Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the Environment

CREW: Update of the evaluation of SEVIRI cloud parameter retrievals

Ulrich Hamann
Andi Walther
Ralf Bennartz
Anke Thoss
Rob Roebeling
Jan Fokke Meirink
The CREW team!

CREW-4 | Grainau | 05 March 2014

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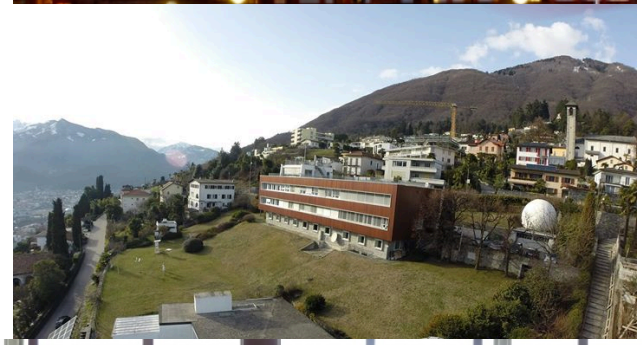
History of CREW

2006 Norrköping, Sweden

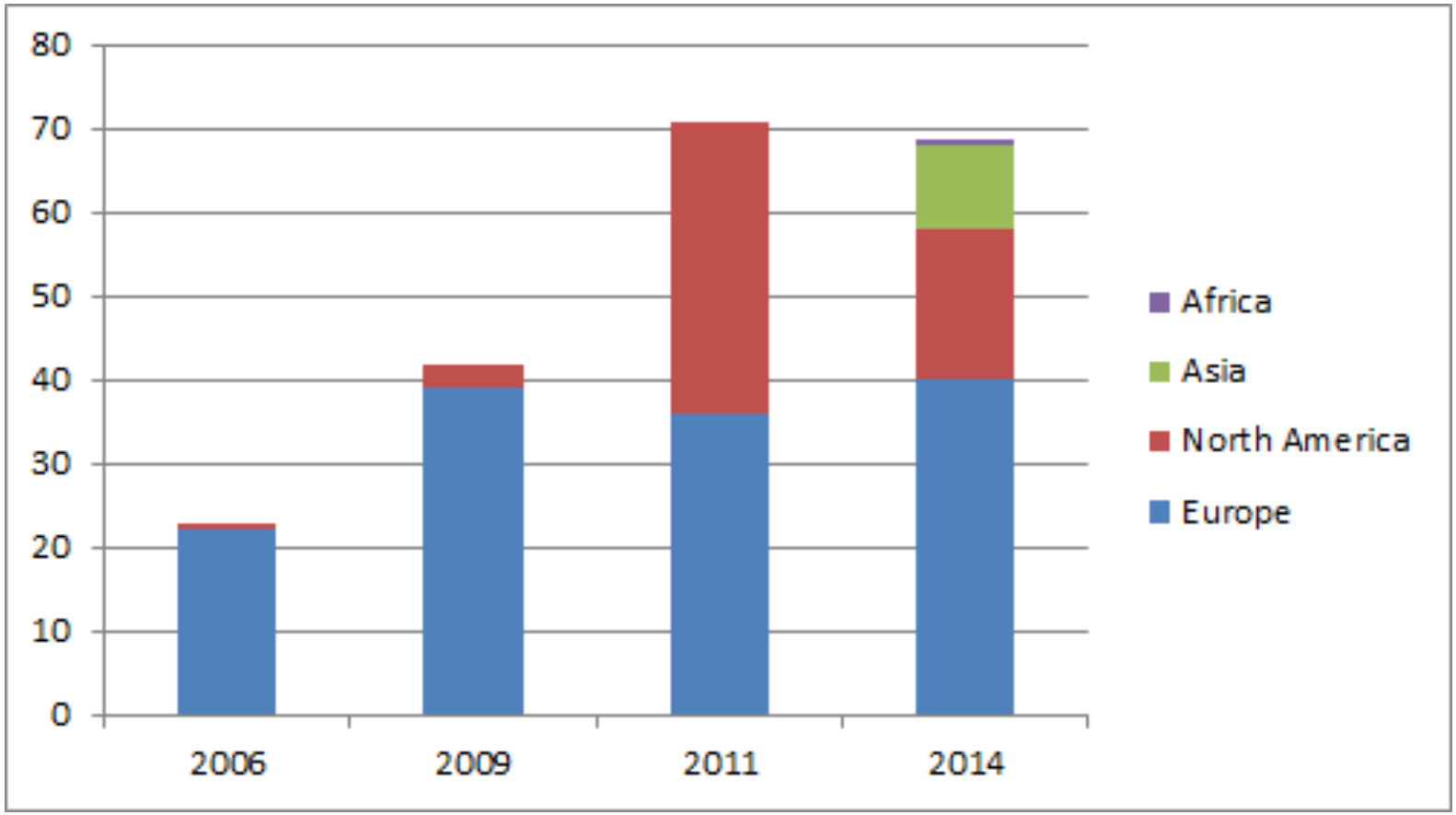
2009 in Locarno, Switzerland



2011 in Madison, USA

2014 in Greinau, Germany

Number of CREW participants



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CREW database

Group	Acronyms	Satellite Instruments	Contacts
Passive Imager Retrievals			
CM-SAF (DWD, KNMI)	CMS	SEVIRI, AVHRR and MODIS	Stengel, Lockhoff, Meirink
CNRS	CNR	AIRS	Stubenrauch
DLR	DLR	SEVIRI	Bugliaro, Kox, Gesell
University of Marburg	EIM	SEVIRI	Kühnlein, Kokhanovsky
EUMETSAT	EUL, EUJ, OCA	SEVIRI	Lutz, Joro, Watts
Free University Berlin	FUB	SEVIRI	Preusker
NASA Goddard	GSF	SEVIRI, MODIS	Platnick, Wind
NASA Langley	LAR	SEVIRI, MODIS	Minnis
NWC-SAF	MFR, SMH	SEVIRI, AVHRR, MODIS	Legleau, Dybroe, Thoss
Royal Met. Inst. of Belgium	RMB	SEVIRI	Ipe, Dewitte
University of Madison	AWG	SEVIRI	Walther, Heidinger
University of Lille	ULI	POLDER	Riedi
UK MetOffice	UKM	SEVIRI	Francis, Taylor
Reference Datasets			
CALIPSO	CAL	CALIPSO	Winker
CLOUDSAT	CLO	CLOUDSAT	Stephens
MIRS	MSR	MIRS	Horváth
CNRS	DAR	Cloudsat/Calipso	Delanoe, Hogan
University of Madison	AMS	AMSR	Bennartz

