# Availability of cloud microphysical properties compatible with forcing data

1. **Microbase products from BNL**
   - **Cloud properties (e.g., LWC/IWC)**
   - **20-min and over 233 levels**
   - **Available 3/00 – 2/01 at SGP; 1/03 – 12/04 at NSA, 11/03 – 10/04 at Manus**
2. **Mace's 8-year data at SGP**
   - **Cloud properties, radiative fluxes, radiative heating rate**
   - **1-hourly and 167 levels**
   - **Available 1997-2004**

***These two datastreams have been regridded onto the temporal and pressure levels of the variational analysis in order to facilitate the use of these data by modelers***

## MICRO_BASE Parameterizations

### Liquid-Ice Partitioning:

simple LWC/IWC fractionating scheme is used, where T = interpolated sounding temperature:

- For T <= -16C, all ice
- For T >= 0 C, all liquid
- For -16 < T < 0 C, ice fraction = linear fraction with no ice at 0 and all ice at -16

### LWC, IWC:

•Reflectivity-weighted distribution of MWR LWP (derivative of Frisch et al., 1995)

•Latest MWR Retrieval (Liljegren and Turner; Variable Coefficient)

•Liu and Illingworth(2000) Z-IWC.

### Liquid Mode Radius:

log-normal droplet distribution with fixed N and sigma

### Ice Effective Radius:

Ivanova et al.(2001): ice effective radius = (75.3 + 0.5895T) / 2

### Ice Crystal Size Distribution:

Bimodal log-normal with large and small crystal populations

**Mace Product (Column Physical Characterization (CPC) Microphysics**:

**Ice and Liquid:** Profiles with only liquid water and/or cirrus can be addressed using existing retrieval algorithms (Dong and Mace 2003, Mace et al., 2002, Liu and Illingworth, 2000).

**Potentially mixed phase**: Because the MWR observes the total liquid water path, the challenge is to treat profiles that contain supercooled clouds/mixed phase volumes along with perhaps cloud volumes that are warm (T>273K).

**Approach to supercooled/mixed phase liquid**:

Step 1: Estimate the fraction of the LWP that is warm and supercooled

Step 2: For the warm layer, apply Dong and Mace, (2003).

Step 3: For Supercooled liquid: Distribute the supercooled LWP vertically using the normalized parameterization of LWC and the MMCR cloud occurrence.

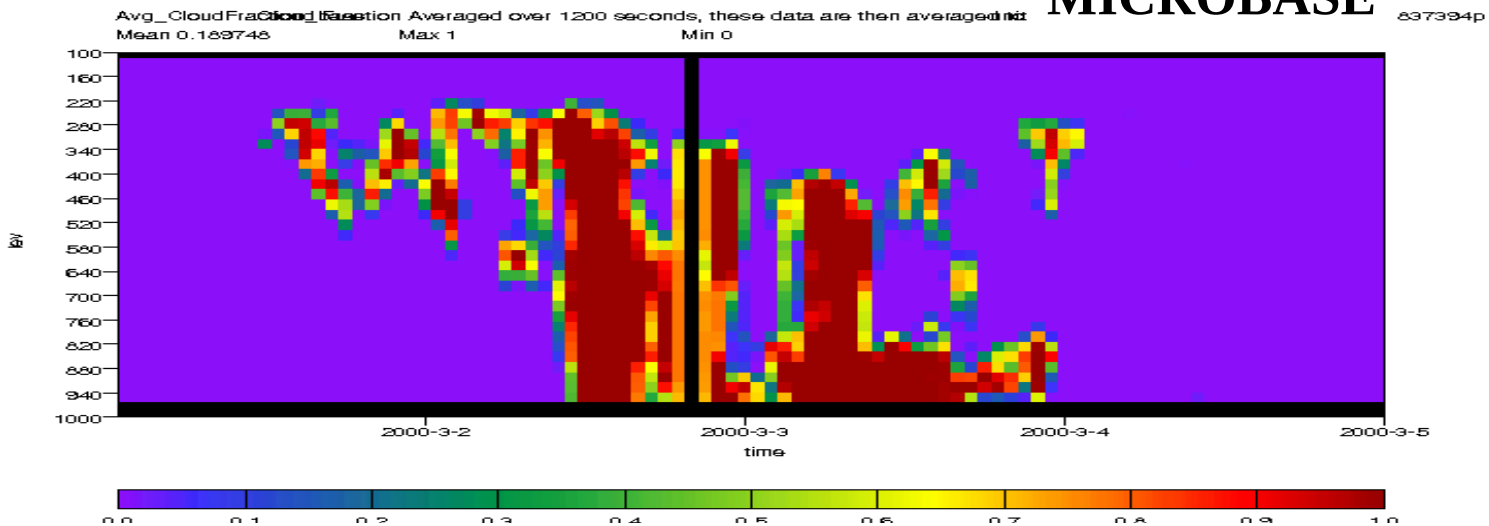
Step 4: For the ice content, apply a parameterization based on a regression between aircraft IWC in mixed phase clouds and radar reflectivity and velocity

