

Validating EarthCARE cloud profiling target categorisation

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FMI



*and the ACTRIS & Cloudnet
profiling community*

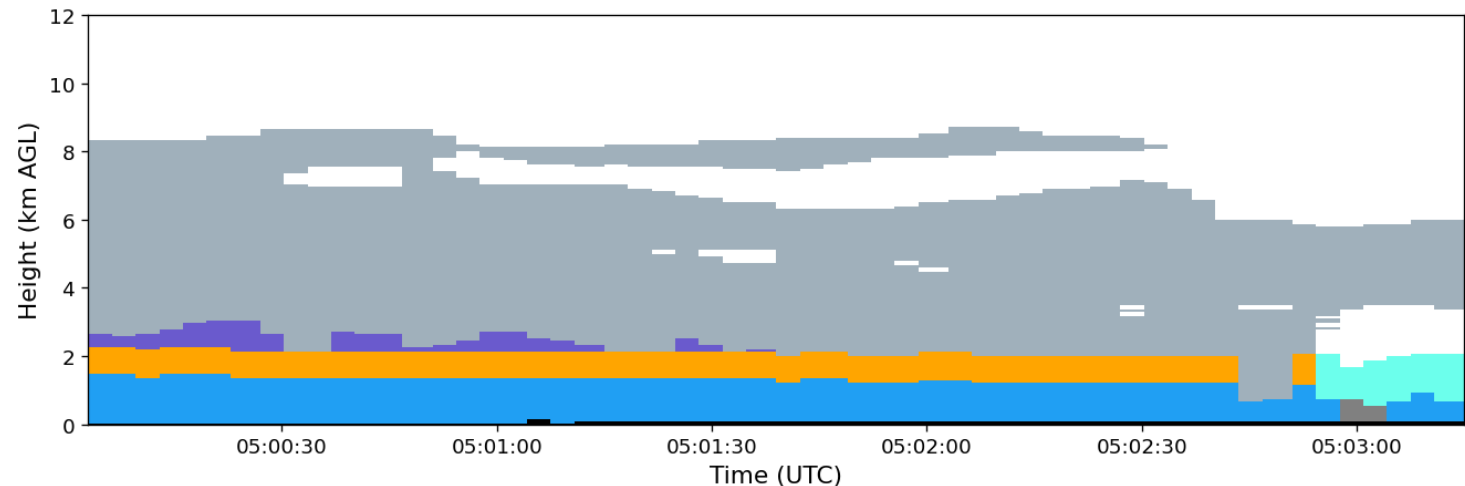
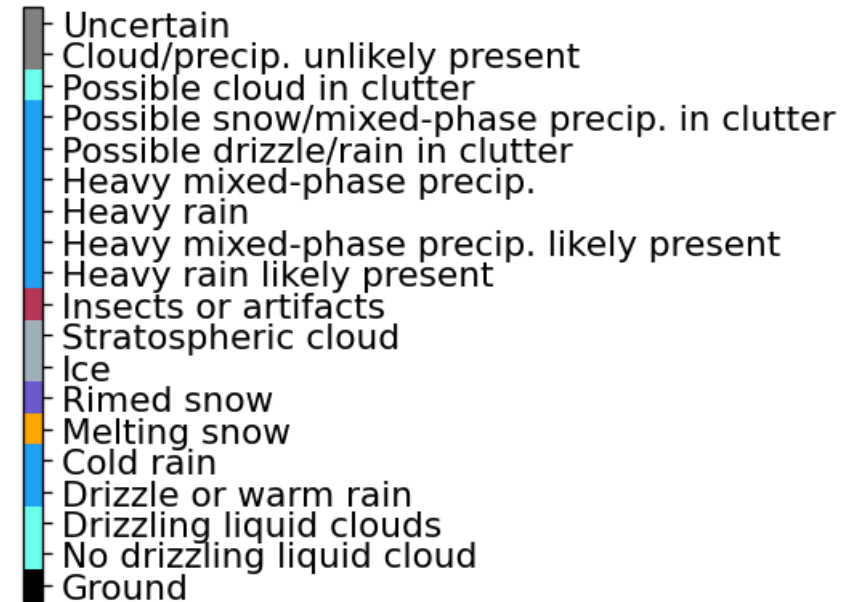
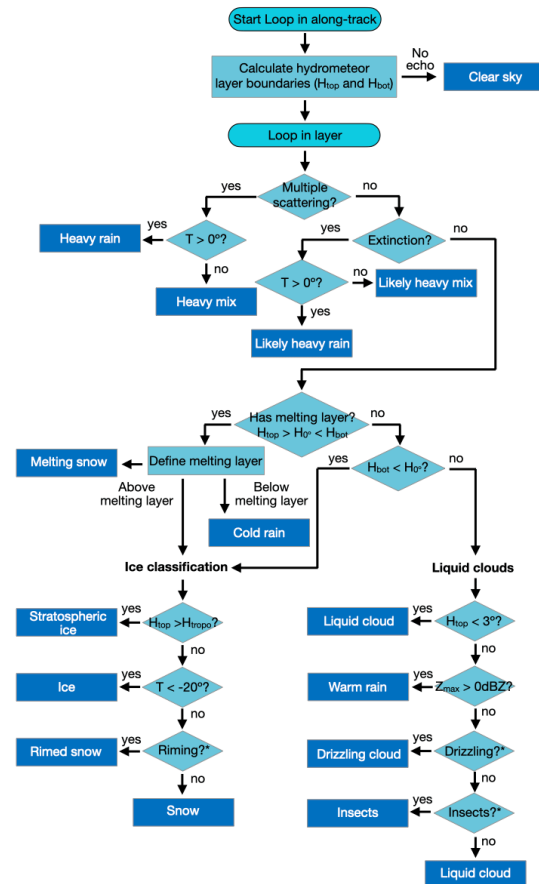


EarthCARE Science and Validation Workshop 2025

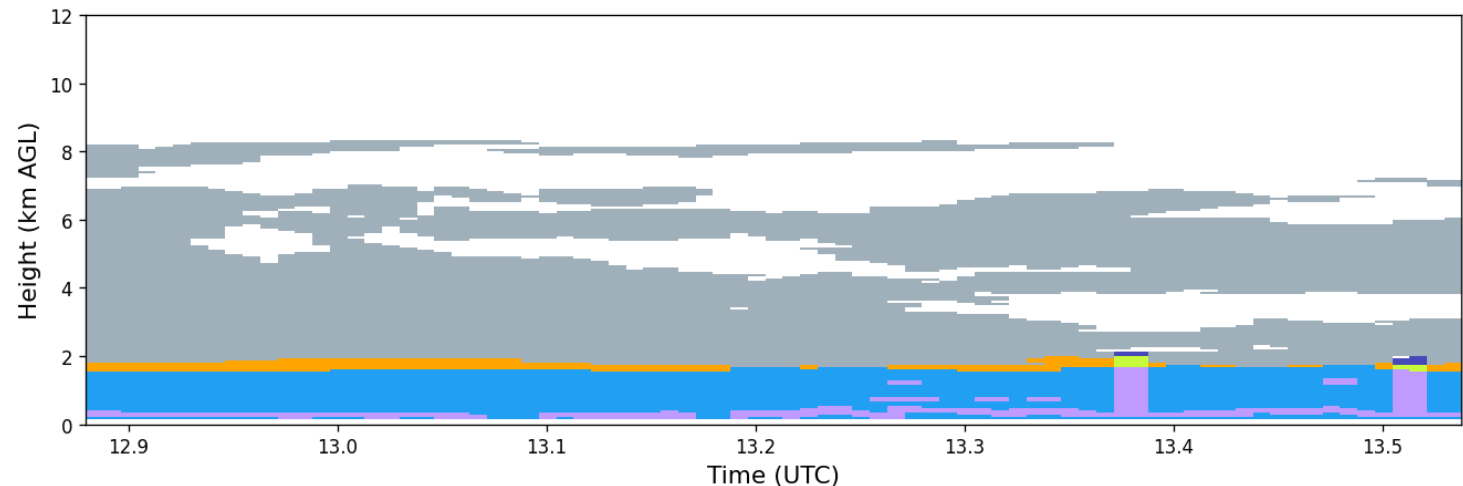
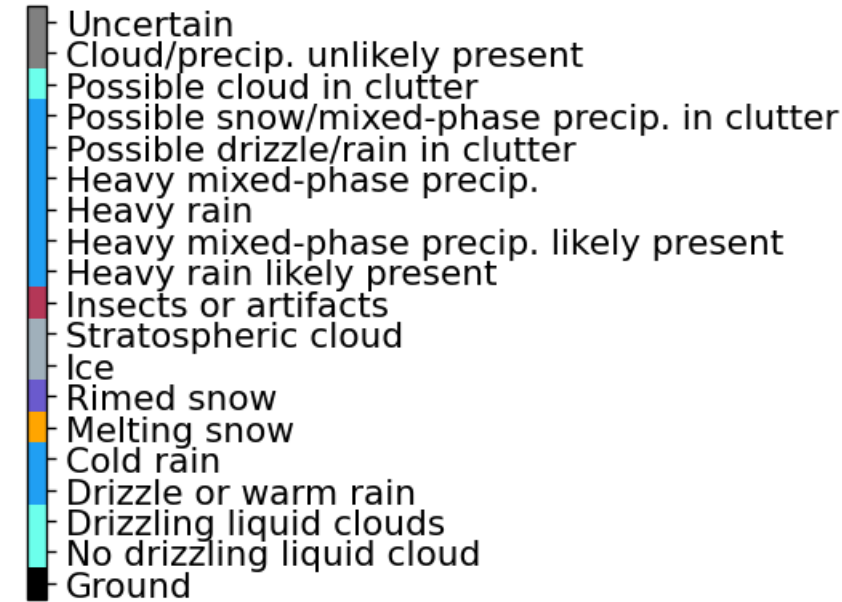
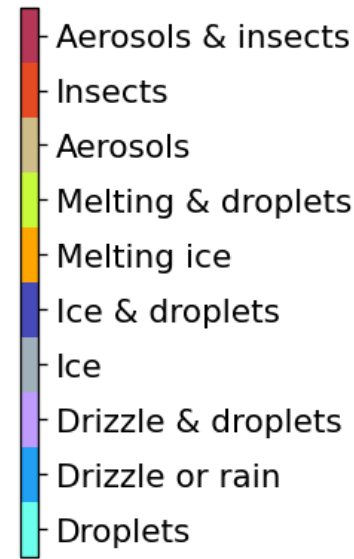
1-5 December 2025 | The University of Tokyo | Tokyo, Japan



