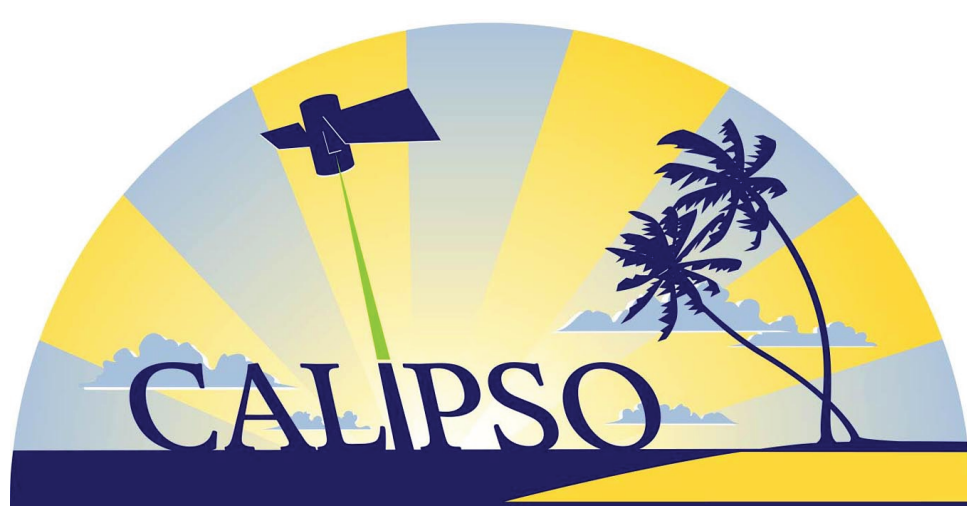




Comparison of the CALIPSO Level 3 Ice Cloud Product with the DARDAR and 2C-ICE products

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Abstract

Understanding the vertical distributin of ice clouds is crucial for climate modeling and wather forecasting. Since its launch to space in 2006, the Cloud-Aerosol Lidar with Orthogonal Polarization instrument (CALIOP) onboard the CALIPSO spacecraft has been providing unprecedented high-quality profiles of ice clouds, especially optically thin cirrus clouds, during both day and night, on a global scale. Recently the lidar science working group at the NASA Langley Research Center delivered a level 3 (L3) ice cloud product which reports monthly statistics of ice cloud extinction coefficient and ice water content on a uniform 3-dimensional spatial grid. This presentation compares the ice cloud climatology derived from this product with two other ice cloud products, namely the raDAR/liDAR(DARDAR) ice cloud product and the CloudSat-CALIPSO Ice Cloud Property Product (2C-ICE). Using processing similar to the CALIPSO L3 product, granules of DARDAR and 2C-ICE data have been processed into monthly statistics for a better comparison. Similarities and differences will be presented and discussed. The findings illustrate the strengths of the different products and help to identify which product might be most appropriate for a given research topic.

Motivation

Three products, i.e., CALIOP L3 ice cloud product,, DARDAR and 2C-ICE, provide profiles of ice clouds extinction coefficients and IWC. **What are the differences?**

Datasets

- **V4.20 CALIOP L2 05kmCPro product**
 - granule, grid: 5 km hori. × 60 m ver.
- **V1.00 CALIOP L3 ice cloud product**
 - global, monthly, grid: 2.5° lat. × 2.0° lon. × 120 m alt.
- **V3.10 DARDAR L2 ice cloud product**
 - granule, grid: ~1.4 km hori. × 60 m ver.
- **R05 2C-ICE L2 cloud product**
 - granule, grid: ~ 1.4 km hori. × 240 m ver.

