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Lightning induced aerosol formation: First aircraft and lightning laboratory measurements of gaseous and ionic acidic aerosol precursors

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Lightning and other atmospheric electrical discharges generate trace gases which are potentially important by influencing the atmospheric environment. Inside a lightning channel air is heated to temperatures in the order of 30000 K inducing air dissociation and ionization. After a lightning discharge there resides a plume of lightning generated atoms and ions which undergoes dilution and cooling by mixing with ambient atmospheric air. During plume ageing atoms and ions experience a complex chemical evolution resulting in the formation of numerous molecular trace species including also gaseous and ionic aerosol precursors.

We report on the first aircraft-based measurements of lightning generated acidic trace gases in young lightning plumes in a tropical thunderstorm cloud. The measured gases include HONO, HNO3, and H2SO4 as well as the H2SO4 precursor SO2. We also report on systematic measurements of acidic trace gases and acidic ions made in laboratory discharges including also lightning impulse discharges. Since H2SO4 and HNO3 are important aerosol precursor gases we conclude that

lightning and other atmospheric electric discharges represent a source of new aerosol particles formed by nucleation.