# Outcome CREW Madison

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- Introduction
- Motivation
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- Traceability and uniformity of Level-3 products
- Conclusions and recommendations

# 3rd Cloud Retrieval Evaluation Workshop

**15- 18 November 2011**

**Madison, Wisconsin, USA**



EUMETSAT

# Motivation

## Overarching objectives:

- **to identify and address research questions related to cloud parameter retrievals;**
- **to access differences between level-2 cloud parameter retrieval algorithms;**
- **to enhance traceability and uniformity of level-3 cloud parameter products;**
- to enhance the communication and develop international partnerships;

## Strategy

- Organize biannual workshops;
- **Build a common data base of monitored and reference cloud parameter retrievals;**
- **Provide statistics of comparisons of monitored vs. reference cloud retrievals;**
- Coordinate sub-working groups focusing on dedicated research topic;
- Establish links with other working groups (e.g. GEWEX-CA or SCOPE-CM);
- Write annual reports and, on an ad hoc basis, collaborative papers;
- Seek funding to finance on CREW related activities;
- Participate in joint research projects.

# Comparison of Level-2 retrievals

# Common Database

## Golden days

**i)** 13 June 2008; **ii)** 17 June 2008; **ii)** 18 June 2008;
**iv)** 22 June 2008; **v)** 3 July 2008

## Products

**C**loud **M**ask (*CMB*); **C**loud **Ph**ase (*CPH*); **C**loud **T**op **H**eight (*CTH*);
**C**loud **T**op **T**emperature (*CTT*); **C**loud **T**op **P**ressure (*CTP*); **C**loud **O**ptical **T**hickness (*COT*);
**C**loud **W**ater **P**ath (*CWP*); Particle Size (*Reff*).

## Monitored data

- datasets from **16 passive imager retrieval algorithms**
- retrievals from **5 instruments**: *SEVIRI, MODIS, AVHRR, AIRS and POLDER*

## Reference data

- observations from 5 instruments: *Cloudsat, Calipso, MERIS , HIRS, and AMSR*

*Thanks to Jerome Riedi, University of Lille, France*

# Evaluation Method

## **Passive imager inter-comparison** *(with focus on the SEVIRI, current status)*

- Full disk images with corresponding statistics (means);
- Scatterplots, frequency distributions, and latitudinal plots;
- Maps of the mean and the standard deviation of all algorithms.

## **Validation against reference datasets** *(with focus on A-train satellites, future)*

- CTH passive imagers (MSG, MODIS, AVHRR) against Calipso and Cloudsat;
- LWP passive imagers (MSG, MODIS, AVHRR) against AMSR;
- COD and REFF passive imagers against Calipso/Cloudsat;
- CPH, COD, REFF, and LWP against MODIS retrievals.

