



ACTRIS

CCRES

Potential of multi-peak analyses of
Doppler spectra from cloud radar and
Doppler lidar
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Content

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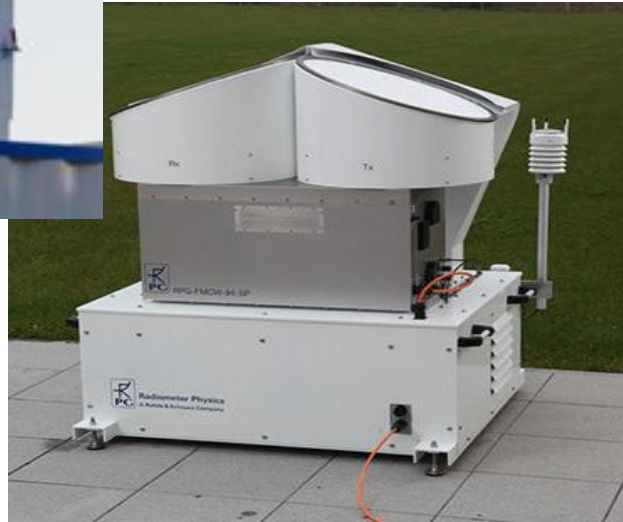
Motivation

- Disentangle multiple co-existing particle populations volume
- Particles with different terminal velocity might be separated in Doppler spectrum
- Goal: Improved microphysical retrievals under multi-peak conditions
 - Reflectivity over extinction
 - Terminal fall velocity

Doppler techniques at TROPOS

Cloud radar

- Metek Mira-35: pulsed 35 GHz radar
- Radiometer Physics RPG94: FMCW 94 GHz radar



