

Georgia Tech Chemical Ionization Mass Spectrometer (GT-CIMS)

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Instrument

The GT-CIMS consists of a low pressure ion molecule reactor (IMR) coupled to a quadrupole mass filter by an actively pumped collisional dissociation chamber (CDC) and an octopole ion guide. The IMR is pressure controlled with a variable orifice and evacuated with a scroll pump (300 l min^{-1}) that also serves as the backing pump for the mass spectrometer. The CIMS is housed in a small vacuum chamber (100 mm OD), is equipped with 9.5 mm quadrupole rods, and is evacuated with two small turbo pumps (70 l s^{-1}). The CDC houses a second octopole ion guide and is evacuated with a hybrid molecular drag pump. The system is similar to that flown on previous GV missions (Chen et al., 2016) and is capable of unattended operation. The instrument has been upgraded by improvements to the ion source (Ji et al., 2020) and the background measurement. The old radioactive ion source has been replaced with a vacuum ultraviolet (VUV) source that provides more sensitivity and eliminates the use of radioactive isotopes. The substrate, formerly activated carbon, used to scrub sampled air has been replaced with glass wool impregnated with sodium carbonate. This significantly improved background stability especially due to fluctuations of absolute humidity.

Detected Species and Data

The CIMS is configured to detect acidic gases for the ACCLIP mission. In particular, the sulfur hexafluoride anion will be used to detect sulfur dioxide (SO_2), formic acid (HCOOH), acetic acid (CH_3COOH), hydrochloric acid (HCl), nitric acid (HNO_3) and pernitric acid (HO_2NO_2). All species will be periodically zeroed in flight by use of the sodium carbonate scrubber. Sulfur dioxide, formic, and acetic acid will be calibrated frequently in flight (\sim every 15 minutes) by standard addition. The other species will be measure relative to SO_2 using both pre- and post-mission calibrations. Detection limits for all species are expected to be of the order of 10 pptv for a one second integration period. Each species will be measured every two seconds with a duty cycle of 10% except for SO_2 which will be measured with a duty cycle of 20%. The accuracy of the measurements are expected to range from 10% for SO_2 to 35% for HO_2NO_2 .

References

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