Future

- GOES
- VIIRS
- COMS
- Himawari
- Geo-KOMPSAT-2A

CREW database

Ten cloud properties

- Cloud Detection
- Top products
- Optical properties
- Macrophysics
- Synoptic

Acronym	*Description*	*Unit*
CMB	Cloud Mask	[%]
CTH	Cloud Top Height	[m]
CTP	Cloud Top Pressure	[Hpa]
CTT	Cloud Top Temperature	[K]
COD	Cloud Optical Depth	[-]
REF	Partical Effective Radius	[mm]
LWP	Liquid Water Path	[g m^{-2}]
IWP	Ice Water Path	[g m^{-2}]
CPH	Thermodynamic Phase	[water, ice, mixed]
CTY	Cloud Type	[-]

Five golden days

- Satellite alignment
- Optimal validation data sets

13-6-2008
17-6-2008
18-6-2008
22-6-2008
3-7-2008

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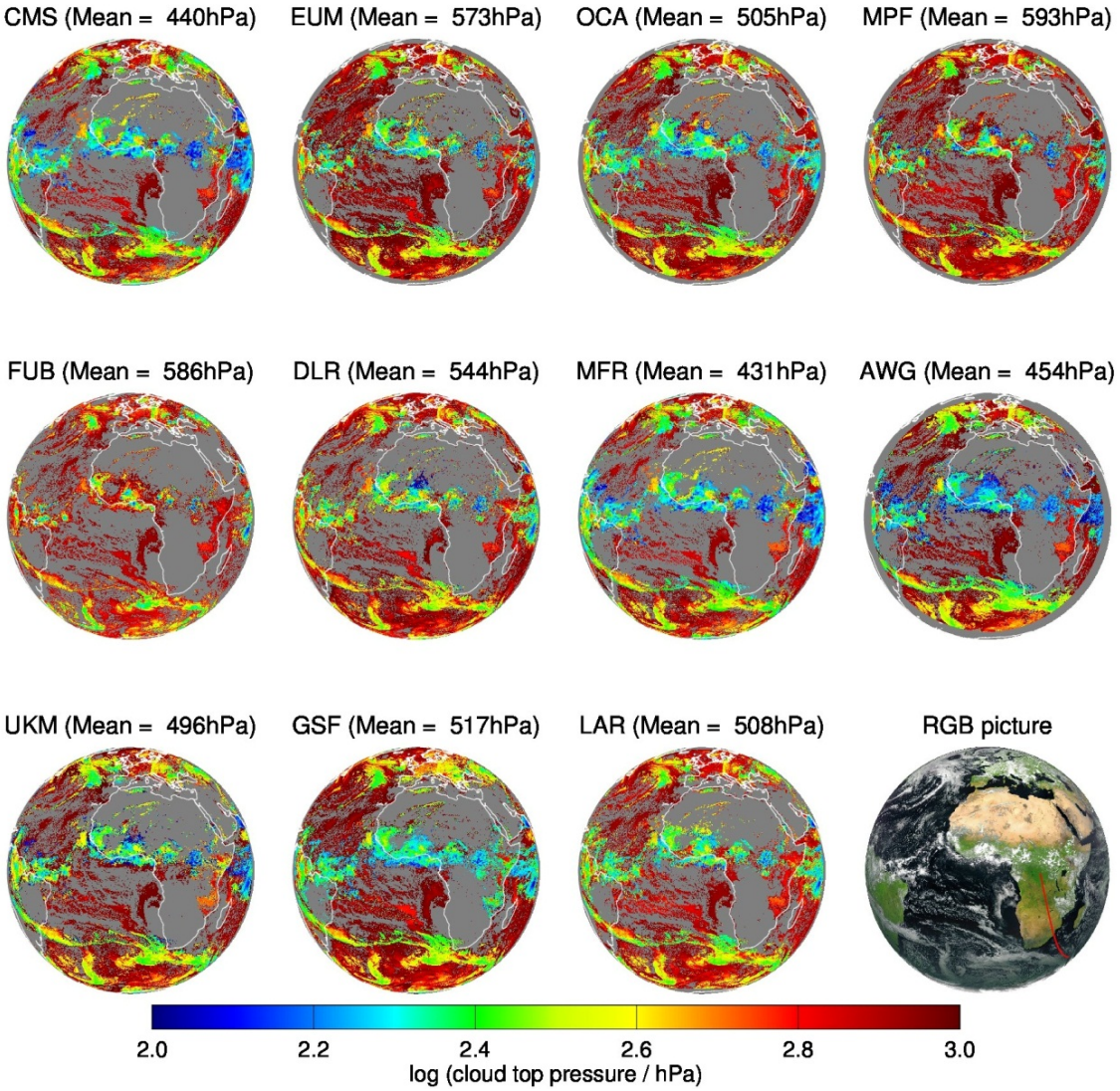
Retrieval inter-comparison

2008-06-13
12:00 UTC

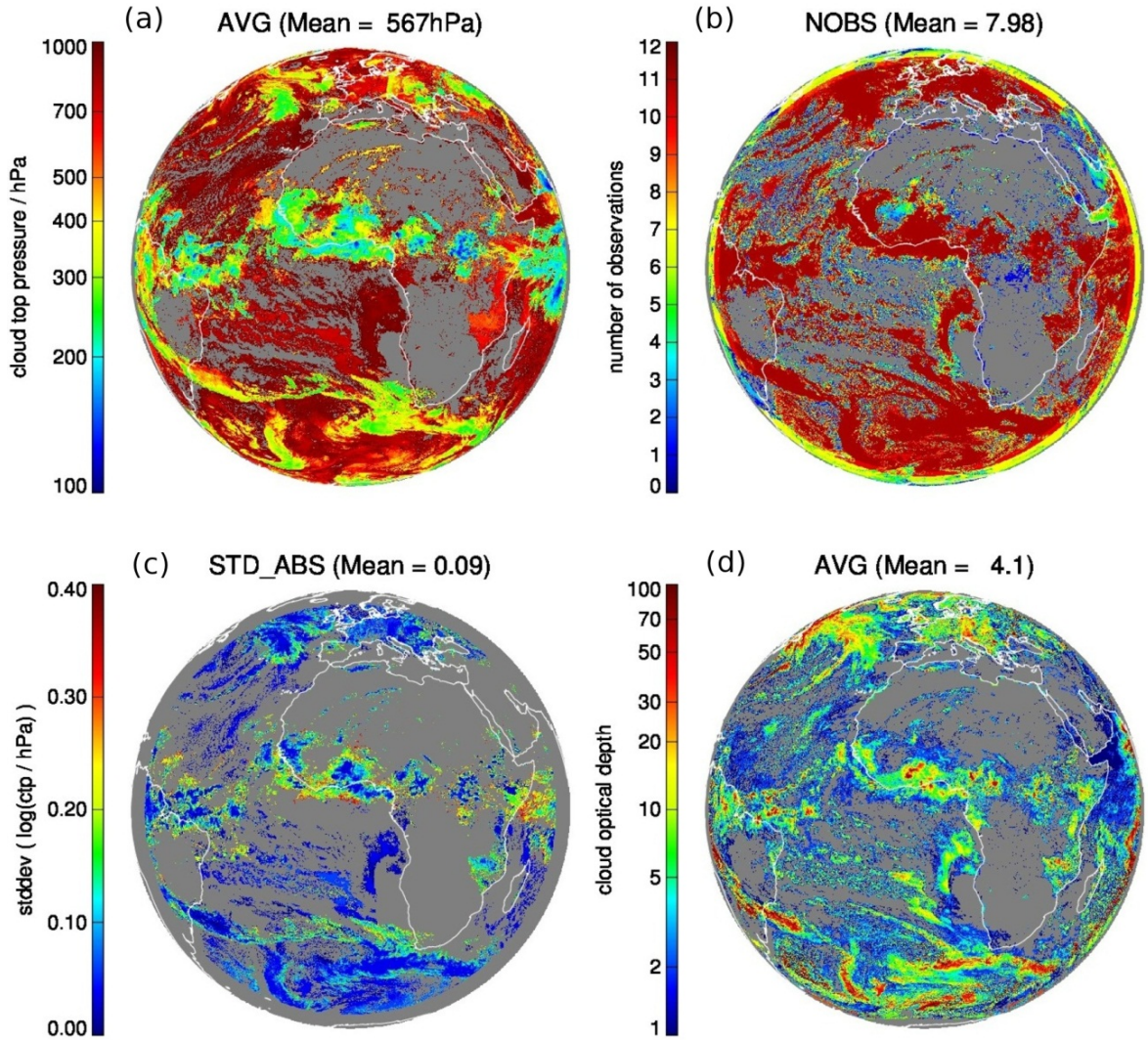
- 11 retrievals
- Different cloud masks
- Different CTP retrievals



