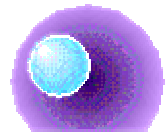

Global Energy and Water Cycle Experiment



Cloud Assessment

Status Report



I P S L

<http://climserv.ipsl.polytechnique.fr/gewexca>

Co-chairs:

Claudia Stubenrauch,
Stefan Kinne,

CNRS/IPSL LMD, France
MPI Hamburg, Germany

Assessments of global climate records

essential for climate studies & model evaluation

& should include:

➤ **Description of retrieval algorithms and references**

➤ **Averages and distributions of the different variables**
(maps, latitude bands, specific regions)

➤ **Time variability**

(seasonal and diurnal variation, interannual variability)

➤ **Uncertainties and biases due to:**

Calibration, sampling (time & space), instrument sensitivity, retrieval method

➤ **Common data base**

providing monthly statistics (for ex. in netCDF)

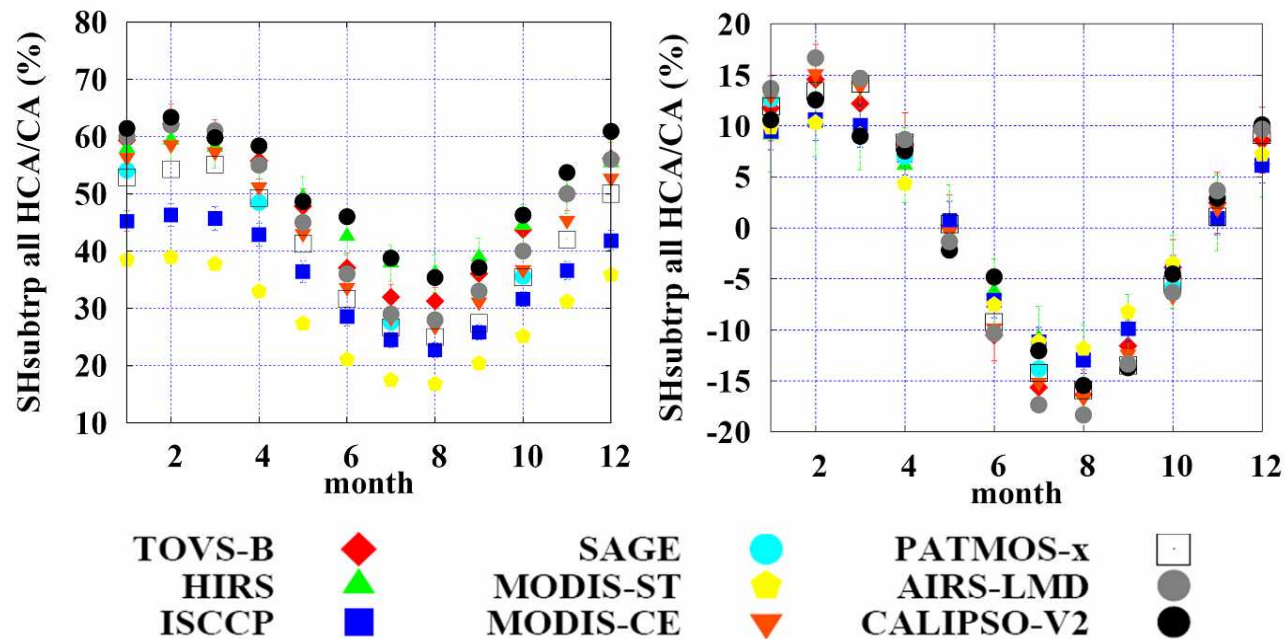
so that every new data base can compare to this data base...

It takes time & effort....



- Apr 2005:** 1. meeting, Madison (co-chairs: G. Campbell, B. Baum)
focus on longterm anomalies
- Jul 2006:** 2. meeting, Madison (co-chairs: B. Baum, C. Stubenrauch)
focus on cloud amount
- 2007/08:** Preparation of datasets for intercomparisons
(via <http://climserv.ipsl.polytechnique.fr/gewexca>)
- Jul 2008:** 3. meeting, New York (co-chairs: C. Stubenrauch, S. Kinne)
intercomparison of cloud variables per type
- 2009:** Preparation of common data base (netCDF)
& quality checks + GEWEX news article (Feb)
- 2010:** Intercomparison & report & article
- Jun 2010:** 4. meeting, Berlin

