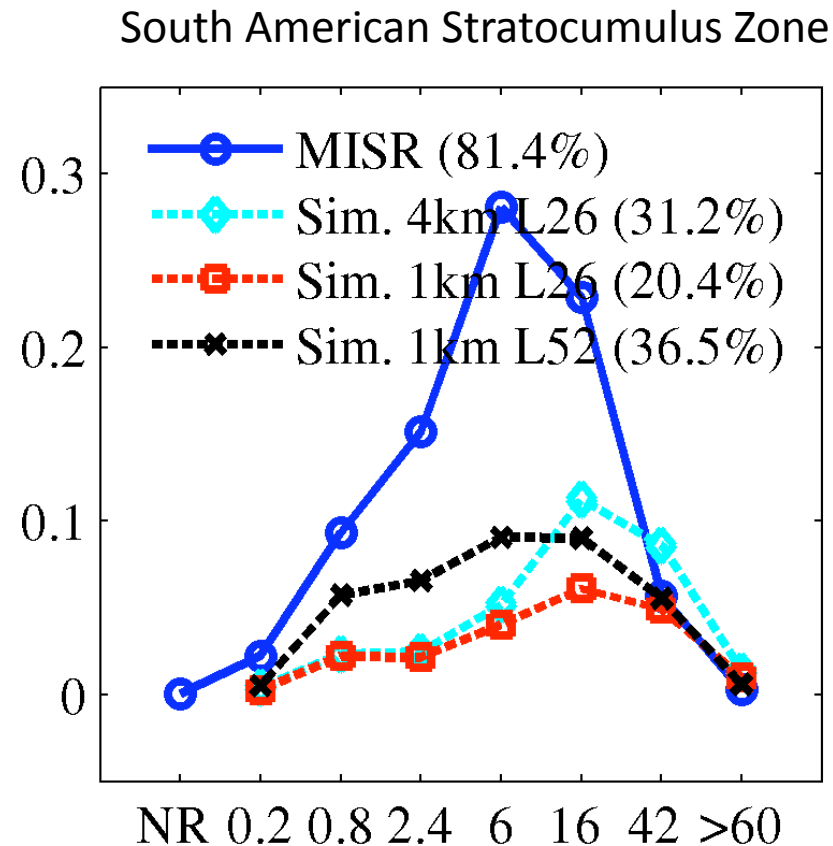
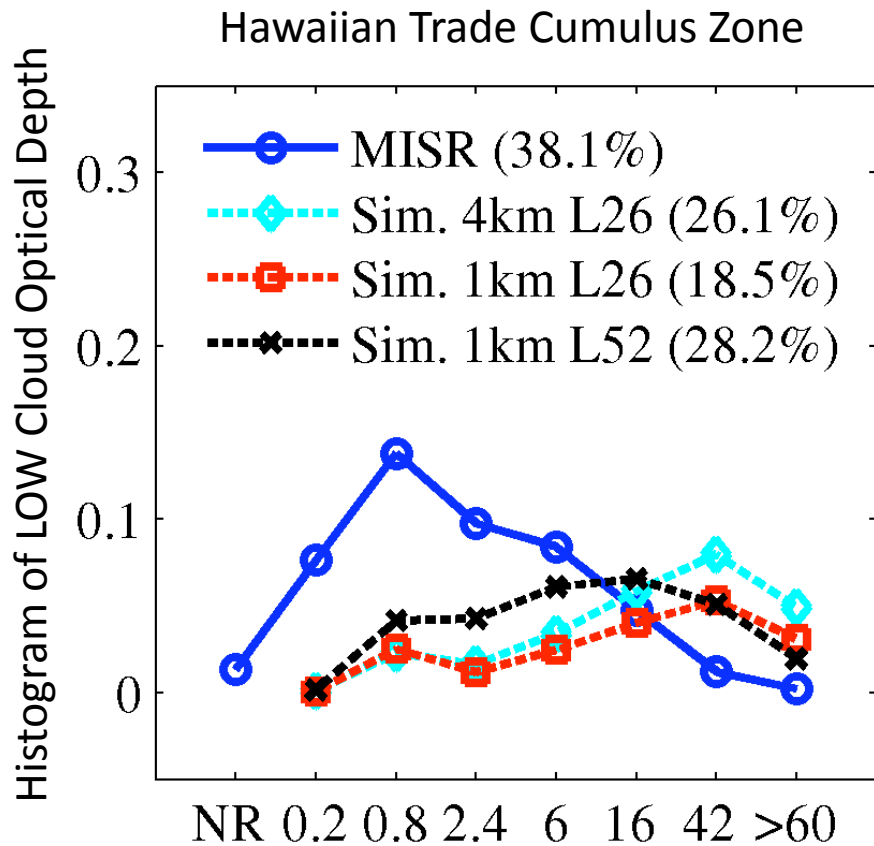


