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Observation of clouds with an airborne DOAS instrument

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We report on observations of clouds with the CARIBIC (Civil Aircraft for Regular Investigation of the atmosphere Based on an Instrument Container) using a DOAS (Differential Optical Absorption Spectroscopy) instrument. The CARIBIC container is regularly installed on a Lufthansa Airbus retrofitted with a three probe inlet (water, aerosols and trace gases). The inlet also contains three small telescopes for the DOAS instrument observing the column densities of oxygen dimers (O_4) and additional trace gases like NO_2, HCHO or HONO. During frequent traverses of smaller clouds enhancements of O_4 are seen; however, the focus of the presentation will be on a cloud event over the Caribbean. During one flight from Frankfurt to Caracas (Venezuela) when the CARIBIC airbus penetrated a large convective cloud over the Caribbean Sea; at this occasion the DOAS instrument observed strongly enhanced column densities of O_4 associated with a strong increase in the Ring effect (filling in of the Fraunhofer lines caused by elastic scattering). At the same time the in situ cloud water instrument measured a strong enhancement of cloud water. The observations are compared with results of a 3-D Monte Carlo Radiative transfer Model to estimate the cloud optical thickness (≈ 160) and the cloud top height (15 km). The high optical density of the cloud enhanced multiple scattering and thereby the light path was extended up to about 100 km inside the cloud. Thereby not only the cloud optical properties can be estimated but also the trace gas concentration inside the cloud.