Comparison of TWP-ICE Satellite and Field Campaign Aircraft Derived Cloud Properties

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1. Motivation

To provide large-scale satellite derived cloud and climate information for the Tropical Western Pacific Region. This information, validated by ARM ground-based and Tropical Warm Pool-International Cloud Experiment (TWPICE) in-situ measurements, gives insight to the impact of deep convective clouds in the region and supports ARM'S goal of characterizing the world's major climate regimes.

2. Methodology

VISST

Visible Infrared Solar-Infrared Split Window Technique

- Utilizes parameterization of theoretical radiance calculations for 7 water and 9 ice crystal size distributions *(Minnis et al. 1998)*
- Retrieves cloud properties by matching calculations to MTSAT-1R multispectral observations
- MTSAT-1R hourly, 4-km pixel resolution data
- Profiles from Global Forecast Model (GFS)
- CERES NB-BB Conversion Coefficients
- IGBP Scene ID
- Compare to in-situ & surface data when possible

3. Products

Cloud Macro and Microphysical Properties

Pixel-level

Binary data retrieved at instrument nominal resolution (τ, r_e, LWP, IWP, Phase, etc)
(Minnis et al. 2004)

Gridded

0.5° or 1.0° means separated by cloud height or by phase.

Surface Site Radial Averages

Means of pixel-level quantities within a 10 or 20-km radius centered at ARM and TWPICE surface sites.

Aircraft Matched

Weighted average of 4 pixels nearest to aircraft flight path.

4. Pixel-Level Products

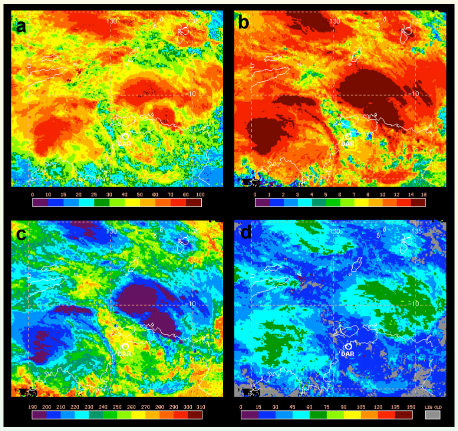

Figure 1. Jan. 23 0433 UTC VISST derived cloud products. (a) Shortwave albedo, (b) Effective cloud height; km, (c) Effective cloud temperature; K, (d) Effective ice particle diameter; µm

5. Surface Site Radial Averages

Mean TSI - 73%, VISST - 67%

TSI	0-20% (VISST)	20-50% (VISST)	50-80% (VISST)	80-100% (VISST)
80-100%	0	2	4	51
50-80%	3	4	3	5
20-50%	14	2	2	1
0-20%	7	0	0	0

a

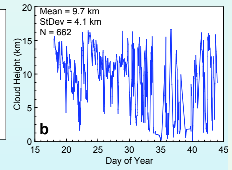

Figure 2. Satellite derived cloud properties over the Darwin ground site. (a) Cloud Fraction Comparison, (b) Effective Cloud Height

6. Aircraft Matched

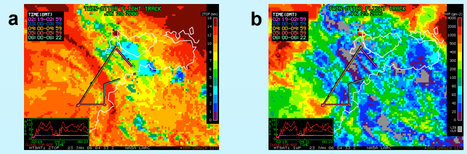

Figure 3. Twin Otter 23 January flight track overlay on VISST Cloud Products. *a) Cloud Top Height, (b) IWP

Summary

Cloud and radiation products derived from the MTSAT-1R satellite have been developed for TWP-ICE. These include pixel-level, gridded, and ground site and aircraft matched. These products are available from the Langley website and the ARM data center. As shown in Figs 2, and 4-6 these products compare favorably with in-situ ground and aircraft based measurements. With additional quantitative validation these products can provide valuable information about tropical convection and its impact on the radiation budget and climate. As new algorithm improvements, such as multi-layer cloud detection, are implemented these products will be reprocessed and updated.

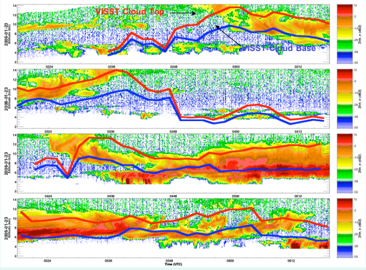

Figure 4. Comparison of Jan. 23 VISST derived cloud boundaries with the 94 GHz Cloudsat/JPL airborne radar (ACR) onboard the Twin Otter

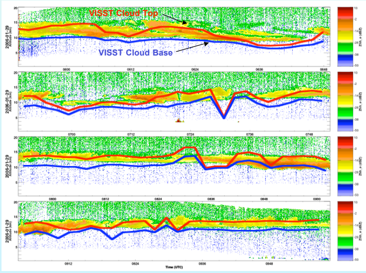

Figure 5. Same as Fig. 4, for Jan. 29.

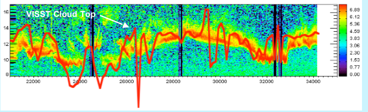

Figure 6. Comparison of Jan. 29 VISST derived cloud top height with the Twin Otter Lidar

References

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