Technologies *Salle Leduc*
12.20 - 13.50	Lunch Break
13.50 - 15.10	FMC: Instrument Characterization *Salle Leduc*
15.30 - 18.00	JMD: Joint Poster Session *Salle Krieghoff*

Tuesday, February 4, 2003

Time	Event
7.30 - 17.30	Registration/Speaker and Presider Check-In *Ballroom Foyer*
7.30 - 8.30	Continental Breakfast *Ballroom Foyer*
8.30 - 10.30	FTuA: Spectroscopy I *Salle Leduc*
10.30 - 11.00	Coffee Break *Salle Krieghoff*
11.00 - 12.20	FTuB: Instrument Technology II *Salle Leduc*
12.20 - 13.50	Lunch Break

ORS Agenda

Sunday, February 2, 2003

Time	Event
14.00 - 19.00	Registration Ballroom Foyer

Monday, February 3, 2003

Time	Event
7:30 - 17:00	Registration/Speaker and Presider Check-In *Ballroom Foyer*
7:30 - 8:30	Continental Breakfast *Ballroom Foyer*
8:15 - 8:30	Opening Remarks *Salle Borduas*
8:30 - 10:30	JMA: Joint Session Atmospheric Remote Sensing *Salle Borduas*
10:30 - 11:00	Coffee Break Salle Krieghoff
11:00 - 12:20	OMB: Radiative Transfer *Salle Leduc*
12.20 - 13.50	Lunch Break
13.50 - 15.30	OMC: Retrieval of Atmospheric and Surface Parameters *Salle Leduc*
15.30 - 18.00	JMD: Joint Poster Session *Salle Krieghoff*

Tuesday, February 4, 2003

Time	Event
7.30 - 17.30	Registration/Speaker and Presider Check-In *Ballroom Foyer*
7.30 - 8.30	Continental Breakfast *Ballroom Foyer*
8.30 - 10.30	OTuA: Validation *Salle Leduc*
10.30 - 11.00	Coffee Break *Salle Krieghoff*
11.00 - 12.20	OTuB: Instruments, Clouds and Aerosols I *Salle Leduc*
Lunch Break/Afternoon off	
TBD	Tour of Bomem

13.50 - 15.30	FTuC: Instrument Characterization II *Salle Borduas*
15.30 - 16.00	Coffee Break *Salle Krieghoff*
16.00 - 17.40	FTuD: Atmospheric Remote Sensing *Salle Borduas*
TBD	Tour of Bomem

Wednesday, February 5, 2003

Time	Event
8.00 - 17.30	Registration/Speaker and Presider Check-In *Ballroom Foyer*
7.30 - 8.30	Continental Breakfast *Ballroom Foyer*
8.30 - 10.30	FWA: Atmospheric Remote Sensing II *Salle Borduas*
10.30 - 11.00	Coffee Break *Salle Krieghoff*
11.00 - 12.20	FWB: Astronomy *Salle Borduas*
12.20 - 13.50	Lunch Break
13.50 - 15.30	FWC: Data Processing, Algorithms, and Simulations *Salle Borduas*
15.30 - 16.00	Coffee Break *Salle Krieghoff*
16.00 - 18.00	FWD: Spectroscopy II *Salle Borduas*

Thursday, February 6, 2003

Time	Event
8.15 - 12.15	Registration/Speaker and Presider Check-In *Ballroom Foyer*
7.30 - 8.30	Continental Breakfast *Ballroom Foyer*
8.30 - 10.30	FThA: Novel Concepts *Salle Borduas*
10.30 - 11.00	Coffee Break *Salle Krieghoff*
11.00 - 12.20	FThB: Applications *Salle Borduas*
12.20 - 12.30	Closing Remarks *Salle Borduas*

Wednesday, February 5, 2003

Time	Event
8.00 - 17.30	Registration/Speaker and Presider Check-In *Ballroom Foyer*
7.30 - 8.30	Continental Breakfast *Ballroom Foyer*
8.30 - 10.30	OWA: Instruments, Clouds and Aerosols II *Salle Leduc*
10.30 - 11.00	Coffee Break *Salle Krieghoff*
11.00 - 12.40	WOWB: Trace Gases *Salle Leduc*
12.40 - 12.50	Closing Remarks Salle Leduc

Fourier Transform Spectroscopy

Abstracts

February 3 – 6, 2003 Loews Le Concorde Quebec
Quebec City, Canada

■ **Monday**
■ **February 3, 2003**

Room: Borduas
8:15am - 8:30am
■ **Chairs Opening Remarks**
D. Hausamann, German Aerospace Res. Est. DLR, Oberpfaffenhofen, Germany; M. Goldberg, NOAA, Camp Springs, MD, USA.

Room: Borduas
8:30am - 10:30am
JMA ■ Atmospheric Remote Sensing – FTS and ORS Joint Session
A. McKellar, Natl. Res. Council of Canada, Ottawa, ON, Canada and M. Goldberg, NOAA, Camp Springs, MD, USA, Presiders

JMA1 8:30am Invited
The MIPAS experiment on board ENVISAT: Status and first results, *H. Fischer, Forschungszentrum Karlsruhe, Karlsruhe, Germany.*
The status of the MIPAS instrument will be described in some details. This includes the testing of the instrument and the presentation of first spectra. Derived vertical profiles of trace constituents will be intercompared with validation measurements. Results on non-LTE effects and on clouds properties will be presented, too. The talk will be concluded with future expectations on MIPAS.

JMA2 9:10am Invited
Infrared remote sensing in the presence of clouds with AIRS-AMSU-HSB, *M. Chahine, Jet Propulsion Lab., Pasadena, CA, USA.*
The Atmospheric Infrared Sounder (AIRS) and its two companion instruments (AMSU) and (HSB) are designed to provide, worldwide, atmospheric temperature and humidity profiles with radiosonde accuracy. The performance of AIRS since launch on Aqua has been exceptional indicating that it will meet or exceed its objectives.

JMA3 9:50am
Airs in orbit infrared calibration performance, *S. Gaiser, Jet Propulsion Lab., Pasadena, CA., USA.*
The Atmospheric Infrared Sounder (AIRS), launched on the Earth Observing System (EOS) Aqua platform in May, 2002, has been operating stably, in normal data acquisition mode, for five months. Based on cloud-free, sea surface temperature comparisons, the in-orbit radiometric calibration is very stable, and has been validated to an absolute accuracy of better than 0.5K, consistent with the 0.2K absolute radiometric accuracy determined pre-launch. Based on upwelling radiance spectra, the in-orbit spectral calibration is stable to better than 0.1% of the Spectral Response Function (SRF) FWHM, and has an absolute accuracy of 0.5% of the SRF FWHM. A small increase (up to 15%) in Noise Equivalent Delta Temperatures (NEdTs) has been observed, and is consistent with a reduction in system transmission due to ice accumulation. Given the precision and stability of its measurements, AIRS should contribute significantly to both weather forecasting and climate studies.

JMA4 10:10am
Scanning High-Resolution Interferometer Sounder (S-HIS) aircraft instrument and validation of the Atmospheric Infrared Sounder (AIRS), *H. Revercomb, R. Knuteson, F. Best, D. Tobin, D. LaPorte, S. Ellington, M. Werner, R. Dedecker, R. Garcia, N. Ciganovich, H. Howell, Univ. of Wisconsin-Madison, Madison, WI, USA; W. Smith, NASA Langley Res. Ctr., Hampton, VA, USA.*
S-HIS developments improve aircraft capabilities for observing the earth-emitted spectrum in great detail and high accuracy. With its spatial mapping, S-HIS is a powerful tool to validate spectra from AIRS on the NASA Aqua satellite.

Room: Salle Krieghoff
10:30am - 11:00am
Coffee Break

Room: Borduas
11:00am - 12:20pm
FMB ■ New Technologies
P. Griffiths, Univ. of Idaho, Moscow, ID, USA, Presider

FMB1 11:00am Invited
Current developments in FTS: What is (and is not) in the book, *M. Abrams, ITT Ind., Fort Wayne, IN, USA.*
Abstract not available.