Full Description in Mace et al., 2006

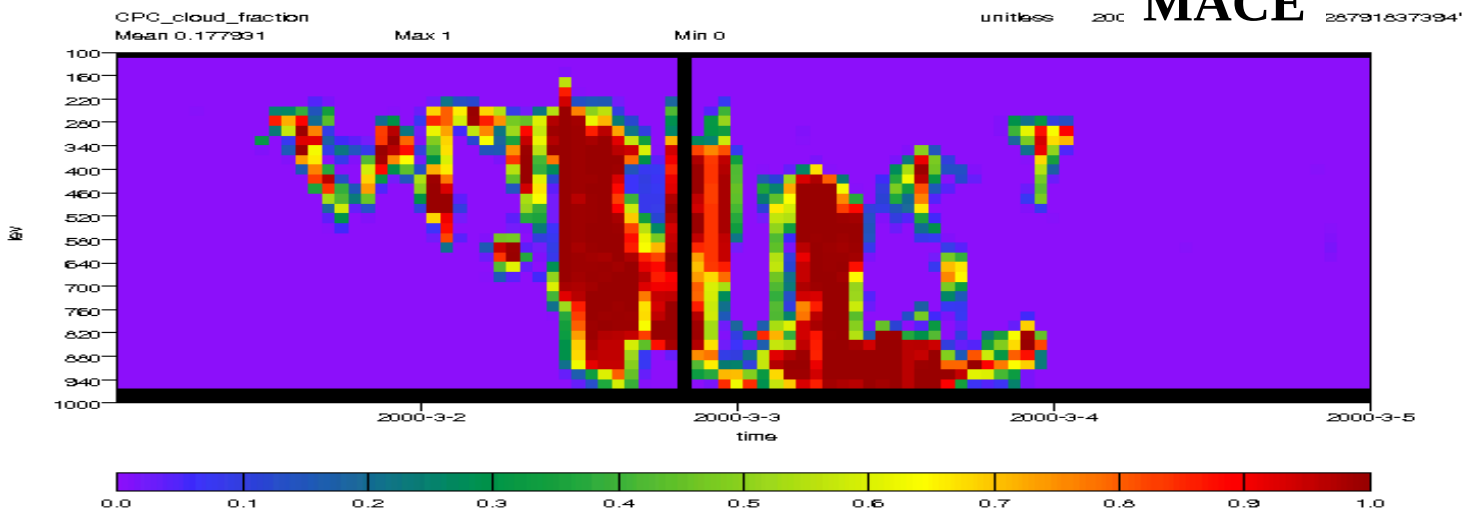
# Examples of the data

# Cloud Fraction

## MICROBASE




## MACE

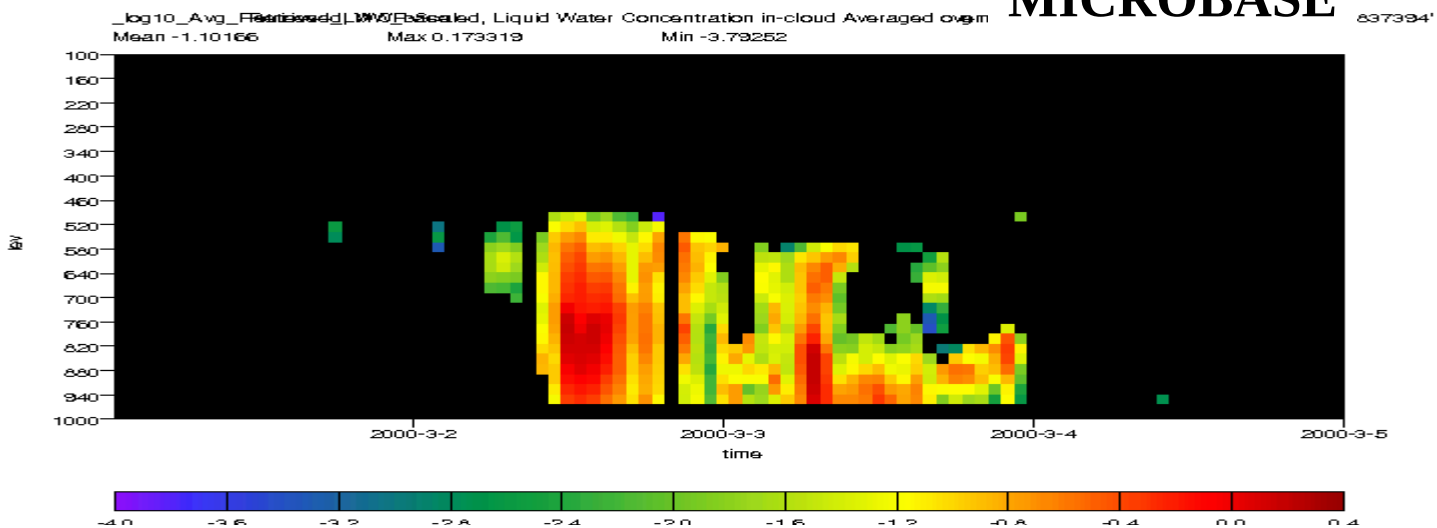



# March 1 – 4, 2000, SGP

***Figures are from Jay Hnilo (LLNL)***