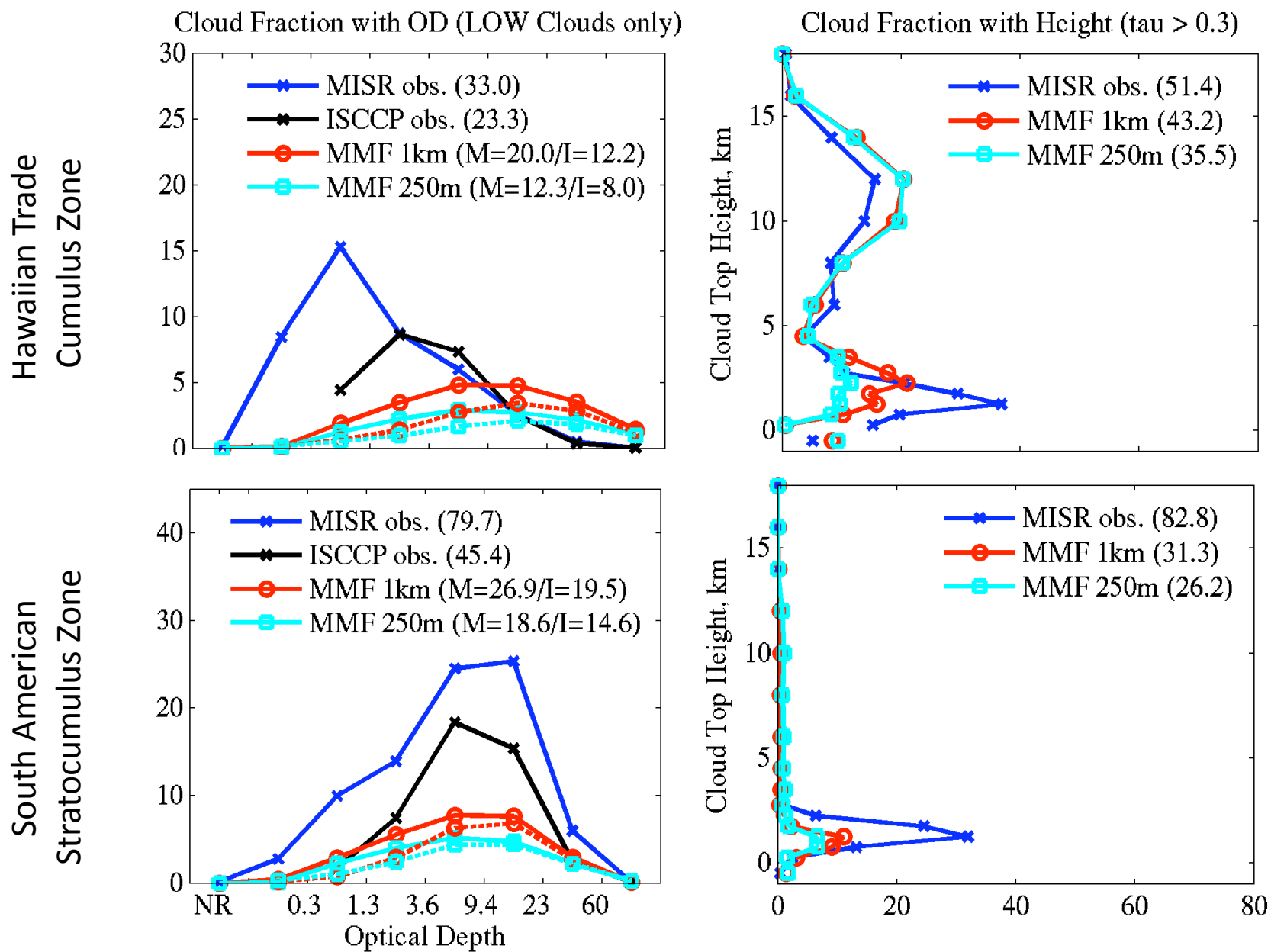
Summary of previous MMF resolution tests