FMB2 11:40am Invited
The imaging FT spectrometer FTIS, *W. Posselt, Astrium GmbH, Muenchen, Germany; H. Tittel, Univ. of Siegen, Siegen, Germany; M. Rost, Zess, Siegen, Germany; B. Harnisch, ESA-ESTEC, Noordwijk, Netherlands.*
The feasibility of a compact Fourier-Transform-Imaging-Spectrometer (FTIS) for small satellite planetary and terrestrial remote sensing missions has been studied under ESA contract. The feasibility of this instrument concept was demonstrated by breadboard testing.

12:20pm-1:50pm
Lunch on Your Own

Room: Borduas
1:50pm - 3:30pm
FMC ■ Instrument Characterization 1
G. Guelachvili, CNRS, Orsay, France, Presider

FMC1 1:50pm Invited
Radiometric accuracy assessment of MIPAS on ENVISAT, *M. Birk, G. Wagner, DLR Institute for Remote Sensing Tech., Wessling, Germany.*
Commissioning phase in-flight measurements of the MIPAS FT-spectrometer on ENVISAT were analyzed with a dedicated IDL tool regarding radiometric accuracy. This included FT instrument characterization as well as parts of level 1b processing, both independent from the nominal ESA data processing and in-flight characterization. At the present state of analysis MIPAS was found to operate close to the physical sensitivity limit with radiometric errors not exceeding the specifications.

FMC2 2:30pm
Characterisation and correction of the instrument line shape in Fourier-transform spectrometry, *F. Chateauneuf, S. Lantagne, R. Poulin, ABB Bomem, Quebec, PQ, Canada.*
A characterisation for the instrument line shape of a Fourier-transform spectrometer is presented. It includes the off-axis effect and a generic term taking into account variation of the transfer function with the path difference. A correction algorithm is also presented.

FMC3 2:50pm
Detailed lineshape measurements using a high resolution, high divergence fourier transform spectrometer, *J. -P. Bouchard, Univ. Laval, Québec, PQ, Canada; P. Tremblay, Telops Inc. St-Augustin, PQ, Canada.*
A high resolution, high divergence Fourier transform spectrometer for detailed instrument lineshape study is presented. The instrument will allow better validation of instrument line-shape models.

FMC4 3:10pm
Overview of the Cross-Track Infrared Sounder (CrIS), *R. Glumb, J. Predina, J. Fennelly, ITT Industries, Fort Wayne, IN, USA.*
CrIS is an interferometric sounder that accurately measures upwelling earth radiances used to construct vertical profiles of atmospheric temperature, moisture and pressure for the NPOESS program. Presented is the CrIS design and performance.

Room: Salle Krieghoff
3:30pm - 6:00pm
FMD ■ FTS Poster Session

FMD1
Construction of a fourier-transform spectrometer for optical communication, *M. Gibeault, E. Lanoue, J. Genest, Univ. of Ottawa, Ottawa, ON, Canada.*
A Fourier transform spectrometer for optical communications is described. The interferometer configuration, the moving stage and its drive, the detection of the signals and the sampling method are discussed. Finally appropriate phase correction and windowing techniques are suggested.

FMD2
Measurement of oscillator strengths using FTS and synchrotron radiation, *Z. Li, G. Nave, J. Curry, Natl. Inst. of Standards and Tech., Gaithersburg, MD, USA.*
We describe the measurement of oscillator strengths by radiometrically calibrating a Fourier transform spectrometer using synchrotron radiation.

FMD3
Fourier transform near-field infrared spectroscopy, *M. Nakauchi, Y. Narita, S. Kimura, JASCO Corp., Tokyo, Japan;* We present a new system that combines a Fourier transform infrared spectrometer with a near-field microscope to achieve subwavelength spatial resolution for mid-IR spectroscopy. Sub-micrometer to nanometer scale chemical structure analysis is attained in IR region.

FMD4
FTS measurements of molecular ion infrared absorption spectra, *A. McKellar, Natl. Res. Council of Canada, Ottawa, ON, Canada.*
Absorption spectra of the molecular ions H_3^+ and N_2H^+ have been measured in the mid-infrared using a Bomem DA3 spectrometer and a cooled hollow-cathode cell fitted with multiple traversal optics.

FMD5
Fourier transform infrared emission spectra of BeH/BeD and BeH_2/BeD_2, *A. Shayesteh, K. Tereszchuk, P. Bernath, Univ. of Waterloo, Waterloo, ON, Canada; R. Colin, Univ. Libre de Bruxelles, Brussels, Belgium.*
High resolution infrared emission spectra of BeH/BeD and BeH_2/BeD_2 have been recorded with a Fourier transform spectrometer. Some vibrational bands of BeH/BeD and several bands of BeH_2/BeD_2 were rotationally analyzed, and the equilibrium structures were determined.

FMD6
Matrix algorithm for integration and inversion of instrument line shape, *R. Desbiens, Univ. Laval, Quebec, PQ, Canada; P. Tremblay, Telops Inc., St-Augustin, PQ, Canada; J. Genest, Univ. of Ottawa, Ottawa, ON, Canada.*
We propose a new and efficient matrix algorithm for the integration and the inversion of wavelength dependent effects in Fourier transform spectrometers. The proposed algorithm takes into account and overcomes finite resolution difficulties.

FMD7
Fourier transform spectroscopy of gas-phase YbH and YbD, *I. Gordon, P. Bernath, Univ. of Waterloo, Waterloo, ON, Canada; M. Dick, C. Linton, Univ. of New Brunswick, Fredericton, NB, Canada.*
The visible and infrared emission spectra of YbH/D were recorded with a Fourier transform spectrometer. New bands were observed in the range 4600-5700 cm^{-1}. These experiments are the first step in a project to investigate spectra of lanthanide hydrides.

FMD8
Atomic and molecular spectroscopy with the Imperial College VUV high resolution fourier transform spectrometer, *R. Blackwell-Whitehead, J. Pickering, A. Thorne, Imperial College, London, United Kingdom.*
We report on recent measurements at Imperial College using our high resolution VUV Fourier Transform Spectrometer to study atomic and molecular spectra relevant to astrophysics and atmospheric physics.

FMD9
Infrared absolute line intensities for minor atmospheric constituents, *J. Vander Auwera, Univ. Libre de Bruxelles, Brussels, Belgium; L. Daumont, J. Teffo, Univ. Pierre et Marie Curie, Paris, France; V. Perevalov, S. Tashkun, Inst. of Atmospheric Optics, Tomsk, Russian Federation.*
We present recent laboratory measurements of absolute line intensities for carbonyl sulfide and nitrous oxide in the infrared and near infrared spectral ranges respectively, using high-resolution Fourier transform spectroscopy.

FMD10
Noise consideration in an FTS for telecommunication applications, *E. Lanoue, G. Scardera, J. Genest, M. Gibeault, Univ. of Ottawa, Ottawa, ON, Canada.*
In this text we study the noise effects on a FTS for optical communication applications. Many noise sources distort our instrument's measurements. A simulation of the system is useful in determining the ultimate performance of our instrument.

FMD11
A MEMS-based fourier transform spectrometer, *G. Jodor, M. Sirota, H. Riris, W. Hasselbrack, Sigma Space Corp., Lanham, MD, USA.*
A miniature FTS instrument where the moving mirror runs on a MEMS-based guiding mechanism is presented. Spectra obtained with a 10 x 15 x 2.5 cm brassboard at 0.1 cm^{-1} resolution will be discussed.

FMD12
First laboratory measurement of the infrared absorption cross section of a new atmospheric greenhouse gas, *S. Melo, D. Barclay, K. Strong, S. Mabury, N. Stock, M. Toohey, Univ. of Toronto, Toronto, ON, Canada.*
We report on the first measurements of infrared spectra of 6:2 FTOH. The measurements were taken using a 25-cm-path cell at room temperature over the spectral range 900-3500 cm^{-1}. Our results reveal 6:2 FTOH as a potentially important greenhouse gas.

FMD13
Pressure, temperature, and volume mixing ratio retrievals for the Atmospheric Chemistry Experiment, *C. Boone, P. Bernath, Univ. of Waterloo, Waterloo, ON, Canada.*
Procedures are described for pressure, temperature, and volume mixing ratio retrievals for the Atmospheric Chemistry Experiment, a satellite mission for remote sensing of the Earth's atmosphere developed under the auspices of the Canadian Space Agency.

FMD14
Data management for the ACE mission, *S. McLeod, Univ. of Waterloo, Waterloo, ON, Canada.*
The design of a database of space-borne FTIR spectra from the Atmospheric Chemistry Experiment is presented, as are its interfaces for data processing and distribution. The popular PostgreSQL system has been chosen for this task.

