Georgia Tech Chemical Ionization Mass Spectrometer (GT CIMS)

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Summary

This dataset provides measurements of acidic gases including sulfur dioxide (SO_2), nitric acid (HNO_3), hydrochloric acid (HCl) and pernitric acid (HO_2NO_2) measured by the Georgia Tech Chemical Ionization Mass Spectrometer (GT-CIMS) during the ACCLIP mission. The dataset includes 12 files in comma-delimited text (ICARTT) format, with one file per flight date.

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 (SF_6^-) was used to detect SO_2, HCl, HNO_3, HO_2NO_2, formic acid (HCOOH) and acetic acid (CH_3COOH). Each species was measured every five seconds with a duty cycle of 10% except for SO2 which was measured with a duty cycle of 20%. All species were periodically zeroed in flight by use of the sodium carbonate scrubber. SO_2 was calibrated frequently in flight (~every 10 minutes) by addition of isotopic $^{34}SO_2$ standard. The sensitivities of the other species were examined relative to SO2 by post-mission calibrations at dew point conditions during the mission. Detection limits for all species are estimated to be 2–10 pptv based on the ion signals measured during the background mode. The accuracies of the measurements are estimated to range from 10% for SO_2 to 50% for HO_2NO_2.

References

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