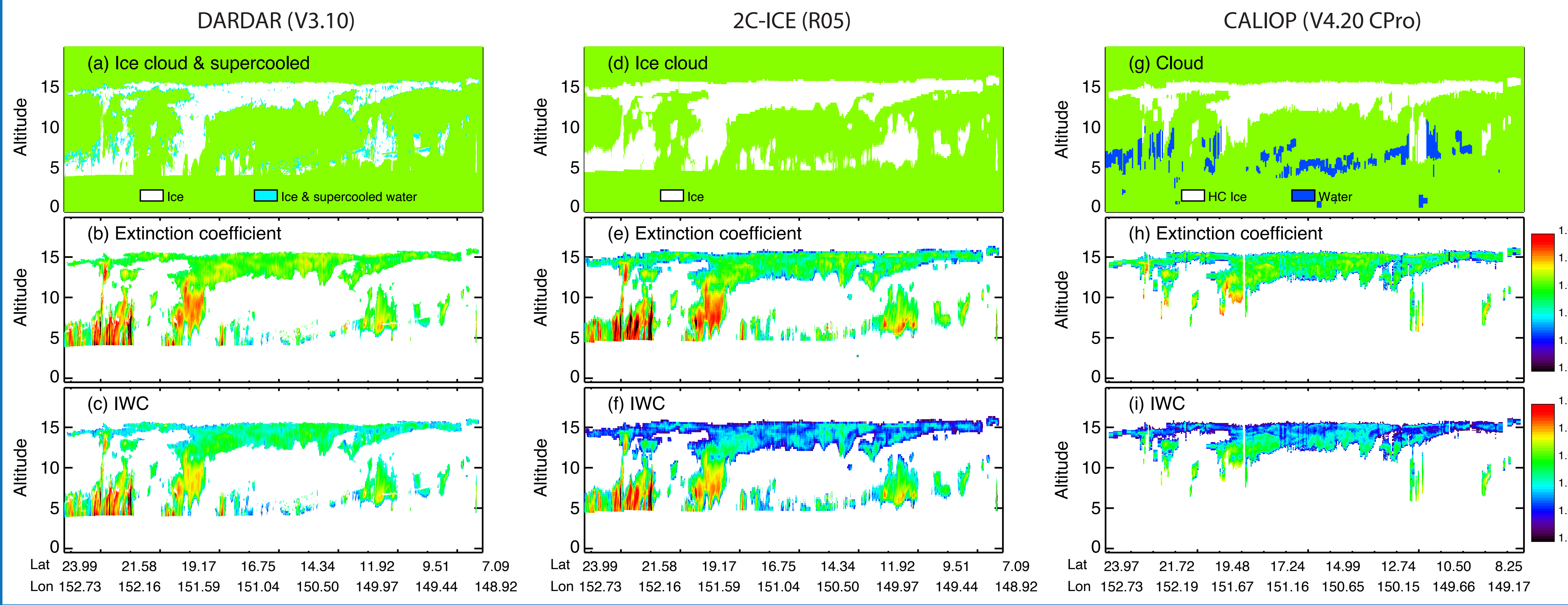
Methodology

- Case study: an ice cloud example on July 28, 2008
- Statistical study: monthly statistics in July 2008
 - Built L3 products with DARDAR and 2C-ICE, using a similar aggregation method as CALIOP L3 ice cloud product.
 - L3 DARDAR: (2.5° lat. × 2.0° lat. × 120 m alt.)
 - L3 2C-ICE: (2.5° lat. × 2.0° lat. × 240 m alt.)

Acknowledgements

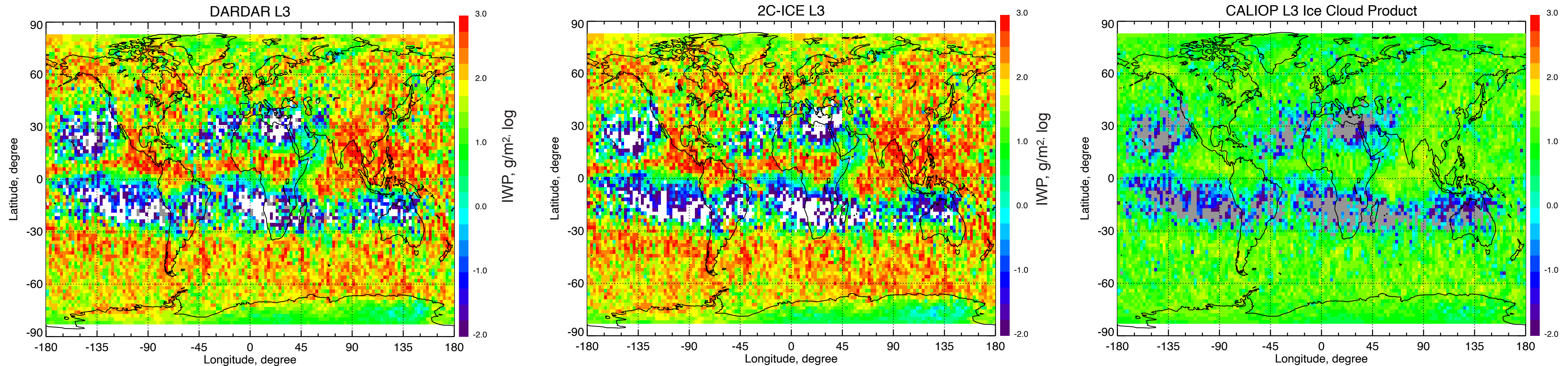
This work is supported by NASA SMD. The DARDAR data is provided by ICARE Data and Service center at the University of Lille, France. The 2C-ICE data is downloaded from the CloudSat Data Processing Center at Colorado State University.

