EarthCARE L2 Cloud and vertical velocity products

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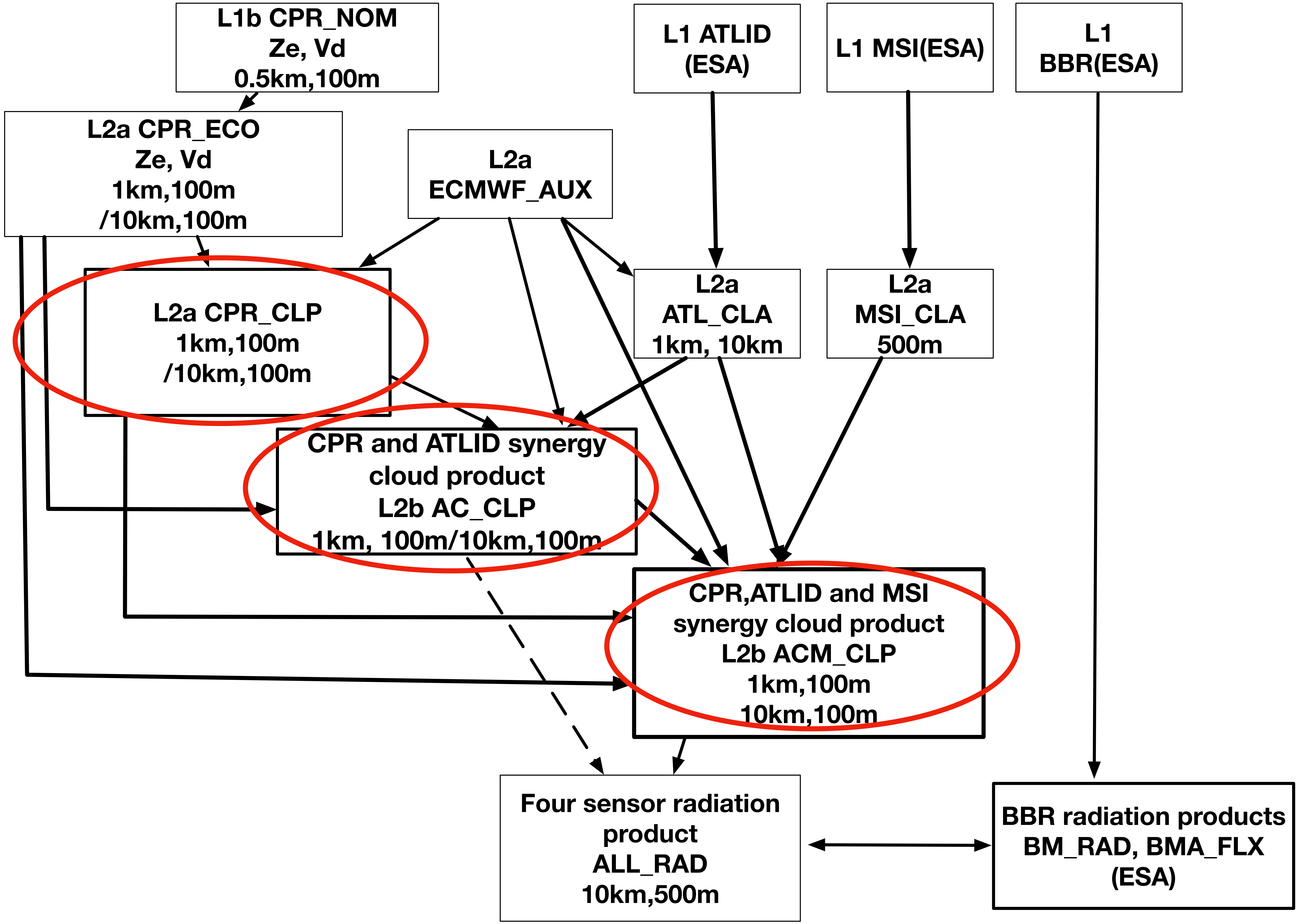
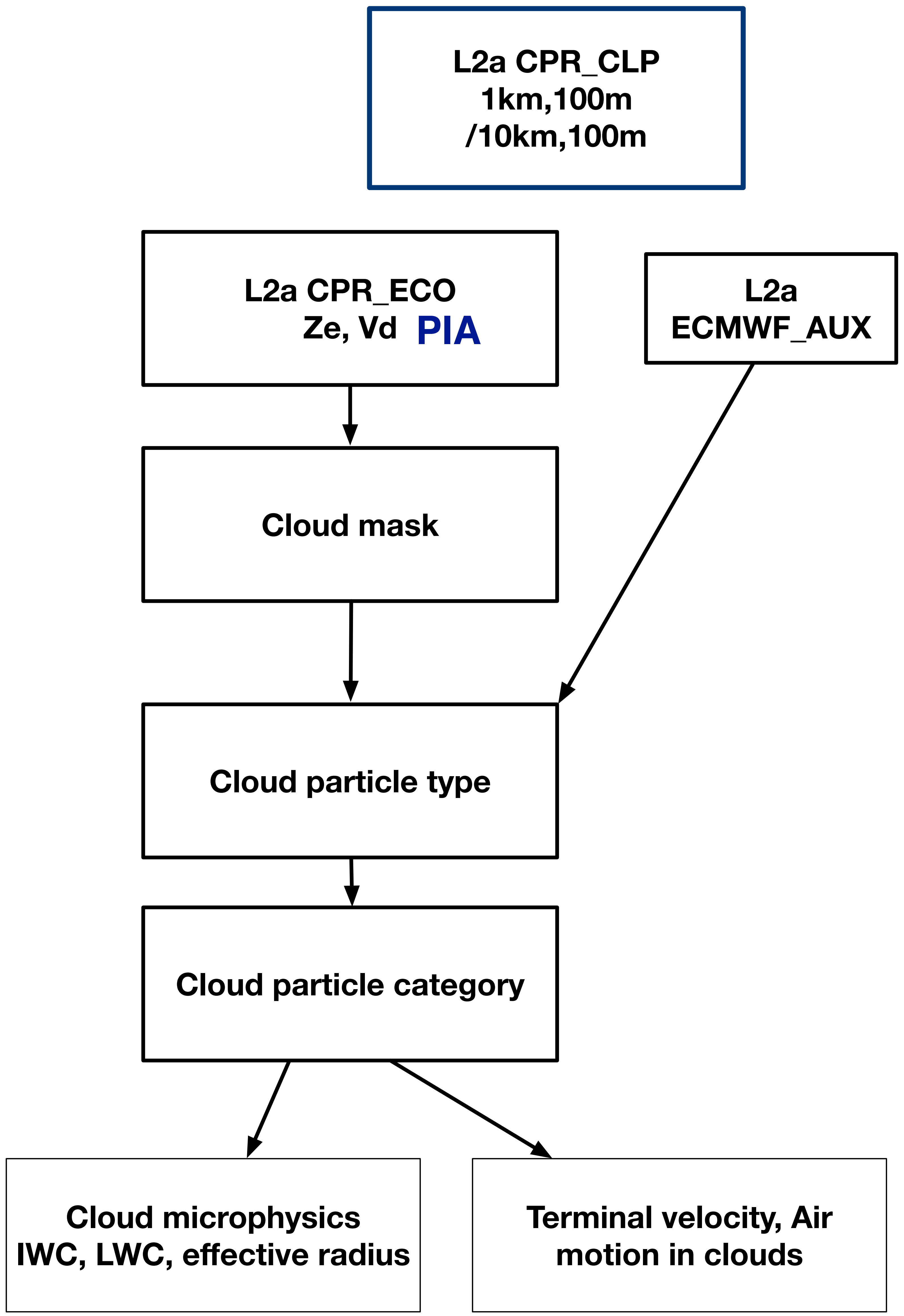
Flow of algorithms for JAXA standard products: CPR_, AC_ and ACM_CLP



Flow of algorithms for JAXA cloud products; CPR_CLP



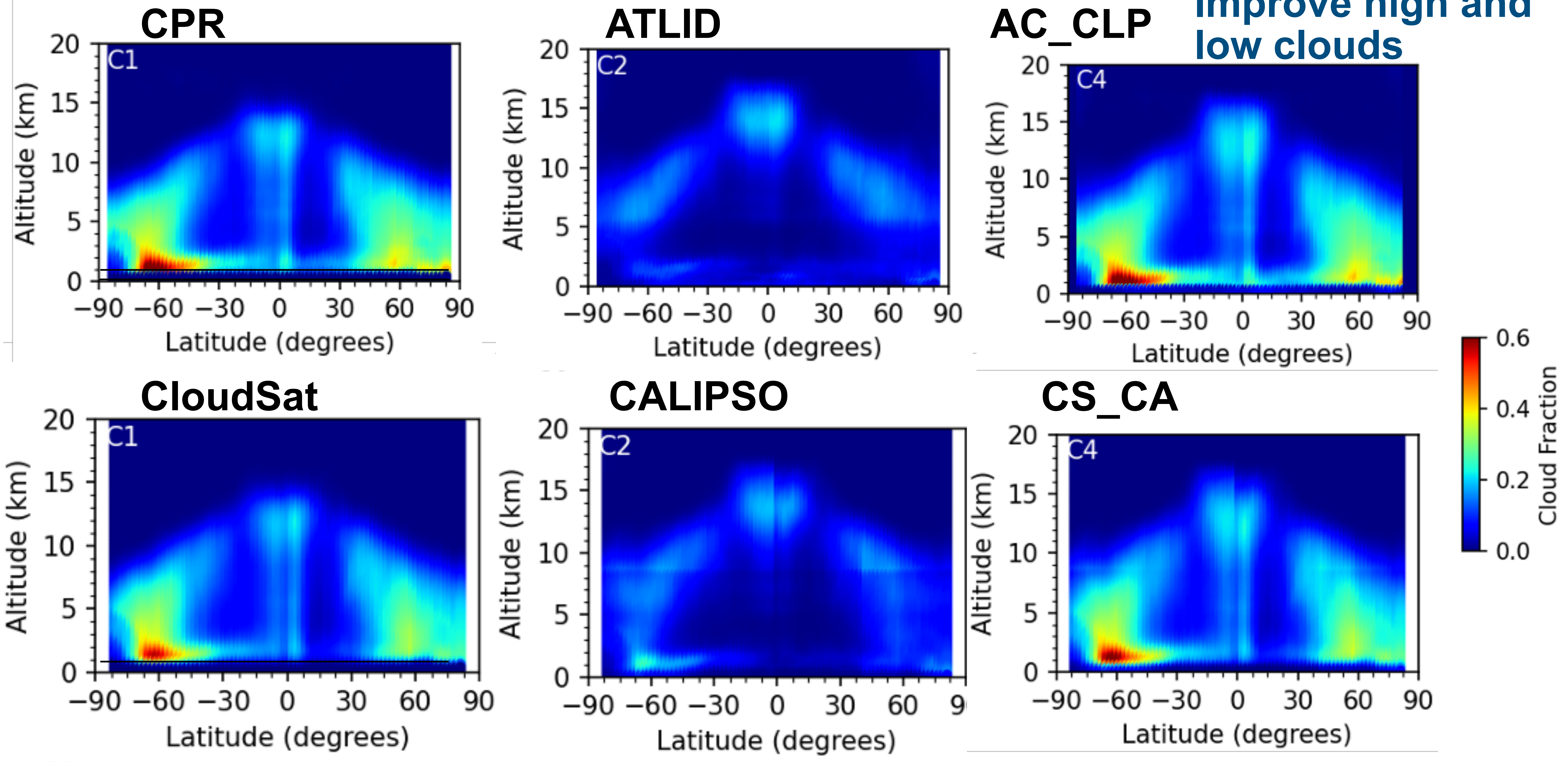
Algorithms are developed on the basis of the algorithms for CloudSat plus information of Vd.

(1) Cloud mask algorithms discriminate clouds/precipitations from clear pixels.
(2) Cloud particle type is to specify cloud phase (ice/water) and precipitation (rain/snow).
(3) Cloud particle category is to retrieve ice particle habit / orientation.
(4) Cloud microphysics provides ice water content/liquid water content and effective radius.
(5) Cloud terminal velocity and vertical air motion are also provided.

