

Statistical Summary Products for the CMBE Dataset.

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Introduction

Statistical summary files are a new addition to the **Climate Modeling Best Estimate (CMBE)** dataset. It includes both monthly mean and monthly mean diurnal cycle and their climatology for all the geophysical quantities contained in the CMBE datasets. These statistics are often used in evaluating climate models.

However, uncertainties may exist in these statistics generated by different research groups due to missing gaps and data quality issues in the original CMBE data. Our purposes are to

- create standard, **highly polished, multi-year statistical summary datasets** from the original imperfect CMBE data.
- make it even easier to use the CMBE data in climate modeling studies.
- facilitate the use of ARM observational data by model developers in their operational **model diagnostic and evaluation**.

CMBE Dataset

The CMBE dataset consists of:

- cloud fraction (*ARSL, TSI*),
- liquid water path and precipitable water (*MWRRET*),
- surface radiation fluxes (*QCRAD*),
- soundings (*wnpn, lssonde, sonde*),
- surface precipitation (*SMOS*),
- surface turbulent fluxes (*BAEBBR*),
- surface meteorology fields (*SMOS, met*),
- top of the atmosphere radiative fluxes (*satellite*),
- Numerical Weather Prediction model analysis data.

The statistical summary CMBE data include:

1. **Diurnal cycle** averaged for each individual month,
2. **Monthly climatology of diurnal cycle** and standard deviation (≥ 3 yrs, except for clouds over TWP C1, C2, and C3),
3. **Monthly mean**,
4. **Monthly mean climatology** and standard deviation (≥ 3 yrs, except for clouds over TWP C1, C2, and C3)

The QC

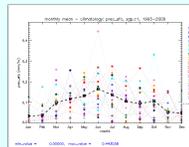
We created the statistical summaries files to provide a "best" estimate of these statistics based on our knowledge of the original CMBE data.

Stringent quality control checks were used to exclude the outliers suspected to be due to missing data

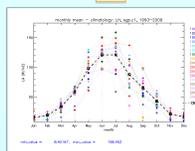
- 1) Set surface and TOA shortwave radiative fluxes to zero when solar insolation $< 0.5 \text{ W/m}^2$ (night),
- 2) Linear interpolation for missing gaps < 6 hours (except soundings and NWP),
- 3) QC flags indicate how many valid data were used,
- 4) Remove suspicious data outliers due to missing data,
- 5) 30% valid data required for generating monthly means,
- 6) Minimum 3 years required for climatology (except for clouds over TWP sites).

Annual Climatology at SGP

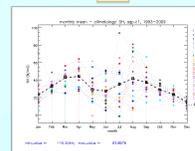
Precipitation



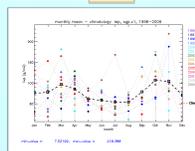
LH



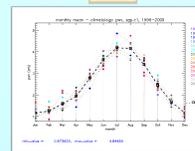
SH



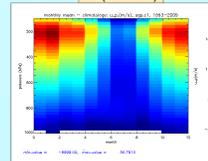
LWP



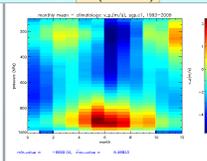
PWV



U (sonde)



V (sonde)



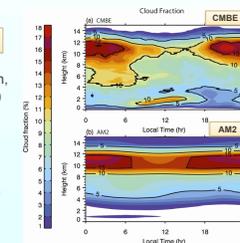
CMBE vs. NCAR and GFDL

GFDL AM2 vs. CMBE

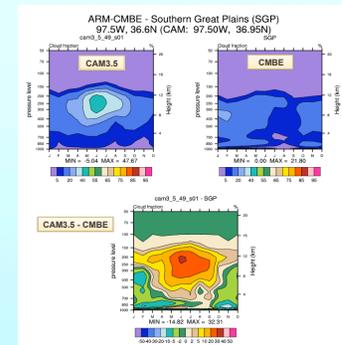
Diurnal cycle of cloud fraction, during summer months (JJA) at SGP

(a) CMBE cloud fraction 1996-2007

(b) GFDL AM2 cloud fraction climatology



NCAR CAM3.5 vs. CMBE



Data Reference

Download CMBE data and Statistical Summaries
<http://iop.archive.arm.gov/arm-iop/0showcase-data/cmbe/>

Webpage with detailed description and plots
http://science.arm.gov/gw/cpm/scm/data/best_estimate/

Xie, S. R.B. McCoy, S.A. Klein, et al. 2010, "ARM CMBE Data". *BAMS.*, 91, 13–20. DOI: 10.1175/2009BAMS2891.1.

Future Work

- Extend in time and enhance (soundings, satellite data, surface met and prec.) CMBE at NSA and TWP.
- CMBE for ARM Mobile Facilities (AMFs).
- High temporal resolution version of CMBE.
- Cloud Properties addition to CMBE (RIPBE led by Sally McFarlane).