Retrieval inter-comparison

2008-06-13
12:00 UTC

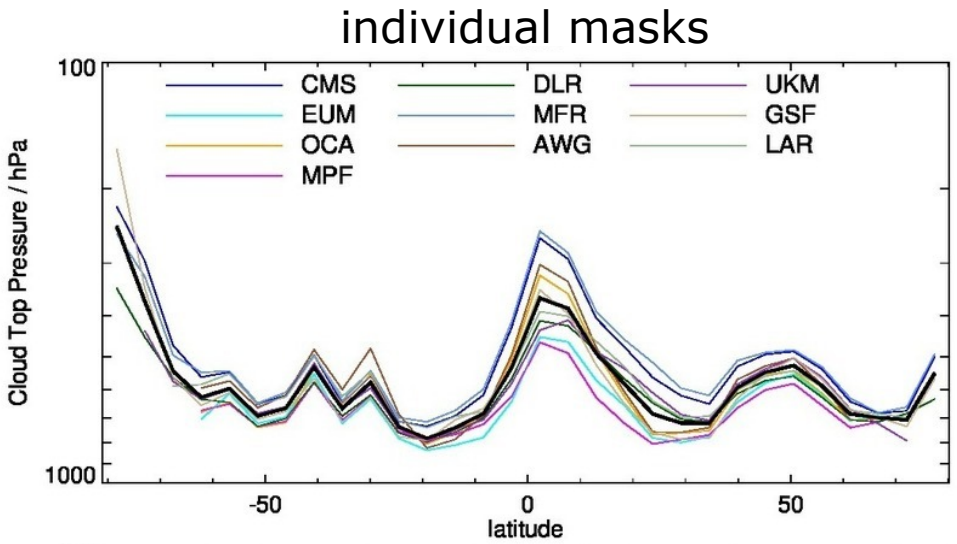
- 11 retrievals
- Different cloud masks
- Different CTP retrievals
- Uncertainties