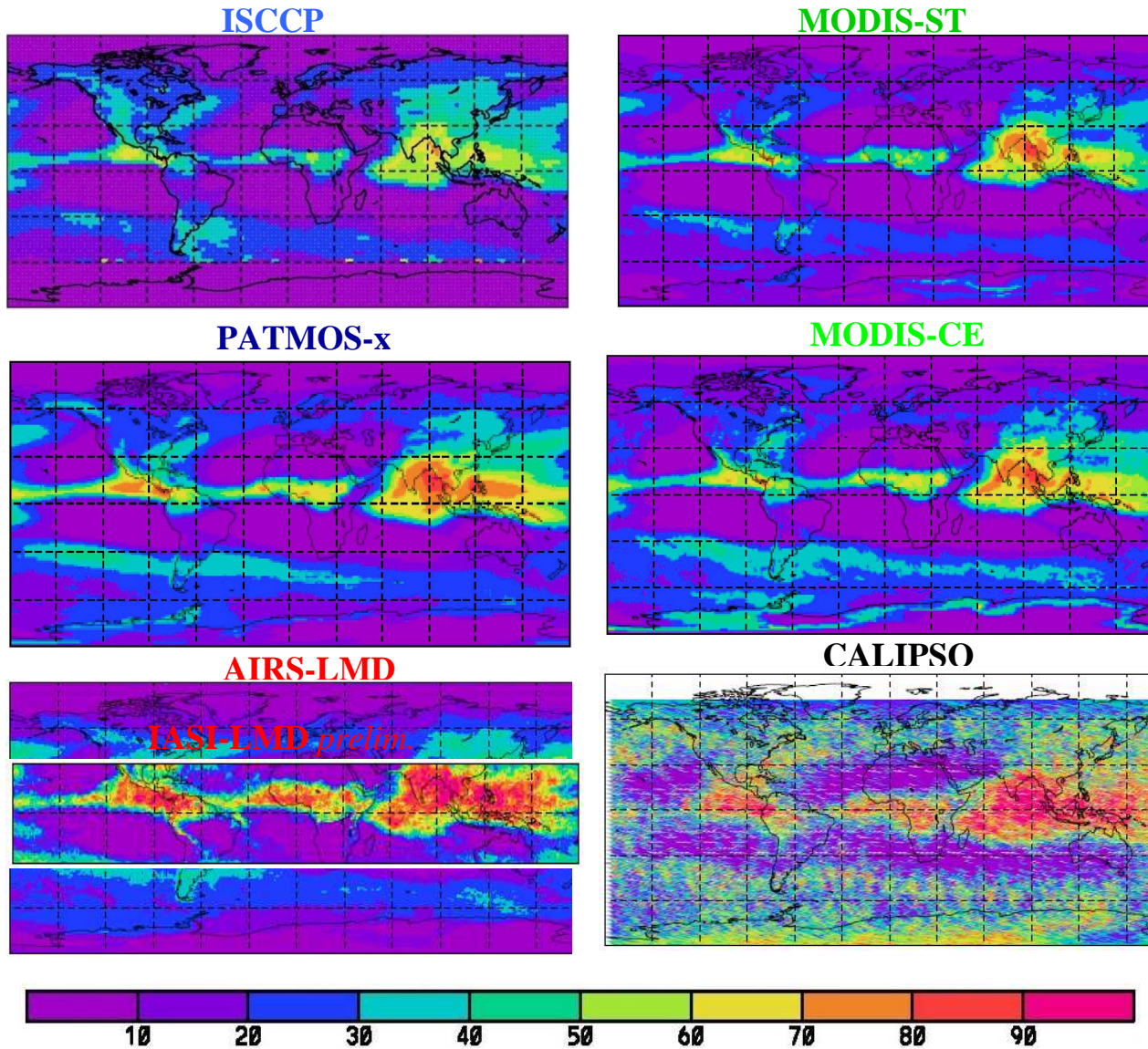
GEWEX news article, Feb 2009



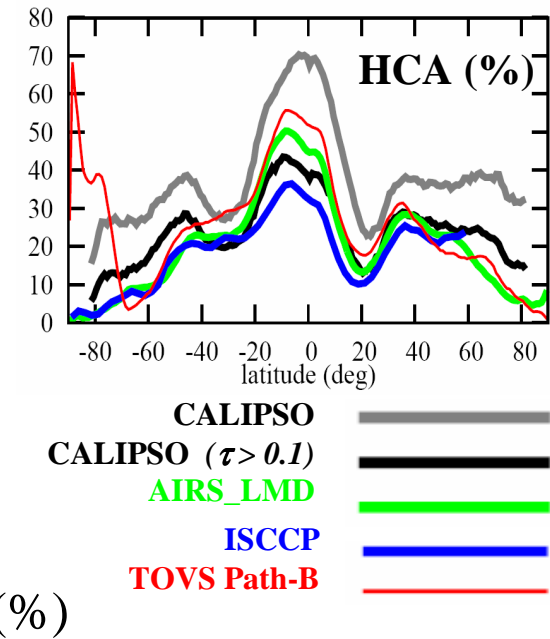
Key results:

- ❖ 70% ($\pm 5\%$) clouds: $\sim 40\%$ high clouds & $\sim 40\%$ single-layer low clouds
- ❖ geographical cloud structures & seasonal cycles agree quite well
- ❖ absolute values depend on instrument sensitivity (& retrieval method)
- ❖ detection thresholds also affect average cloud opt. depth & T
- ❖ trend analysis difficult, synergy of data sets & variables important

CAH geographical distributions (*July*)



absolute values depend on instrument sensitivity & method, but distributions similar



Data requests

Monthly statistics per year & obs time, $1^\circ \times 1^\circ$

- average, • standard deviation, • uncertainty,
- histograms, • nb obs

properties

- cloud amount **CA** (tot, H, M, L, W, I)
- rel. cloud amount **CAR** (H, M, L, W, I)
- VIS optical depth **COD** (tot, H, M, L, W, I)
- IR emissivity **CEM** (tot, H, M, L, W, I)
- pressure **CP** (tot)
- temperature **CT** (tot, H, M, L, W, I)
- Water path **CLWP/CIWP** (W, I, IH)
- r_{eff} **CRE** (W, I, IH)

joint histograms

COD – CP, CEM – CP, COD – CRE

Preparation of GEWEX CA common data base

10/2008: send out *detailed* data request document

01/2009: send out Fortran program to build netCDF files

02/2009: discuss with PATMOSX, MODIS-ST & MODIS-CE teams
(*EUMETSAT Cloud meeting in Locarno*)

04-08/2009: data sets arrive at IPSL ftp server

08-10/2009: checking of data sets, reporting errors,
& teams resending data sets

- Most teams respond now quite fast (this is a non-paid activity)
- Each data set had been produced so far at least 3 times
- Hopefully reliable **common** data base by 12/2009 !!!!



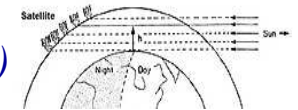
Cloud Assessment

co-chairs:
C. Stubenrauch, S. Kinne

<http://climserv.ipsl.polytechnique.fr/gewexca>

Longterm cloud climatologies:

*ISCCP <i>GEWEX cloud dataset</i>	1984-2007	(Rossow et al. 1999)
PATMOS-x <i>AVHRR</i>	1981-2007	(NESDIS/ORA; Heidinger)
*TOVS Path-B <i>7h30/19h30</i>	1987-1995	(Stubenrauch et al. 2006)
HIRS-NOAA <i>13h30/1h30</i>	1985-2001	(Wylie et al. 2005)
SAGE <i>limb solar occultation</i>	1984-2005	(Wang et al. 1996, 2001)
SOBS <i>Surface OBServations</i>	1952-1996	(Hahn & Warren 1999; 2003)



EOS cloud climatologies (since 2001, 2002):

MODIS-ST (Ackerman et al.; Platnick et al.)	*MODIS-CE (Minnis et al.)
*AIRS-LMD (Stubenrauch et al. 2008, 2009)	MISR (DiGirolamo)

+ A-Train (since 2006):

CALIPSO (Winker et al. 2007, 2009) **CloudSat** (Mace et al. 2009)

GOCCP (Chepfer et al. 2009) **POLDER** (Riedi)

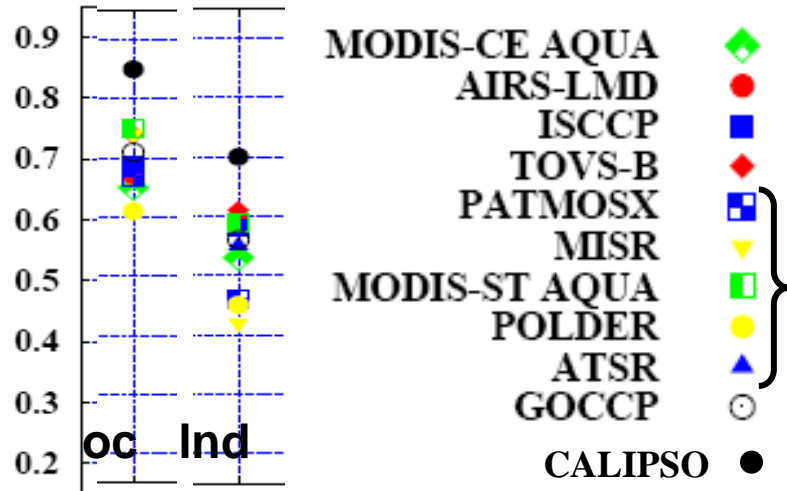
***ATSR-GRAPE** *ERS, 1997-2000* (Poulsen)