# MSG inter-comparison

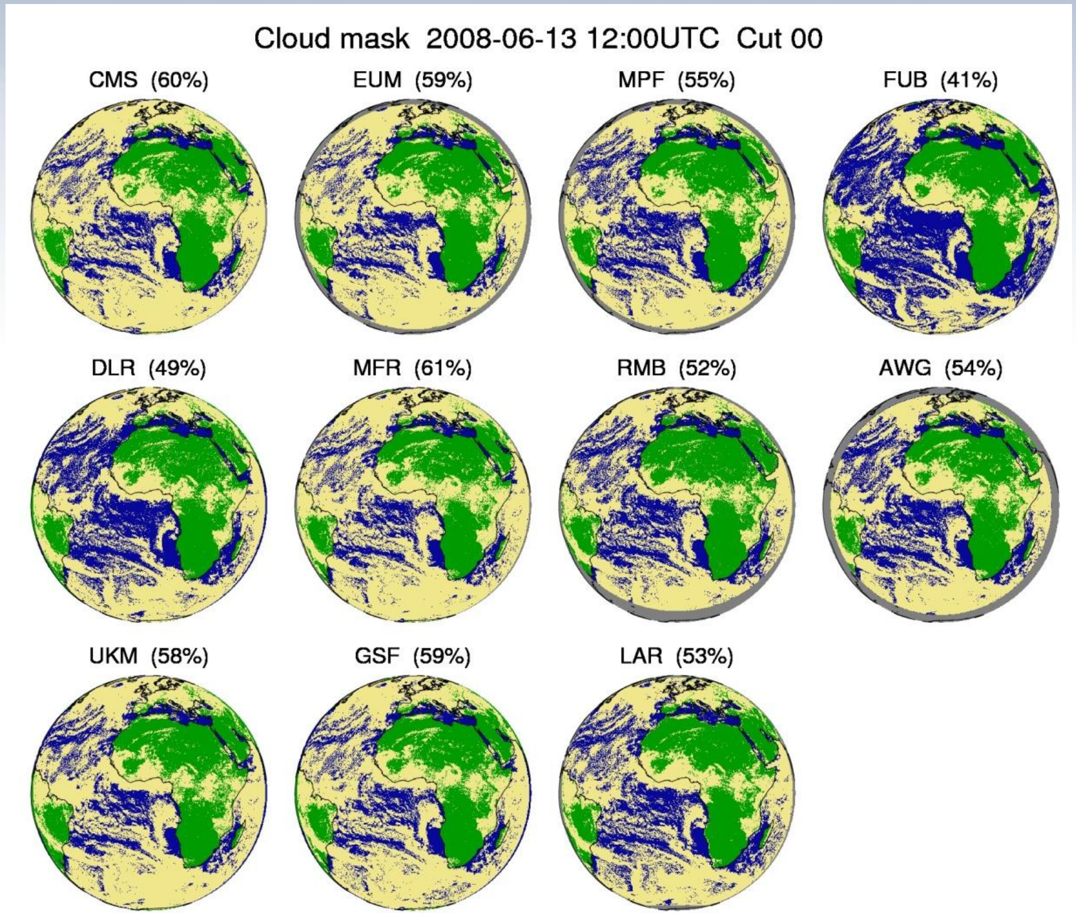



***Fig. :*** *Cloud masks of 11 MSG algorithms (13 June 2008, 12 hr UTC)*

# Multiple Algorithm Ensemble plots

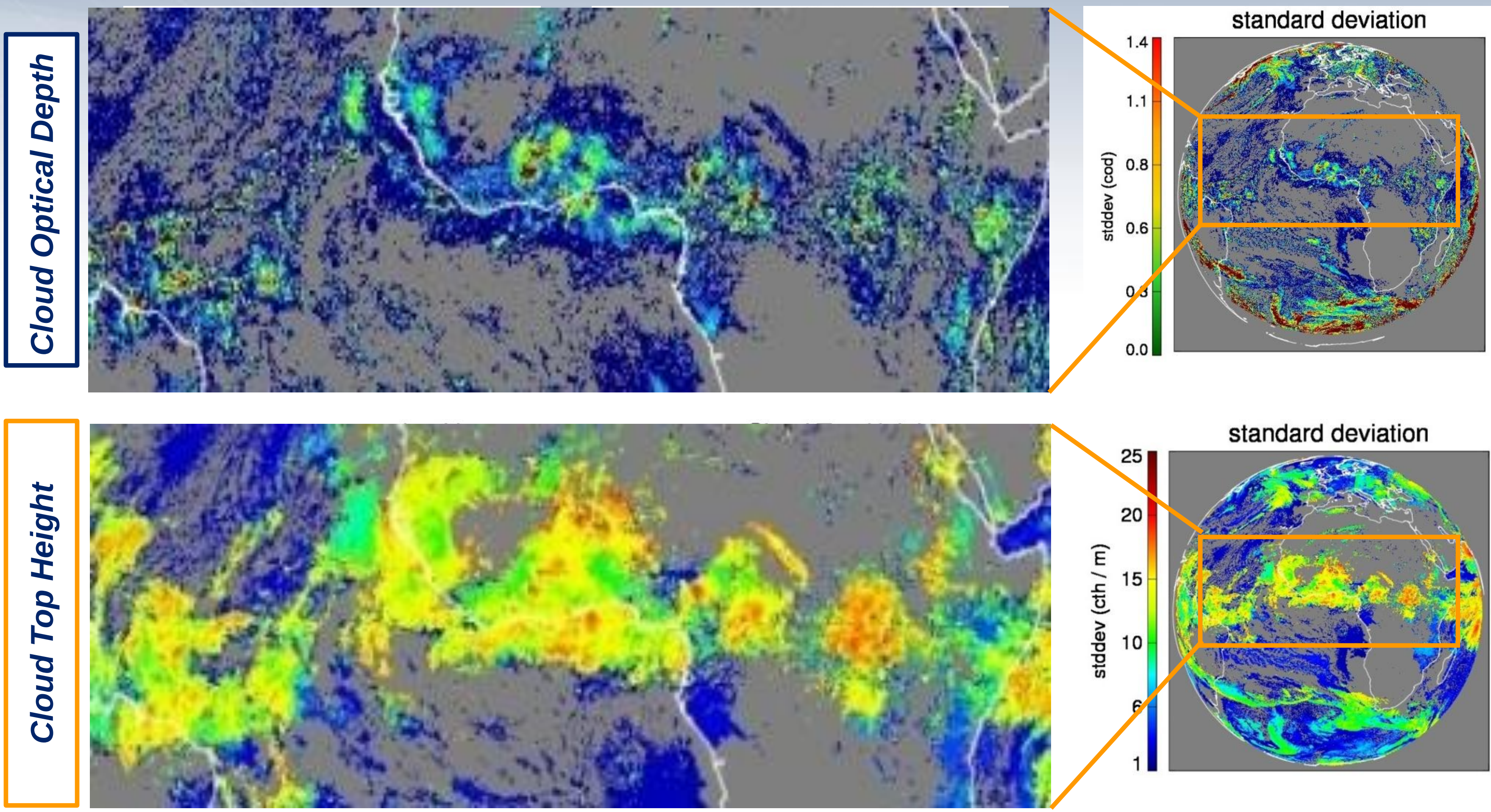



***Fig. :*** *Examples of Multiple Algorithm Ensemble plots for the*
***Cloud Optical Depth*** *(upper panel) and* ***Cloud Top Height products*** *(lower panel).*