Retrieval inter-comparison

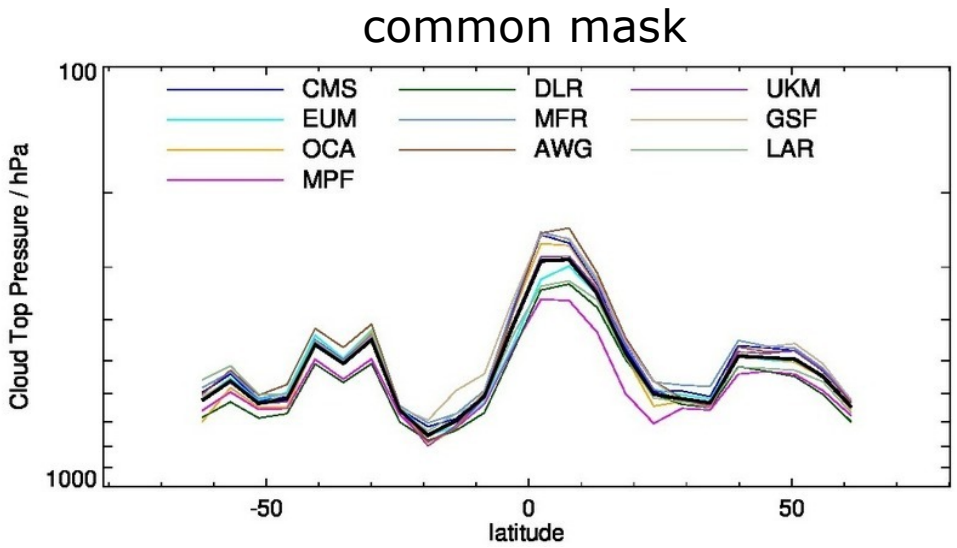
Individual masks

Differences caused by
- CTH retrievals and
- Cloud detection



Common mask

- Use common pixels only
- No cloud mask effect



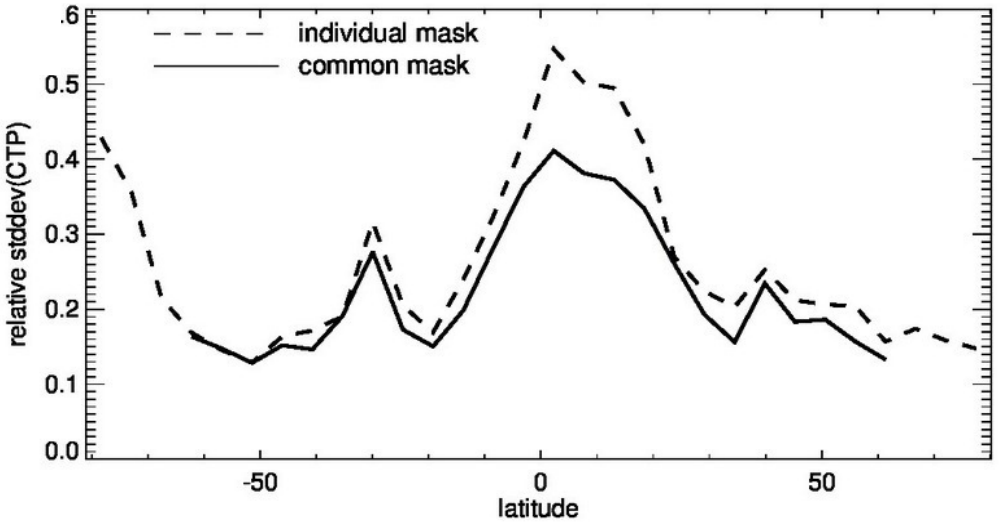
Retrieval inter-comparison

Agreement

- Extra-tropics
  Agreement within 15-30%
  2-5% effect of common mask

- Tropics
  Agreement within 30-55%
  5-15% effect of common mask

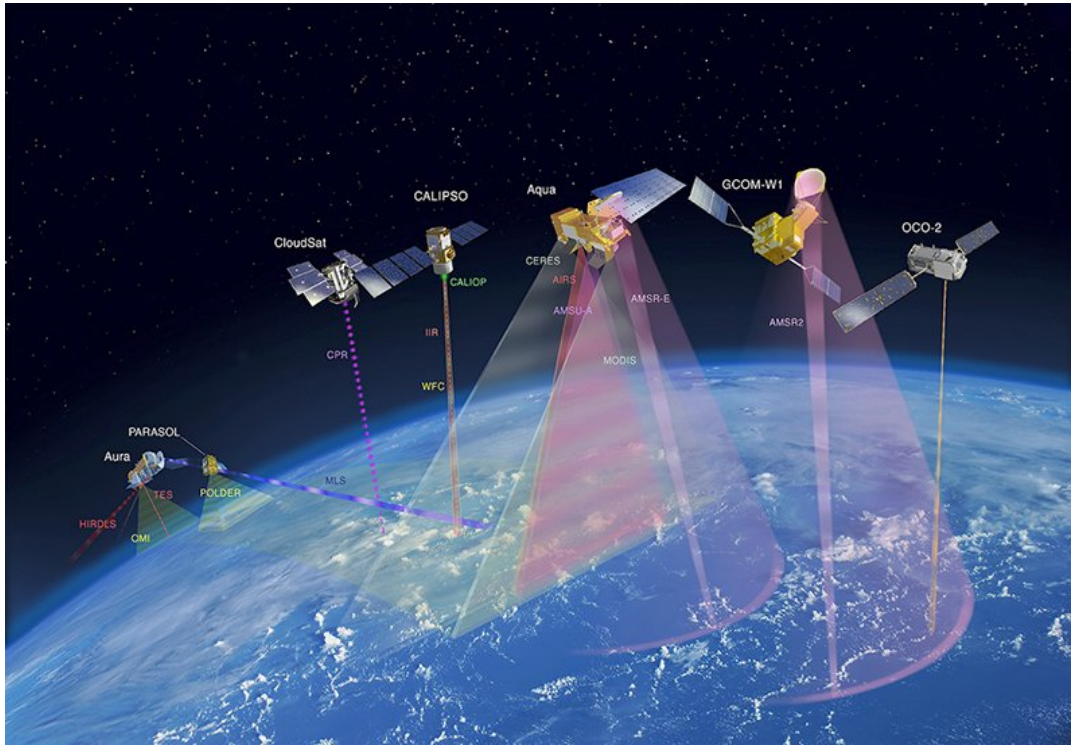
Relative standard deviation



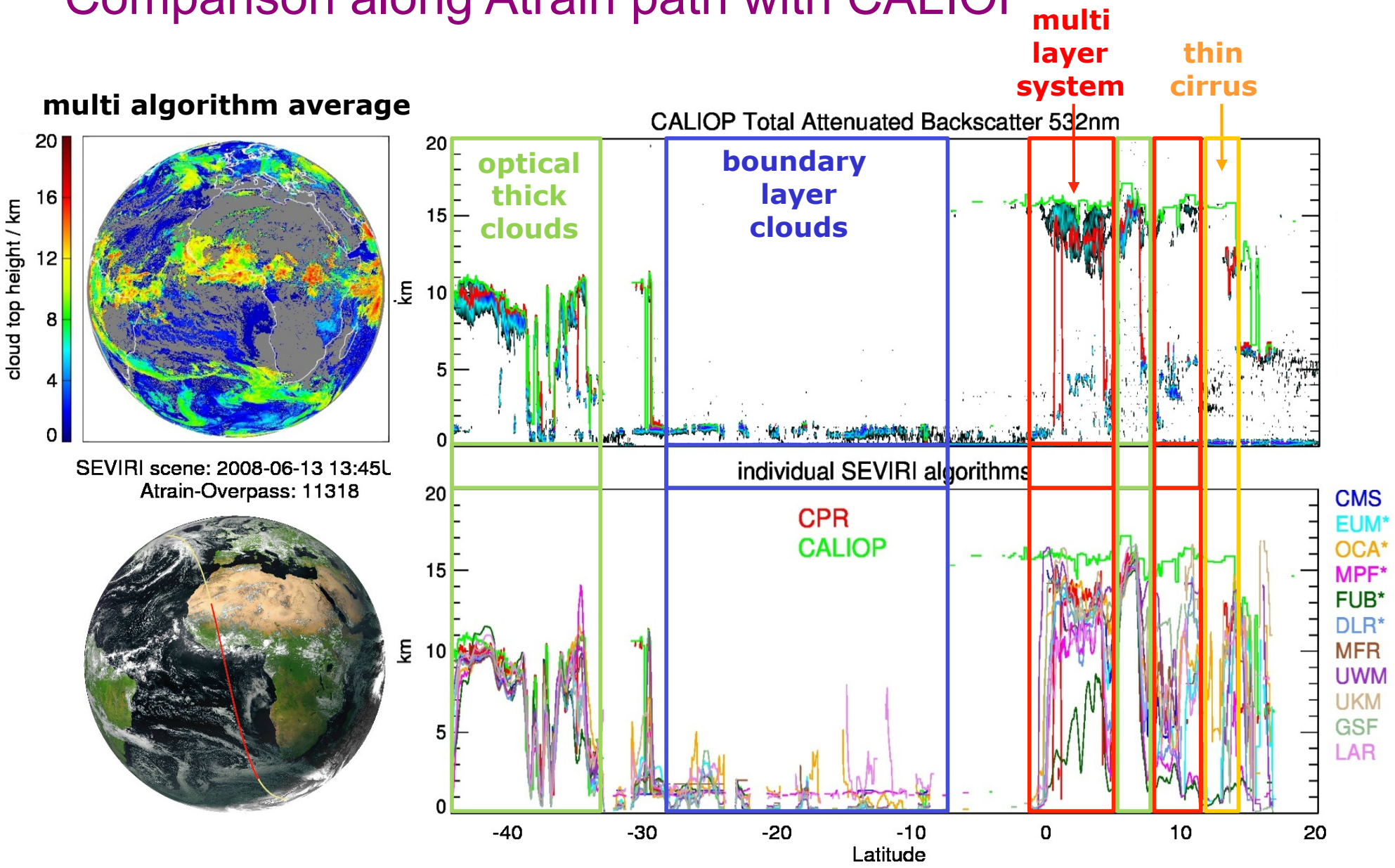
Comparison with CALIOP and CPR

The A-train satellite constellation

- 6 satellites in polar orbit
- Sun synchronous orbit
  Local time: 13h30
  705 km height
  99min for one rotation
- Near simultaneous observation
- Various instrumentations
  Active instruments dashed
  Microwave in red/purple
  Solar wavelength in yellow
  Solar & IR wavelength in grey



