The Trace Organic Gas Analyzer (TOGA) - An Airborne Fast Gas Chromatograph Mass Spectrometer for Atmospheric Chemistry Measurements

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Recently an airborne gas chromatograph mass spectrometer (GC-MS) was developed for atmospheric chemistry research performed with the NSF Gulfstream V (GV) aircraft. The instrument is denoted TOGA-GV (Trace Organic Gas Analyzer) and is an airborne fast GC-MS capable of measuring a suite of volatile organic compounds (VOCs), including: oxygenates (OVOCs), non-methane hydrocarbons (NMHCs), halocarbons, and nitrogen and sulfur containing species. The compounds are diverse in their range of sources (anthropogenic, biogenic, or a combination thereof), of atmospheric reactivity with OH (minutes (isoprene, terpenes) to years (CFCs)), of loss to photolysis (days (acetaldehyde) to negligible (NMHCs)), and of solubility (k_H ~ 150 to 10^{-4}) and toxicity (formaldehyde, benzene, etc.). The TOGA-GV measures these organic compounds with high accuracy, precision, and low detection limits (~ 10 ppt to < 1 ppt) at a sampling rate of 2 minutes or less. The instrument is usable throughout the troposphere and lower stratosphere to an altitude of approximately 45k feet.

We will describe a number of the design issues involved in the TOGA instrument development and will show data from recent experiments where the instrument was used to measure the movement of boundary layer atmospheric chemicals to the upper troposphere via convective storms.