GEWEX CA

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# GCM Oriented Calipso Cloud Product (GOCCP)

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LMD / IPSL

# Content

- Presentation of GOCCP
- Examples of GOCCP uses
- Comparison of GOCCP cloud cover with CALIPSO-NASA cloud cover
- Comparison of GOCCP cloud cover with passive remote sensors climatologies from the GEWEX CA database
- About CFMIP-OBS database

# GOCCP: GCMs Oriented CALIPSO Cloud Product

**GOCCP-CALIPSO Dataset (obs)**

\+ Data processing like in the simulator

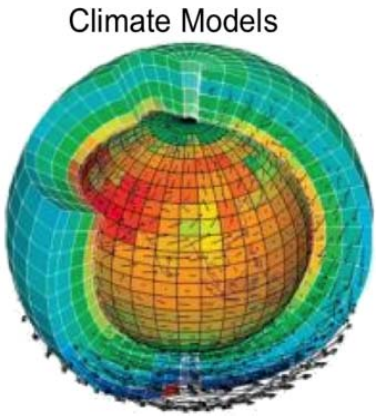
http://climserv.ipsl.polytechnique.fr/cfmip-obs.html

H. Chepfer, S. Bony, D. Winker, G. Cesana, JL. Dufresne, P. Minnis, C. J. Stubenrauch, S. Zeng, 2010 : « The GCM Oriented CALIPSO Cloud Product (CALIPSO-GOCCP) », J. Geophys. Res, 135, D00H16.

CONSISTENT

**« GCM+Simulator » Dataset (mod)**

COSP / CALIPSO Simulator +




http://cfmip.metoffice.com/COSP.html

H. Chepfer, S. Bony, D. M. Winker, M. Chiriaco, J.-L. Dufresne, and G. Seze, 2008 : « Use of CALIPSO lidar observations to evaluate the cloudiness simulated by a climate model », Geophys. Res. Lett., vol. 35, L15704

➔ **GOCCP-CALIPSO** is directly comparable to « GCM+Simulator » outputs, it is used by several climate models in the framework of the Cloud Feedback Model Intercomparison Program (CFMIP).

# Description of GOCCP files

1) **Scattering Ratio : Definition**

2) **File : « instant SR »**

3) **Scene classification**

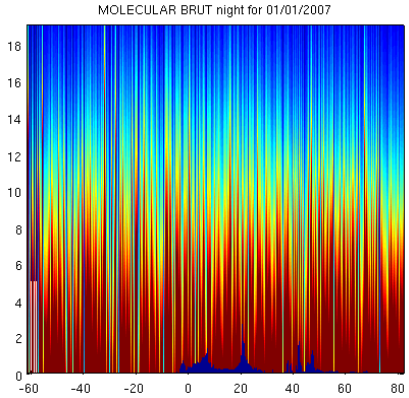
4) **File : « 3D_CloudFraction »**

5) **File : « MapLowMidHigh »**

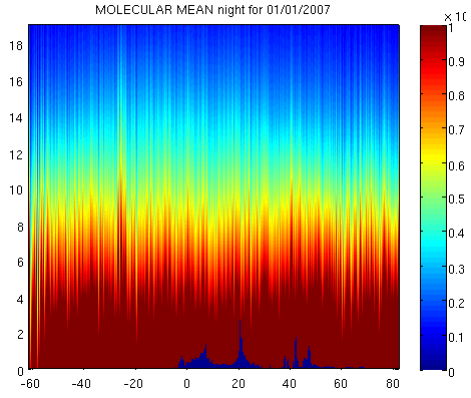
6) **File : « SR_histograms »**

# Description of GOCCP files

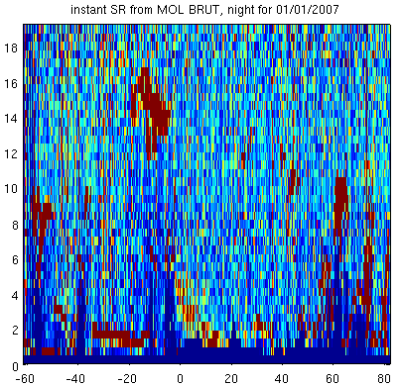
## 1) Scattering Ratio : Definition



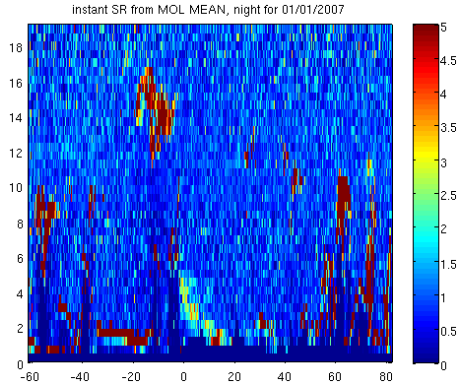

ATBmol brut




ATBmol mean




SR brut



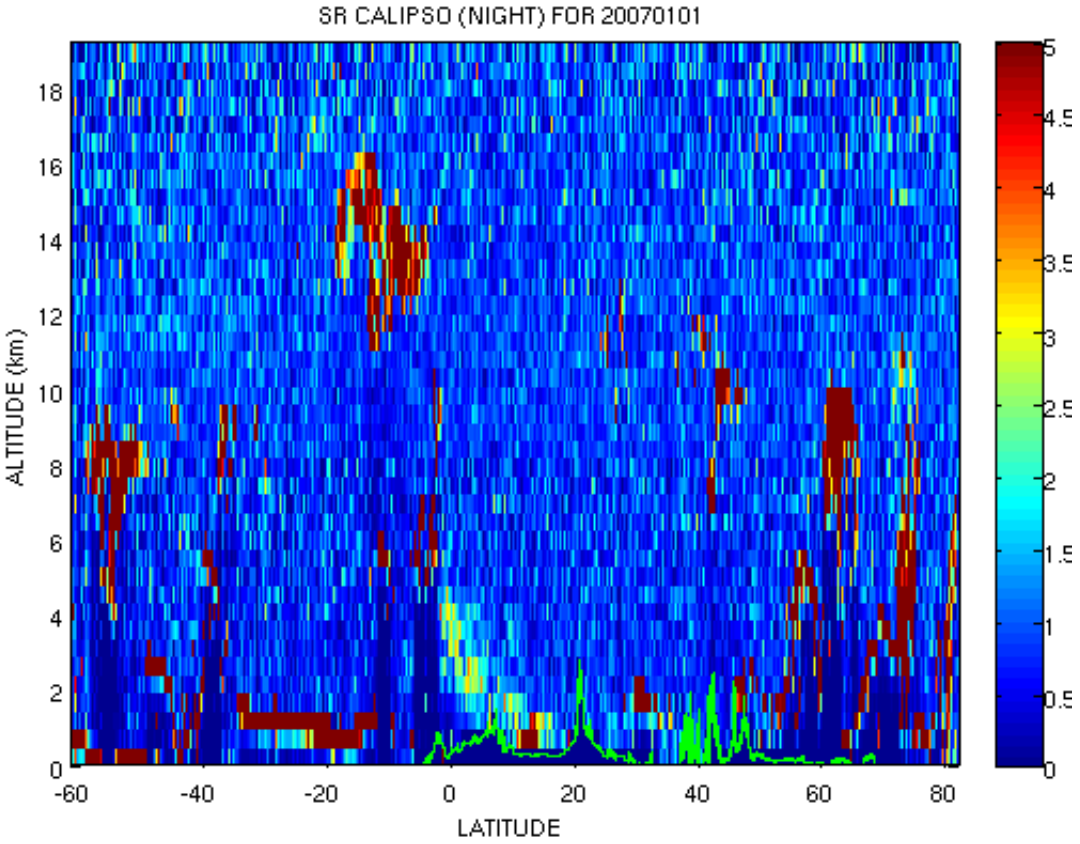

SR mean

- SR : computed from the ATB and the ATBmol
- Calculation of the ratio (<ATB>/<MD>) with a sliding average:
  - Different altitude day/night
  - PSC filter
- Calculation of the new ATBmolecular
- SR = ATB / ATBmol

➔ The Scattering Ratio is an indicator of clouds presence

# Description of GOCCP files

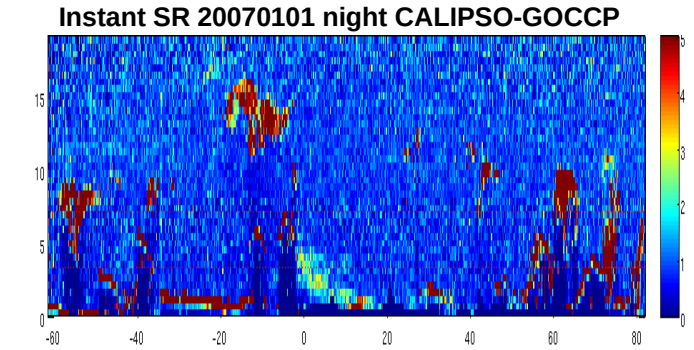
## 2) File : « instant SR »

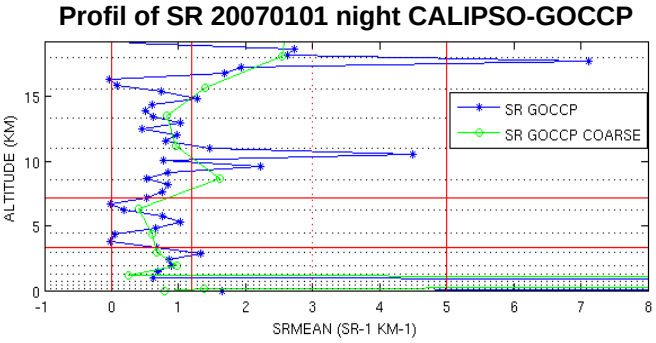


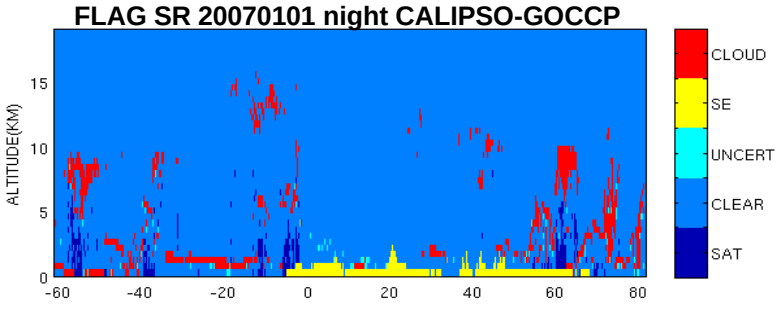

- SR value each 330m vertically averaged on 40 predefined vertical levels.
- Variables kept :
  - latitude
  - longitude
  - altitude
  - hour
  - surface elevation
- One file for each orbit (match with NASA CALIPSO Level1 files).
- Reduction of noise

# Description of GOCCP files

## 3) Scene classification



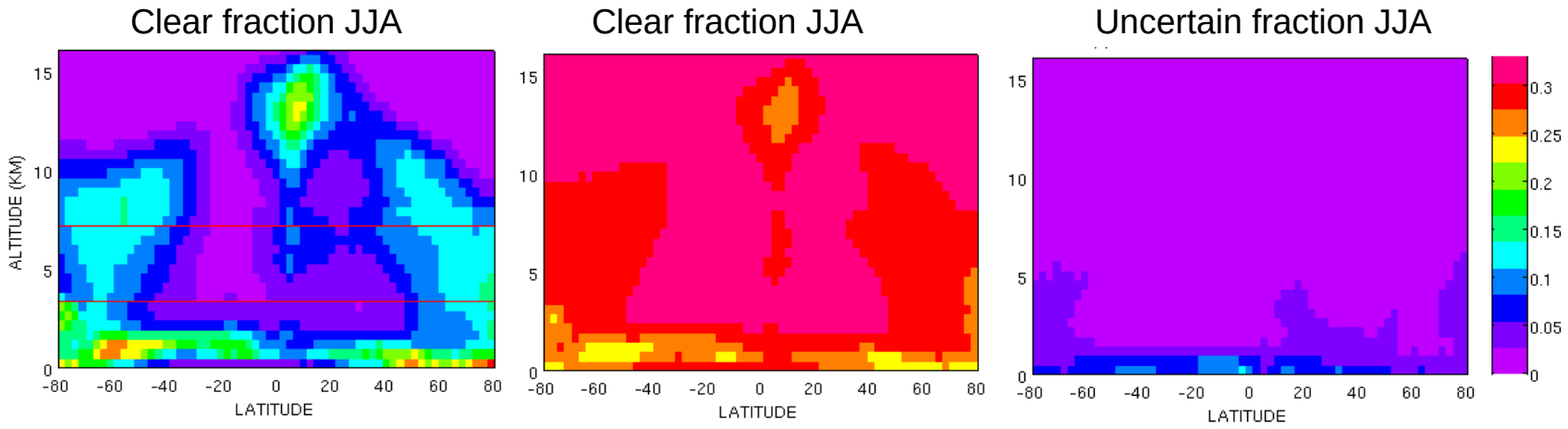

- 4 classes are defined :
  - SR >= 5 ➔ cloud
  - 1.2 < SR < 5 ➔ undefined
  - 0.01 < SR < 1.2 ➔ clear
  - SR < 0.01 ➔ Fully attenuated

- Other thresholds do not have their counterpart in the simulator outputs
  - Rejected point ➔ SR = -777
  - Surface point ➔ SR = -888
  - Not a Number ➔ SR = -9999

➔ This classification is used to build statistics (next slides)