Comparison along Atrain path with CALIOP



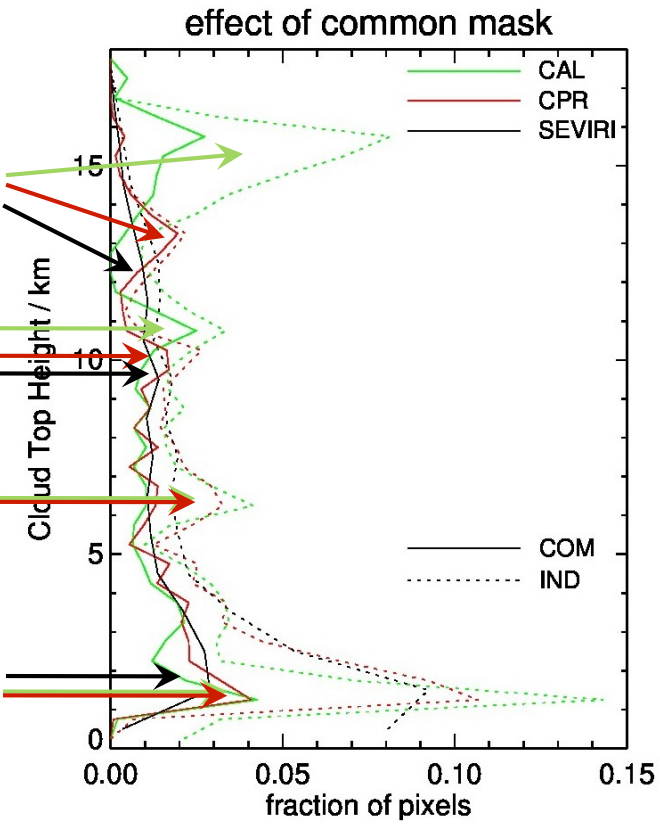
Cloud top height histograms

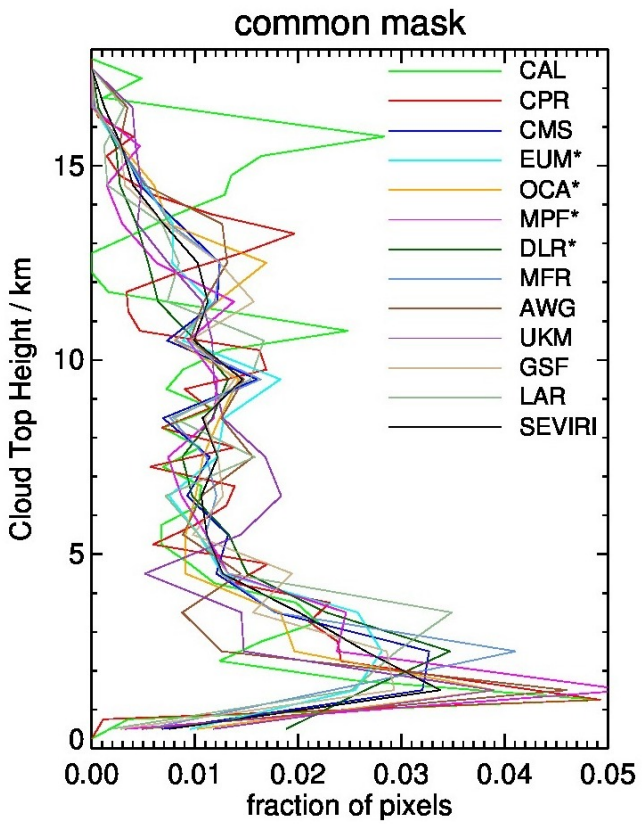
Tropical tropopause

Extra-tropical tropopause

Melting layer

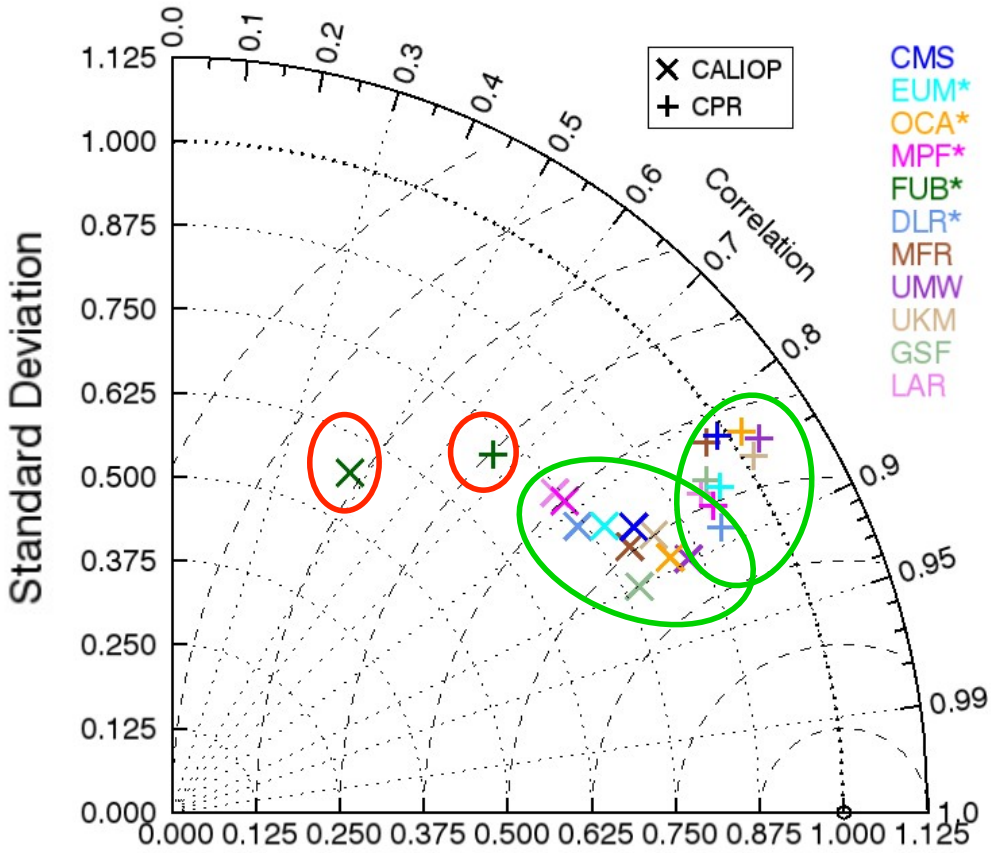
