An update on recent Landsat cloud research by Lazaros Oreopoulos (NASA-GSFC)

- ✓Setting thin cirrus detection thresholds
- ✓Simple cloud masks operating on Irish/Scaramuzza dataset
- ✓Cloud fraction sensitivity to thresholds for marine clouds

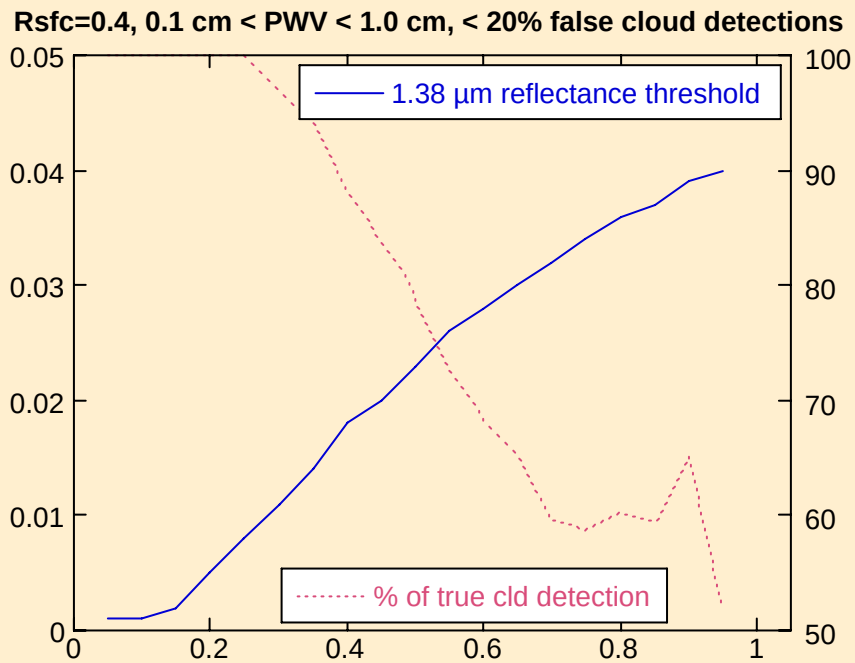
LANDSAT LDCM Data Continuity Mission

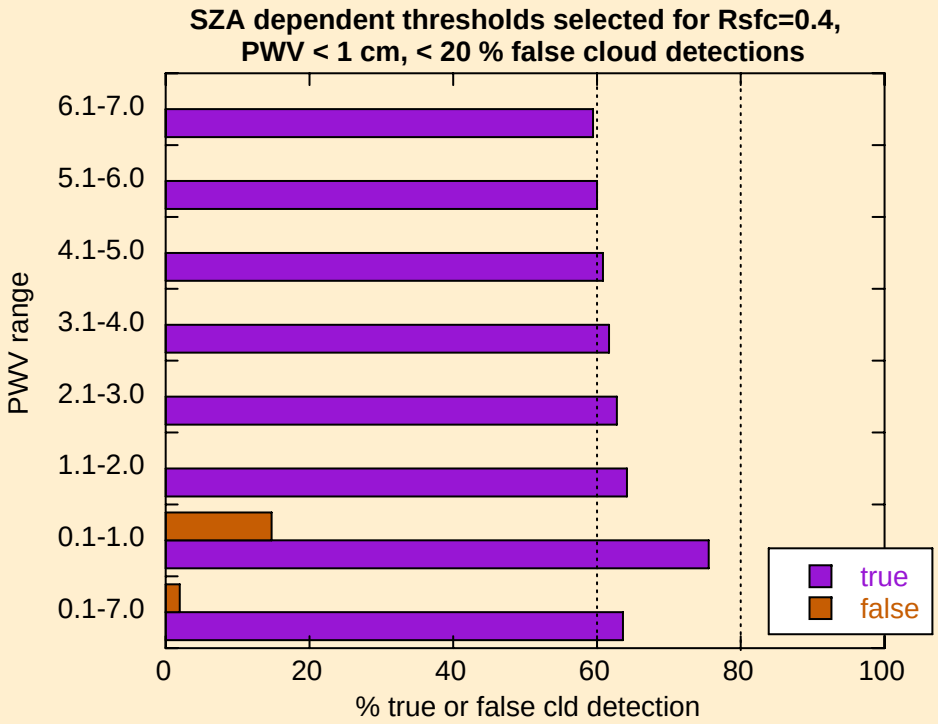
Setting Cirrus detection thresholds

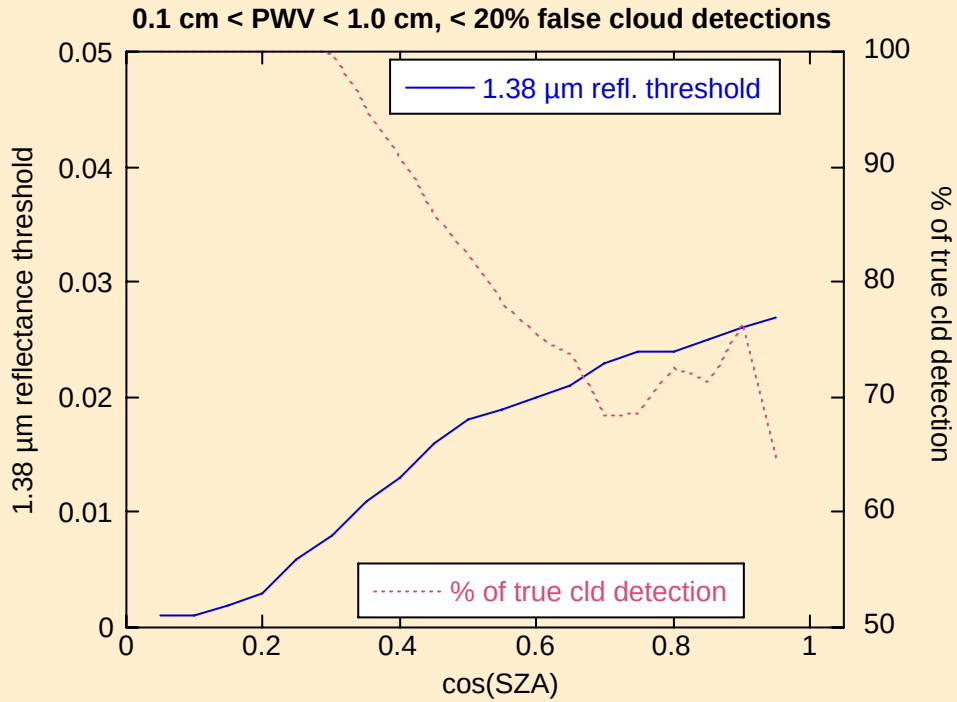
1.38 µm simulations with DISORT tool

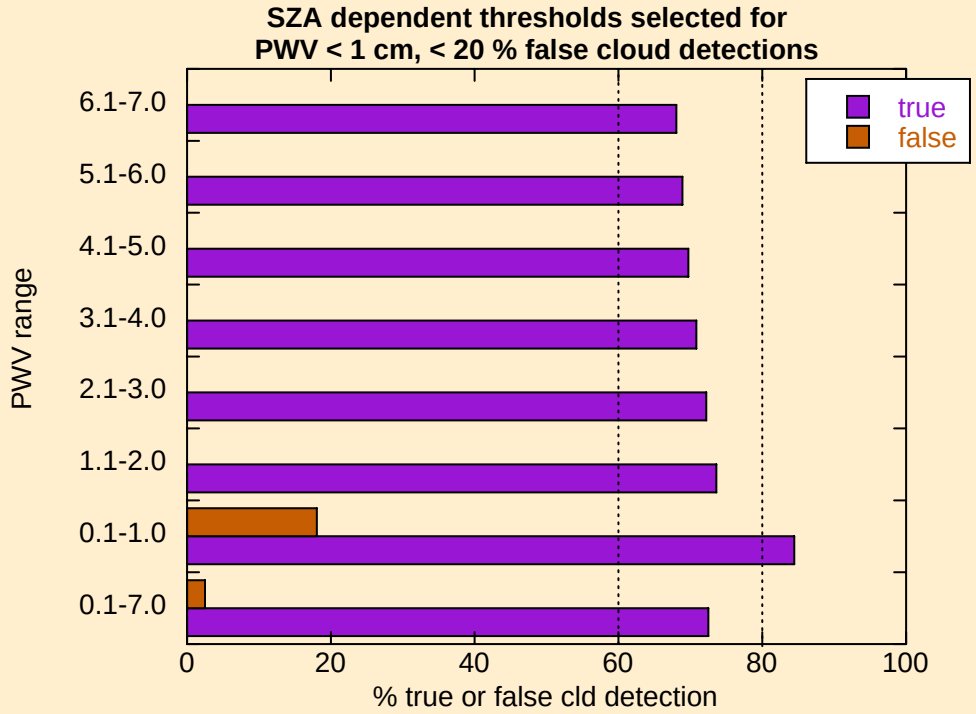
- **Summary of simulations performed:**
- Cirrus clouds with effective diameter d=50, 60, 70 µm, optical depth OD=0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0,1.5, 2.0, 2.5….
- …placed at 8-9, 9-10, 10-11, 11-12 km layers…
- …within 15 different atmospheres whose precipitable water vapor PWV was forced to range from 0.1 to 7.0 cm, in steps of 0.1 (the WV vertical distribution is different among the atmospheres).
- Surface albedo Rsfc used was 0.1, 0.2, 0.3, 0.4.
- Solar zenith angle SZA varied from 0.05 to 0.95 in steps of 0.05.
- Obviously, the above numbers give a large number of permutations: DISORT was run > 12,000,000 times!