AC_CLP needs input from CPR_ECO and ATL_CLA

Comparison of zonal mean of cloud fraction (CPR_CLP and AC-CLP vBb)

Improve high and low clouds



CloudSat/CALIPSO 2007 February - June

AC_CLP 2025 February - June

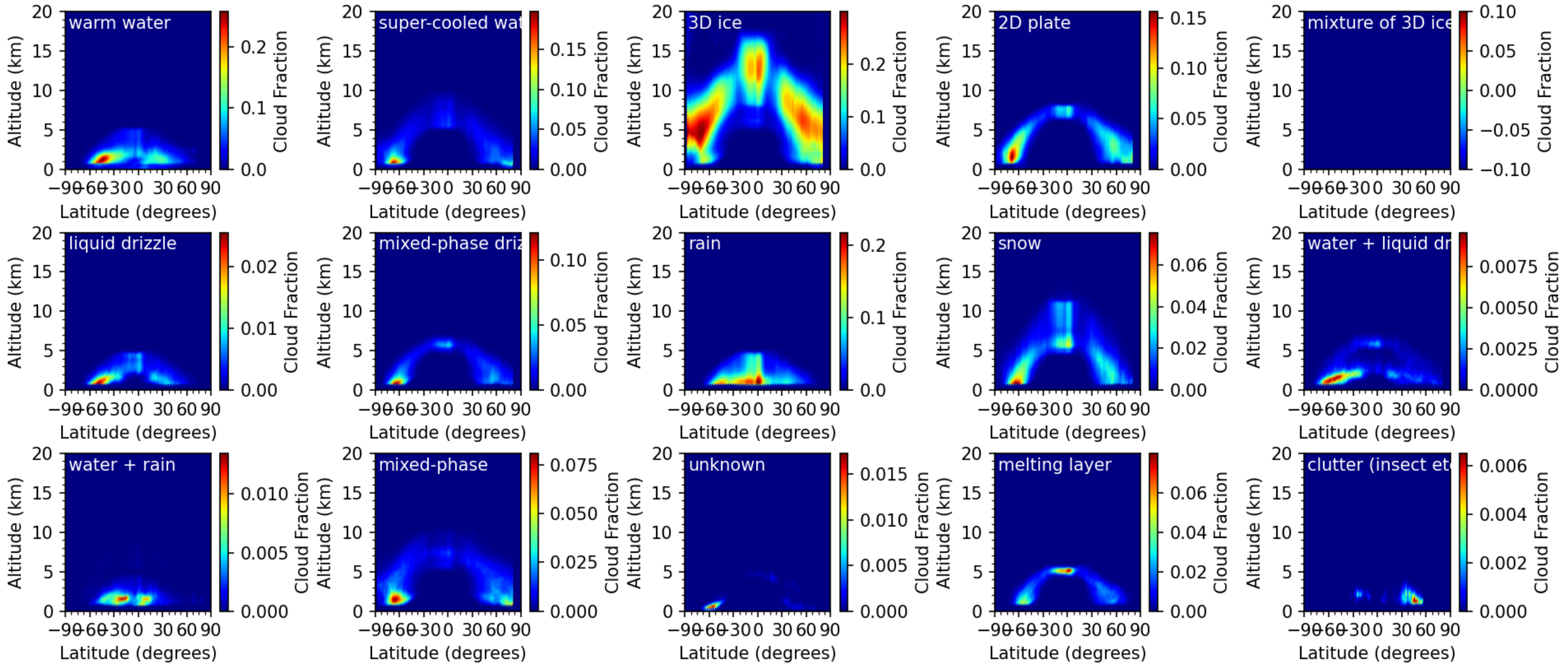
Cloud particle type in AC_CLP

vBb

Ze and temperature relation is applied to retrieve cloud particle type.

ATLID type was retrieved by depolarization ratio and attenuation.

Synergy type is also reported in AC_CLP.



cloud particle types by ATLID-CPR synergy. 2025 February - June

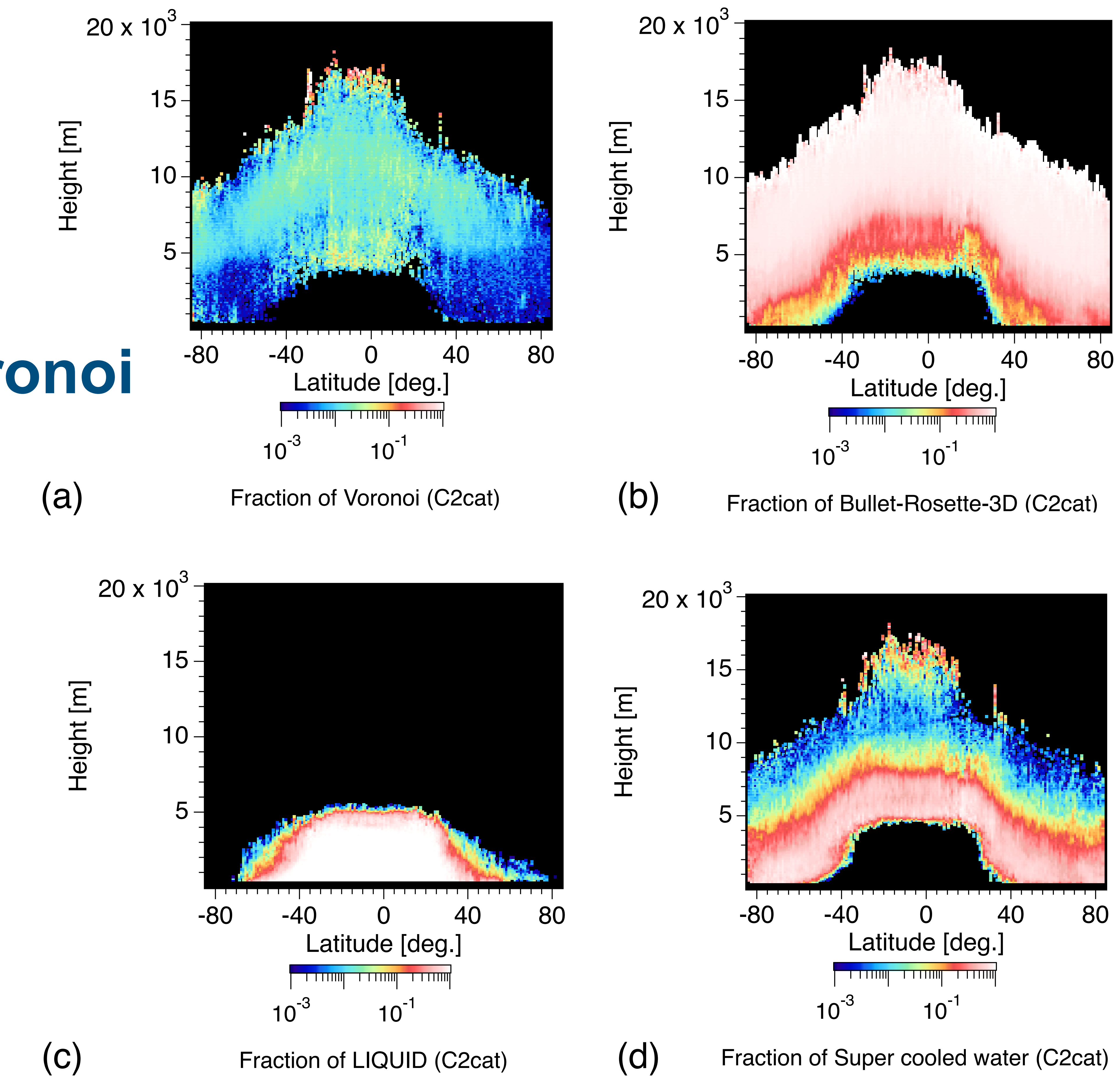
Cloud particle category in AC_CLP vBb

ATLID cloud category(ice habit) was retrieved by depolarization ratio and algorithm was first developed for CALIPSO (Sato and Okamoto 2023).

CPR category is retrieved by Ze and Temperature. Algorithm was first developed for CloudSat (Sato and Okamoto 2025 in review).

Fraction of Voronoi

Bullet-Rosette



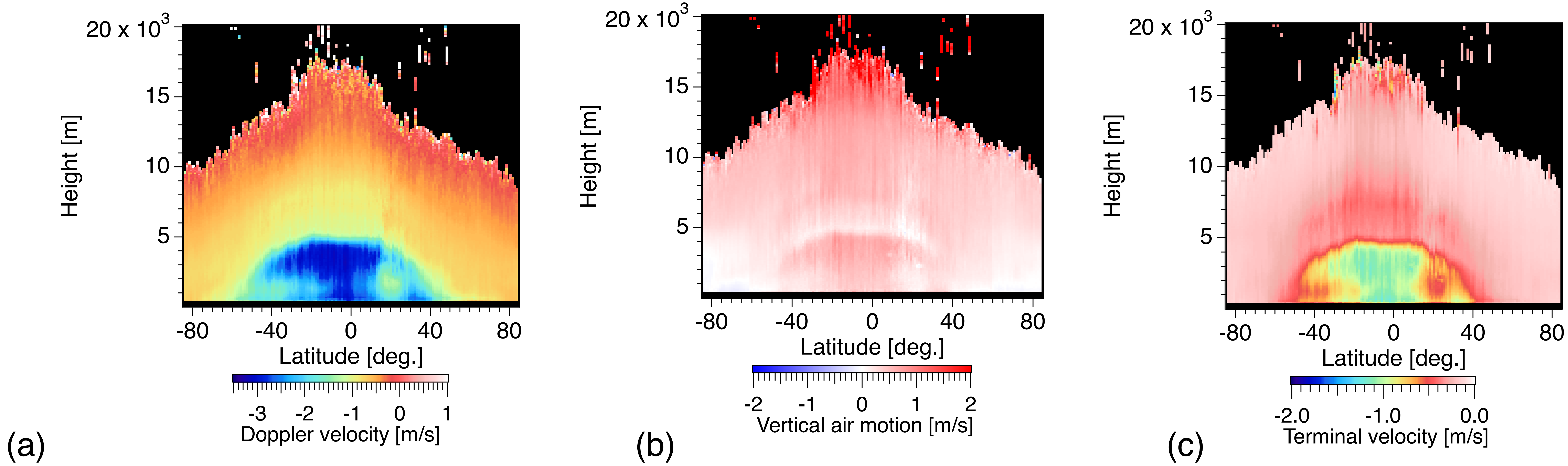
Warm water

Super cooled water

(Okamoto et al., 2025)

Zonal mean of Doppler velocity, vertical air motion and fall speed vBb

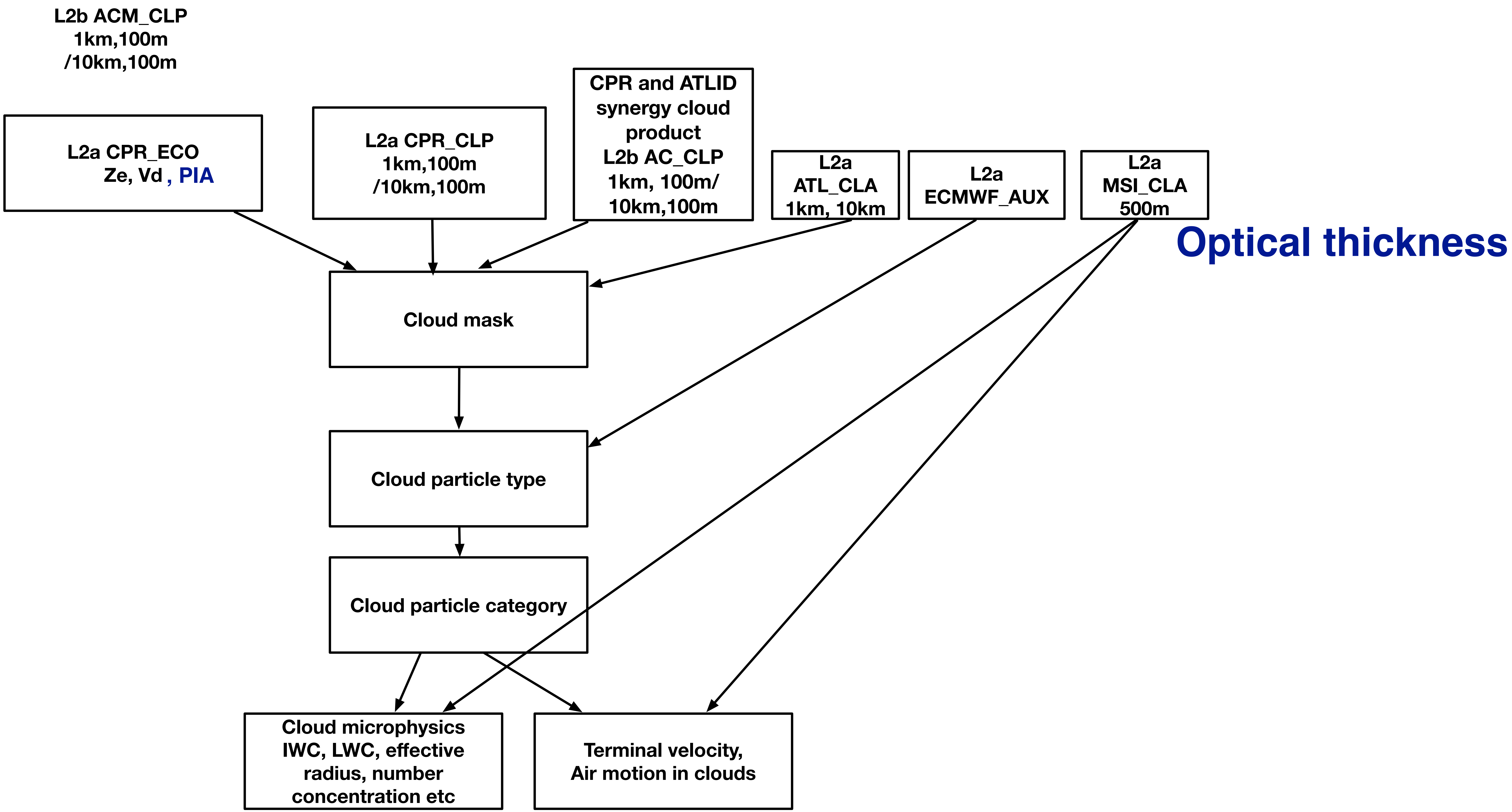
Cloud microphysics, vertical air motion and terminal velocity are derived (Sato et al., 2025, Sato and Okamoto 2025). When Ze>-20dBZ, Vair is mostly upward. When all Ze ranges are considered, Vair at low levels inside rain shows downward motion.