# Cloud Liquid Water Content [log10(gm/m^3)]

**MICROBASE**

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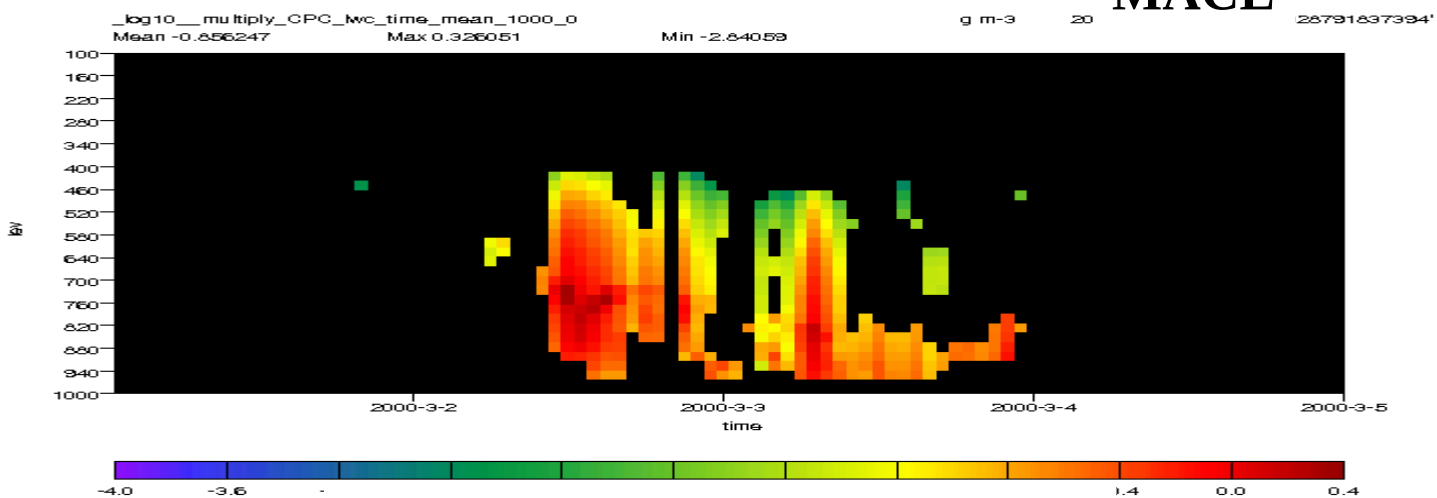


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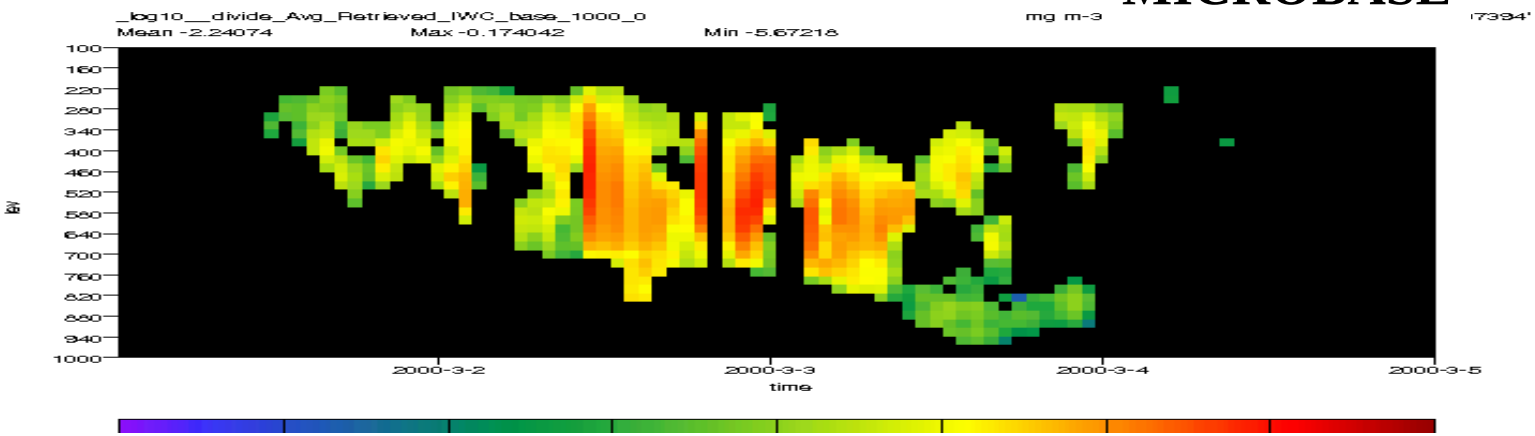


