L2 validation

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1st ESA-JAXA EarthCARE In-Orbit Validation Workshop
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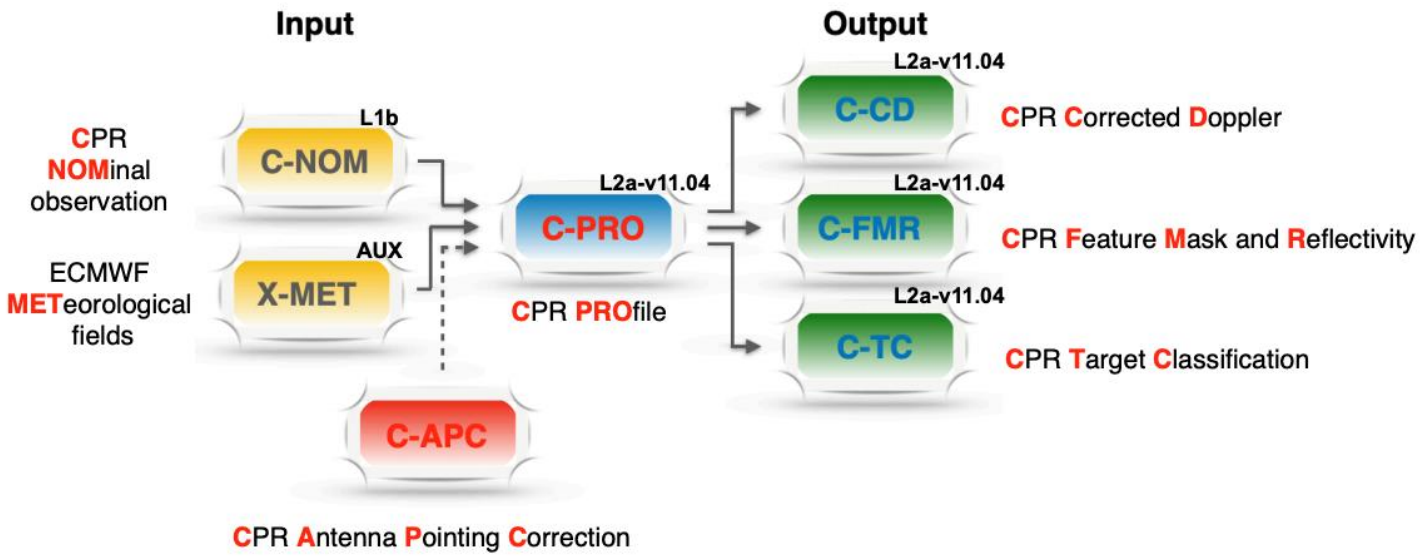
Processing reflectivity and Doppler velocity from EarthCARE's cloud-profiling radar: the C-FMR, C-CD and C-APC products

Overall flowchart



Several updates have been implemented in the C-PRO algorithms, primarily to address issues with the CPR L1b. The updates include:

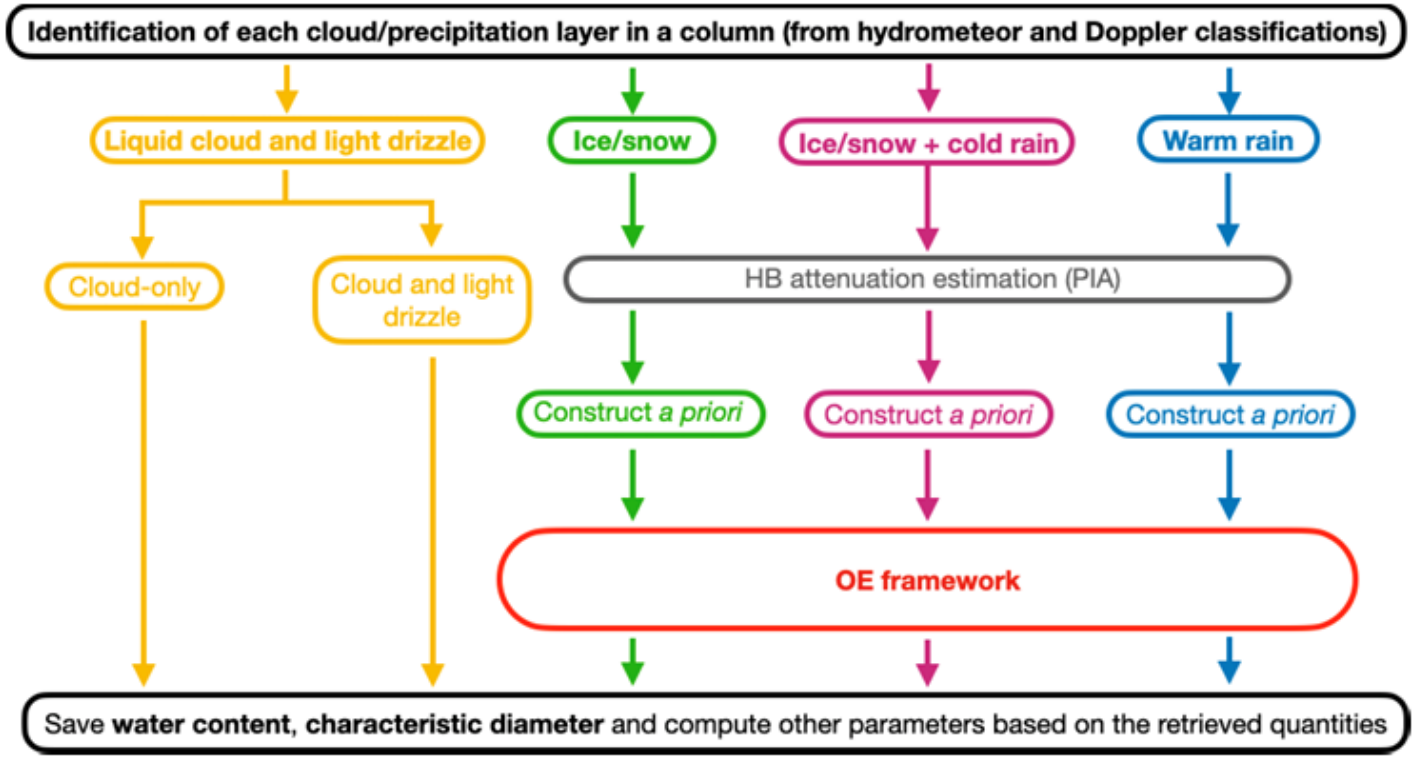
- Manual radar reflectivity calibration
- Corrected antenna mispointing
- Removal of second-trip echoes
- Updated Path Integrated Attenuation estimation
- Enhanced bright band detection
- Improved clutter detection
- New noise-floor computation
- Updated multiple scattering detection
- Updated hydrometeor classifications
- Improved surface detection
- Improved velocity unfolding
- "Correct" spectrum width

Kollias, P., Puidgomènech Treserras, B., Battaglia, A., Borque, P. C., and Tatarevic, A.: Processing reflectivity and Doppler velocity from EarthCARE's cloud-profiling radar: the C-FMR, C-CD and C-APC products, Atmos. Meas. Tech., 16, 1901–1914, https://doi.org/10.5194/amt-16-1901-2023, 2023.

Cloud and precipitation microphysical retrievals from the EarthCARE Cloud Profiling Radar: the C-CLD product

The C-CLD algorithm primarily uses an optimal estimation (OE) except in drizzle free and lightly drizzling warm clouds (use climatological relationships)

Validation should focus in water content and characteristic diameter linked to radar reflectivity and Doppler velocity with the idea to improve the forward model assumptions used in the processor



Cloud and precipitation microphysical retrievals from the EarthCARE Cloud Profiling Radar: the C-CLD product
Mroz K., Puigdomènech Treserras B., Battaglia A., Kollias P., Tatarevic A. and Tridon F.

