Validation of EUMETSAT cloud mask using ceilometer data

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EUMETSAT

Outline

1. Introduction
2. Ceilometers
3. Comparison algorithm
4. Results
5. Conclusions & Future work

Introduction

- Cloud Mask, separating between cloudy and cloud free pixels, is one of the most important products derived from satellite data

- Helsinki Testbed instrumentation includes 12 ceilometers giving a baseline for Cloud Mask validation

- Data collected August 2006

- Study evaluates the performance of the EUMETSAT Cloud Mask in the Northern latitudes, not full disc!

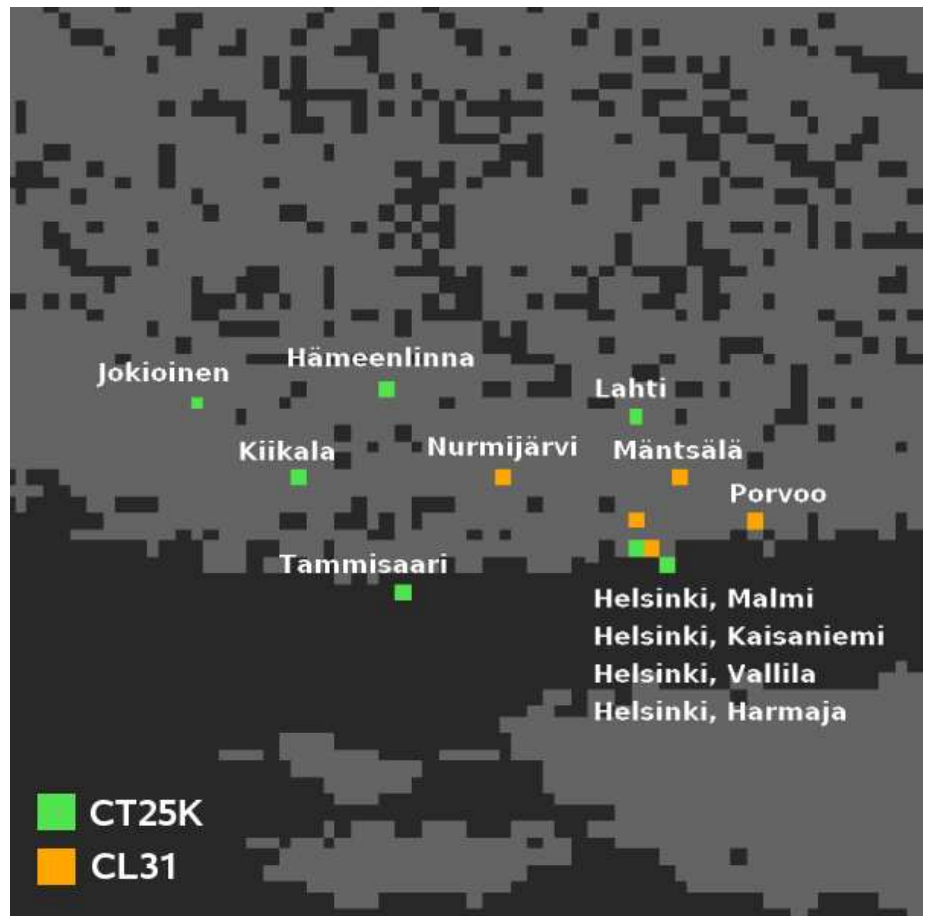# Ceilometer locations as seen from Met-8
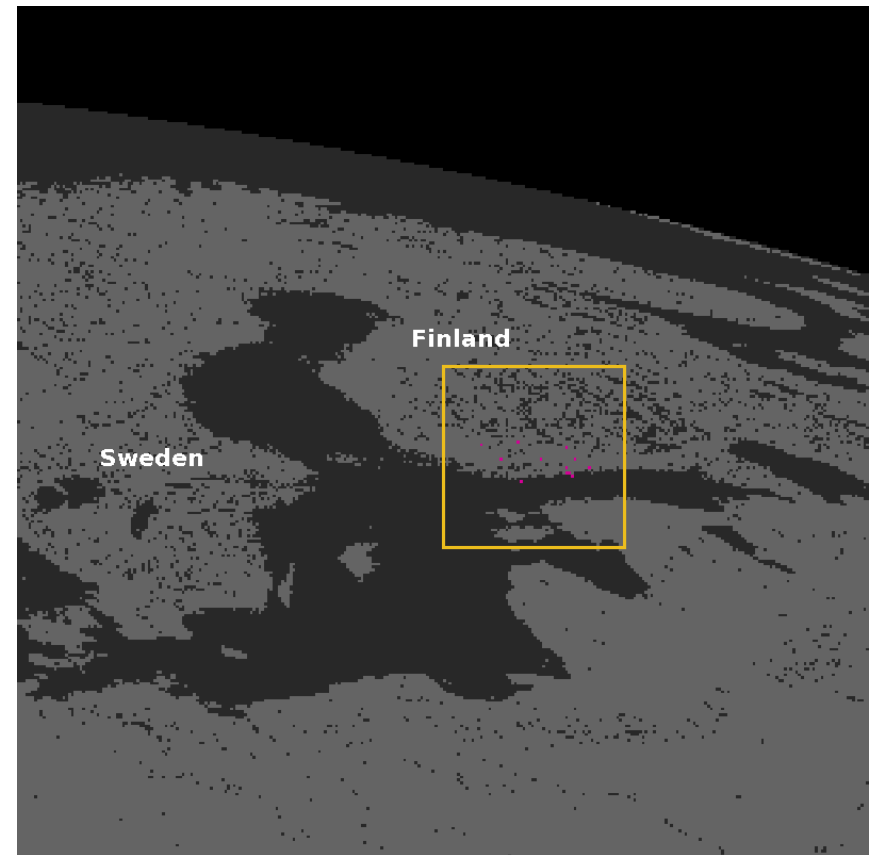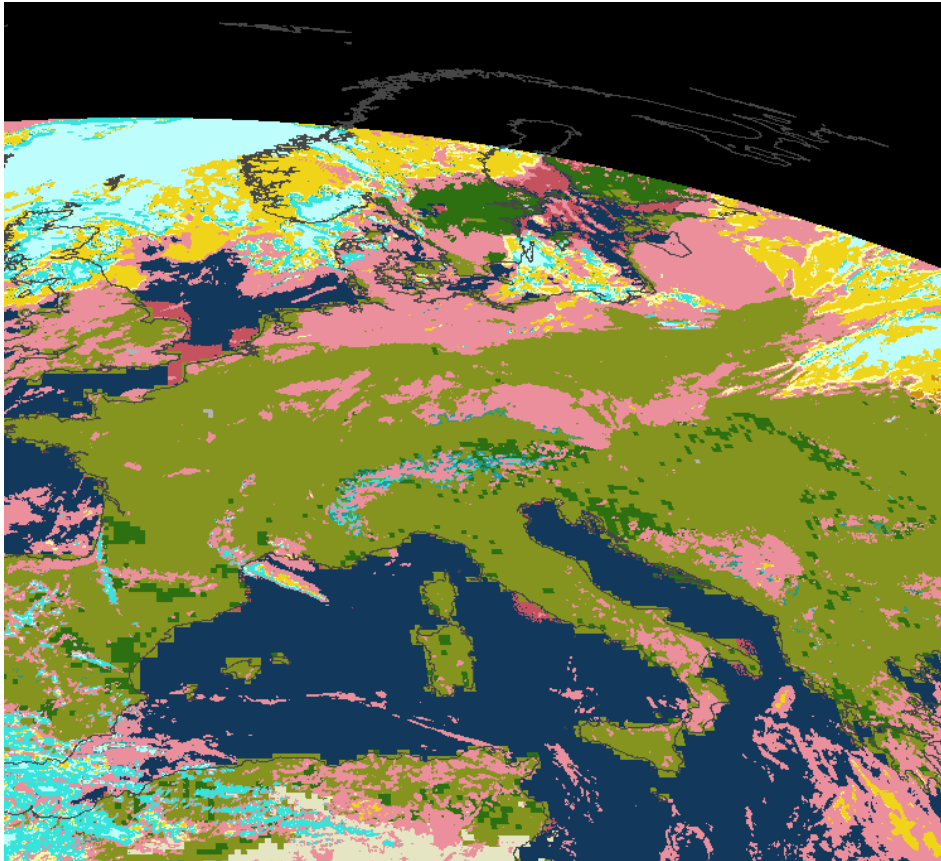
Ceilometers