# Description of GOCCP files

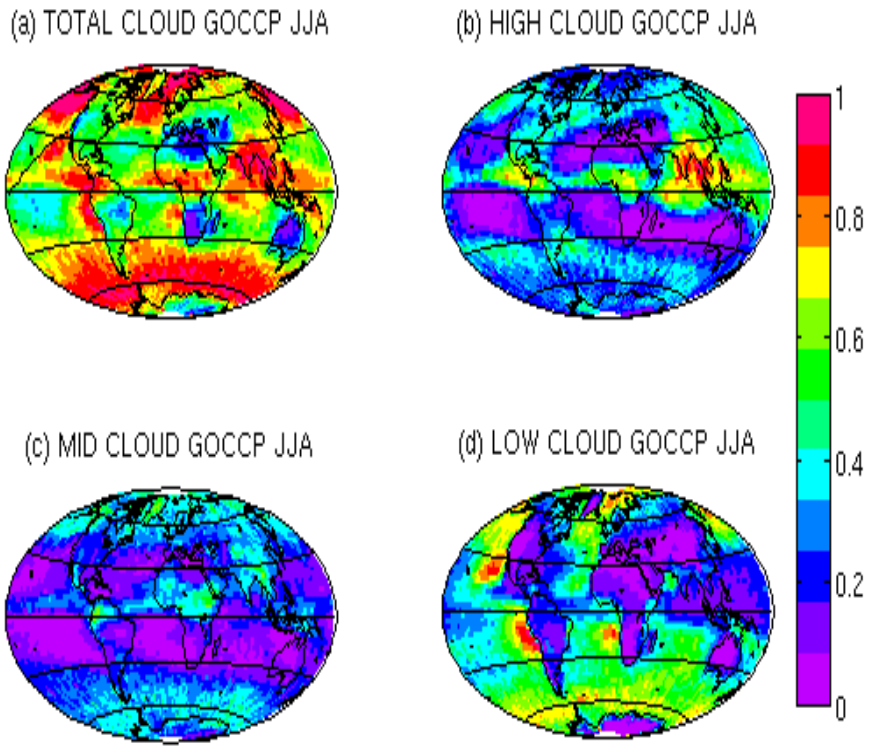
## 4) File : « 3D_CloudFraction »




- 3D dataset grids :
  - CFMIP2 : 2°x2° (lon/lat) & 40levels (official CFMIP-2 experiment)
  - CFMIP2.5 : 2.5°x2.5°xL40
  - CFMIP1 : 1°x1°xL40
  - CFMIP : 3.5°x2.5°xL40 (LMDZ horizontal grid)
- 3 monthly variables : cloud, clear, uncertain fractions
- Information about vertical distribution of clouds
- daily & monthly fields + monthly climatology

# Description of GOCCP files

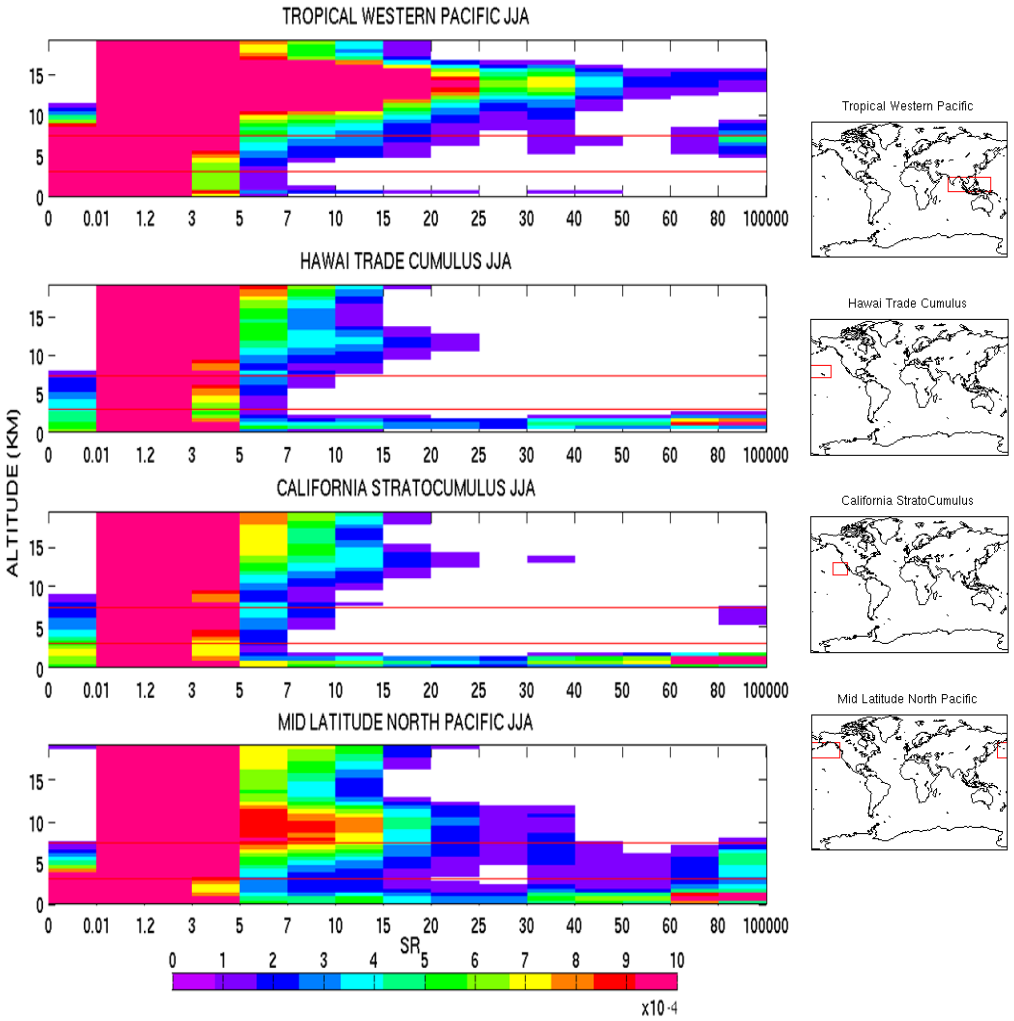
## 5) File : « MapLowMidHigh »




- 2D dataset, on grids :
  - CFMIP2 : 2°x2° (lon/lat) (official CFMIP-2 experiment)
  - CFMIP2.5 : 2.5°x2.5°
  - CFMIP1 : 1°x1°
  - CFMIP : 3.5°x2.5° (LMDZ horizontal grid)
- Variables classified according to the 3 ISCCP levels :
  - Low clouds : P° < 680 hPa
  - Mid clouds : 680 hPa < P° < 440 hPa
  - High clouds : P° > 440 hPa
- 2 other variables recorded :
  - Total cloud fraction
  - Clear-sky fraction

# Description of GOCCP files

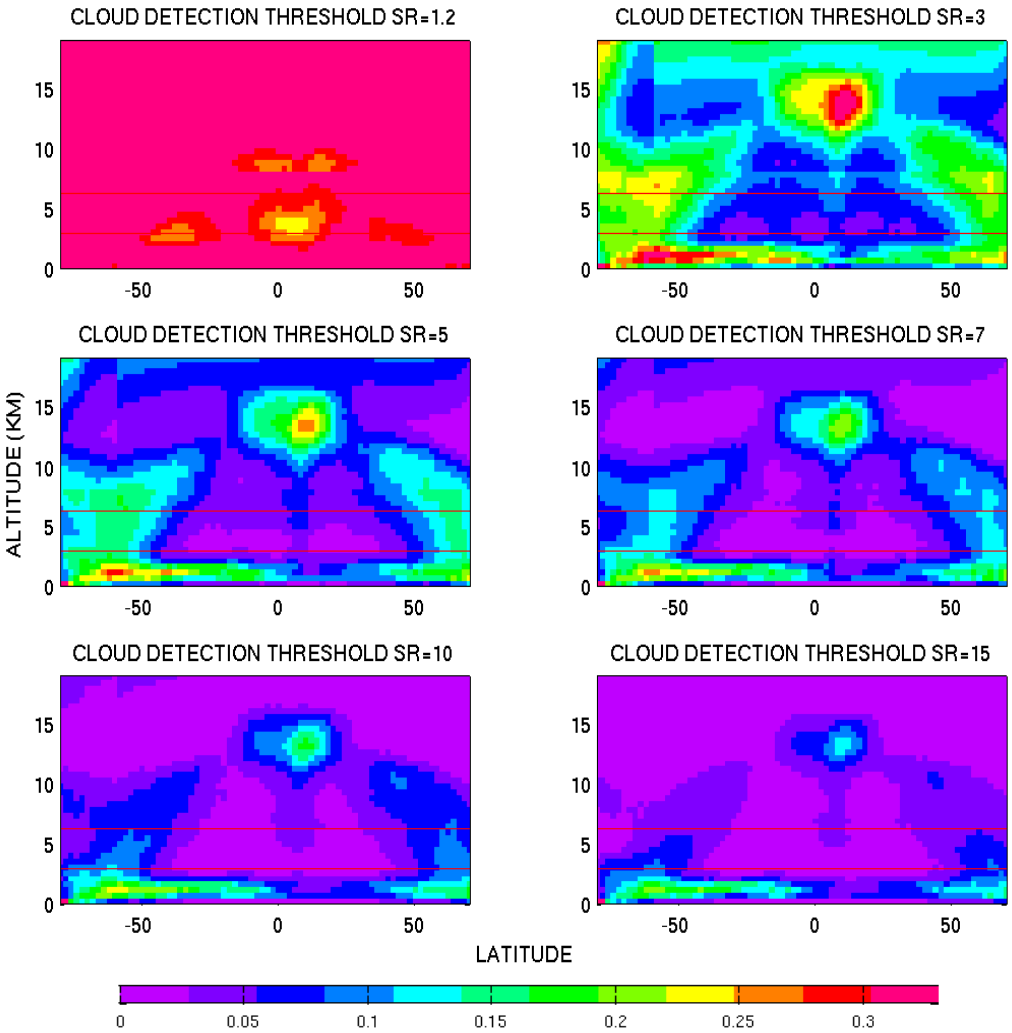
## 6a) File : « SR_histograms »




- Dimension of monthly variables SR_histo = 4D (lon,lat,alt,srbox=15)
- Allows us to discriminate the different types of clouds

# Description of GOCCP files

## 6b) File : « SR_histograms »




- Reconstitution of 3D_CloudFraction for different cloud detection threshold, SR=3, SR=5, SR=7… (except in the stratosphere, where an additional criteria is needed to diagnose the cloud fraction)
- All the SR values are stored, contrary to the 3D_CF files (data rejected, point below the surface…)