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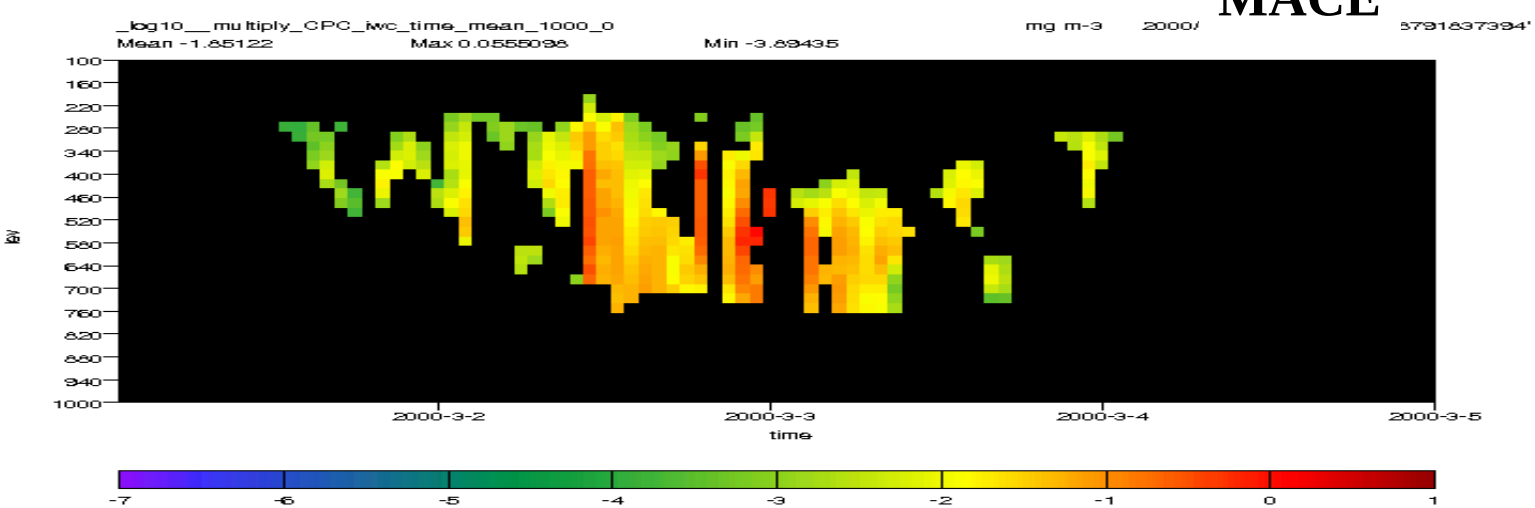