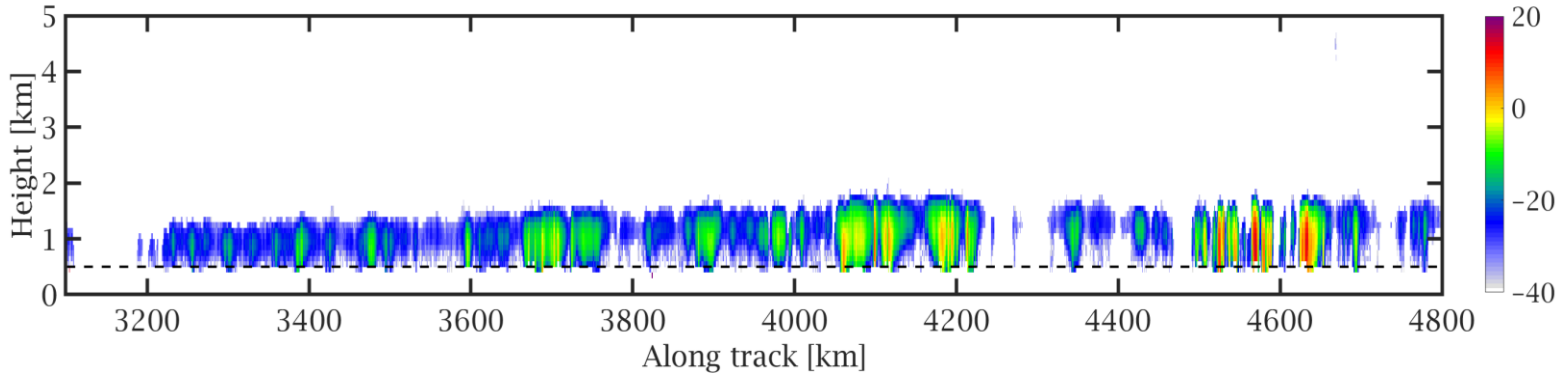
Liquid cloud and light-drizzle retrieval

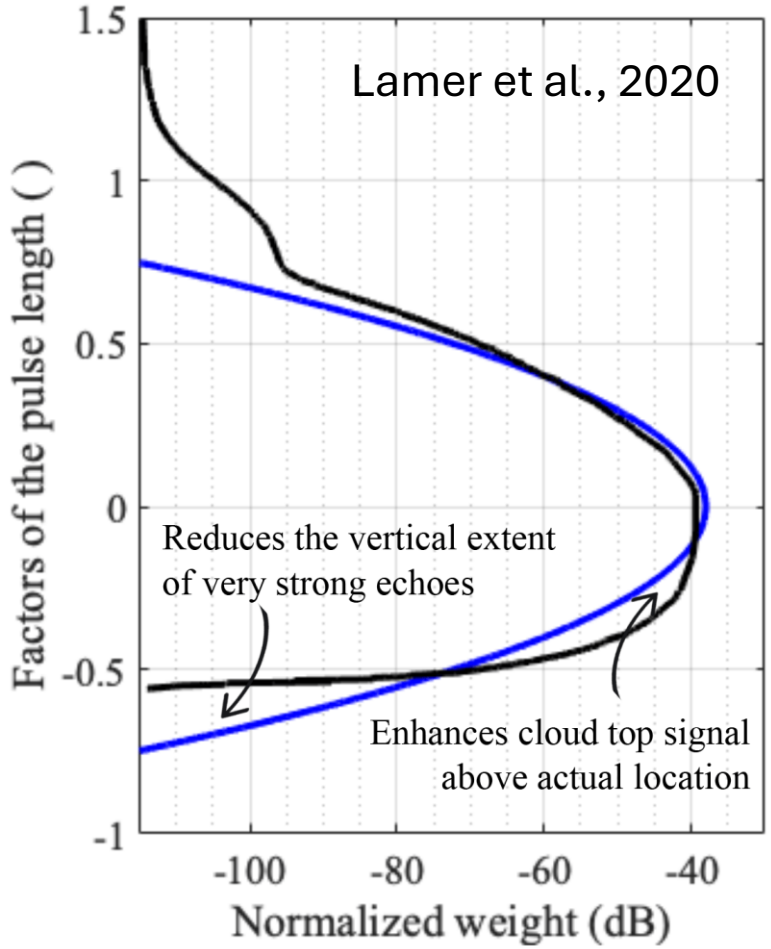
Take advantage of the improved detection of low-level marine clouds to identify the presence of drizzle