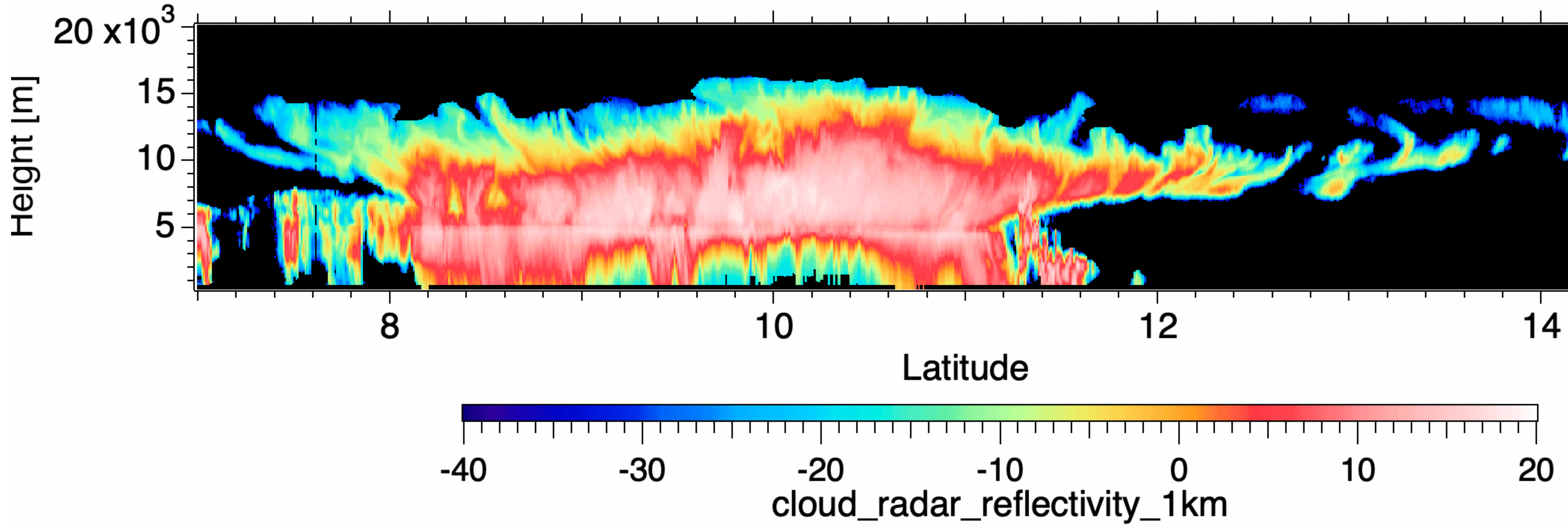
Vd for Ze>-20dBZ **Vair for Ze>-20dBZ** **Terminal velocity for Ze>-20dBZ**

Note ; Vt(terminal velocity) is not reflectivity weighted velocity.

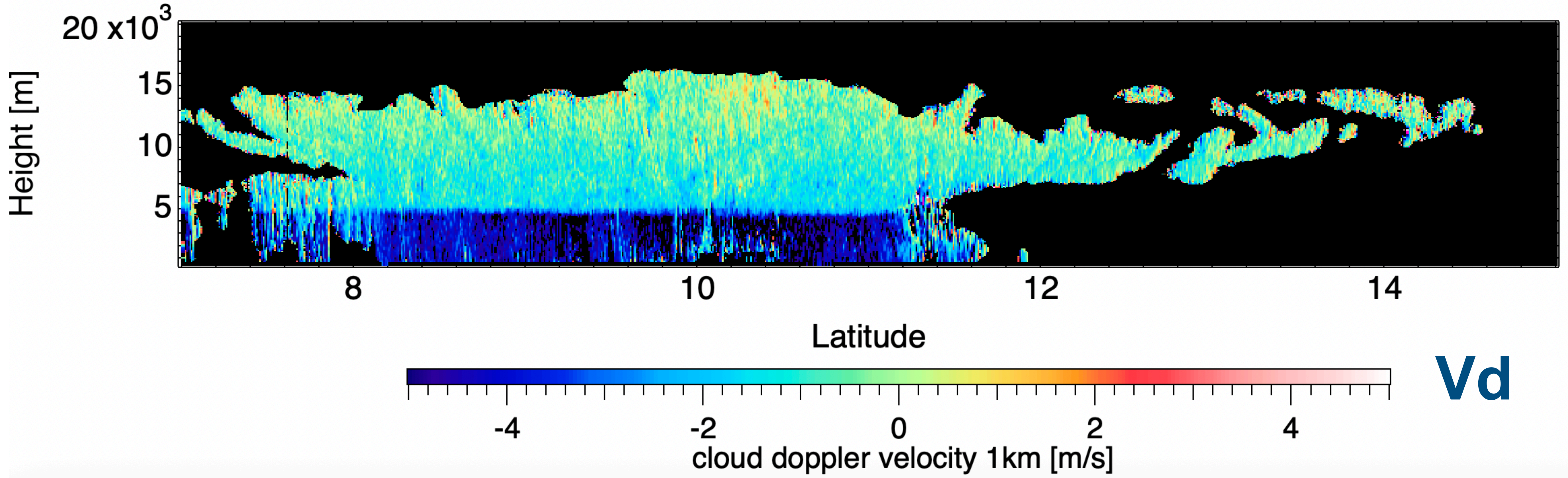
Flow of algorithms for JAXA standard products: ACM_CLP