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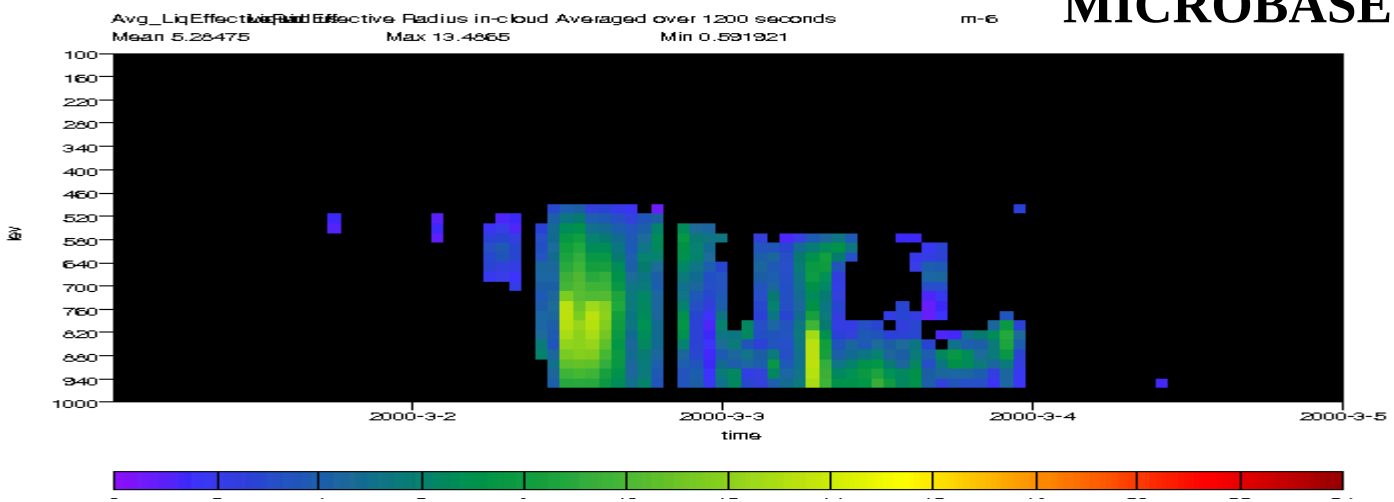
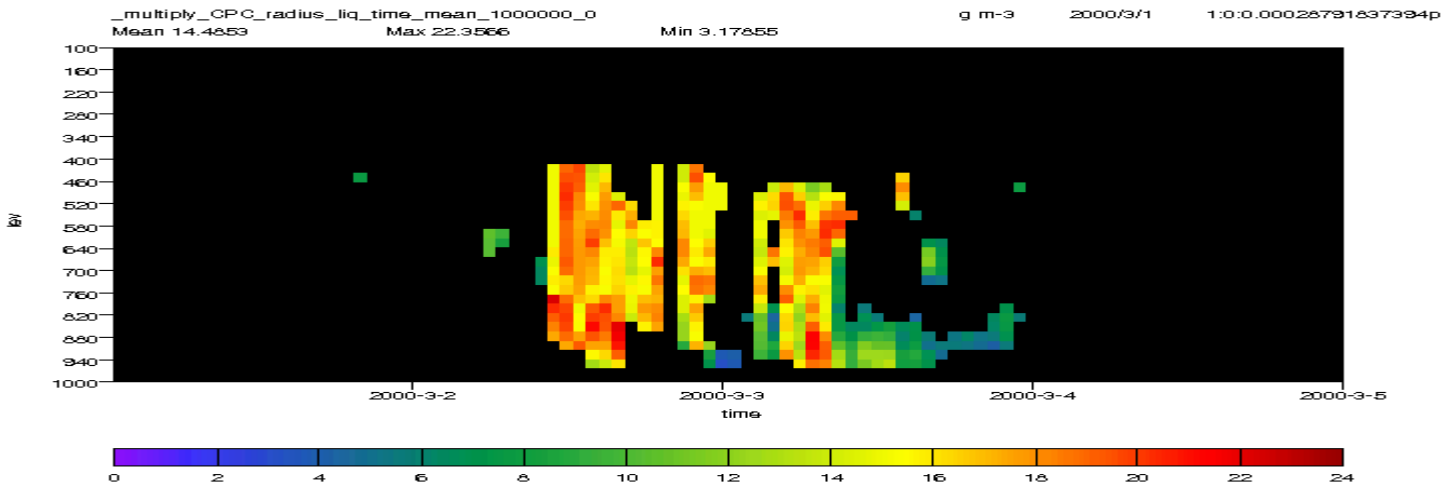
# Cloud Liquid Particle Radii [microns]

**MICROBASE**




**MACE**

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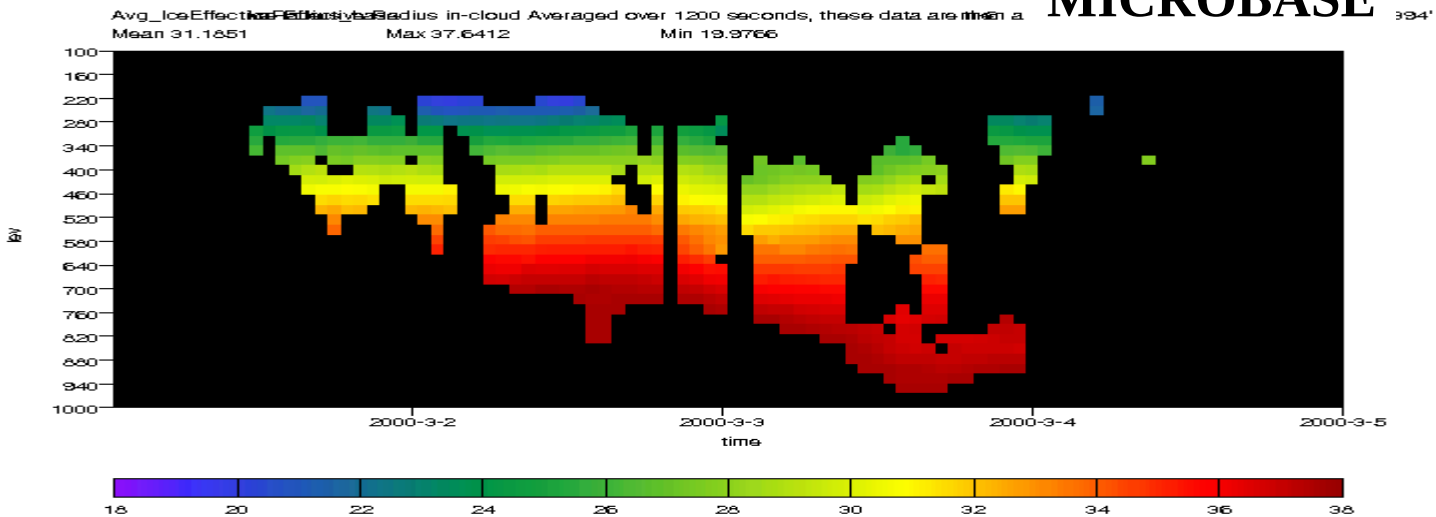