# Inter-algorithm consistency

## Cloud Optical Depth MODIS/AQUA for June 13, 2008 13:55

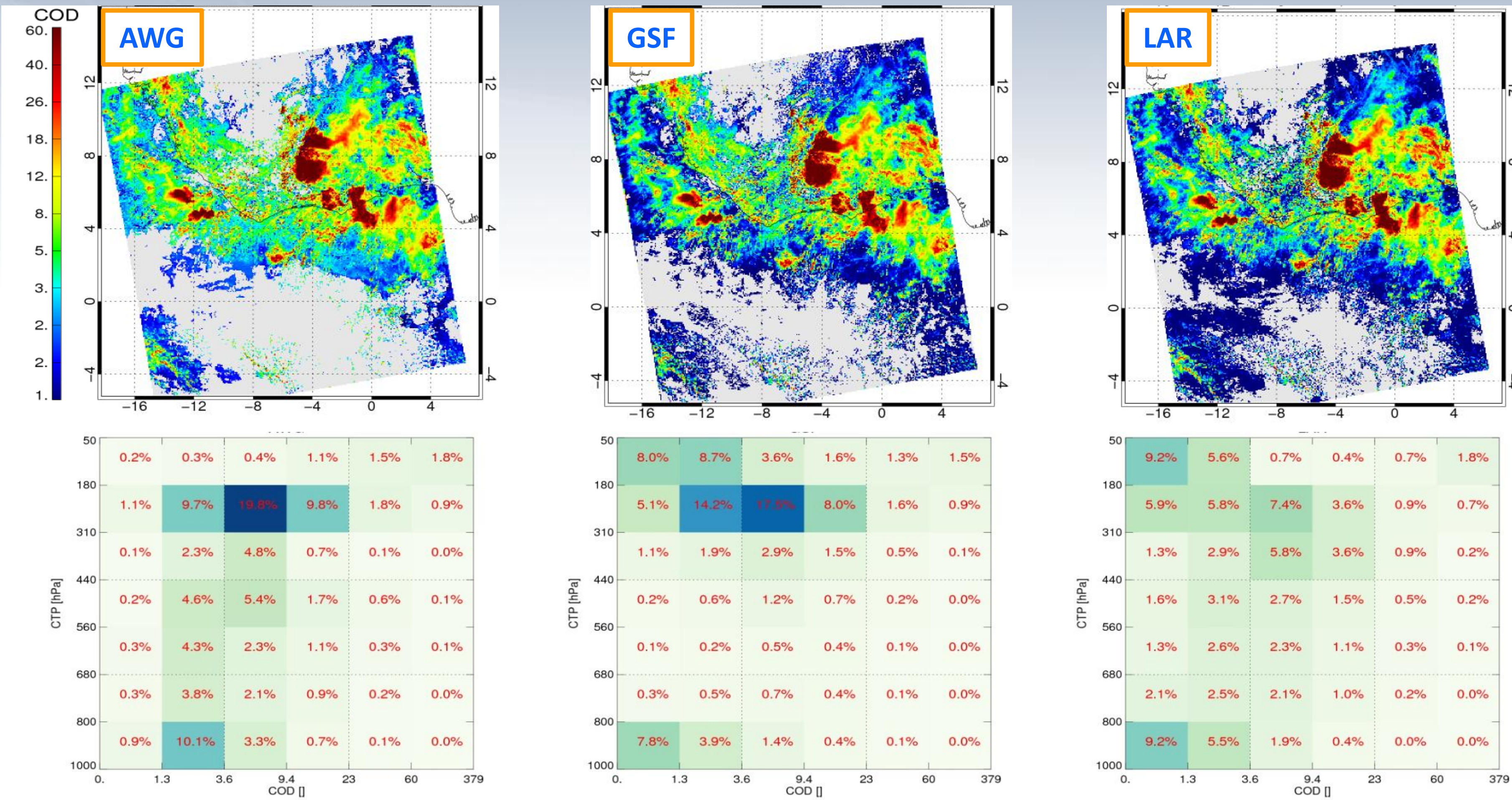



***Fig. :*** *Comparison of MODIS COD and CTH retrievals from three algorithms, i.e.: AWG, GSF, and LAR*

# Inter-sensor consistency
## DCOMP PATMOS-x

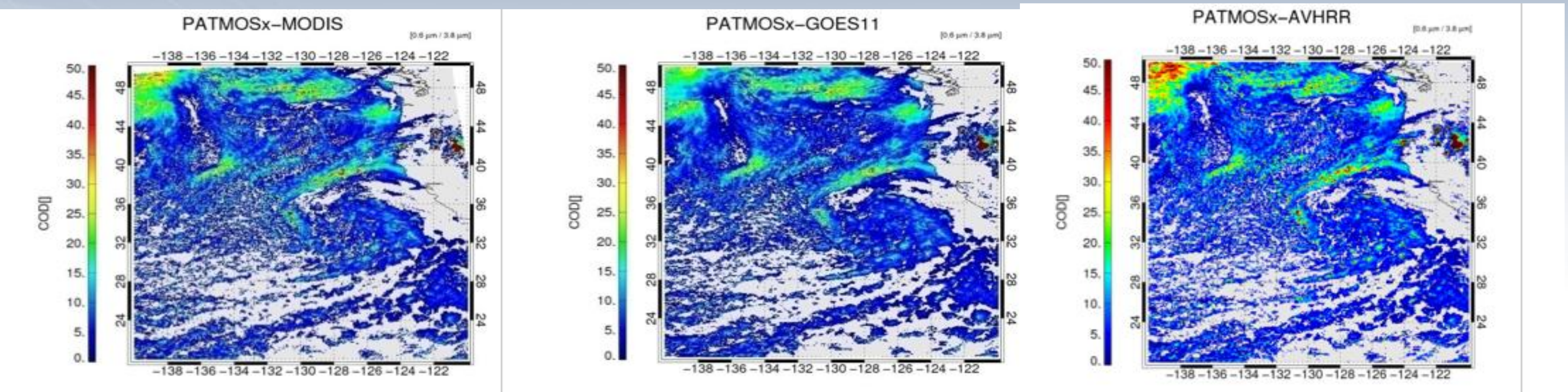