FMD15
The Waterloo Atmospheric Observatory, *K. Walker, P. Bernath, Univ. of Waterloo, Waterloo, ON, Canada; M. Soucy, F. Chateauneuf, ABB-Bomem Inc., Quebec, PQ, Canada.*
An atmospheric observatory is being constructed at the Univ. of Waterloo to employ high resolution infrared and UV/visible Fourier transform spectroscopy to investigate trace gases in the stratosphere and troposphere.

FMD16
A fourier transform spectrometer simulator for IASI, *L. Moreau, G. Perron, ABB Bomem Inc., Québec, PQ, Canada; L. Moreau, G. Perron, ABB Bomem Inc., Québec, PQ, Canada; D. Miras, B. Chétrite, Alcatel Space Ind., Cannes, France.*
A complete Fourier-transform spectrometer simulator is described. It simulates a single mirror sweep. This simulator is designed to test the signal chain of IASI but it is generic enough to simulate most scanning FTS.

FMD17
Ground truth measurements for validation of AIRS land surface temperature and emissivity products at the Southern Great Plains validation site, *B. Osborne, R. Knuteson, H. Revercomb, J. Short, D. Tobin, Univ. of Wisconsin-Madison, Madison, WI, USA.*
This paper presents results from a land use/land cover ground survey in the ARM/CART site region and investigates the applicability of the USGS land use/land cover database to surface emissivity validation activities.

FMD18
High resolution FTIR spectroscopic study of the ν_4 band of CH_3CHF_2 (R152a) enclosed in a flow of cold N_2 gas, *D. Appadoo, Univ. of Waterloo, Waterloo, ON, Canada; E. Robertson, D. McNaughton, Monash Univ., Clayton, Australia.*
An Enclosive Flow Cooling (EFC) cell has been constructed, and coupled to an FTS to record rotationally-cold spectra of gases of atmospheric interest. The high-resolution FTIR spectra of the ν_4 band of cooled 1,1difluoroethane have been measured and analysed.

FMD19
Ground-based solar absorption FTIR spectroscopy at the Reunion Island, *P. Coheur, M. Bach, M. Carleer, C. Clerbaux, R. Colin, D. Hurtmans, ULB, Brussels, Belgium; B. Barret, C. Hermans, E. Neefs, M. De Mazière, BISA, Brussels, Belgium; J. Metzger, J. Leveau, Univ. de la Réunion, Saint-Denis, Reunion.*
This paper gives preliminary results of FTS atmospheric measurements at the Reunion Island. A special emphasis is given to the retrievals of CH_4, CO, O_3, N_2O, HCl, HF and HNO_3

FMD20
Externally dispersed interferometer: Implementation on a 2d Echelle Spectrograph, *D. Erskine, Lawrence Livermore Natl. Lab., Livermore, CA, USA.*
A fixed delay interferometer is placed at the slit of the Lick Obs. 2d-Echelle Spectrograph to imprint a periodic sinusoidal fringe comb against the input spectrum. This boosts the effective resolution by a factor of 2-3.

FMD21
Aluminum prototype interferometer, a rapid prototyping exercise for the CrIS program, *M. Webb, S. Cronin, G. Walker, D. Cordray, ITT Ind., Fort Wayne, IN, USA.*
Rapid sensor prototyping using advanced manufacturing and assembly techniques in support of the CrIS program is discussed. Key success factors and performance from the uncompensated prototype version of the CrIS sensor is presented.

FMD22
Engineering development unit 2 (EDU2) test program for CrIS, *R. Hookman, M. Tritch, G. White, ITT Ind., Fort Wayne, IN, USA.*
Presented is the CrIS EDU2 test program, including EDU2 sensor, test methodology, test equipment, procedures, and the EDU2 test schedule which focuses on risk mitigation for radiometric and structural performance.

FMD23
Generation of CrIS Sensor data records (SDRs), *J. Prednia, R. Glumb, ITT Ind., Fort Wayne, IN, USA.*
Presented is an overview of the CrIS optical hardware, signal processing hardware and ground calibration software necessary for the production of SDRs. The ground calibration software's 9 modular groups will be examined.

FMD24
The difference of the SER spectra of symmetrical molecules adsorbed on rare earth and noble metal substrates, *A. Polubotko, Russian Acad. of Sciences, Saint Petersburg, Russian Federation.*
The paper compares the main regularities of the SER spectra of symmetrical molecules adsorbed on noble and rare-earth metals. It is demonstrated that there is a difference between regularities in the SER spectra for adsorbed molecules

FMD25
The BARCOS system for automatic and remote control of a Bruker FTS for solar absorption measurements from ground, *E. Neefs, F. Scolas, M. De Mazière, B. Barret, Belgian Inst. for Space Aeronomy, Brussels, Belgium; T. Stephen, T. Hawat, Univ. of Denver, Denver, CO, USA.*
The first phase of BARCOS has been tested successfully during an FTIR measurement campaign at Ile de la Réunion in September-October 2002. Its development and operation are described.

■ **Tuesday**
■ **February 4, 2003**

Room: Borduas
8:30am - 10:30am
FTuA ■ Spectroscopy 1
J. Vander Auwera, Univ. Libre de Bruxelles, Brussels, Belgium, Presider

FTuA1 8:30am Invited
A new perspective of quasilinear molecules, *B. Winnewisser, M. Winnewisser, Ohio State Univ., Columbus, OH, USA.*
In the perspective of potential surface monodromy, we have found clues to reading the spectra of quasilinear molecules. Some recently gained insight will be presented, based primarily on data for the series of molecules NCCNO, HCNO, BrCNO and ClCNO.

FTuA2 9:10am Invited
FTS studies of line shapes, *P. Varanasi, State Univ. of New York-Stony Brook, Stony Brook, NY, USA.*
With the advent of high-resolution infrared spectroscopic observations of the atmosphere the need for precise characterization of spectral line shapes has arisen and is being met using ultra-high-resolution FTS in the laboratory.

FTuA3 9:50am Invited
High sensitivity time-resolved Fourier Transform Spectroscopy: Quantitative wideband spectroscopy with kilometric absorption paths, *N. Picqué, CNRS, Orsay, France.*
Combining intracavity laser spectroscopy and step-scan time-resolved Fourier Transform Spectroscopy enables to get high sensitivity molecular laboratory spectra, exhibiting kilometric absorption paths. Specific advantages of the method, especially for frequency and intensity metrology of weak absorption transitions, are illustrated and discussed.

Room: Salle Krieghoff
10:30am - 11:00am
Coffee Break
Room: Borduas

11:00am - 12:20pm
FTuB ■ Instrument Technology
H. Buijs, ABB BOMEM Inc., Quebec, Canada, Presider.

FTuB1 11:00am Invited
Synchrotron radiation sources for FTIR spectroscopy, *G. Williams, Jefferson Lab., Newport News, VA, USA.*
We will review the properties of electron particle accelerators as sources of infrared light for spectroscopy, paying particular attention to the brightness advantages over thermal sources. 35 such facilities are running or being planned.

FTuB2 11:40am Invited
Far infrared fourier transform spectroscopy facility at the Canadian Light Source, *T. May, Canadian Light Source, Saskatoon, SK, Canada.*
The CLS synchrotron will provide diffraction limited light for Mid and Far Infrared Spectroscopy. The Far-Infrared (>25 micron wavelength) beamline for high-resolution gas-phase molecular spectroscopy is described. Optical design and various experiments are presented.

Lunch on Your Own
12:20pm - 1:50pm

Room: Borduas
1:50pm - 3:30pm
FTuC ■ Instrument Characterization 2
J. Maillard, Inst. d'Astrophys. de Paris, Paris, France, Presider

FTuC1 1:50pm Invited
Status of the FTS for the ACE mission, *M. Soucy, ABB Bomem, Inc., Quebec, PQ, Canada.*
This paper presents the status of the FTS for the Atmospheric Chemistry Experiment (ACE) mission selected by the Canadian Space Agency for its next science satellite, SciSat-1. ACE consists of a suite of instruments in which the primary element is a Fourier Transform Spectrometer.

FTuC2 2:30pm
Performances of the ACE-FTS instrument, *F. Chateauneuf, S. Fortin, C. Frigon, M. Soucy, ABB Bomem, Quebec, PQ, Canada.*
This paper describes the performances of the ACE-FTS Flight Model (FM) as measured during the verification campaign. It also presents the expected on-orbit performances of the instrument in terms of key parameters like signal-to-noise ratio and resolution.

