

Nice to have in cloud physics (modelling)

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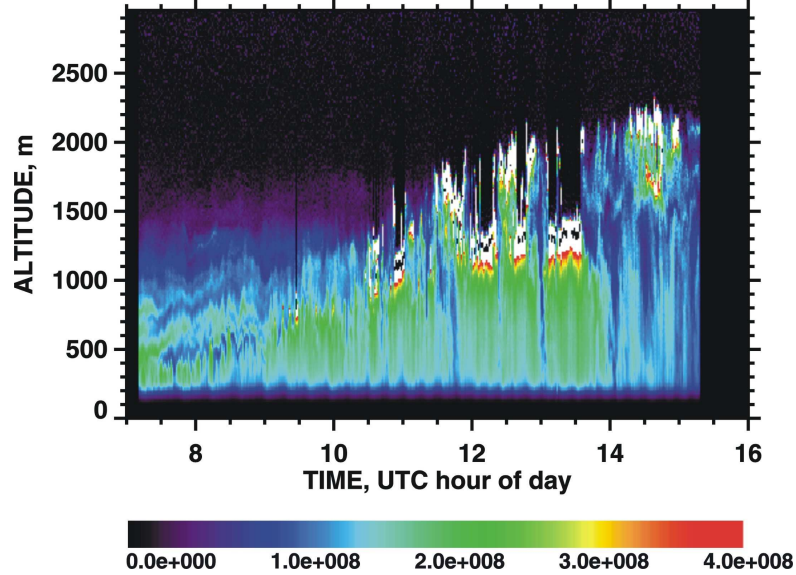
- Cloud initiation
- Cloud evolution
- Cloud dynamics

Cloud initiation

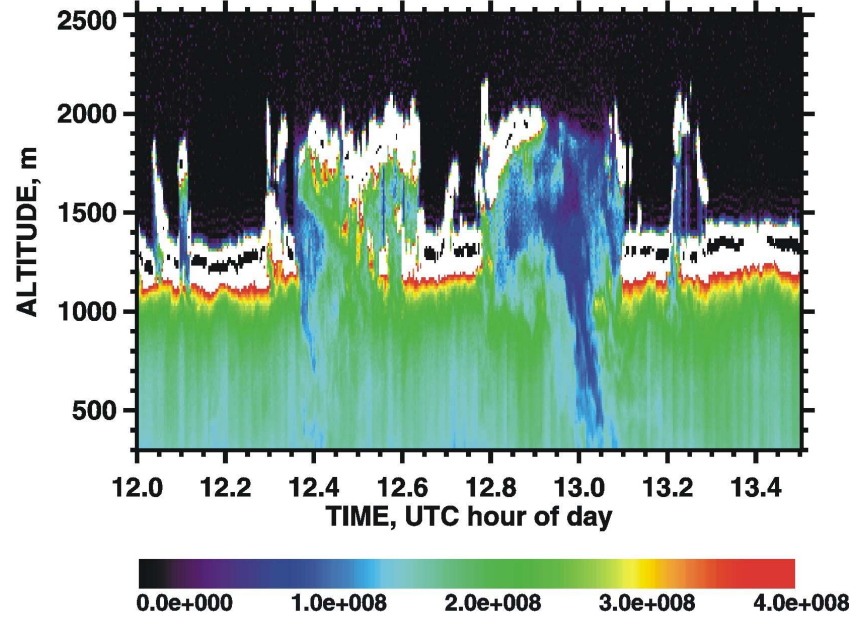
- pre cloud conditions and conditions at cloud base - (*cf. also cloud dynamics*)

- air mass raising to LCL (or LFC) or CCL (convective temperature),
i.e. appropriate T- and RH-profiles (available from soundings)
- extent and timing of penetrating warm (and moist) air bubbles in ABL
- in case of convective clouds (lidar)
- magnitude, extent and timing of vertical velocity (lidar, *example*)

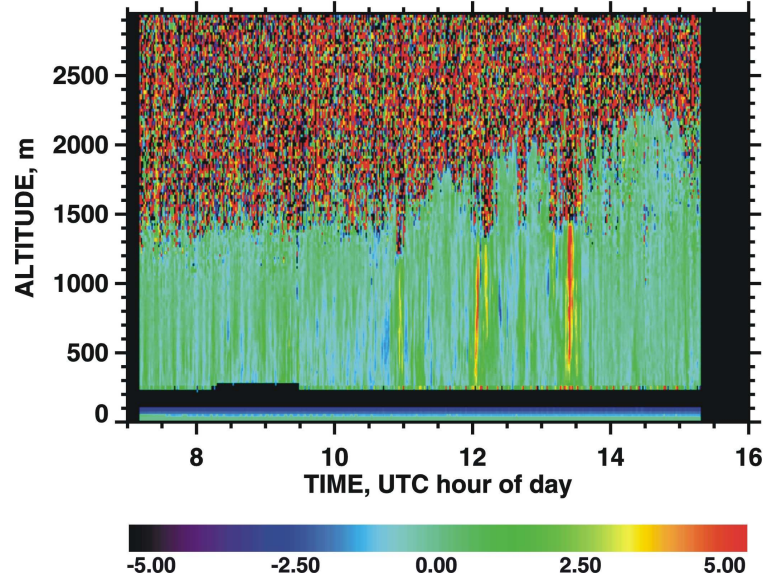
RANGE-CORRECTED SIGNAL, res. 15 m, 10 s
MPI Doppler Lidar at Leipzig, 24 Sep 2003, 07.00 UTC