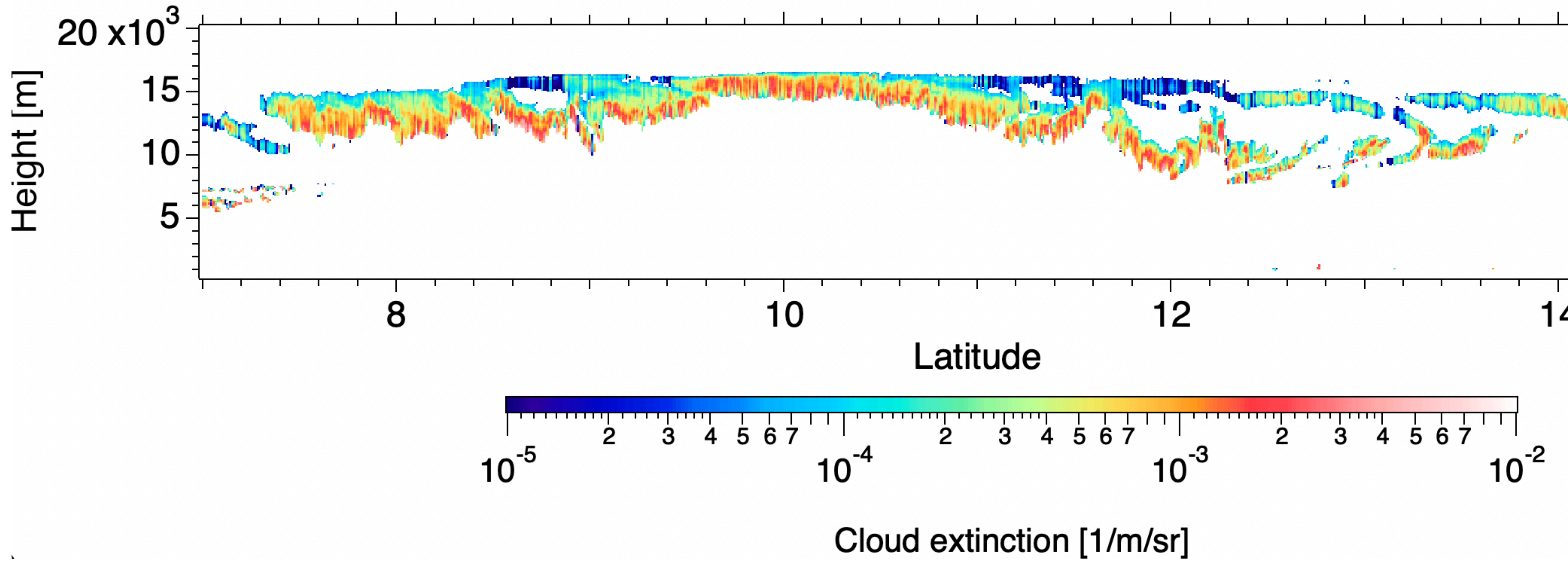
ACM_CLP : tropical case



Ze



Vd



Extinction by ATLID

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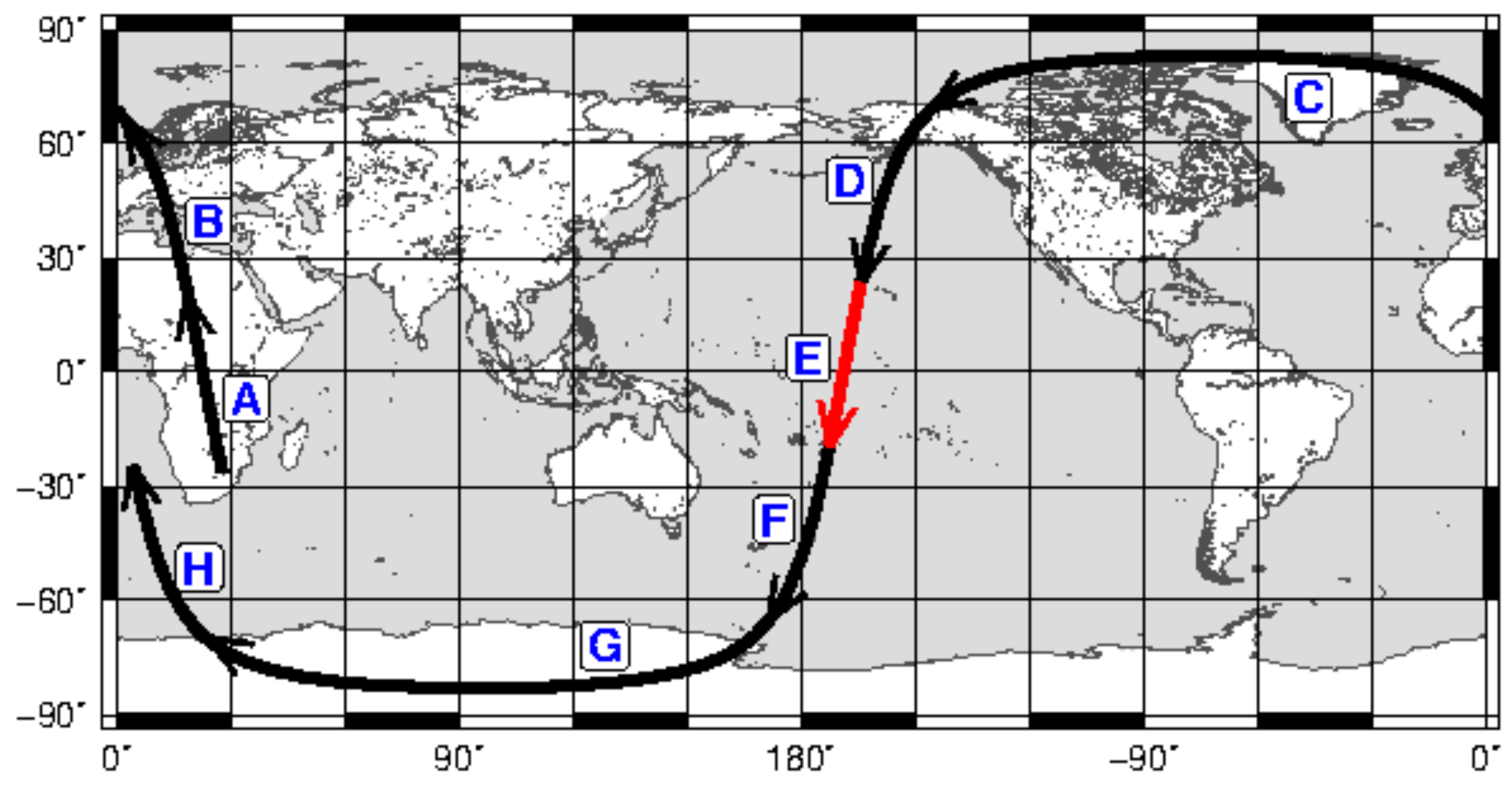
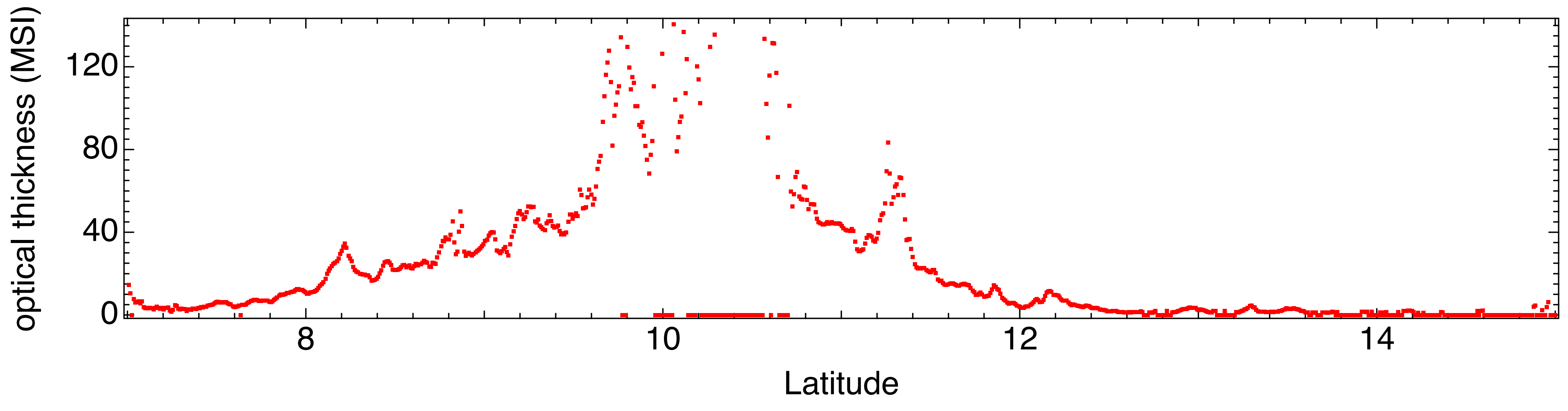
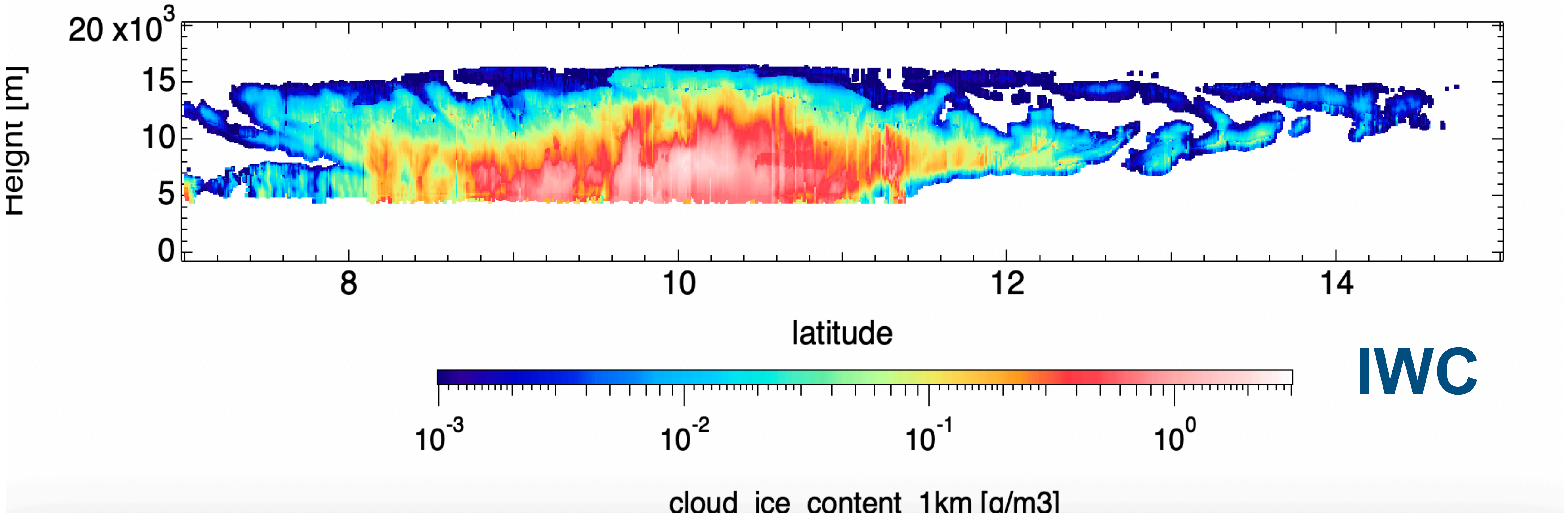
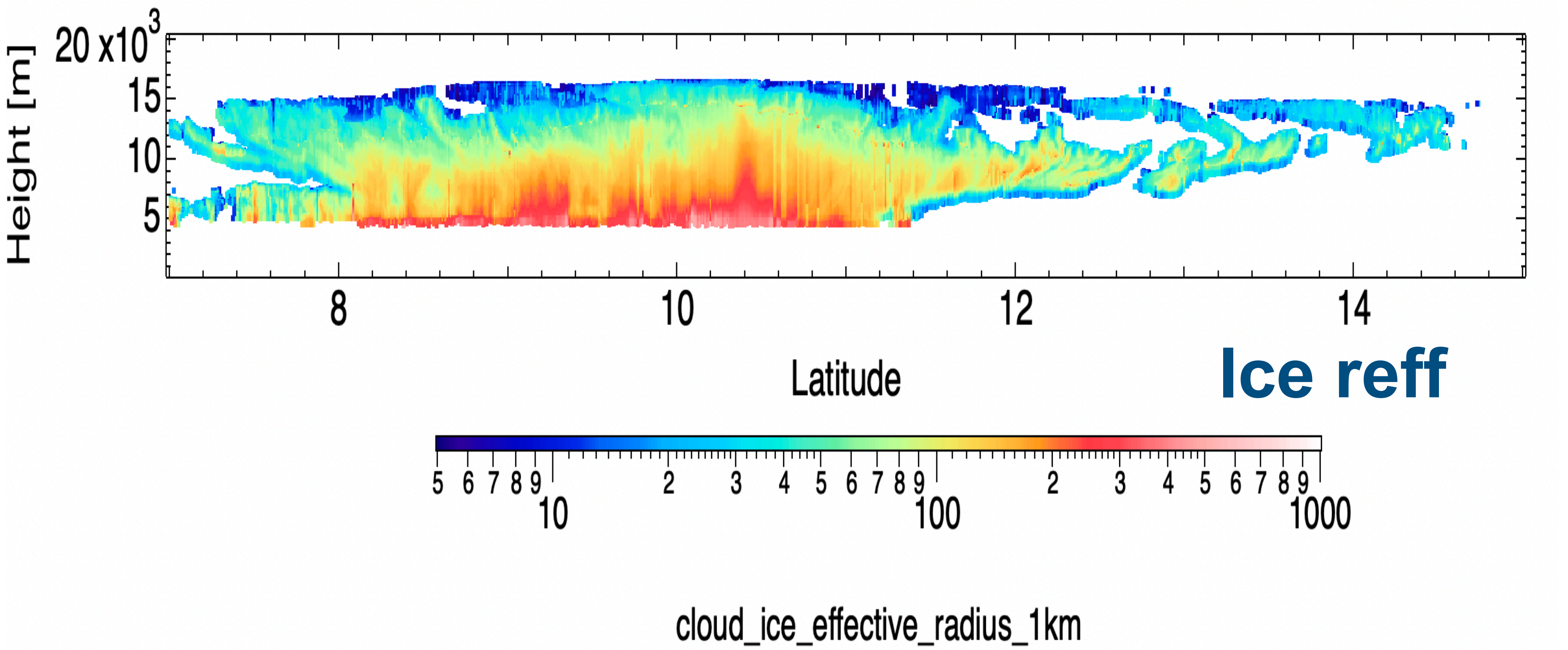


