SPACECARE : Study of Precipitation in the AntarctiC with EarthCARE

In situ, radar and space data for the calibration and validation of precipitation and related cloud products from EarthCARE over Antarctica

* IGE Grenoble – soon LMD Paris: C. Genthon (PI, precipitation)

* LATMOS: C. Listowski, J. Jumelet, J. Delanoë (clouds),
* LMD: C. Claud (precipitation)

* LTE-EPF Lausanne: A. Berne (precipitation)

See poster # 59

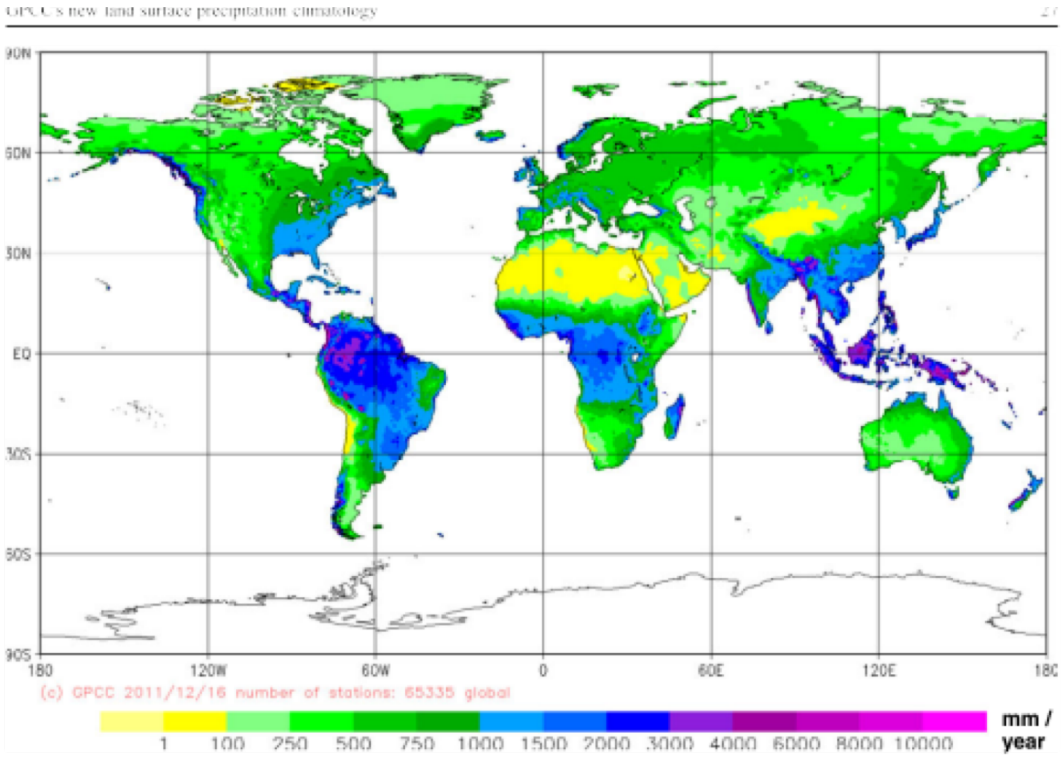


Fig. 8 Mean annual precipitation (mm/year) on a 0.25° grid from the new GPCC precipitation climatology released in Dec. 2011 based on ca. 67,200 stations

GPCC's continental precipitation analysis from obs (Schneider et al. 2014):

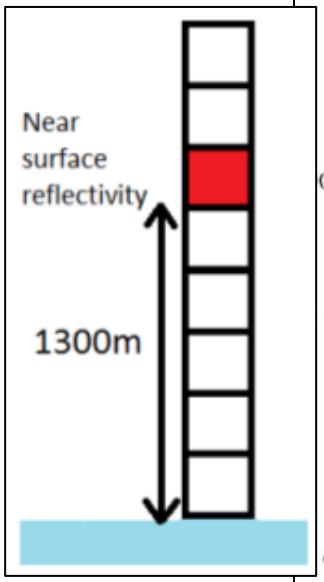
we have got a problem over Antarctica (because very sparsely "populated", extreme conditions, standard measurement methods do not apply)

