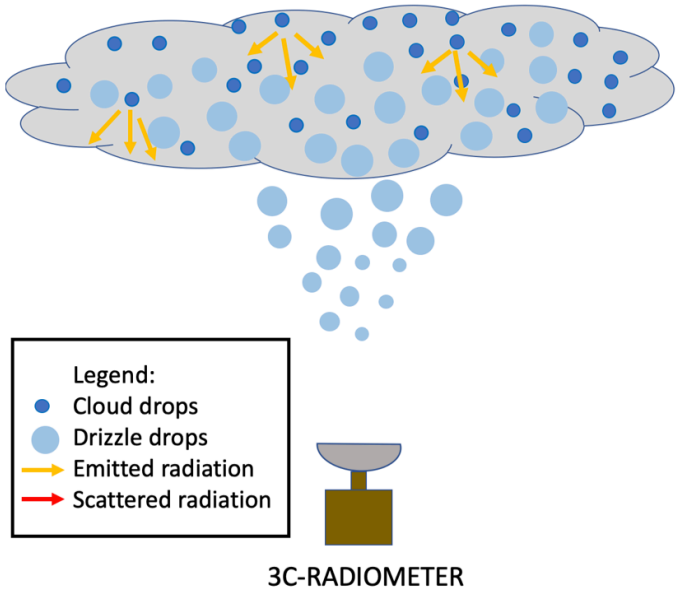
Partition of cloud and drizzle LWP using synergistic active and passive sensors

Maria P. Cadeddu and Virendra Ghate
Argonne National Laboratory

Current setup for retrieving liquid water path ignores scattering from drizzle drops

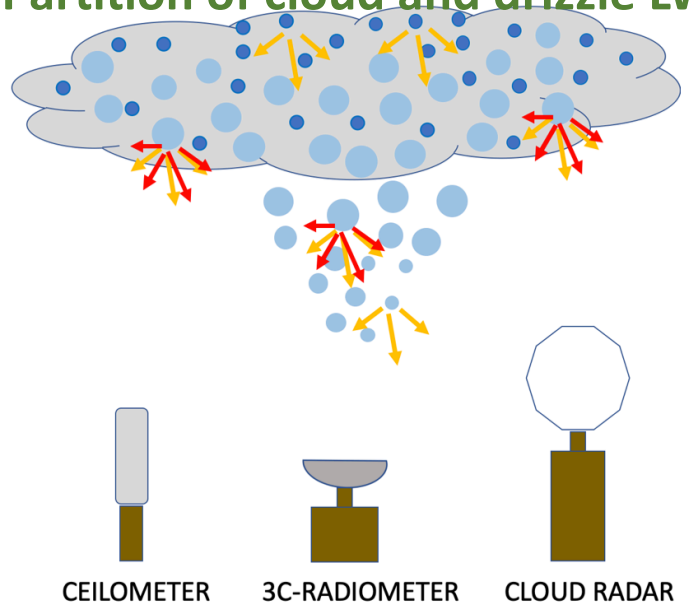
Overestimation of cloud LWP



Current methodologies neglect drizzle scattering effects and assume the entire liquid water located in the cloud as cloud drops with diameter < 90 µm.

