Derivation of cloud droplet size from polarized reflection measurements by the Research Scanning Polarimeter

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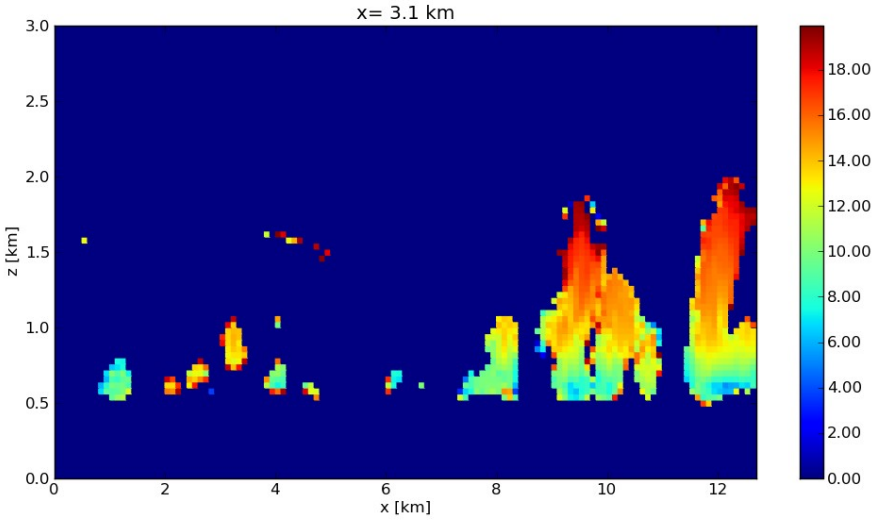
Test on 3D Radiative Transfer Model

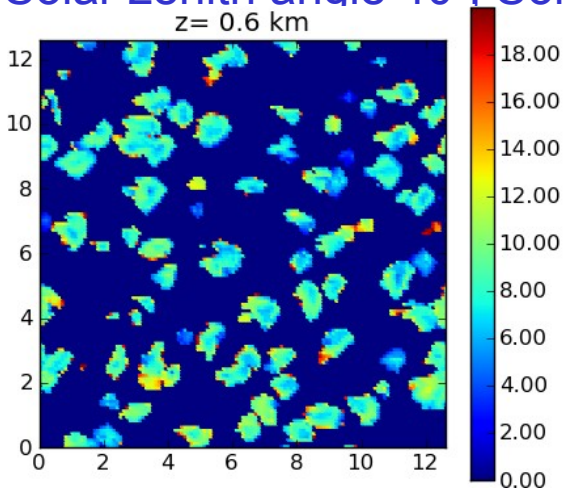
- Model: **MYSTIC** (Monte Carlo code for the phYSically correct Tracing of photons In Cloudy atmospheres)

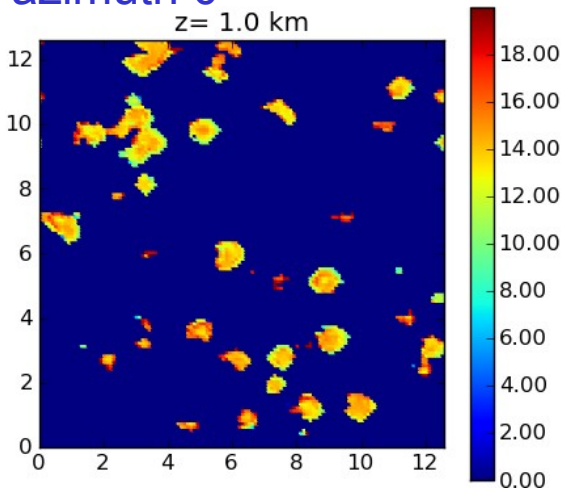
- Applied to realistic cloud fields generated by microphysical simulations (LES for RICO fie campaign by A. Ackerman)