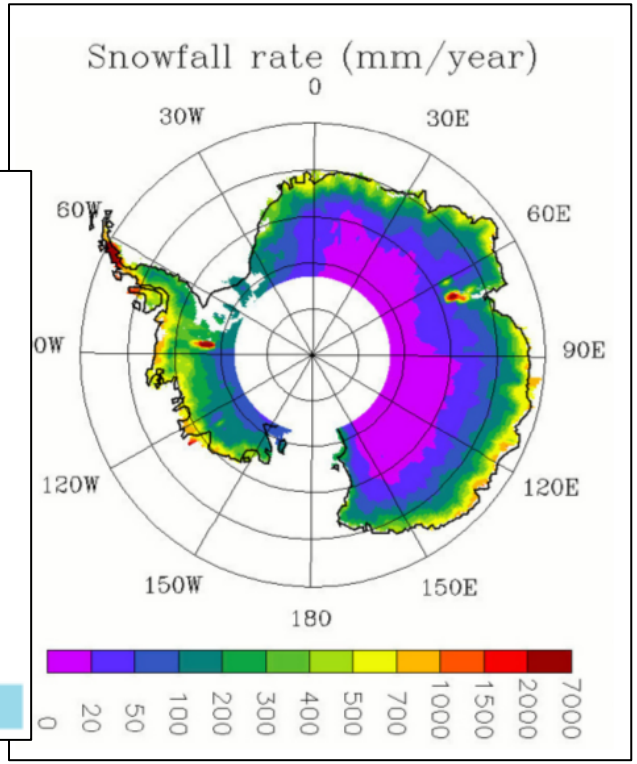
who cares?

Bonn elevation 60 m ~= sea level equivalent of the Antarctic ice sheet

We know how to make an Antarctic precipitation climatolgy with CloudSat (the 1st model-free climatology of Antarctic precipitation)

- Earth observation satellite belonging to the A-train (NASA).
- Meteorological radar :
  - Clouds and precipitation observations.
  - Altitude limit for observation : ~ 1,2km.
  - Cloud Profiling Radar (CPR)
  - 94 GHz frequency.





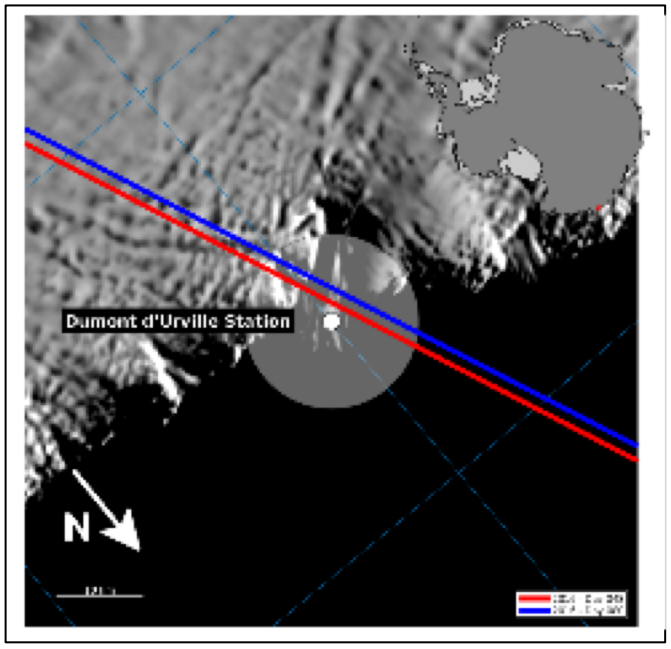
Palerme et al., 2014

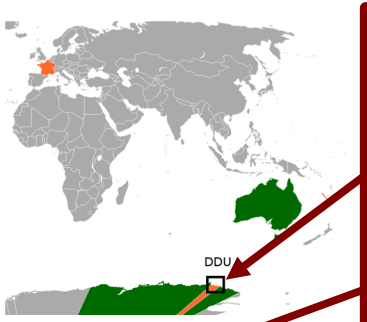
How to calibrate/validate, to intercompare

