Measurement Challenges
for Global Observation Systems
for Climate Change Monitoring
Traceability, Stability and Uncertainty

SESSION B2:

REMOTE SENSING OF ATMOSPHERIC COMPOSITION ON AND TRACEABILITY ISSUES IN SPECTROSCOPIC DATA

Chair:	James Whetstone,	NIST
Rapporteur:	Robert Weilgosz,	BIPM
	Wednesday	31 March 2010, 1600
	Thursday	1 April 2010, 0830
	Salle A	

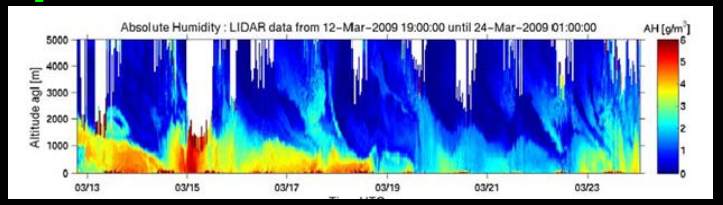
B2 Session Synopsis

- Stimulate or enlarge discussions concerning comparison of atmospheric composition measurements obtained from surface based methodologies and those from satellites.
  - Challenge to climate-oriented fields is improving the quantitative basis for comparing results from differing measurement methods for the same quantity, e. g., column averaged greenhouse gas concentrations.
  - Challenging accuracy requirements lie ahead
    - To the NMI Community to better appreciate the standards dissemination challenge presented by the Climate Observing Community
    - To the Climate Observing Community to better utilize NMI capabilities and to identify areas where improved standards and dissemination methods are needed.
  - This conference can be an opportunity for complementary effort by the meteorology and metrology communities to take advantage of the expertise of each to strengthen the scientific basis for climate change monitoring worldwide.
- Part 1 – Wednesday afternoon at 16:00 – 18:00
- Part 2 – Thursday morning at 8:30 – 11:00

Session B2- Part 1 March 31 16:00

- Relating point measurements of atmospheric composition to integrated-path and range-resolved measurements
  Prof. Dr. *Bertrand Calpini*
  METEOSWISS
- Satellite measurements of tropospheric species from GOSAT
  Dr. *Tatsuya Yokota*
  National Institute of Environmental Studies, Japan
- Reference standards for space-based remote sensing of carbon dioxide and greenhouse gases
  Dr. *Charles Miller*
  Jet Propulsion Laboratory USA
- Integration of column CO_2 measurements into the existing in situ network for greenhouse gases
  Dr. *Thorsten Warneke*
  University of Bremen

B2: Remote Sensing of Atmospheric Composition on and Traceability Issues in Spectroscopic Data



Prof. Dr. Bertand Calpini

Vice-President of CIMO

(Commission for Instruments and Methods of Observations)

Head, Aerological Station Payerne , MeteoSwiss

Relating point measurements of atmospheric composition to integrated-path and range-resolved measurements

Dr. Calpini will discuss:

- CIMO, its origins, responsibilities, and efforts in standards and SI traceability
- The CIMO Guide, currently in 7th edition (2008), is the most influential WMO publications regarding standardization of meteorological observations
- Examples of CIMO contributions to standardization in meteorological measurements, and interactions with national meteorological services
- Some recent absolute humidity vs. altitude results will be presented and discussed by considering absolute vs. relative calibration issues.

B2: Remote Sensing of Atmospheric Composition on and Traceability Issues in Spectroscopic Data

Dr. Tatsuya Yokota, NIES GOSAT Project Leader
Center for Global Environmental Research
National Institute of Environmental Studies, Japan

Satellite Measurements of Tropospheric Species from GOSAT – Greenhouse Gases Observing Satellite "IBUKI"

Dr. Yakota will briefly discuss:

- GOSAT's two sensors
  - Thermal And Near infrared Sensor for carbon Observation-Fourier Transform Spectrometer (TANSO-FTS) and
  - TANSO-Cloud and Aerosol Imager (TANSO-CAI).
- Data retrievals for CO_2 and methane column abundance from short wavelength IR spectra on cloud-free scenes.
- Methods for handling optically thick and thin clouds
- GOSAT Level 2 data products (column abundances of carbon dioxide and methane), estimation uncertainties and biases.

B2: Remote Sensing of Atmospheric Composition on and Traceability Issues in Spectroscopic Data

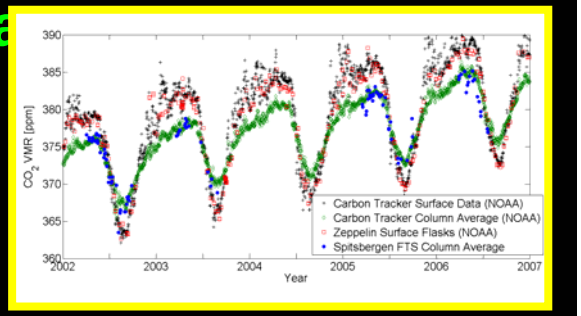
Dr. Charles Miller, Senior Scientist
California Institute of Technology, Jet Propulsion Laboratory, USA
Deputy Principal Investigator, Orbiting Carbon Observatory

Reference standards for space-based remote sensing of carbon dioxide and greenhouse gases

Dr. Miller will briefly discuss:

- Potential of sub 1% observational precision for remote sensing of greenhouse gases, CO_2 , CH_4, N_2O, etc.
- Technical challenges presented by
  - Radiometric calibration at high spectral resolution
  - Requirements for spectroscopic data fundamental to retrieval algorithms that transform radiance measurements Into concentration estimates
  - Validation needs to properly quantify total uncertainty estimates that include both biases (type B uncertainties) and randomly distributed (type A uncertainties) to meet targeted performance.
- Challenge to remote sensing when performance targets below sub-1% relative are desired

B2: Remote Sensing of Atmospheric Composition on and Traceability Issues in Spectroscopic Da



Dr. Thorsten Warneke

Institute of Environmental Physics
University of Bremen, Germany

Integration of column CO_2 measurements into the existing in situ network for greenhouse gases

Dr. Warneke will briefly discuss:

- Advances in column measurements using solar absorption FTIR methods
- The use of these for validating space-borne sensors
  - Calibration of the column measurements against the in situ standard and the ground-based validation
- Describe the background and role of the the ground-based Total Carbon Column Observing Network (TCCON) that uses solar absorption FTIR spectrometers.
  - Long time scale measurements
  - Linking the in-situ network with aircraft profiling of the column.
- Present the current status of the measurements within this network

Session B2 – Part 2 April 1 8:30

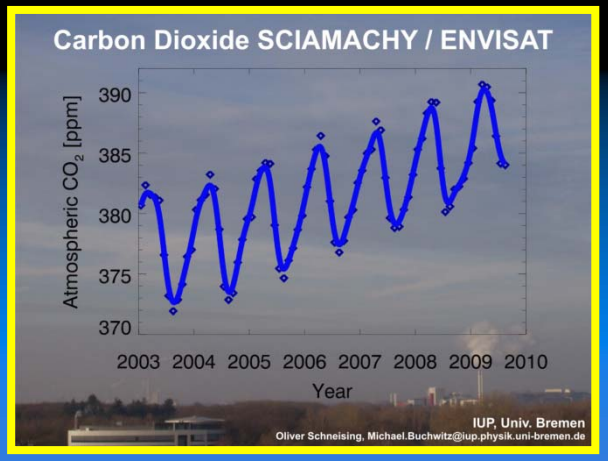
- Global observation of Greenhouse Gases using SCIAMACHY
  Dr. *John Burrows, Institute of Environmental Physics*
  University of Bremen, Germany
- Comparison of Spectroscopic Measurements of Water Vapour
  Dr. *Volker Ebert, Analytics and Thermodynamic State Behaviour of Gases, PTB, Germany*
- Linking remote measurements of GHG concentrations to the SI through intrinsic molecular properties
  Dr. Joseph T. Hodges, Optical and Nanoscale Metrology
  NIST
- Satellite observations of greenhouse gases
  Peter Bernath, University of York

- Topic Discussion

B2: Remote Sensing of Atmospheric Composition on and Traceability Issues in Spectroscopic Data

Dr. John Burrows, *Institute of Environmental Physics*
University of Bremen, Germany

Global Observation of Greenhouse Gases using SCIAMACHY
(SCanning Imaging Absorption spectroMeter
for Atmospheric CHartographY)



Dr. Burrows will briefly discuss:

- The SCIAMACHY instrument that flies on ENVISAT
- Its performance from the UV to the near IR (214 nm to 1750 nm) + 2 micron channels
- Retrieval, validation, and interpretation for CO_2, CH_4, and H_2O from nadir measurements

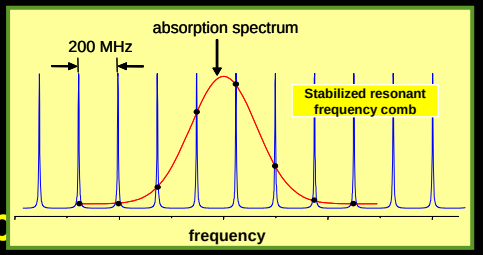
B2: Remote Sensing of Atmospheric Composition on and Traceability Issues in Spectroscopic Data

Dr. Volker Ebert
Department Head
Analytics and Thermodynamic State Behaviour of Gases
Physikalisch-Technische Bundesanstalt (PTB), Germany

Comparison of Spectroscopic Measurements of Water Vapour

Dr. Ebert will briefly discuss experiences at PTB with atmospheric water vapour determinations

B2: Remote Sensing of Atmospheric Composition on and Traceability Issues in Spectroscopic Data



Dr. Joseph T. Hodges
Senior Scientist, Optical & Nanoscale Metrology Group
National Institute of Standards and Technology (NIST), USA

Linking Remote Measurements of Greenhouse Gas Concentrations to the SI Through Intrinsic Molecular Properties

Dr. Hodges will briefly discuss:

- High-accuracy laboratory measurements of greenhouse gas infrared absorption line reference data as an intrinsic standard
- The influence of pressure, temperature and composition on line shapes to avoid significant bias in the reported concentration.
- How these measurements and models underpin SI-traceability in remote sensing of atmospheric greenhouse gases
- The accuracy of advanced laboratory measurements and models for line parameters of CO_2, H_2O and O_2

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Dr. Peter Bernath
Department of Chemistry
University of York, Heslington, York, UK

Satellite observations of greenhouse gases

Dr. Bernath will briefly discuss:

- Existing and planned satellite instruments for greenhouse gas concentration measurements.
- Some recent activity with nadir sounders with their higher temporal and spatial resolution.
- Vertical greenhouse gases profiles and their importance
- The potential advantage that limb sounders such as the Atmospheric Chemistry Experiment (ACE) and MIPAS have for providing height information complementary to the nadir sounder observations

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