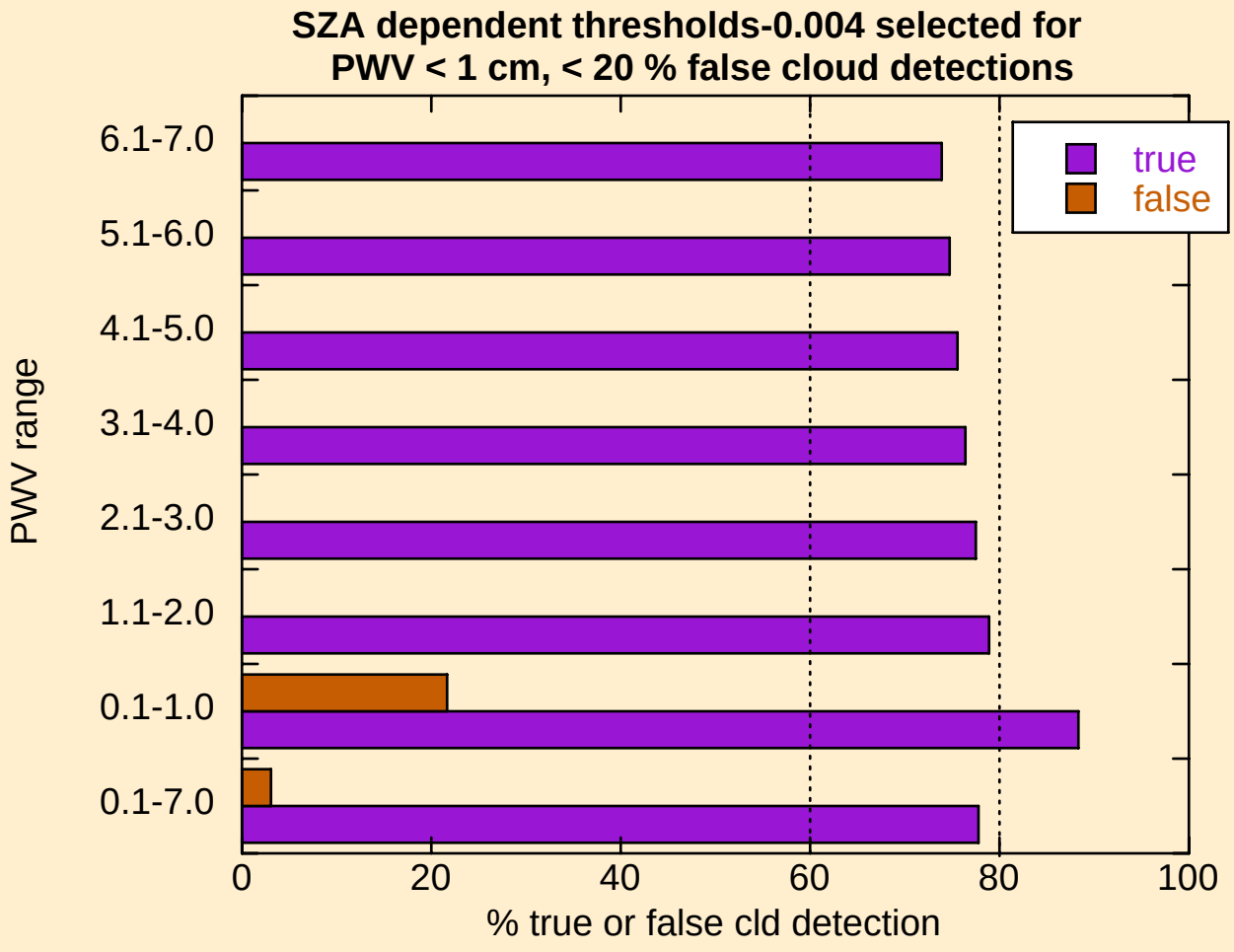
- Runs with the above atmospheres, Rsfc's, and SZAs were also performed for clear skies (~80 K runs)

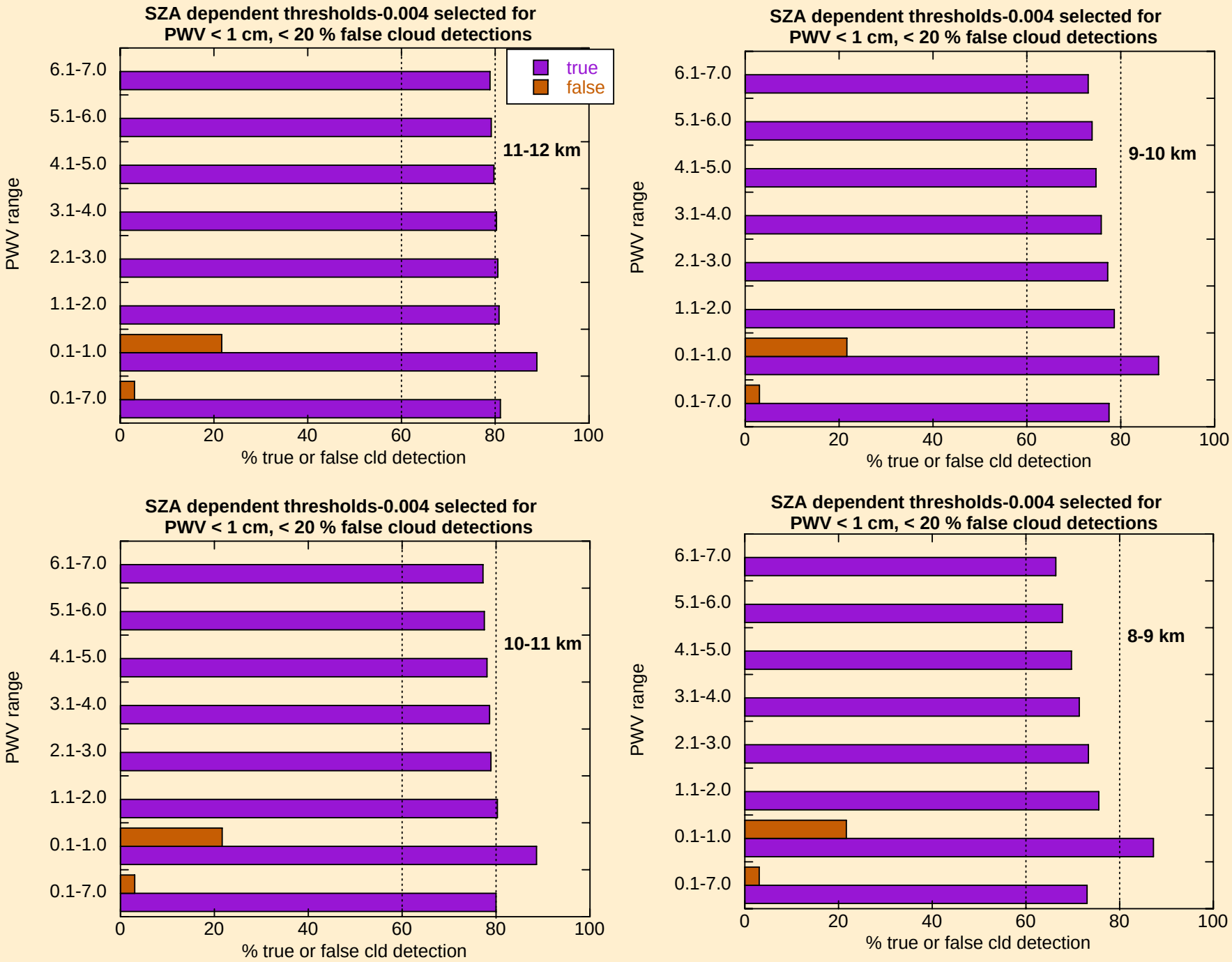

Rsfc=0.4, 0.1 cm < PWV < 1.0 cm, < 20% false cloud detections
1.38 µm reflectance threshold
% of true cld detection
0.05
0.04
0.03
0.02
0.01
0
100
90
80
70
60
50
0
0.2
0.4
0.6
0.8
1

