Upper atmospheric ions and ion processes – Implications for trace gases and aerosol

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Upper atmospheric ions and ion processes are of interest for several reasons. They influence atmospheric electrical properties, potentially influence aerosol formation, and serve as powerful diagnostic tools in trace gas and aerosol detection. It has been hypothesized that atmospheric ions may even influence clouds and climate. Currently this, so called Ion-Cloud-Climate Connection is subject of a highly controversial discussion. Airborne ion mass spectrometry measurements, made on rockets, stratospheric balloons, and research aircraft have a major role in exploring atmospheric ions and ion processes. This contribution reviews major progress in our understanding of atmospheric ions and attempts to identify future developments. Regarding experiments, the focus is on airborne ion mass spectrometry, particularly made on rockets. Regarding major atmospheric implications, emphasis is placed upon the role of ion measurements in understanding mesospheric aerosol, molecular clusters, ultra trace gases, and clouds. Emphasis is also placed upon cosmic influences on mesospheric ions, aerosol, and clouds. These cosmic influences include cosmic dust and energetic particle radiation.