FTuC3 2:50pm
NESR characterization of a novel interferometer, *C. Manning, M. Gross, Manning Applied Tech., Troy, ID, USA; A. Samuels, US Army Edgewood Chemical and Biological Ctr., Aberdeen, MD, USA.*
Noise-equivalent spectral radiance (NESR) is an important figure of merit that defines the sensitivity limit of interferometry. NESR is predicted and measured for a novel variation of Barringer's interferometer, which employs refractive scanning by a flat compensator plate.

FTuC4 3:10pm
Wavelength standards in the ultraviolet, *G. Nave, C. Sansonetti, Natl. Inst. of Standards and Tech., Gaithersburg, MD, USA.*
We have made accurate wavelength measurements for lines of Pt I and II, Fe I, Ge I, and Kr II in the region 1800 Å to 3100 Å.

Room: Salle Krieghoff
3:30pm - 4:00pm
Coffee Break
Room: Borduas

4:00pm - 5:40pm
FTuD ■ Atmospheric Remote Sensing 1
M. Abrams, ITT Ind., Fort Wayne, IN, USA, Presider

FTuD1 4:00pm Invited
The ACE (Atmospheric Chemistry Experiment) satellite mission: An overview, *P. Bernath, Univ. of Waterloo, Waterloo, ON, Canada.*
ACE will measure and help to understand the chemical processes that control the distribution of ozone in the atmosphere. The main ACE instrument is an infrared FTS working in solar occultation mode.

FTuD2 4:40pm
First results of tropospheric ozone retrievals from BBAERI, *K. Lightner, Univ. of Maryland Baltimore County, Baltimore, MD, USA.*
We present the first results of an algorithm to retrieve tropospheric ozone abundances from the 1000 to 1100 cm^{-1} spectral region. This algorithm will be used to monitor tropospheric ozone and, with meteorological observations, determine the origins of the ozone.

FTuD3 5:00pm
Validation of CO_2 line parameters used in temperature retrievals, *M. Shephard, S. Clough, J. Delamere, Atmospheric and Environmental Res. (AER), Inc., Lexington, MA, USA; D. Tobin, D. Turner, H. Revercomb, R. Knuteson, Univ. of Wisconsin-Madison, Madison, WI; R. Beer, Jet Propulsion Lab., Pasadena, CA, USA.*
A simultaneous retrieval procedure is utilized to investigate CO_2 spectroscopic line parameters in order to reduce systematic errors in temperature retrievals. Provided are initial retrieval results and validations using AFWEX, CAMEX and AERI observations.

FTuD4 5:20pm
Studies of the upper mesosphere and lower thermosphere from ATMOS measurements, *M. McHugh, GATS Inc, Newport News, VA, USA; C. Rinsland, NASA Langley Res. Ctr., Hampton, VA, USA.*
We present upper mesosphere and lower thermosphere temperatures and volume mixing ratios of CO_2 and CO retrieved from the 1994 ATMOS Atlas-3 mission. Vibrational non-LTE effects for CO_2 are also examined.

■ **Wednesday**
■ **February 5, 2003**

Room: Borduas
8:30am - 10:30am
FWA ■ Atmospheric Remote Sensing 2
P. Bernath, Univ. of Waterloo, Waterloo, ON, Canada, Presider

FWA1 8:30am Invited
Current status of IASI, an IR Space FTS for atmospheric sounding, *P. Hebert, CNRS, Gif Sur Yvette, France.*
IASI is an infrared atmospheric sounder. It will provide meteorologist and scientific community with atmospheric spectra. The IASI system includes 3 instruments that will be mounted on the Metop satellite series, a data processing software integrated in the EPS (EUMETSAT Polar System) ground segment and a technical expertise centre implemented in CNES Toulouse.

FWA2 9:10am
Characterization of atmospheric infrared sounder (AIRS) earth scene radiances, *D. Tobin, Space Science and Engineering Ctr., Univ. of Wisconsin-Madison, Madison, WI, USA.*
Analyses of Atmospheric Infrared Sounder (AIRS) Earth Scene Radiances are presented, including comparisons to coincident broadband observations, comparisons to calculations based on global radiosonde and ARM site observations, and noise characterization using principle component analysis.

FWA3 9:30am
Aircraft measurements for validation of AIRS land surface temperature and emissivity products at the Southern Great Plains validation site, *R. Knuteson, B. Osborne, H. Revercomb, D. Tobin, Univ. of Wisconsin-Madison, Madison, WI, USA.*
This study presents a technique for the separation of land surface infrared emissivity and surface skin temperature using high spectral resolution infrared observations from aircraft. Validation mesurements are compared with AIRS satellite products.

FWA4 9:50am
Far infrared radiation measurements from the TAFTS instrument during EMERALD 2001, *G. Straine, P. Green, J. Murray, A. Last, J. Pickering, J. Harries, Imperial College, London, United Kingdom.*
The TAFTS instrument was flown at high altitude in clear and cloudy sky conditions during the EMERALD project. Here we discuss the results including clear sky net flux profiling in the far infrared.

FWA5 10:10am
A new high-resolution fourier transform infrared spectrometer for atmospheric remote sensing in Toronto, *D. Yashcov, A. Wiacek, K. Strong, N. Faridi, Dept. of Physics, Univ. of Toronto, Toronto, ON, Canada.*
Atmospheric remote sensing is performed with a new Bomem DA8 FTIR spectrometer at the Univ. of Toronto Atmospheric Observatory. The abilities of the instrument and the first retrieved vertical profiles of atmospheric constituents are presented.

Room: Salle Krieghoff
10:30am - 11:00am
Coffee Break

Room: Borduas
11:00am - 12:20pm
FWB ■ Astronomy
G. Nave, Natl. Inst. of Standards and Tech., Gaithersburg, MD, USA, Presider

FWB1 11:00am Invited
Current applications of FTS in astronomy, *J.-P. Maillard, Inst. d'Astrophysique de Paris, Paris, France.*
A historical review of FTS in astronomy will show that after an explosion in the 70's the number of instruments currently in service or in project has been constantly declining with the advance of array detectors in size and sensitivity, in favor of grating spectrometers considered more sensitive. However, specific niches remain, and some revival could come with extremely large telescopes.

FWB2 11:40am
Astronomical far-infrared FTS of the FIS instrument onboard the *ASTRO-F* satellite, *M. Kawada, N. Murakami, K. Ozawa, H. Shibai, Nagoya Univ., Nagoya, Japan; H. Takahashi, H. Matsuo, Natl. Astronomical Observatory of Japan, Mitaka, Japan; T. Nakagawa, The Inst. of Space and Astronautical Science, Sagamihara, Japan.*
The far-infrared Fourier transform spectrometer is developed for an application of the astronomical satellite *ASTRO-F*. FIS-FTS is the unique instrument which covers 50 - 200μm wavelength range with spectral resolution of 0.3cm^{-1}.

FWB3 12:00am
Externally dispersed interferometry for low photon noise high resolution broadband spectroscopy, *D. Erskine, Lawrence Livermore Natl. Lab., Livermore, CA, USA.*
An externally dispersed interferometer (EDI) is a hybrid instrument combining the compactness and beamshape insensitivity of a FTS with the low photon noise of a grating spectrograph. High resolution mapping demonstrated on the solar spectrum.

Lunch on Your Own
12:20pm - 1:50pm

Room: Borduas
1:50 pm - 3:30 pm
FWC ■ Data Processing, Algorithms and Simulations
R. Winkel, US Military Acad., West Point, NY, USA, Presider

FWC1 1:50pm Invited
The instrument lineshape, an imperative parameter for the absolute spectral calibration of an FTS, *M. Chamberland, V. Farley, L. Belhumeur, Telops Inc., St-Augustin, PQ, Canada; F. Williams, J. Lawrence, ITT AC/D, Fort Wayne, IN, USA; P. Tremblay, Telops Inc., St-Augustin, PQ, Canada; R. Desbiens, Univ. Laval, Québec, PQ, Canada.*
An Instrument Lineshape model is presented with capabilities to predict various field-of-view geometries, including general illumination. A sensitivity analysis has been performed for various contributors to the lineshape. Measurements made with a gas cell and a laser source are presented.