Helsinki Testbed configuration

CT25K (old):

- *measurements every 10 minutes*
- *reports cloud amount (octas) up to 4 cloud layers (30 min average)*

CL31 (new):

- *measurements every 16 seconds*
- *reports cloud amount (octas) up to 5 cloud layers (30 min average, last 10 min double weighted)*
- *cloud information updated every 5 minutes*

Comparison algorithm

- Segment size 3 × 3 pixels

- 16 minutes added to the cloud mask product time, closest ceilometer observation, using 5 minute window, is extracted. Minimum cloud overlap is assumed

  0, 1, 2 = cloud free

  3, 4, 5 = not used

  6, 7, 8 = cloudy

- Results are interpreted using a 2×2 contingency table

- Minimum cloud overlap scheme is the natural one for the ceilometers as they are detecting the clouds advecting over the instrument
- Ceilometers <u>typically</u> can't see through clouds – they detect the lowest layer

Minimum

$N_1 = 3$
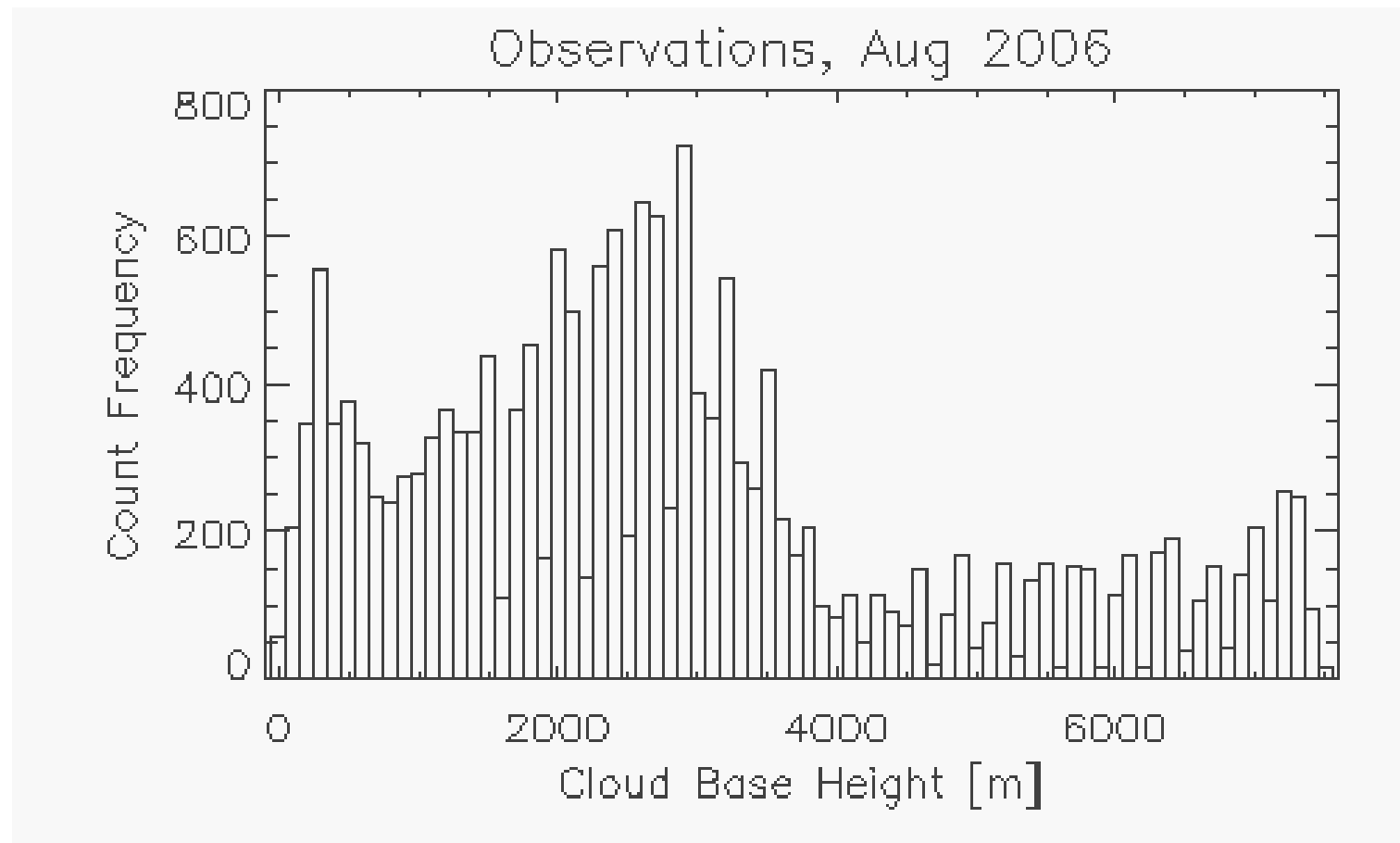
$N_2 = 2$

$N_3 = 3$

$$N_{tot} = \sum_{i=1}^{3} N_i = 8$$

Earth
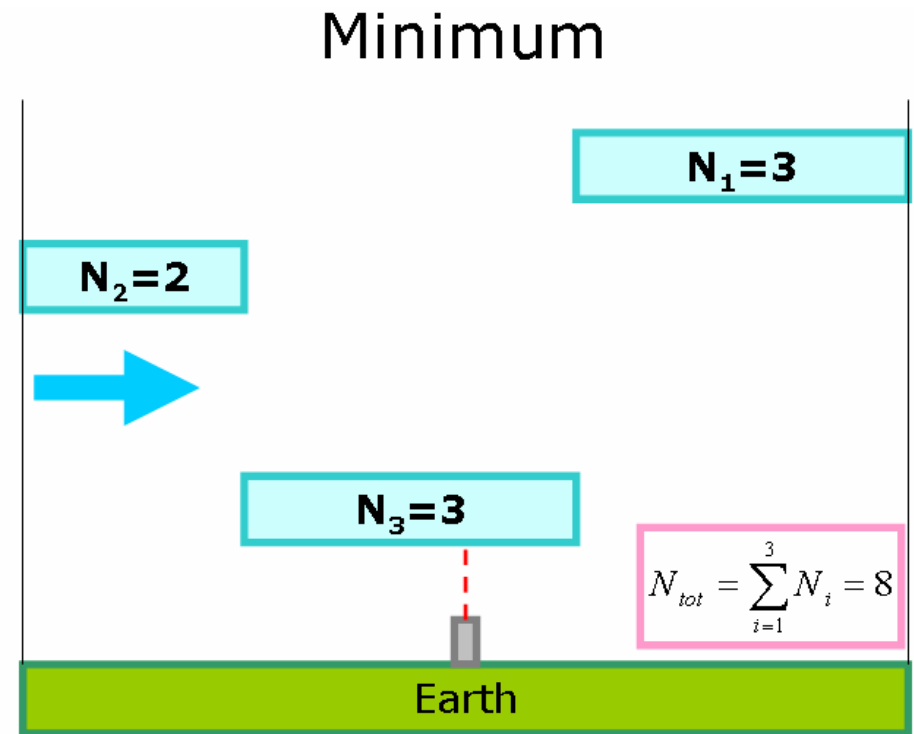
2×2 Contingency Table

Observations

		yes	no	
CM	yes	A	B	A+B
	no	C	D	C+D
		A+C	B+D	N= A+B+C+D

Portion Correct (PC)	=	(A+D)/N
Miss Rate (MR)	=	C/(A+C)
False Alarm Rate (FAR)	=	B/(A+B)
BIAS	=	(A+B)/(A+C)