Understand the impact of the range weighting function on the reported CPR radar reflectivities

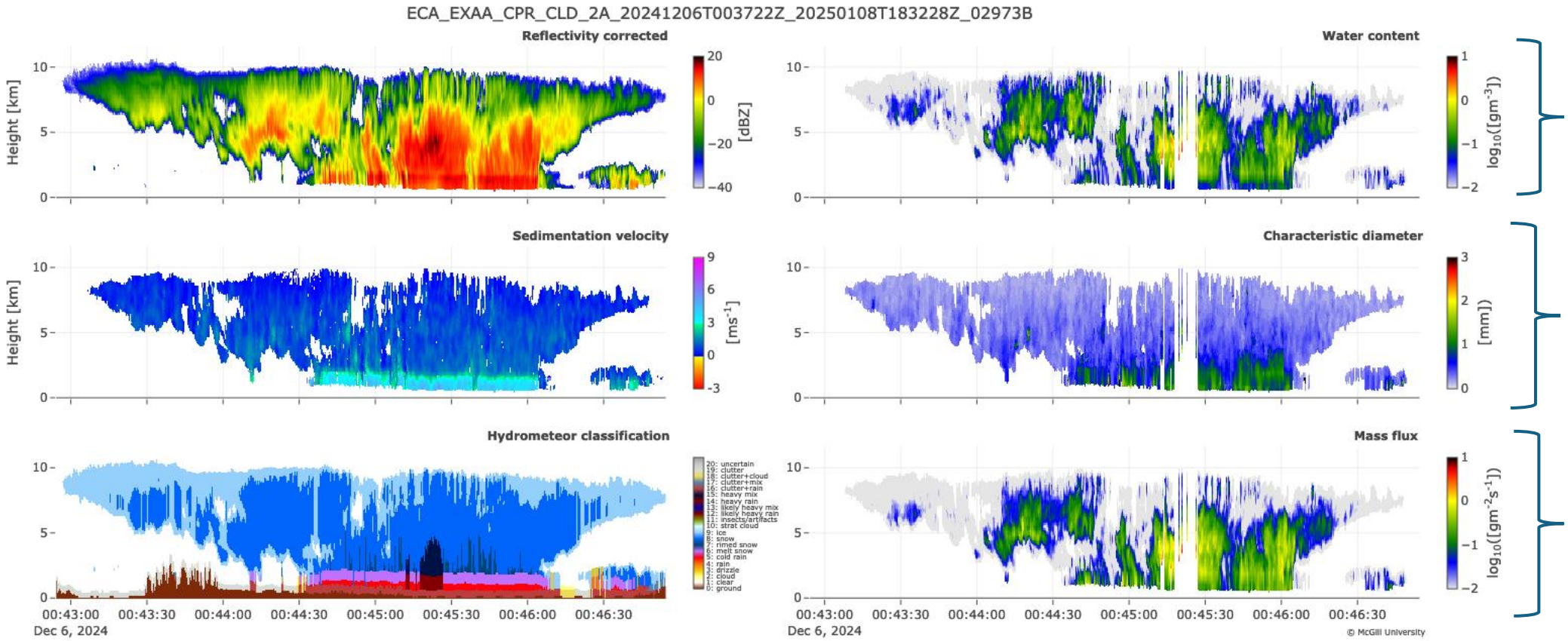
Introduce the Doppler velocity to refine the Z-LWC relationship.