FWC2 2:30pm Invited
New methods of data processing in FTS equipment, *A. Keens, Bruker Optik GmbH, Ettlingen, Germany.*
Interferogram acquisition with a Delta Sigma ADC and digital signal processor enables the implementation of additional data processing functions. Signal fidelity is enhanced significantly. In addition, for imaging applications a new acquisition scheme is presented.

FWC3 3:10pm
Efficient algorithm to correct for tilt disturbances on FTS data, *P. Tremblay, Telops Inc., St-Augustin, PQ, Canada; D. Mooney, M. Kelly, MIT Lincoln Lab., Lexington, MA, USA; M. Chamberland, V. Farley, Telops Inc., St-Augustin, PQ, Canada; J. Predina, ITT Ind. Inc., Fort Wayne, IN, USA.*
Fourier-transform spectrometers using plane mirror interferometers can suffer from residual mirror misalignment. An efficient algorithm has been developed to correct directly, in real-time, the sampled interferogram for signal distortions arising from this residual tilt.

Room: Salle Krieghoff
3:30pm - 4:00pm
Coffee Break

Room: Borduas
4:00pm - 5:50pm
FWD ■ Spectroscopy 2
M. Winnewisser, Ohio State Univ., Columbus, OH, USA, Presider

FWD1 4:00pm Invited
Laboratory fourier transform spectroscopy in support of MIPAS, *J. Flaud, Laboratoire de Photophysique Molèculaire, CNRS, Orsay, France.*
Examples showing improvements brought by laboratory FTS in the determination of spectral line parameters of atmospheric molecules will be presented focusing on recent efforts dedicated to thegeneration of an improved database for MIPAS.

FWD2 4:40pm Invited
Very high resolution studies of chiral molecules with a Bruker IFS 120 HR: The rovibrational spectrum of CDBrClF in the range 600-2300 cm^{-1}, *S. Albert, K. Albert, M. Quack, ETH Zurich, Zurich, Switzerland.*
The infrared spectrum of the chiral molecule CDBrClF has been measured with a resolution of 0.001 cm^{-1} and analysed in the ν_5, ν_4, ν_3 and $2\nu_4$ regions. The results are discussed in relation to molecular parity violation.

FWD3 5:10pm Invited
Achieving kilometric absorption paths using intracavity laser absorption spectroscopy detected by FTS (FT-ICLAS); Development and applications, *D. Hurtmans, D. Hurtmans, Univ. Libre de Bruxelles,, Bruxelles, Belgium.*
We have built an intracavity laser absorption spectrometer based on a pulsed Ti:Sa laser synchronized to a commercial continuous scan interferometer. A two generation times technique was used to improve the signal-to-noise ratio. Overtone absorption spectra will illustrate the technique.

■ **Thursday**
■ **February 6, 2003**

Room: Borduas
8:30am - 10:30am
FThA ■ Novel Concepts
J. Johns, Steacie Inst. Nonlinear Sci., Ottawa, ON, Canada, Presider

FThA1 8:30am Invited
Ultrafast multidimensional Fourier transform spectroscopy, *N. Belabas, Lab. of Optical Biosciences, Palaiseau, Cedex, France.*
Multidimensional Fourier transform spectroscopy (nD-FTS) is the extension of linear Fourier transform spectroscopy to the measurement of the non-linear n-dimensional response of a material. We discuss here two-dimensional visible-infrared spectroscopy.

FThA2 9:10am Invited
Photon games with three pieces of glass, *G. Guelachvili, CNRS, Orsay, France.*
Several aspects of the well-established modern spectroscopic method named FTS are considered.

FThA3 9:50am
SIAMOIS: A monolithic visible interferometer for stellar seismology, *J. Maillard, Inst. d'Astrophys. de Paris, Paris, France; B. Mosser, Observatoire de Paris, Meudon, France; J. Reess, Observatoire de Paris, Paris, France.*
An interferometer consisting entirely of optically contacted optical elements is described. The interferometer is part of a system to measure the p-mode oscillations of stars from the Doppler signal on a fringe, in the visible.

FThA4 10:10am
Spatial heterodyne spectroscopy: A non-scanned method for high-resolution interference spectroscopy, *J. Harlander, St. Cloud State Univ., St. Cloud, MN, USA; F. Roesler, Univ. of Wisconsin-Madison, Madison, WI,USA; C. Englert, J. Cardon, M. Stevens, US Naval Res. Lab., Washington, DC, USA; R. Reynolds, K. Jaehnig, Univ. of Wisconsin-Madison, Madison, WI, USA.*
Spatial Heterodyne Spectroscopy stands poised to play a significant role in astrophysics and atmospheric remote sensing from space and ground-based platforms. This paper will briefly describe the technique and applications in process.

Room: Salle Krieghoff
10:30am - 11:00am
Coffee Break

Room: Borduas
11:00am - 12:20pm
FThB ■ Applications
P. Tremblay, Univ. Laval, Québec, PQ, Canada, Presider

FThB1 11:00am Invited
Bio-medical imaging applications of FTS, *M. Jackson, Natl. Res. Council of Canada, Winnipeg, ON, Canada.*
Abstract not available.

FThB2 11:40am
Passive remote monitoring of chemical vapors with CATSI, *J. Thériault, Defence Res. and Development Canada - Valcartier, Quebec, PQ, Canada; L. Moreau, ABB Bomem Inc., Quebec, PQ, Canada.*
A passive method to detect and quantify chemical vapors based on a dual beams FTS named CATSI will be presented. The instrument automatically removes the background signal to improve the detection efficiency.

FThB3 12:00pm
Fourier transform spectrometry for the optical communications, *J. Genest, M. Gibeault, É. Lanoue, G. Scardera, SITE, Univ. of Ottawa, Ottawa, ON, Canada.*
Application of the FTS expertise to the optical spectrum analysis for the telecommunication market is presented. Current wavelength meters are based on interferometers but without fully exploiting the FTS capabilities. Similarities and differences with more conventional FTS applications are highlighted.

Room: Borduas
12:20pm - 12:30pm
■ **Chairs Closing Remarks**
D. Hausamann, German Aerospace Res. Est. DLR, Oberpfaffenhofen, Germany.

Optical Remote Sensing of the Atmosphere
Abstracts

February 3 – 6, 2003 Loews Le Concorde Quebec
Quebec City, Canada

■ **Monday**
■ **February 3, 2003**

Room: Borduas
8:15am - 8:30am
■ **Opening Remarks**
D. Hausamann, German Aerospace Res. Est. DLR, Oberpfaffenhofen, Germany; M. Goldberg, NOAA, Camp Springs, MD, USA.

Room: Borduas
8:30am - 10:30am
JMA ■ Atmospheric Remote Sensing – FTS and ORS Joint Session
A. McKellar, Natl. Res. Council of Canada, Ottawa, ON, Canada and M. Goldberg, NOAA, Camp Springs, MD, USA, Presiders

JMA1 8:30am Invited
The MIPAS experiment on board ENVISAT: Status and first results, *H. Fischer, Forschungszentrum Karlsruhe, Karlsruhe, Germany.*
The status of the MIPAS instrument will be described in some details. This includes the testing of the instrument and the presentation of first spectra. Derived vertical profiles of trace constituents will be intercompared with validation measurements. Results on non-LTE effects and on clouds properties will be presented, too. The talk will be concluded with future expectations on MIPAS.

JMA2 9:10am Invited
Infrared remote sensing in the presence of clouds with AIRS-AMSU-HSB, *M. Chahine, Jet Propulsion Lab., Pasadena, CA, USA.*
The Atmospheric Infrared Sounder (AIRS) and its two companion instruments (AMSU) and (HSB) are designed to provide, worldwide, atmospheric temperature and humidity profiles with radiosonde accuracy. The performance of AIRS since launch on Aqua has been exceptional indicating that it will meet or exceed its objectives.