Reducing the CRM horizontal grid spacing from 4 km to 1 km removes “stratofogulus”, but the amount of low-optical-depth-cloud remains the same (less total BL cloud).

Reducing vertical grid spacing (to ~ 100 m BL and keeping 1 km horizontal grid spacing) increases the amount of cloud (esp. low optical depth cloud) and improves the vertical distribution of cloud-top-height (not shown) == better agreement with MISR/ISCCP obs.

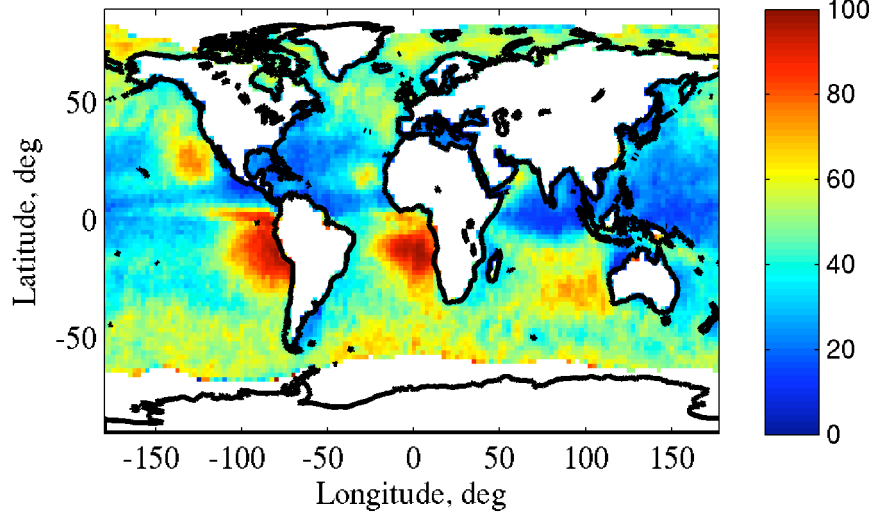


Comparison of MMF 1 km & 250 m runs

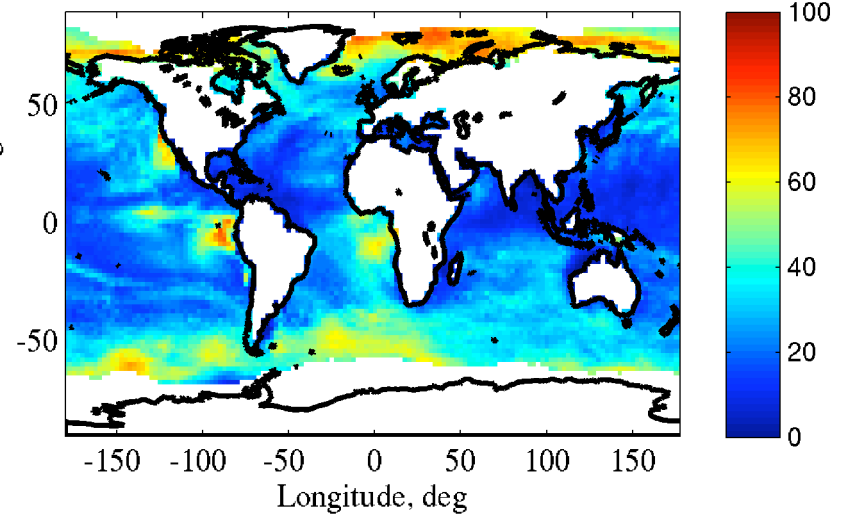


Global Low Cloud Cover, September

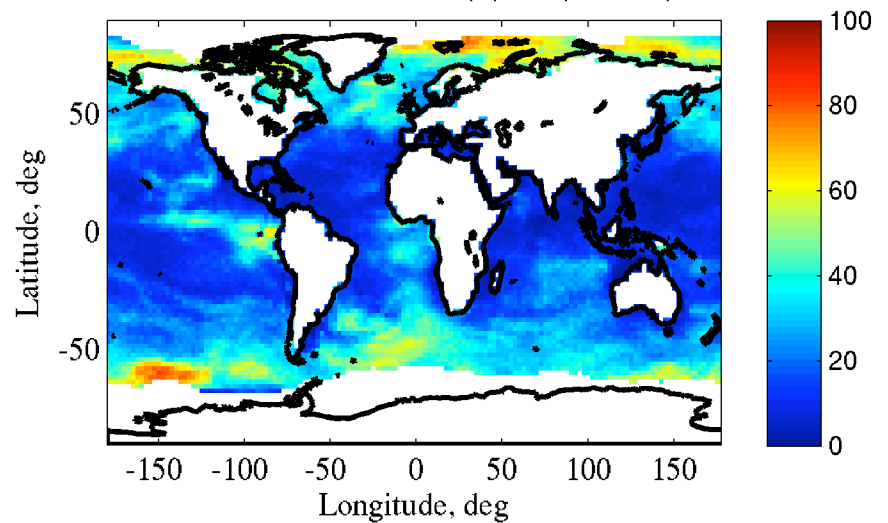
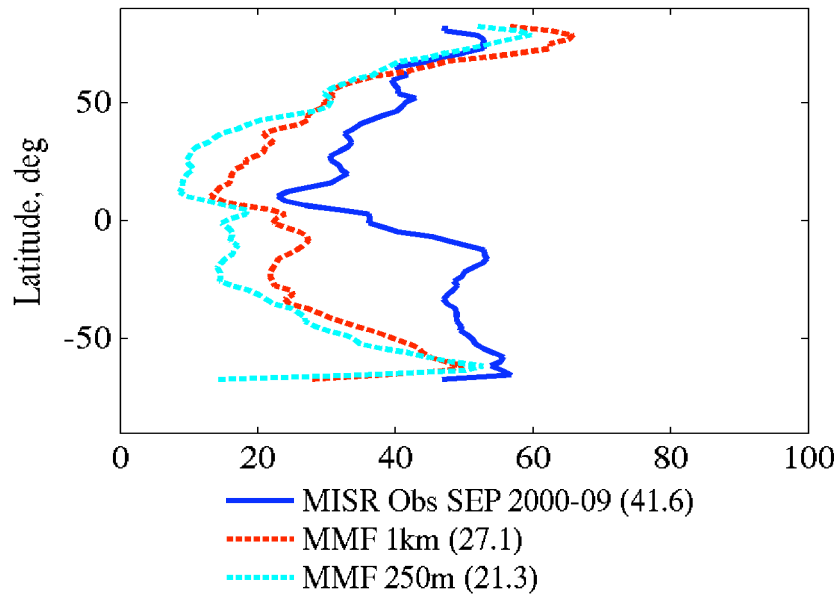
MISR Obs SEP 2000-09 Low-Level (L) CF (tau>0.3)



