

# Ice cloud formation in the exhaust plume from an Ariane5 rocket

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## Abstract

Rockets directly emit water vapour and aerosol into the atmosphere, promoting ice nucleation and cloud formation in cold, ice supersaturated regions of the atmosphere. Enhanced ice cloud occurrence has been detected in the mesosphere near 80 km altitude after the launches of large space shuttles and smaller rockets. Here, we present unique evidence for ice cloud formation below 20 km altitude caused by ice nucleation in the exhaust plume from an Ariane5 launch vehicle. The rocket condensation trail has been detected in the tropical tropopause region south of Kourou, French Guiana, in high resolution data products from the SEVIRI imager (Spinning Enhanced Visible and Infrared Imager) on the METEOSAT-9 satellite. Co-located meteorological reanalysis data from the European Centre for Medium-Range Weather Forecasts show significant ice supersaturation near the 100 hPa level. We investigate the ice nucleation processes in the rocket exhaust plume and follow the evolution of the rocket contrail in the upper troposphere/lower stratosphere region for almost two hours. The frequency of occurrence and the climate impact of cirrus formation in rocket exhaust plumes is discussed.