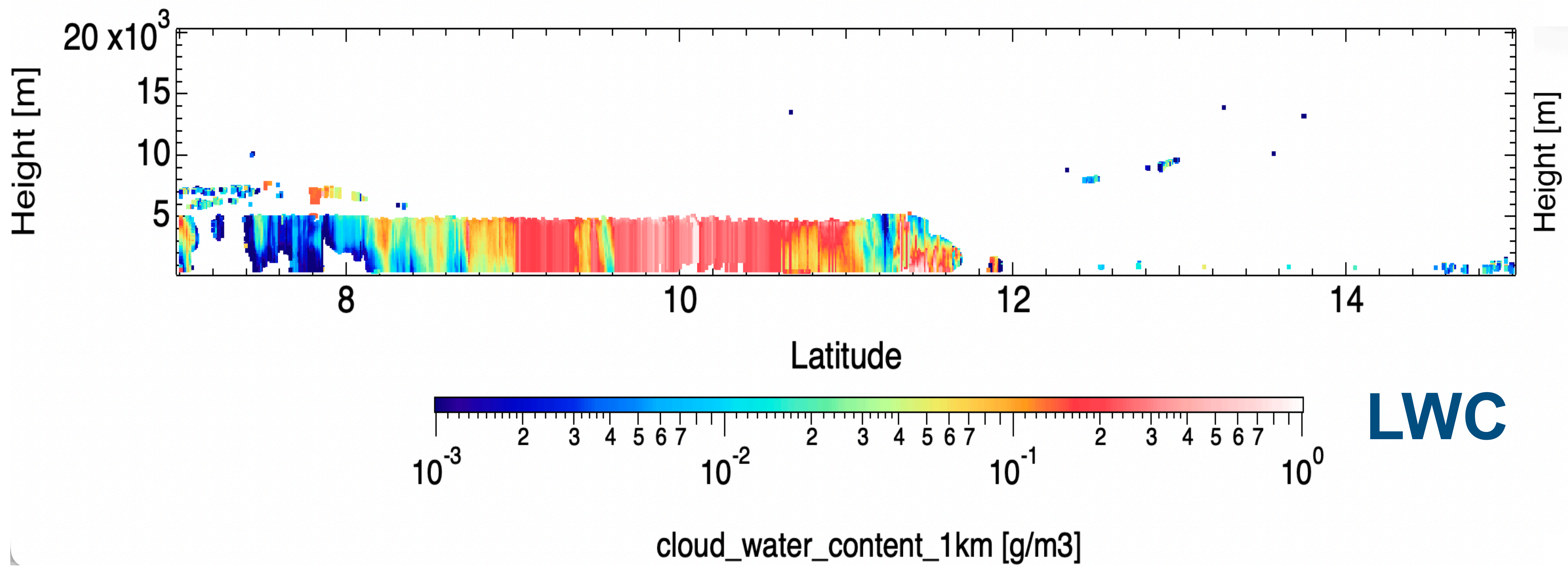
Optical thickness from MSI

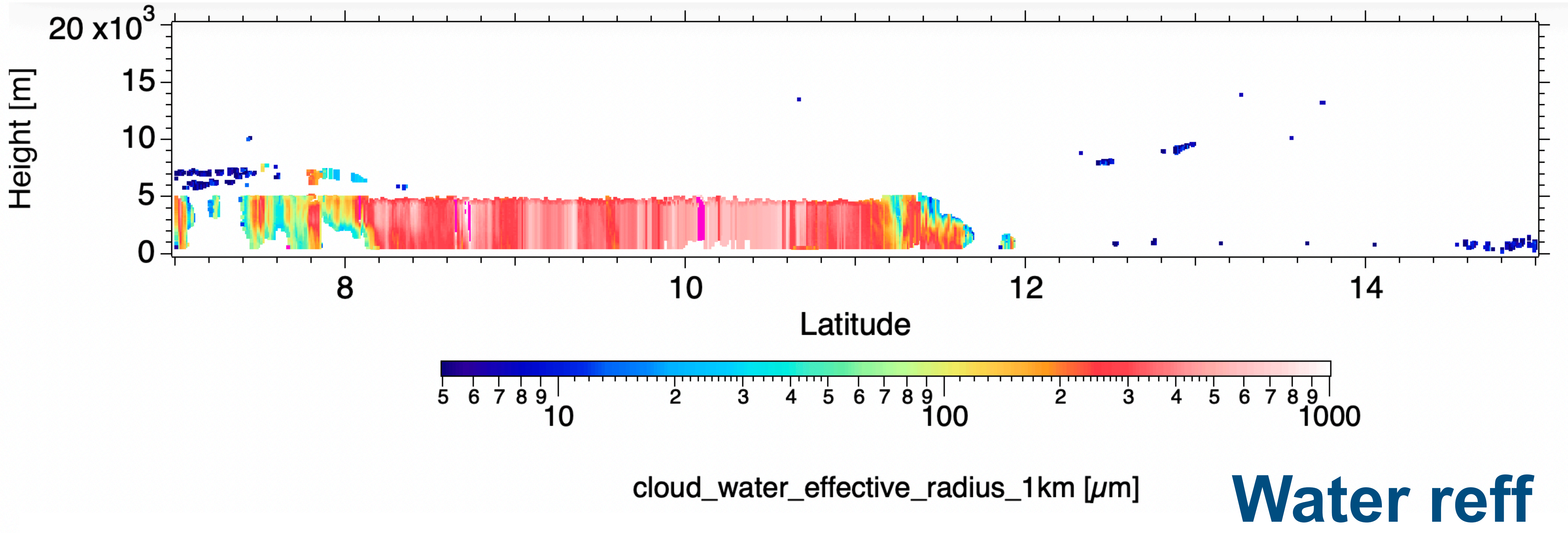


Cloud microphysics in ACM_CLP

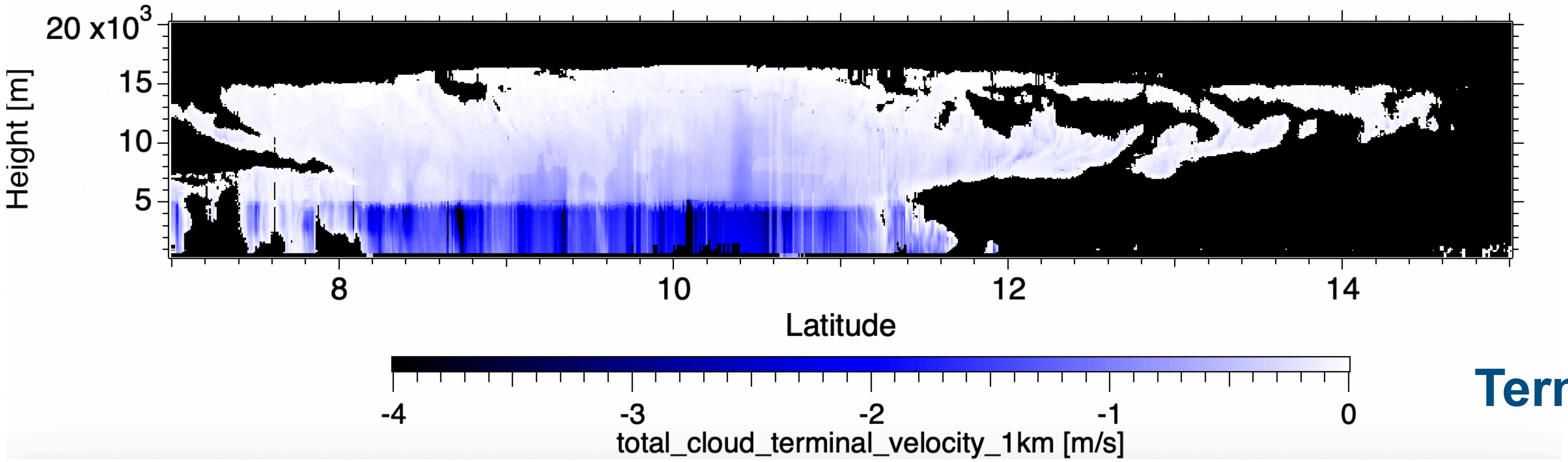




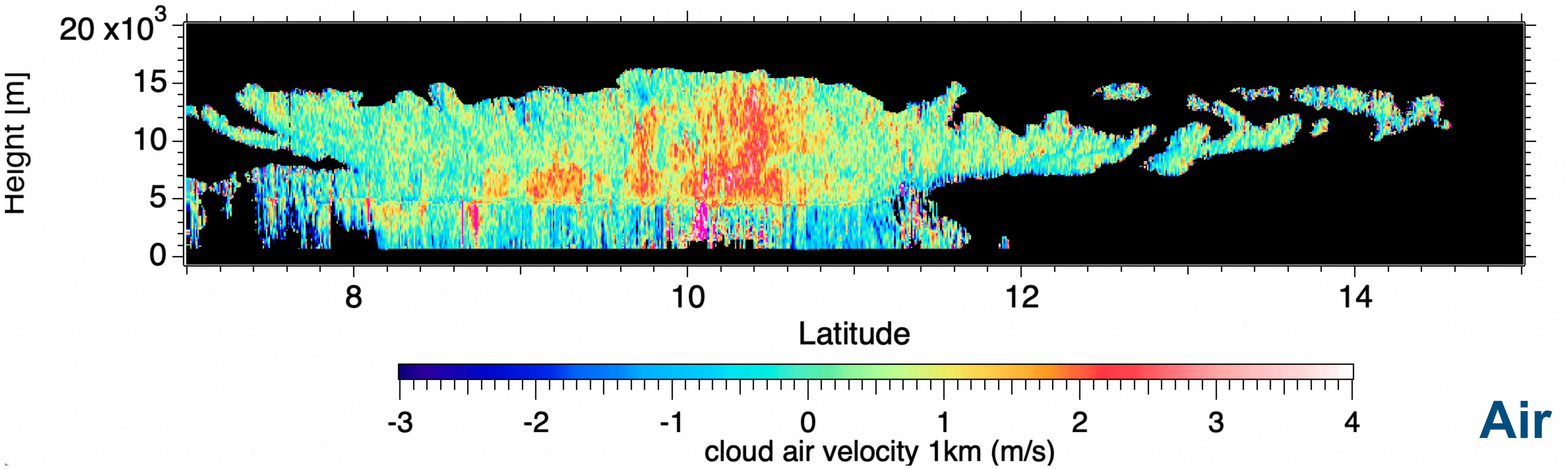




Terminal velocity and air motion in ACM_CLP



Terminal velocity



Air motion in clouds

Optical thickness in CPR_CLP, AC_CLP and ACM_CLP

Estimated optical thickness in CLP products is compared with those in MSI_CLA.

Version 2 (xCb) agrees better than version 1(xBb).

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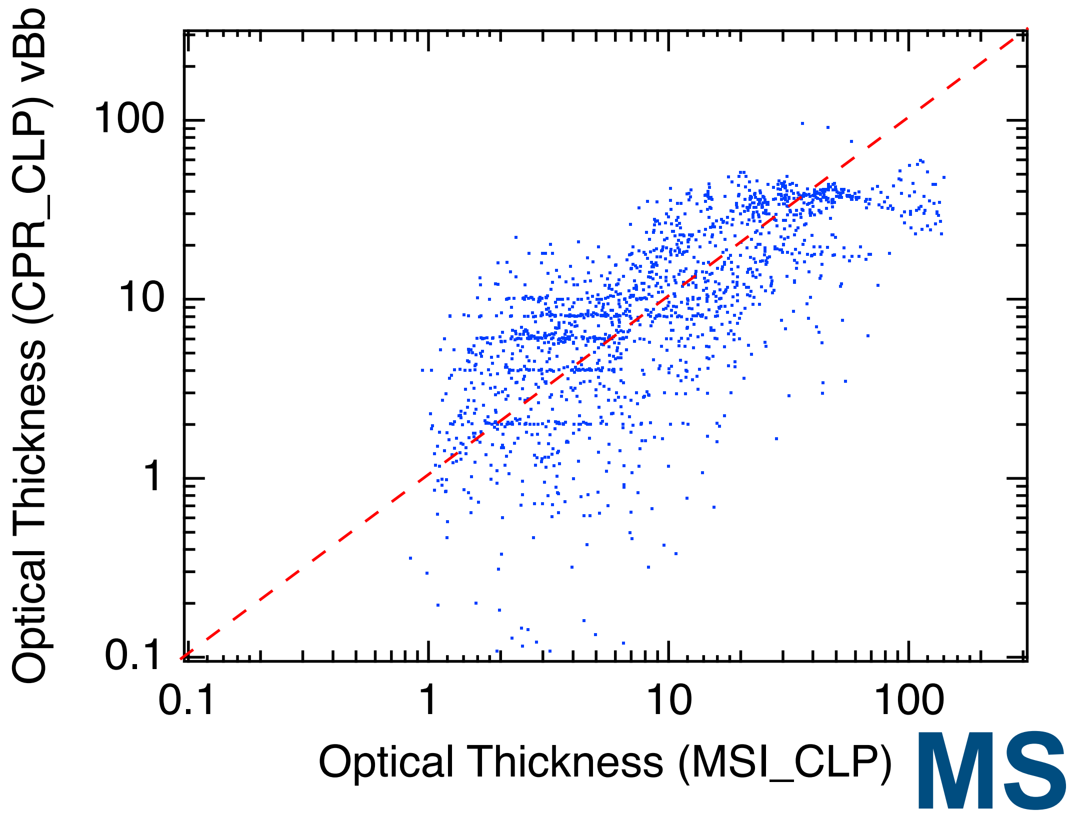
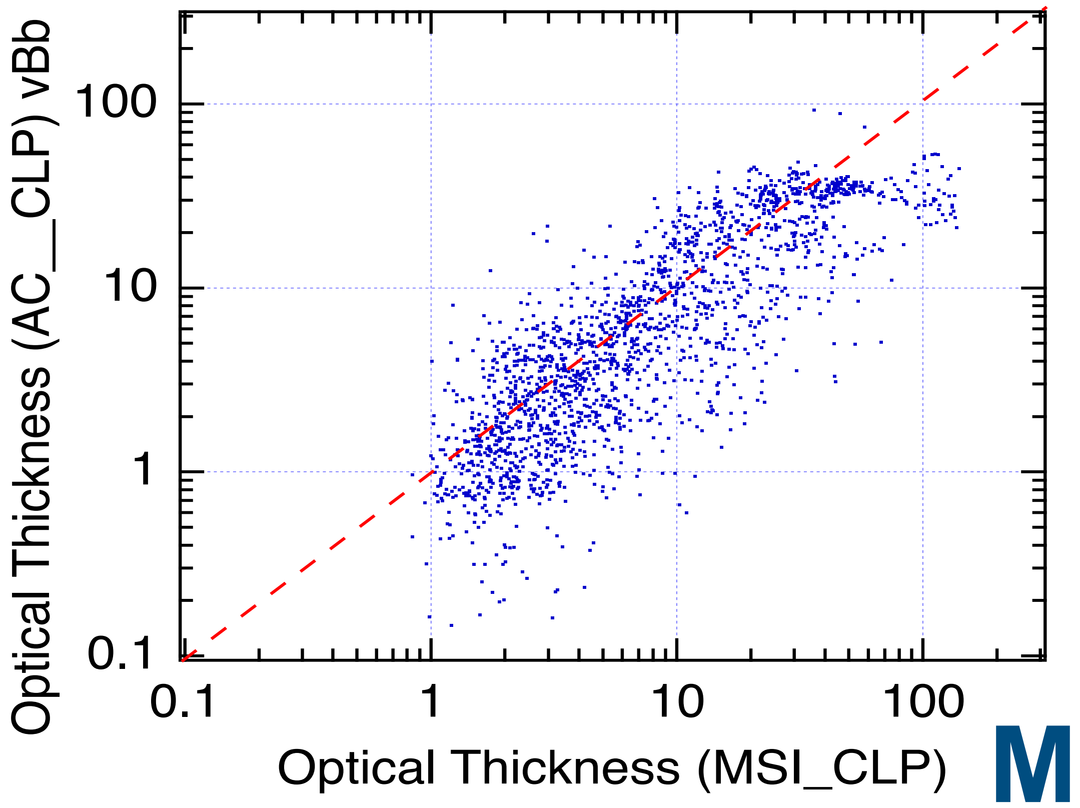
V1.0