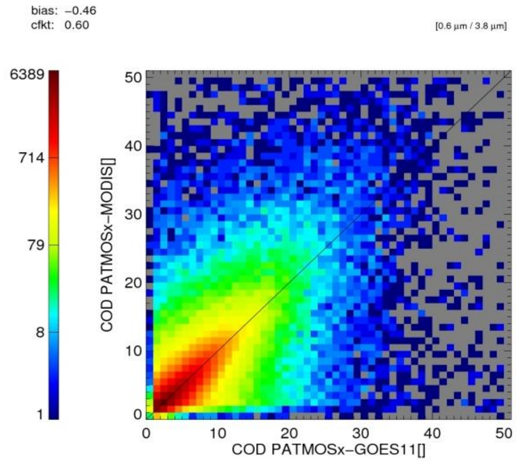



***Fig.:*** *MODIS, GOES and AVHRR retrievals of COD using the AVG algorithm.*

### Matching method:

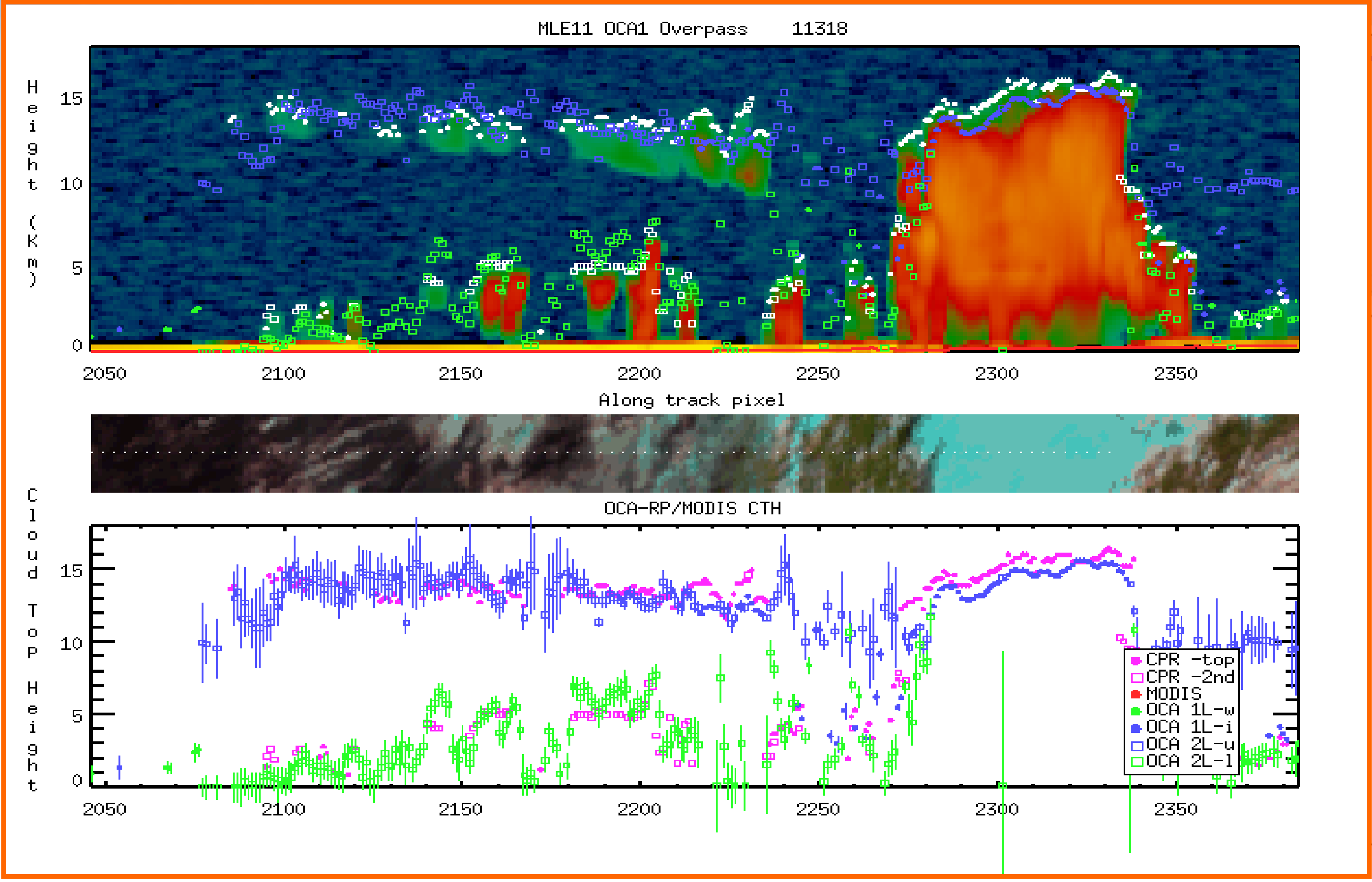
10 minutes time difference threshold, sampled to a 0.05 lat/lon grid corresponding to approx. 5 km for this latitude range.