MMF 1km Low-Level (L) CF (tau>0.3)



MMF 250m Low-Level (L) CF (tau>0.3)

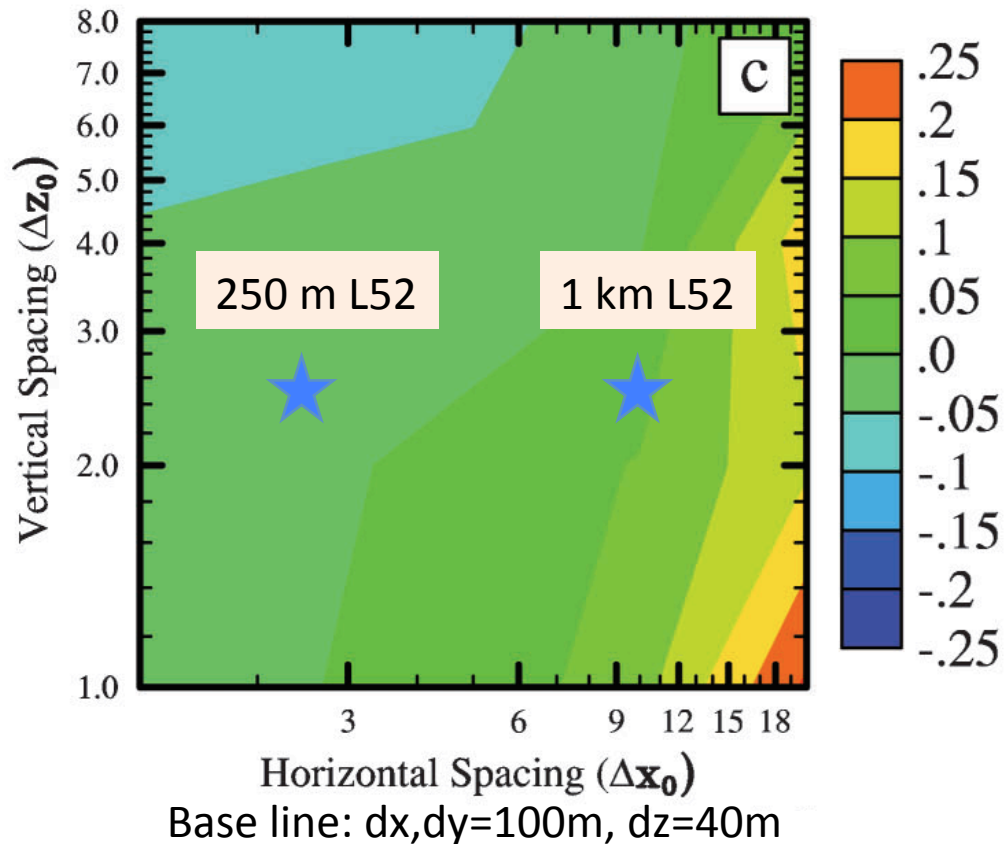


Summary

- MMF 250m runs have less BL cloud than 1 km runs
 - Change is pronounced in tropics and subtropics
- There is a slight shift in OD distribution towards smaller optical depths and little (to no) change in the relative vertical distribution.
- In most respects, this is the expected result ...

Expected sensitivity of cloud fraction to CRM grid spacing in cumulus zones

Shallow Cumulus Cases
(BOMEX, RICO, ARM)
Column Cloud Fraction ()