JMA3 9:50am
Airs in orbit infrared calibration performance, *S. Gaiser, Jet Propulsion Lab., Pasadena, CA., USA.*
The Atmospheric Infrared Sounder (AIRS), launched on the Earth Observing System (EOS) Aqua platform in May, 2002, has been operating stably, in normal data acquisition mode, for five months. Based on cloud-free, sea surface temperature comparisons, the in-orbit radiometric calibration is very stable, and has been validated to an absolute accuracy of better than 0.5K, consistent with the 0.2K absolute radiometric accuracy determined pre-launch. Based on upwelling radiance spectra, the in-orbit spectral calibration is stable to better than 0.1% of the Spectral Response Function (SRF) FWHM, and has an absolute accuracy of 0.5% of the SRF FWHM. A small increase (up to 15%) in Noise Equivalent Delta Temperatures (NEdTs) has been observed, and is consistent with a reduction in system transmission due to ice accumulation. Given the precision and stability of its measurements, AIRS should contribute significantly to both weatherforecasting and climate studies.

JMA4 10:10am
Scanning High-Resolution Interferometer Sounder (S-HIS) aircraft instrument and validation of the Atmospheric Infrared Sounder (AIRS), *H. Revercomb, R. Knuteson, F. Best, D. Tobin, D. LaPorte, S. Ellington, M. Werner, R. Dedecker, R. Garcia, N. Ciganovich, H. Howell, Univ. of Wisconsin-Madsion, Madison, WI, USA; W. Smith, NASA Langley Res. Ctr., Hampton, VA, USA.*
S-HIS developments improve aircraft capabilities for observing the earth-emitted spectrum in great detail and high accuracy. With its spatial mapping, S-HIS is a powerful tool to validate spectra from AIRS on the NASA Aqua satellite.

Room: Salle Krieghoff
10:30am - 11:00am
Coffee Break

Room: Leduc
11:00am - 12:20pm
OMB ■ Radiative Transfer
L. McMillin, NOAA/NESDIS, Camp Springs, MD, USA, Presider

OMB1 11:00am
Validation of the AIRS radiative transfer algorithm, *L. Strow, S. Hannon, S. De Souza-Machado, H. Motteler, Univ. of Maryland-Baltimore, Baltimore, MD, USA.*
This paper presents comparisons between observed AQUA-AIRS spectra and spectra computed from the European Center for Medium Range Forecasting (ECMWF) numerical weather prediction model fields.

OMB2 11:20am
A fast and accurate forward model for NAST-I instrument, *X. Liu, AER Inc., Lexington, MA, USA; J. Moncet, AER, Lexington, MA, USA; D. Zhou, W. Smith, NASA Langley Res. Ctr., Hampton, VA, USA.*
We will discuss a fast and accurate forward model for the NAST-I instrument. The forward model is capable of modeling the observed radiances at different observation altitudes using a single set of the forward model parameters.

OMB3 11:40am
Validation of spectroscopy and water vapor continuum in the infrared using airborne FTS observations, *S. Newman, J. Taylor, Met Office, Farnborough, United Kingdom.*
Comparisons between radiative transfer calculations and airborne FTS infrared spectra are used to investigate the accuracy of current models, concentrating on recent spectroscopy updates and the water vapor continuum.

OMB4 12:00pm
Multiple scattering corrections for space and airborne laser remote sensing of the atmosphere and surface, *J. Spinhirne, NASA/GSFC, Greenbelt, MD, USA.*
The Geoscience Laser Altimeter System is an atmospheric lidar and surface altimeter launching in late 2002. An essential part of the surface and atmospheric analysis is correction for cloud and aerosol multiple scattering. Calculations and algorithms have been developed.

12:20pm-1:50pm
Lunch on Your Own

Room: Leduc
1:50pm - 3:30pm
OMC ■ Retrieval of Atmosphere and Surface Parameters
M. Chahine, Jet Propulsion Lab., Pasadena, CA, USA, Presider

OMC1 1:50pm
Real time operational products from AIRS,
M. Goldberg, L. McMillin, NOAA, Camp Springs, MD, USA; Y. Qu, Decision System Tech. Inc., Rockville, MD, USA; W. Wolf, L. Zhou, QSS Group Inc., Lanham, MD, USA; M. Divarkarla, Decision Sytem Technolgy Inc., Camp Springs, MD, USA.
The assimilation of Atmospheric InfraRed Sounder, Advanced Microwave Sounding Unit-A and Humidity Sounder Brazil (AIRS/AMSU/HSB) data by Numerical Weather Prediction (NWP) centers is expected to result in improved forecasts. Specially tailored radiance and retrieval products derived from AIRS/AMSU/HSB data are being prepared for NWP centers. There are two types of products – thinned radiance data and full resolution retrieval products of atmospheric and surface parameters. The radiances are thinned because of limitations in communication bandwidth and computational resources at NWP centers. There are two types of thinning: a) spatial and spectral thinning, and b) data compression using principal component analysis (PCA). PCA is also used for quality control and for deriving the retrieval first guess used in the AIRS processing software. Results show that PCA is effective in estimating and filtering instrument noise. The PCA regression retrievals show layer mean temperature (1 km in troposphere, 3km in stratosphere) accuracies of better than 1 K in most atmospheric regions from simulated AIRS data. Moisture errors are generally less than 15% in 2 km layers, and ozone errors are near 10% over approximately 5 km layers from simulation. The PCA and regression methodologies will be described.

OMC2 2:10pm
Comparison of AIRS and NAST-I spectra and retrievals during CRYSTAL-FACE,
W. Smith, D. Zhou, A. Larar, NASA Langley Res. Ctr., Hampton, VA, USA; D. Tobin, H. Huang, H. Revercomb, J. Li, Univ. of Wisconsin-Madison, Madison, WI, USA.
During the Cirrus Regional Study of Tropical Anvils and Cirrus Layers - Florida Area Cirrus Experiment (CRYSTAL-FACE) experiment, the Proteus with the NAST-I instrument under flew the Aqua satellite on five different occasions. For the last under flight, July 26, 2002, AIRS was in a stable earth viewing operating mode . In this paper, the much higher spectral and spatial resolution airborne NAST-I radiance spectra are reduced to AIRS resolution for direct comparisons of the AIRS observed radiance spectra. Residual differences due to instrument line shape differences are accounted for using line-by-line radiative transfer calculations for both instruments using nearby radiosonde profiles. AIRS spectral radiances are also transformed to vertical temperature and moisture profiles using exactly the same statistical retrieval algorithms and training data used to process the NAST-I data during CRYSTAL-FACE field program. AIRS radiance and retrievals are compared with those of NAST-I obtained from the full resolution NAST-I data as well as from the NAST-I radiance spectra reduced to spectral and spatial resolution of the AIRS. The results of these comparisons are discussed with respect to spectral coverage and resolution, cloud effects, and other surface and atmospheric influences.

OMC3 2:30pm
Analysis of the spatial-temporal stability of the estimates of surface emissivity and atmospheric moisture profiles in meteorological processing of infrared spectral measurements from the GOES-8 sounder,
P. Menzel, NOAA/ NESDIS, Madison, WI, USA; Y. Plokhenko, Univ. of Wisconsin-Madison, Madison, WI, USA.
Infrared radiative transfer solutions for surface emissivities using GOES Sounder measurements show temporal consistency and significant spatial variability over non-homogeneous land scenes; associated lower tropospheriuc profiles agree well with radiosonde observations.

OMC4 2:50pm
Unified ground and cloud emissivity temperature seperation technique,
H. Huang, Cooperative Inst. for Meteorological Satellite Studies, Madison, WI, USA.
Knowledge of the surface, ground or cloud, emissivity is essential for remote sensing parameters retrieval, radiation balance study, and satellite data assimilation. Emissivity in infrared spectral region, which measures a surface's ability to radiate energy, is the vital link in remote sensing of actual ground or cloud surface temperature. By taking advantage of high-spectral resolution semi-continuous spectral measurements provided by interferometer or grating spectrometer, the unified ground/cloud emissivity temperature separation technique will be demonstrated to separate spectral independent temperature and spectral dependent emissivity of the ground and cloud surfaces. Besides ground and cloud emissivity spectrum, their respected actual temperature, and their corresponding surface pressure can also be determined. There is a reasonable hope that, due to this recent exploration and the availability of high-spectral resolution infrared measurements, the improved usage of the global satellite infrared radiances under cloudy and over non-water areas can be achieved in the near future.