Events and data selection for surface / space comparison

Results courtesy Florentin Lemonnier, PhD, LMD, paper in progress

- When CloudSat track within a 10 km – radius of measurement site





APRES3

APRES3: Antarctic Precipitation, Remote Sensing from Surface and Space

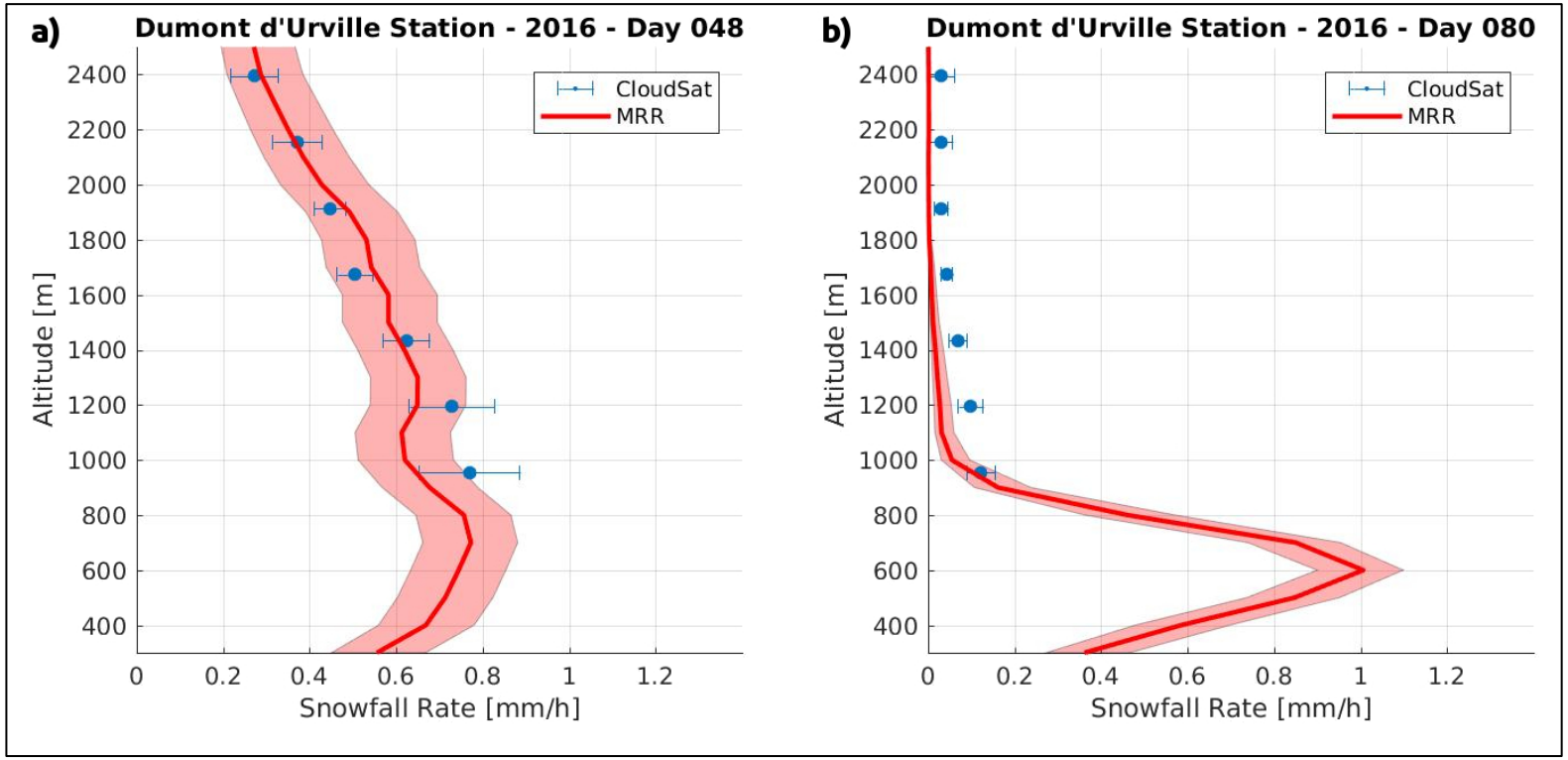
An on-going program to acquire long series of precipitation data at Dumont d'Urville, Adélie Land