- Decision-tree based classification (Irbah et al., 2023)



- Decision-tree based classification (Tukiainen et al., 2020)
 - Multi-instrument
 - Multiple classes permitted
- Fewer classes



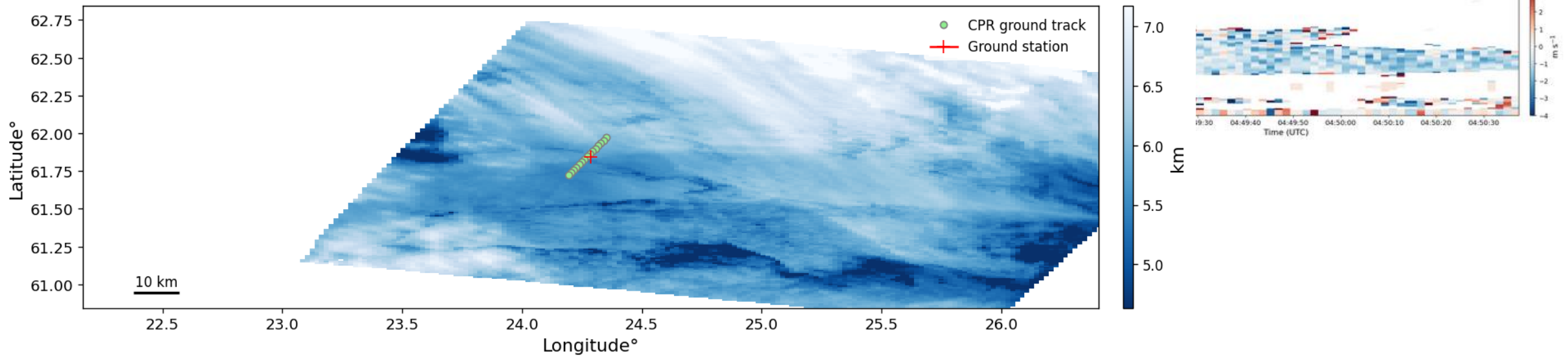
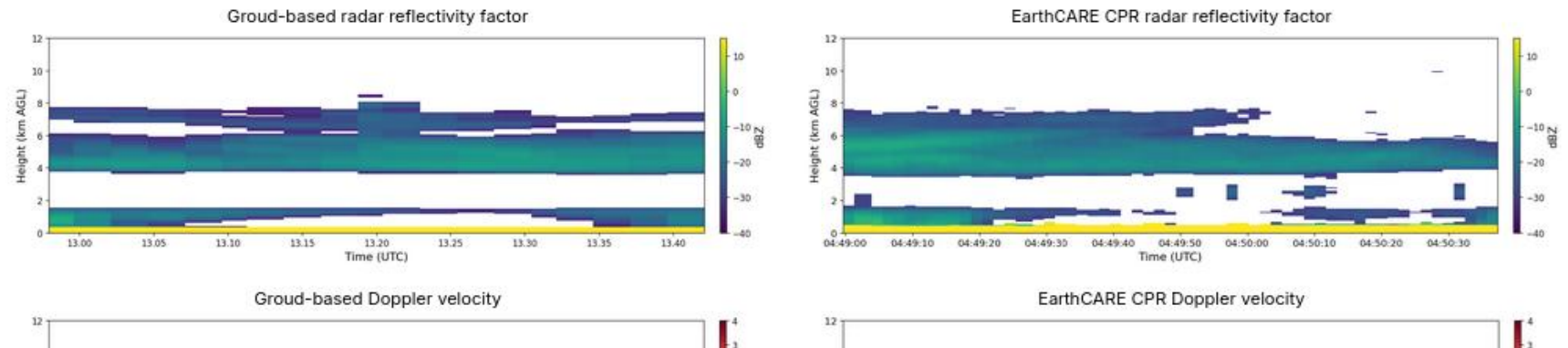
Overpasses

- Overpass selection
 - Station – 40 min
 - CPR – 30 km radius



EarthCARE CPR Level 1 data from Hyytiälä ACTRIS Volatile Experimental Delete

[Summary](#) [Visualisations](#) [Quality report](#)



Overpasses



- Overpass selection
 - Station – 40 min
 - CPR – 30 km radius

Visualisations for 23 May 2025

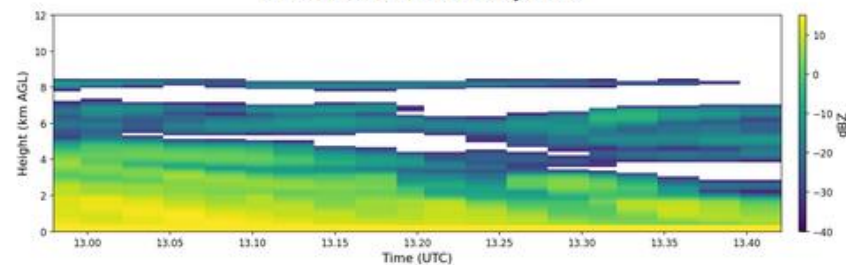
comparison view ☒

EarthCARE CPR Level 1, Hyytiälä

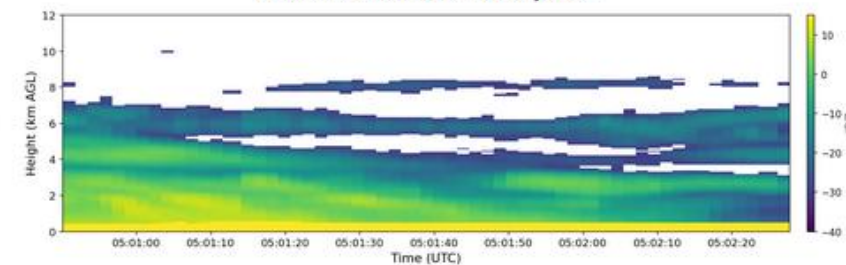
☑ Volatile

Experimental

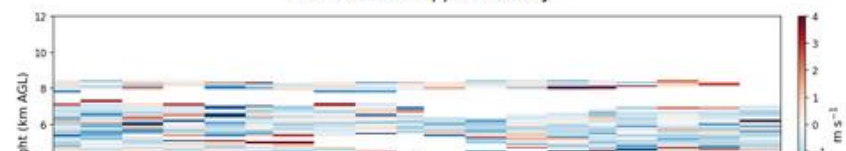
Ground-based radar reflectivity factor



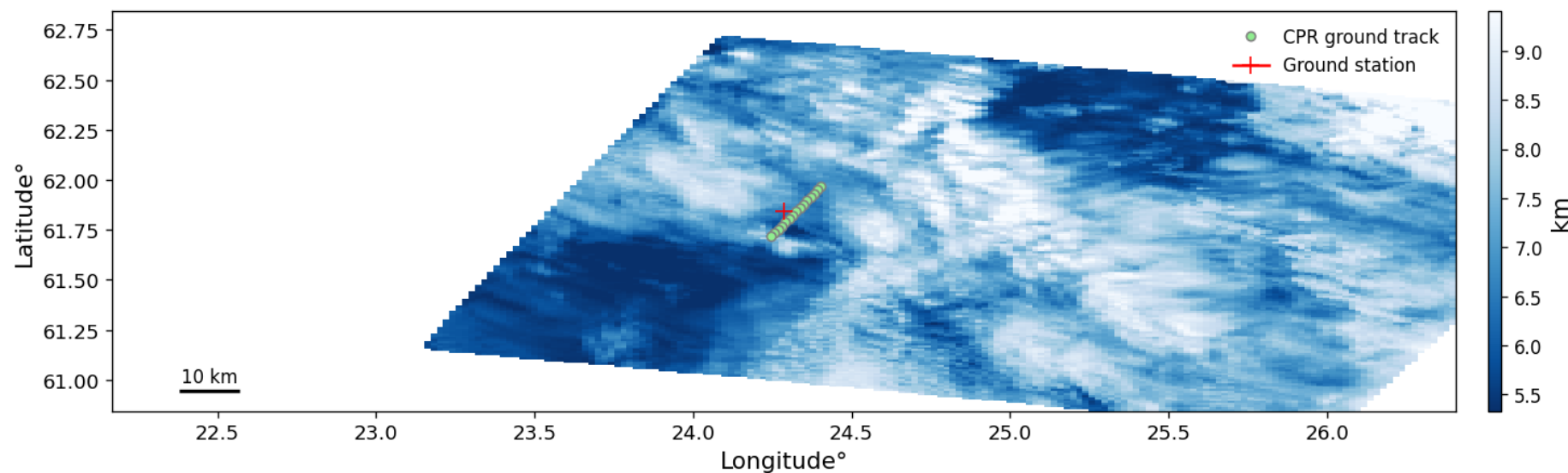
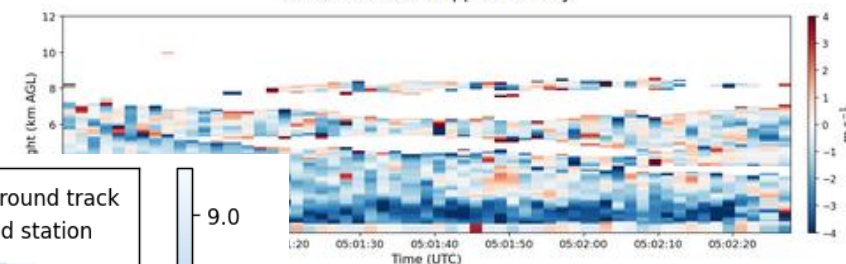
EarthCARE CPR radar reflectivity factor