Extensive validation at sites with low-level clouds climatology (BCO and ENA)





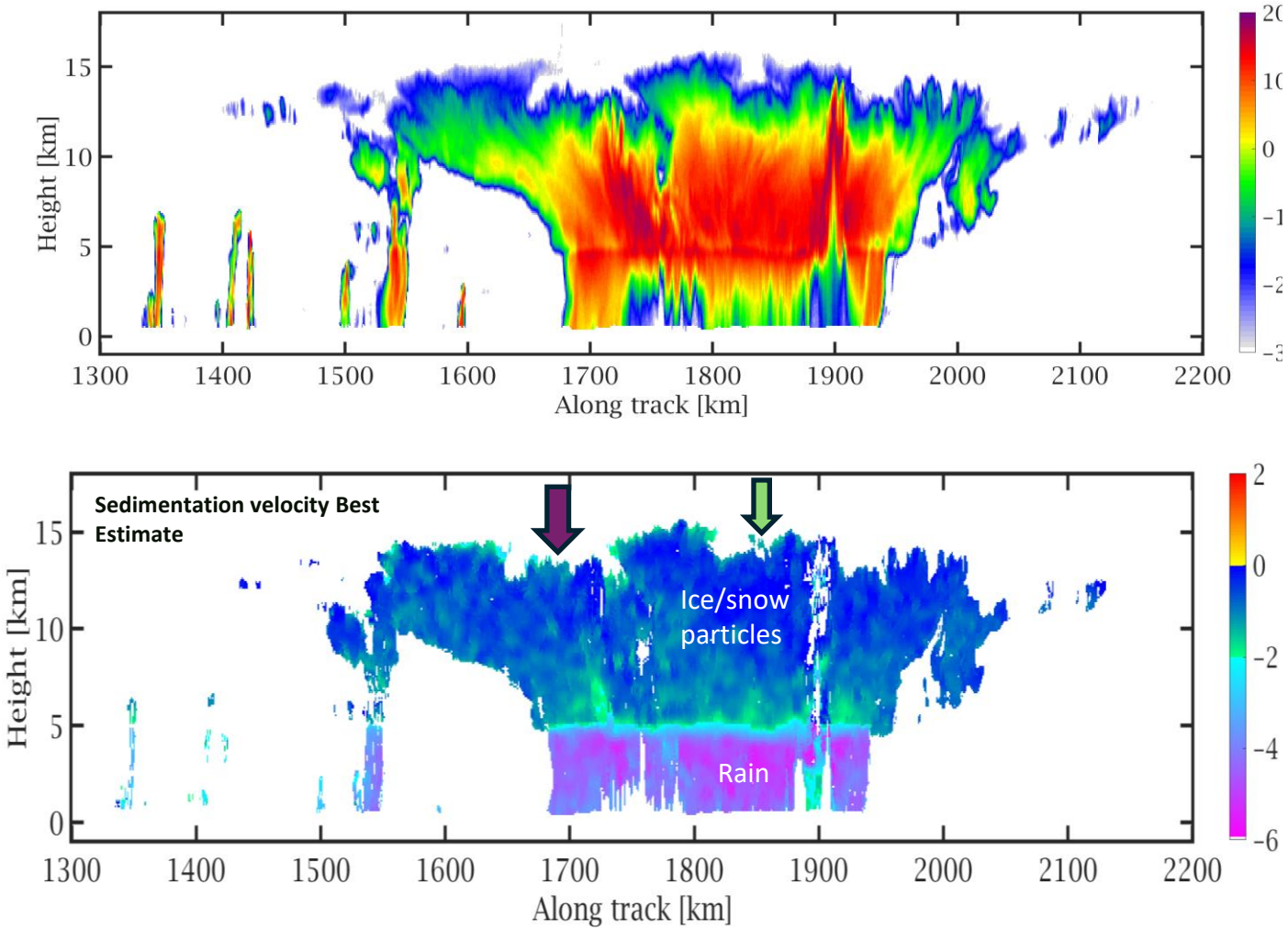
Ice/snow and cold rain

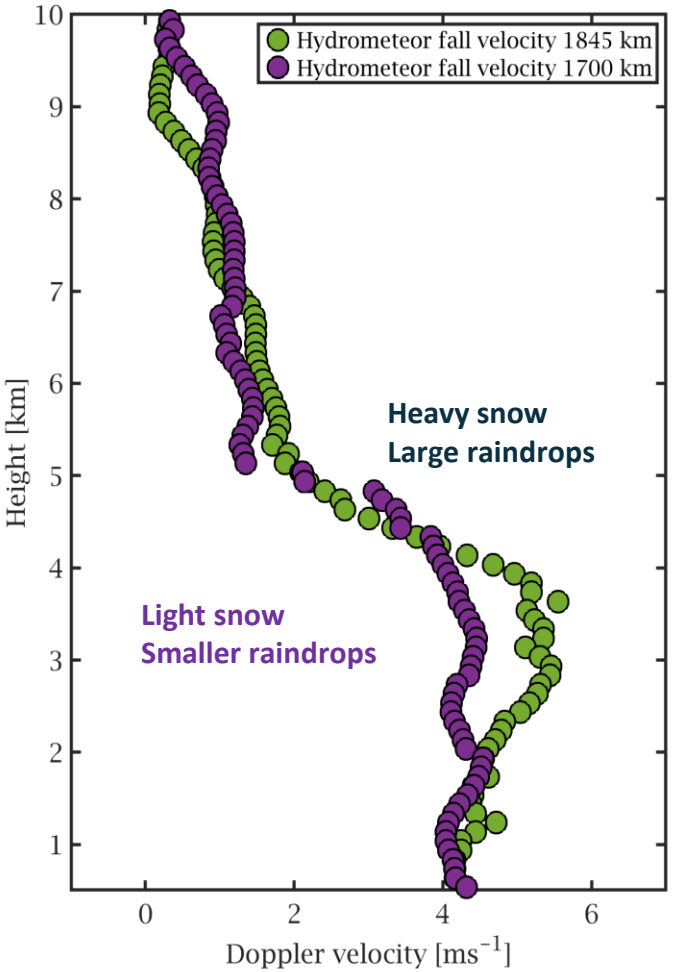