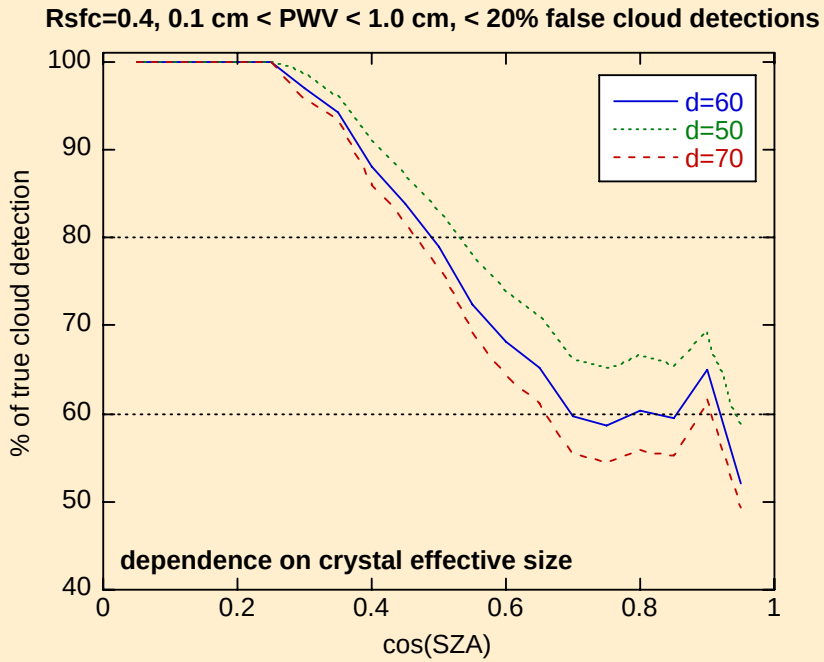

SZA dependent thresholds selected for Rsfc=0.4,
PWV < 1 cm, < 20 % false cloud detections
PWV range
6.1-7.0
5.1-6.0
4.1-5.0
3.1-4.0
2.1-3.0
1.1-2.0
0.1-1.0
0.1-7.0
true
false
0
20
40
60
80
100
% true or false cld detection

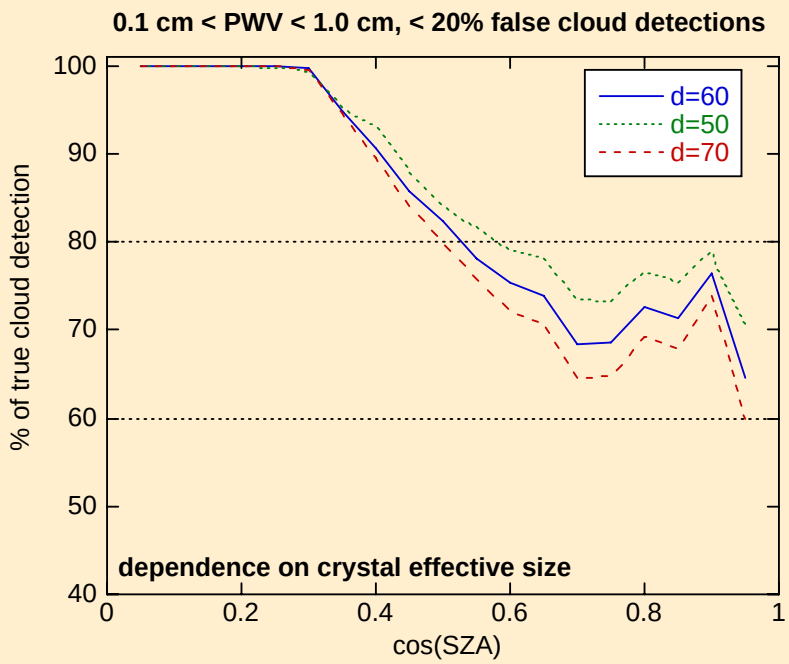

0.1 cm < PWV < 1.0 cm, < 20% false cloud detections
1.38 µm refl. threshold
% of true cld detection
1.38 µm reflectance threshold
% of true cld detection
cos(SZA)
0.05
0.04
0.03
0.02
0.01
0
100
90
80
70
60
50
0
0.2
0.4
0.6
0.8
1


SZA dependent thresholds selected for
PWV < 1 cm, < 20 % false cloud detections
true
false
PWV range
6.1-7.0
5.1-6.0
4.1-5.0
3.1-4.0
2.1-3.0
1.1-2.0
0.1-1.0
0.1-7.0
0
20
40
60
80
100
% true or false cld detection


SZA dependent thresholds-0.004 selected for
PWV < 1 cm, < 20 % false cloud detections
PWV range
6.1-7.0
5.1-6.0
4.1-5.0
3.1-4.0
2.1-3.0
1.1-2.0
0.1-1.0
0.1-7.0
0
20
40
60
80
100
% true or false cld detection
true
false