CPR_CLP



MSI

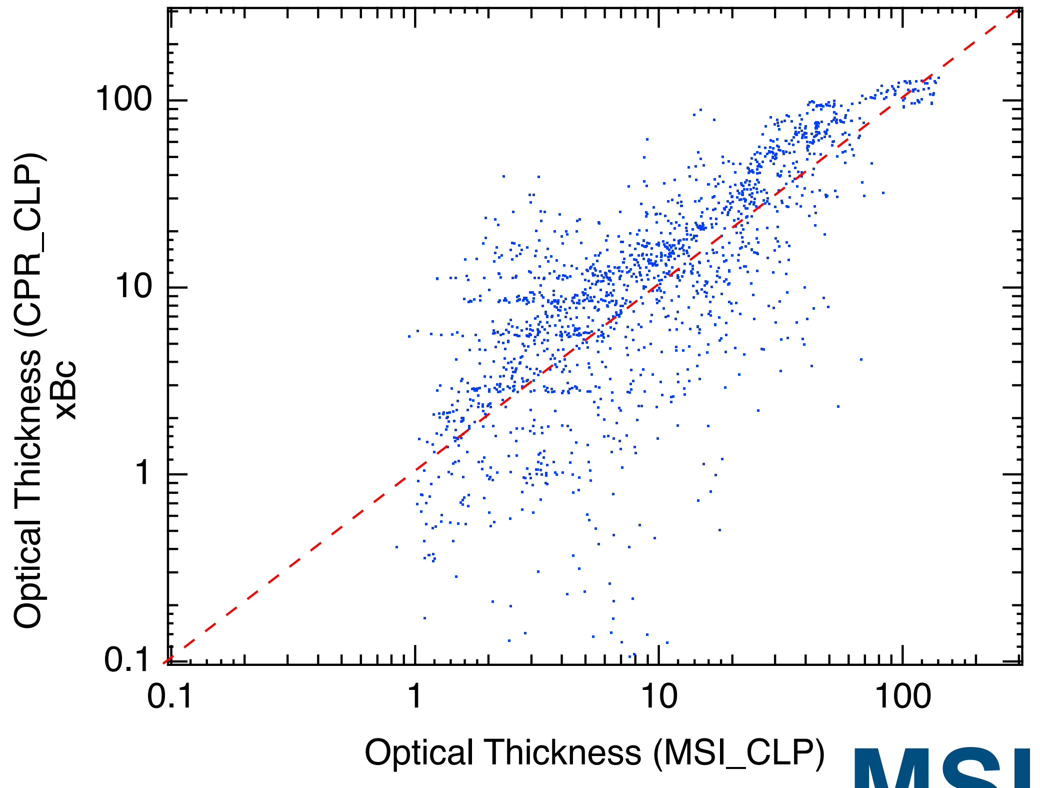
AC_CLP



MSI

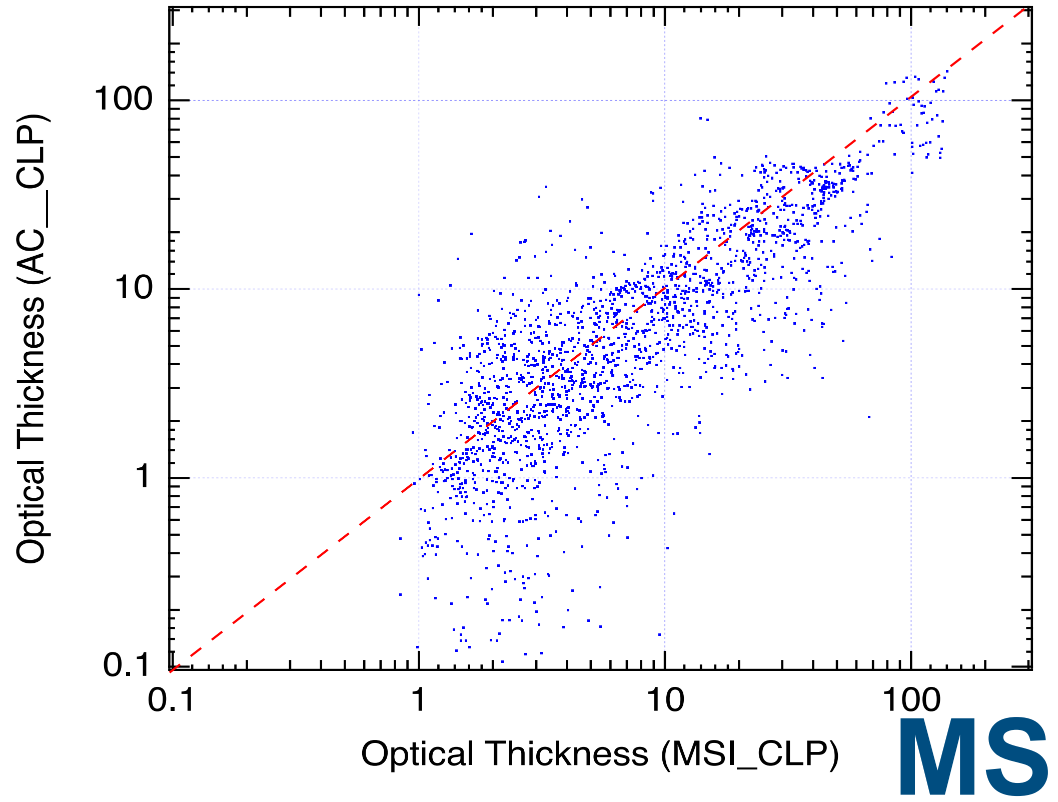
V2.0

CPR_CLP



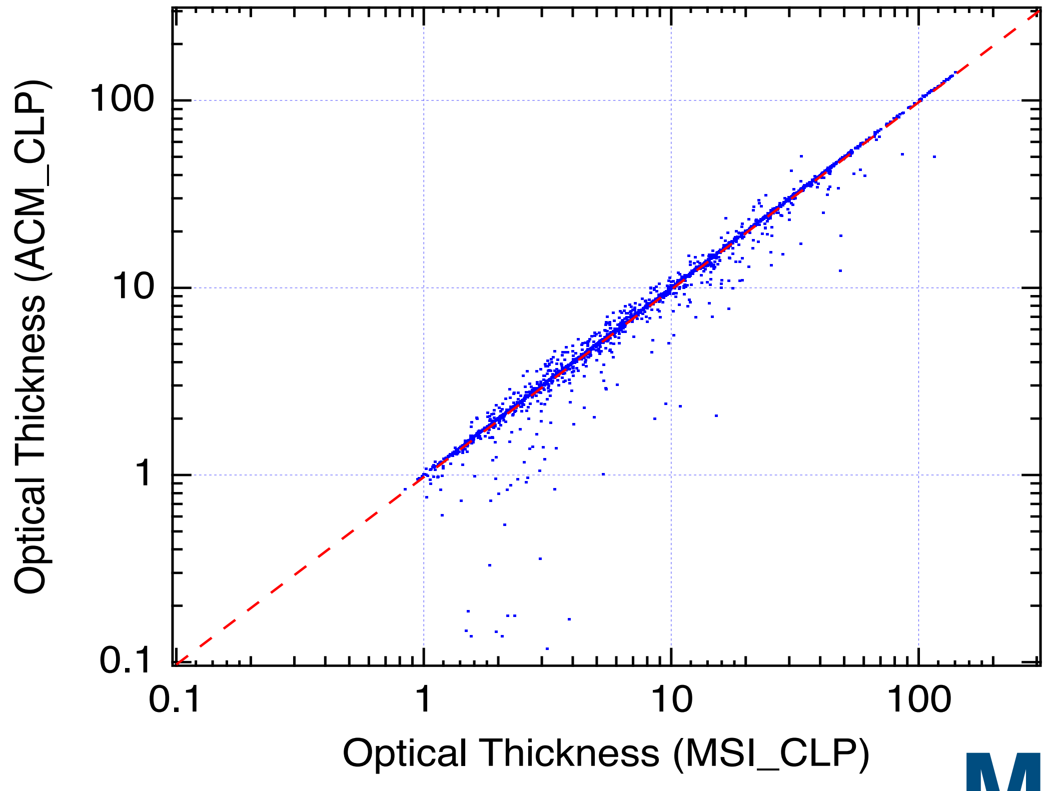
MSI

AC_CLP



MSI

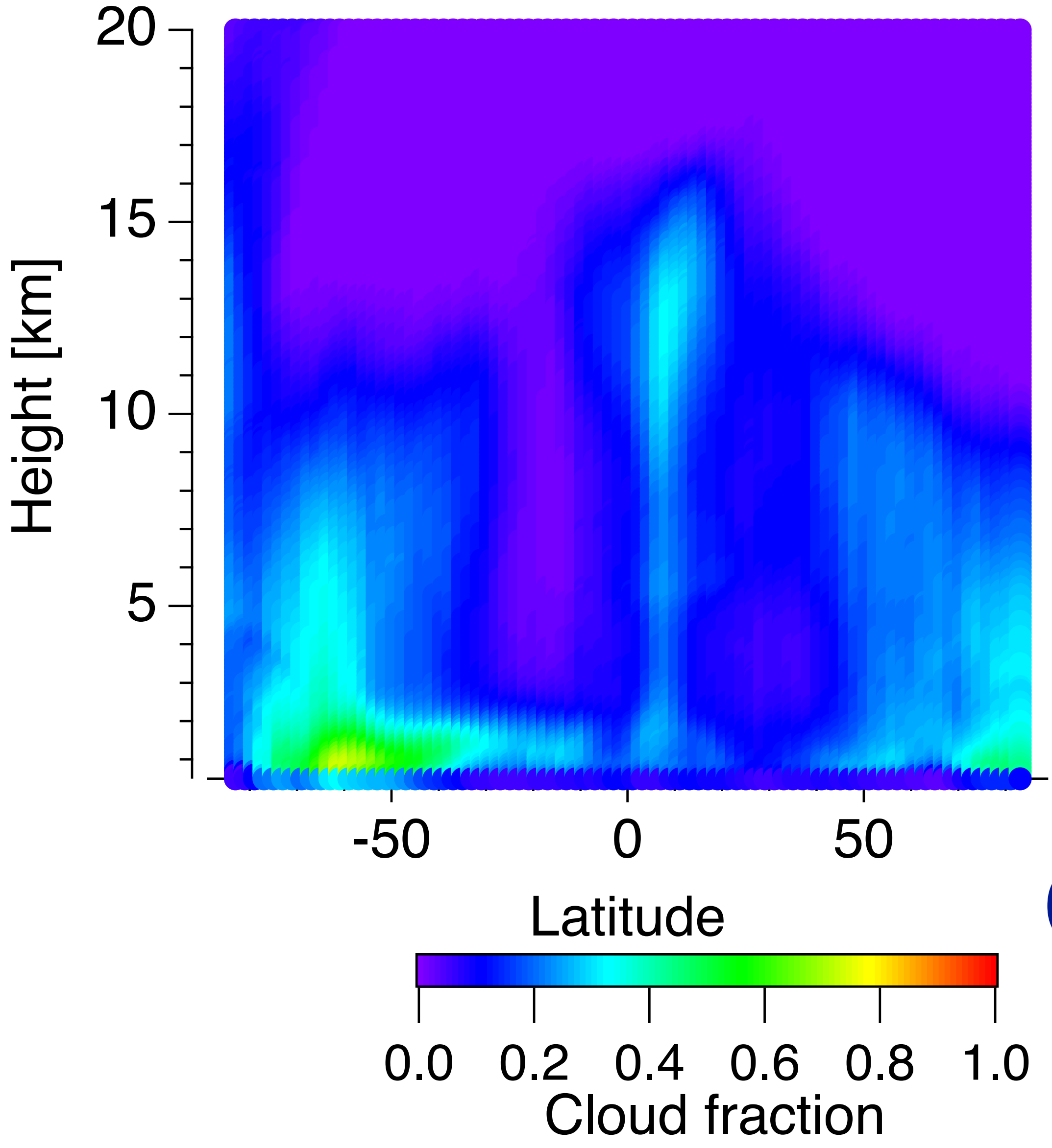
ACM_CLP