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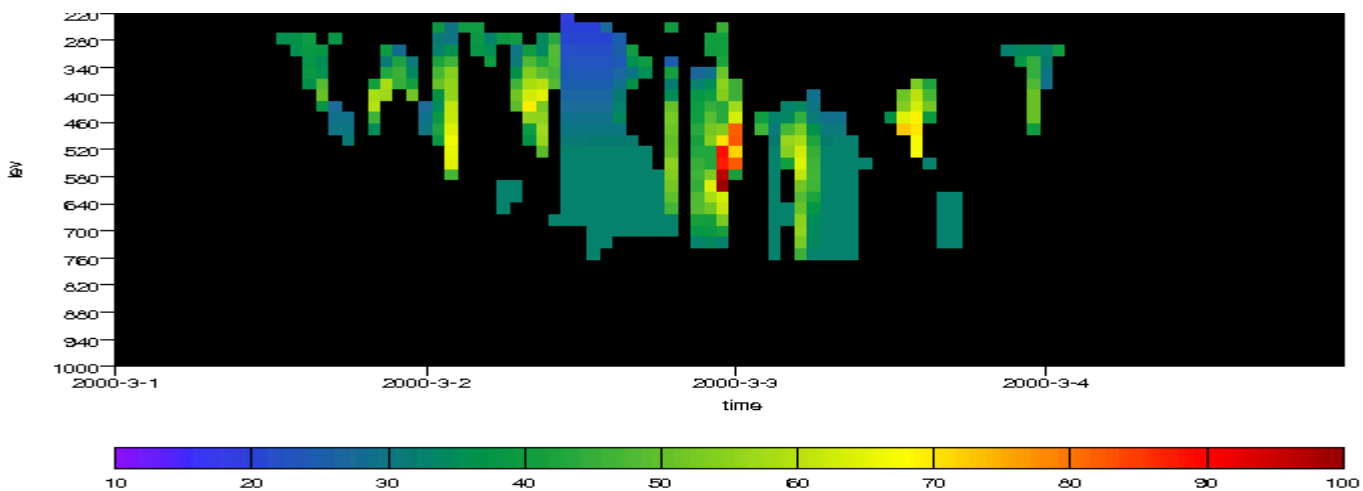