Use PIA and compensate for attenuation to estimate water content

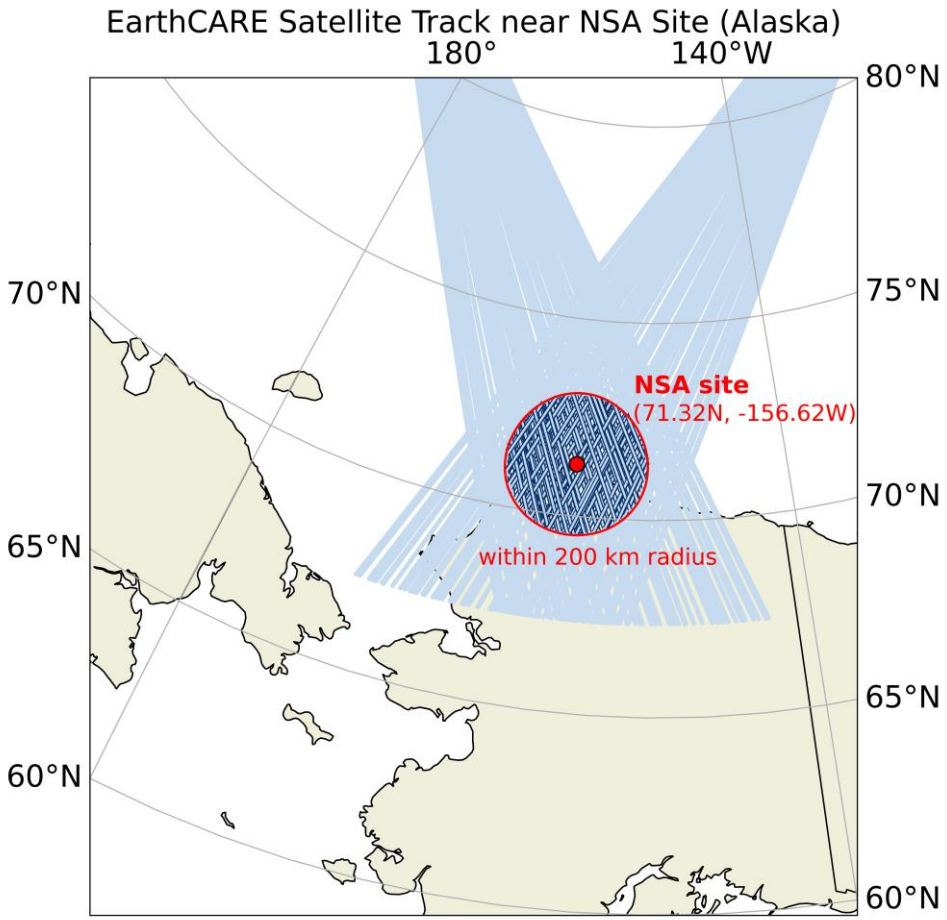
Use sedimentation Doppler velocity for estimating Dm