OMC5 3:10pm
Optimal nonlinear hyperspectral noise filtering,
B. Huang, Univ. of Wisconsin-Madison, Madison, WI, USA.
With the advance of hyperspectral sounders such as NAST-I, AIRS (2002), CrIS (2006), IASI (2006), GIFTS (2005/6) and ABS/HES (~2010), hyperspectral noise filtering has become a new challenge for improving atmospheric and surface retrieval. A wavelet-based noise filtering scheme is applied to hyperspectral observations. The optimal threshold for each wavelet subband minimizes the mean square error of the result as compared to the unknown, exact data and is determined by the method of generalized cross validation (GCV). The wavelet transforms used here are fast and are done in-place without additional memory needed. Also, the noise filtering scheme has low complexity for hardware implementation and does not rely on an estimate of noise equivalent radiance (NER). Colored or white noise can be filtered with this scheme. Furthermore, it can be embedded in a wavelet-based hyperspectral lossy data compression scheme. These features have made it an ideal candidate for both onboard and ground hyperspectral noise filtering.

Room: Salle Krieghoff
3:30pm - 6:00pm
OMD ■ ORS Poster Session

OMD1
Rapid scan AERI observations: Benefits and analysis, *W. Feltz, SSEC/CIMSS Univ. of Wisconsin-Madison, Madison, WI, USA; D. Turner, CIMSS/PNNL Univ. of Wisconsin-Madison, Madison, WI, USA; R. Dedecker, CIMSS/SSEC Univ. of Wisconsin-Madison, Madison, WI, USA; R. Knuteson, CIMSS/SSEC Univ. of Wisconsin-Madison, Madison, WI, USA.*
The temporal frequency (currently ten minute) of high spectral resolution radiances measured by the Atmospheric Emitted Radiance Interferometer (AERI) have been increased to less than one minute to provide improved temporal monitoring of clouds and atmospheric thermodynamics.

OMD2
The SHIMMER Instruments: Spatial heterodyne imagers for space based remote sensing of the atmosphere, *C. Englert, J. Cardon, M. Stevens, Naval Research Laboratory, Washington, DC, USA; J. Harlander, St. Cloud State Univ., St. Cloud, MN, USA; F. Roesler, Univ. of Wisconsin-Madison, Madison, WI, USA.*
SHIMMER (Spatial Heterodyne Imager for Mesospheric Radicals) denotes a family of SHS instruments for space based UV remote sensing of the atmosphere. Two future satellite missions, a shuttle mission and their objectives are presented here.

OMD3
Temperature profiles for the ACE forward model, *R. Nassar, P. Bernath, Univ. of Waterloo, Waterloo, ON, Canada.*
Initial temperature profiles for ACE are based on a thermospheric model for upper altitudes and a weather forecast model for the troposphere and lower stratosphere. Methods of splicing together data from the models are examined here.

OMD4
Preparing AIRS data ingest and processing for direct broadcast users, *E. Weisz, H. Huang, L. Gumley, T. Rink, Cooperative Institute for Meteorological Satellite Studies, Univ. of Wisconsin-Madison, Madison, WI, USA.*
As part of the International MODIS/AIRS Processing Package (IMAPP), we present a real-time processing algorithm to convert AIRS/AMSU/HSB level 0 data to level 1b measurements and level 2 products.

OMD5
Cloud detection from MODU and AIRS, *R. Frey, Univ. of Wisconsin-Madison, Madison, WI, USA; D. Tobin, S. Ackerman, Univ. of Wisconsin-Madison, Madison, WI, USA.*
The EOS space platform Aqua carries both the Moderate-Resolution Imaging Spectroradiometer (MODIS) and the Atmospheric Infrared Sounder (AIRS) instruments. The MODIS measures Earth reflected and emitted radiation in 36 spectral bands at spatial resolutions between 250 and 1000 meters. The AIRS is a high spectral resolution infrared sounder with an unprecedented 2378 bands and a spatial resolution of 13.5 km. The MODIS cloud detection algorithm reports a confidence of clear sky in four categories for all MODIS pixels at 1-km resolution. The method has been refined using data from the Terra platform as well as Aqua and validated against ground-based and aircraft measurements. Currently, efforts are underway to devise cloud detection algorithms for use with AIRS data. Correctly identified clear FOVS are necessary for proper instrument characterization and validation of the AIRS cloud-clearing algorithm. This poster will outline current research making use of the relatively high spatial resolution of the MODIS in conjunction with the high spectral resolution of the AIRS. Collocated MODIS 1-km data provide estimates of cloud fraction and variability within AIRS footprints. On the other hand, AIRS measurements provide additional spectral information not available from the relatively broad-band MODIS channels. For example, clear-sky ocean observations at night are ideal for initial AIRS science but these are conditions where low-level clouds are difficult to detect using either instrument alone. Use of both can eventually result in a global, high quality, clear-sky AIRS data set.

■ **Tuesday**
■ **February 4, 2003**

Room: Leduc
8:30am - 10:30am
OTuA ■ Validation
M. Goldberg, NOAA, Camp Springs, MD, Presider

OTuA1 8:30am Invited
The NASA earth observing system moderate resolution imaging spectroradiometer on-orbit characterization and status, *V. Salomonson, W. Barnes, NASA Goddard Space Flight Ctr., Greenbelt, MD, USA; X. Xiong, MODIS Characterization Support Team (MCST), Seabrook, MD, USA.*
The Moderate Resolution Imaging Spectroradiometer (MODIS) has been operating on the NASA Terra mission since February 2000 and on the Aqua mission since June 2002. The performance of the instrument is characterized using on-board devices and data product results.

OTuA2 9:10am
ABOVE: The BBAERI AIRS ocean validation experiment, *W. McMillan, R. Hoff, L. Strow, J. Comer, K. Lightner, E. Maddy, K. McCann, M. McCourt, UMBC, Baltimore, MD; K. Rutledge, AS&M, Hampton, VA, USA.*
We present initial validation results for NASA's Atmospheric InfraRed Sounder (AIRS) from combined observations by the Baltimore Bomem Atmospheric Emitted Radiance Interferometer (BBAERI), the UMBC Elastic Lidar Facility (ELF) and Rawinsondes

OTuA3 9:30am
Comparisons of retrievals and radiances from the AIRS and AMSU instruments on the aqua satellite to those obtained from operational radiosondes, *L. McMillin, NOAA/NESDIS, Camp Springs, MD, USA.*
Measurements from the AIRS and AMSU instruments on the Aqua satellite are being matched with radiosonde and aircraft data used in the NCEP analysis. Over five months of data will be available. Results of these matches will be presented.

OTuA4 9:50am
GPS validation of AIRS water vapor, *J. Yoe, NOAA/NESDIS Office of Res. and Applications, Camp Springs, MD, USA; S. Gutman, NOAA/OAR Forecast Syst. Lab., Camp Springs, MD, USA; M. Rama Varma Raja, Cooperative Inst. for Res. in the Atmosphere, Camp Springs, MD, USA.*
The Atmospheric Infrared Sounder (AIRS) aboard the Aqua spacecraft launched in April 2002 is being used to provide vertical profiles of moisture and column-integrated precipitable water vapor (IPW.) NOAA's Forecast Systems Laboratory operates a network of over 200 geodetic-quality Global Positioning System (GPS) receivers at fixed surface locations across the United States to determine IPW from the excess zenith-scaled signal delays induced by the presence of water vapor in the troposphere. The GPS IPW observations are accurate, precise to about 1 mm, and can be made under all meteorological conditions encountered to date. They are characterized by a small (20 km) footprint and are delivered every 30 minutes with less than 20 minutes latency. These data are shown to be an ideal resource with which to validate AIRS IPW retrievals and to provide a reliable constraint for the verification of AIRS vertical water vapor profiles using radiosonde observations. This paper describes the principle of measurement of GPS zenith delay, the identification of the residual zenith delay attributable to moisture, and the conversion of the moist delay to IPW. Standards for hardware and software for producing validation-quality observations are outlined. The extraction of a database of collocated AIRS and GPS IPW and radiosonde moisture profiles is described. Plans for statistical and case study analyses are discussed, and preliminary intercomparison results are presented.

OTuA5 10:10am
Comparison of AIRS retrievals and dedicated validation observations, *E. Fetzer, B. Irion, Jet Propulsion Lab., Pasadena, CA, USA; D. Tobin, Univ. of Wisconsin-Madison, Madison, WI, USA.*
The EOS project office supports a number of field experiments providing data for comparison with AIRS observations. These include dedicated radiosondes, ozone and humidity sondes, cloud and water vapor lidars, infrared spectrometers and Global Positioning System receivers. These observations are timed to coincide with Aqua satellite overpasses, thus minimizing errors from atmospheric variability. These dedicated observations have measurement uncertainties better the AIRS system specifications, and the meteorological context of many are well characterized through additional observations. We describe here the data sets acquired by the AIRS dedicated validation experiments. Also presented are initial comparisons between AIRS retrievals and these dedicated observations, including direct comparisons of land and sea surface temperatures, profiles of temperature, water vapor and ozone, plus total ozone and water vapor. Indirect comparisons of cloud fraction are also discussed.