# Examples of GOCCP uses

**Evaluation of the cloud description in GCM within CFMIP**

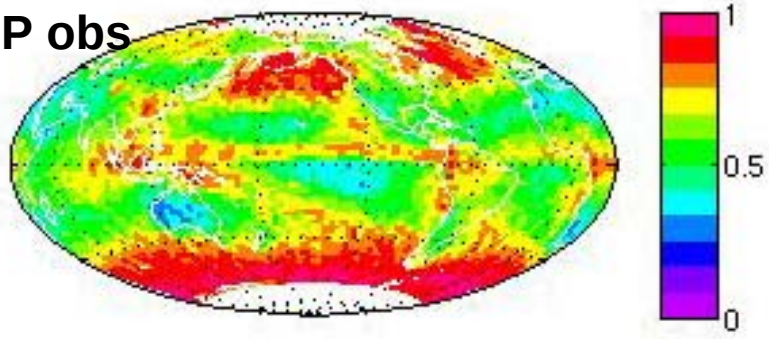
1) **Map LowMidHigh**

2) **3D Cloud Fraction**

# 1a) Total cloud cover model evaluation

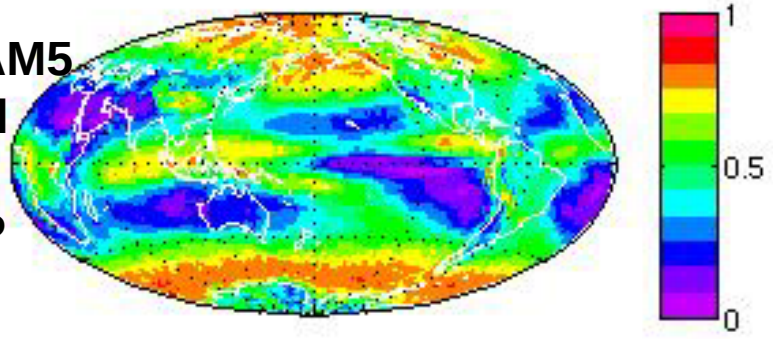
TOTAL CLOUD COVER: OBSERVATIONS

**GOCCP obs**



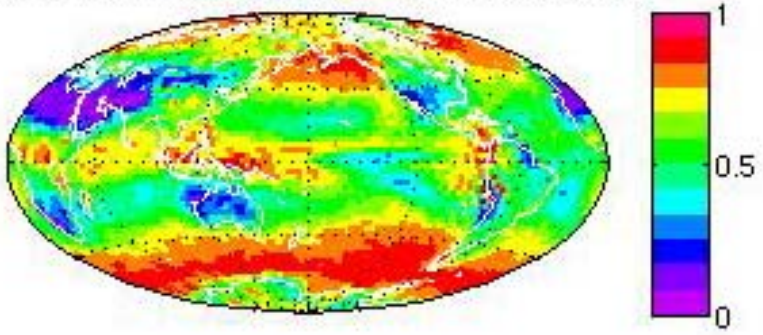

TOTAL CLOUD COVER: ECHAM5 + LIDAR SIMULATOR

**ECHAM5 Model + COSP**



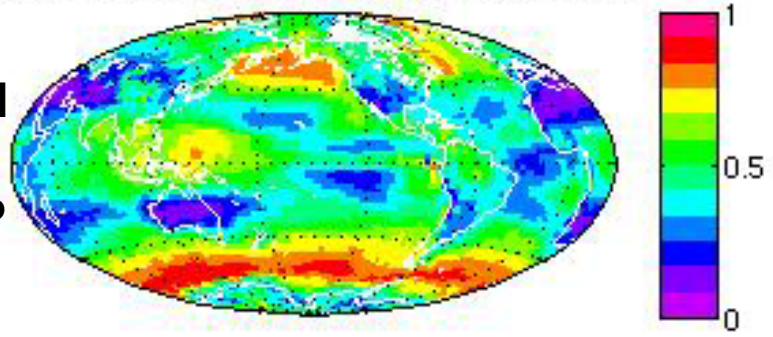

TOTAL CLOUD COVER: CCMA + LIDAR SIMULATOR

**CCAM Model + COSP**



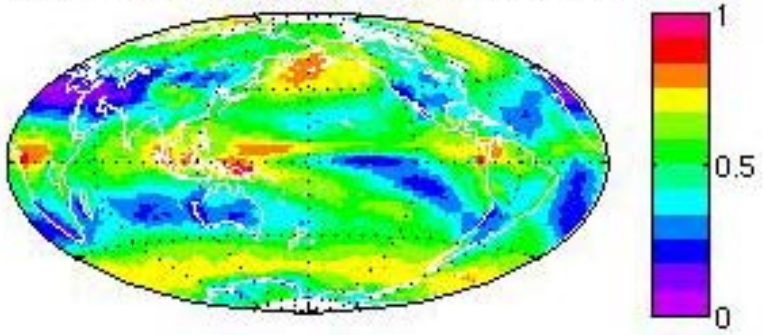

TOTAL CLOUD COVER: IPSL + LIDAR SIMULATOR

**IPSL Model + COSP**



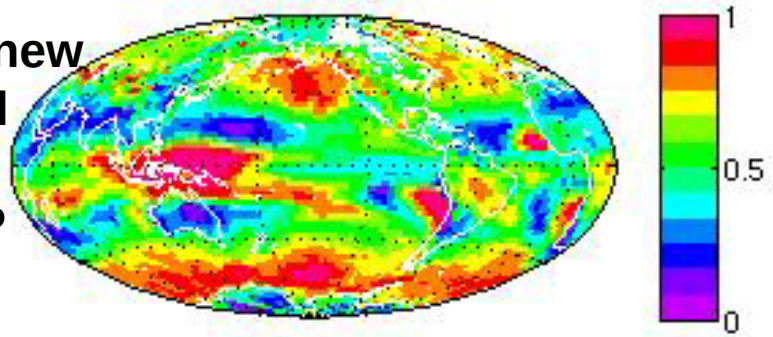

TOTAL CLOUD COVER: LLNL + LIDAR SIMULATOR

**LLNL Model + COSP**




TOTAL CLOUD COVER: IPSL-new physics + LIDAR SIMULATOR

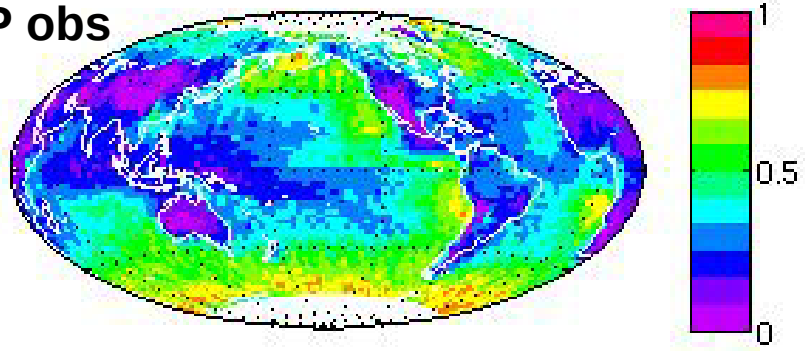
**IPSL new Model + COSP**



# (1b) Low clouds model evaluation

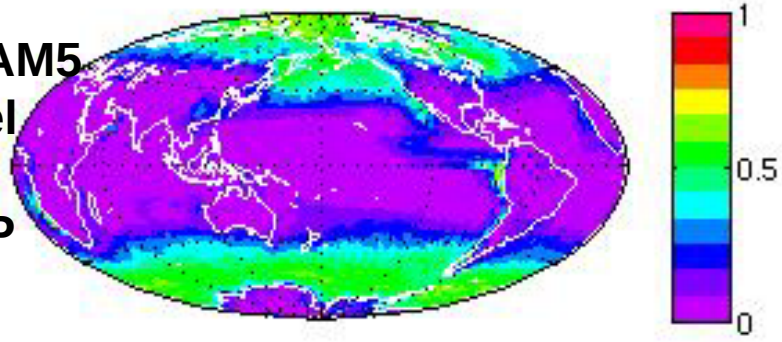
LOW CLOUD COVER: OBSERVATIONS

**GOCCP obs**



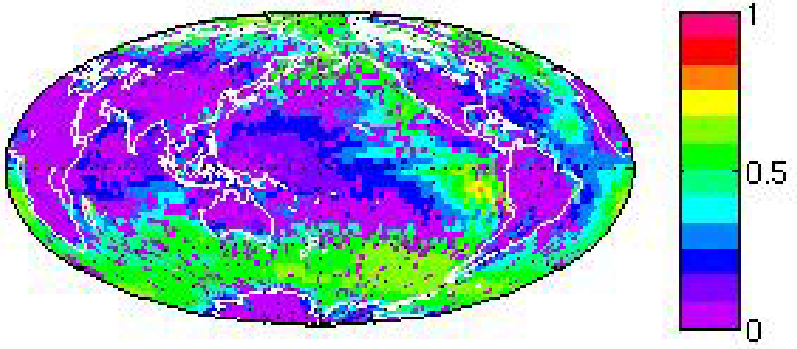

LOW CLOUD COVER: ECHAM5 + LIDAR SIMULATOR

**ECHAM5 Model + COSP**



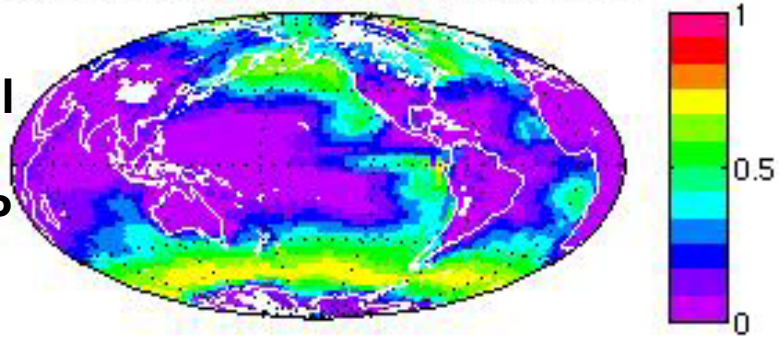

LOW CLOUD COVER: CCMA + LIDAR SIMULATOR

**CCAM Model + COSP**



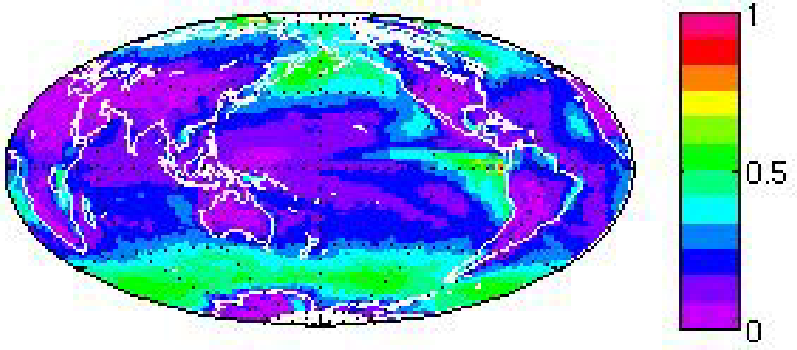

LOW CLOUD COVER: IPSL + LIDAR SIMULATOR

**IPSL Model + COSP**



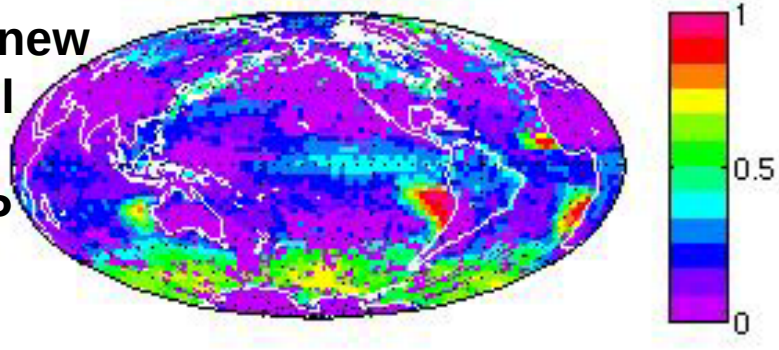

LOW CLOUD COVER: LLNL + LIDAR SIMULATOR

**LLNL Model + COSP**

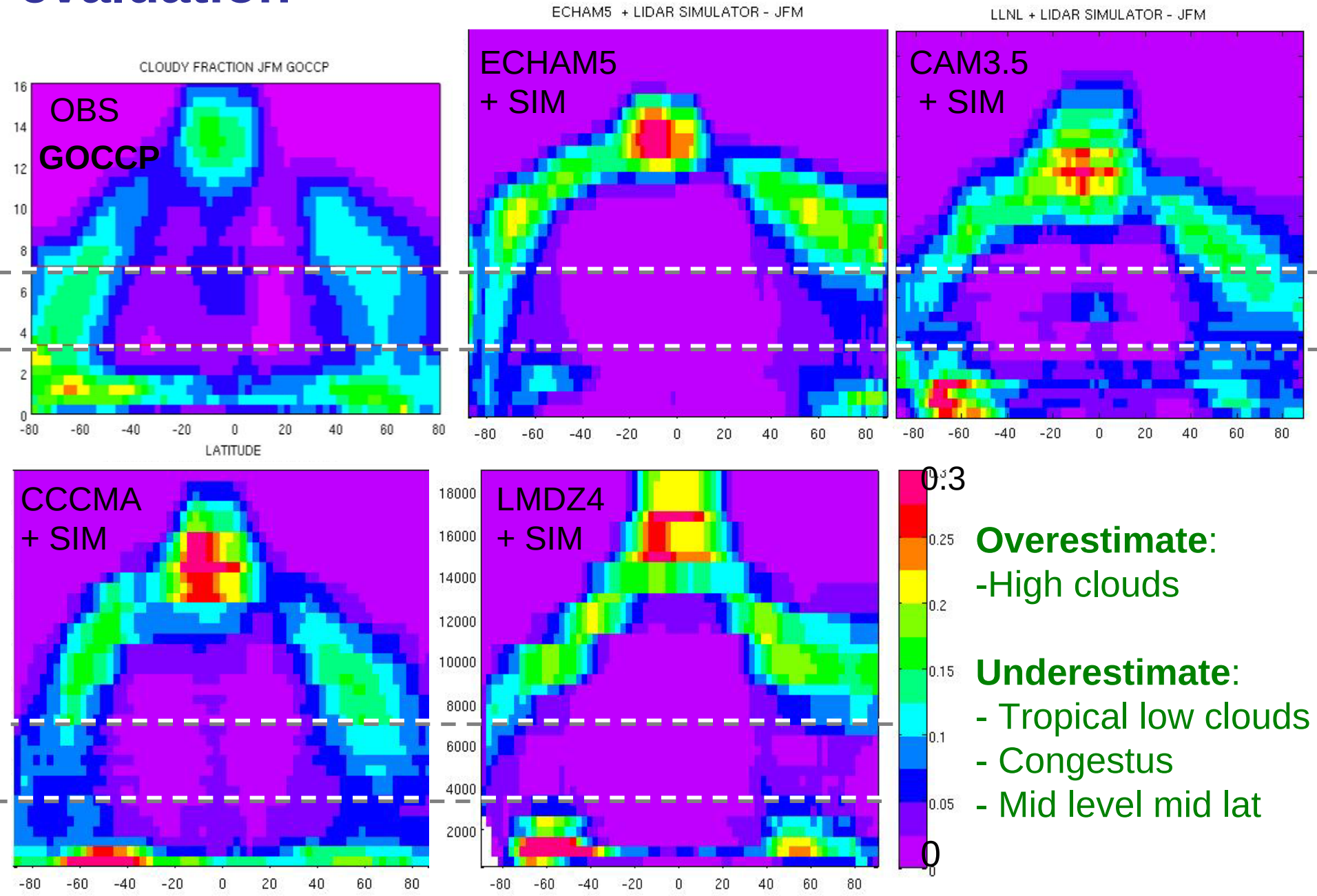



LOW CLOUD COVER: IPSL-new physics + LIDAR SIMULATOR

**IPSL new Model + COSP**



# 2) Cloud Vertical Distribution model evaluation




**Overestimate**:
-High clouds

**Underestimate**:
- Tropical low clouds
- Congestus
- Mid level mid lat

# Comparison between GOCCP and CALIPSO-NASA cloud cover

We do not expect the two datasets to give similar results !