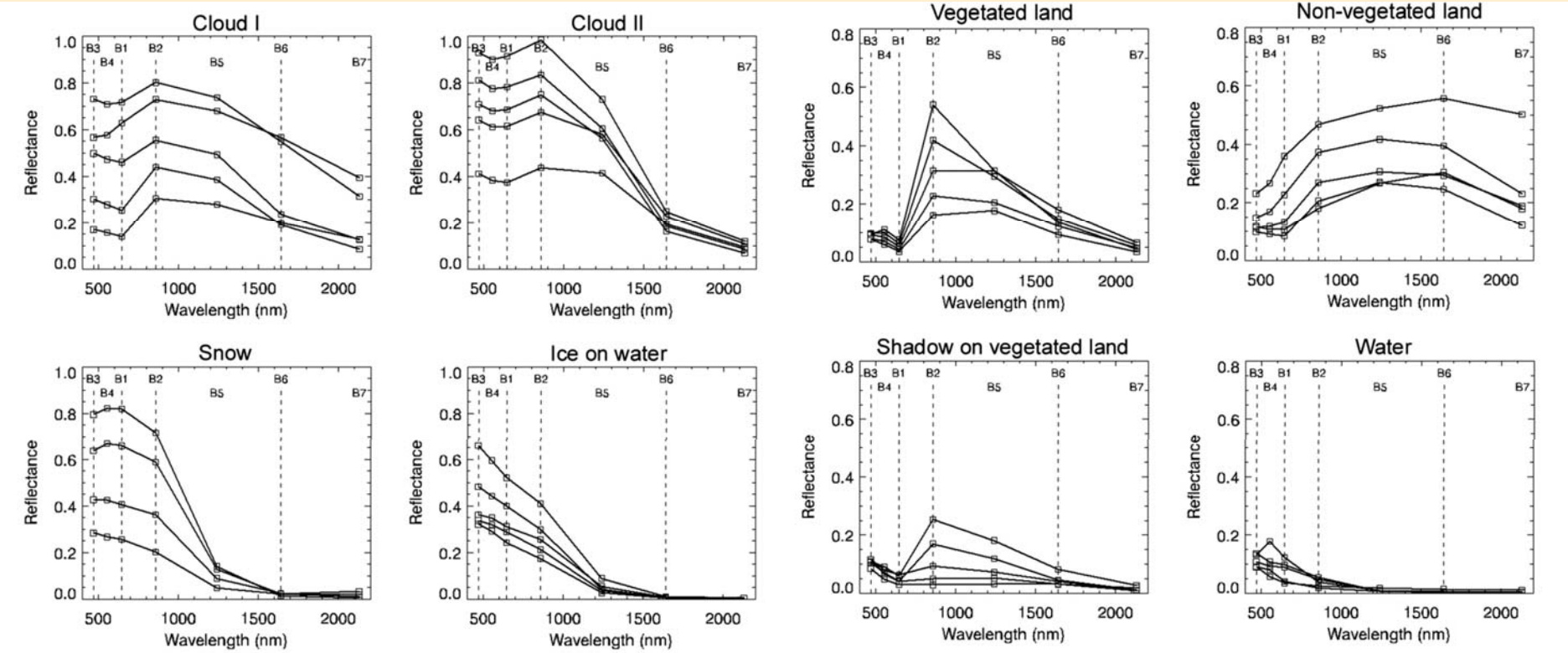

SZA dependent thresholds-0.004 selected for
PWV < 1 cm, < 20 % false cloud detections
true
false
11-12 km
9-10 km
10-11 km
8-9 km
PWV range
6.1-7.0
5.1-6.0
4.1-5.0
3.1-4.0
2.1-3.0
1.1-2.0
0.1-1.0
0.1-7.0
0
20
40
60
80
100
% true or false cld detection


Rsfc=0.4, 0.1 cm < PWV < 1.0 cm, < 20% false cloud detections
% of true cloud detection
cos(SZA)
d=60
d=50
d=70
dependence on crystal effective size
100
90
80
70
60
50
40
0
0.2
0.4
0.6
0.8
1

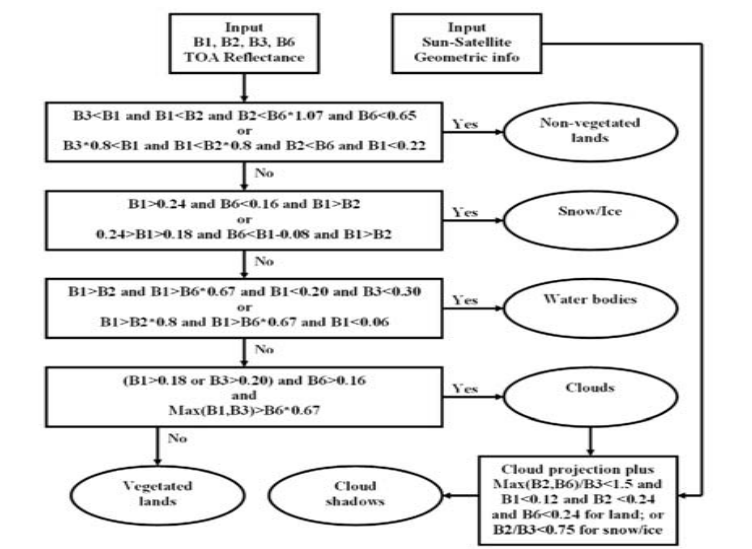

0.1 cm < PWV < 1.0 cm, < 20% false cloud detections
% of true cloud detection
cos(SZA)
d=60
d=50
d=70
dependence on crystal effective size
100
90
80
70
60
50
40
0
0.2
0.4
0.6
0.8
1

Simple cloud mask tests

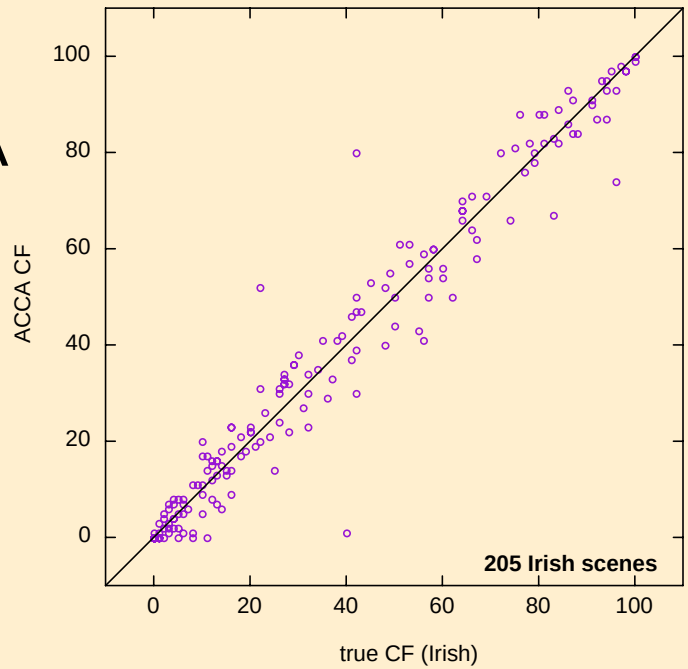
A simple algorithm with no thermal

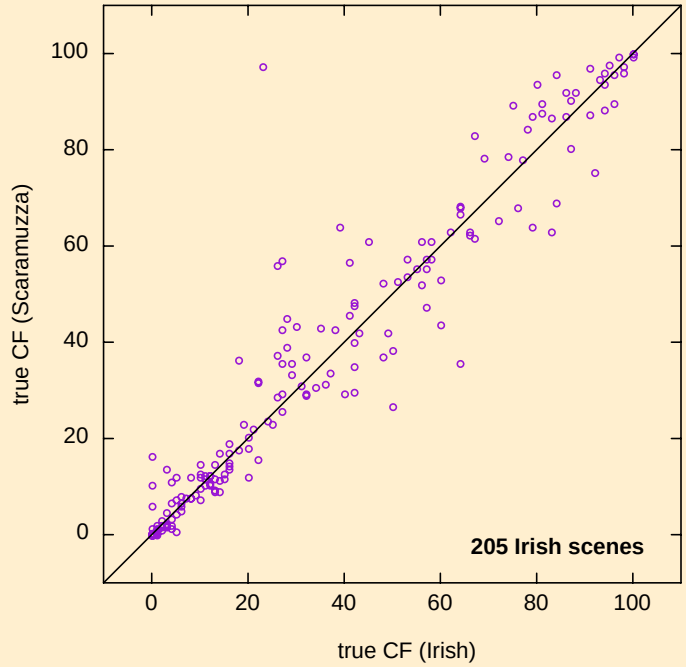


Luo et al., RSE (2008)