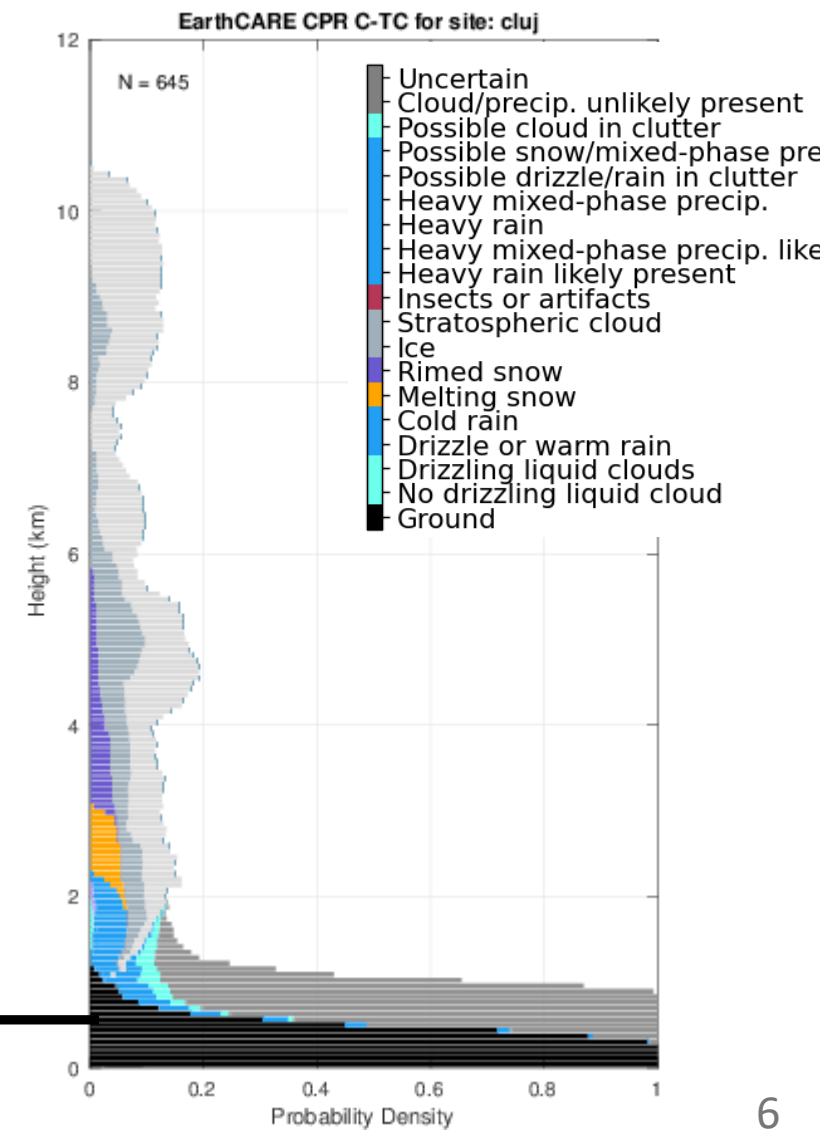
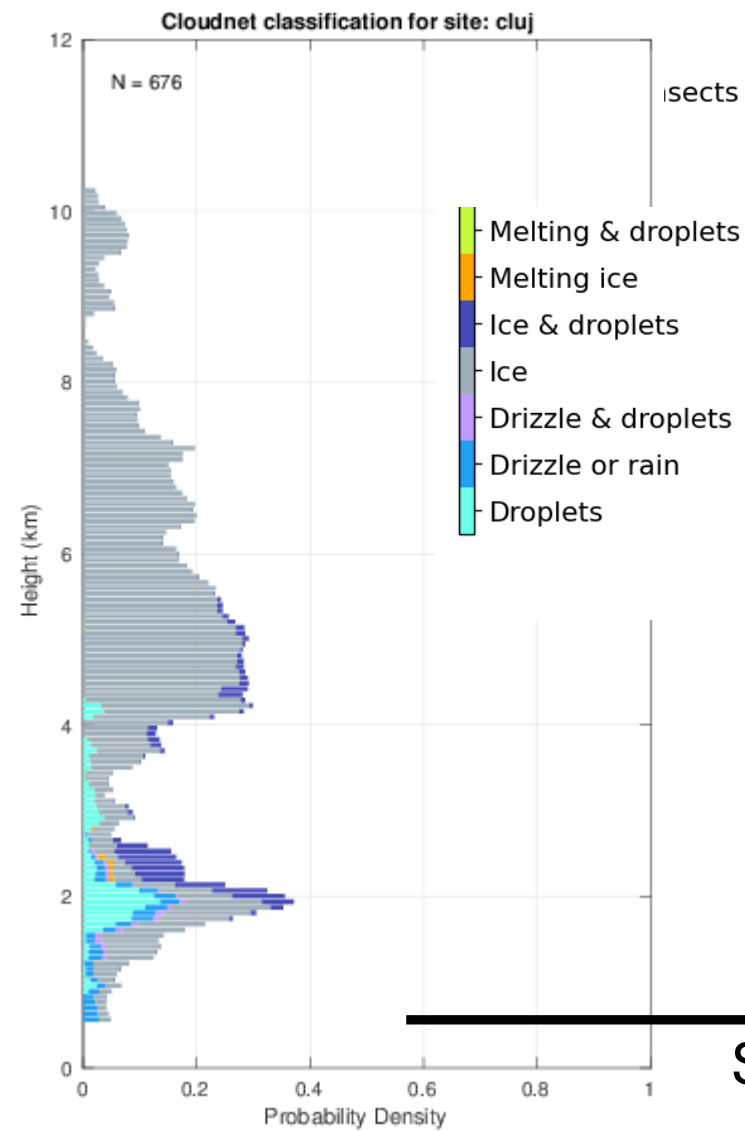
Ground-based Doppler velocity



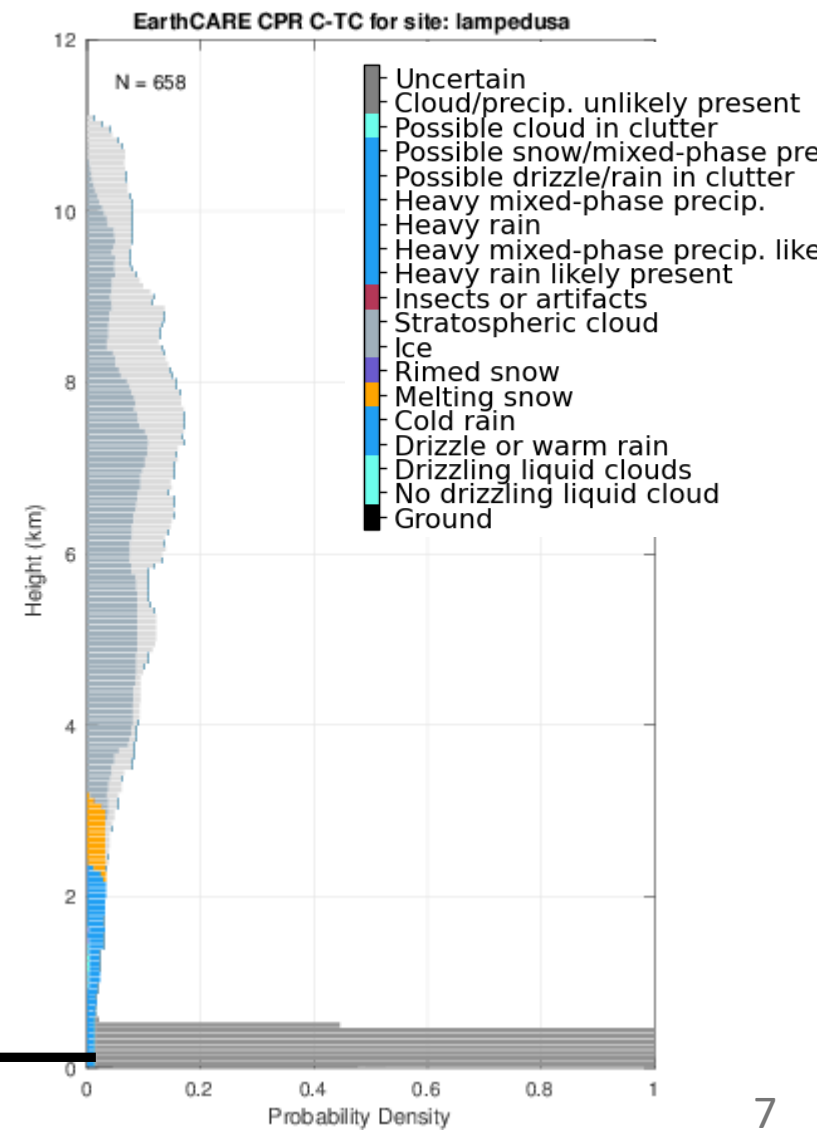
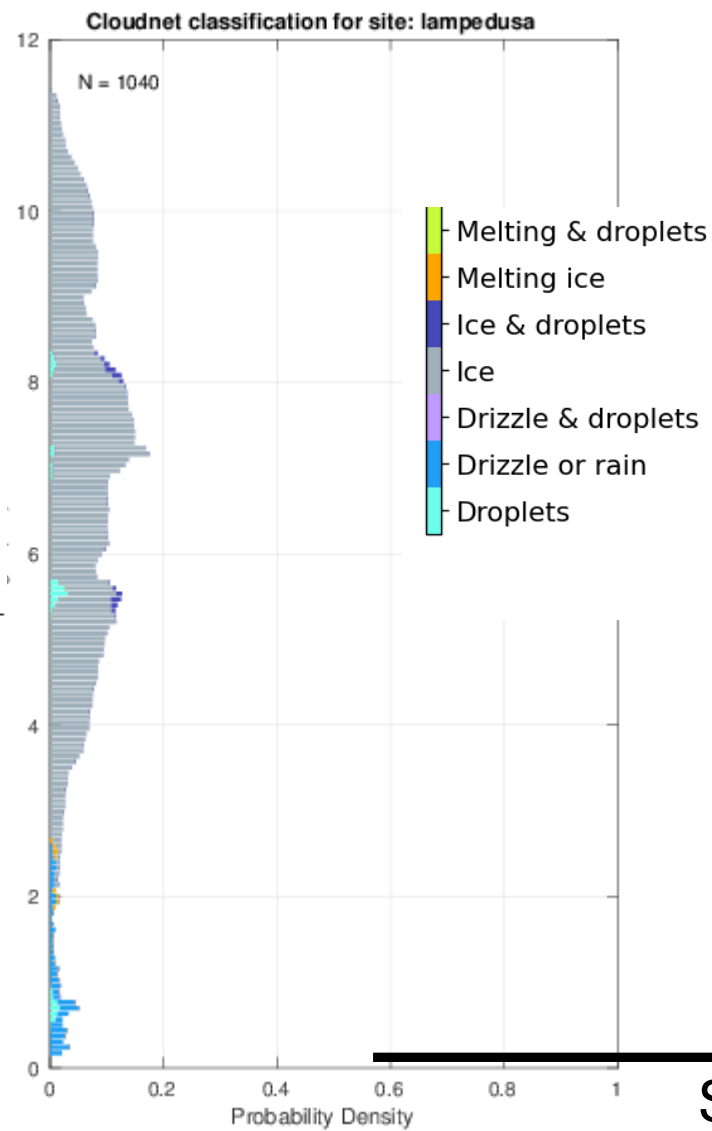
EarthCARE CPR Doppler velocity