Boundary layer

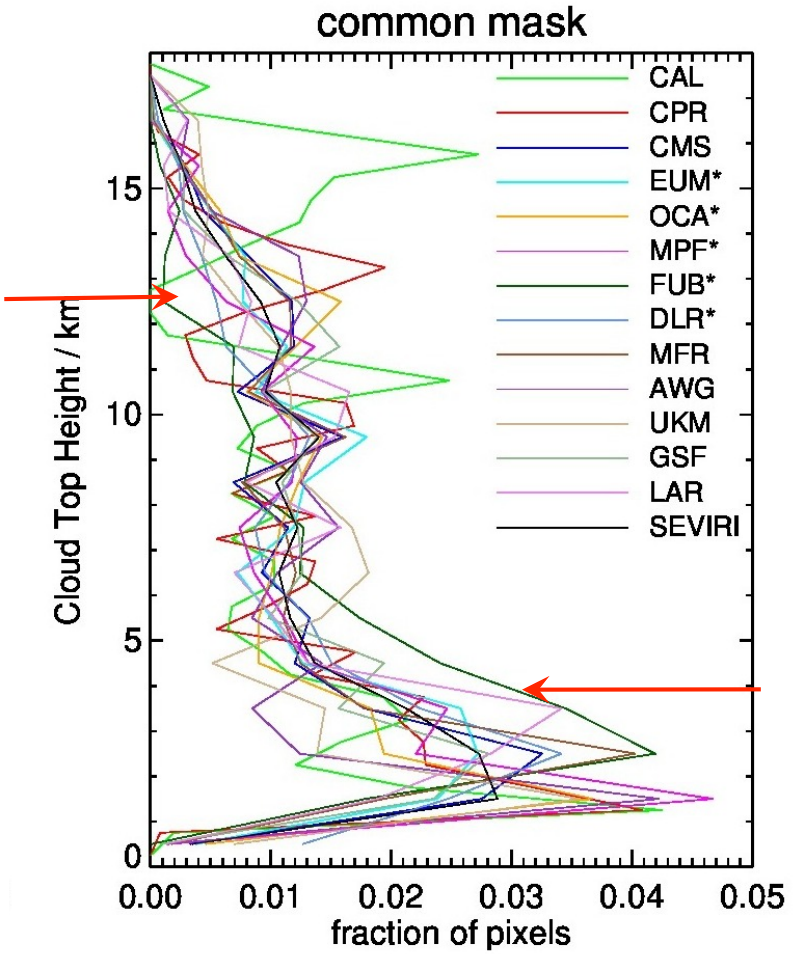




Taylor diagram comparing CALIOP and CPR

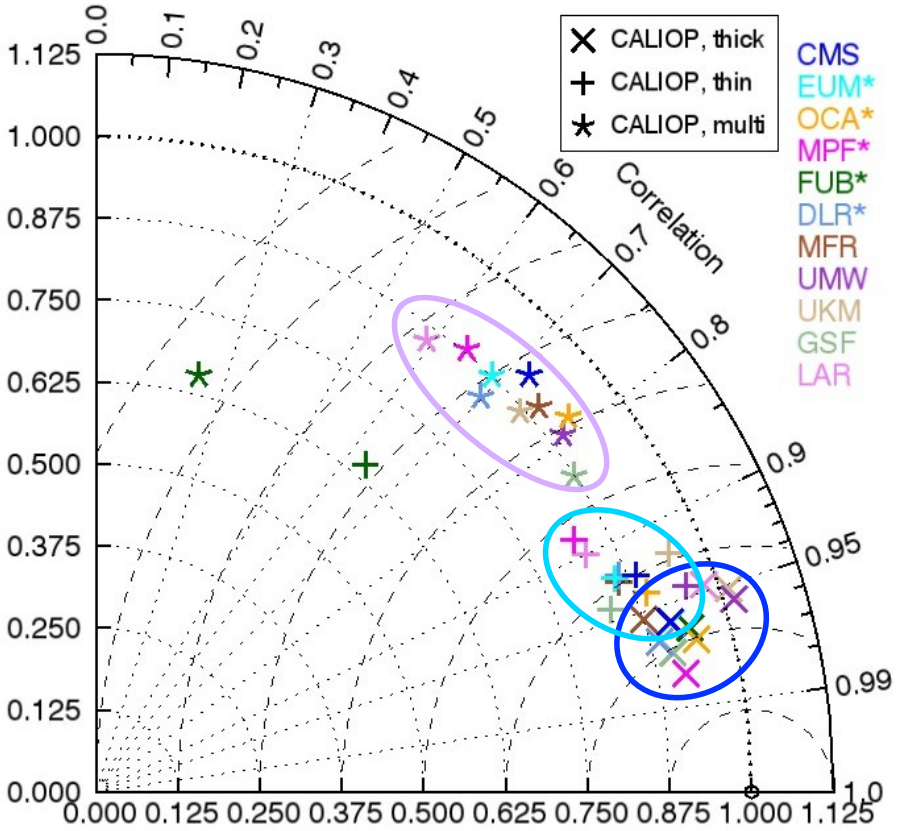
Taylor diagram (CALIOP/CPR)





Taylor diagram CALIOP with cloud regimes

Taylor diagram (CALIOP/cloud regimes)