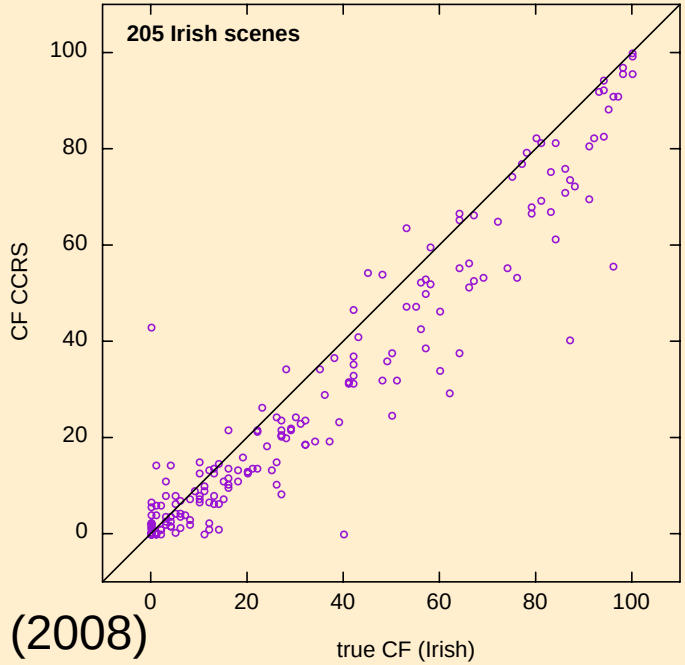
ACCA

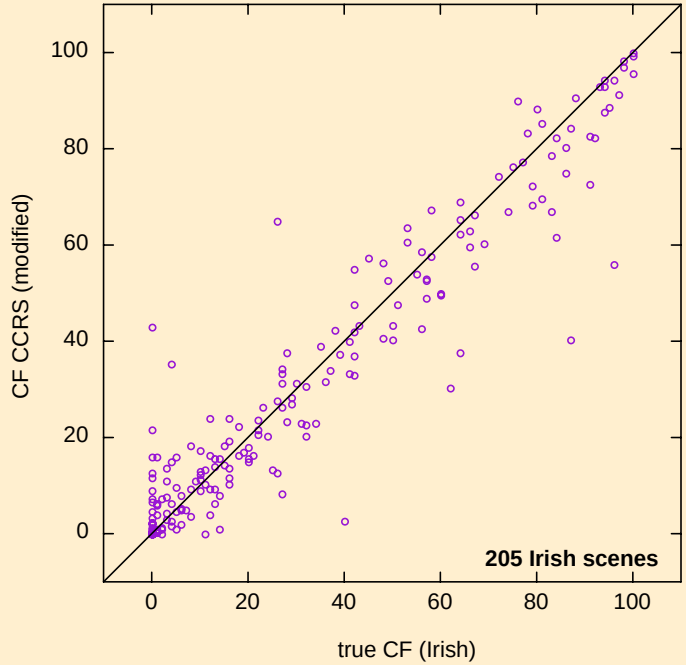




Scara

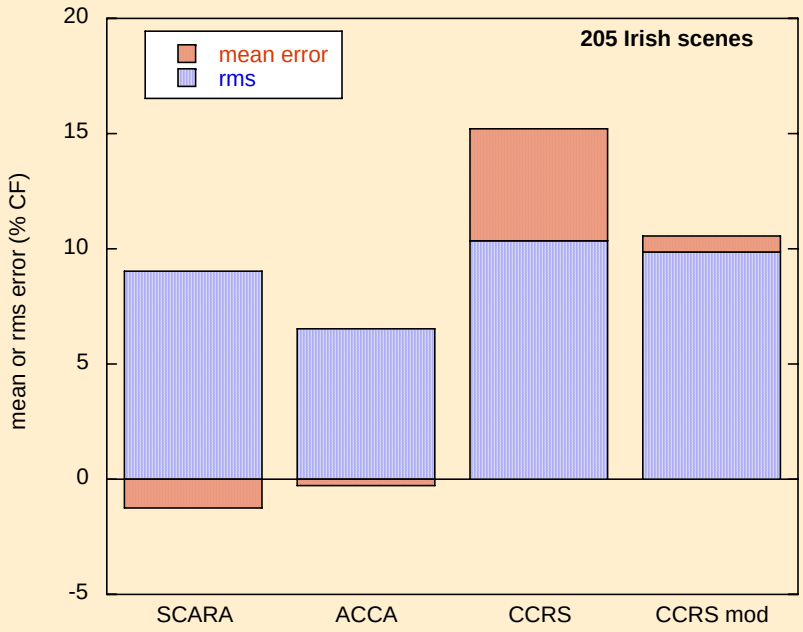
CCRS



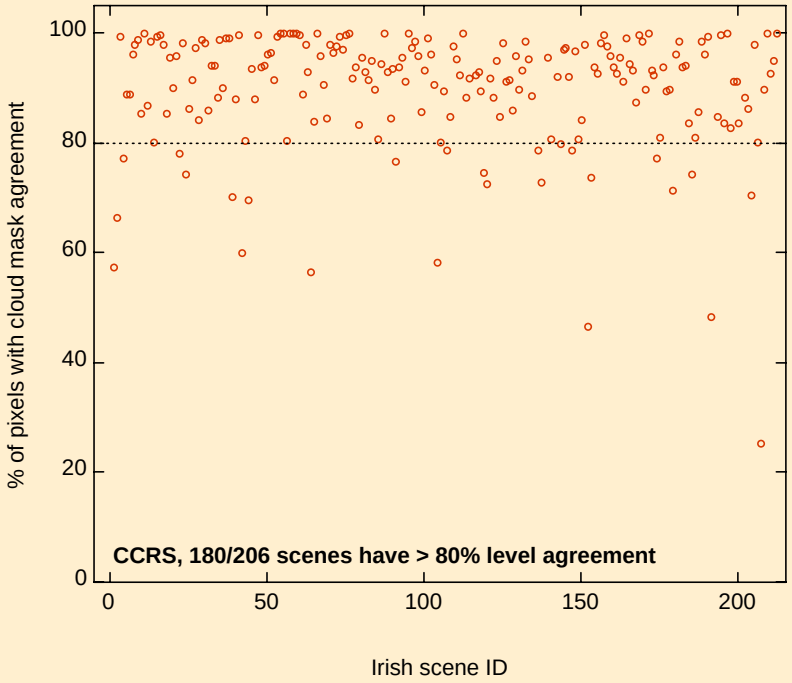


CCRS mod

Luo et al. (2008)