Doppler lidar

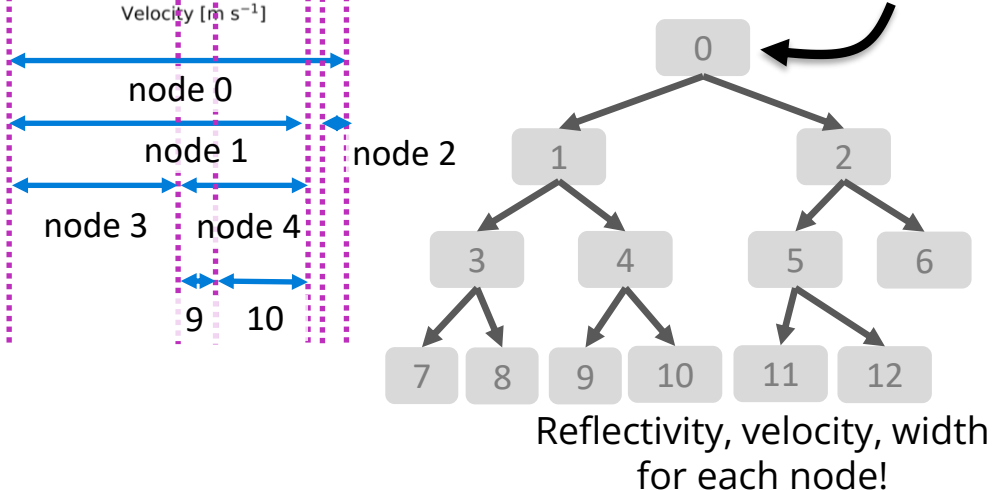
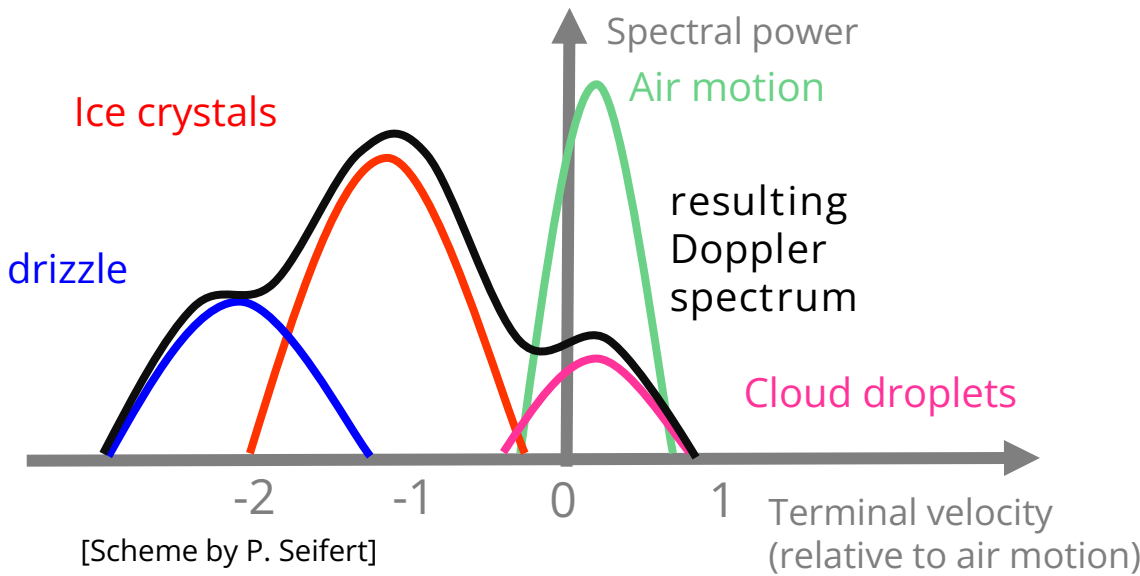
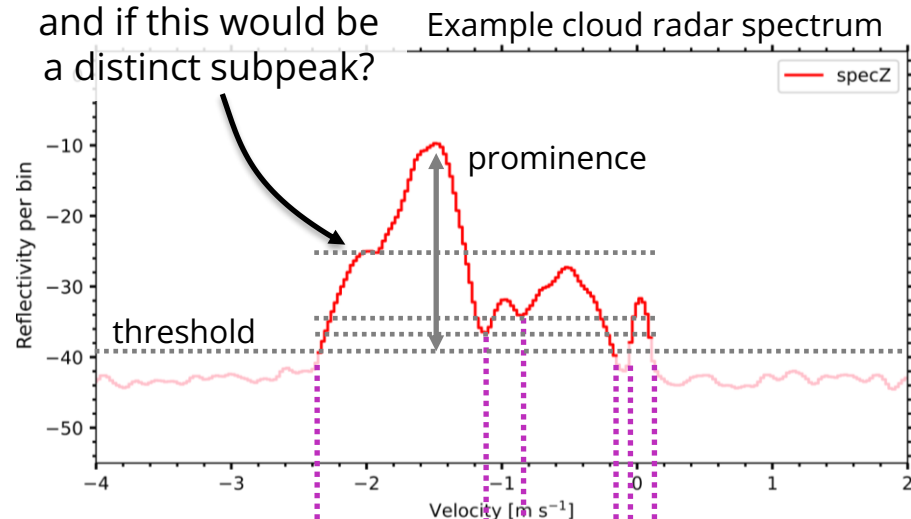
- HALO Streamline: 1.5 μm Doppler lidar
- Abacus Laser LiTraS: 1.5 μm Doppler lidar
- CHARLY: 532 nm Doppler lidar