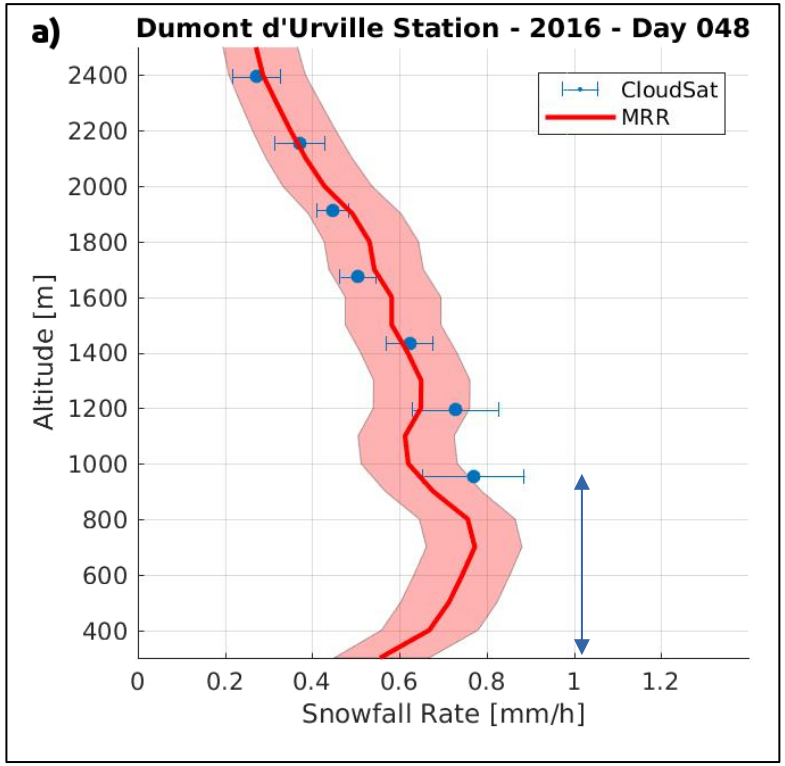
Please See poster #59

Radar observation
=> not just cumulated snowfall at surface but also vertical profile
=> satellite + model validation beyond the surface product
=> The "blind zone" versus the "evaporation layer"

Comparing precipitation profiles

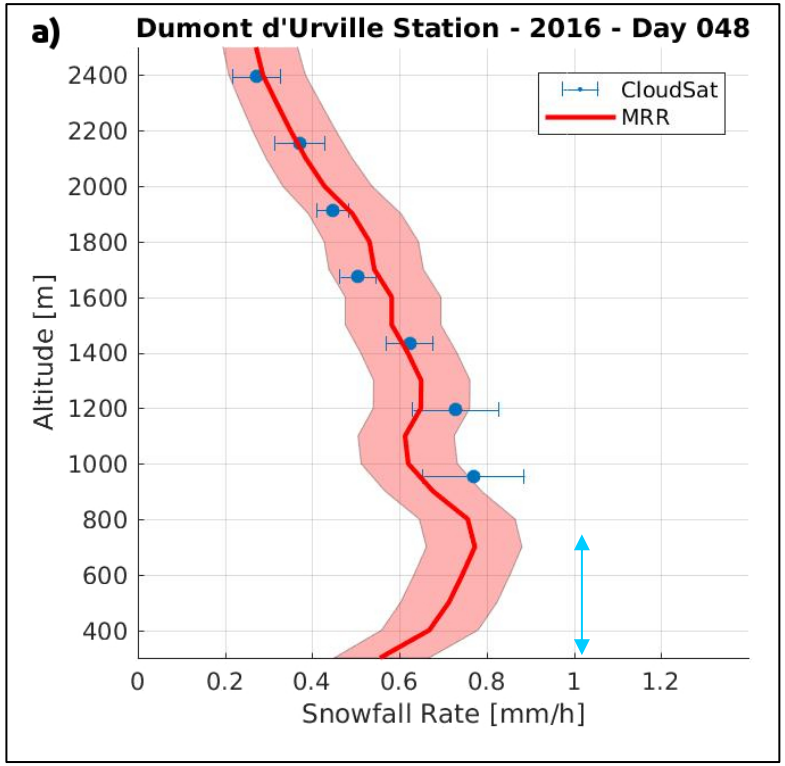
Surface radar profiler allows CalVal in the column, not just at surface
=> physical processes (cold microphysics, fall speed, etc)