Aim of this comparison: to quantify & to ***understand*** the difference

1) **Map LowMidHigh**

2) **Map zonal Mean**

3) **3D Cloud Fraction**

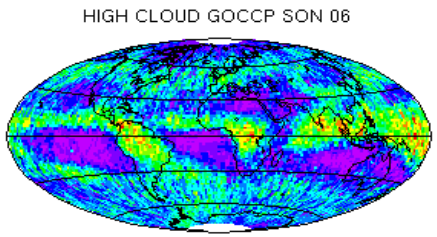
# Comparison GOCCP / CALIPSO-NASA

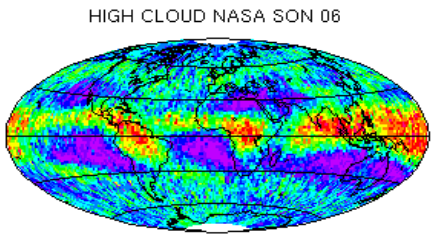
## 1a) Map LowMidHigh

GOCCP

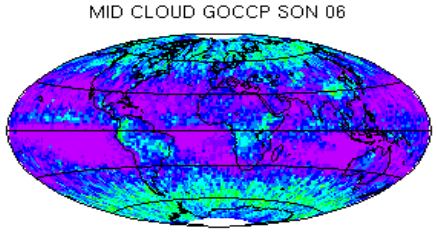
CALIPSO-NASA

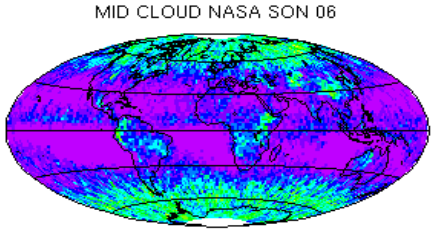
HIGH



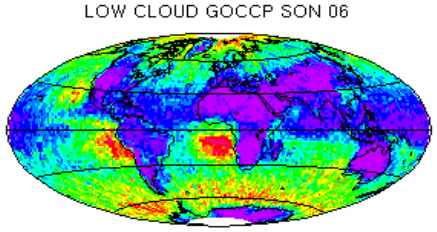



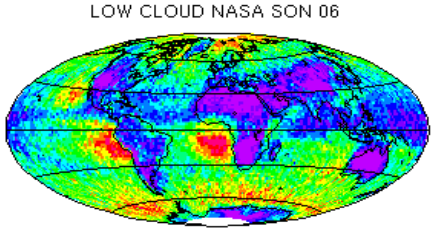

MID




LOW

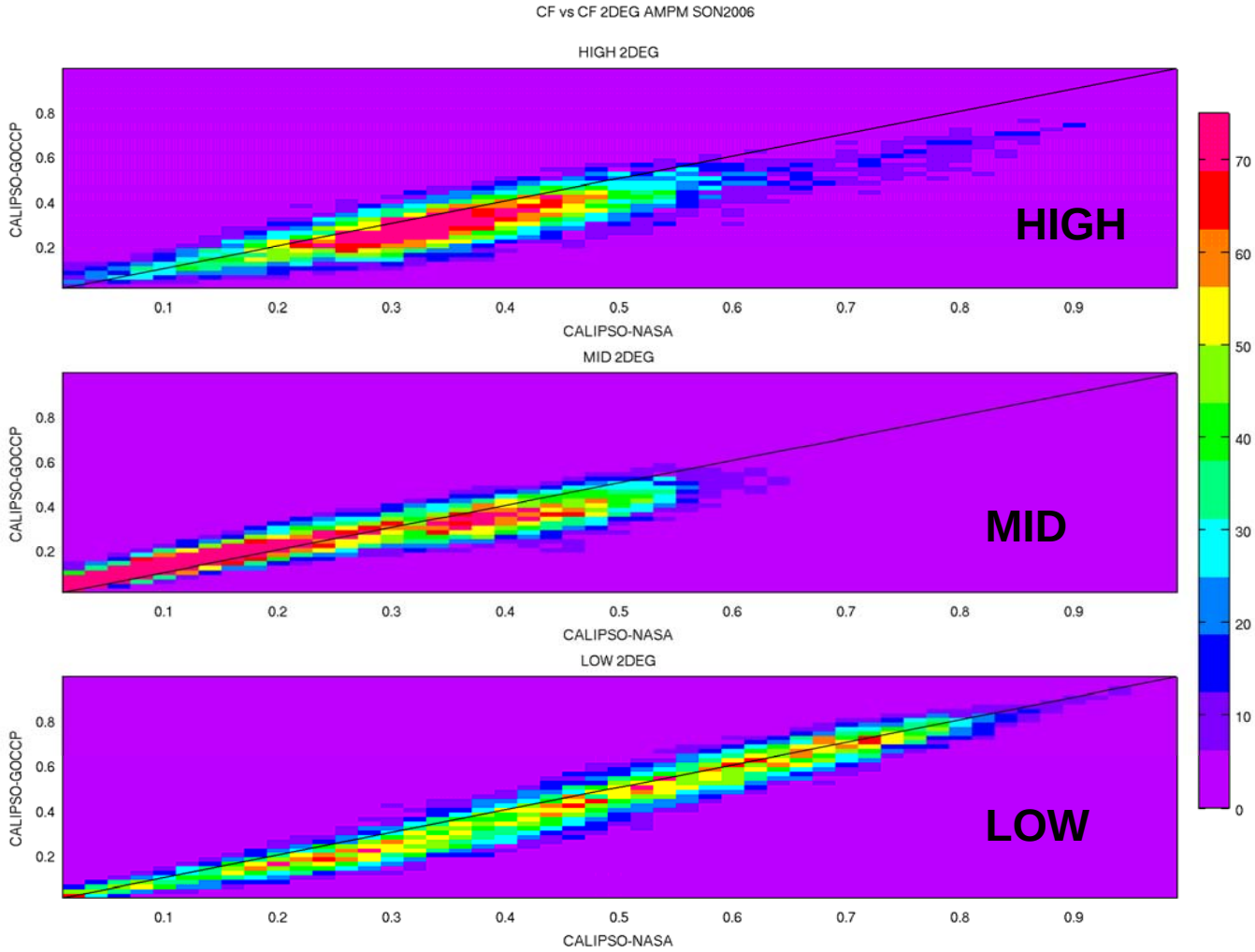


- Horizontal averaging
- Vertical averaging
- Cloud detection threshold

# Comparison GOCCP / CALIPSO-NASA

## 1b) Map LowMidHigh




GOCCP

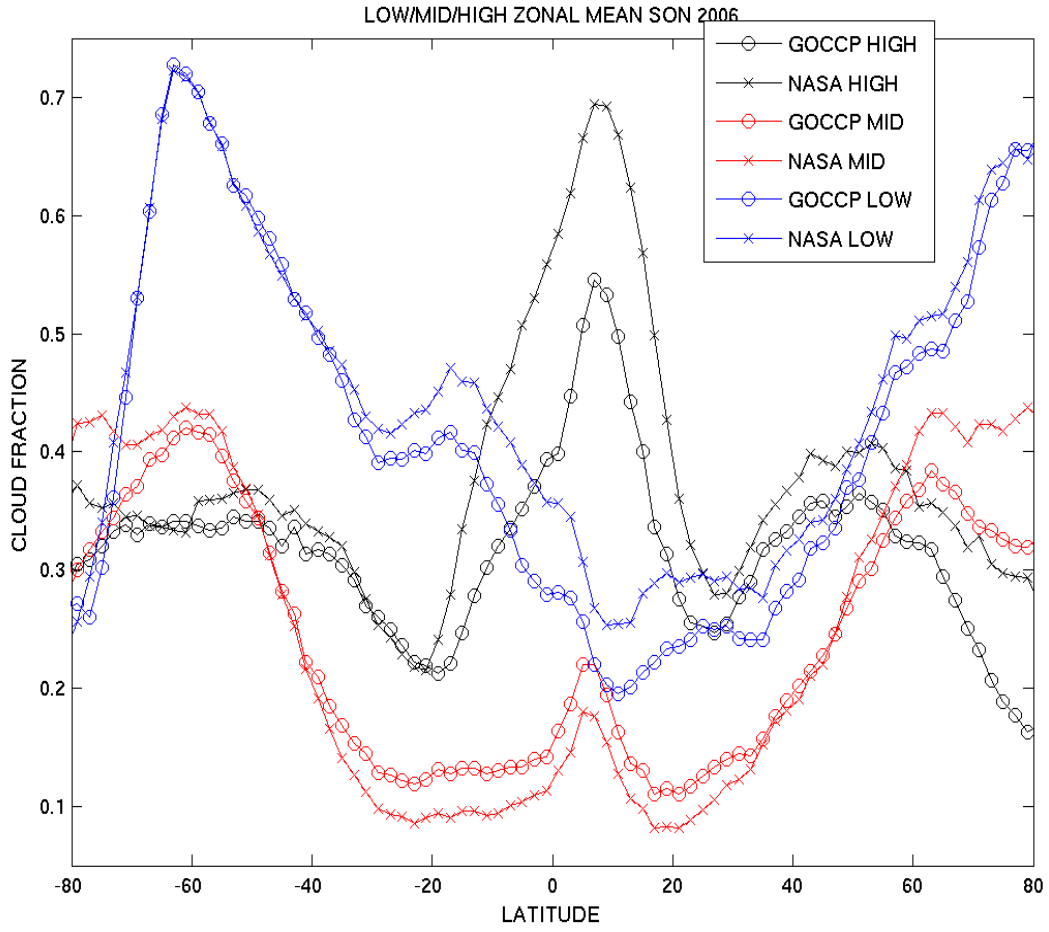
GOCCP

GOCCP

CALIPSO-NASA

# Comparison GOCCP / CALIPSO-NASA

## 2) Map zonal Mean



# Comparison GOCCP / CALIPSO-NASA

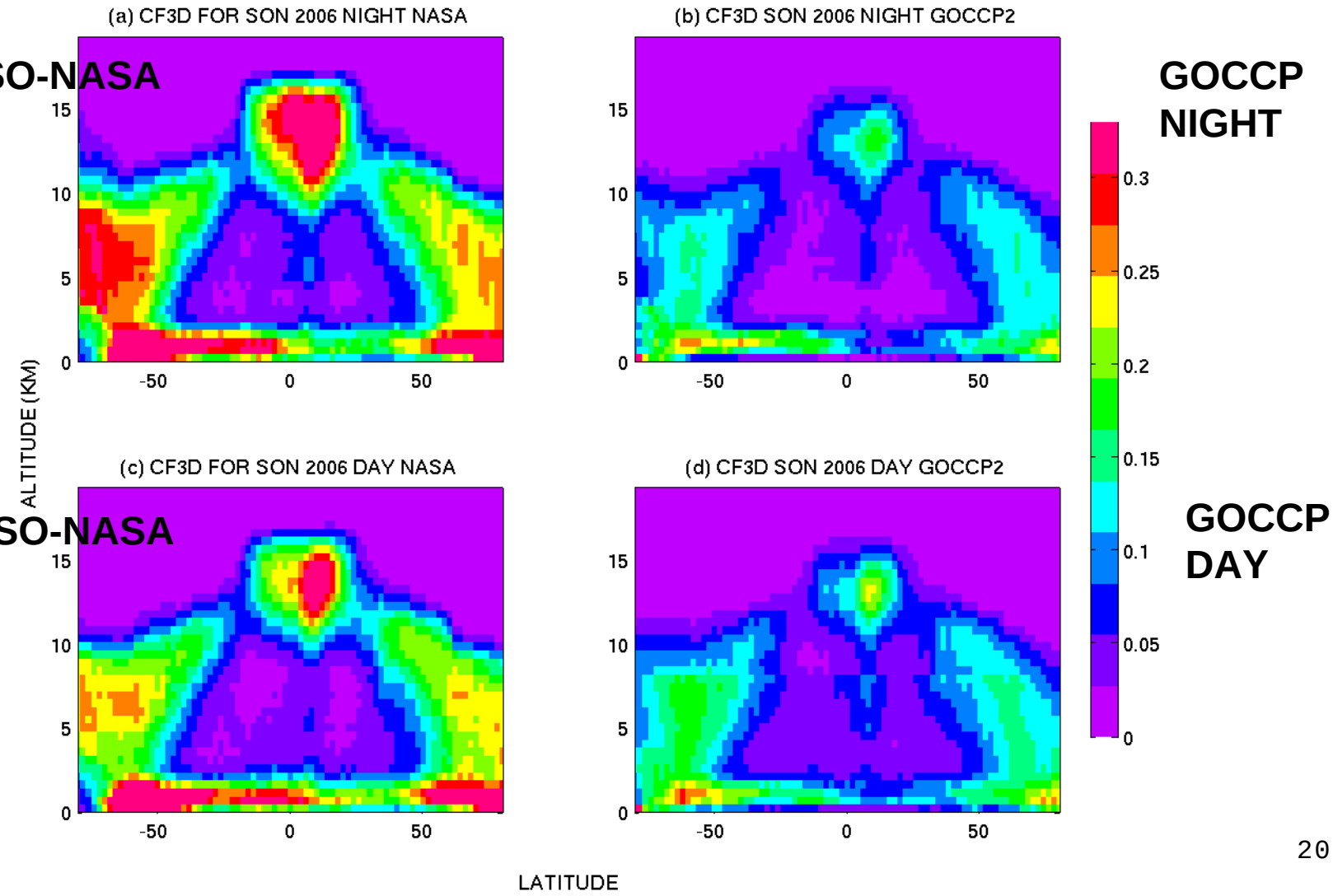
## 3) 3D Cloud Fraction

**CALIPSO-NASA NIGHT**

**GOCCP NIGHT**

**CALIPSO-NASA DAY**

**GOCCP DAY**



# Comparison between GOCCP and passive remote sensing cloud cover

For comparison with passive remote sensing climatologies,
we define **GOCCP-no-overlap:** the first cloud layer encountered from above