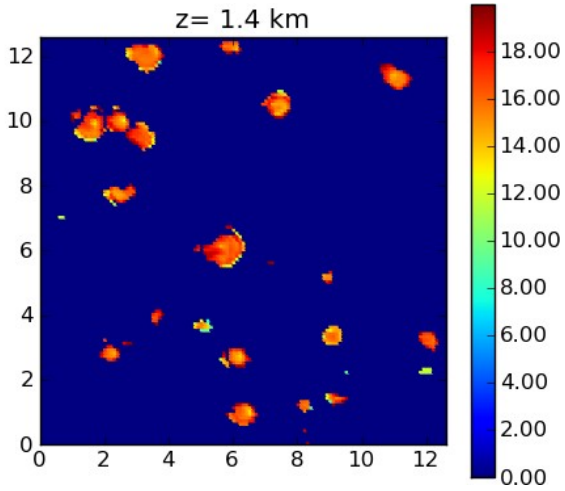
- Wavelength 555 nm, RSP altitude 2.4 km Solar zenith angle 40°, Solar azimuth 0°



Cloud droplet effective radius at 8 h (simulation time)







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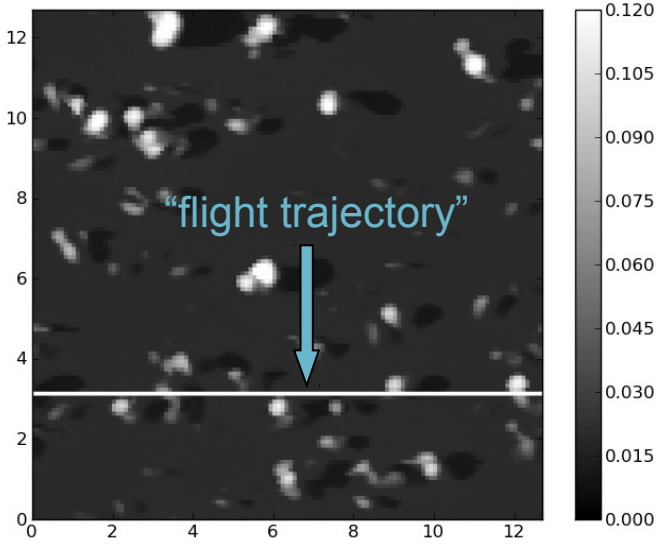
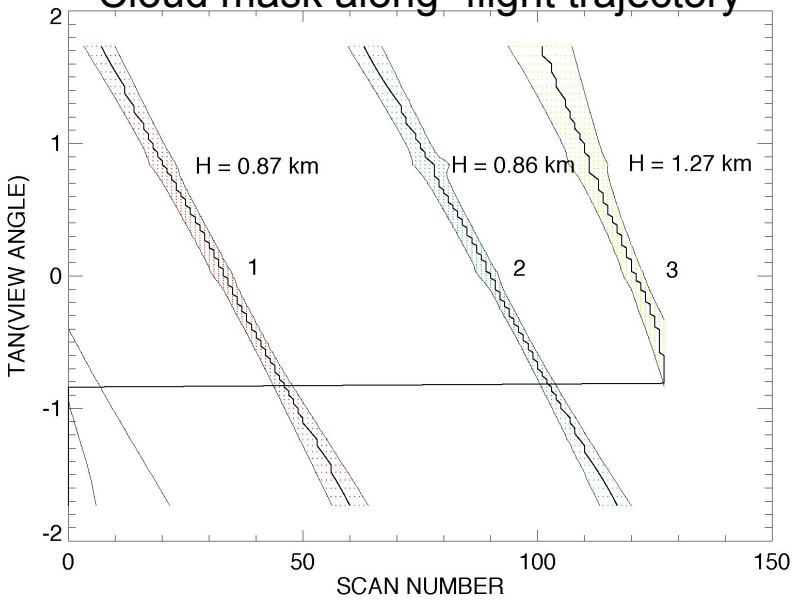
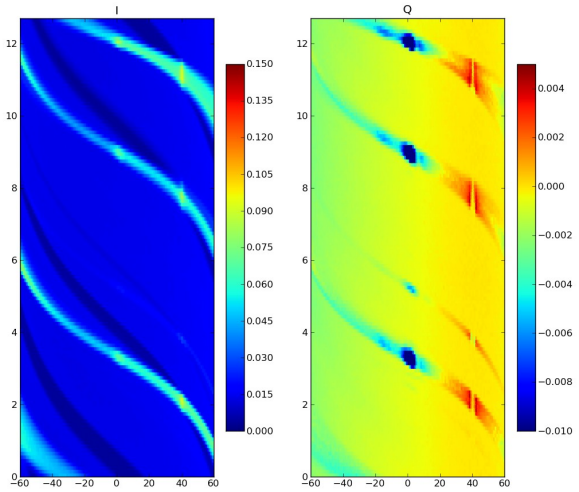
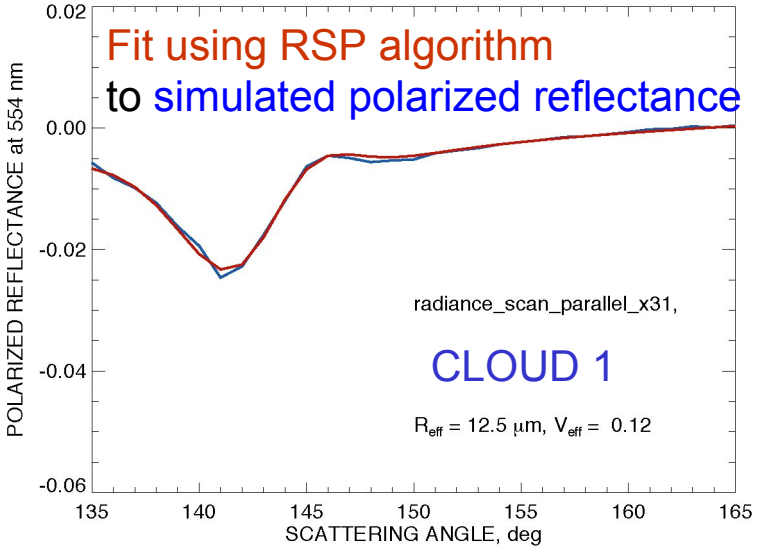