netCDF data

* most complete variables

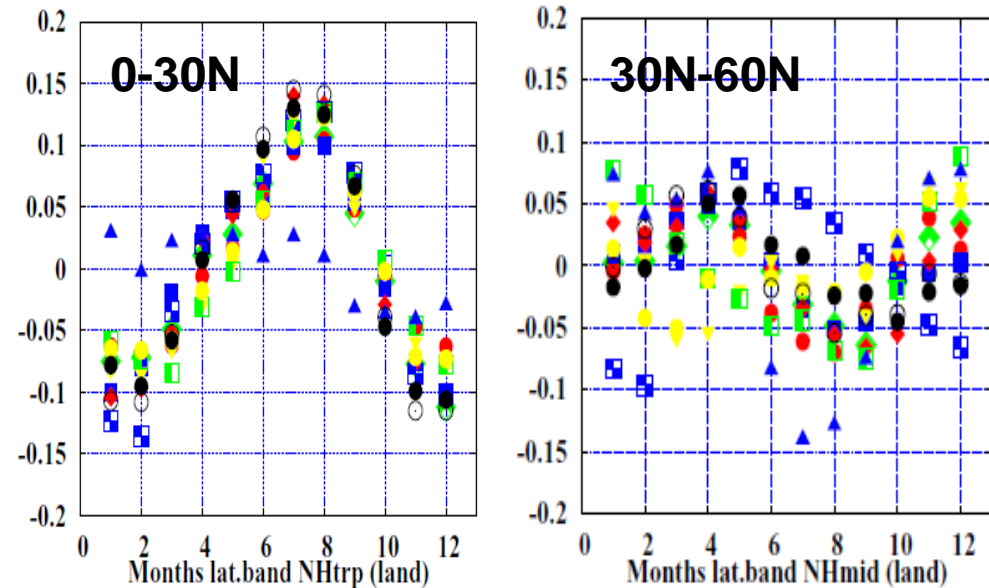
Preliminary results from common data base in netCDF format

global CA



Global spread:
0.15/0.20 -> 0.10

CA seasonal cycle over land



CALIPSO highest CA (sensitive to subvisible Ci)