Station network

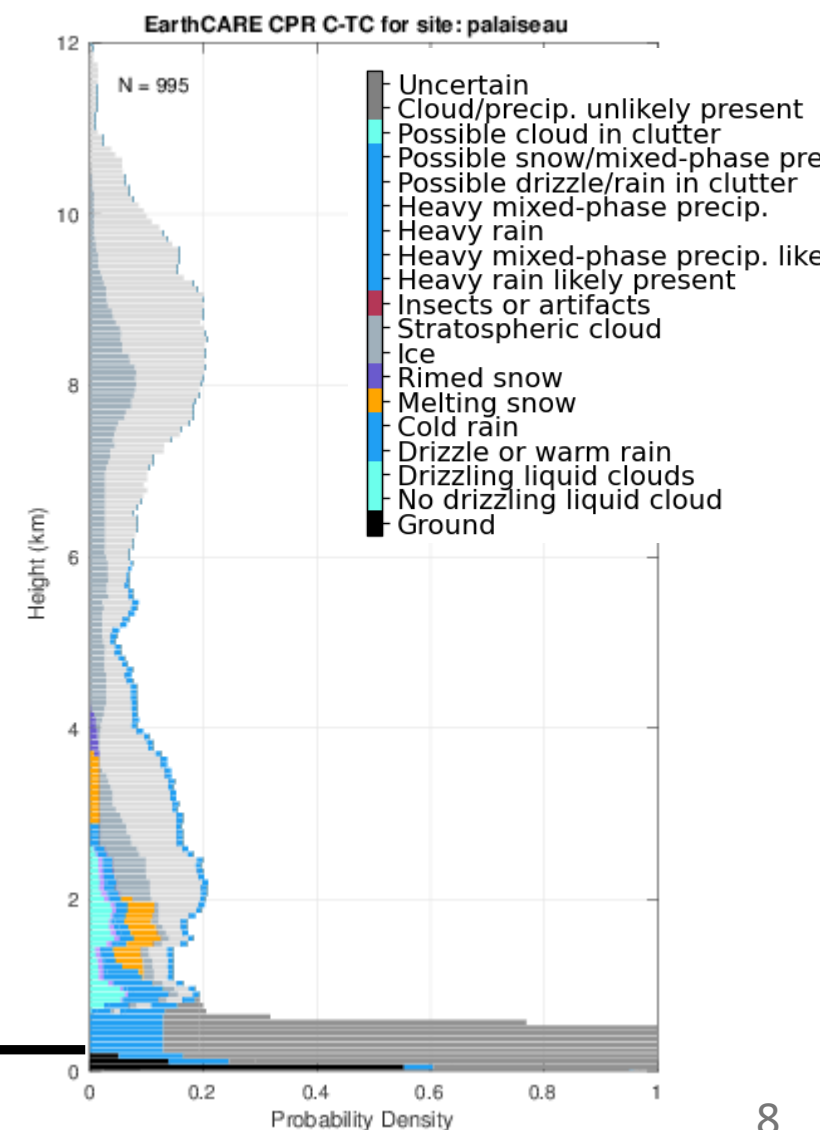
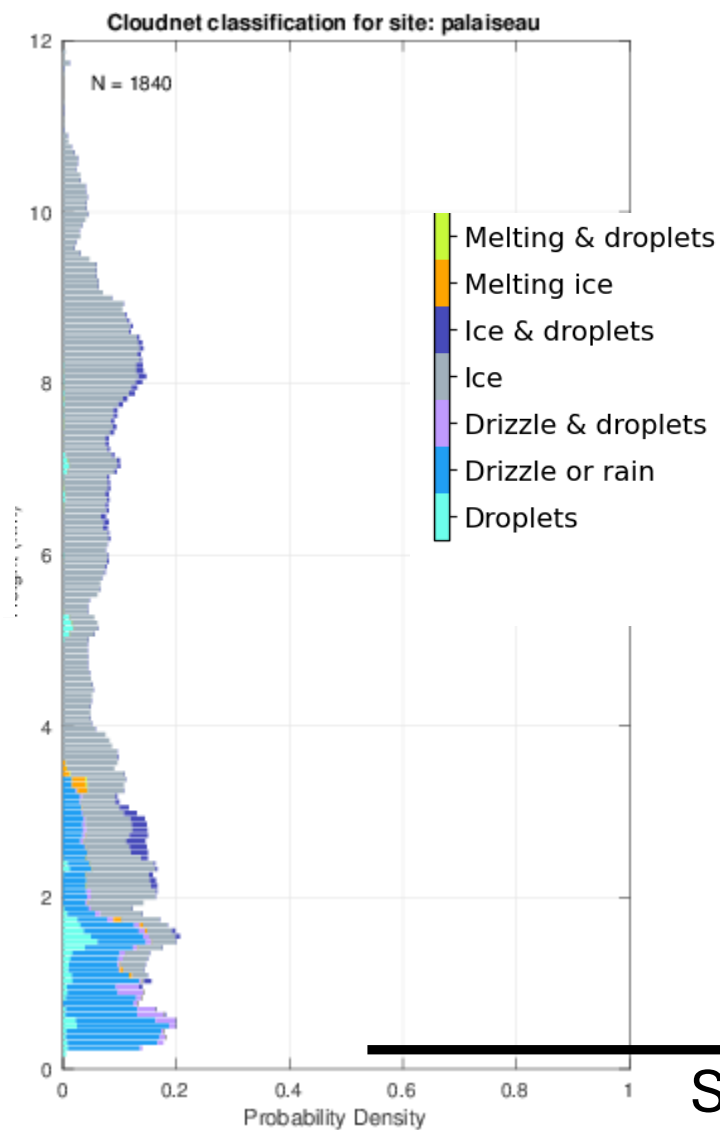


Station network

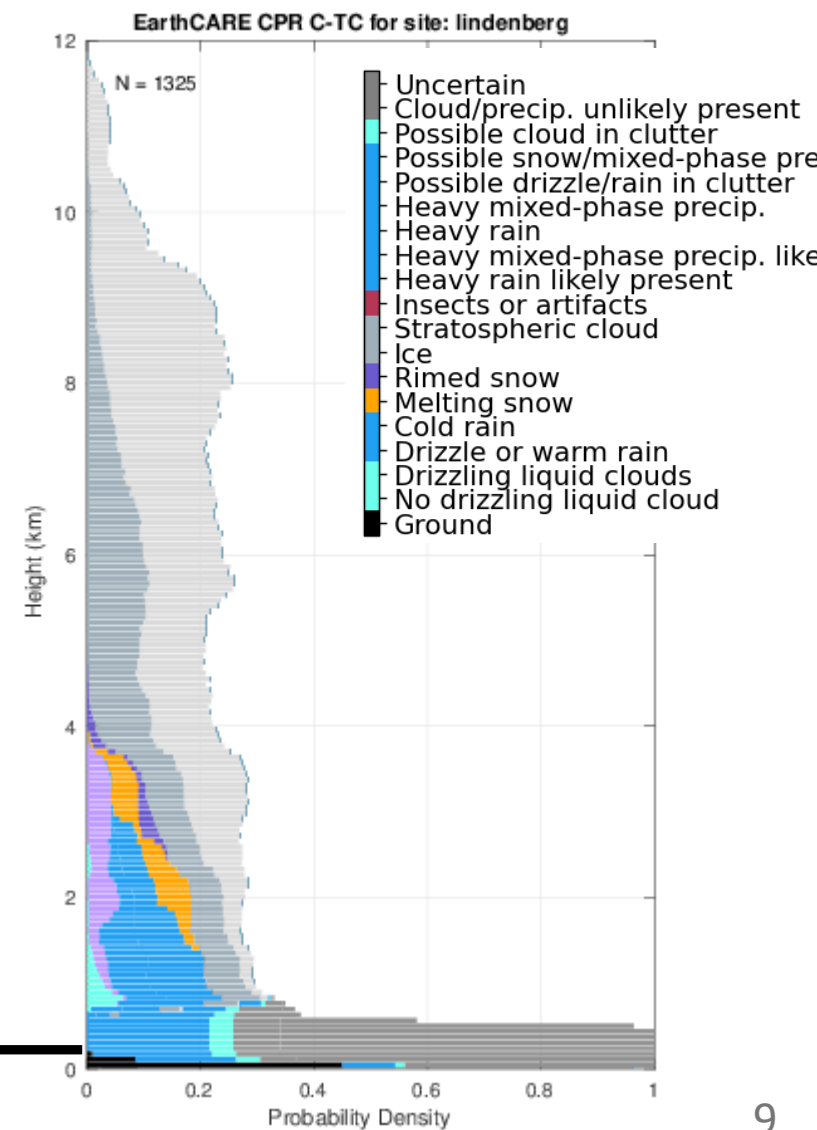
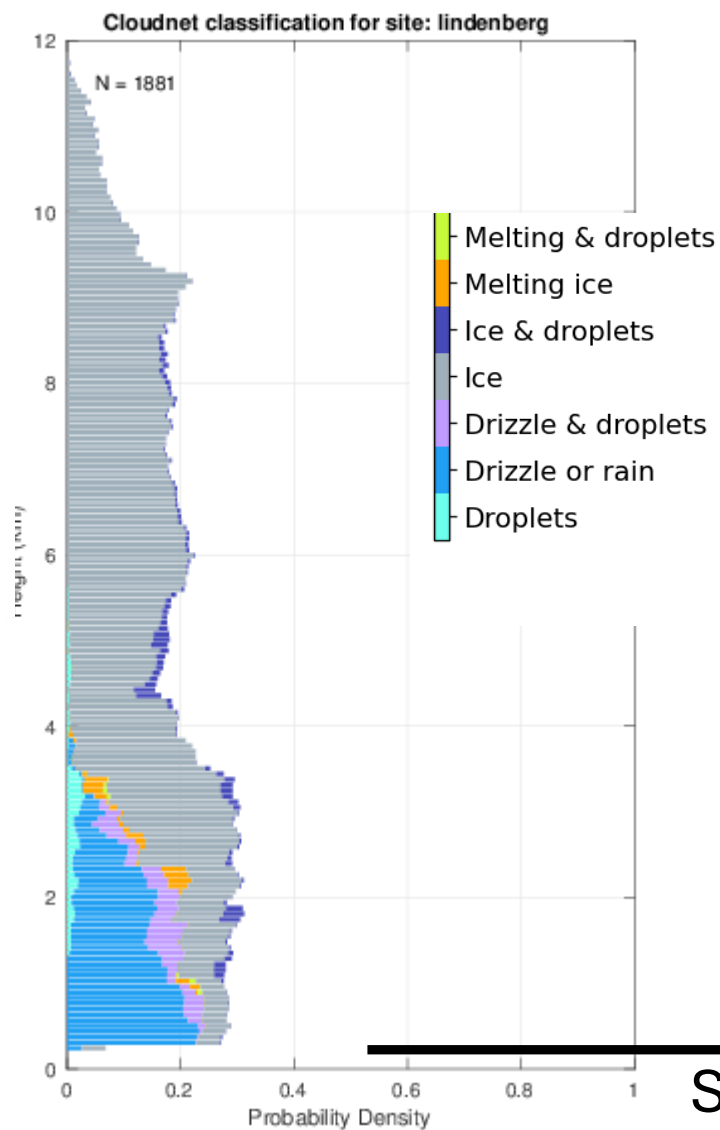


