Collocated Airborne Measurements of Microphysical and Radiation Cloud Properties

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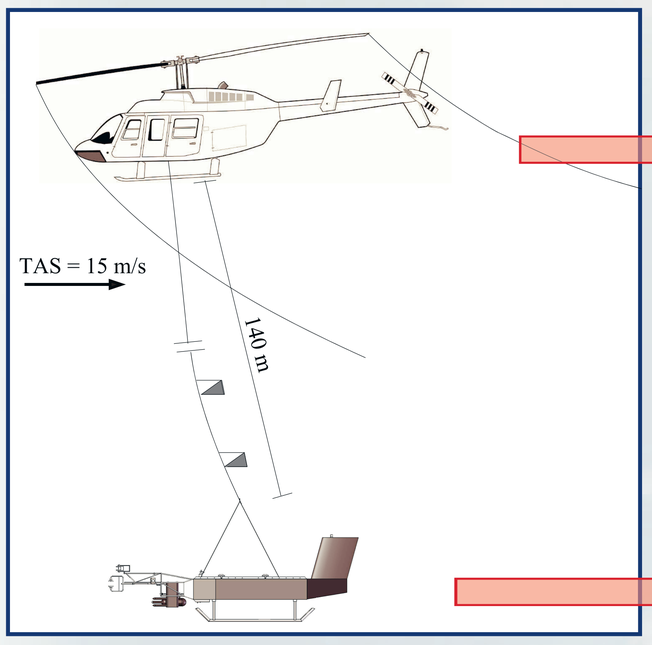
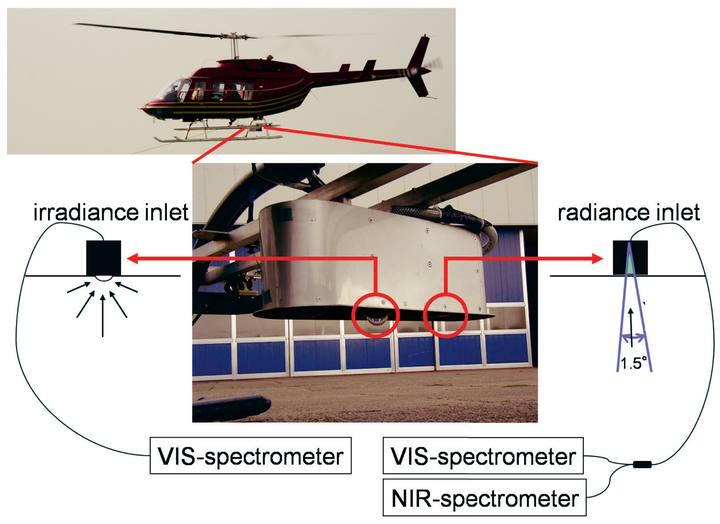
Helicopter with the external payload „ACTOS"



The Airborne Cloud Turbulence Observation System ACTOS is carried by a helicopter by means of a 140 m long rope. Typical true air speed during measurements is 15 m s^{-1}. While ACTOS is performing in-situ cloud measurements, the helicopter remains above the clouds which allows perfect collocation between the radiation measurements onboard the helicopter and the microphysical cloud properties. For more details see Siebert et al., 2006.

Radiation Measurements onboard the helicopter



Measurement Quantity	Spectral range	Resolution (FWHM)
VIS – spectral upwelling irradiance $F_\lambda^\uparrow$	400 – 1000 nm	2 – 3 nm
VIS – spectral upwelling radiance $I_\lambda^\uparrow$	400 – 1000 nm	2 – 3 nm
NIR – spectral upwelling radiance $I_\lambda^\uparrow$	1000 – 2000 nm	9 – 16 nm

Derived Quantities:

Spectral albedo $\alpha_\lambda = F_\lambda^\uparrow / F_\lambda^\downarrow$

Spectral reflectance $R_\lambda = \pi I_\lambda^\uparrow / F_\lambda^\downarrow$

$F_\lambda\downarrow$ is simulated! → reasonable for cloudless conditions above helicopter

Measurements onboard ACTOS

Airborne Cloud Turbulence Observation System „ACTOS"