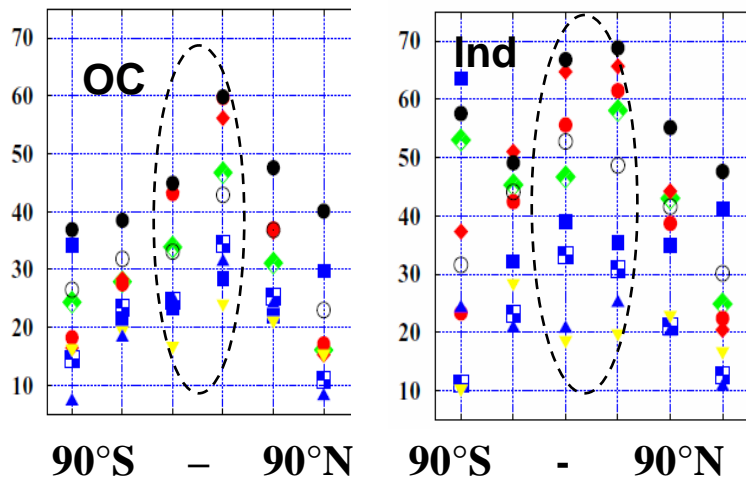
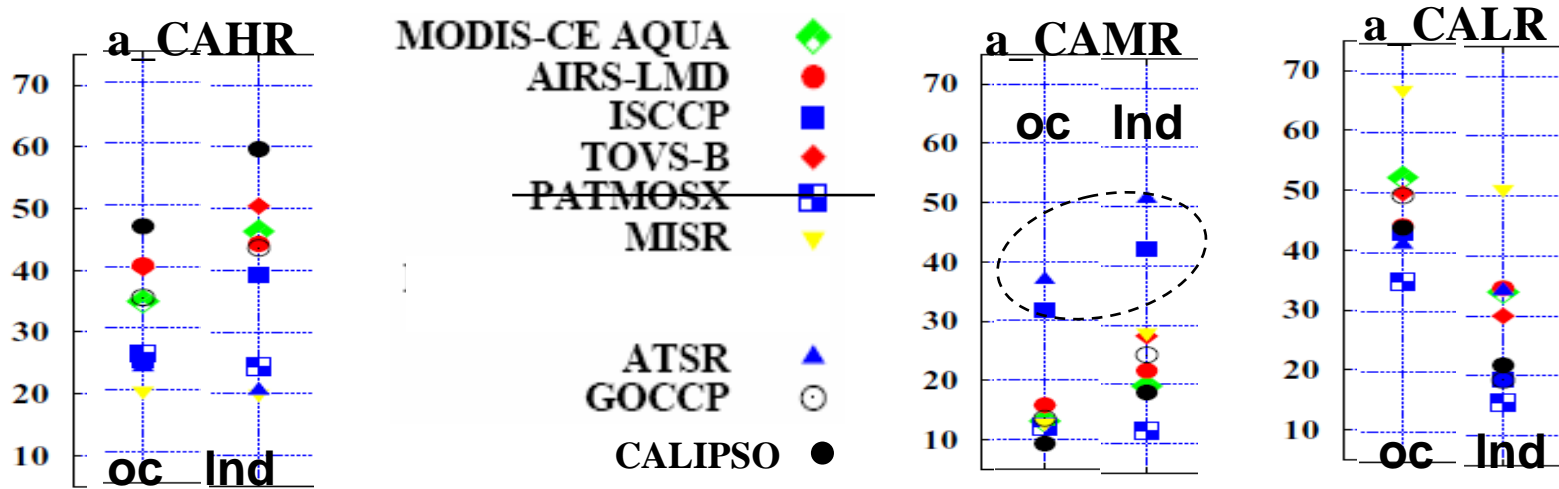
~70 % CA (+ 10% from CALIPSO): 5-15% more over ocean than over land

lowest CA: MISR (esp. over ocean), POLDER, PATMOSX over land

Seasonal cycle over land: 25% in subtrp-trp– 10% in midlat.

Outliers: ATSR-GRAPPE, PATMOSX, MODIS-ST, POLDER, MISR

Cloud type amount from common data base in netCDF format



40% (+5% from CALIPSO) high clouds: 10% more over land than over ocean

40% single-layer low clouds: 20% more over ocean than over land

IR sounders ~ 10% more sensitive to Ci than ISCCP (20% in trps)

ATSR-GRAPE & ISCCP :

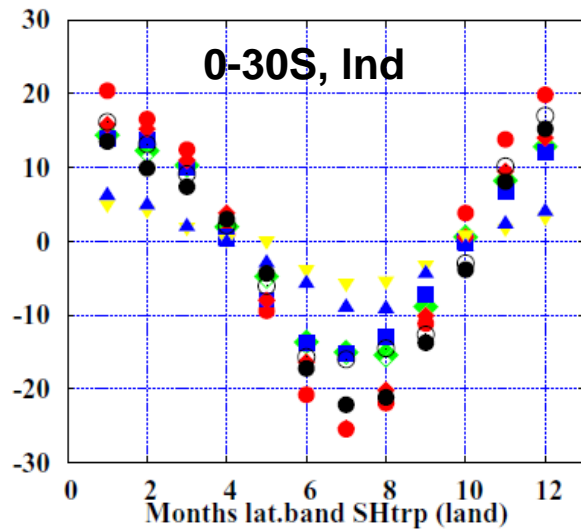
Ci above low cloud, Ci at night -> midlevel cloud

MISR: mostly low clouds

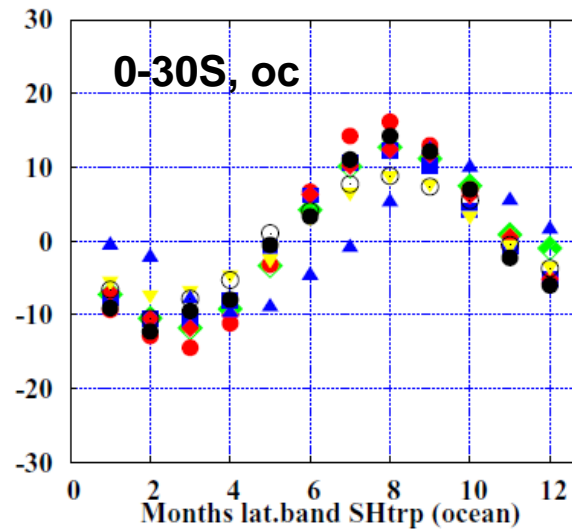
PATMOSX : pb (CAHR+CAMR+CALR<100%!)