Surface

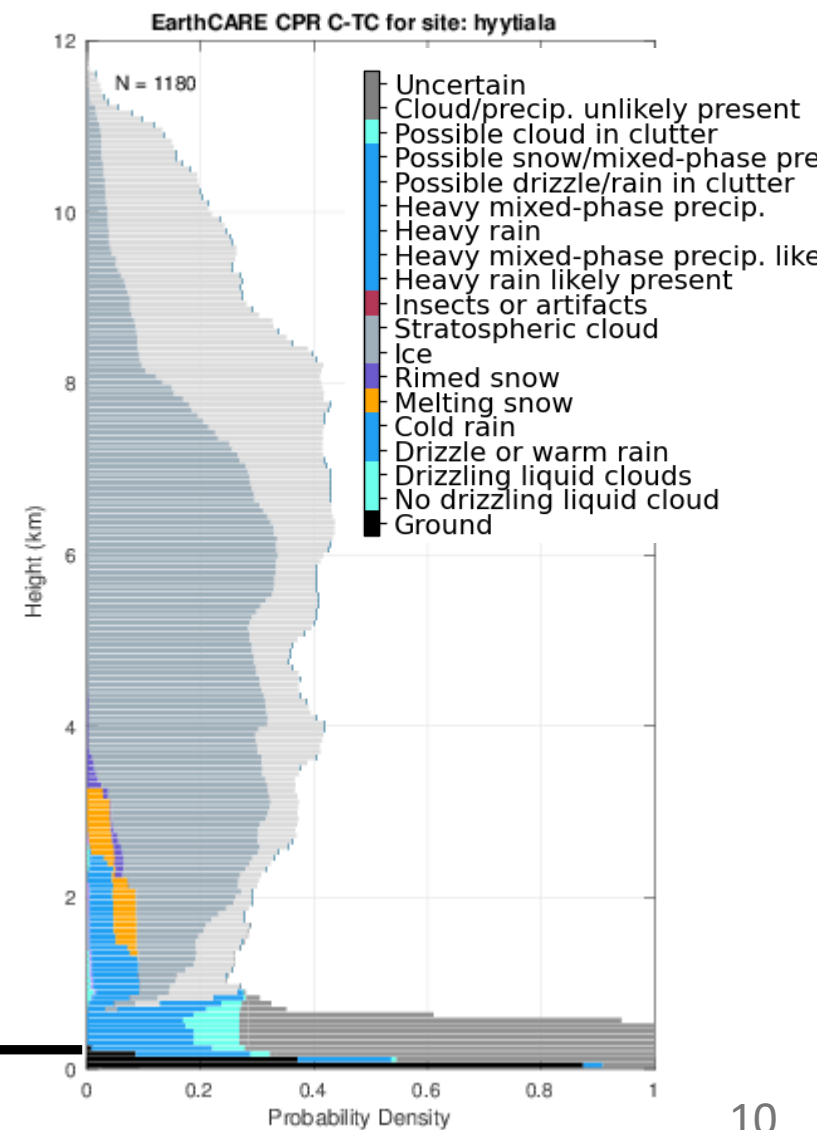
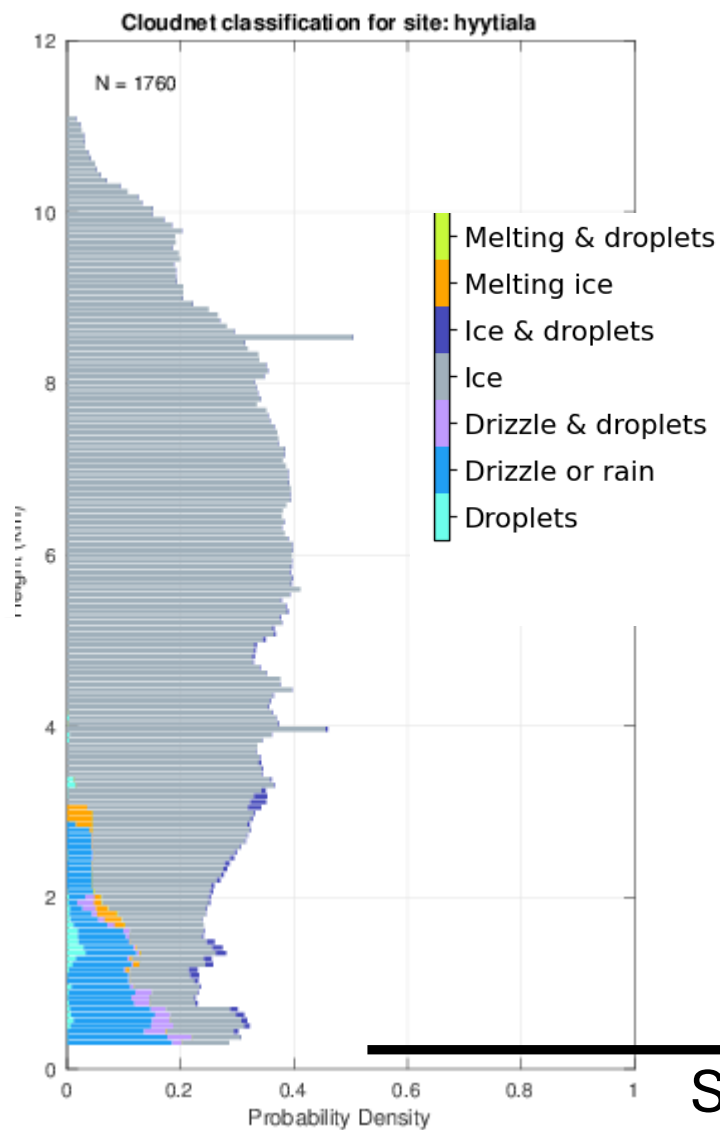
Station network