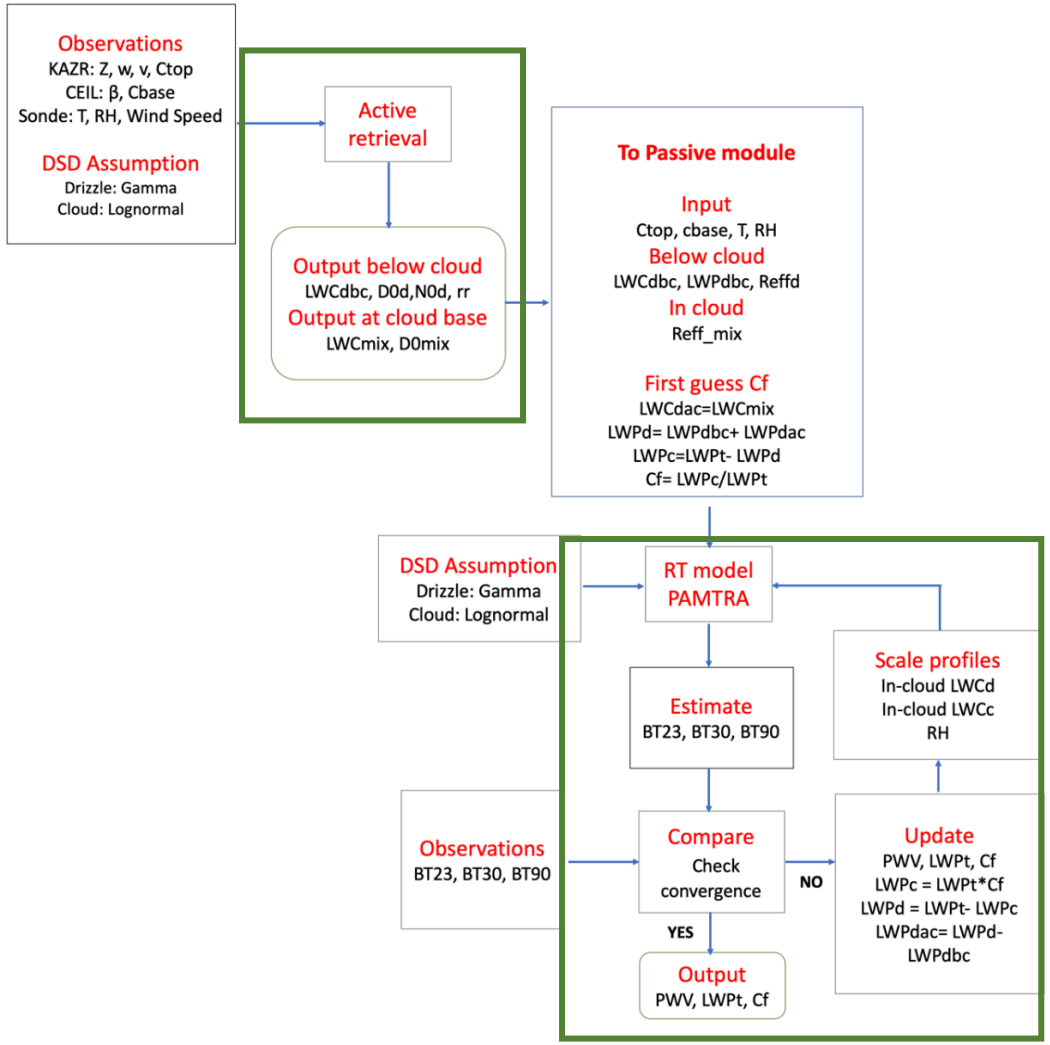
Proposed setup for retrieving liquid water path includes scattering from drizzle drops

Partition of cloud and drizzle LWP

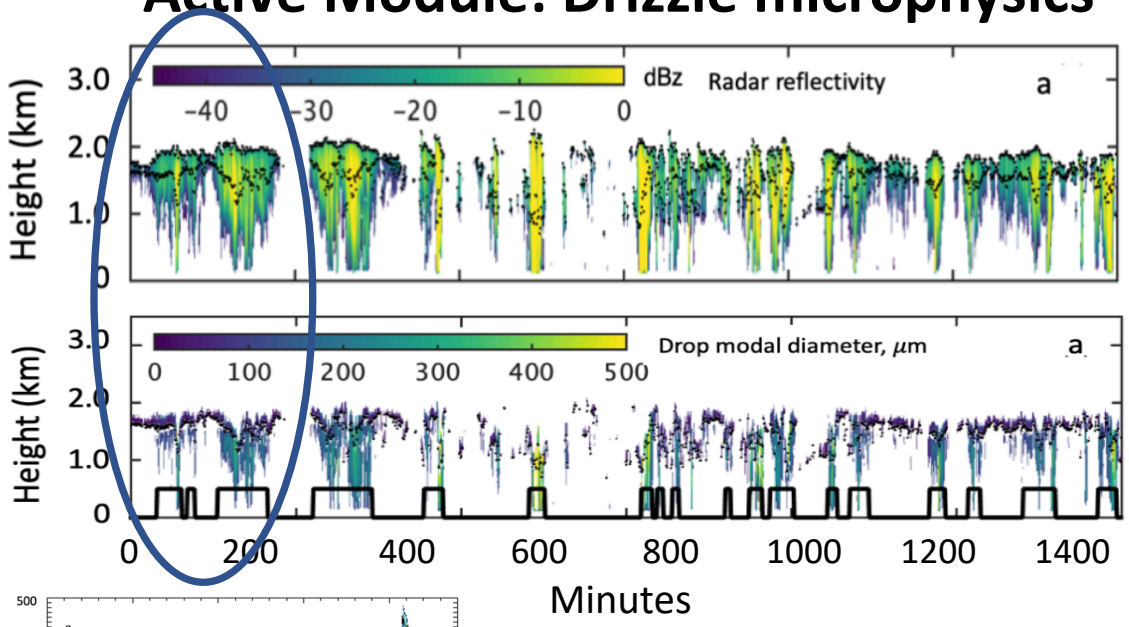


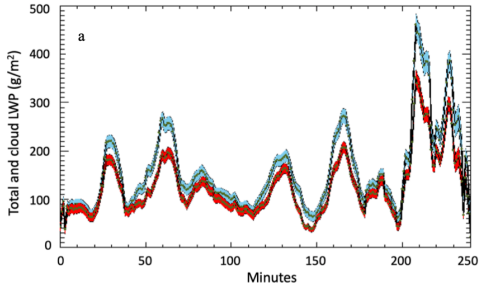
The proposed methodology includes drizzle scattering effects for drizzle drops with diameter > 100 µm and assumes a realistic drizzle drop size distribution.