For BOMEX, $dz = 40\text{ m}$

Table 4, Neggers et al. 2003 JAS

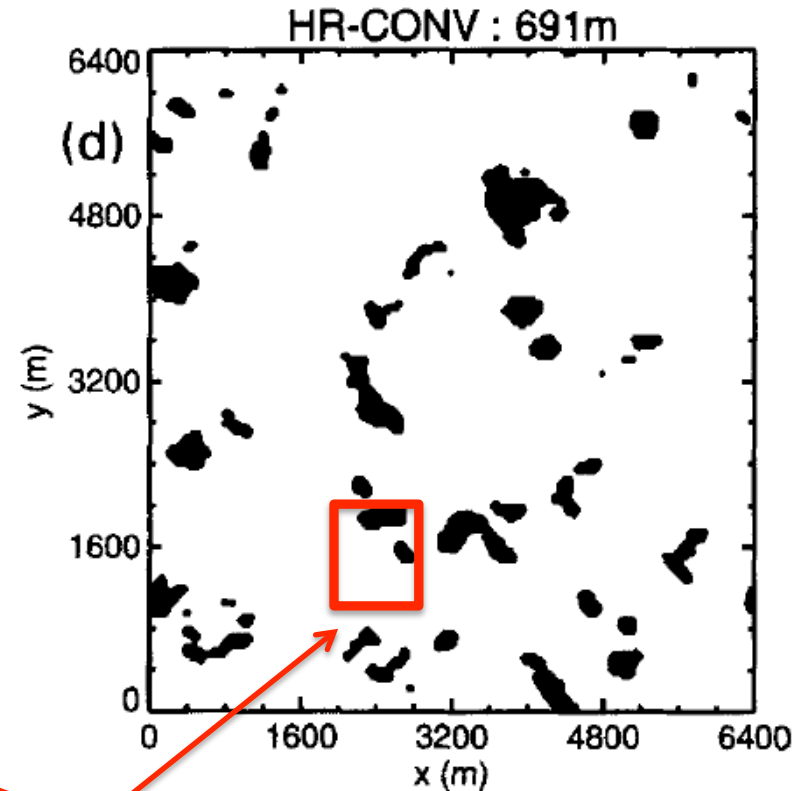
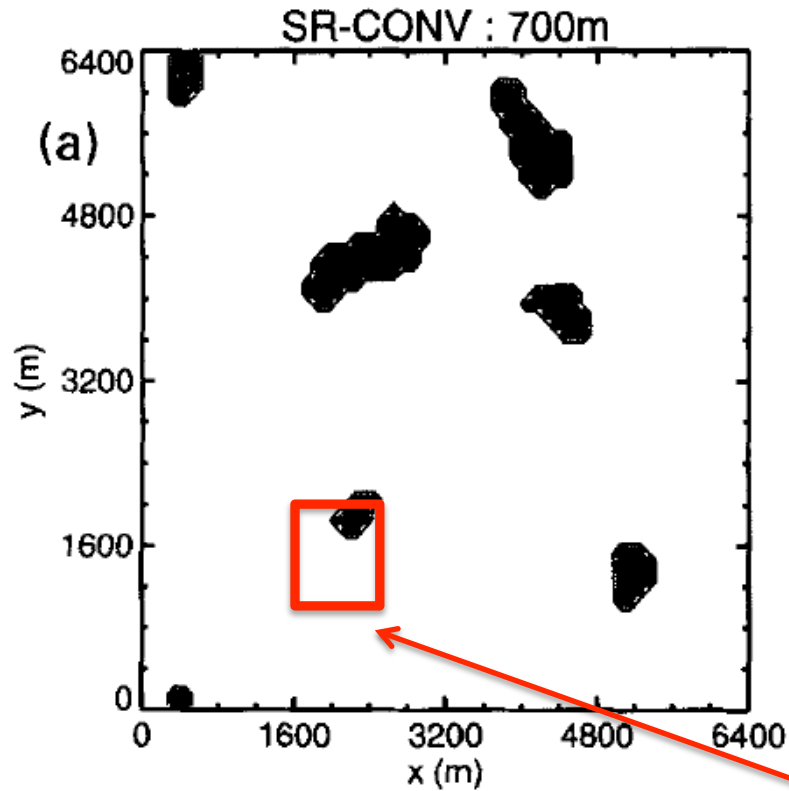
Specifics of simulation	a^p (%)
$\Delta x = 100\text{ m}$	14.48
$\Delta x = 50\text{ m}$	14.15
$\Delta x = 25\text{ m}$	16.41

Contour plot taken from Cheng et al. 2010 JAMES

But the size of cloud elements depends on the horizontal grid spacing ...