Turbulence and thermodynamic parameters

Payload attitude, position, and velocity

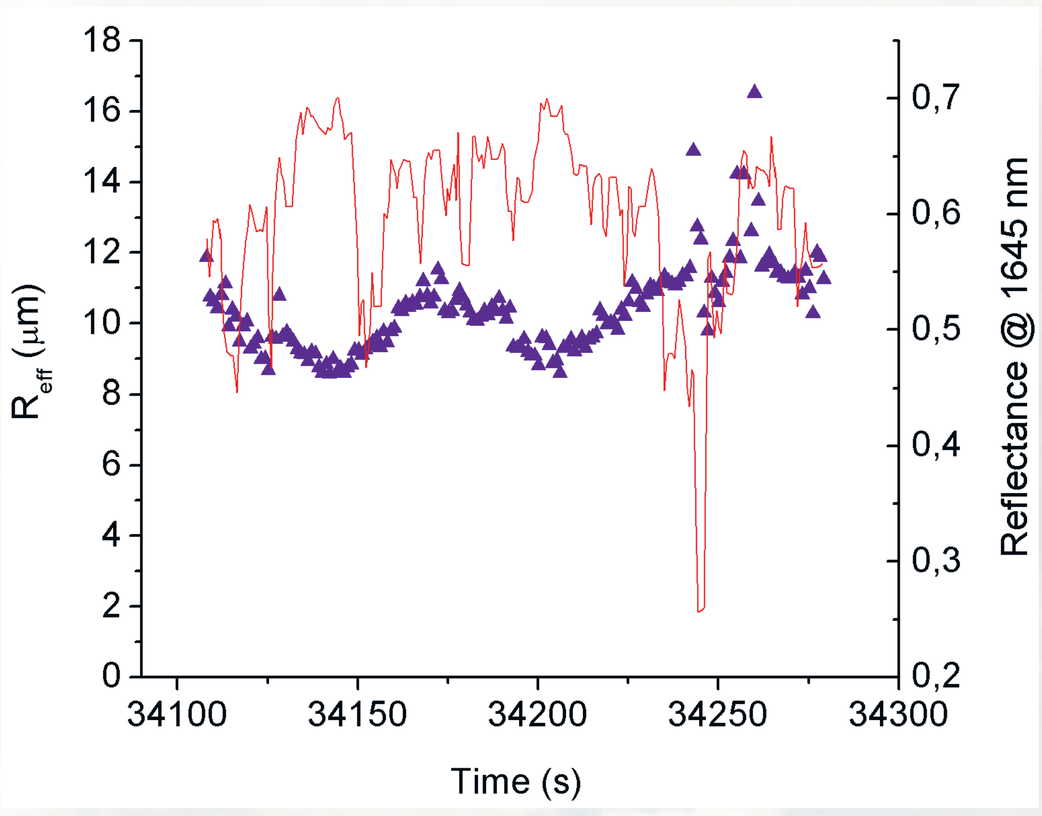
Interstitial aerosol (number concentration and size distribution)

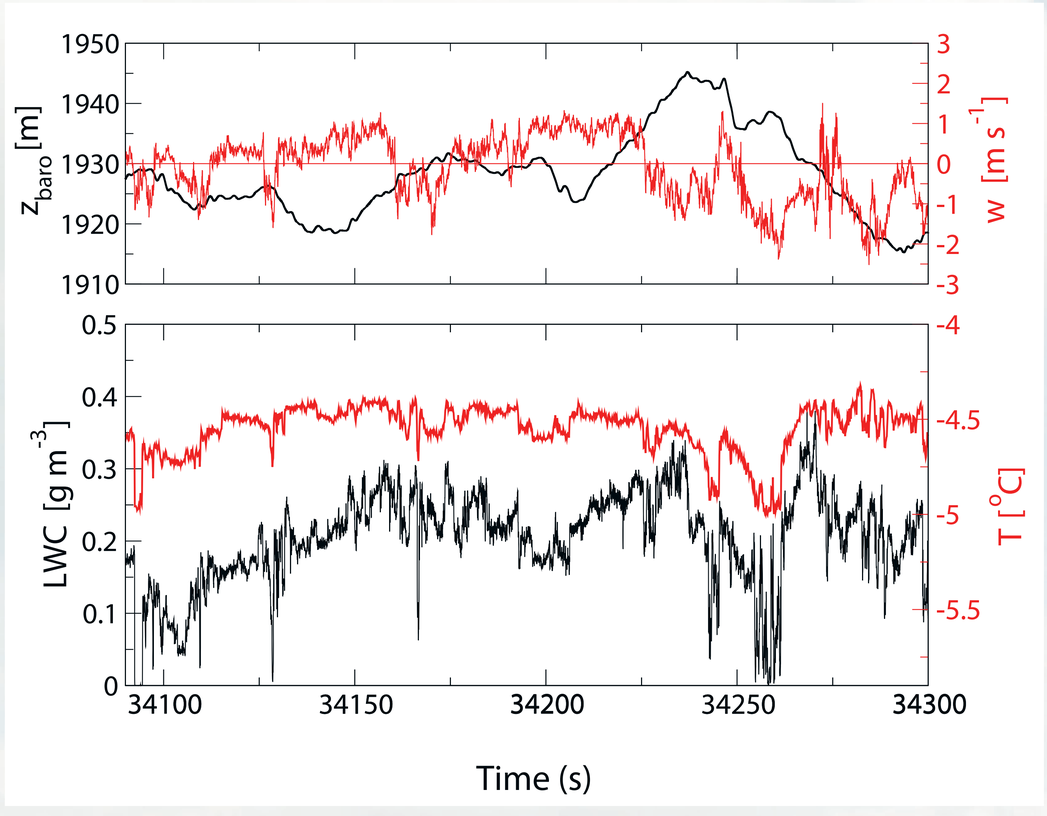
Cloud microphysical properties (Liquid Water Content, Droplet number concentration, and size distribution)

Onboard video camera and laser ceilometer

(for further details see Siebert et al. 2006)

Exemplary Results





The two figures show measurements performed during the IMPACT campaign 2008 in Cabauw (NL). The data were sampled in a field of shallow cumulus clouds with cloud top in about 2000 m. During this flight leg, ACTOS was at a nearly constant height in 1930 m above ground level and 50 m below cloud top. The left plot shows the time series of reflectance at a wavelength of 1645 nm (red curve) measured onboard the helicopter and effective radius (blue triangles) measured with the PVM onboard ACTOS. The right plot shows the corresponding time series of vertical velocity w, measurement height z, liquid water content LWC, and temperature T.

Reference

Siebert, H., H. Franke, K. Lehmann, R. Maser, E. W. Saw, D. Schell, R. A. Shaw, and M. Wendisch (2006) Probing Fine-Scale Dynamics and Microphysics of Clouds with Helicopter-Borne Measurements, Bull. Amer. Met. Soc., 87, 1727 – 1738.

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