Mass flux continuity (Mroz et al., 2024)


Height [km]
Along track [km]
Sedimentation velocity Best Estimate
Ice/snow particles
Rain


Hydrometeor fall velocity 1845 km
Hydrometeor fall velocity 1700 km
Heavy snow
Large raindrops
Light snow
Smaller raindrops
Height [km]
Doppler velocity [ms^{-1}]

Mixed-Phased Clouds



NSA ground-based measurements

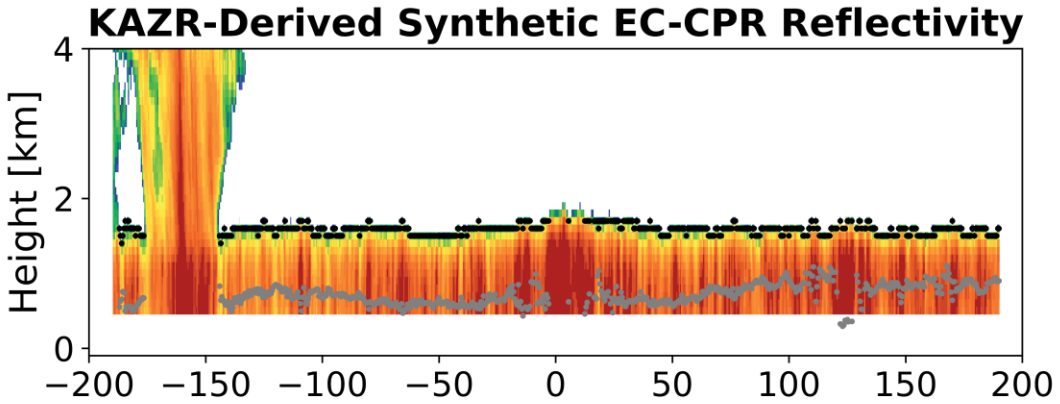
- KAZR: reflectivity & Doppler velocity (adjusted via orbital-radar algorithm to synthetic EC-CPR data)
- MPL: backsatter, LDR, and cloud base height
- Ceilometer: backscatter, cloud base height
- MWR3C: LWP
- Sonde: temperature & RH profiles