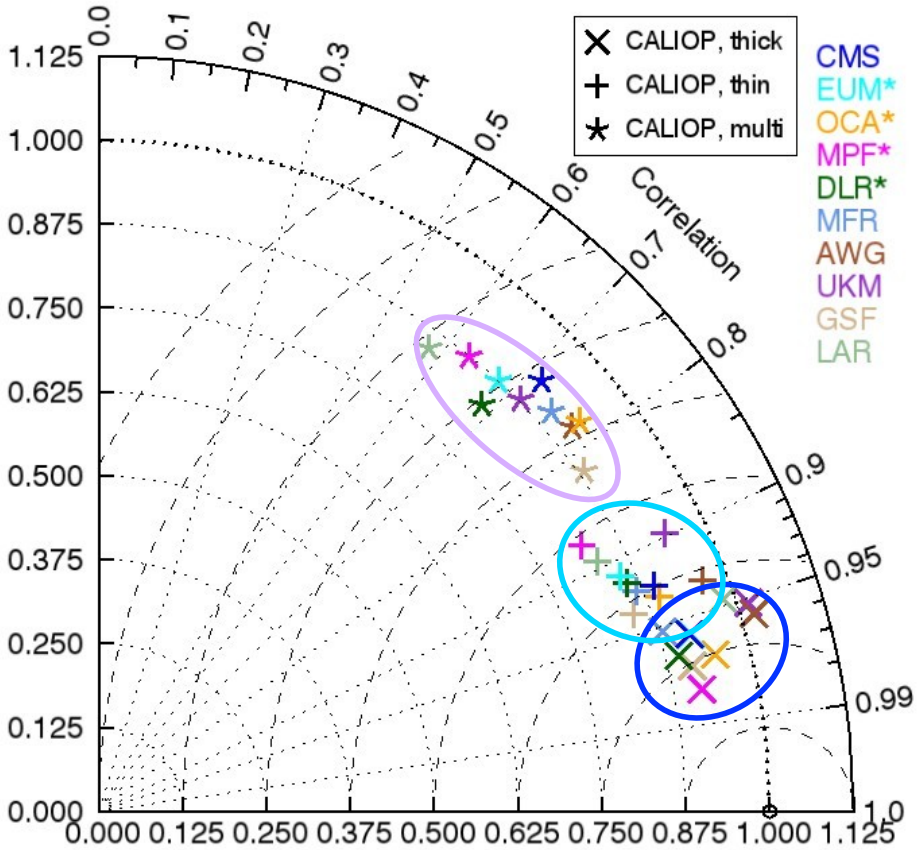


Definition of cloud regimes with
Cloud optical depth and
NLF (number of layers found),
both measured by CALIOP

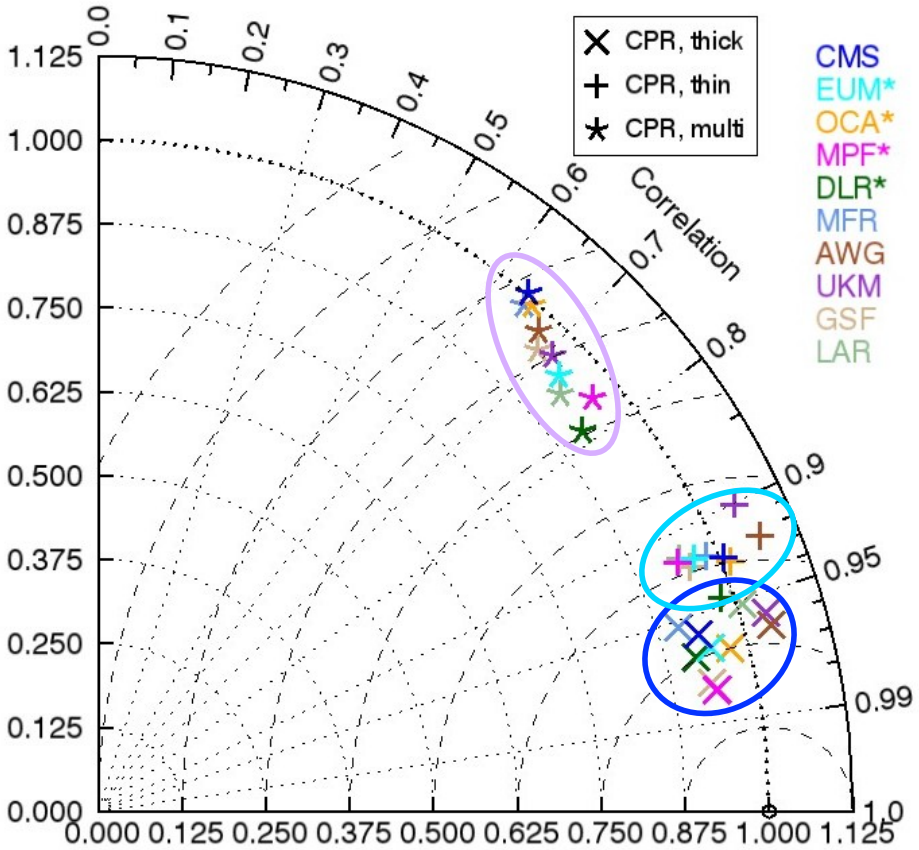
Cloud category	Criteria
Single layer thin cloud	NLF = 1 and $\tau_{cal} < 3$
Single layer thick cloud	NLF = 1 and $\tau_{cal} \geq 3$
Multi-layer clouds	NLF > 1

Taylor diagrams with different cloud regimes

CALIOP & cloud regimes



CPR & cloud regimes



Summary (1)

Cloud Retrieval Evaluation Workshops (CREW)

CREW database created

12 SEVIRI algorithms
5 days in 2008
10 cloud parameters
5 reference data sets

Inter-comparison and validation

Good agreement with CALIOP and CPR
CALIOP correlation coefficients: 0.78 … 0.90
CPR correlation coefficients: 0.82 … 0.88

Cloud conditions and uncertainties

Best accuracy for thick clouds
Good accuracy for thin clouds
Multi layer clouds are challenging

Paper submitted to AMT, 2014: Remote sensing of cloud top pressure/height from SEVIRI
Hamann, Walther, Baum, Bennartz, Bugliaro, Derrien, Francis, Heidinger, Joro, Kniffka, Le Gléau, Lockhoff, Lutz, Meirink, Minnis, Palikonda, Roebeling, Thoss, Platnick, Watts,