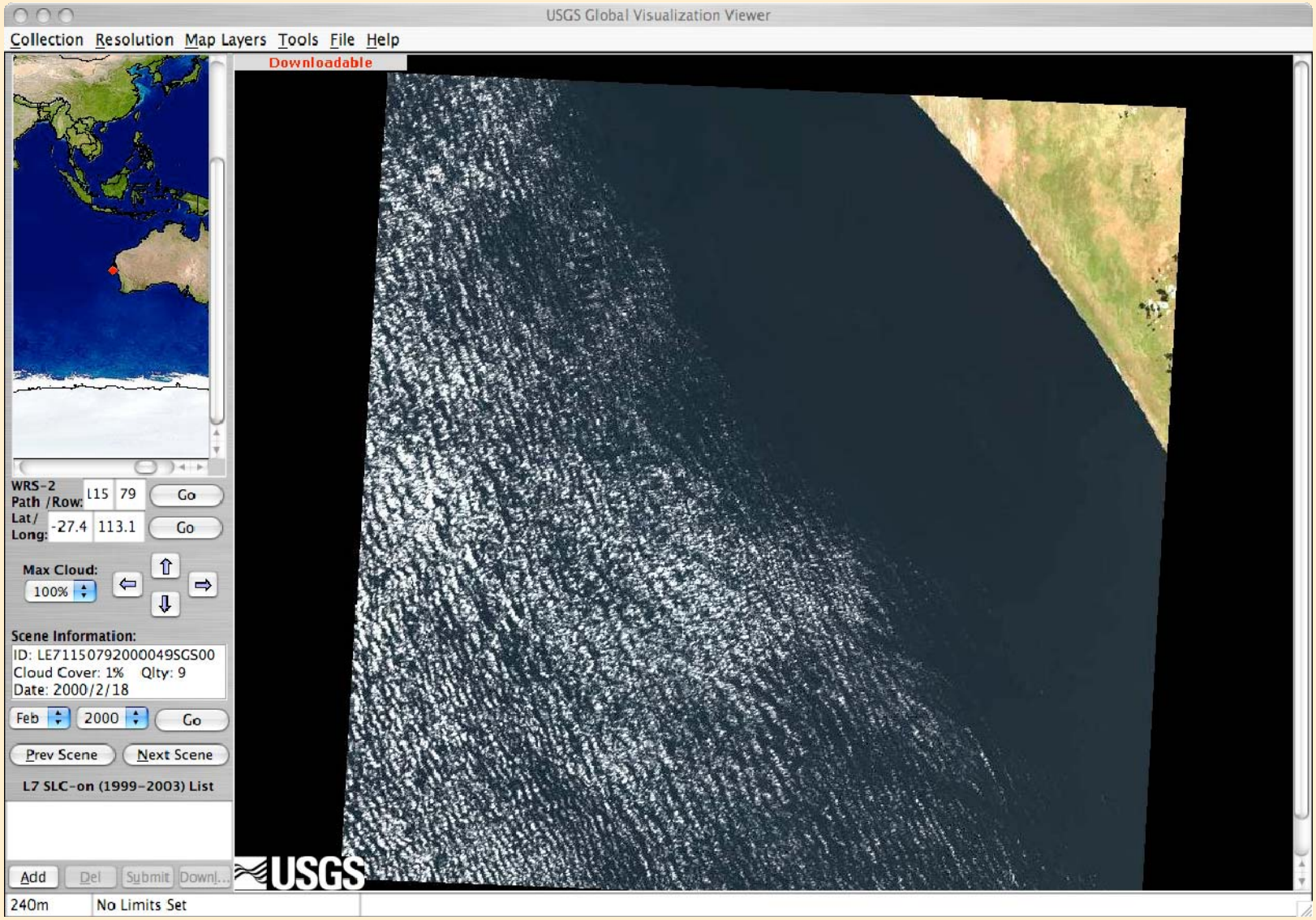
Score comparison



Mask comparison

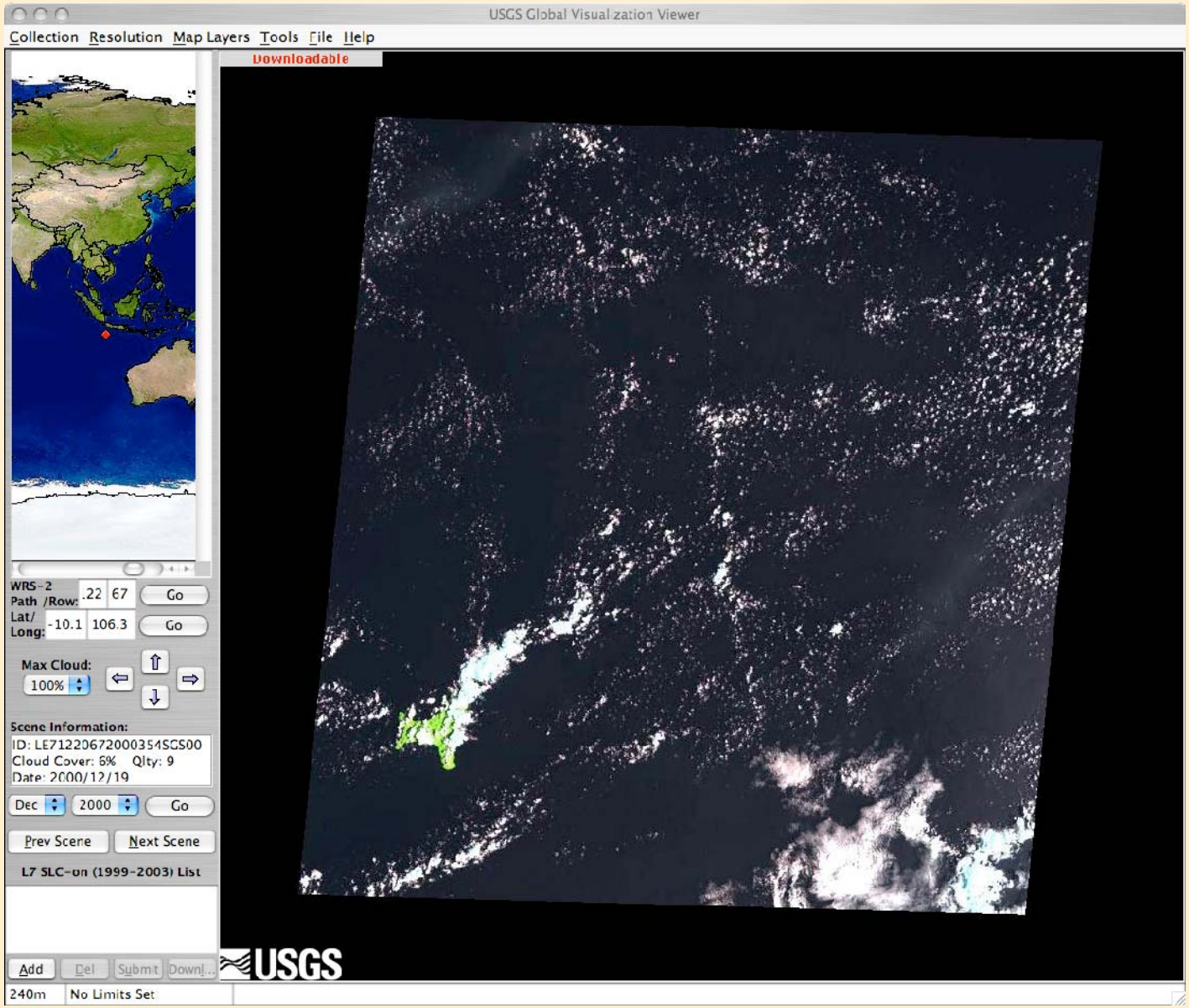
Marine cloud detection

ACCA underestimates Cloud Cover!