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Results, Aug 2006

Observations

CM		yes	no	
	yes	8445	4892	13737
	no	926	8207	9133
		9771	13099	22870

Portion Correct (PC)	=	0.741
Miss Rate (MR)	=	0.099
False Alarm Rate (FAR)	=	0.367
BIAS	=	1.423

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Observed Cloud Base Heights, August 2006

MPEF, Cases C, Aug 2006
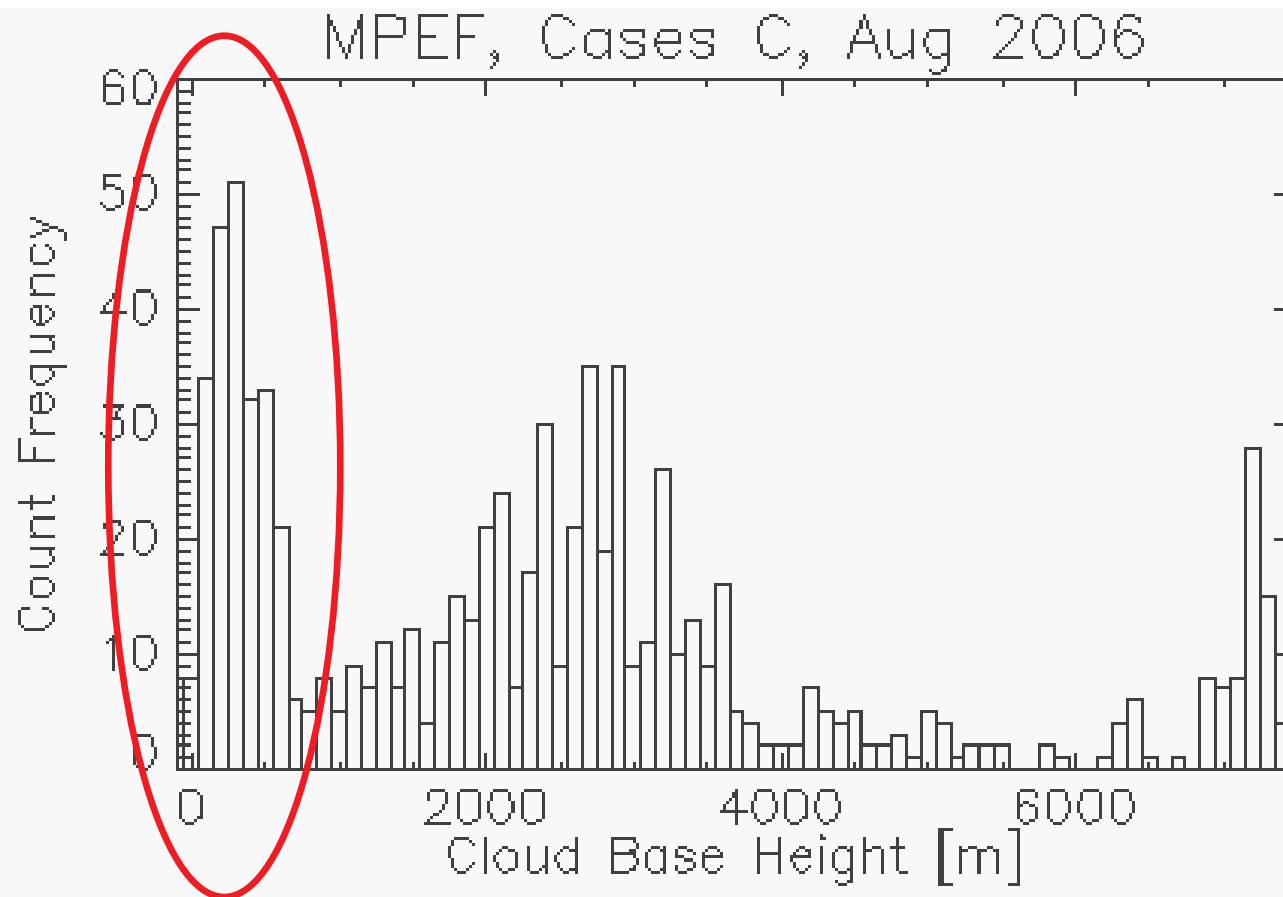
*No clear signal that a specific cloud type is
always missed – maybe some very low clouds*
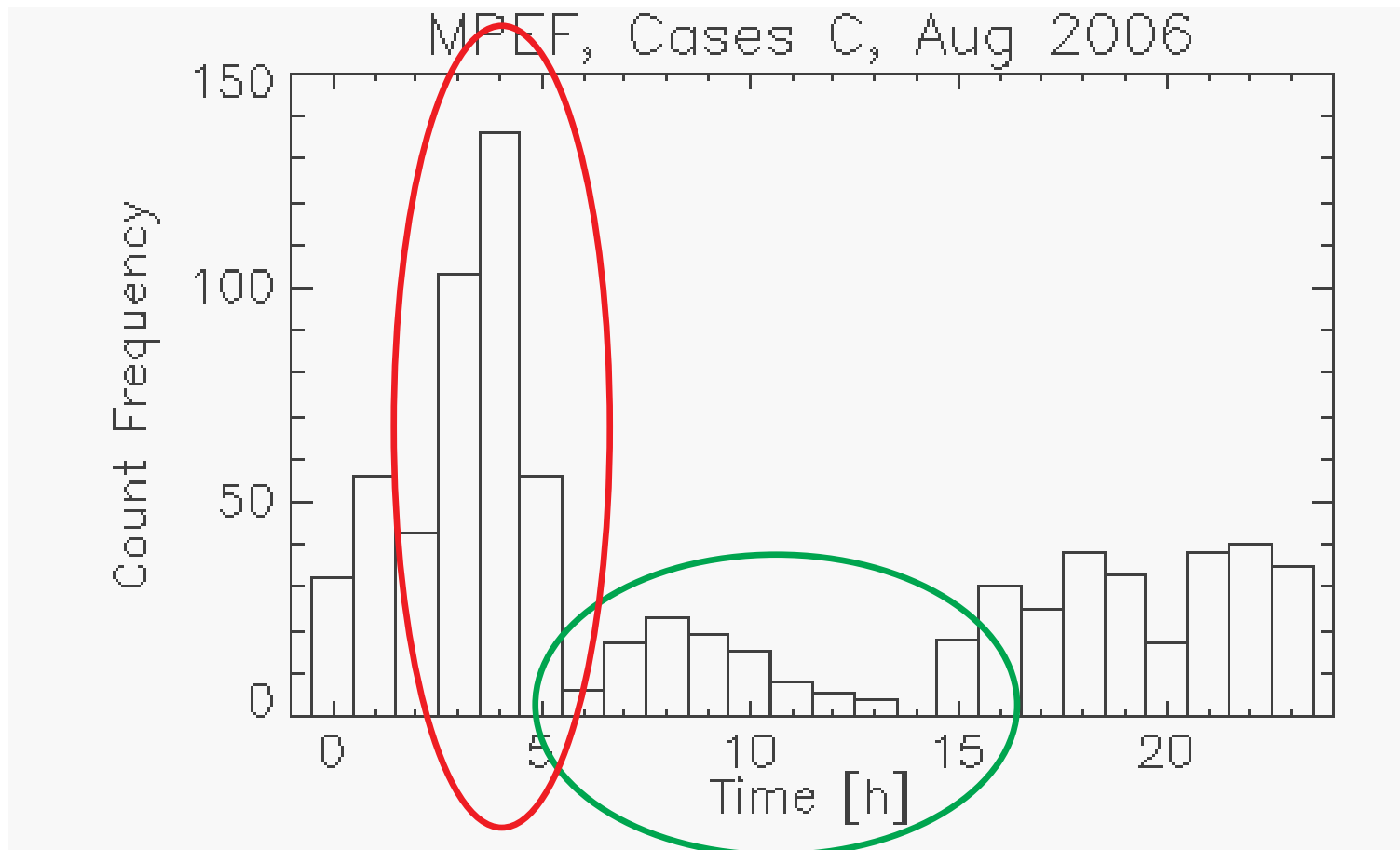
Early morning hours just after sunrise troublesome:
10.8μm – 3.9μm turned off, VIS tests still not on