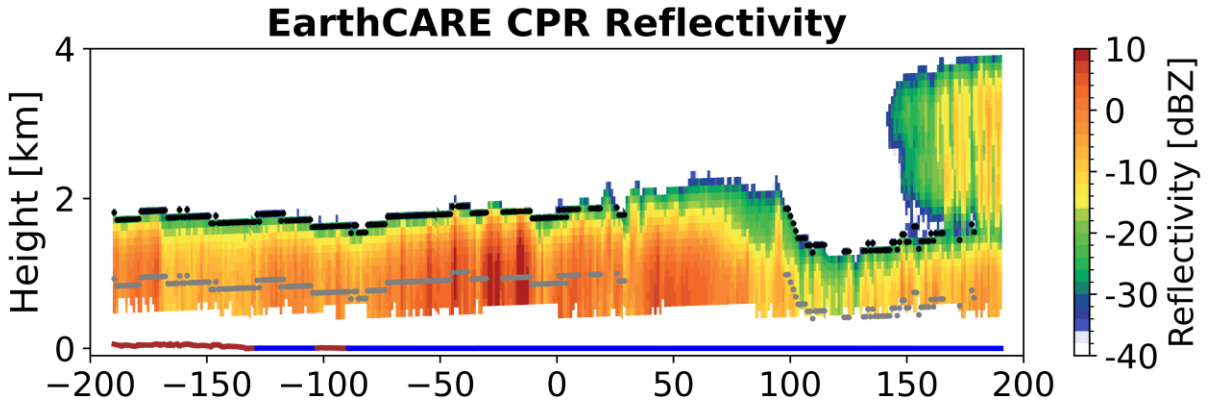
EarthCARE CPR measurements

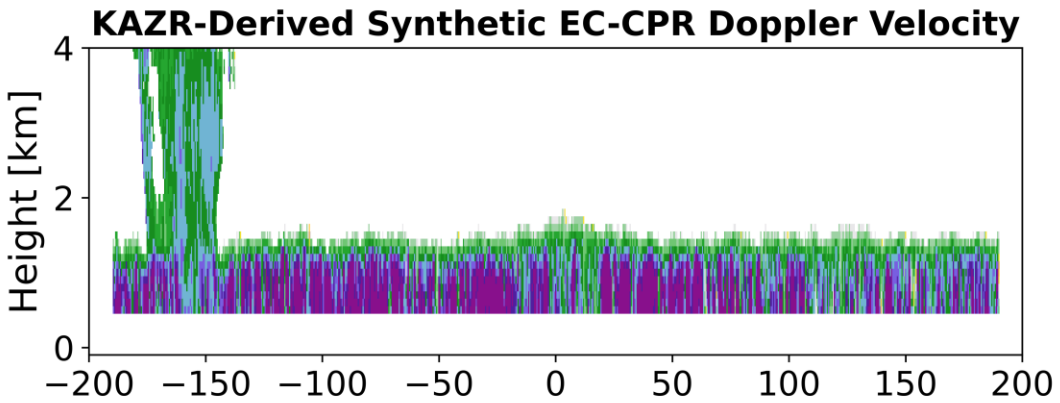
- Reflectivity corrected
- Doppler velocity (Z > -35 dBZ)
- SVBE (Z > -35 dBZ)
- Brightness temperature

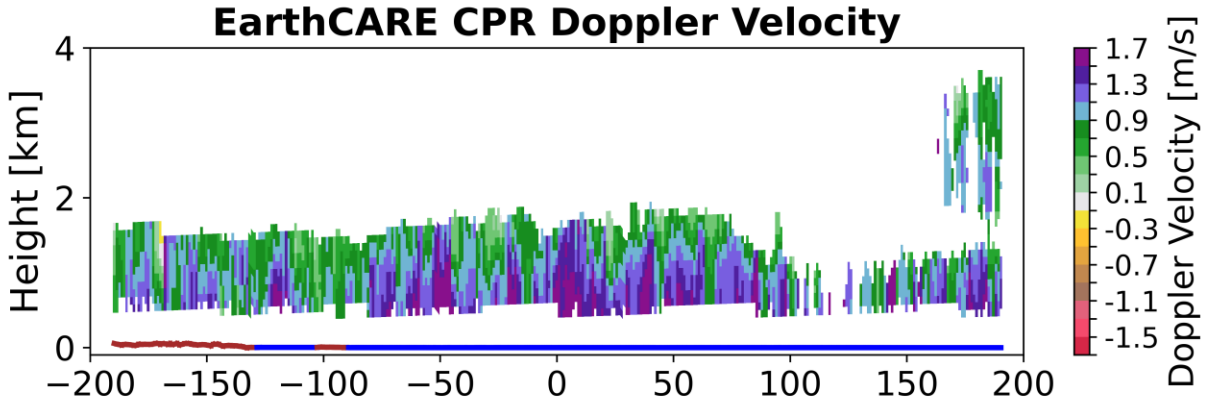
Slides provided by Jiseob Kim (McGill)

Evaluating the performance of the CPR Doppler velocity in shallow arctic mixed-phase clouds









C-CLD Cloud and Precipitation Microphysical retrievals CAL/VAL efforts

Interested in statistics over many overpasses:

Marine clouds: ENA, BCO,..
Mixed-phase clouds: NSA, Ny-Alesund
Cirrus clouds: ACTRIS/ARM sites
Warm and Cold rain: airborne field campaigns

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