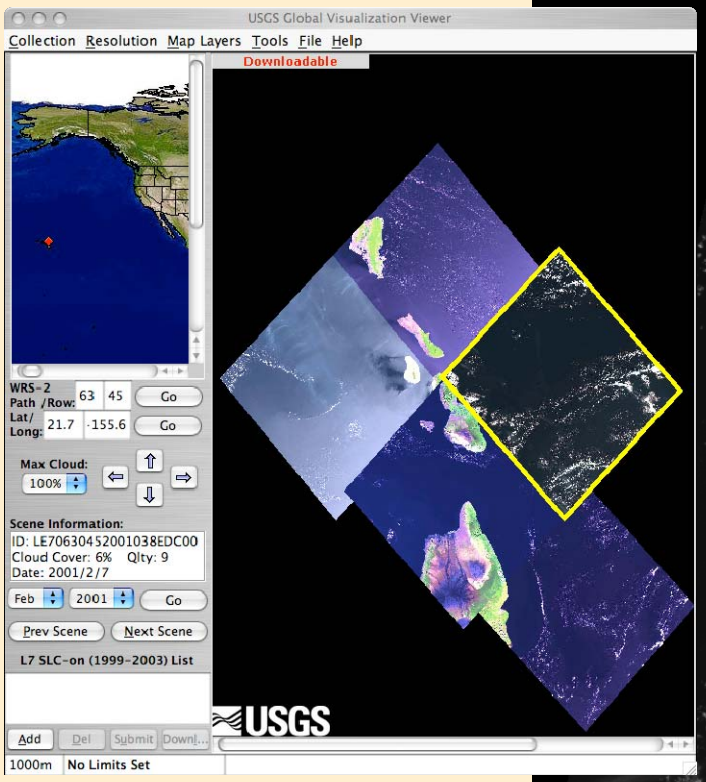
ACCA CF=1%

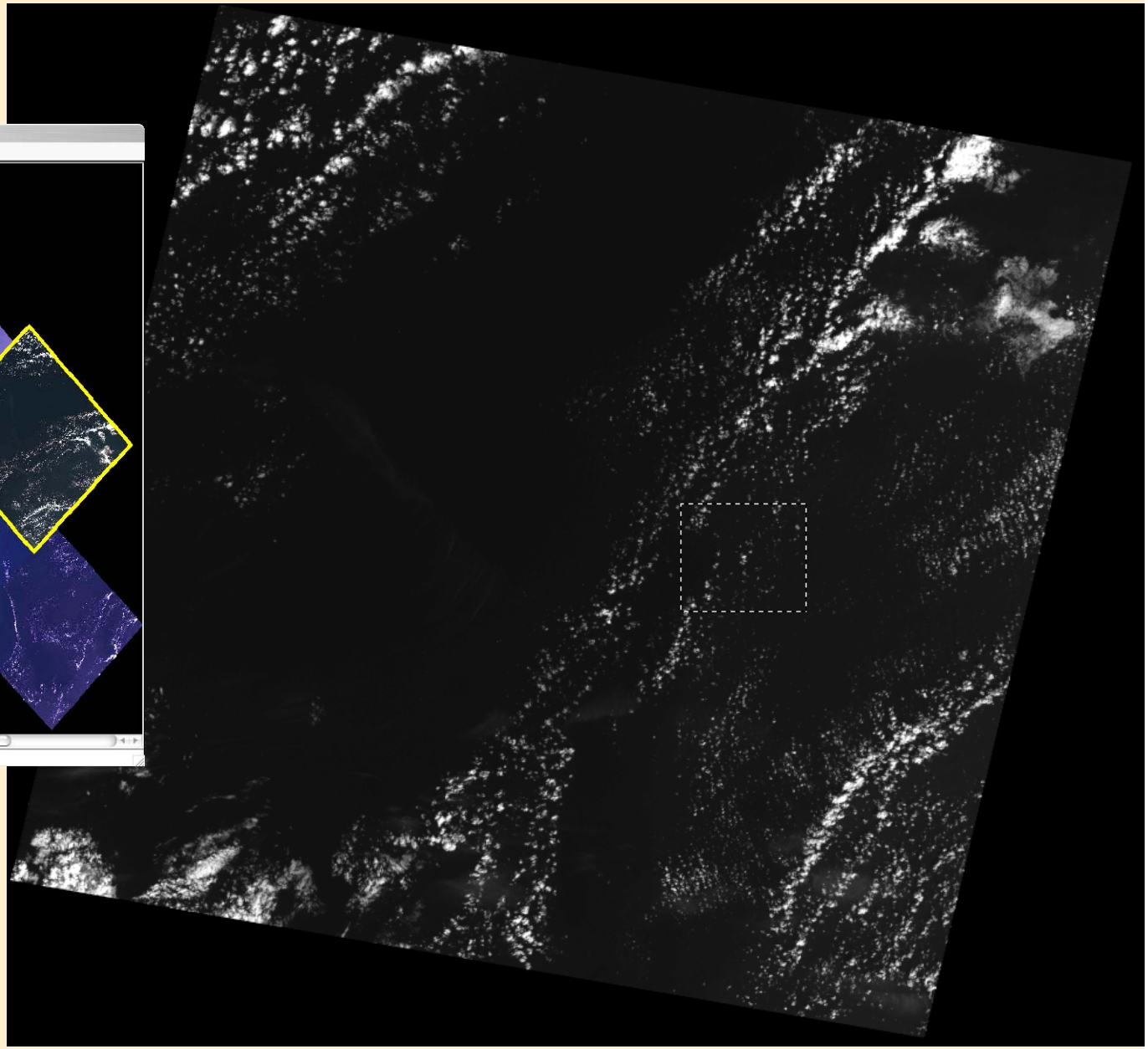
Another example



ACCA CF=6%

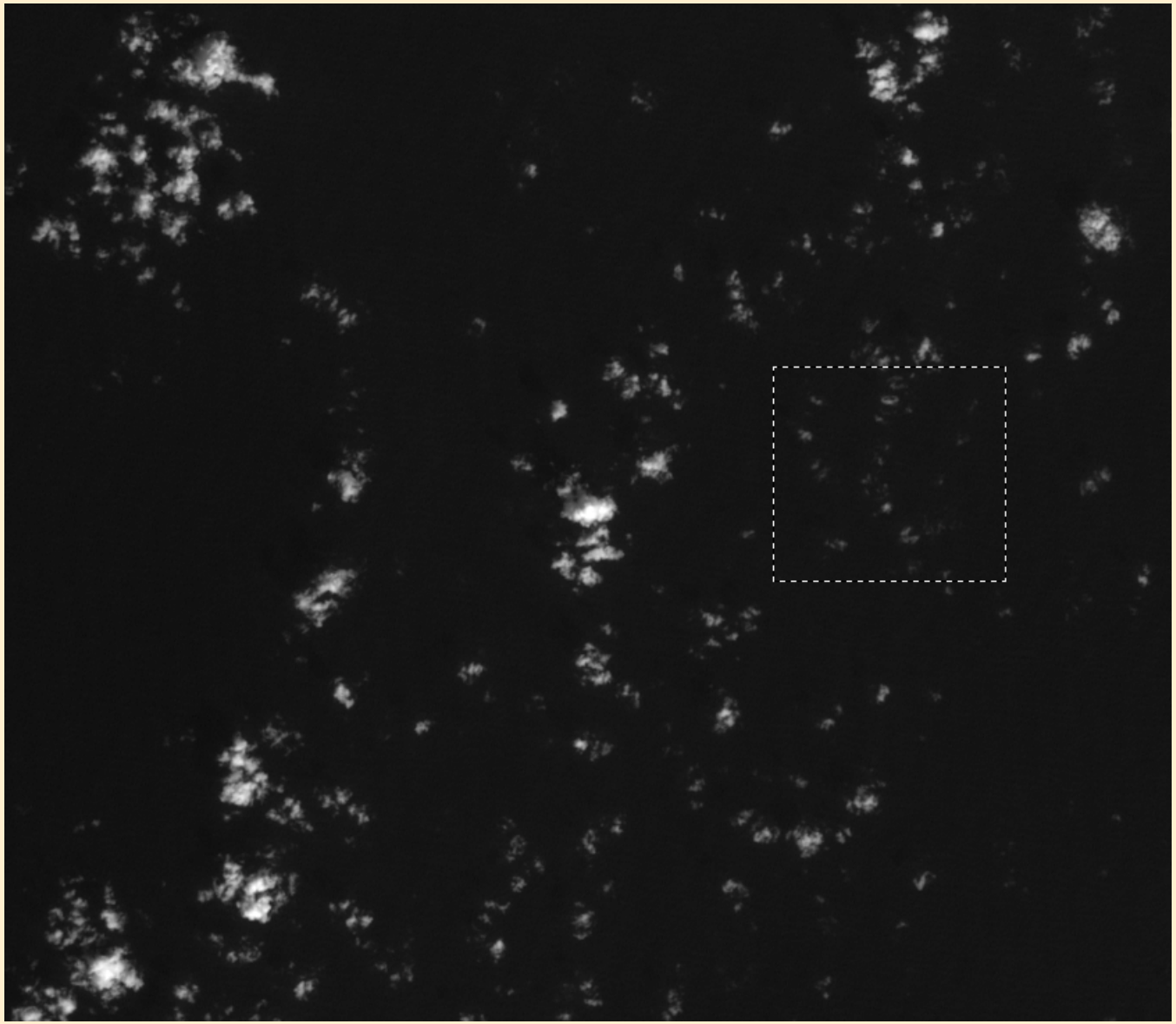
A more detailed look



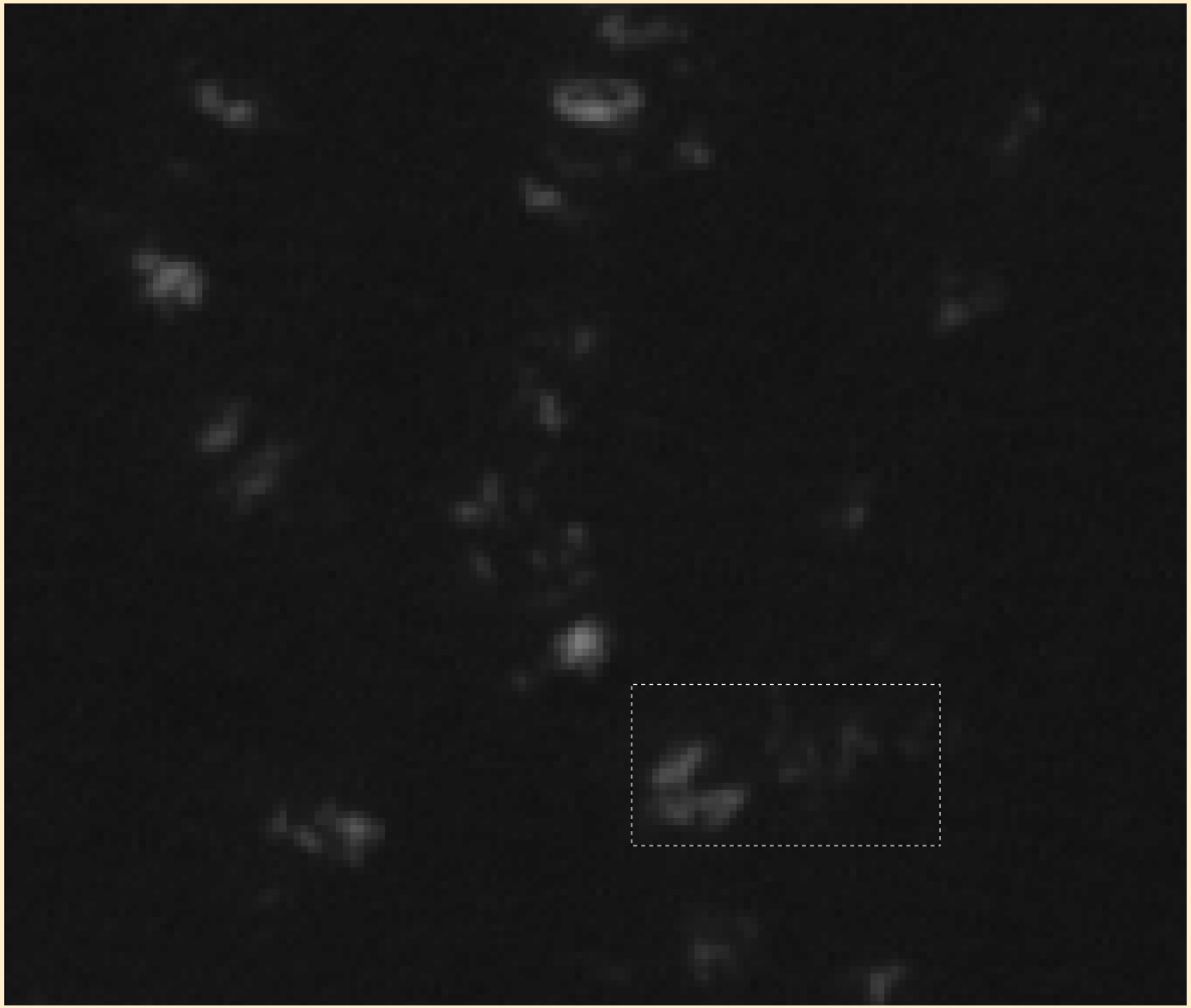


ACCA CF=6%