An ice cloud on July 28, 2008

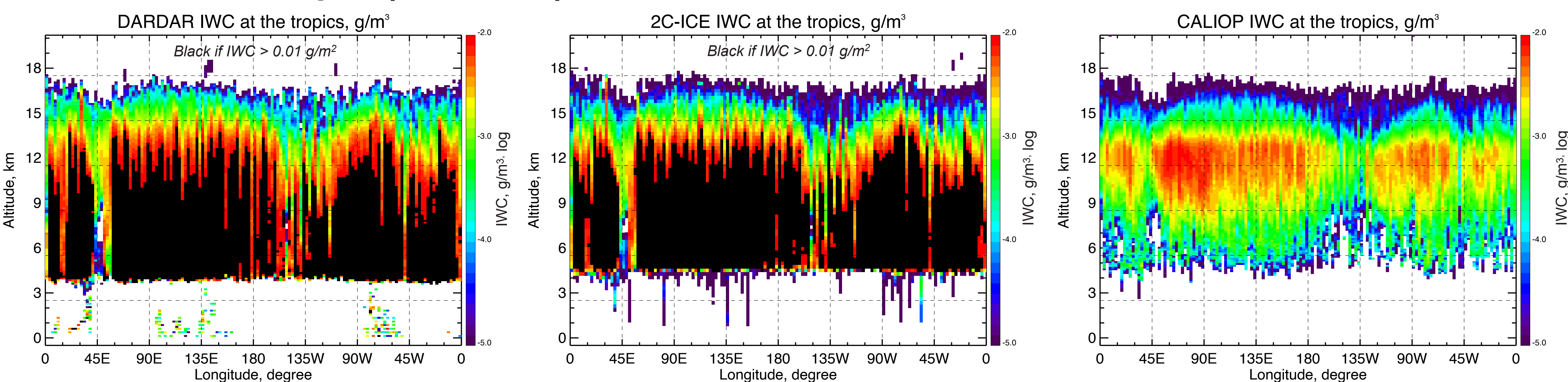


Statistical analysis in July 2008

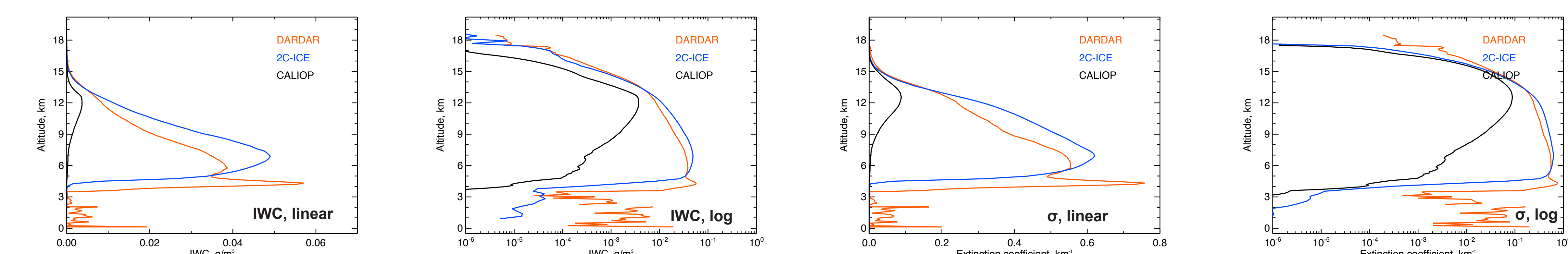
Ice water path



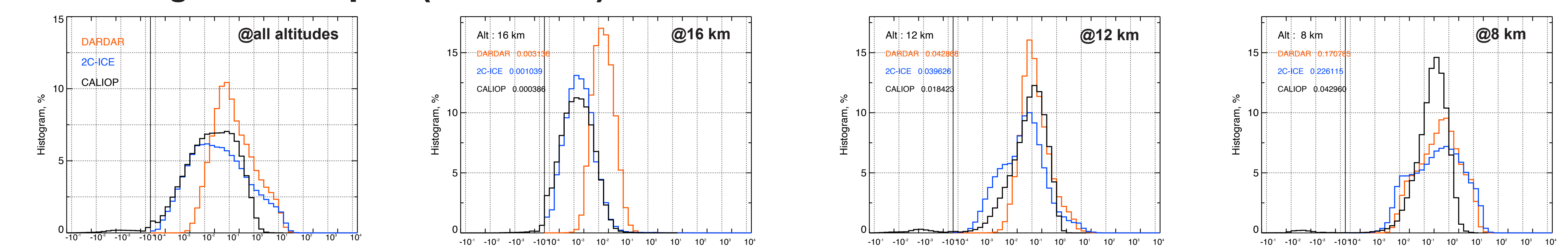
Meridional IWC at tropics (10°S - 10°N)



IWC and extinction coefficient profile at tropics (10°S - 10°N)



IWC histograms at tropics (10°S - 10°N)



Discussion

- CALIOP L3 ice cloud product has limited information of optically thick ice clouds due to totally attenuated lidar signal.
- Three products report different geometrical and optical properties of ice clouds using different phase algorithm and microphysics. For example, CALIOP uses the emperical parameterization from *Heymsfield et al.* [2014], DARDAR considers a physics-based modified version.
- DARDAR extinction coefficient and IWC tend to be on large side due to a higher retrieved lidar ratio than what CALIOP retrieved, e.g., 40 vs. 20 of the cirrus cloud on the right.
- Three L3 products find a similar IWP pattern in July 2008. However the CALIOP IWP is one magnitude smaller than both DARDAR IWP and 2C-ICE IWP, which have similar magnitudes. Cirrus clouds with OD > 5 become opaque to CALIOP (A. Garnier, personal communication).