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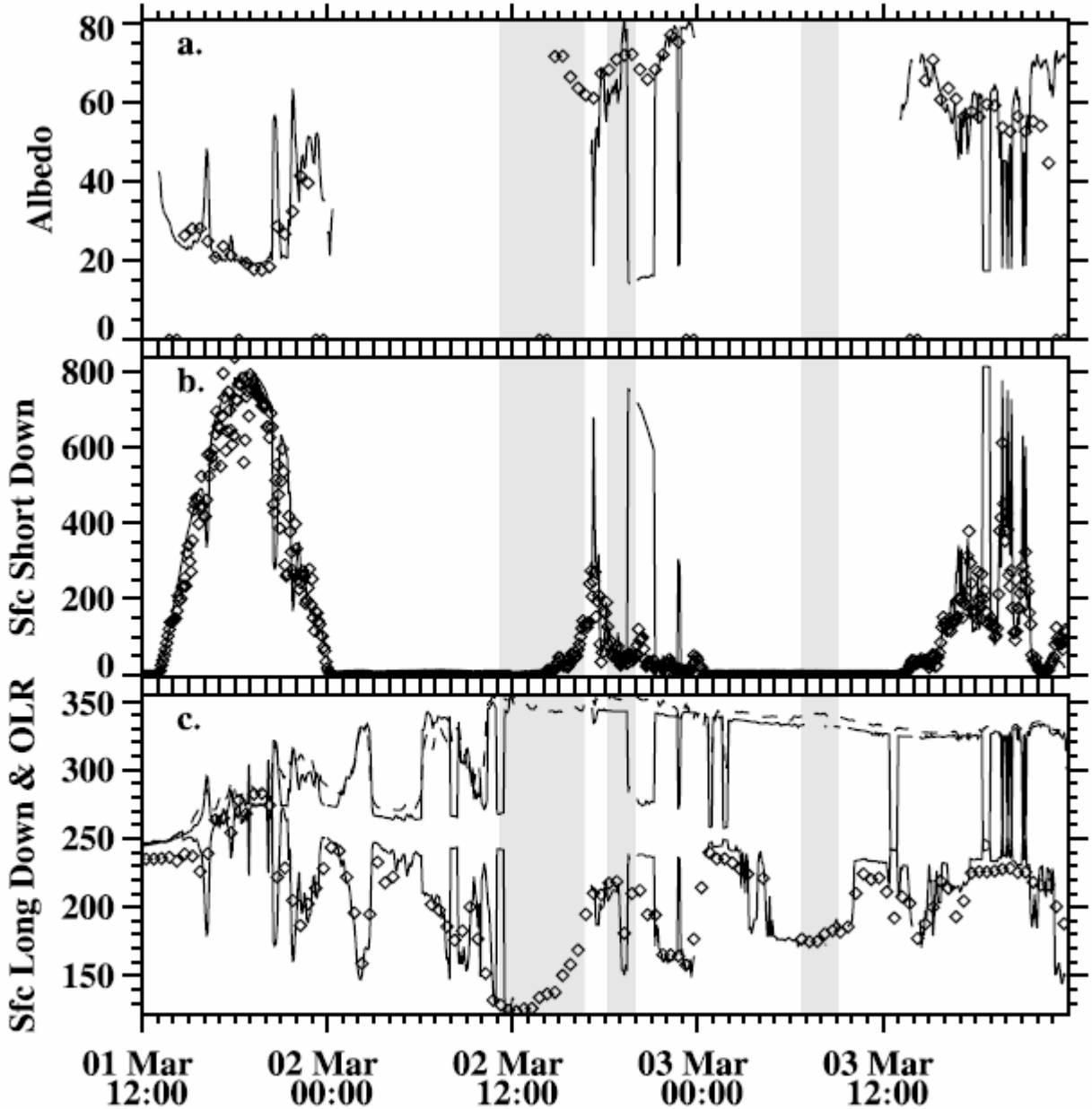
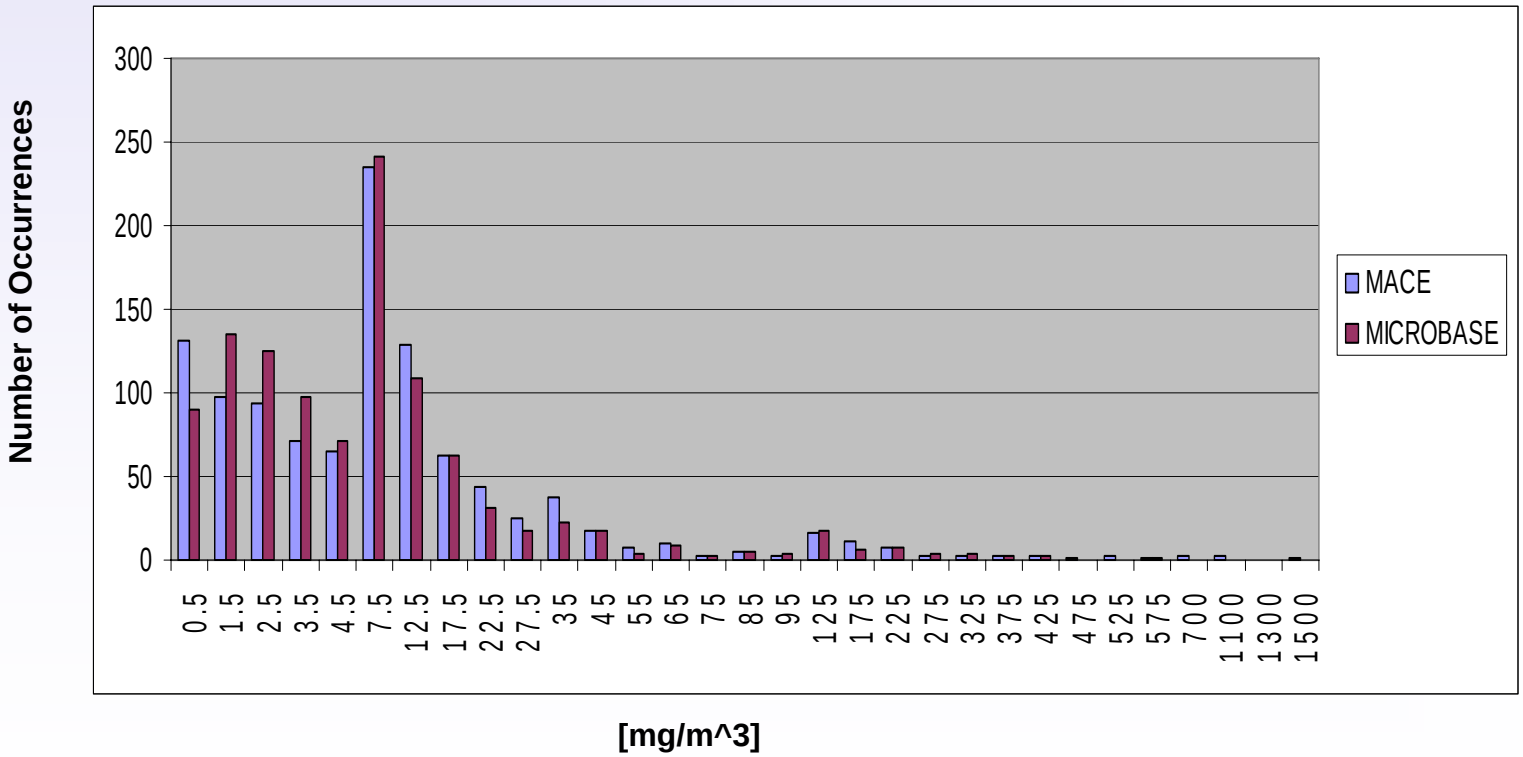



**Figure 12.** Comparison of derived fluxes (solid lines) with observations. (a) Calculated albedo compared with values derived from GOES. (b) Surface solar flux (W $m^{-2}$) compared with derived values and (c) OLR (lower values) and the surface downwelling longwave (higher values) (W $m^{-2}$).