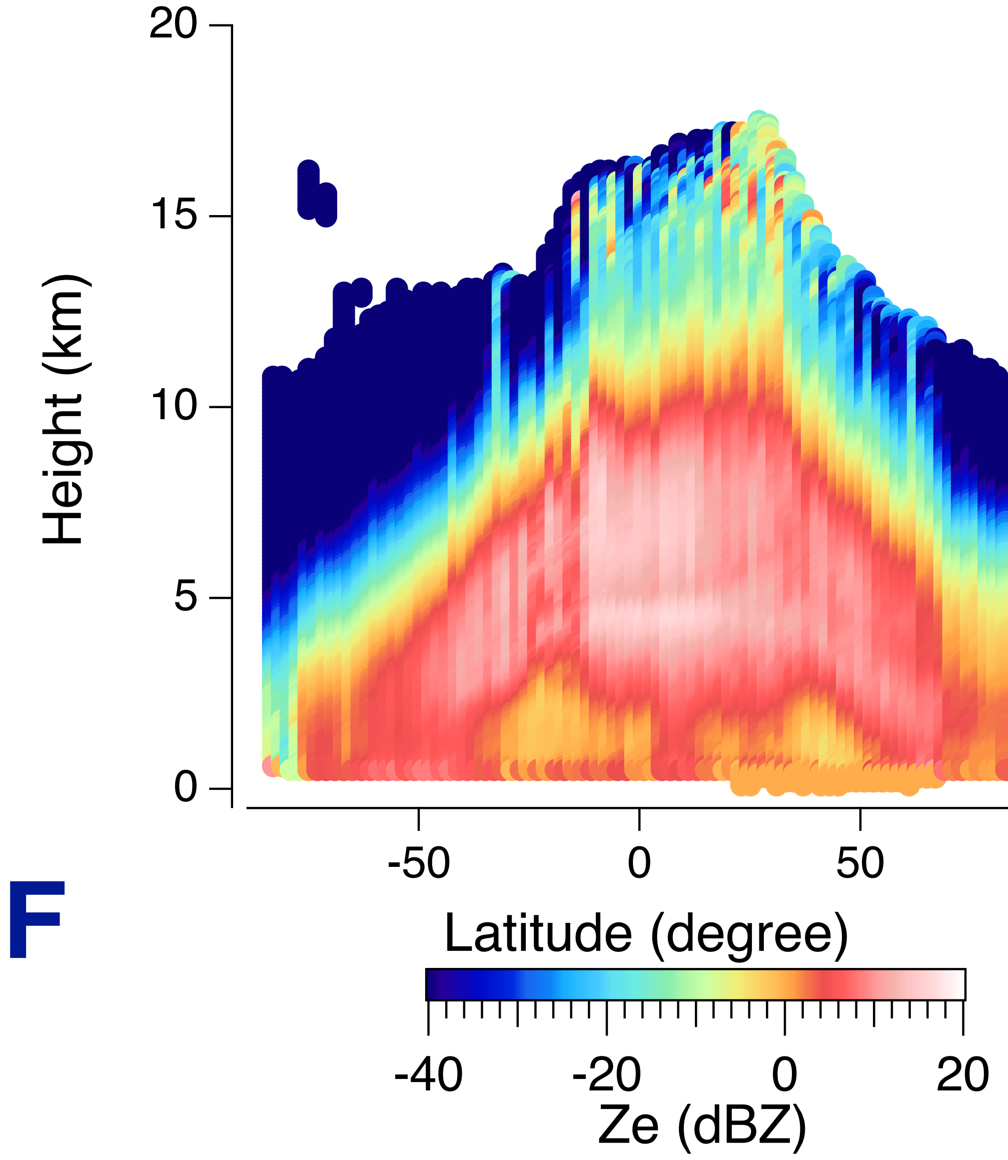
MSI

Global analysis of cloud microphysics and velocity-products in ACM

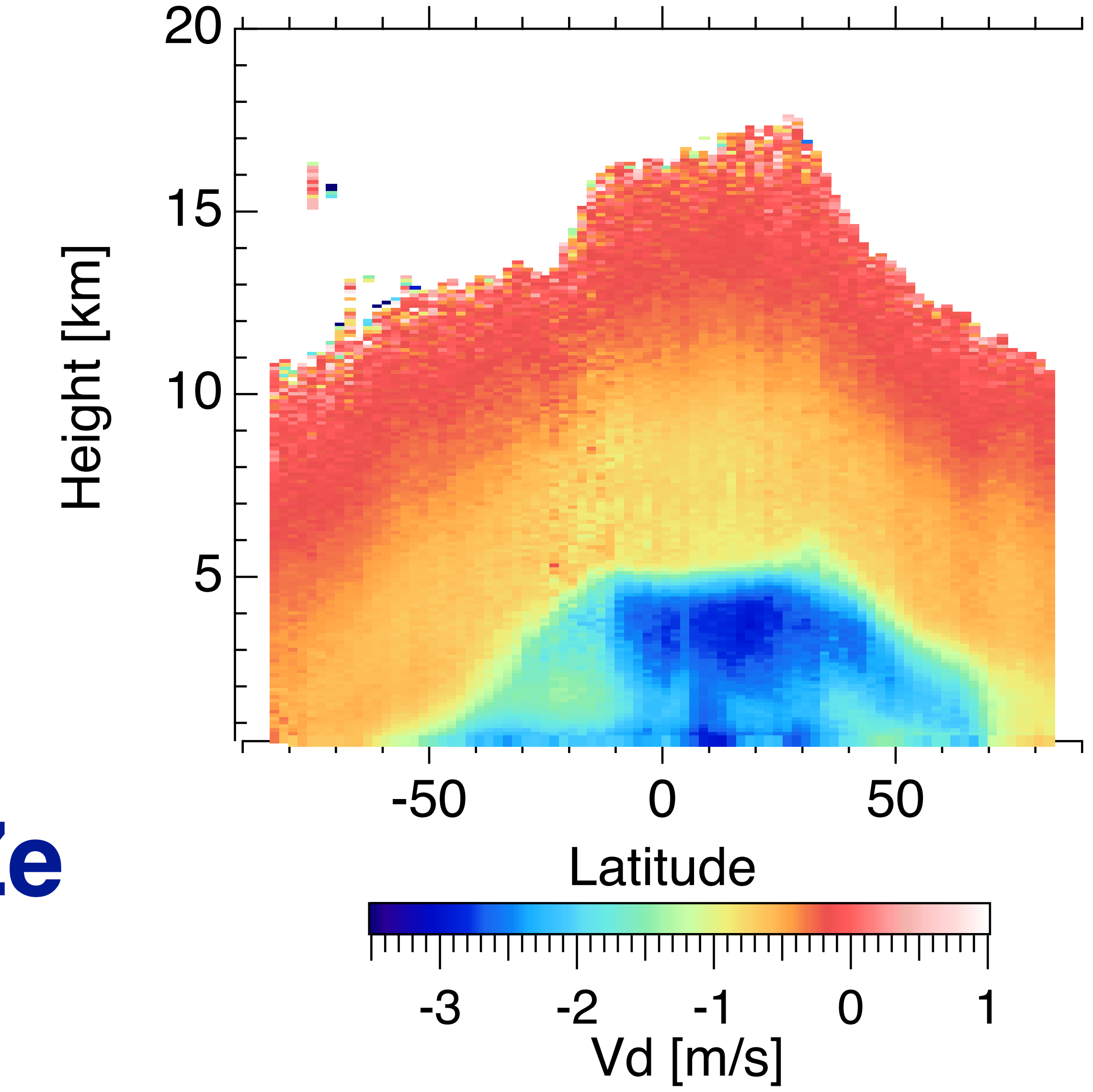
Monthly mean of height-latitude pattern of cloud microphysics is derived in August 2025.