Coastal ceilometers

Observations

MPEF		yes	no	
	yes	3469	2606	6075
	no	450	4064	4514
		3919	6670	10589

PC = 0.7114
FAR = 0.4290
MR = 0.1148
BIAS = 1.5501

Inland ceilometers

Observations

MPEF		yes	no	
	yes	4976	2286	7262
	no	476	4143	4619
		5452	6429	11881

PC = 0.7675
FAR = 0.3148
MR = 0.0873
BIAS = 1.3320
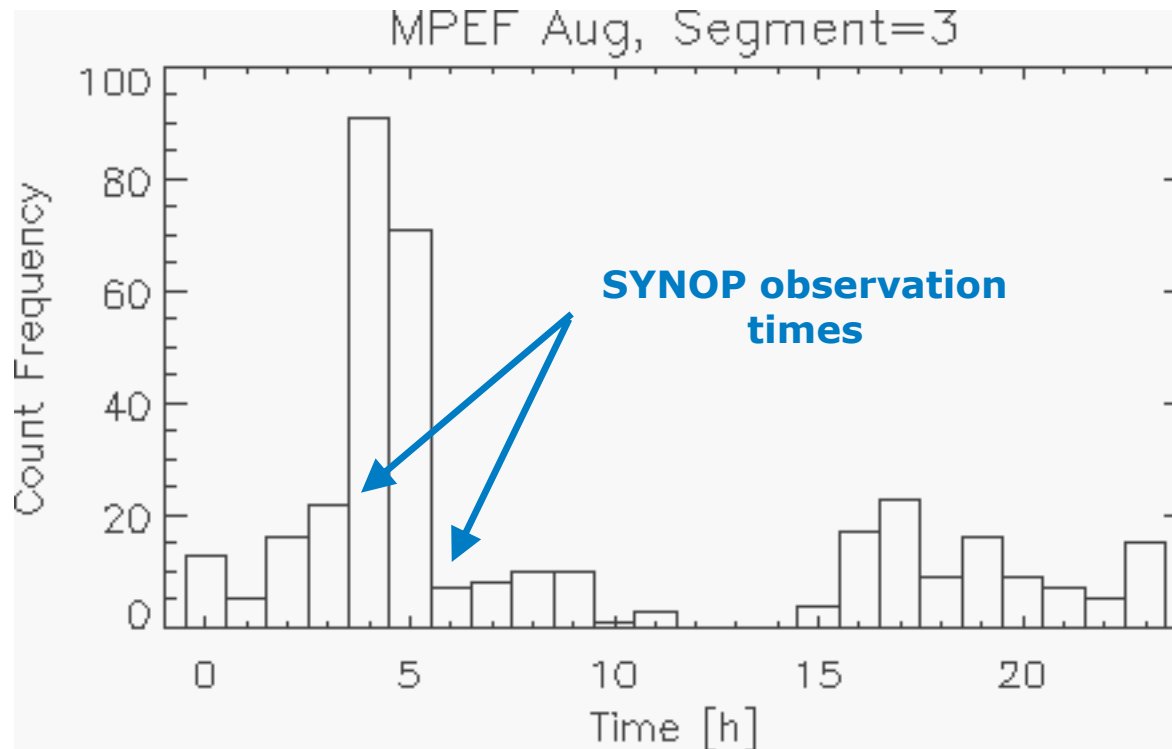
Again, clouds are missed after the sunrise, until the VIS tests are being activated.

Conclusions & Future work

- The overall performance of EUMETSAT cloud mask is good with a PC of ~75% and MR below 10%

- Coastal areas are troublesome, possible improvements coming with a higher resolution surface type map

- The algorithm is having trouble detecting clouds just after sunrise → a possibility to turn on VIS tests earlier is being investigated

- A comparison to SAFNWC clouds masks is to come—are the same difficulties to be found there?

- An improved cloud mask algorithm is being implemented at EUMETSAT after which a new study, using data from June, July, and August 2007, would be interesting