### Result:

Low bias in comparison with other sensor PATMOS-x retrievals.

# Comparison against Calipso/Cloudsat: Cloud Top Heights



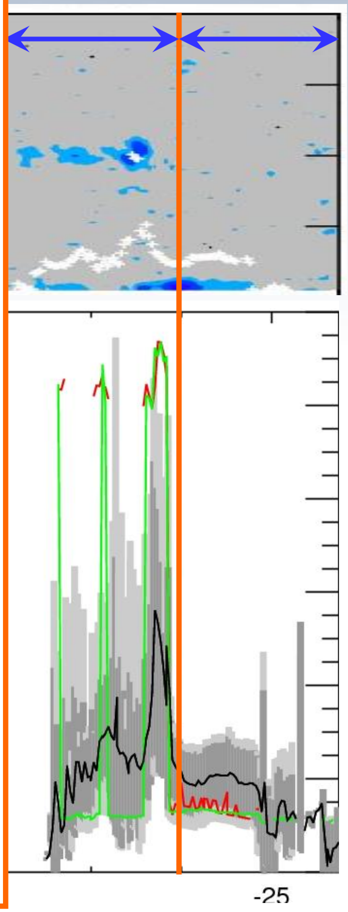




***Fig. :*** *Comparison of* ***Calipso***, ***Cloudsat*** *and* ***SEVIRI mean*** *cloud top heights. The grey areas indicate the min/max of 7 SEVIRI retrievals (CUT-05)*

*Courtesy of Phil Watts, Eumetsat, Germany*

# Traceability and Uniformity of Level-3 products

# Introduction: Level-3 data

## Why grid data?

**Observation grid**
- **non-uniform** -

**Space-time grid**
- **uniform** -

**Key questions**:

Statistical characterization

Error traceability

Limit on number of observations per cell

Correlation in grid space

- Data reduction
- Accessibility
- Multi-instrument comparisons
- Time series analysis
- Large scale geophysical analysis

*Courtesy of Nadia Smith, University of Wisconsin, USA*

# Level-3 Products: Sensitivity to cloud mask

| | Cloud Optical Depth Individual Cloud Mask | | | | Cloud Optical Depth Common Cloud Mask | | | |
|---|---|---|---|---|---|---|---|---|
| Group | Mean | 25%_P | Medi | 75%_P | Mean | 25%_P | Medi | 75%_P |
| CMS | 6.27 | 1.13 | 2.99 | 7.12 | 9.08 ↑ | 2.71 | 5.27 ↑ | 10.38 |
| OCA | 5.67 | 1.46 | 2.95 | 6.43 | 7.69 | 2.57 | 4.59 | 9.14 |
| DLR | 6.77 | 1.30 | 3.00 | 6.75 | 7.35 | 2.40 | 4.40 | 8.25 |
| RMB | 15.94 | 2.36 | 5.83 | 13.73 | 14.94 | 4.38 | 7.91 | 15.05 |
| UWM | 4.63 | 1.30 | 2.76 | 5.79 | 6.75 | 2.83 | 4.78 | 8.56 |
| UKM | 10.41 | 1.86 | 4.07 | 9.43 | 10.31 | 3.30 | 5.85 | 11.54 |
| GSF | 3.24 | 0.35 | 1.53 | 4.20 | 5.01 | 1.23 | 3.13 | 6.39 |
| LAR | 7.85 | 1.20 | 3.22 | 8.01 | 10.20 ↑ | 3.01 | 5.53 ↑ | 11.31 |