But

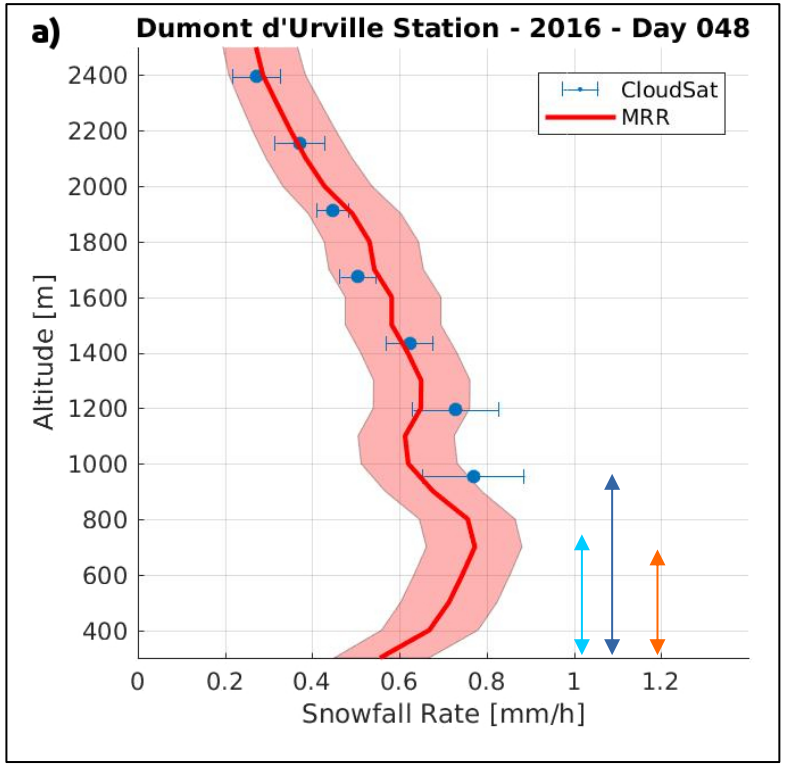
On space radar side: Blind zone = ground clutter



But

On surface side: Evaporation layer = a dry air layer near the surface where a significant fraction of precipitation falling from above evaporates before reaching the surface and contributing to “feed” the ice sheet

Up to 30% lost in peripheral katabatic (dry wind) regions



EarthCARE CPR will have shallower ground clutter than CloudSat. Better comparison, still a missing part.

Data requirement: level-2 CPR precipitation product (C-CLD and C-TC)

Deliverable: A quantitative evaluation in coastal Antarctica

What about clouds?

- Precipitation originates from clouds

- Clouds affect the surface energy balance / the contribution of Antarctica to the global energy cycle (Antarctica is the main energy sink)