MODIS-ST, POLDER: scaling pb (.01)

CAHR seasonal cycle



CALR seasonal cycle



largest over 0-30S lat band:

40% high clds,

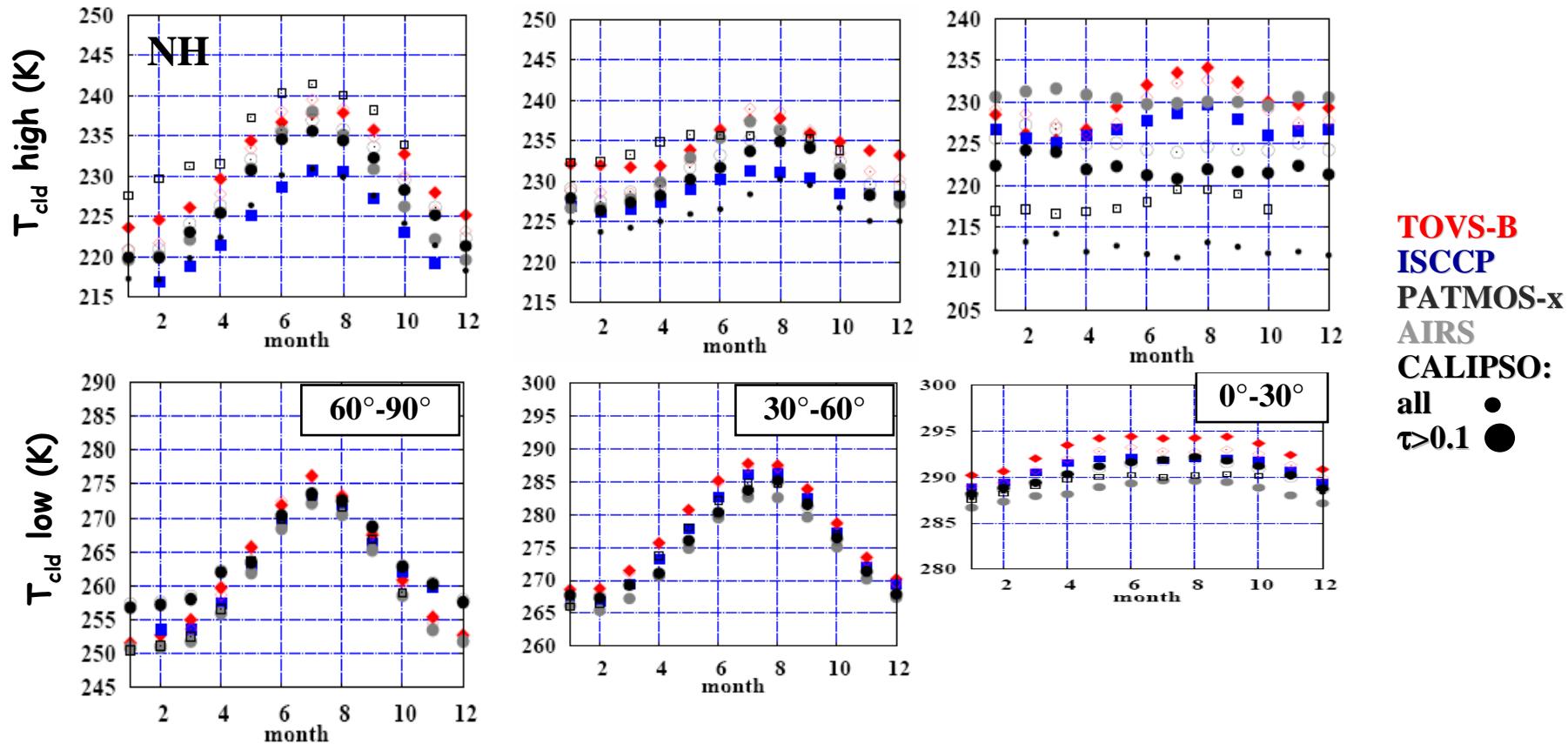
20% low clds

seasonal cycle of single-layer low clds modulated by high clds

good agreement with CALIPSO (esp. IR sounders),

exceptions: MISR (hgh clds), ATSR-GRAPE

cloud temperature of high & low clouds



Seasonal cycle of high T_{cld} decreases from polar (15°), midlat (10°) to tropics (5°)
 low T_{cld} (20°) (20°) (5°)