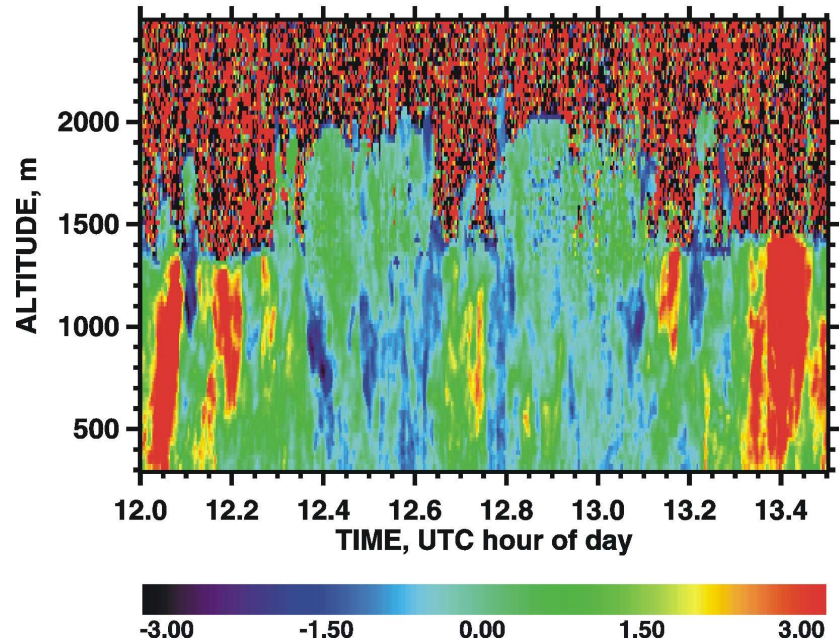
RANGE-CORRECTED SIGNAL, res. 15 m, 10 s
MPI Doppler Lidar at Leipzig, 24 Sep 2003, 07.00 UTC



VERTICAL WIND SPEED, m/s, res. 22.5 m, 30 s
MPI Doppler Lidar at Leipzig, 24 Sep 2003, 07.00 UTC



VERTICAL WIND SPEED, m/s, res. 22.5 m, 30 s
MPI Doppler Lidar at Leipzig, 24 Sep 2003



Cloud initiation

- pre cloud conditions and conditions at cloud base - (*cf. also cloud dynamics*)

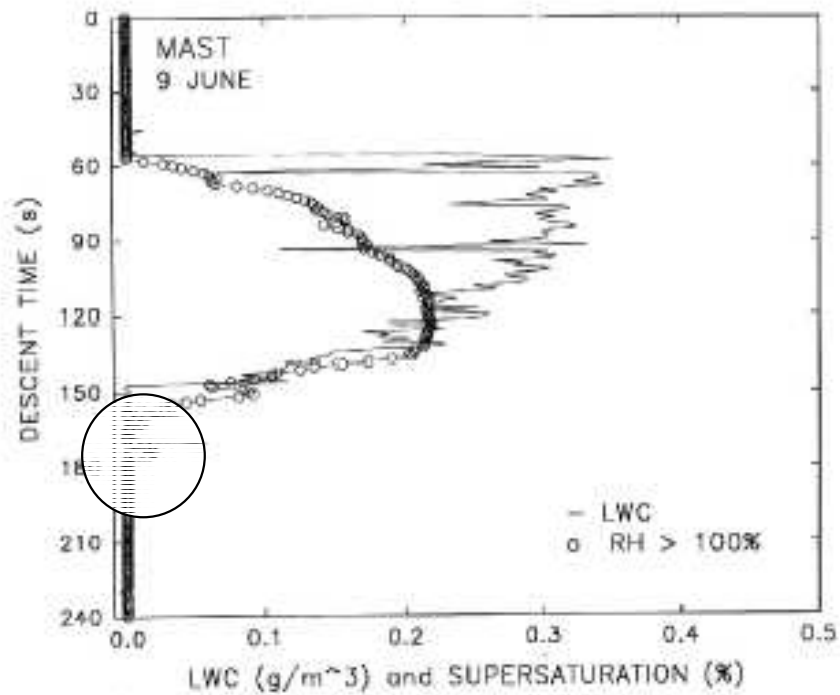
- air mass raising to LCL (or LFC) or CCL (convective temperature), i.e. appropriate T- and RH-profiles (available from soundings)
- extent and timing of penetrating warm (and moist) air bubbles in ABL - in case of convective clouds (lidar)
- magnitude, extent and timing of vertical velocity (lidar, *example*)
- turbulent fluxes at cloud base (in particular water vapour, ?)
- aerosol particles / CCN – concentration (size distribution), appearance of ultragiant nuclei

