

## Standards Development and Measurements to Support Global Climate Change Studies

*Gaseous primary standard mixtures (PSMs) have been developed by NIST for several atmospheric gases that can contribute to changes in the radiative environment of the earth. These greenhouse gases have been monitored by the atmospheric-environment community worldwide for many years, and have gained importance since the Kyoto protocol was implemented to promote reduced emissions of greenhouse gases.*

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NIST had previously developed gaseous primary standard mixtures (PSMs) for methane (CH<sub>4</sub>), carbon dioxide (CO<sub>2</sub>), tetrafluoromethane (CF<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), dichlorodifluoromethane (CCl<sub>2</sub>F<sub>2</sub>), trichlorofluoromethane (CCl<sub>3</sub>F), sulfur hexafluoride (SF<sub>6</sub>), 1,1,1,2-tetrafluoroethane (C<sub>2</sub>F<sub>4</sub>H<sub>2</sub>), carbon tetrachloride (CCl<sub>4</sub>), chloroform (CHCl<sub>3</sub>), trichlorotrifluoroethane (C<sub>2</sub>Cl<sub>3</sub>F<sub>3</sub>), 1,1,1-trichloroethane (C<sub>2</sub>H<sub>3</sub>Cl<sub>3</sub>), and trichloroethylene (C<sub>2</sub>HCl<sub>3</sub>). These standards were developed to support the in-house standards base for SRM certification; international intercomparison programs between national metrology institutes (NMIs) to determine equivalence; the NIST Fourier transform infrared (FTIR) spectral database project; and the International Halocarbon Experiment (IHALACE) program sponsored by the World Meteorological Organization (WMO), the National Oceanographic and Atmospheric Administration (NOAA), and the National Aeronautics and Space Administration (NASA). More than 20 gravimetrically-prepared PSMs now exist and are used to define the NIST primary calibration scales for these key atmospheric species and in the analysis of samples in various international comparisons.

### ***IHALACE Program:***

Twenty laboratories around the world involved in atmospheric measurements participated in the program to assess the agreement of measurements; the ultimate goal was to determine whether a single traceable source of standards was necessary. NIST used PSMs to analyze one set of three atmospheric gas samples passed among 10 of the 20 labs. NIST analyzed and assigned values for CH<sub>4</sub>, N<sub>2</sub>O, CCl<sub>2</sub>F<sub>2</sub>, CCl<sub>3</sub>F, CCl<sub>4</sub>, CHCl<sub>3</sub>, C<sub>2</sub>Cl<sub>3</sub>F<sub>3</sub>, C<sub>2</sub>H<sub>3</sub>Cl<sub>3</sub>, and C<sub>2</sub>HCl<sub>3</sub> in the low pmol/mol concentration region. Results were sent to the IHALACE referrers for compilation with other participants' data. At this time, the IHALACE samples are in their final cycle of analysis. Compilation of results will be completed in 2007.

### ***CCQM GAWG Activities with WMO's Global Atmospheric Watch:***



As part of a subcommittee of the Gas Analysis Working Group (GAWG) of the Consultative Committee for Amount of Substance – Metrology in Chemistry (CCQM), NIST is participating in the development of a VOC standard for the WMO Global Atmospheric Watch (GAW) volatile organic compounds (VOCs) program

operated by the Institute for Metrology and Climate Research (IMK-IFU) in Garmisch-Partenkirchen, Germany. Representatives from several NMIs and the IMK-IFU met in Germany in 2006 to begin discussions on the standards needed.

### ***AIGER:***

Standards were also developed to support the American Industry/Government Emissions Research (AIGER) program (a consortium of the major automotive producers) in the measurement of exhaust species related to climate change and to help them meet regulations for emissions requirements. Individual standards containing methanol, ethanol, HFC-134a, N<sub>2</sub>O, and toluene were developed and certified.

Development of PSMs for these programs will both underpin the SRM and NIST Traceable Reference Materials (NTRM) programs, and serve to establish equivalency between NMIs and atmospheric research measurement laboratories.

### ***Future Plans:***

In 2007, standards development will begin for hydrocarbon (VOC) standards in conjunction with other NMIs to help support the WMO/GAW-VOC program.

In addition, research will begin on the feasibility of gas mixtures containing key terpenes, also in support of the WMO/GAW-VOC program.

NIST will participate in a EUROMET comparison of VOC standards, beginning in March 2007.