| | Effective Radius Individual Cloud Mask | | | | Effective Radius Common Cloud Mask | | | |
|---|---|---|---|---|---|---|---|---|
| Group | Mean | 25%_P | Medi | 75%_P | Mean | 25%_P | Medi | 75%_P |
| CMS | 13.08 | 7.89 | 8.29 | 18.08 | 13.77 ↑ | 7.69 | 8.89 ↑ | 21.47 |
| OCA | 19.94 | 6.10 | 10.44 | 34.31 | 19.92 | 5.70 | 8.76 | 39.17 |
| DLR | 11.64 | 5.99 | 6.49 | 14.73 | 12.51 | 5.99 | 5.99 | 14.98 |
| AWG | 17.83 | 10.41 | 14.95 | 21.76 | 13.19 | 8.06 | 11.03 | 17.60 |
| UKM | 15.84 | 6.79 | 14.43 | 22.28 | 13.87 | 5.92 | 11.58 | 20.71 |
| GSF | 23.14 | 11.32 | 18.67 | 28.19 | 21.61 | 9.99 | 17.17 | 27.31 |
| LAR | 19.72 | 10.09 | 15.58 | 26.02 | 18.01 ↓ | 8.89 | 12.18 ↓ | 25.42 |

# Level-3 Products: Sensitivity to viewing geometry

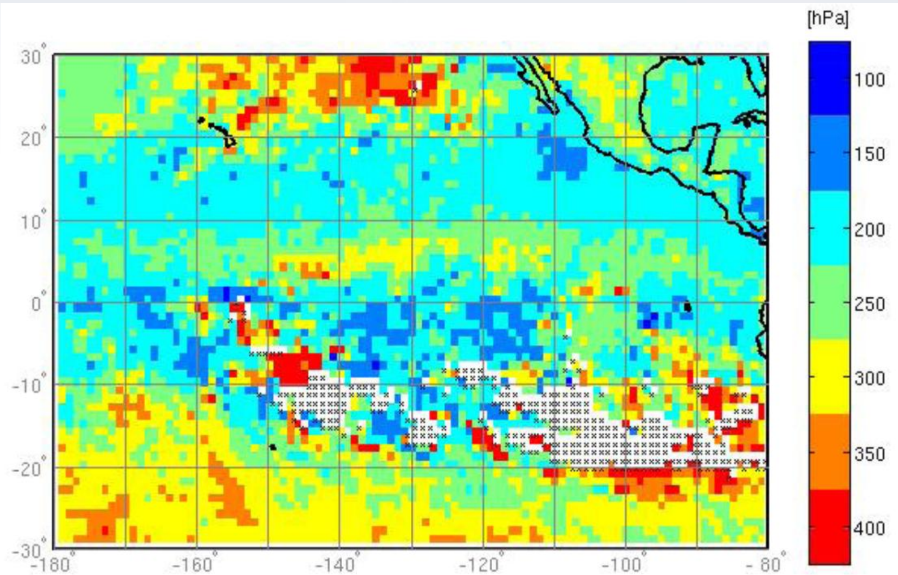



***Fig. :*** *Gridding using all viewing angles*

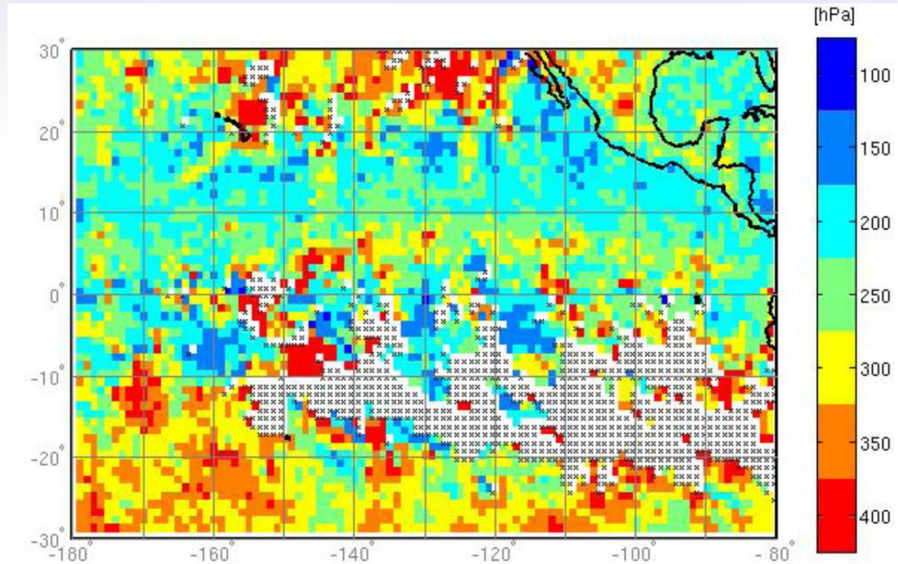



***Fig. :*** *Gridding using viewing angles < 32 degrees*

*Courtesy of Nadia Smith, University of Wisconsin, USA*

# Level-3 Products: Sensitivity to sampling period

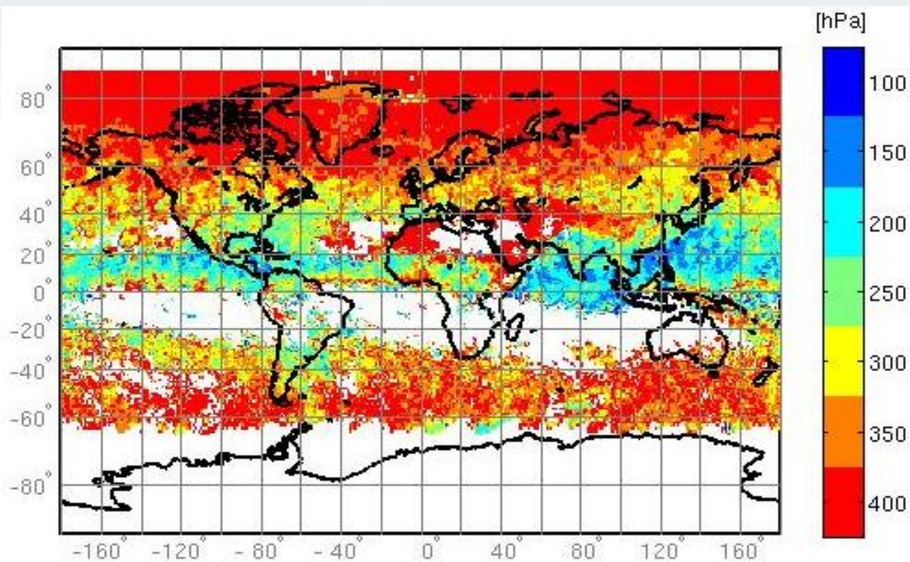



***Fig. :*** *Gridding of 15 days*

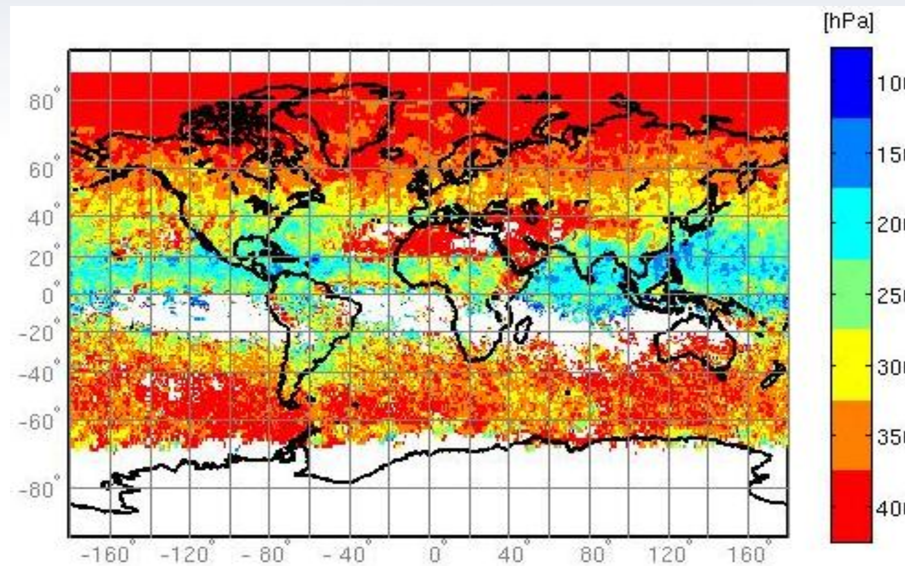



***Fig. :*** *Gridding of 30 days*

*Courtesy of Nadia Smith, University of Wisconsin, USA*