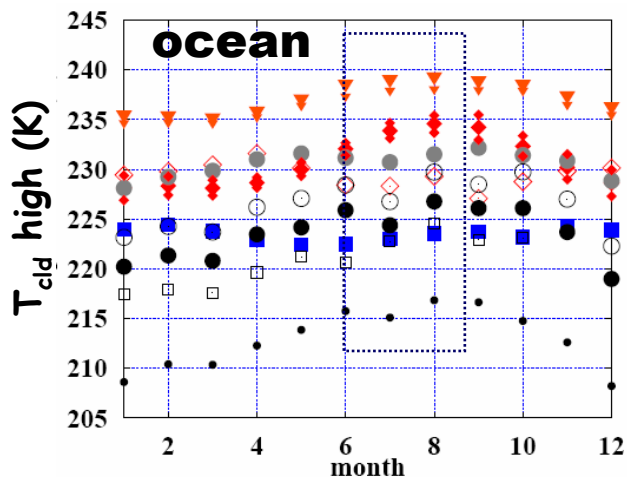
CALIPSO: thin high clouds colder than thicker high clouds ($\tau > 0.1$), esp. in tropics
 differences : largest for high clouds in tropics, very good agreement for low clouds
 uncertainties in cloud height determination (esp. thin cirrus), T profiles

SH

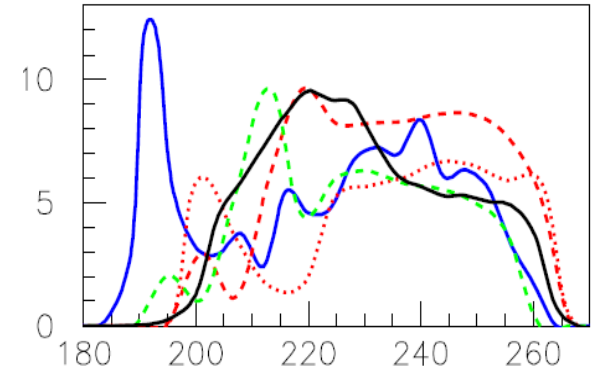
0°-30°

TOVS-B
ISCCP
PATMOSX
MODIS-CE
AIRS
CALIPSO:
 all ●
 $\tau > 0.1$ ●
 $\tau > 0.2$ ○

Tropical high clouds: T_{cld} distributions



ISCCP CALIPSO TOVS AIRS

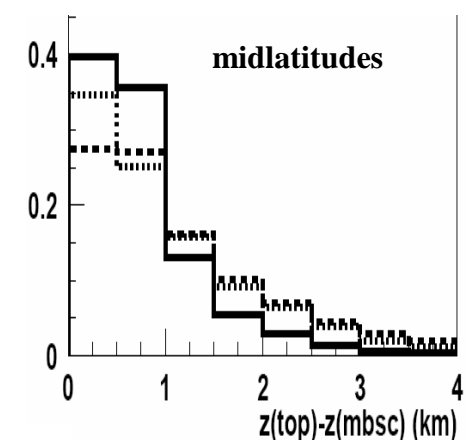
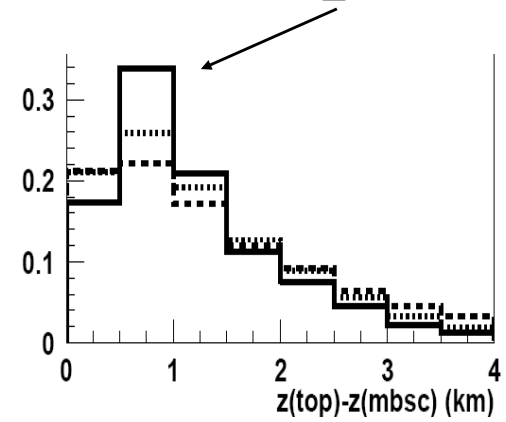


Clouds in tropics have diffuse cloud tops:

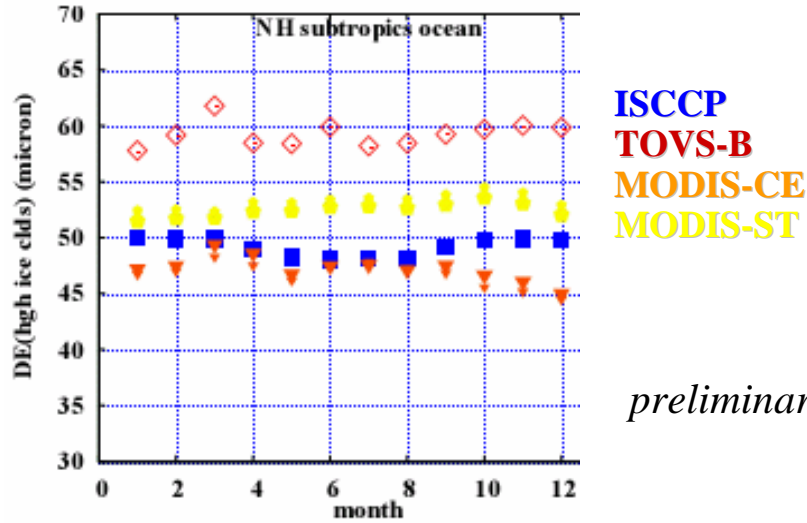
CALIPSO max backscatter ≥ 1 km below cloud top *Stubenrauch et al. 2009*

AIRS-LMD:

- $\epsilon_{cld} > 0.95$
- $0.95 > \epsilon_{cld} > 0.50$
- ⋯ $0.50 > \epsilon_{cld} > 0.05$



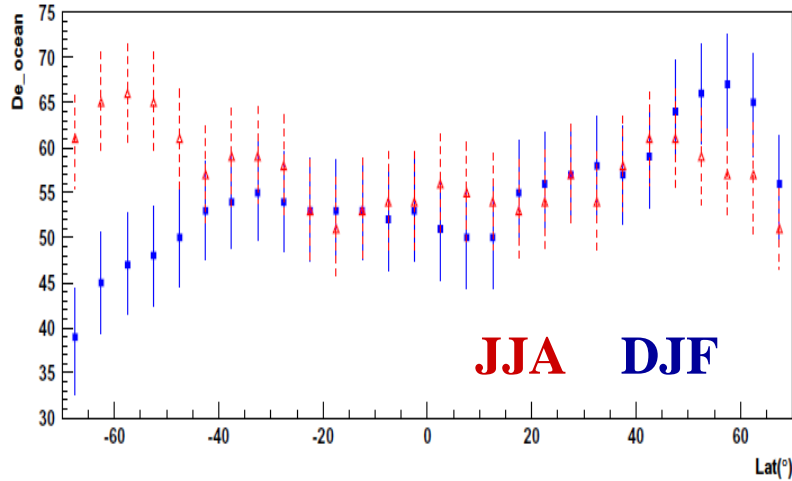
effective ice crystal diameter



preliminary

NIR-VIS:
 D_e near cloud top

IR:
 D_e averaged over cloud depth
 aggregates assumed



AIRS-LMD, *preliminary* (Guignard, Stubenrauch, Cros)

16 channels between 8 and 12 micron

⇒ Ice crystal shape estimation:
 more columns than aggregates

SSP's by A. Baran (MetOffice),

LUT's using 4A-DISORT radiative transfer

still to check:

COD, CEM: ISCCP *too low* (average pb?), MODIS-CE *too large*

**CREI, CREW: PATMOSX $20 \mu\text{m}$ for every lat band,
MODIS-CE *scaling factor 2***

CIWP, CLWP: *other pb's...*

monthly standard deviations:

some teams provide neg. values when not calculated

histograms & joint histograms

longterm anomalies of all variables

uncertainties provided by:

ATSR-GRAPE (OE) & TOVS/AIRS (χ^2 method)

once the common data base seems to be ok...:

- **distribute data sets to assessment group**
- **redo all analyses shown at the New York meeting**
- **split data sets into mature, less mature (PATMOSX, ATSR-GRAPE) & complementary (MISR, POLDER) ?**
- **gather all data descriptions for the WCRP report**
- **actualize sections about cloud amounts**
(global, maps, seasonal cycles, interannual variations, longterm anomalies, regions, diurnal cycle)
- **write part about new variables**
(CT, COD, CREI, CREW, CIWP, CLWP: averages, standard variations & histograms)
- **write summarizing article**
- **make data base public**
- **prepare Berlin meeting (22-25 June 2010)**