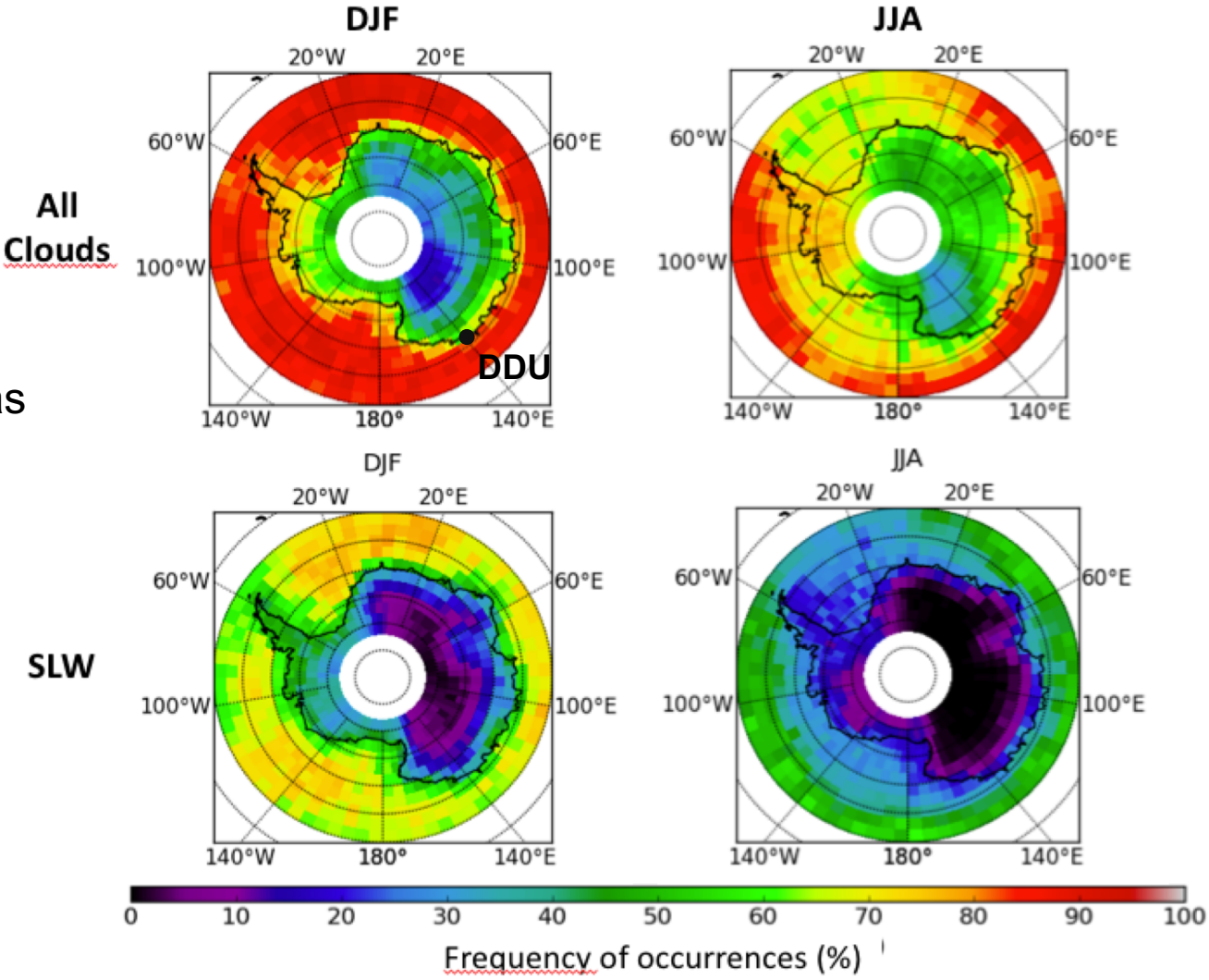
- Clouds (nature, characteristics, microphysics) are highly uncertain in Antarctica

A-Train DARDAR-MASK products (radar/lidar synergy) provide with a statistics of cloud (and any cloud) phase occurences

Example of 4 years seasonal averages (2007-2010) for all the clouds and the supercooled liquid water (SLW) occurrences:

Already climatology that could be used as reference

Data requirement: AC-TC synergistic classification product



Listowski et al., in prep

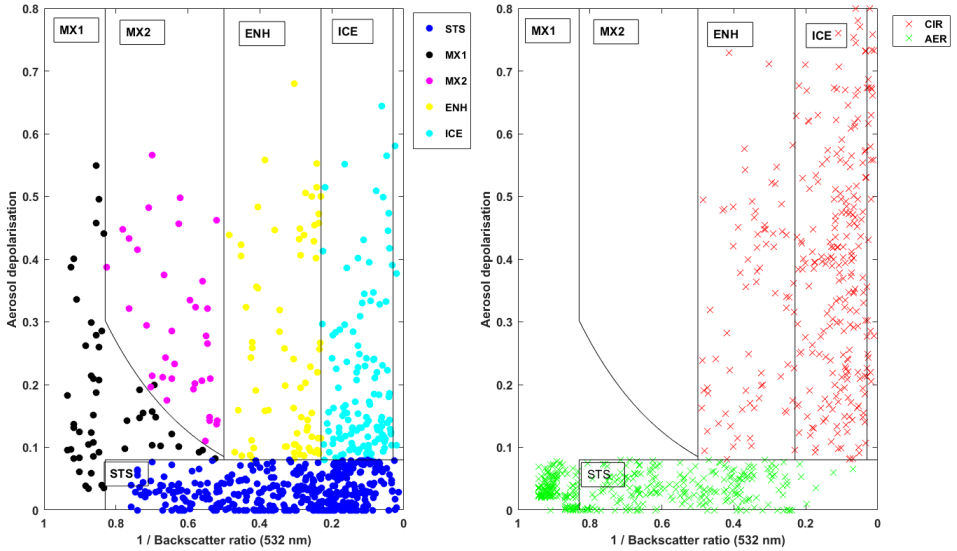
Stratospheric clouds above DDU :

Jumelet et al.

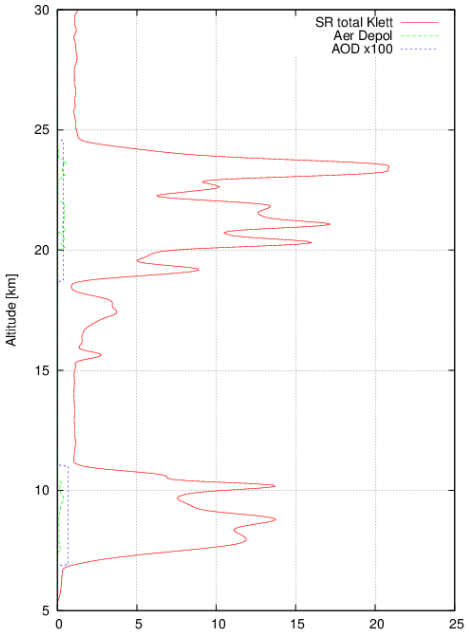
> Impact of cirrus and ice clouds on the vertical distribution of water vapor in the PSC season in the upper troposphere/lower stratosphere region.
> Detection of multiple particle types (aerosol/cirrus/PSC) may help in understanding the vertical distribution of H_2SO_4, HNO_3 and H_2O species above DDU.

Earthcare products: 355nm backscatter, depolarisation + Ice water Content ?

2007-2017 lidar cloud classification - cloud type using backscatter/depolarisation