→ Spectral information

peakTree

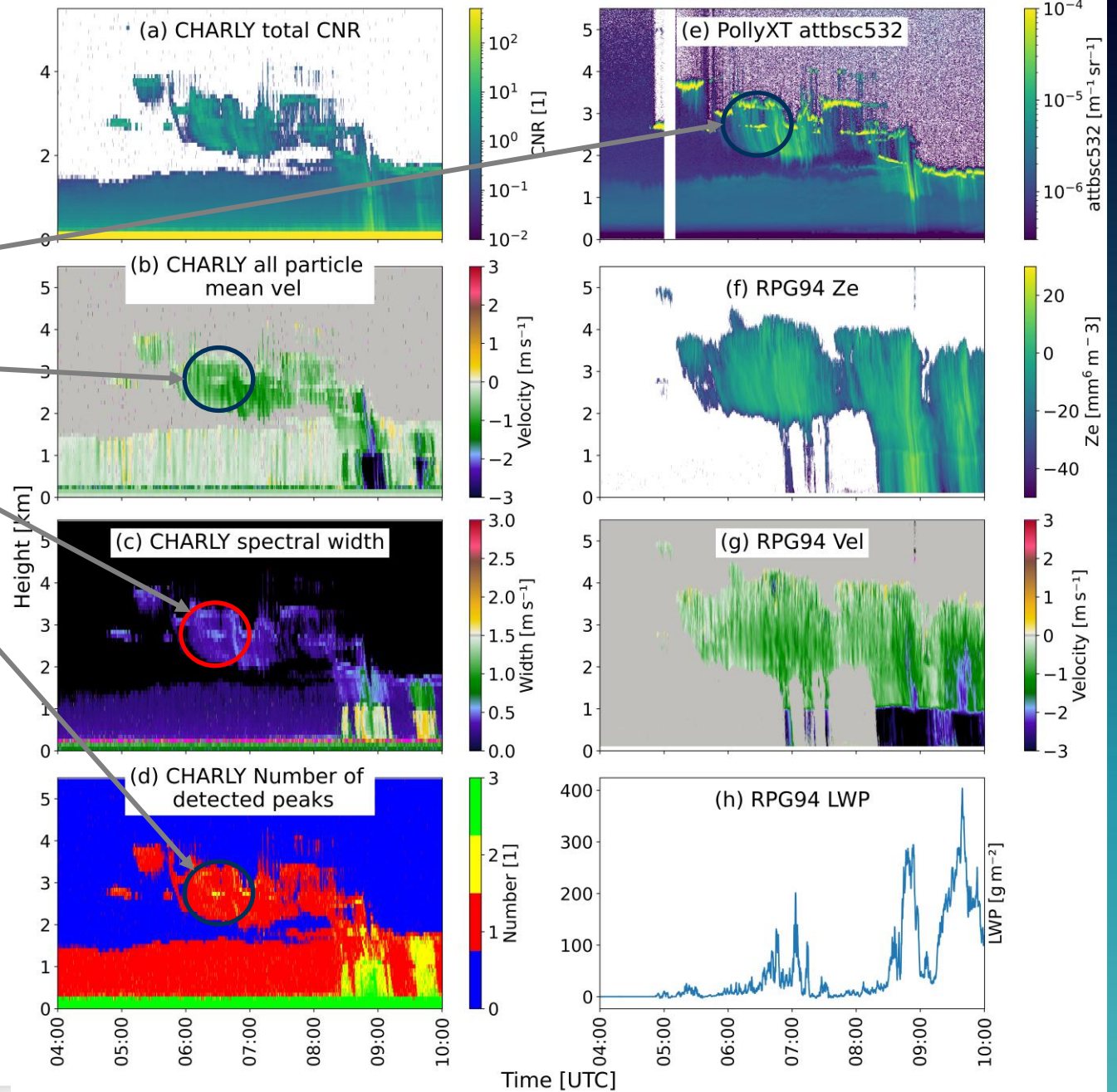
- Different particle populations (or scattering processes) might show up as distinct peaks in the Doppler spectrum
- depends on differences in fall speed and turbulence broadening