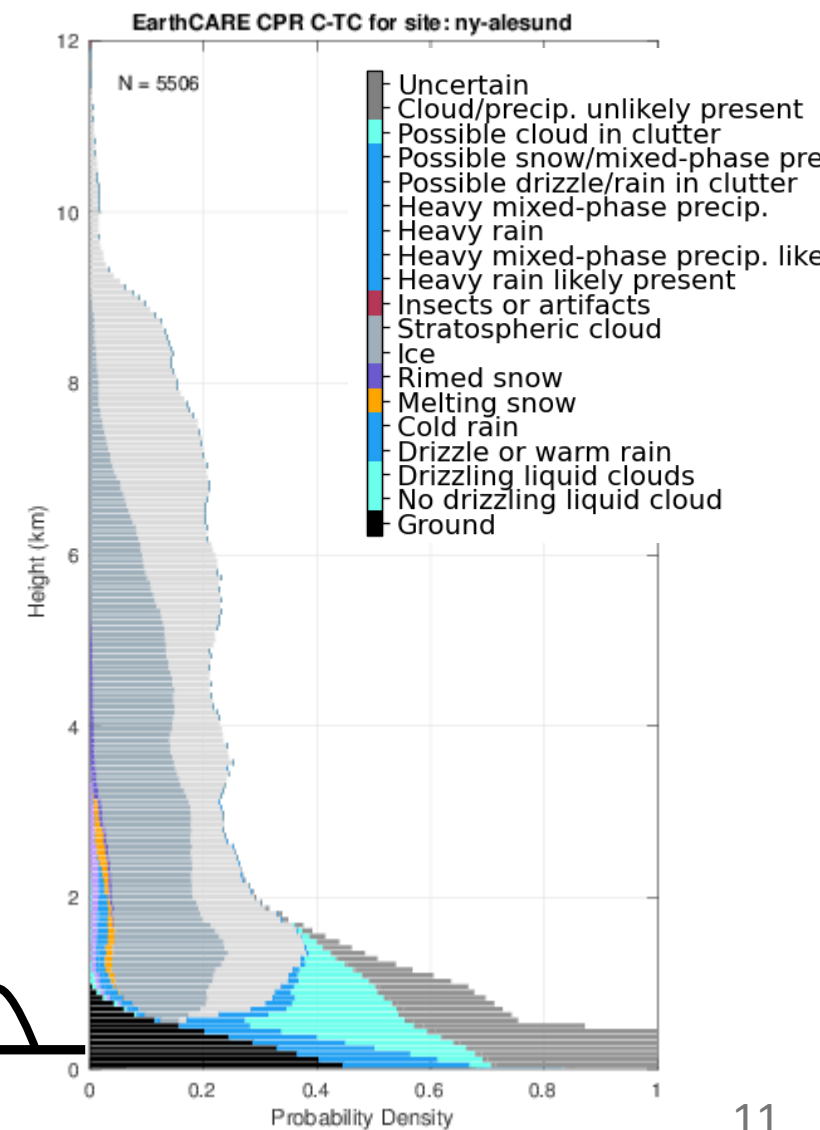
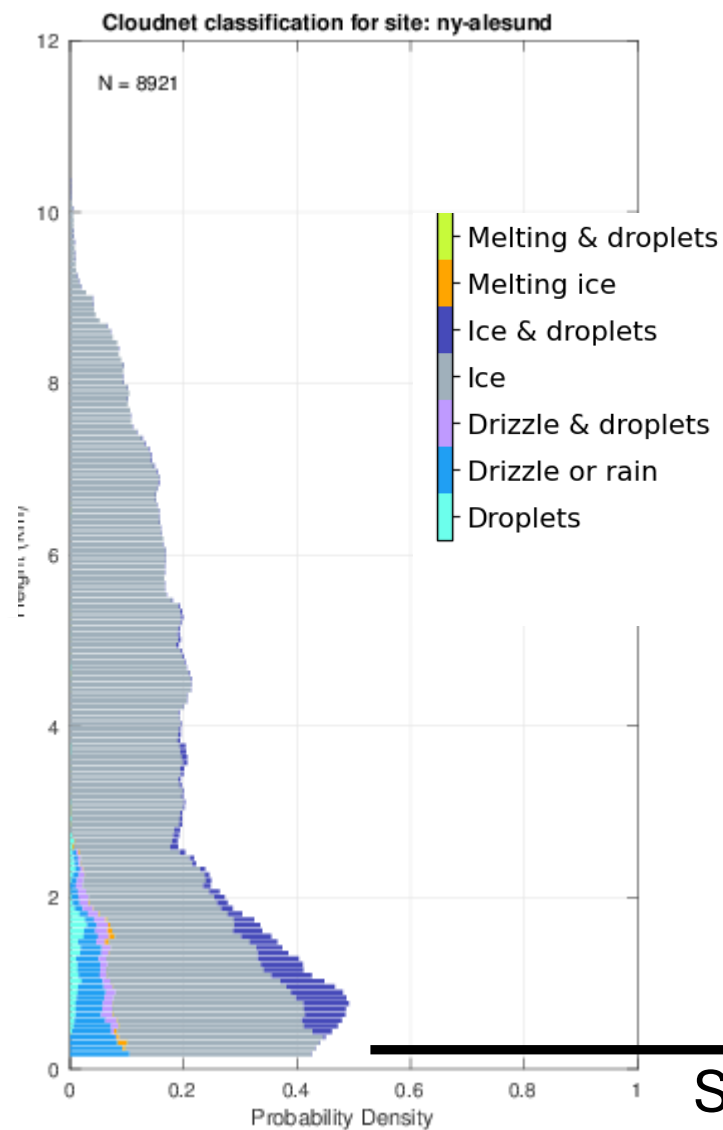
Station network



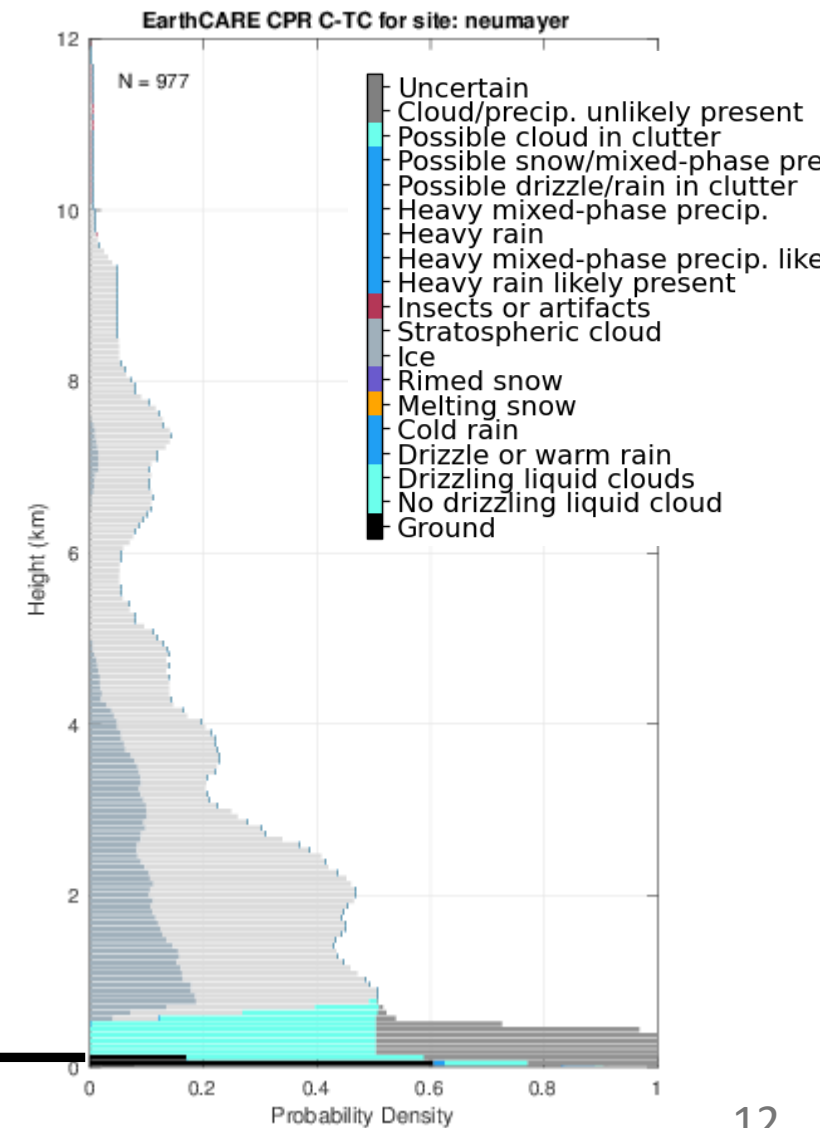
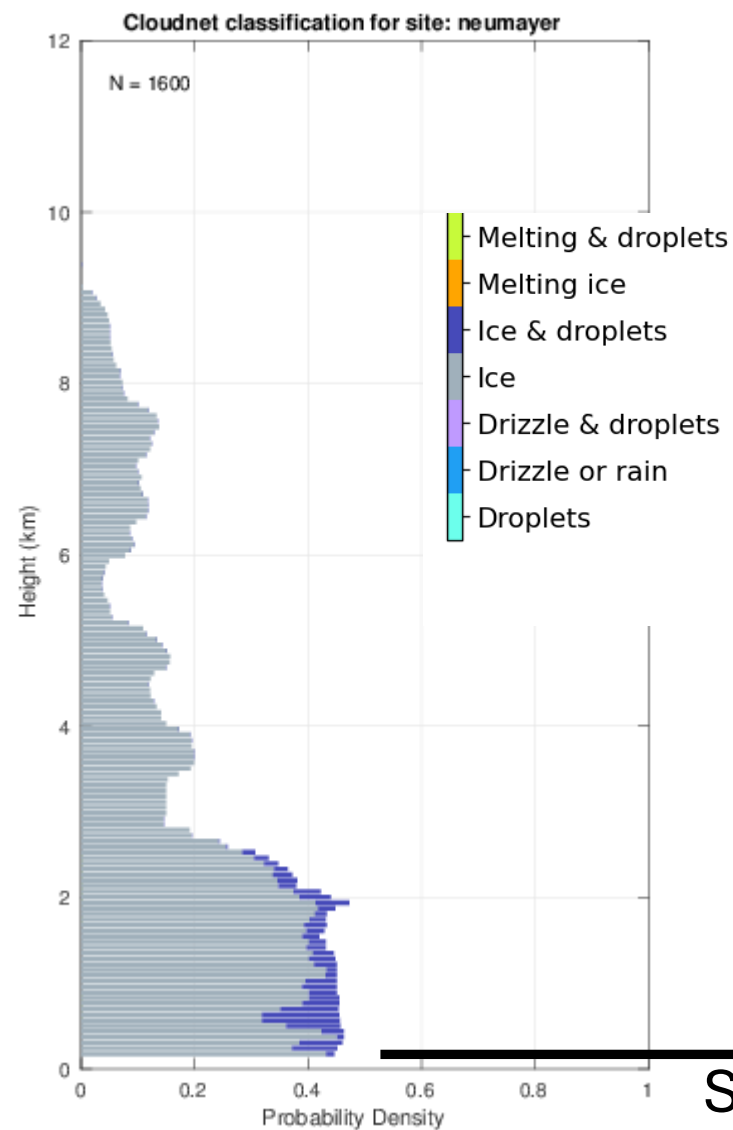
Station network