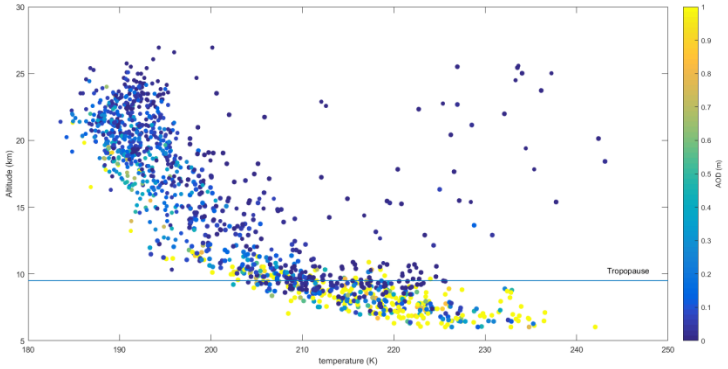


Sample 2016 profile in winter season with strong cirrus and ice PSC layers



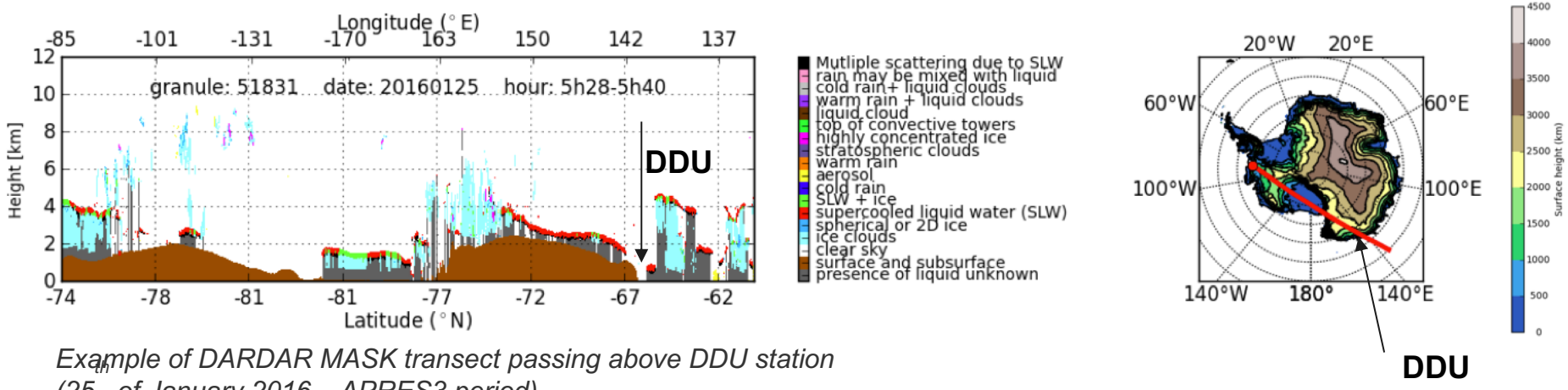
Backscatter coefficient 532nm

2007-2017 lidar cloud classification - Temperature/Altitude/AOD correlation

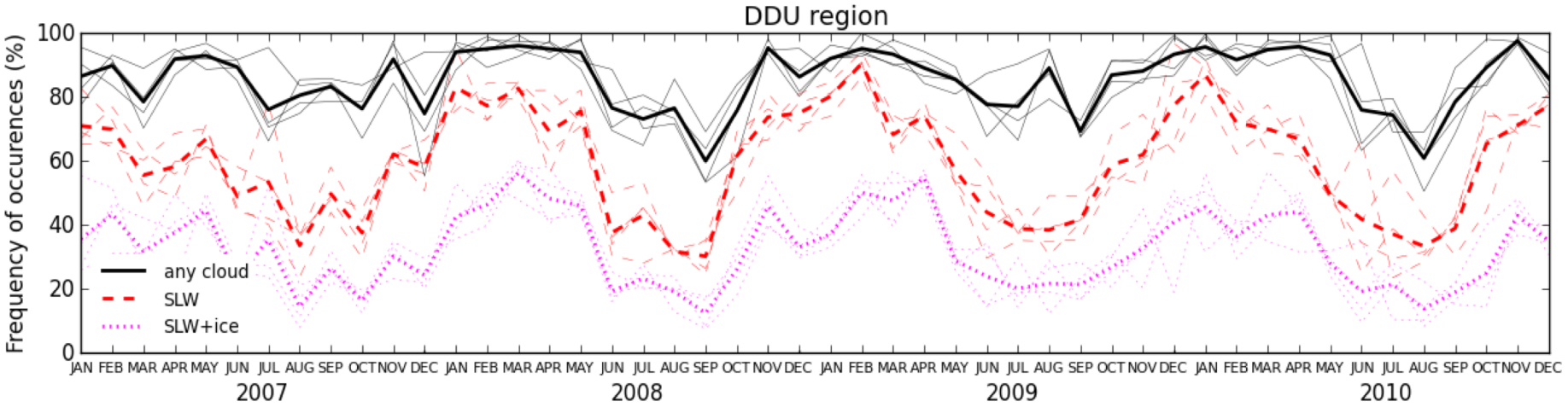



THANK YOU

Antarctic clouds in DDU region : comparing AC-TC product to DARDAR-MASK statistics (and link with precipitation measurements/products – see previous part)



Example of DARDAR MASK transect passing above DDU station (25th of January 2016 – APRES3 period)



Time series of cloud occurences, SLW occurences, and SLW+ice (mixed-phase) occurrences over DDU region within 250 km around the station, from 2007 to 2010. The thick line is the average over 4 gridboxes of the lat/lon map, while the thin lines represent the individual gridboxes..

Data requirement: AC-TC synergetical classification product