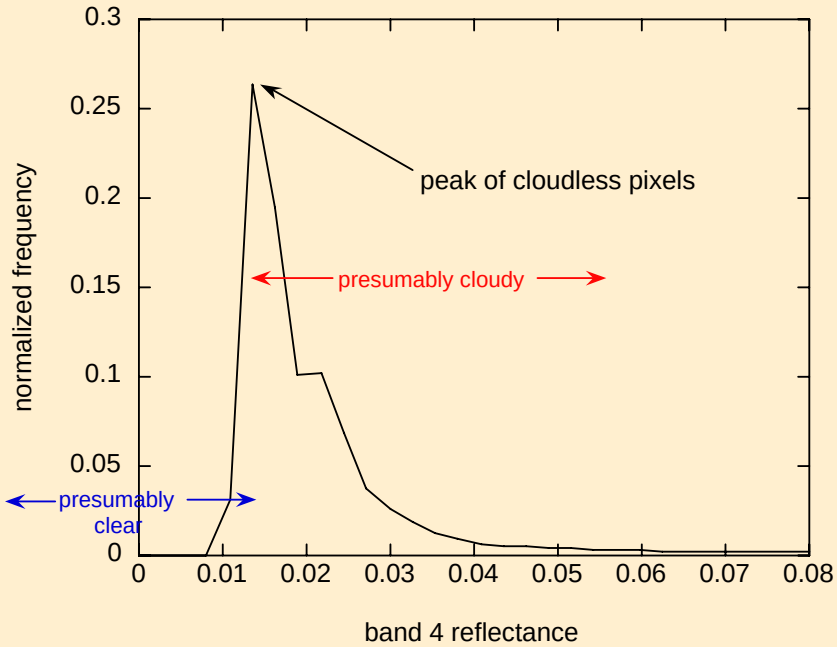
Detail of P63/R45, 2001/2/7

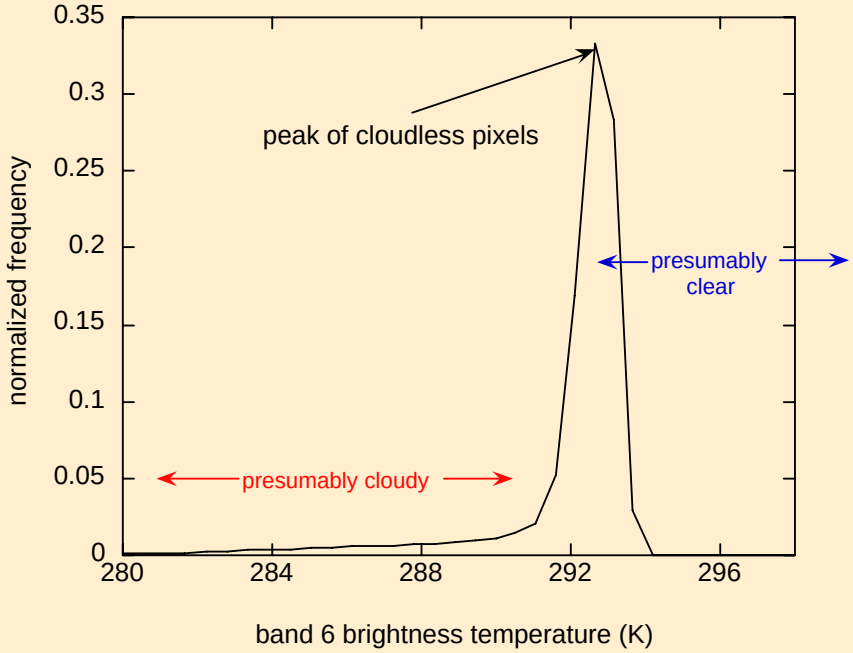
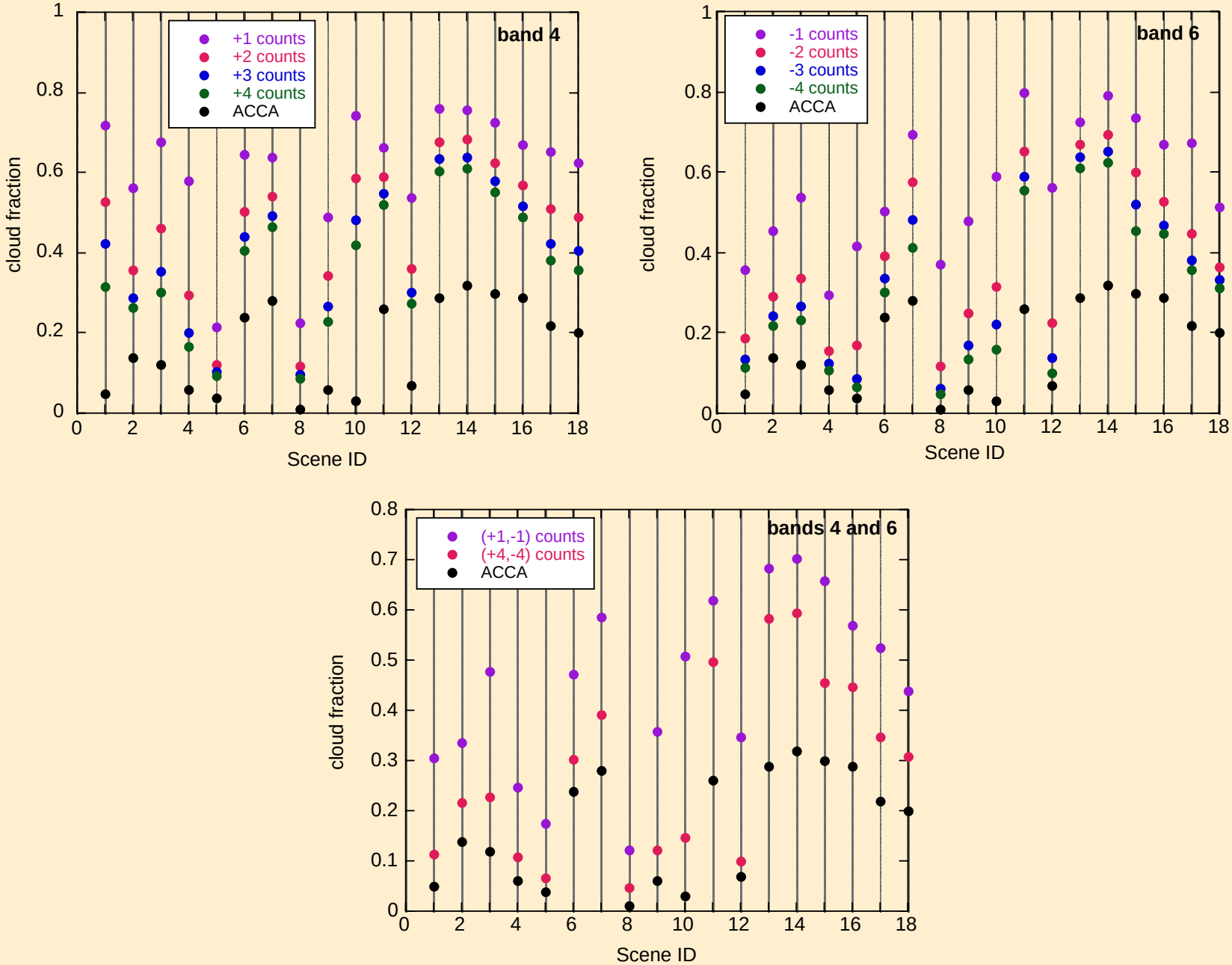


Detail of P63/R45, 2001/2/7



Threshold selection





Sensitivity to threshold