Station network

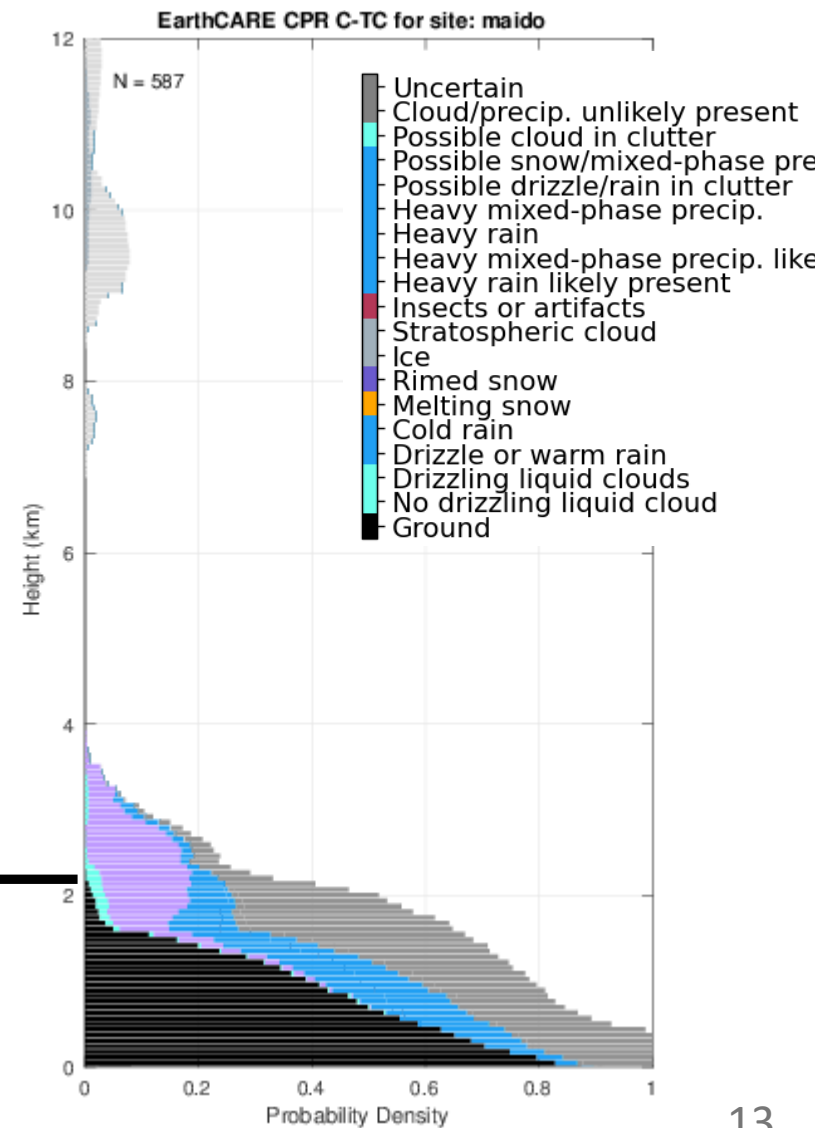
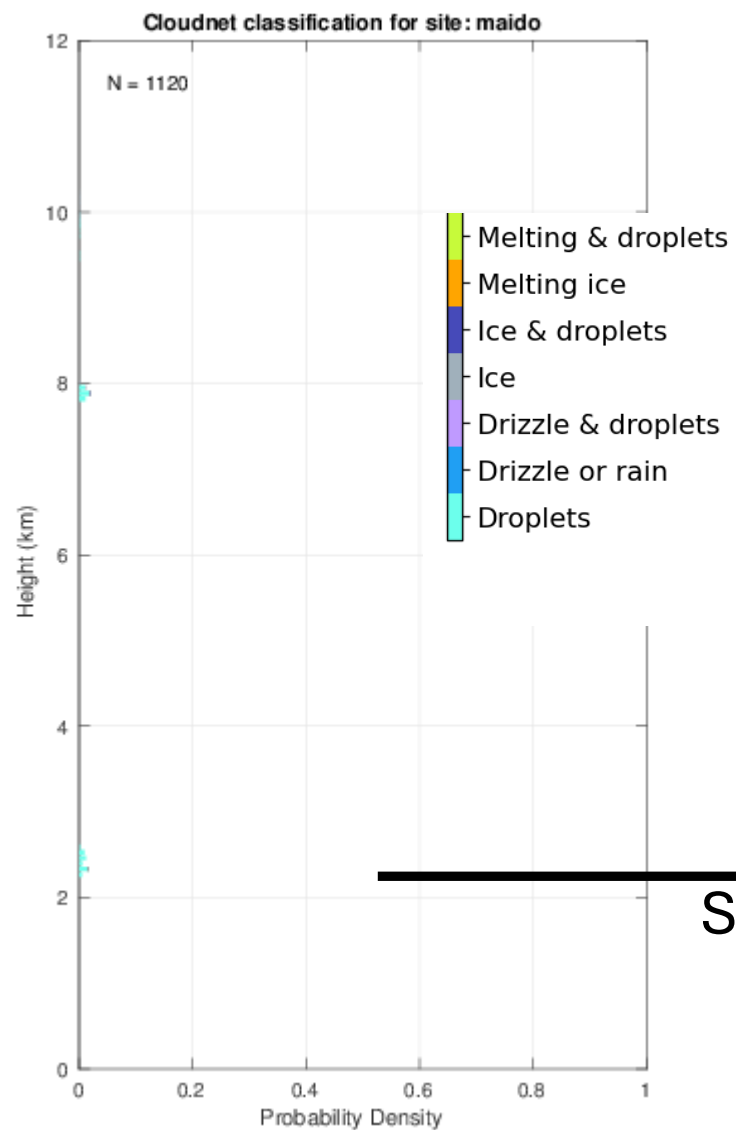


Station network

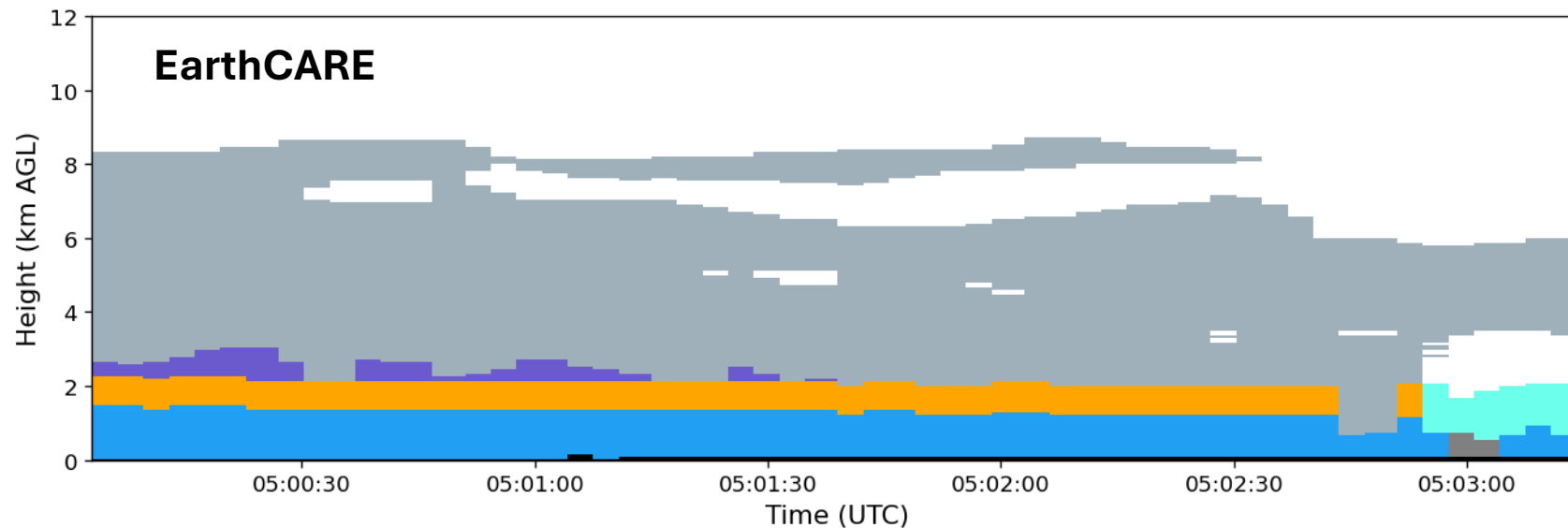
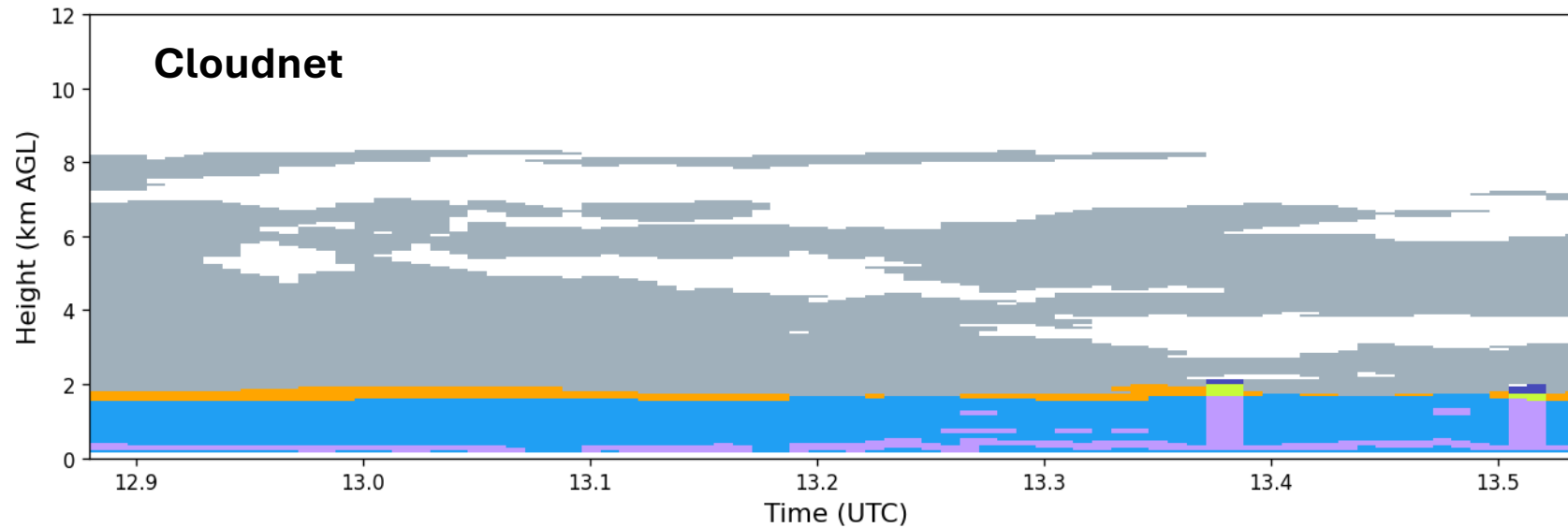
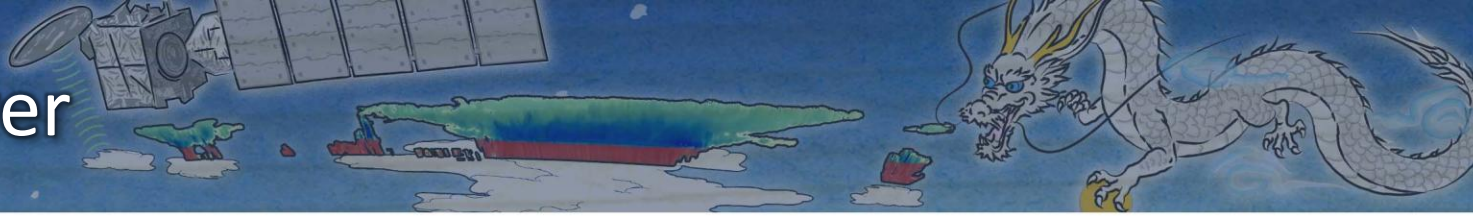