# Level-3 Products: Sensitivity to grid size (degrees)

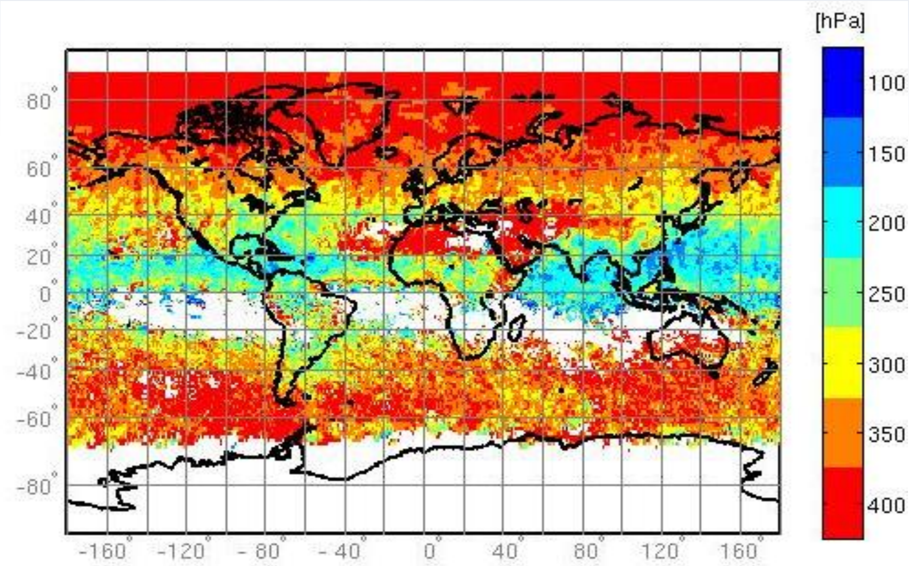



***Fig. :*** *Gridding at 1 degree resolution*

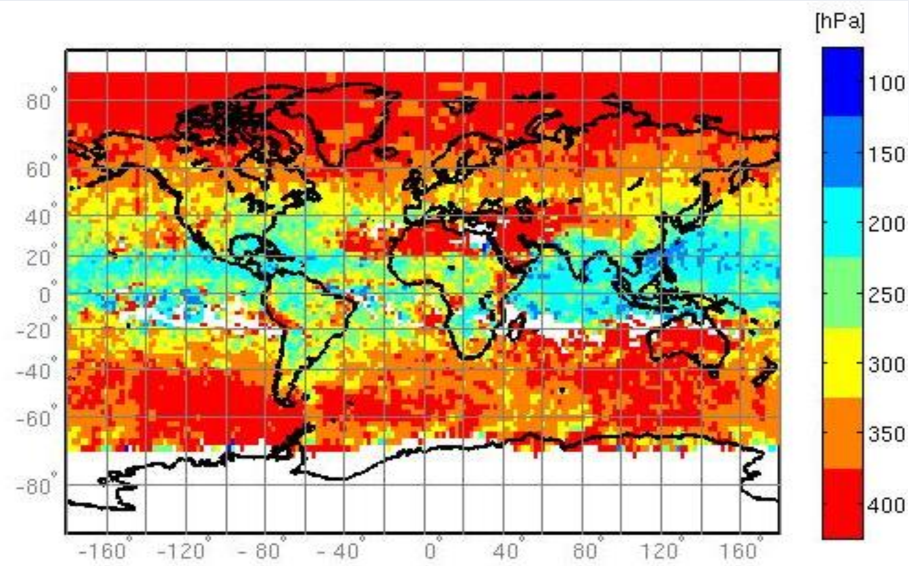



***Fig. :*** *Gridding at 2 degree resolution*

*Courtesy of Nadia Smith, University of Wisconsin, USA*

# Conclusions and Recommendations

# Conclusions

**Level-2**

- Large differences between cloud masks (instantaneous difference up to 20%);
- Passive imagers underestimate CTH relative to Cloudsat and Calipso.
- Best agreement for homogeneous water clouds, whereas larger differences for multiple layer and broken clouds;
- For homogeneous thick ice clouds good agreement for CTH, but fair agreement for IWP and particle size;

**Level-3**

- Instrument-independent gridding approach are being developed to reduce differences in Level 3 products;
- Zonal statistics are parameter specific, i.e. cloud parameters are not all treated the same. This leads to more meaningful analysis;
- Gridding needs to be tested for cloud retrievals from other instruments and algorithms, and analysed for global time-series.

# Recommendations

- Increase focus on detection and analysis of **multiple layer clouds**;
- Increase our skills of cloud property **retrievals** from **infrared observations**;