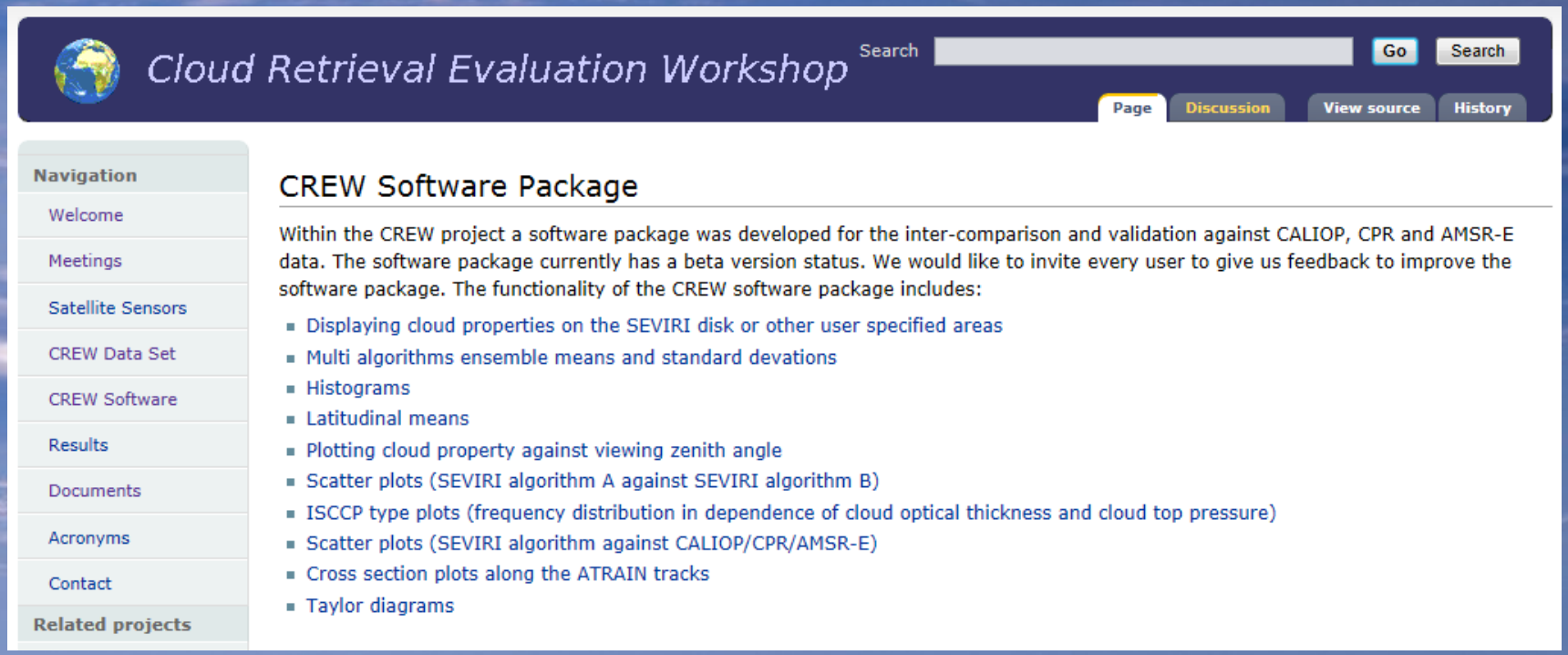
and Wind

Summary (2)

CREW project website

CREW database available for registered participants

CREW validation software package



Please contribute to CREW with datasets and inter-comparison and validation activities

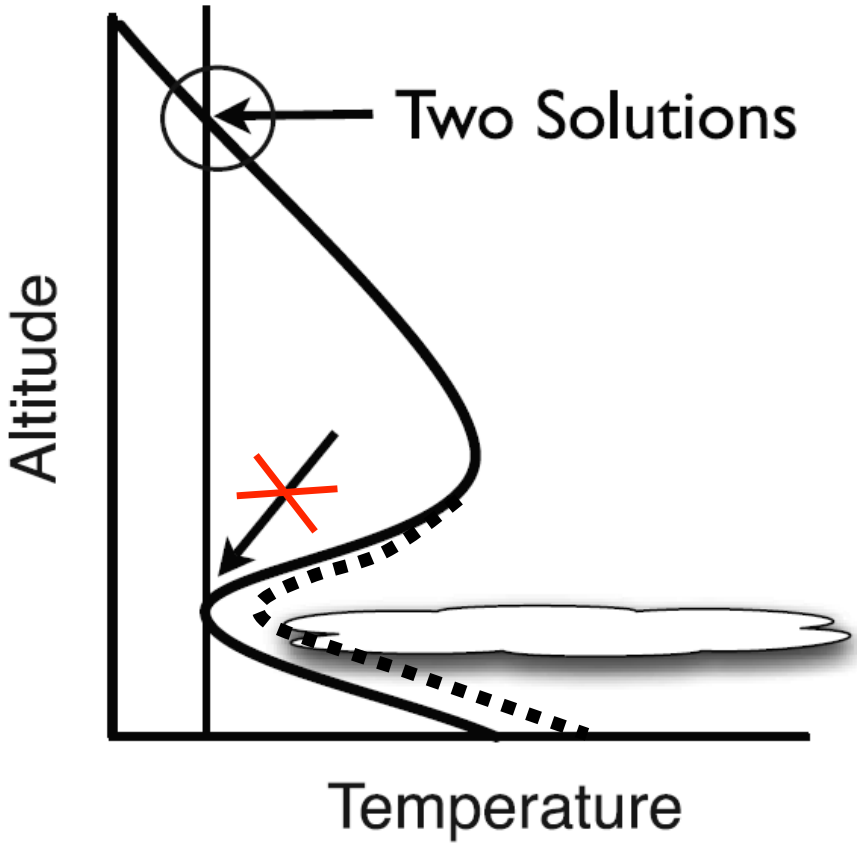
Boundary layer challenges

1. Ambivalence

In case of temperature inversion several Solutions may be possible.

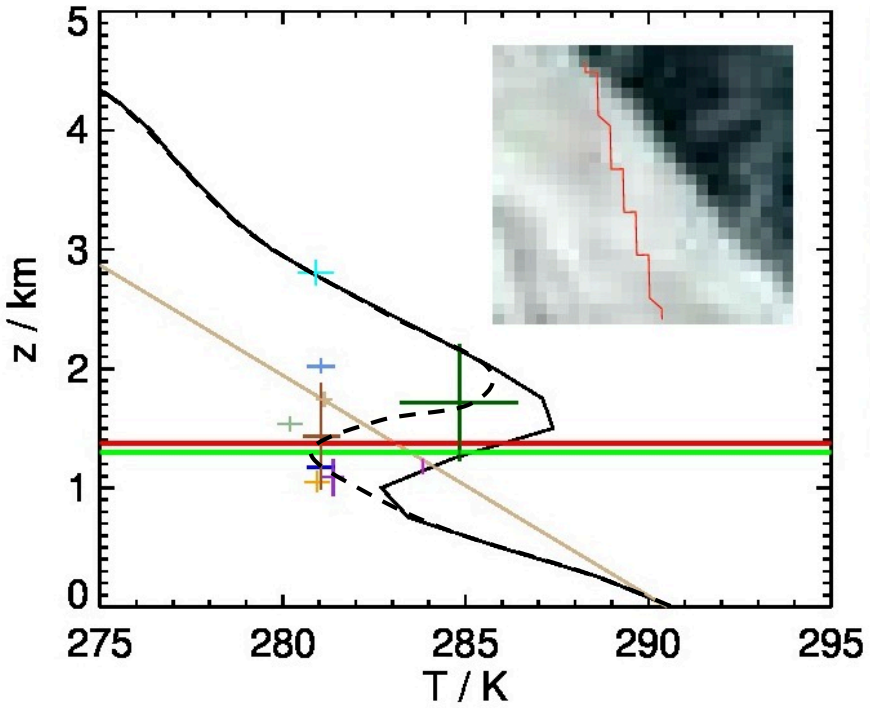
2. Temperature uncertainty

Possibilty to miss the right solution if assumed temperature profile has uncertainties.



Holz et al, 2008, modified

Boundary layer challenges



CALIPSO
CPR
CMS
EUM*
OCA*
MPF*
DLR*
MFR
AWG
UKM
GSF
LAR

CMS inversion correction
EUM no correction
OCA no correction, but usage of WV channels
MPF CTH inversion correction with CTT modification
MFR inversion correction
UKM inversion correction
GSF assuming constant temperature gradient
LAR constant lapse rate