L-13

Lead-salt and difference frequency generation ir spectrometers: performance comparisons and common requirements for ultra sensitive airborne measurements

Alan Fried, Dirk Richter, Petter Weibring, and James G. Walega

The National Center for Atmospheric Research, Boulder, Colorado 80301

www.apol.ucar.edu

&

Chad Roller and Frank Tittel

Rice University, Houston, Texas, 77005

Tunable infrared absorption spectroscopy employing lead-salt diode lasers as well as other infrared laser sources continues to provide atmospheric researchers an important means of acquiring measurements of numerous trace gases in the atmosphere. Since many of these gases are present in the atmosphere at mixing ratios in the 1 to 1000 parts-per-trillion (ppt) range, the specific measurement approach requires extremely low limits of detection. Airborne measurements are particularly useful for atmospheric studies, and such measurements further require instruments with fast response times (seconds to minutes) and instruments that are immune to severe vibrations and variable sampling conditions of temperature, pressure, relative humidity, and aircraft accelerations.

The present talk will discuss an airborne tunable diode laser absorption spectrometer based on a cryogenically cooled lead-salt diode laser operating at 3.5 microns to acquire ambient measurements of the important trace gas formaldehyde (CH_2O). This system has been developed and continuously refined over the past 10 years, and 1σ detection limits for CH_2O in the 30 to 40 ppt range are now routinely achieved during airborne operation employing 30-second integration times. The approaches to achieve this performance during our most recent airborne campaign in the summer of 2004 will be discussed. In addition, an overview of a new room temperature operation difference frequency generation (DFG) system developed in our laboratory for airborne CH_2O measurements will also be presented. This system is significantly smaller, lighter, and has demonstrated even lower limits of detection than the lead-salt instrument in our laboratory. Common features and requirements with the lead-salt system will be given, including performance comparisons between the two systems. A more detailed discussion of the new DFG instrument will be provided by a companion poster paper by Weibring et al. at this same conference.