Synergistic Passive and Active Retrieval of CLoud properties (SPARCL)



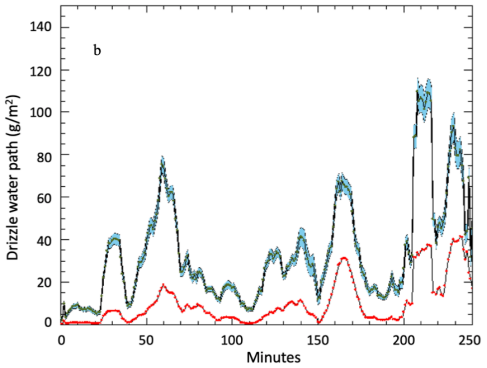
Active Module: Drizzle microphysics





Total LWP

Cloud LWP

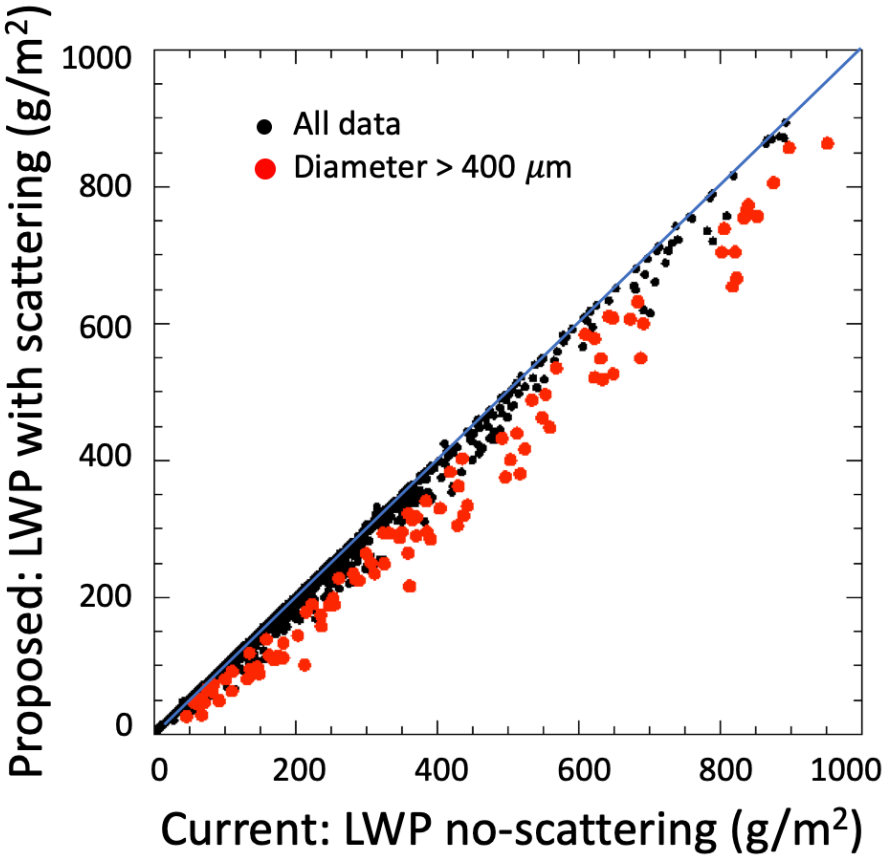


In cloud drizzle LWP

Below cloud drizzle LWP

Passive Module: Drizzle macro-physics

Reduction of cloud LWP



The inclusion of scattering reduces the cloud liquid water path of 8-15% depending on the amount of precipitation and drizzle drop size and allows to gain insight into the partition of cloud and drizzle water path in the cloud.

Ongoing work

Datasets 2015-2019:

Merged 5 yrs of Radar, Ceilometer, Doppler lidar, aerosol, and radiometer data
Selected **56 days** of closed cell stratocumulous clouds

Current work:

- Evaluating uncertainty in Active module due to assumptions in the retrieval
- Characterizing drizzle sedimentation rate
- Analyze data from these cleaned datasets with a focus on **aerosols, and drizzle intraction**

Details of our work so far can be found in:

Ghate, V., Cadeddu, M.P.: "Drizzle and Turbulence Below Closed Cellular Marine Stratocumulus Clouds", J. Geophys. Res.: Atmos., 2019, 124, 5724–5737, DOI: 10.1029/2018JD030141, 2019.
Cadeddu, M.P., Ghate, V., Mech, M.: "Ground-based observations of cloud and drizzle liquid water path in stratocumulus clouds", Atmospheric Measurement Techniques . 2020, Vol. 13 Issue 3, p1485-1499.
Ghate, V. et al., "Turbulence in Marine Boundary Layer Observed at the ARM Eastern North Atlantic site"**,** in preparation, 2020