→ Adapted peakTree for the Coherent Doppler Lidar Charly

Case study 20 March 2026

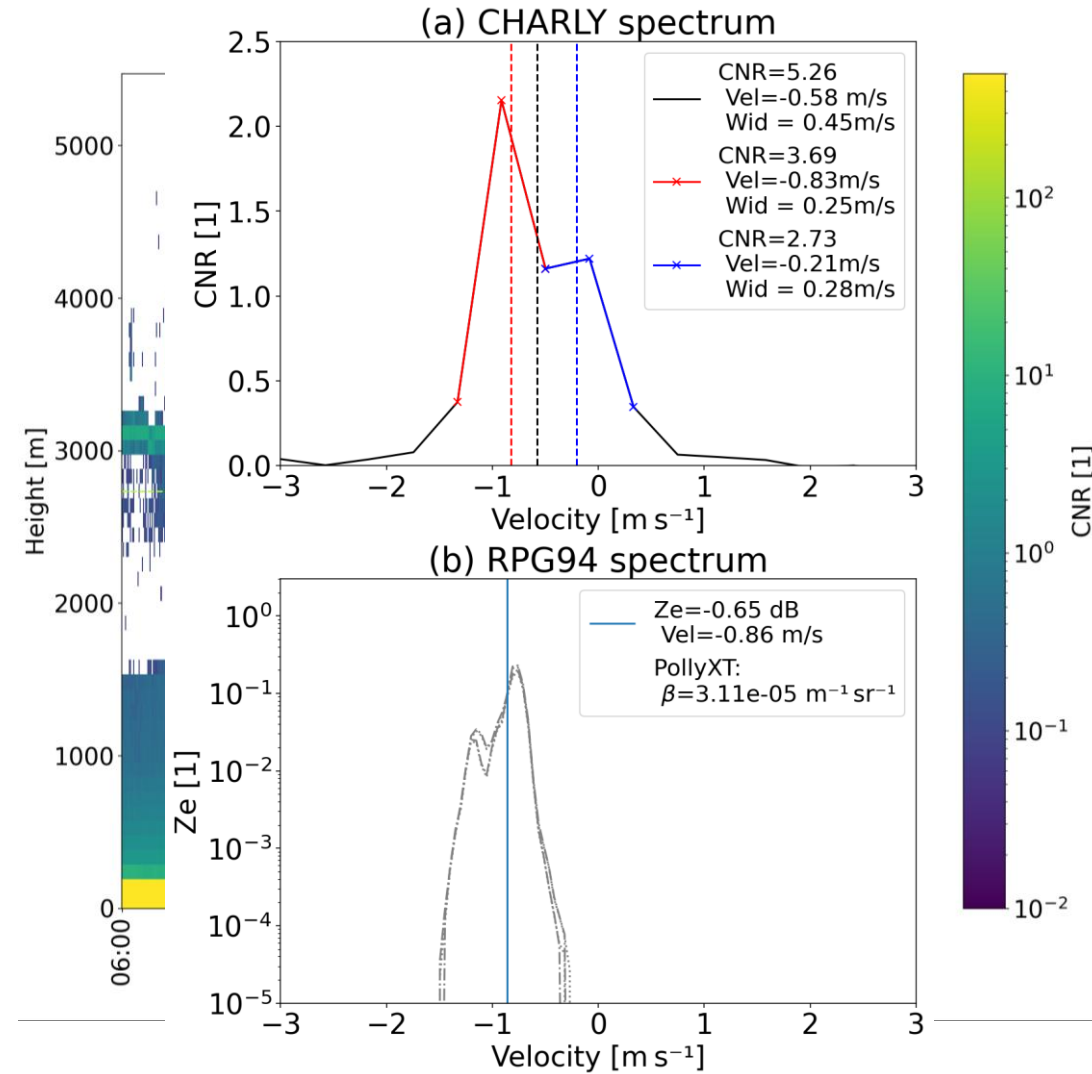
- Mid-level cloud over Leipzig
- 06:00 and 07:00 UTC:
 - Strong scattering (PollyXT)
 - Slower fall velocity (CHARLY)
 - Higher spectral width (CHARLY)
 - Multiple peaks detected (CHARLY)
- Temperature at cloud top -18°C
- Interpretation: multiple liquid layers interacting with ice virga



Case study 20 March 2026

Spectral analysis and comparison

- Spectra from liquid layer at 2735m
 - Two peaks in CHARLY spectra visible
 - With peakTree: ice particle
 - Radar reflectivity Z_e
 - Extinction (ratio ice peak to total CNR)
 - Terminal fall velocity
- Size-dependent values → Ice particle size, number concentration and formation rate



Data from: CHARLY, 20 March 2026 06:30:33 UTC,
Height: 2736 m, Leipzig, Germany [preliminary]

Discussion

Spectral analysis and comparison

- Synergy between radar and lidar needed to cover size range of droplets and crystals
- Advantage Doppler lidar:
Sensitivity for smaller droplets and crystals + better separation by size
- Disadvantage: Penetration of clouds only in lower < 400 m

- Doppler devices: Spectra with multiple particle features

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- peakTree: Elaborate analysis of Doppler spectra

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Insights in cloud particle formations *within* complex cloud environment



Thank you !

Appendix