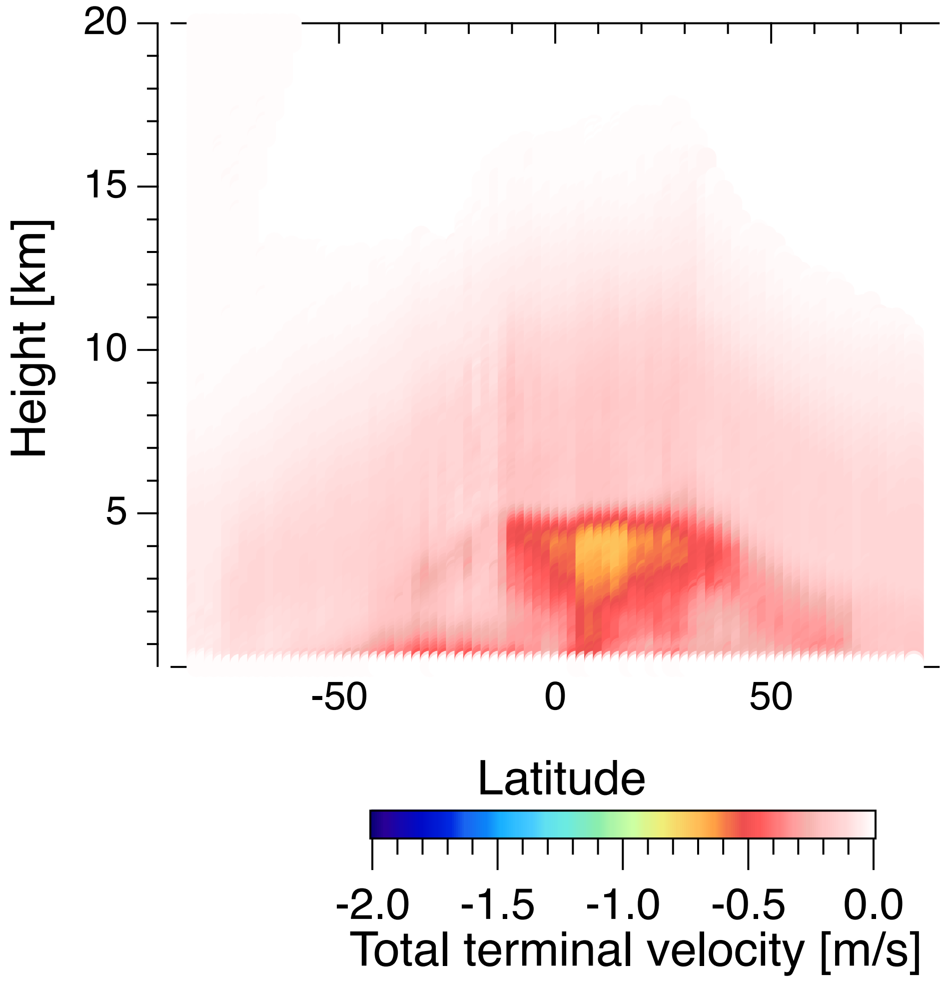
CF



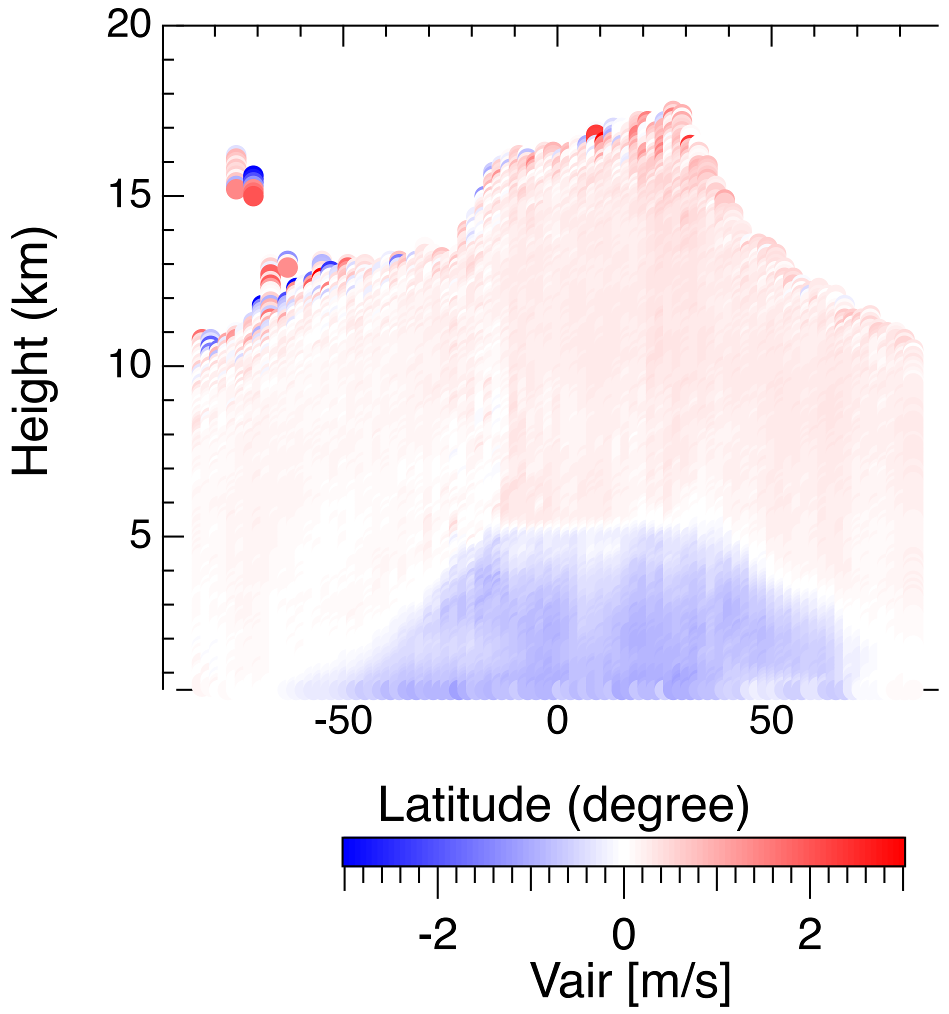
Ze



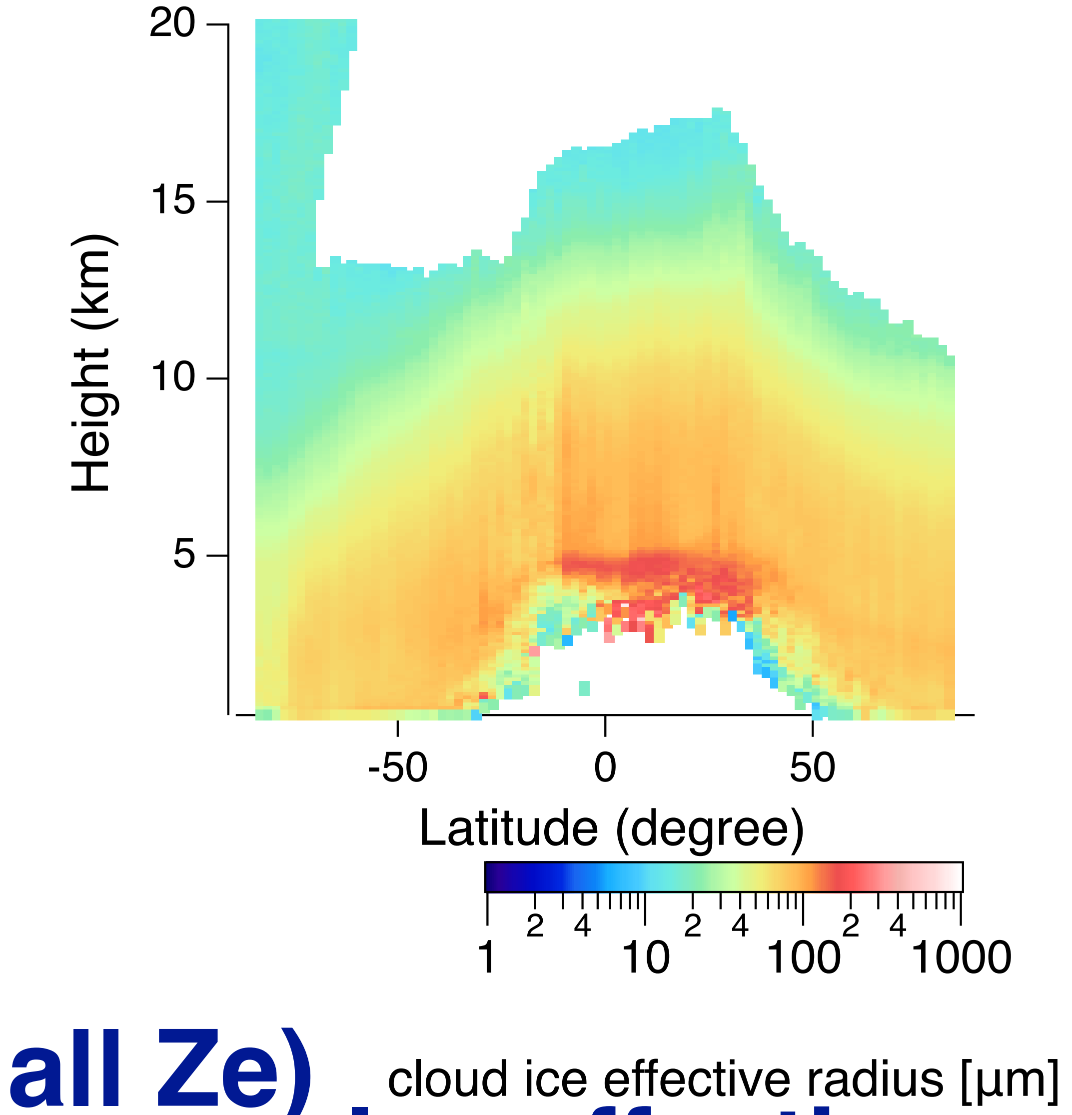
Vd



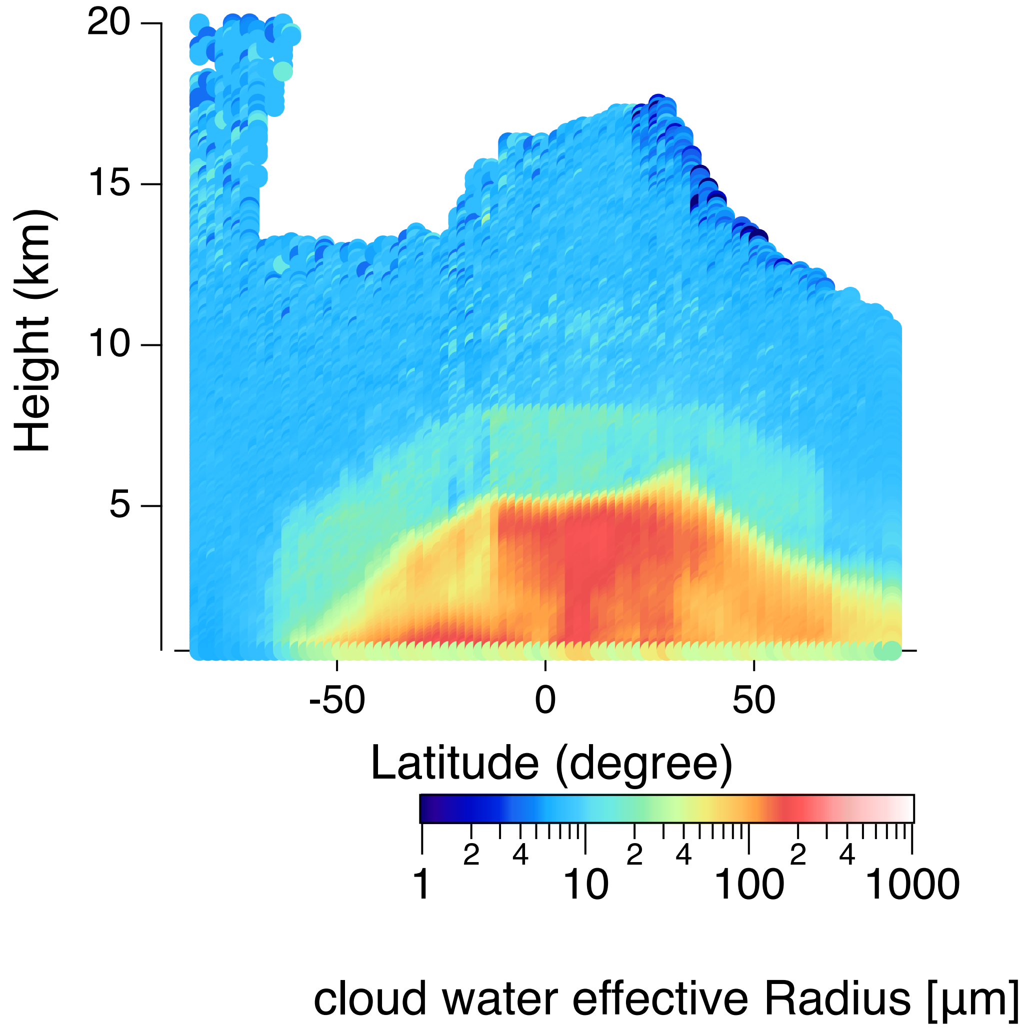
Terminal velocity



Air velocity (* for all Ze)



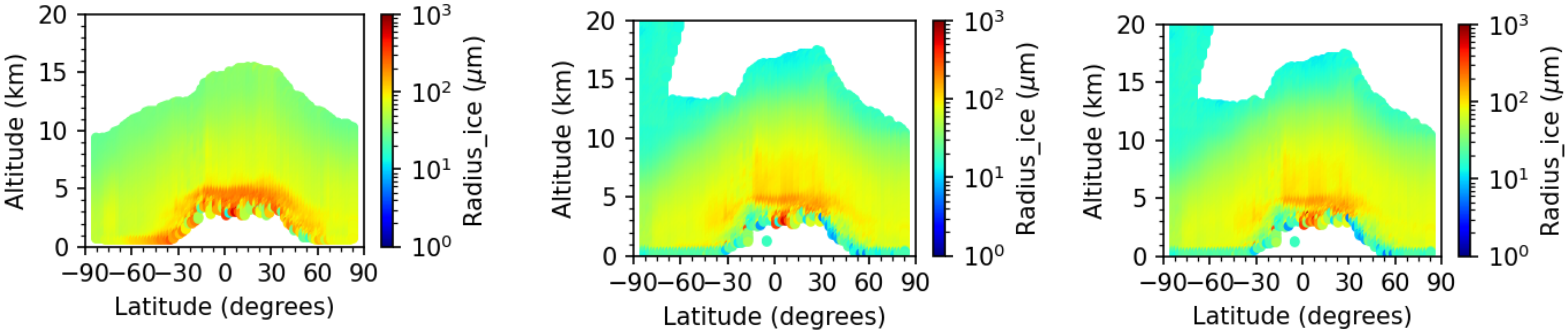
Ice effective radius



Water effective radius

Differences in microphysics among CPR_, AC_ and ACM_CLP

Zonal mean values of ice radius in CPR-CLP tends to be larger than in AC_CLP and differences in cloud microphysics between AC_CLP and ACM_CLP are small.



Evaluation activities and future plans for improvement of algorithms

Evaluation of CLP products by using ground-based measurements (HG-SPIDER, Doppler lidar, Wind profiler, HSRL) at NICT and evaluation of LES using EarthCARE by H. Zhang (Day2 H219) —understand mechanism of vertical motion

Evaluation of CLP products by K2W (MRR and disdrometer) in Antarctic by G. Roversi (CNR-ISAC) (Day2 H215)

Unfolding of Doppler velocity by A. Shaik (Day5 Annex 48)

Evaluation in the Arctic with L. Pfitzenmaier, K. Ebell (Univ. of Koeln) and M. Koike (Univ. Tokyo)