# IWC at 300mb for the SGP (mg/m3) for the Microbase and Mace data.

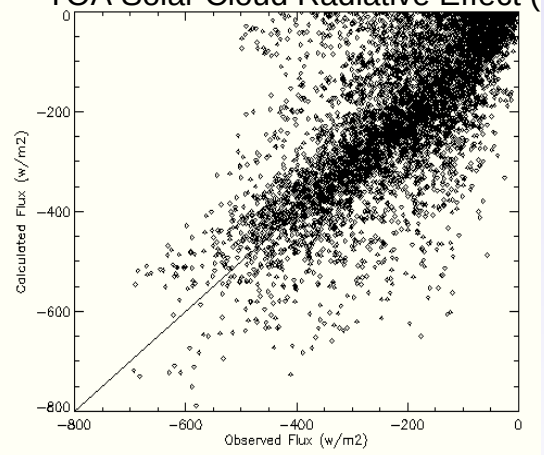
***From 03/01/2000-12/31/2000, 7343 total time points, 1090 mutual IWC observations binned below.***



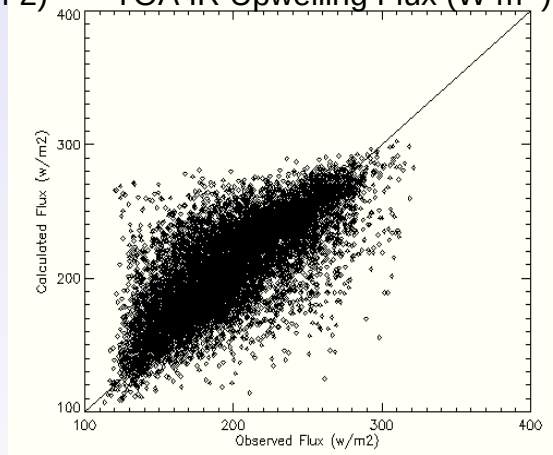

***Figures are from Jay Hnilo (LLNL)***

# CPC Validation (8 Years of data)

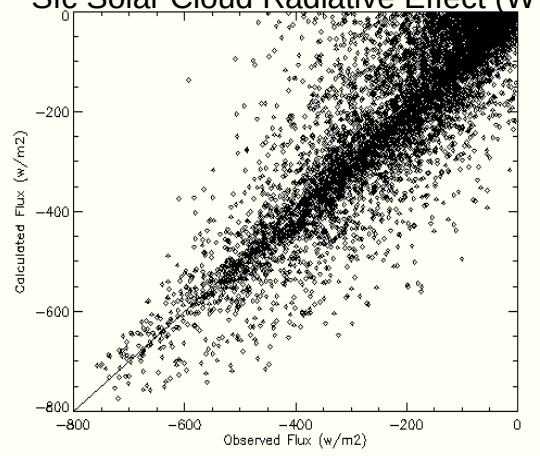
TOA Solar Cloud Radiative Effect (W m-2)



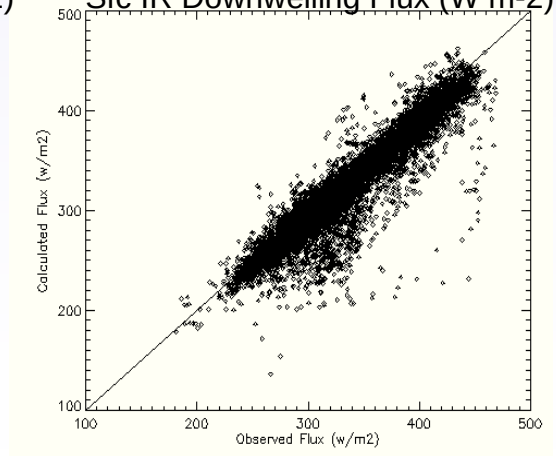

TOA IR Upwelling Flux (W m-2)




Sfc Solar Cloud Radiative Effect (W m-2)




Sfc IR Downwelling Flux (W m-2)




| | | Median Fractional Difference | Bias | Correlation Coefficient |
|---|---|---|---|---|
| TOA | $CFC - NS_t$ | 0.13 | +0.02 | 0.81 |
| | $L\uparrow_t$ | 0.07 | +0.05 | 0.75 |
| | $S\uparrow_t$ | 0.31 | +0.03 | 0.73 |
| SFC | $S_Frac\downarrow_s$ | 0.25 | -0.09 | 0.75 |
| | $L\downarrow_s$ | 0.02 | -0.04 | 0.94 |
| | $CFC - NS$ | 0.26 | +0.03 | 0.87 |