Surface

Station network

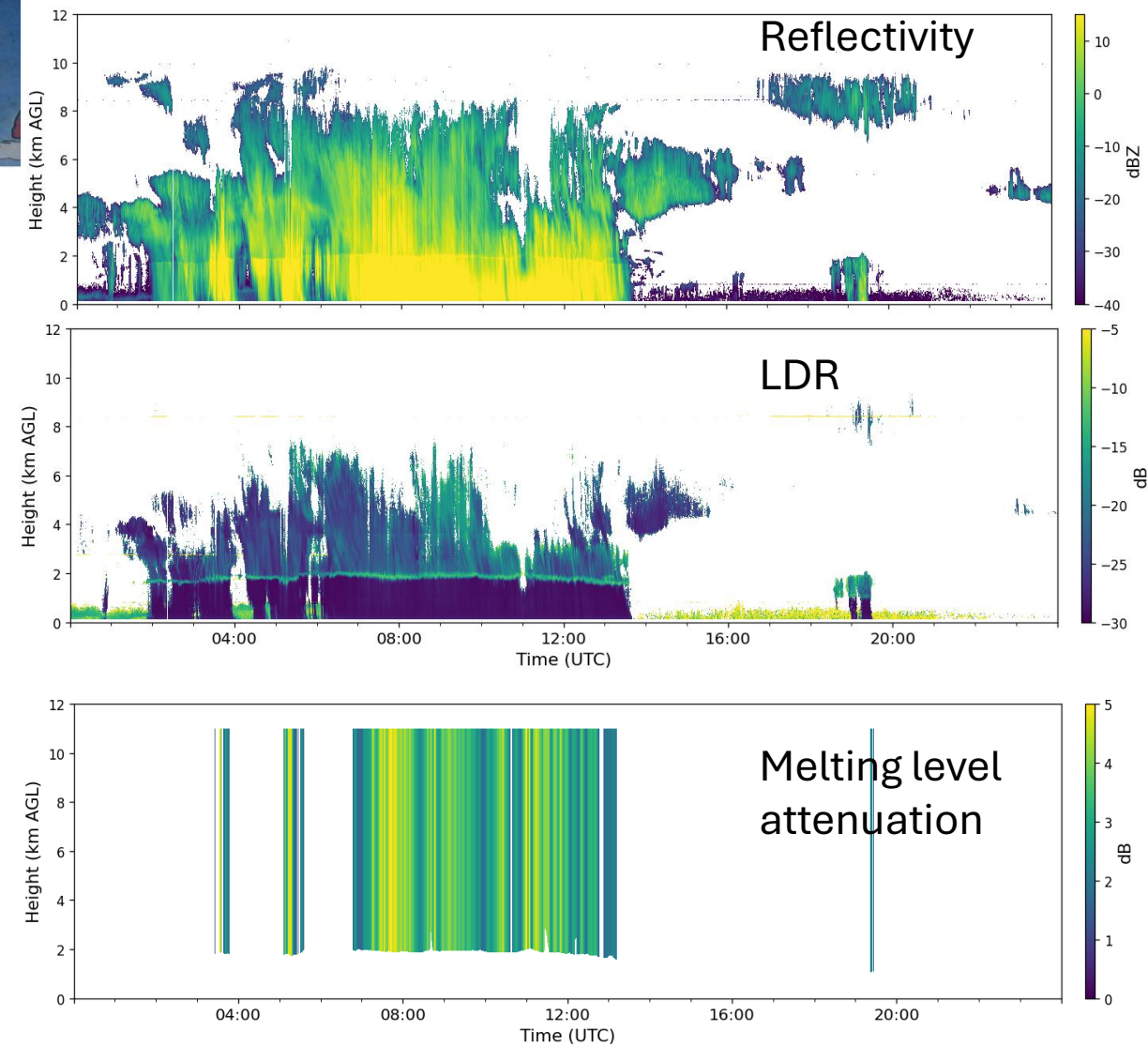


Melting layer

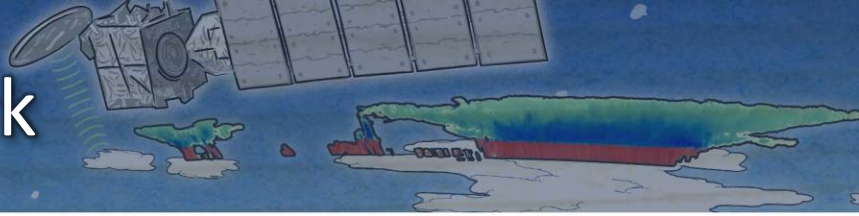


Melting level depth and attenuation

- Li and Moisseev 2019
- Z-LDR relationship
- Integrated attenuation varies from 1-5 dB @ 94 GHz



Future work



- New riming class being added to ACTRIS-Cloudnet ground-based classification
- Combining ground-based cloud and aerosol classifications
- Evaluate
 - AC-TC and AC-TC vs C-TC
 - AC-CLP and AC-CLP vs C-CLP
 - etc.

A-TC C-TC	-3 missing data	-2 sub-surface	-1 attenuated	0 clear	1 liquid cloud	2 supercooled liquid	3 ice cloud	10-15 aerosol types	20 STS PSC type I	21 NAT PSC type II	22 stratospheric ice	25-27 aerosol types
-1 missing data	unknown	sub-surface	unknown	clear	liquid	supercooled	ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types
0 sub-surface	sub-surface	sub-surface	sub-surface	clear	liquid	supercooled	ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types
1 clear	7 clear (possible liquid)	0 sub-surface	7 clear (possible liquid)	clear	liquid	supercooled	ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types
2 liquid cloud	8 liquid	0 sub-surface	8 liquid	25 insects	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types
3 drizzling liquid cloud	9 drizzling liquid cloud	0 sub-surface	9 drizzling liquid cloud	25 insects	9 drizzling liquid cloud	20 ice and supercooled	21 ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types
4 warm rain	10 warm rain	0 sub-surface	10 warm rain	25 insects	9 drizzling liquid cloud	20 ice and supercooled	21 ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types
5 cold rain	11 cold rain	0 sub-surface	11 cold rain	25 insects	9 drizzling liquid cloud	20 ice and supercooled	21 ice cloud	11 cold rain	23 STS	24 NAT	22 stratospheric ice	11 solid rain
6 melting snow	12 melting snow	0 sub-surface	12 melting snow	12 melting snow	12 melting snow	12 melting snow	12 melting snow	12 melting snow	12 melting snow	12 melting snow	12 melting snow	12 melting snow
7 rimed snow	15 rimed snow (possible liquid)	0 sub-surface	15 rimed snow (possible liquid)	14 snow	16 rimed snow and supercooled	16 rimed snow and supercooled	14 snow	14 snow	14 snow	14 snow	14 snow	14 snow
8 snow	13 snow (possible liquid)	0 sub-surface	13 snow (possible liquid)	14 snow	17 snow and supercooled	17 snow and supercooled	14 snow	14 snow	14 snow	14 snow	14 snow	14 snow
9 ice cloud	19 ice cloud (possible liquid)	0 sub-surface	19 ice cloud (possible liquid)	21 ice cloud	20 ice and supercooled	20 ice and supercooled	21 ice cloud	21 ice cloud	21 ice cloud	21 ice cloud	21 ice cloud	21 ice cloud
10 stratospheric ice	22 stratospheric ice	22 sub-surface	22 stratospheric ice	22 stratospheric ice	20 ice and supercooled	20 ice and supercooled	21 ice cloud	22 stratospheric ice	22 stratospheric ice	22 stratospheric ice	22 stratospheric ice	22 stratospheric ice
11 insects	25 insects	0 sub-surface	25 insects	25 insects	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types
12 heavy rain likely	5 heavy rain	0 sub-surface	5 heavy rain	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	5 heavy rain	5 heavy rain	5 heavy rain	32-34 aerosol types
13 heavy snow likely	6 heavy snow	0 sub-surface	6 heavy snow	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	6 heavy snow	6 heavy snow	6 heavy snow	32-34 aerosol types
14 heavy rain	5 heavy rain	0 sub-surface	5 heavy rain	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	5 heavy rain	5 heavy rain	5 heavy rain	32-34 aerosol types
15 heavy snow	6 heavy snow	0 sub-surface	6 heavy snow	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	6 heavy snow	6 heavy snow	6 heavy snow	32-34 aerosol types
16 rain in clutter	2 rain in clutter	0 sub-surface	2 rain in clutter	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	2 rain in clutter	2 rain in clutter	2 rain in clutter	32-34 aerosol types
17 snow in clutter	3 snow in clutter	0 sub-surface	3 snow in clutter	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	3 snow in clutter	3 snow in clutter	3 snow in clutter	32-34 aerosol types
18 cloud in clutter	4 cloud in clutter	0 sub-surface	4 cloud in clutter	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	4 cloud in clutter	4 cloud in clutter	4 cloud in clutter	32-34 aerosol types
19 clear in clutter	-1 unknown	0 sub-surface	-1 unknown	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types
20 uncertain	-1 unknown	0 sub-surface	-1 unknown	1 clear sky	8 liquid	18 supercooled	21 ice cloud	26-31 aerosol types	23 STS	24 NAT	22 stratospheric ice	32-34 aerosol types