1) **GOCCP-no-overlap .vs. GOCCP (both included in GEWEX CA database)**

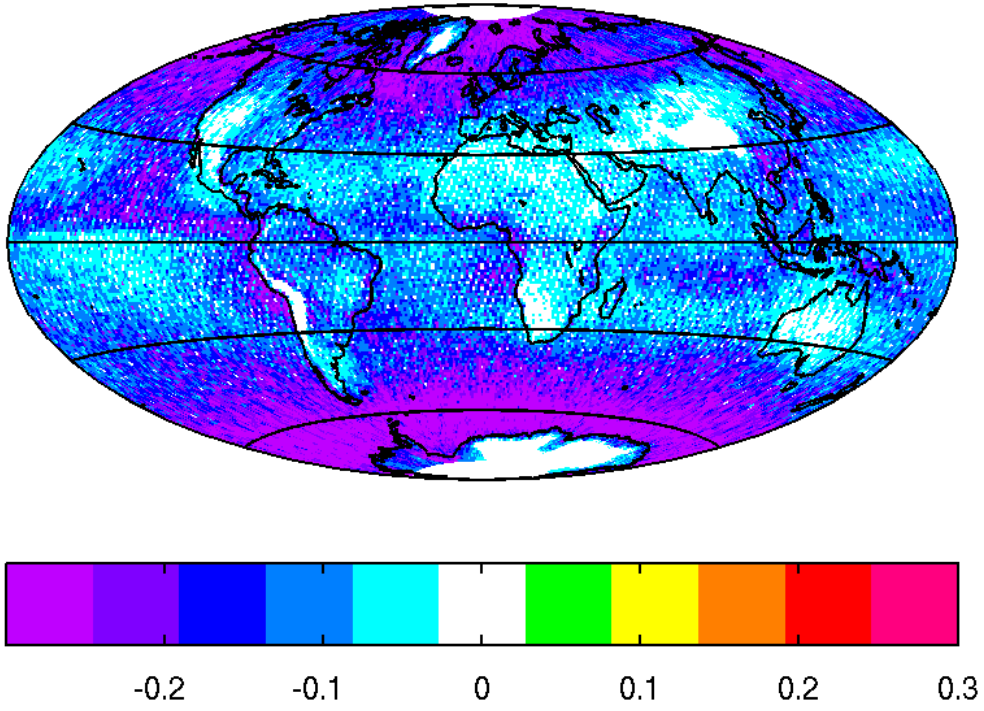
2) **Zonal Means: GOCCP .vs. GEWEX CA climatologies**

3) **Maps: GOCCP .vs. GEWEX CA climatologies**

# Comparison GOCCP / passive remote sensing

**1) GOCCP-no-overlap .vs. GOCCP (both included in GEWEX CA database)**

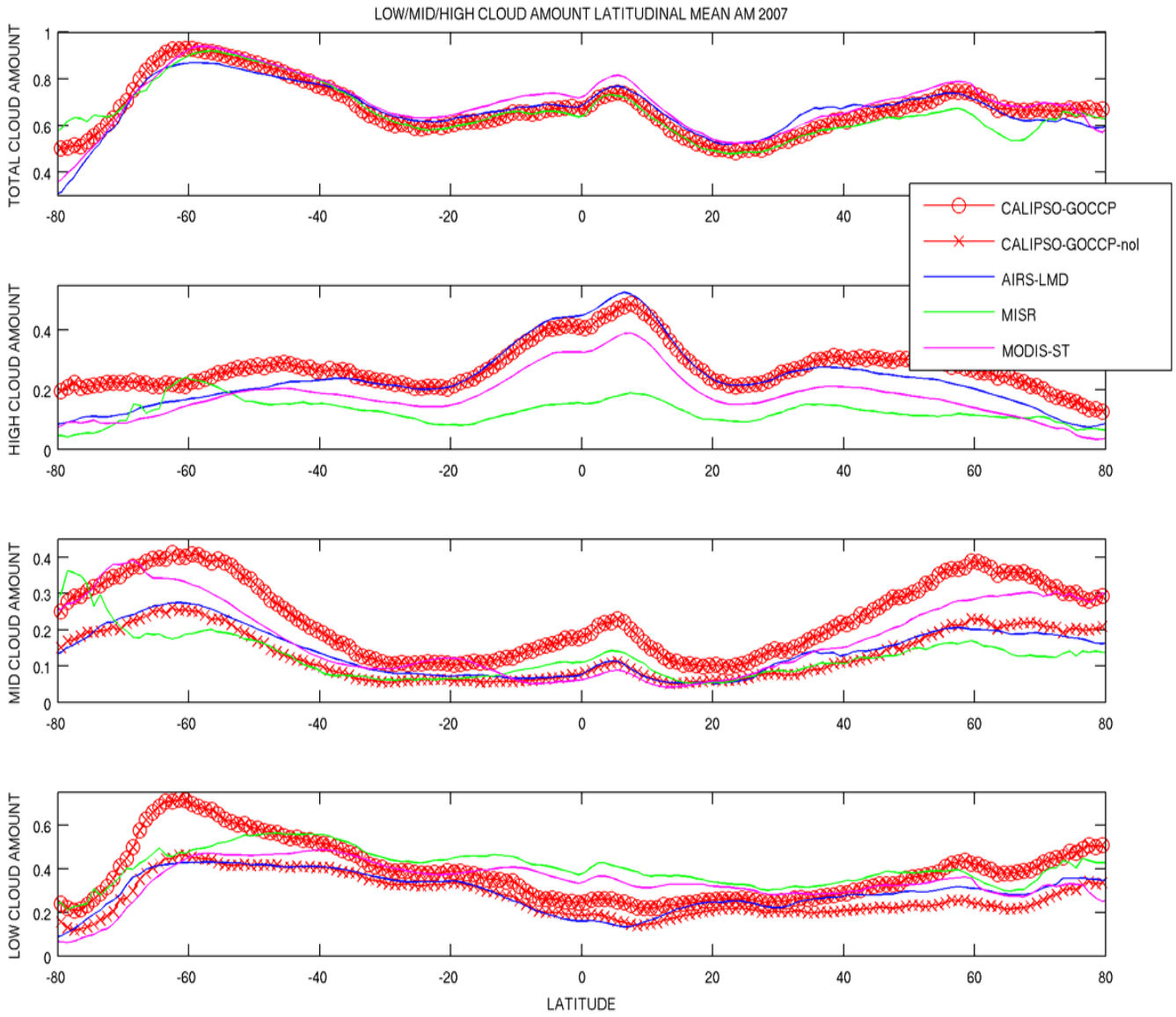
**Low Cloud Cover:**
**GOCCP_no_overlap – GOCCP**




**For comparison with passive remote sensing cloud climatolgies (hereafter), we use the GOCCP-no-overlap**

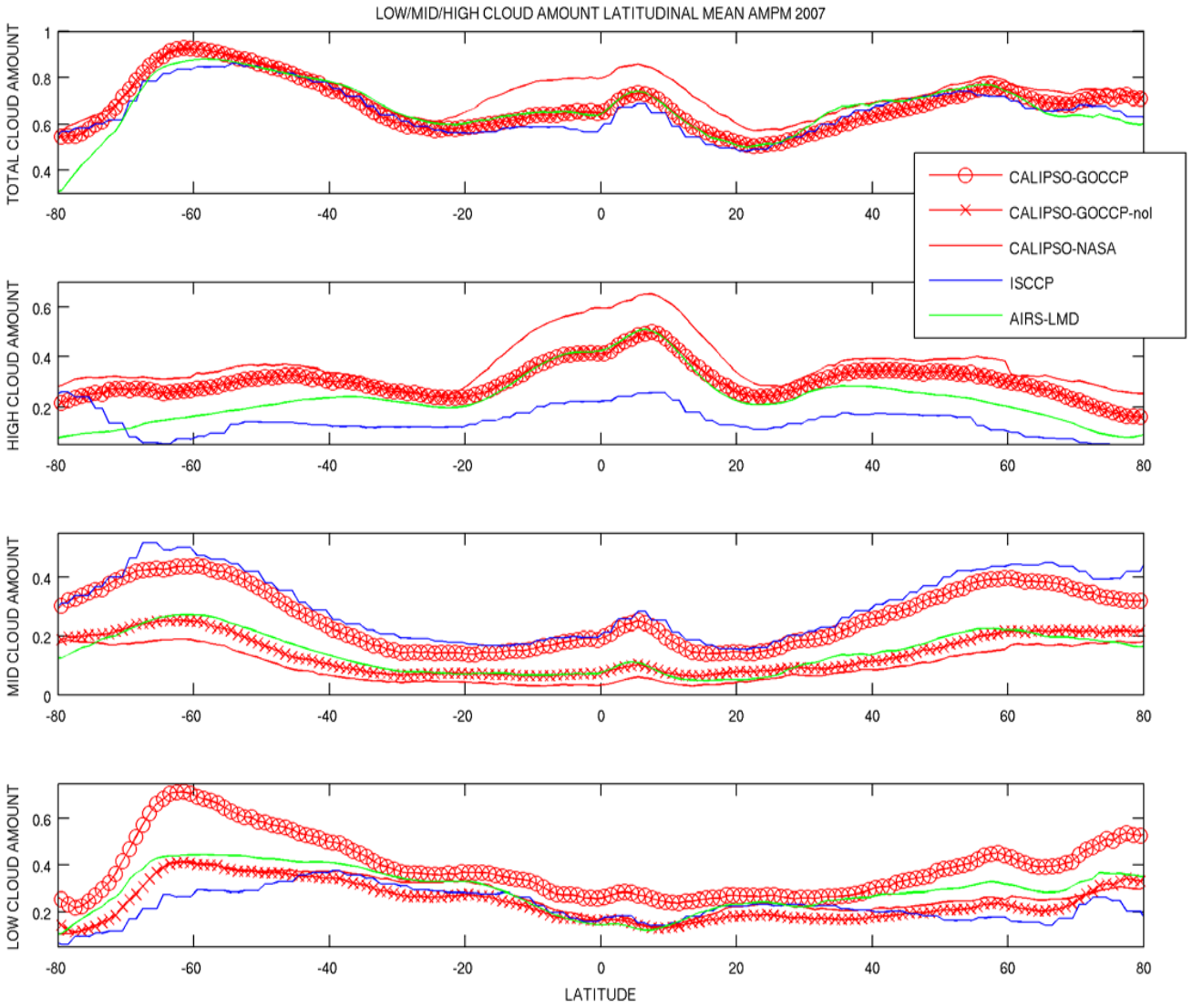
# Comparison GOCCP-nol / passive remote sensing