- A spike is seen around 4 km of the DARDAR IWC profile, which is due to large radar signals in the melting zone. Those signals seem being removed by 2C-ICE.
- At high altitude, the 2C-ICE IWC histogram is similar to CALIOP IWC histogram. At low altitude, it is similar to DARDAR IWC histogram.

Summary

- All CALIOP L3 ice cloud product, DARDAR and 2C-ICE products provide profiles of ice clouds σ and IWC. CALIOP ice cloud product provides global monthly statistics over a uniform 3D grid. Both DARDAR and 2C-ICE products are granules.
- For a single event, ice cloud geometrical and optical properties reported from CALIOP L2 cloud profile product, DARDAR and 2C-ICE products could be quite different due to lidar signal attenuation, different phase algorithm and microphysics.
- Though monthly CALIOP L3 ice cloud product, L3 DARDAR and 2C-ICE products report similar IWP patterns, the CALIOP L3 ice cloud IWP is one magnitude smaller than the other two IWP.

Reference

Heymsfield, A., Winker, D., Avery, M., Vaughan, M., Diskin, G., Deng, M., Mitev, V., and Matthey, R.: Relationships between Ice Water Content and Volume Extinction Coefficient from In Situ Observations for Temperatures from 0° to -86°C: Implications for Spaceborne Lidar Retrievals, *J. Appl. Meteor. Climatol.*, 53, 479–505, <https://doi.org/10.1175/JAMC-D-13-087.1>, 2014.