Cloud development (above/near cloud base)

- Condensational growth depending on supersaturation triggered by vertical velocity → supersaturation (Gerber, 2004; *example*)

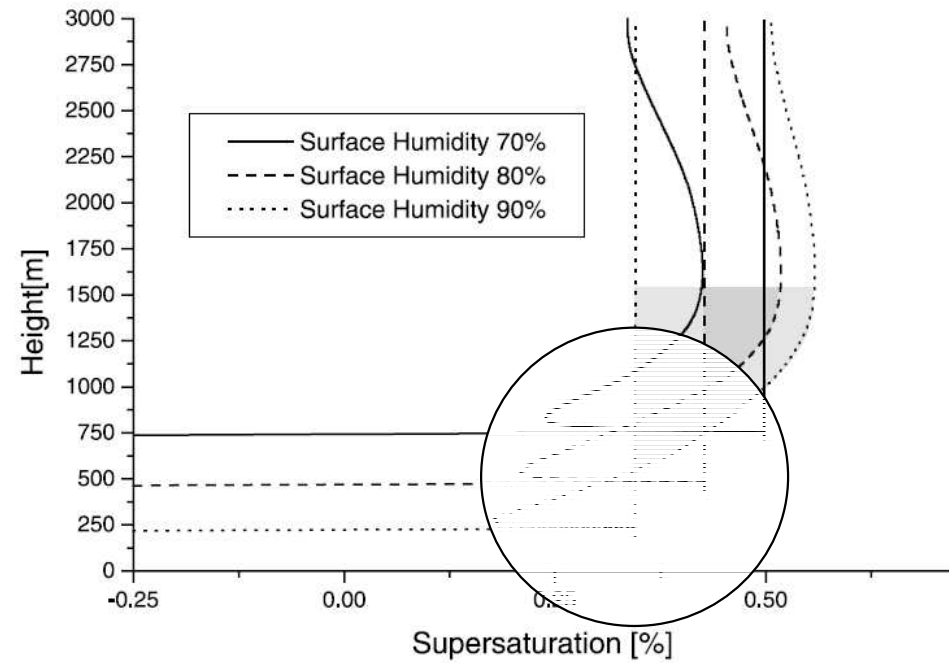
Gerber, H., 2004:

Supersaturation measurements in a stratocumulus,
Proc. 14th ICCP, Bologna, 528-529



Segal, Y., et al., 2003:

Thermodynamic factors influencing bimodal
spectrum formation in cumulus clouds,
Atmos. Res., 66, 43-64



Cloud development (above/near cloud base)

- condensational growth depending on supersaturation triggered by vertical velocity
→ supersaturation (Gerber, 2004)
- measurement of drop size spectra (PMS FSSP 100),
detection of ,broad' spectra ? → effect of entrainment and/or ultragiant nuclei
- detection of onset of coagulation (PMS OAP 2DC; cloud radar ?)
- measurement of in cloud turbulence and
electric charges on droplets if any (how ?) → effects on coagulation
- **at higher levels**: detection of onset of ice phase and its evolution (PMS probes;
polarization radar)
- morphology of bright band (radar – pol – ; in situ: PMS probes)

Cloud dynamics

- pre cloud
 - profile of horizontal wind and CAPE (single, multi, super cells) (lidar and soundings)
 - vertical wind at/near cloud base (lidar)
- in cloud
 - up- and downdrafts (extent, timing) (?)
 - size spectra (and LWC), maybe ice (PMS probes)
 - volumetric growth of (single) clouds, esp. cloud tops (radar, ?)
- cloud edges
 - entrainment range (?), → effects on size spectra triggering change of in cloud conditions
 - subsidence near cloud environment (presumably small, ?)
- below cloud/surface
 - evaporation rate (lidar ?, FMCW Doppler radars)
 - surface rain rate (distrometers, FMCW Doppler radars)
 - development of cold pool, downburst / gust front (lidars, ground stations)

End of shopping list