Room: Salle Krieghoff
10:30am - 11:00am
Coffee Break

Room: Leduc
11:00am - 12:20pm
OTuB ■ Instruments, Clouds and Aerosols 1
A. Huang, Univ. of Wisconsin-Madison, Madison, WI, USA, Presider

OTuB1 11:00am Invited
High resolution airborne water vapour DIAL during IHOP, *G. Ehret, A. Fix, H. Flentje, C. Kiemle, G. Poberaj, M. Wirth, DLR, Oberpfaffenhofen, Germany.*
During the International H_2O Project (IHOP 2002) DLR's 100 Hz airborne water vapour DIAL enabled two-dimensional scans of small-scale humidity structures in the boundary layer with unprecedented spatial resolution. At an aircraft speed of 130 m/s the horizontal/vertical resolution in the humidity field is 200/100m which fulfils the stringent requirements for the determination of the turbulent moisture transport in the PBL.

OTuB2 11:40am
The NPOESS spacecraft and payload suite a next generation low earth orbit observation platform, *H. Bloom, NOAA, Woodbine, MD, USA.*
The National Polar Orbiting Earth Satellite System (NPOESS) is the follow on mission to TIROS and DMSP weather satellites.

OTuB3 12:00pm
Airborne thermal infrared FTS measurements of the radiative properties of aerosols and cirrus clouds, *J. Taylor, J. Haywood, P. Francis, A. Baran, J. Smith, Met Office, Farnborough, United Kingdom; E. Highwood, Univ. of Reading, Reading, United Kingdom.*
Airborne thermal infrared interferometer and short wave spectrometer data are used in the analysis of the radiative properties of cirrus clouds and Saharan dust. Good comparison between model simulations and observations is shown.

12:20pm ■ Lunch on Your Own

■ **Wednesday**
■ **February 5, 2003**

Room: Leduc
8:30am - 10:30am
OWA ■ Instruments, Clouds and Aerosols 2
J. Yoe, NOAA, Camp Springs, MD, Presider

OWA1 8:30am Invited
Coherent Doppler wind lidar for the Japanese experimental module of the ISS, *T. Itabe, K. Mizutani, Comm. Res. Lab., Koganei-shi, Tokyo, Japan.*
A feasibility study has been done for a space-borne 2micron coherent Doppler lidar system aiming at demonstration of the technology onboard the Japanese Experiment module of the International Space Station. We are also developing an airborne coherent Doppler lidar system for simulation of the Doppler lidar measurement in space.

OWA2 9:10am
First results from a MAESTRO instrument: Field-testing MAESTRO-B during the MANTRA 2002 balloon campaign, *C. Nowlan, J. Drummond, B. Quine, K. Strong, Univ. of Toronto, Toronto, ON, Canada; T. McElroy, D. Barton, R. Hall, C. Midwinter, A. Ullberg, Meteorological Service of Canada, Toronto, ON, Canada.*
The first atmospheric spectra recorded by a MAESTRO instrument were collected during the MANTRA 2002 field campaign. These spectra will be used in the development and testing of retrieval algorithms for the MAESTRO satellite instrument.

OWA3 9:30am
2 µm detectors for atmospheric CO_2 DIAL measurements, *T. Refaat, Science and Tech. Corp., Hampton, VA, USA; M. Abedin, G. Koch, S. Ismail, U. Singh, NASA Langley Res. Ctr., Hampton, VA, USA.*
Advancement in two micron lasers technology allows applying the DIAL technique for measuring atmospheric carbon dioxide. Several infrared detectors were characterized and compared with system requirements, to evaluate their applicability for DIAL measurements.

OWA4 9:50am
Systematic tropospheric aerosol lidar measurements over Potenza within the EARLINET project, *G. Pappalardo, A. Amodeo, L. Mona, M. Pandolfi, IMAA-CNR, Tito Scalo (PZ), Italy.*
A statistical analysis on two years of systematic lidar measurements of aerosol backscatter and extinction, performed in Tito Scalo (Potenza) within EARLINET, shows the seasonal variation and the large variability of the aerosol properties.

OWA5 10:10am
NIR spectral investigations of water in clouds with FTS, *W. Evans, E. Puckrin, Trent Univ., Peterborough, ON, Canada.*
NIR spectra of clouds taken with FTS instruments from the ground and aircraft are presented.
The detection of large liquid water droplets and solid ice particles is demonstrated. The applications to climate models are discussed.

Room: Salle Krieghoff
10:30am - 11:00am
Coffee Break

Room: Leduc
11:00am - 12:40pm
OWB ■ Trace Gases
W. McMillan, UMBC, Baltimore, MD, Presider

OWB1 11:00am
Ozone retrieval from SAGE III limb scattering measurement, *D. Rault, NASA Langley Res. Ctr., Hampton, VA, USA; D. Flittner; R. Loughman, Univ. of Arizona, Tucson, AZ, USA; R. McPeters, NASA Goddard Space Flight Ctr., Greenbelt, MD, USA.*
Atmospheric Ozone concentration is retrieved from SAGE III measurement of the Earth limb scattering radiation. Retrieval algorithm is described and sample data is presented

OWB2 11:20am
Trace gas measurements from the Atmospheric Infrared Sounder (AIRS), *C. Barnet, S. Datta, L. Strow, Univ. of Maryland-Baltimore, Baltimore, MD, USA.*
The Atmospheric Infrared Sounder (AIRS), recently launched aboard NASA's EOS Aqua satellite, is making useful observations in the context of carbon cycle research. AIRS measurements of carbon monoxide, methane, and carbon dioxide are shown and discussed.

OWB3 11:40am
Measuring sulfur dioxide from space: The promise of ozone monitoring instrument (OMI) on EOS-AURA platform, *A. Krueger, JCET/UMBC, Baltimore, MD, USA; N. Krotkov, GEST/UMBC, Baltimore, MD, USA; S. Datta, JCET/Univ. of Maryland-Baltimore, Baltimore, MD, USA; D. Flittner, Inst. of Atmospheric Physics/ Univ. of Arizona, Tucson, AZ, USA; O. Dubovik, GEST/UMBC, Greenbelt, MD, USA; F. Huang, UMBC, Baltimore, MD, USA.*
OMI is an UV-Visible imaging spectrometer with the capability to measure boundary layer SO_2 from space. This paper discusses the sensitivity of the OMI SO_2 retrieval algorithm to different geophysical perturbations.

OWB4 12:00pm
Measurements of stratospheric trace gases column density and J-values using UV-visible photodiode array spectroscopy during the MANTRA 2002 balloon campaign, *H. Wu, C. Nowlan, K. Strong, J. Drummond, Department of Physics, Univ. of Toronto, Toronto, ON, Canada; C. McElroy, C. Midwinter, R. Hall, A. Ogyu, Meteorological Service of Canada, Toronto, ON, Canada.*
Three spectrophotometers were used to measure stratospheric constituents during the MANTRA 2002 balloon campaign. The instrument, calibration, and observations are described. The raw data are now being analyzed, and the results will be compared with previous balloon flights.

OWB5 12:20pm
Ground-based measurements of ozone and NO_2 at Vanscoy, SK during the MANTRA 2000 and 2002 campaigns, *E. Farahani, K. Strong, S. Melo, C. Nowlan, J. Drummond, Univ. of Toronto, Toronto, ON, Canada; C. McLinden, J. Davies, C. McElroy, Meteorological Service of Canada, Downsview, ON, Canada; F. Goutail, Service d'Aeronomie, CNRS, Verrieres-le-Buisson, France.*
We have deployed a UV-visible zenith-sky spectrometer in seven field campaigns to investigate Arctic and mid-latitude ozone depletion. In this presentation, we describe the instrument and present ozone and NO_2 measurements obtained during MANTRA 2000 and 2002 campaigns.

Room: Leduc
12:40pm – 12:50pm
■ Closing Remarks
M. Goldberg, NOAA, Camp Springs, MD, USA.