BOMEX Clouds with
 $dx, dy = 100 \text{ m}, dz = 40 \text{ m}$

BOMEX Clouds with
 $dx, dy = 33 \text{ m}, dz = 17 \text{ m}$

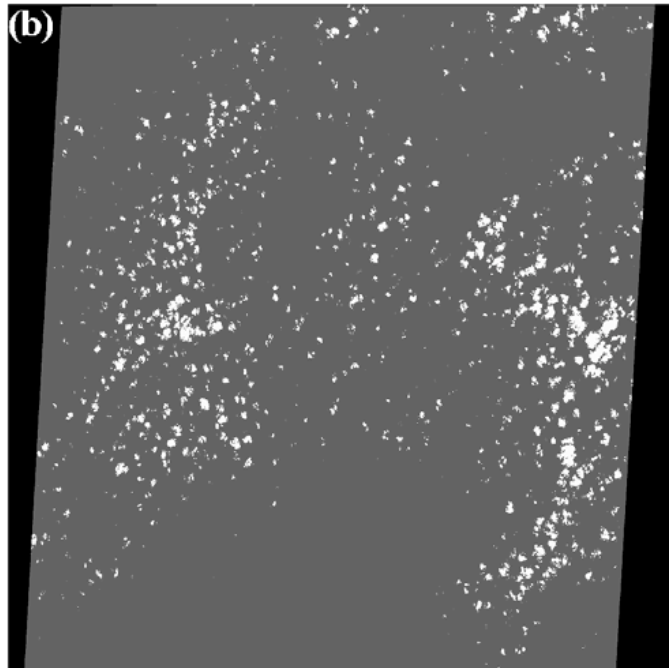


Taken from Brown 1999 QJRM

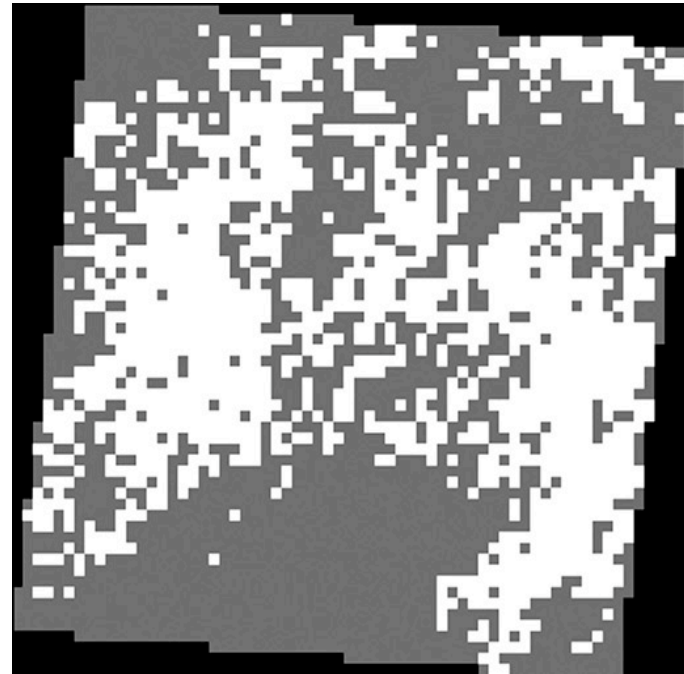
Satellite ~ 1km Pixel

This is a known problem with the observations ...