- Increase our understanding of the **microphysical properties of ice cloud models** used to retrieve cloud parameters from visible and shortwave infrared observations;
- Accommodate a **common standard** for generating **global gridded (Level 3) cloud climatologies;**
- Coordinate activities to improve traceability and uniformity in data products;
- Establish Working Groups and enhance the collaboration on the topics: ***Cloud Vertical Placement; Cloud Physical Properties; Cloud Climatologies***;
- Plan biannual meetings.

***Next workshop: Grainau, Germany in 2013 or 2014***

*R. Roebeling, B. Baum, R. Bennartz, U. Hamann, A. Heidinger, A. Thoss, and A. Walther, 2012: THE THIRD CLOUD RETRIEVAL EVALUATION WORKSHOP (submitted to BAMS)*

# Where to get the data?

## More information on Wiki site:

**http://www.icare.univ-lille1.fr/crew/**

## Common Data Base on FTP site:

- Input files (reflectances and angles) MSG/MODIS golden days
- Input files (reflectances and angles) simulator
- Output retrievals participating groups golden days
- Output retrievals participating groups simulator
- Communication of results

**ftp://ftpush.icare.univ-lille1.fr/crew/**

*CREW acknowledges Jerome Riedi (Univ. Lille, France) for providing infrastructure for website and common database*

# Thank You

## Any Questions?