

MACSIMS :
MEASUREMENT OF ATMOSPHERIC CONSTITUENTS
BY SELECTIVE ION MASS SPECTROMETRY

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The objective of this cooperation between the above mentioned institutes is the development of a new active chemical ionization method (ACIMS) for the simultaneous insitu measurement of stratospheric nitric acid and dinitrogen pentoxide, two gases playing an important role in the stratospheric ozone chemistry.

The ACIMS method relies upon the formation of specific product ions from reactions of atmospheric trace gases with precursor ions produced by an external ion source mounted in front of a balloon borne mass spectrometer. The mixing ratio of reactive trace gases can be derived from the analysis of the relative abundance of precursor and product ions in spectra, obtained with the ion source. The innovation of the method proposed in the MACSIMS project, lies in the fact that an attempt is made to develop ion sources, producing mainly Cl^- or I^- ions. Whereas the Cl^- ions react both with HNO_3 and N_2O_5 , I^- only reacts with N_2O_5 . Both reactions result in NO_3^- core ions. From the abundance ratios $[\text{NO}_3^-]/[\text{Cl}^-]$ and $[\text{NO}_3^-]/[\text{I}^-]$, measured with the ion mass spectrometer and the known rate coefficient of the ionmolecule reactions involved, the HNO_3 and N_2O_5 concentrations can in principle be inferred.

To reach the final objectives put forward above, two major phases were foreseen. The first phase consisted of the development of a new sensitive ion mass spectrometer, allowing the recording of spectra in a short time, to obtain a high altitude resolution in the ACIMS method, as well as a first study of

suitable ion sources and their testing in the laboratory. A new type of balloon borne Mattauch-Herzog magnetic mass spectrometer with simultaneous ion detection, including its cryopumping system and the control electronics has been developed and tested during two balloon flights (in 1991 and 1992).

The second phase includes the realization of flight models of the ion sources developed within the SIDAMS project and the testing of the unit in the stratosphere. It also contains measurements in the laboratory of ionmolecule reactions involved in the proposed method.

In 1993, the ACIMS payload, consisting of the ion source, an ion transport device (flow tube) and the appropriate gas control units as well as the control electronics has been realized and tested in the laboratory. Presently the first flight with the combined instrument (mass spectrometer and ACIMS package), which is scheduled in 1994 is prepared.

Parallel to these activities laboratory studies are undertaken to measure the rate constants of the ionmolecule reactions, playing a role in the developed method.

It is the intention to launch the instrument regularly, if possible during international balloon campaigns, to contribute to the study of the ozone depletion mechanism.

References

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