1) **Zonal means AM**



# Comparison GOCCP-nol / passive remote sensing

1) **Zonal means AMPM**

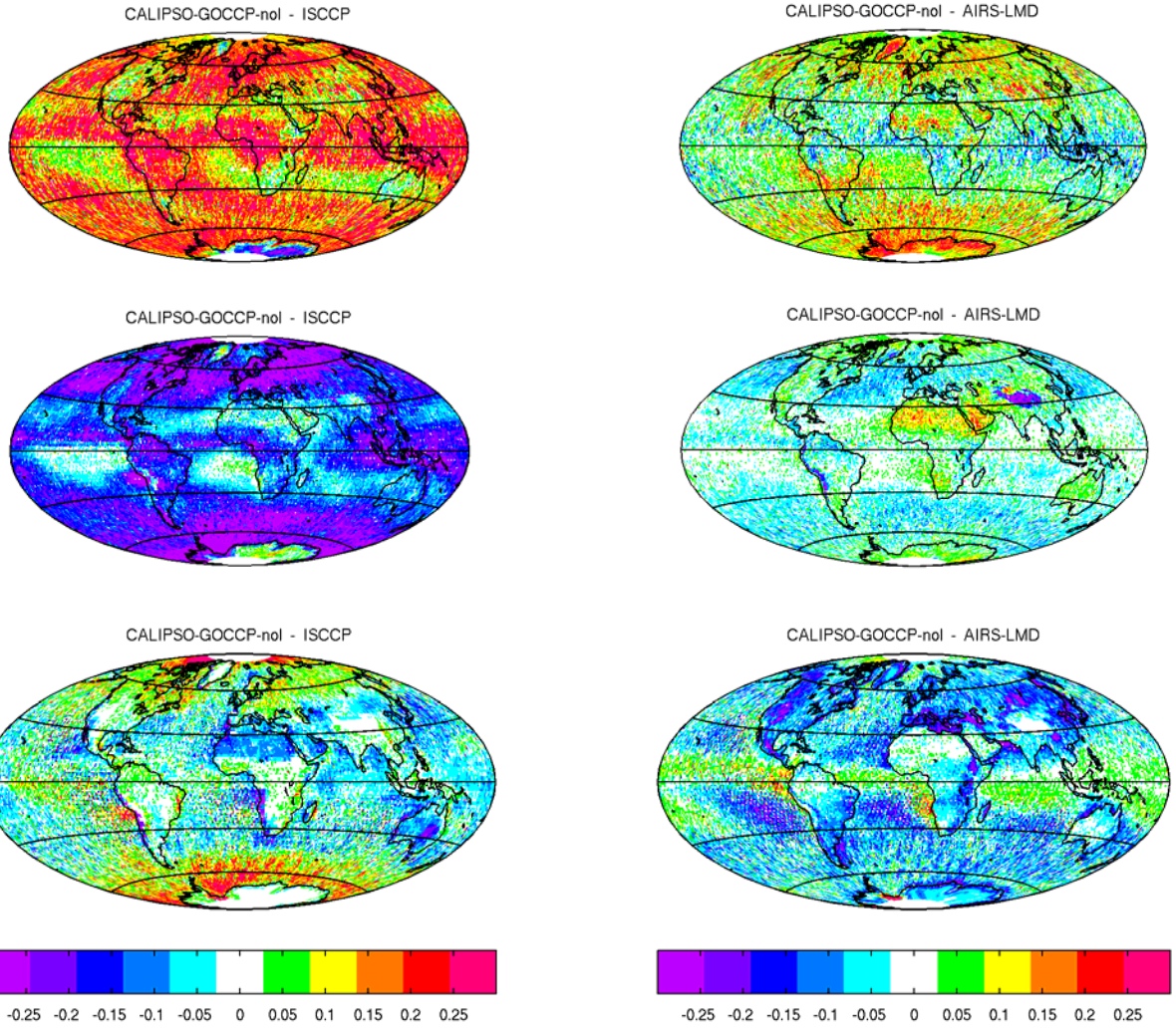


# Comparison GOCCP-nol / passive remote sensing

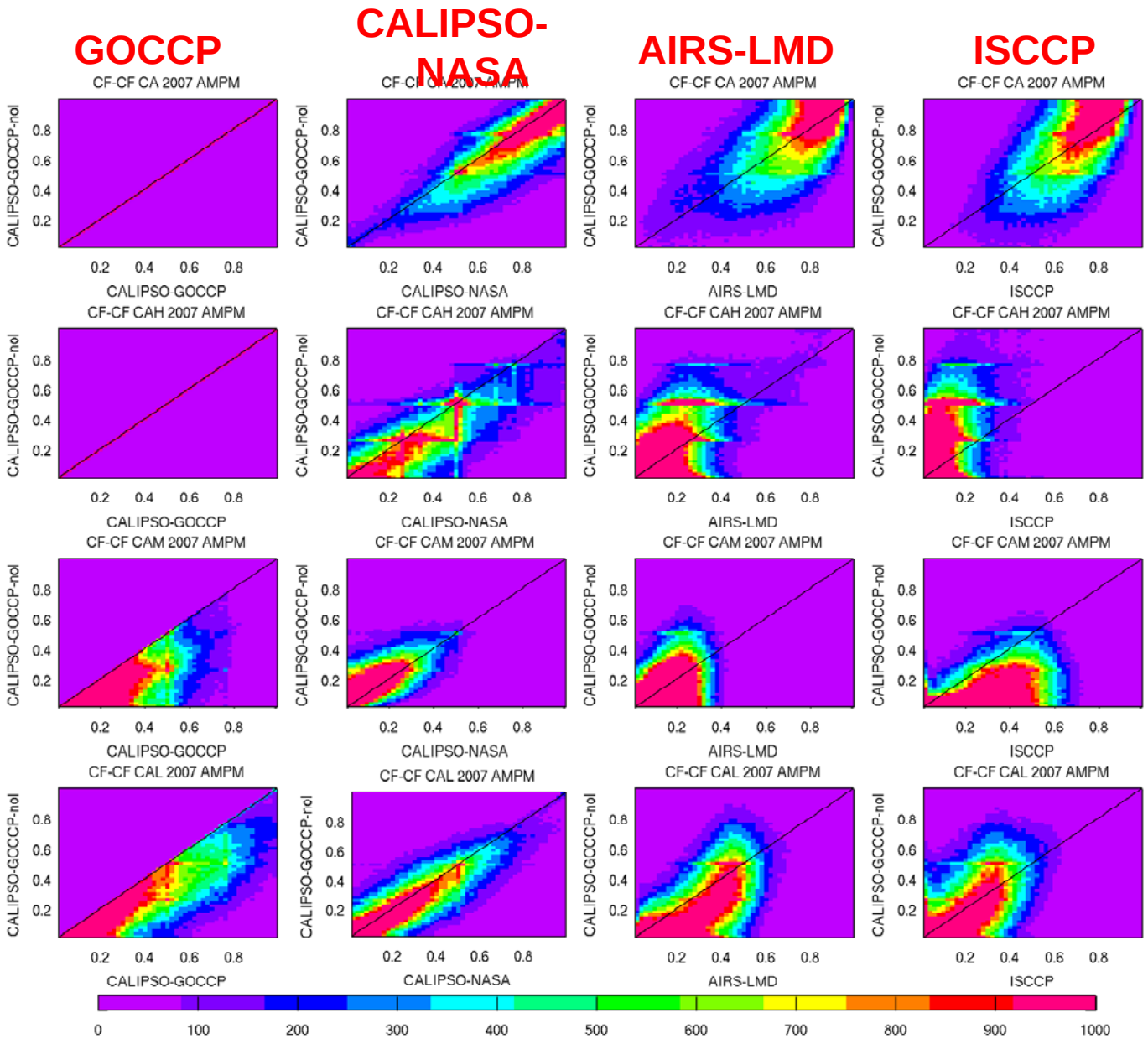
**2) Maps**
**DAY NIGHT**

**GOCCP_no_overlap - ISCCP**

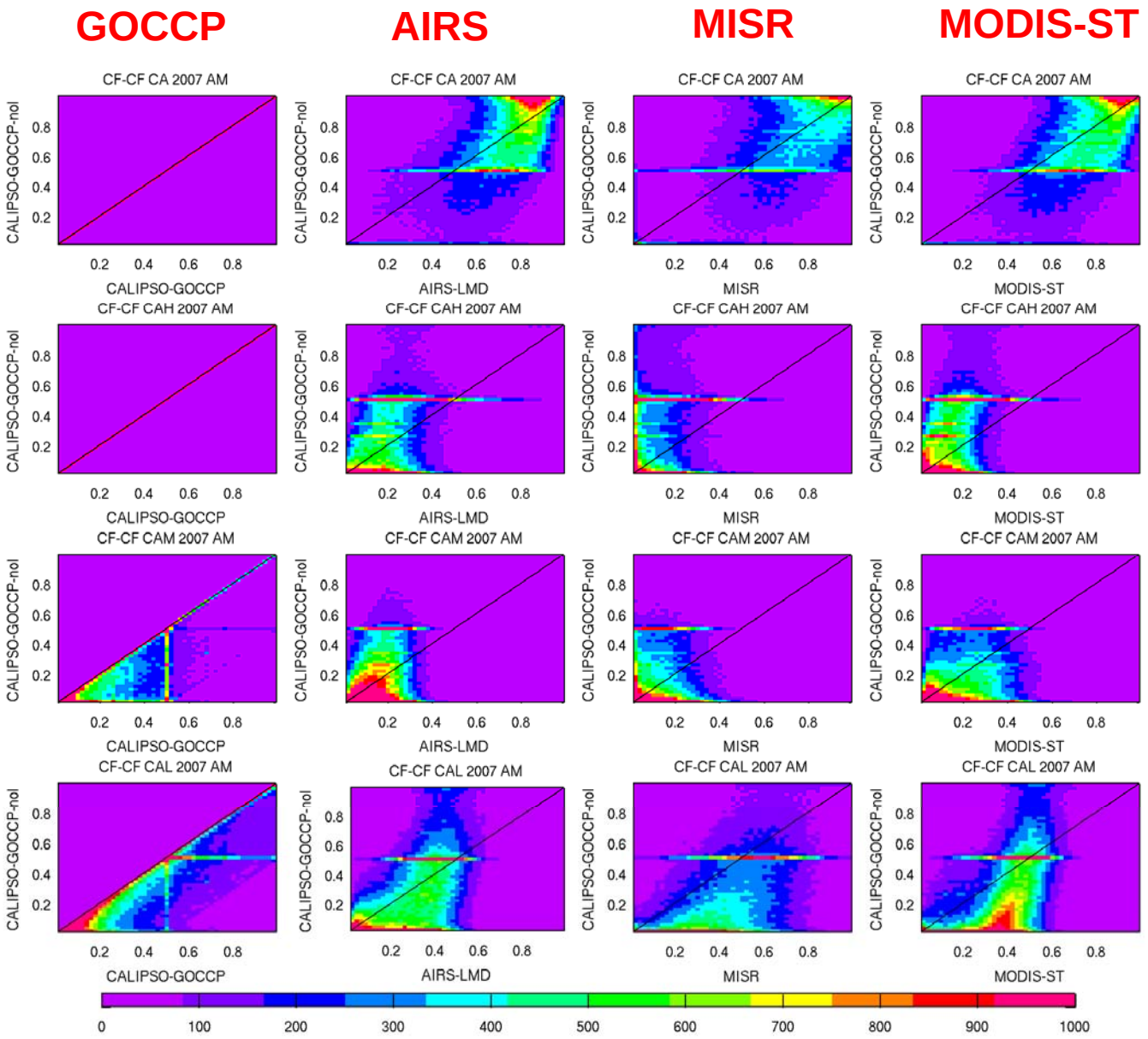
**GOCCP_no_overlap - AIRS**



# Comparison GOCCP-nol / passive remote sensing



# Comparison GOCCP-nol / passive remote sensing



# CFMIP-OBS database

- Web site : **http://climserv.ipsl.polytechnique.fr/cfmip-obs.html**
- GOCCP netCDF monthly files (GIECCMIP5 standard) for the period 200606 to 200906 (LMD)
- PARASOL netCDF monthly files (GIECCMIP5 standard) for the period 200503 to 200812 (LOA)
- CLOUDSAT netCDF monthly files (GIECCMIP5 standard) for the period 200606 to 200807 (JISAO)
- CERES-EBAF single netCDF file for the period 200003 to 200510. (NASA/LarC)

All the data are regularly udapted.

**Questions**: goccp@lmd.polytechnique.fr

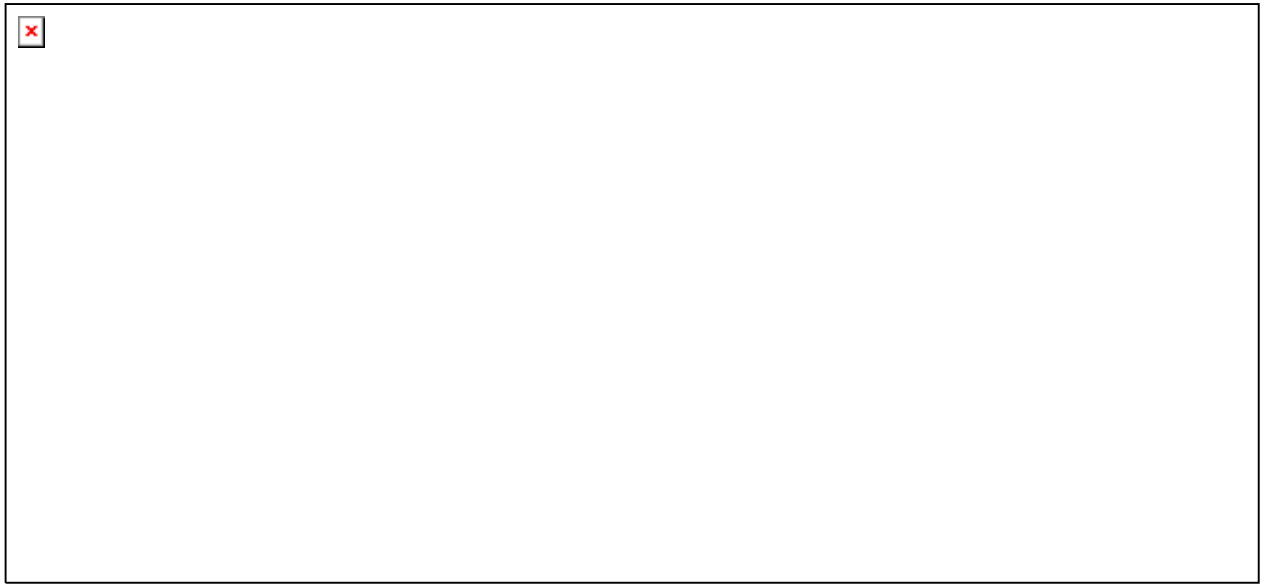
Coming soon:

- New observations in the database:
  ISCCP (Y. Zhang, LLNL)
  MISR (R. Marchand, JISAO)
  MODIS (R. Pincus, UCB)