Cloud mask along "flight trajectory"





I and Q along "flight trajectory"



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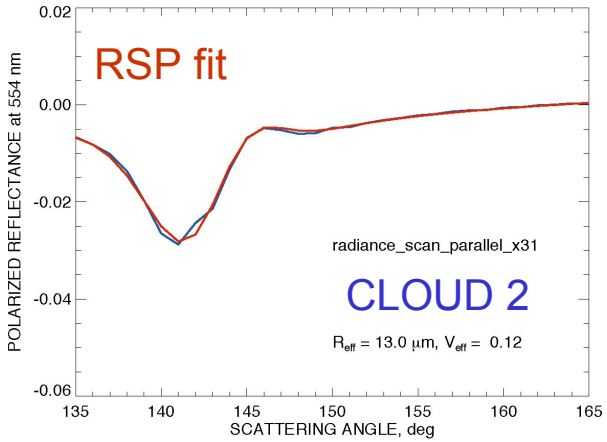

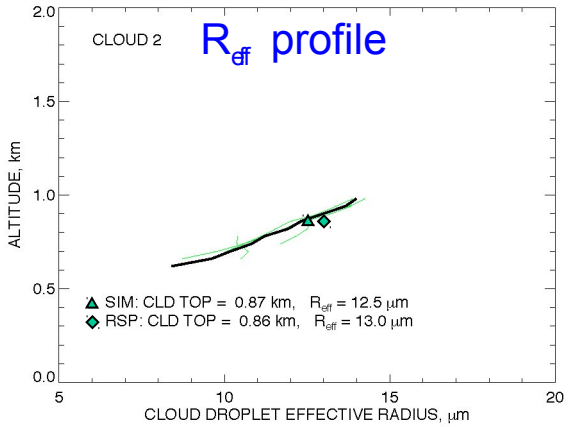

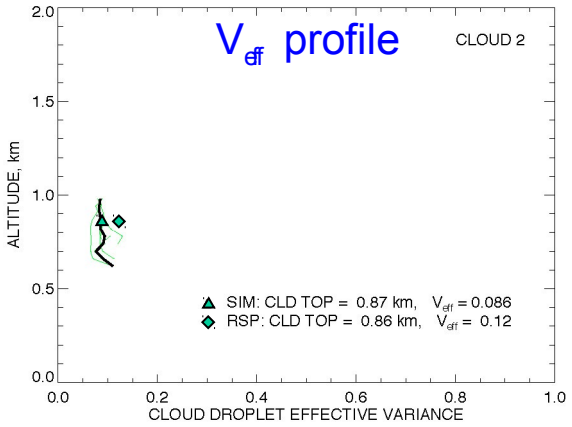

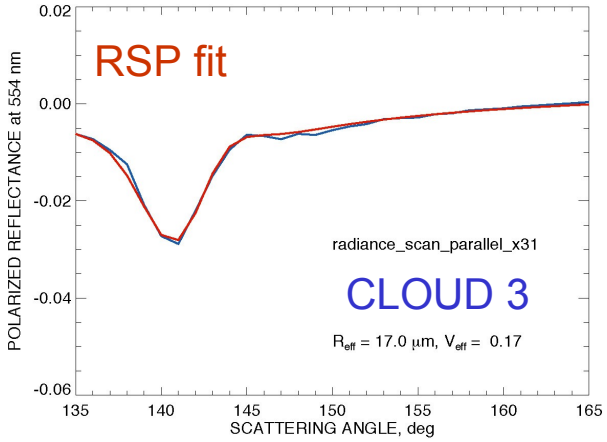

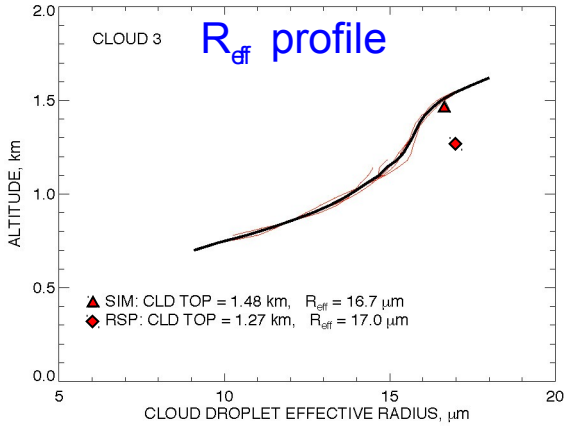

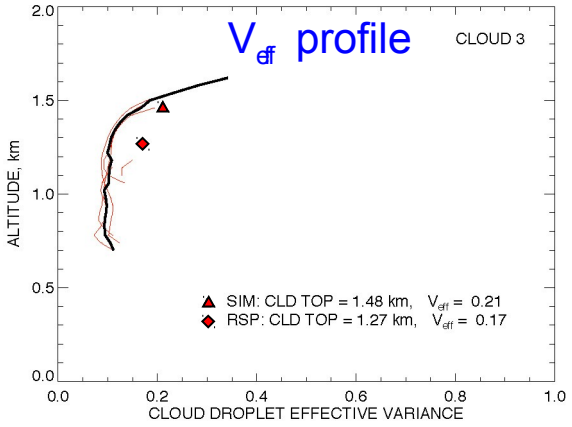

Retrievals of cloud droplet sizes (12.5 - 17 μm) and cloud top heights (diamonds) from the simulated 3D radiation dataset are consistent with those obtained from the microphysical model by averaging of vertical profiles with transmission-like weighting function (triangles).

Cloud droplet size Summary

- Cloud droplet size distribution estimates from polarization observations:
  - The depth into cloud that contributes to the rainbow appears to be sufficient to **suppress issues with droplet evaporation** near cloud top.
  - Are **tested on output of 3D radiative transfer model** applied to realistic simulated cloud fields
  - Are **consistent with in situ observations** near cloud top (50-100 m)
  - Are just as accurate over land, or ocean (**no surface albedo issues**)
  - Are valid independent of the optical depth down to unity optical depth (i.e. **work for common low water path clouds**)
- Future Work
  - Survey size retrieval differences between “MODIS”-like retrievals from RSP and polarization retrievals.
  - Evaluate the combination of HSRL estimates of extinction and RSP size retrievals to estimate **droplet number concentration**.