- Developpement of a Cloud phase diagnostic in COSP and GOCCP

# CFMIP-OBS database

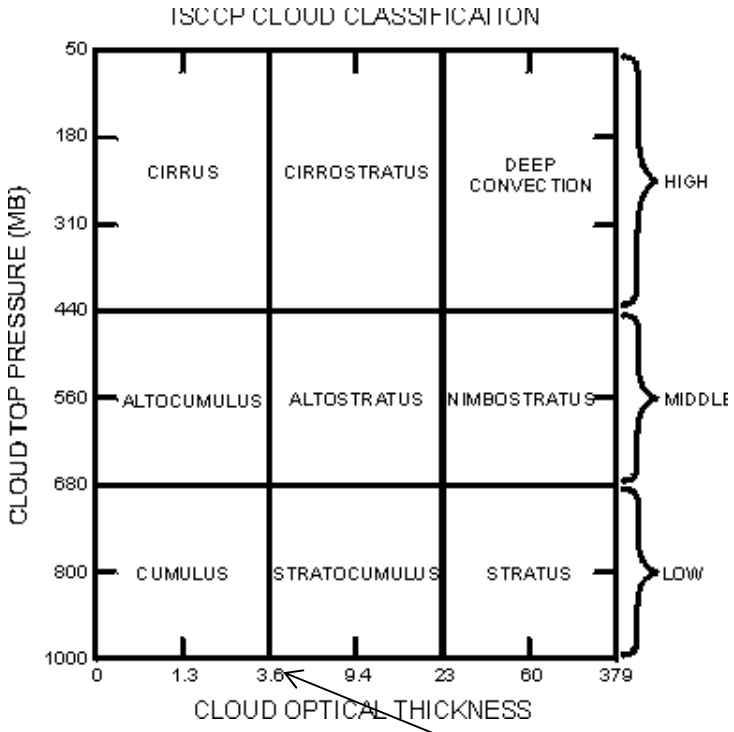
**PARASOL**
**Reflectance 1dir**

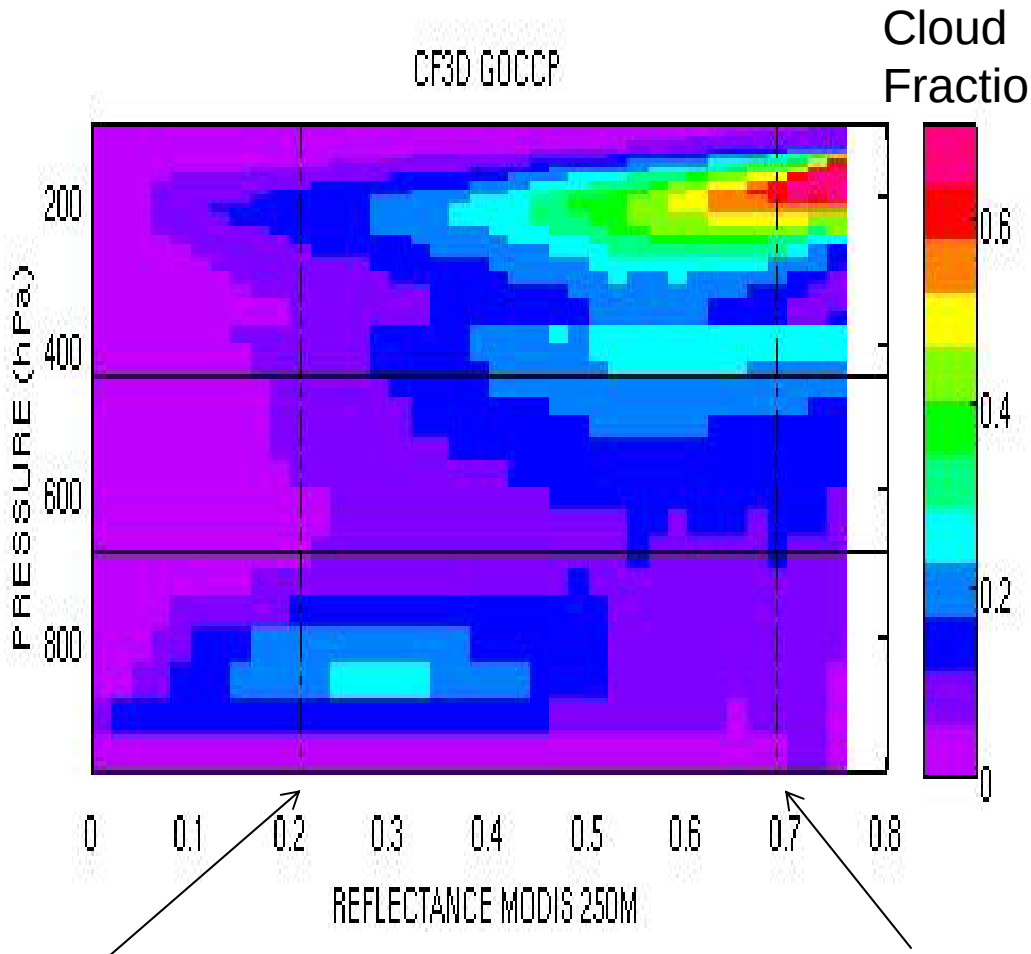


- Information about the reflectance in 1 direction
- Period 200503_200812 (courtesy LOA)

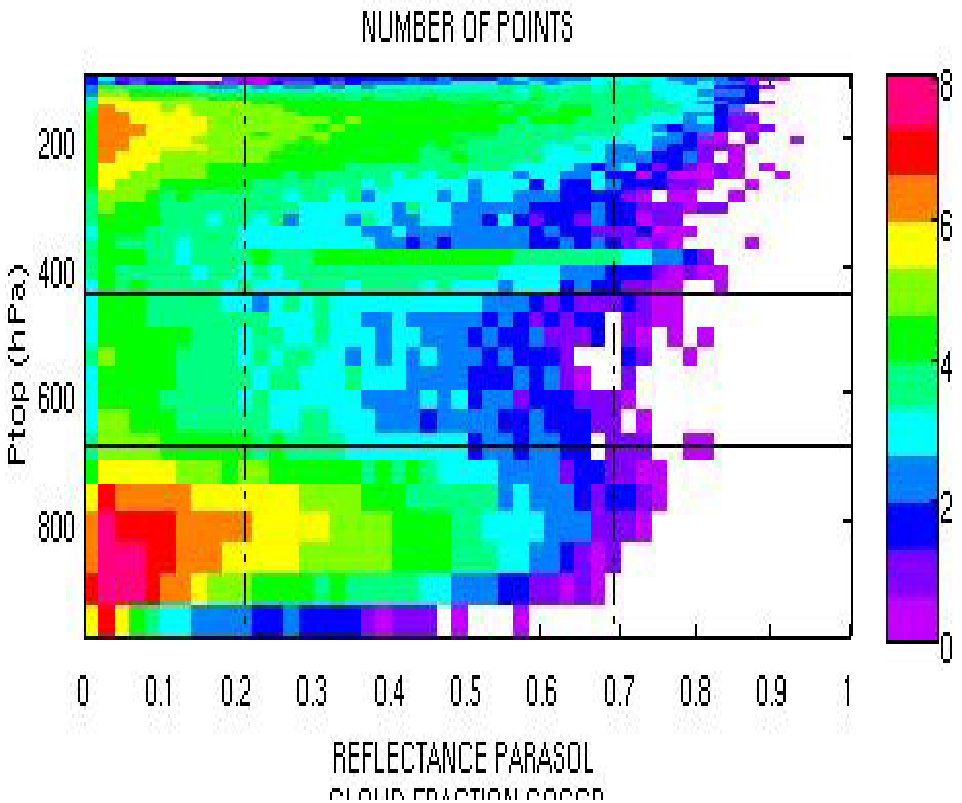
# CFMIP-OBS database

## Example of multi instruments diagnostics




**For Tropical oceans**


NUMBER OF POINTS
Ptop (hPa)
200
400
600
800
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
REFLECTANCE PARASOL
0
2
4
6
8

## Summary

GOCCP dataset is designed to be fully consistent with COSP/CALIPSO simulator:
horizontal resolution, vertical resolution, threshold of detection, etc…

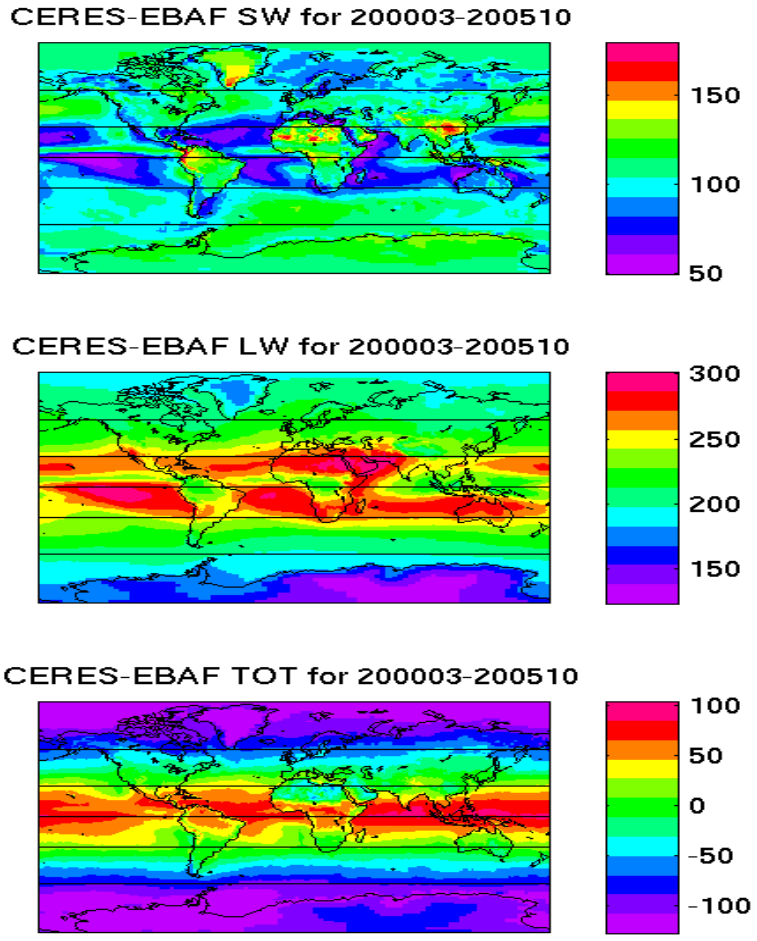
GOCCP and CALIPSO-NASA datasets exhibit differences:
in L, M, H cloud amount…
in 3D cloud structure
we understand the reasons of these differences

In GEWEX CA, the different global cloud covers are rougly consistent,
Looking in more details, the different cloud climatologies are different
because of sensor sensitivities, resolution etc…

Cloud climatologies comparisons:
- in joint histograms ?
- in dynamical regimes ?
- multilayer clouds ?
- subvisible cirrus, shallow cu, deep convective clouds, polar clouds,…

# CFMIP-OBS database

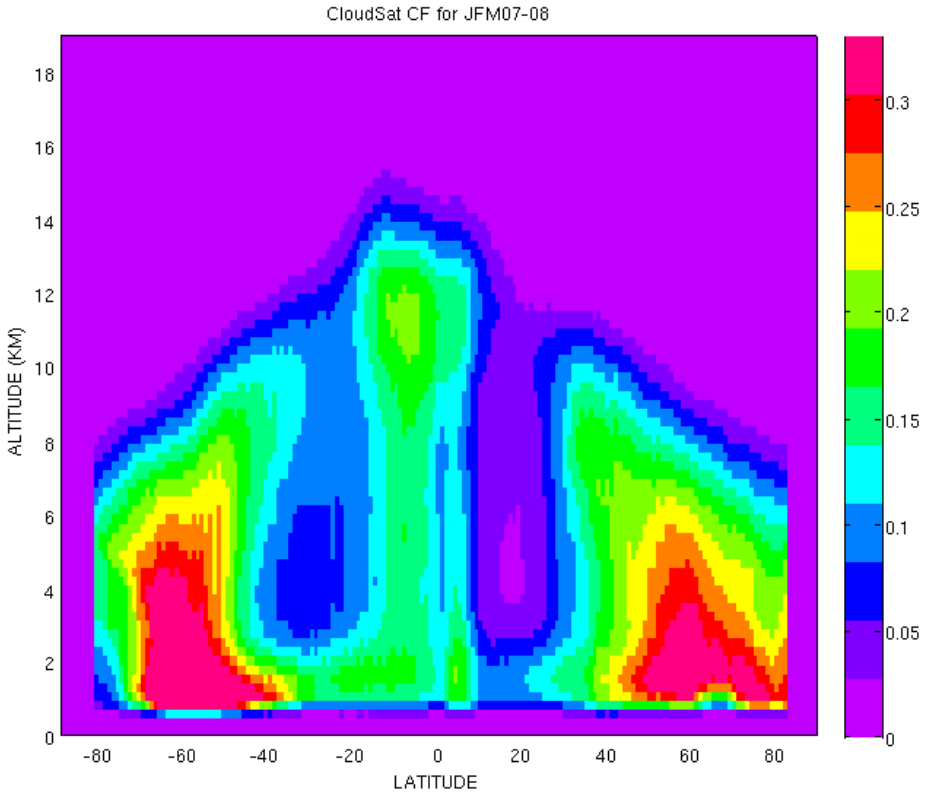
## CERES - EBAF



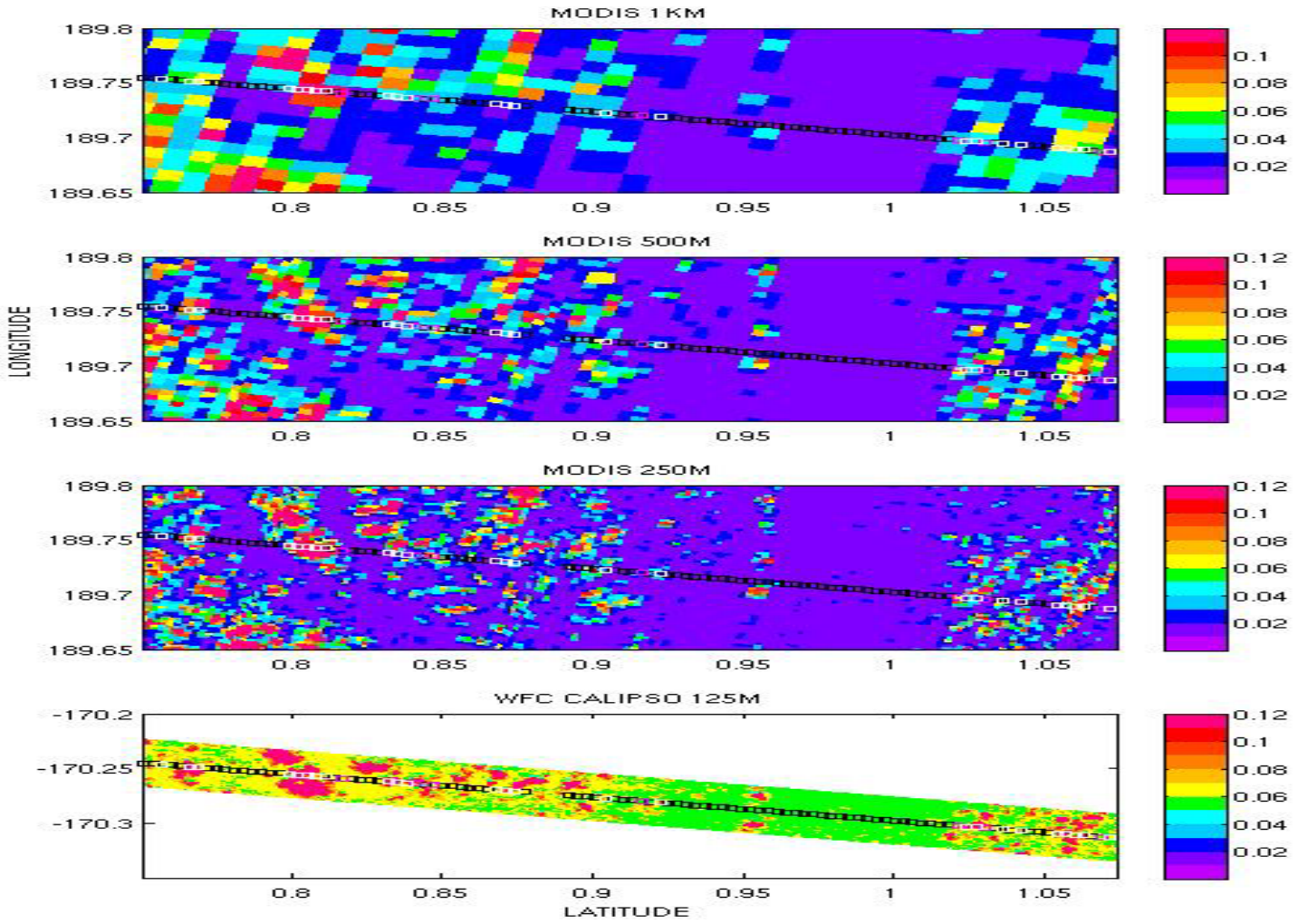

- Information about the short and long wave TOA fluxes
- Period 200003_200510 (courtesy of Norman G. Loeb LaRC)
- *"Towards Optimal Closure of the Earth's Top of-Atmosphere Radiation Budget", N.G.Loeb, B. A.Wielicki, D.R.Doelling, G.L.Smith, D.F.Keyes, S.Kato, N.Manalo-Smith, T.Wong, Journal of Climate, Vol 22, Issue 3 (February 2009) pp. 748 766 ,DOI: 10.1175/2008JCLI2637.1*

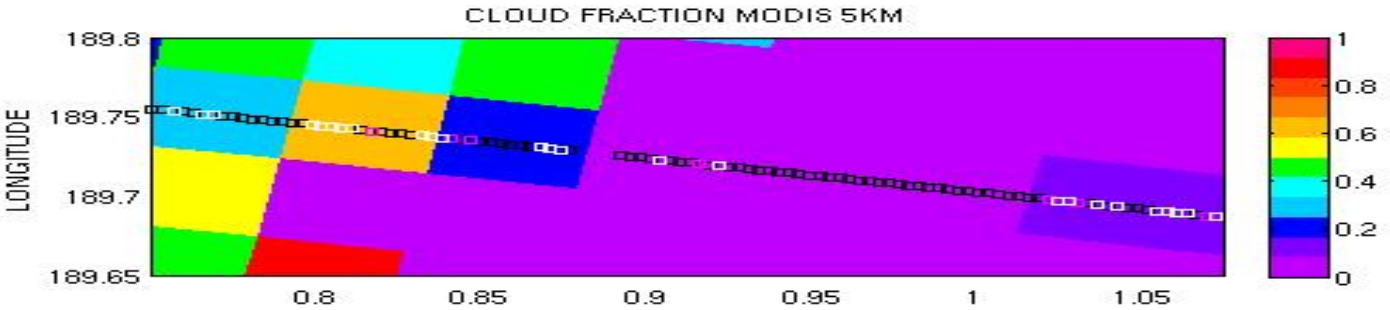
# CFMIP-OBS database

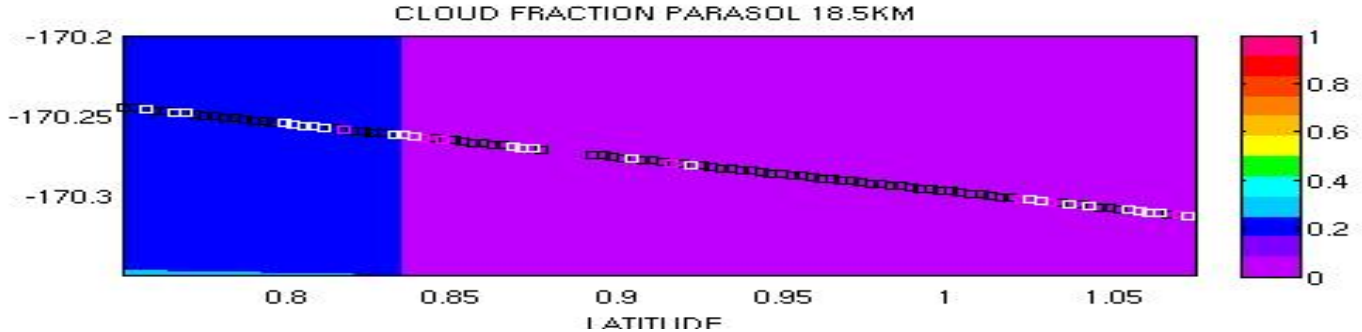
## CLOUDSAT - CFAD

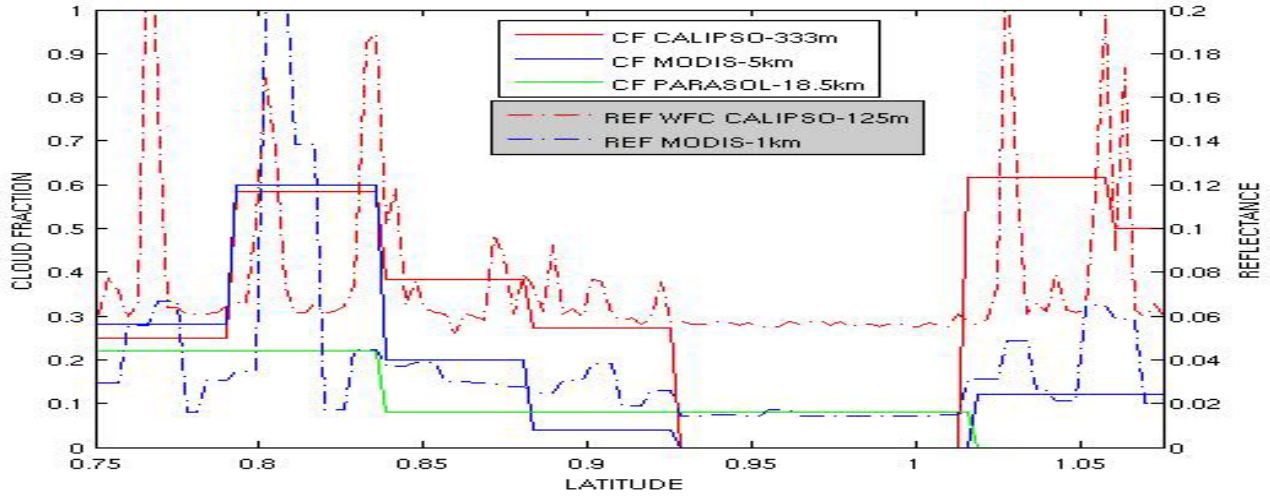


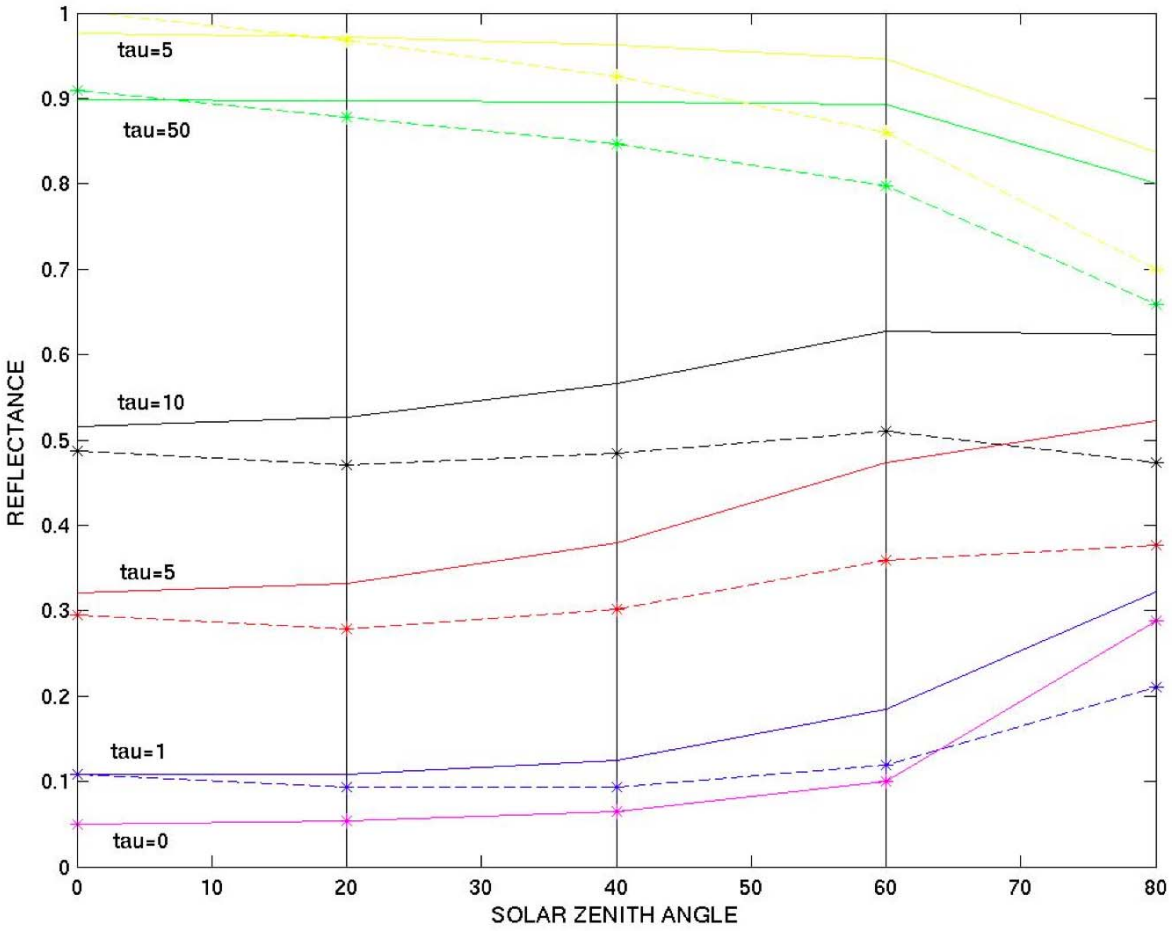

- Information about the cloud fraction
- Period 200606_200806 (courtesy of Roger Marchand, JISAO)
- *"A comparison of simulated cloud radar output from the multiscalemodeling framework global climate model with CloudSat cloud radarobservations", R. Marchand, J.Haynes, G.G.Mace, T.Ackerman, G.Stephens, JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 114, D00A20, doi:10.1029/2008JD009790, 2009*


MODIS 1KM
MODIS 500M
MODIS 250M
WFC CALIPSO 125M
LONGITUDE
LATITUDE
189.8
189.75
189.7
189.65
-170.2
-170.25
-170.3
0.8
0.85
0.9
0.95
1
1.05
0.12
0.1
0.08
0.06
0.04
0.02


CLOUD FRACTION MODIS 5KM
LONGITUDE
189.8
189.75
189.7
189.65
0.8
0.85
0.9
0.95
1
1.05
1
0.8
0.6
0.4
0.2
0


CLOUD FRACTION PARASOL 18.5KM
-170.2
-170.25
-170.3
0.8
0.85
0.9
0.95
1
1.05
LATITUDE
1
0.8
0.6
0.4
0.2
0


CF CALIPSO-333m
CF MODIS-5km
CF PARASOL-18.5km
REF WFC CALIPSO-125m
REF MODIS-1km
CLOUD FRACTION
REFLECTANCE
LATITUDE
0.75
0.8
0.85
0.9
0.95
1
1.05
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0


tau=5
tau=50
tau=10
tau=5
tau=1
tau=0
REFLECTANCE
SOLAR ZENITH ANGLE
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
10
20
30
40
50
60
70
80