ASTER Cloud Mask 15 m



Perfect Cloud Mask 1100 m



ASTER Scenes : 124

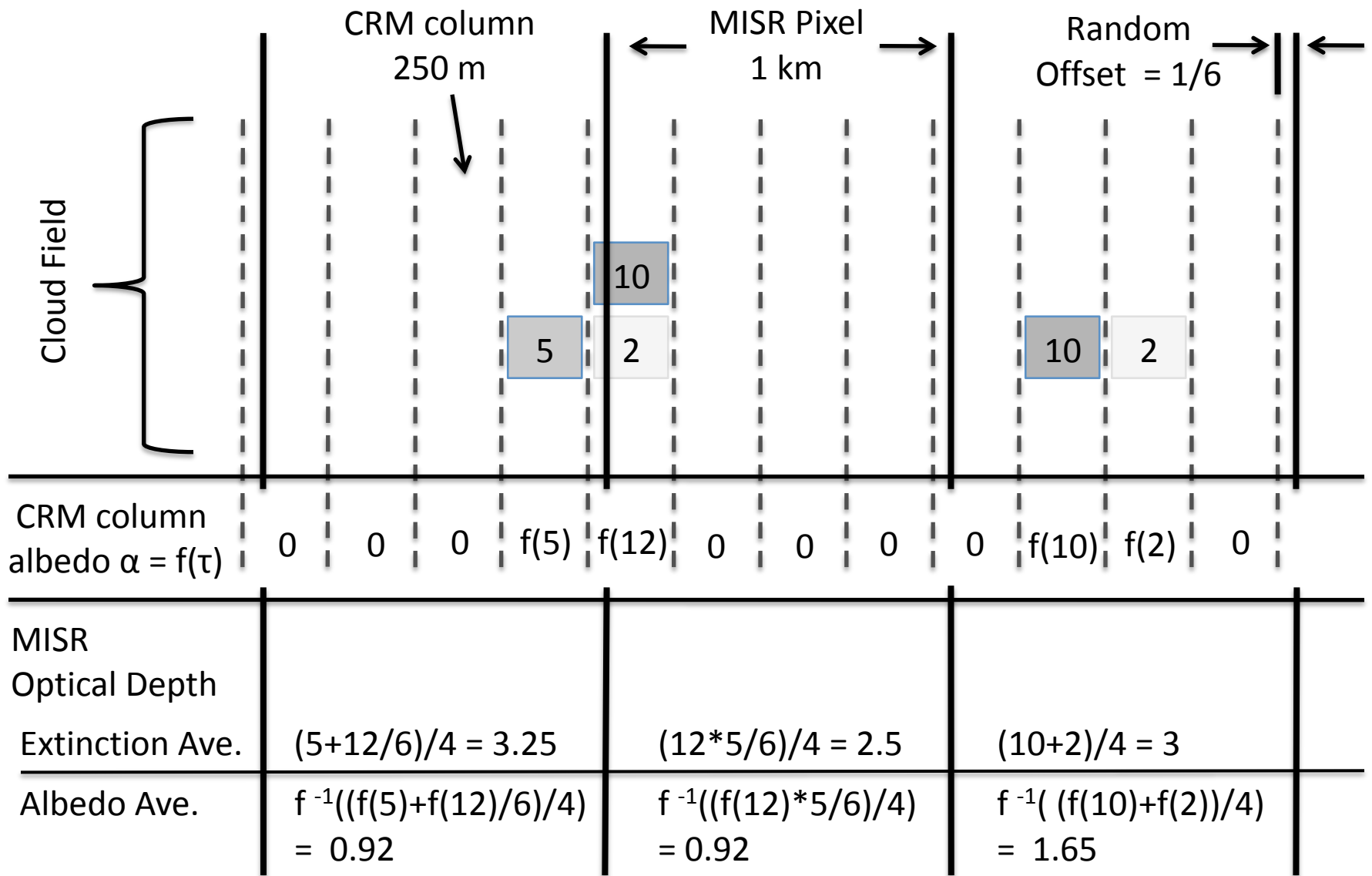
ASTER 15 m CF = 8 %

ASTER 1100 m CF = 50 %

MISR CF = 44 %

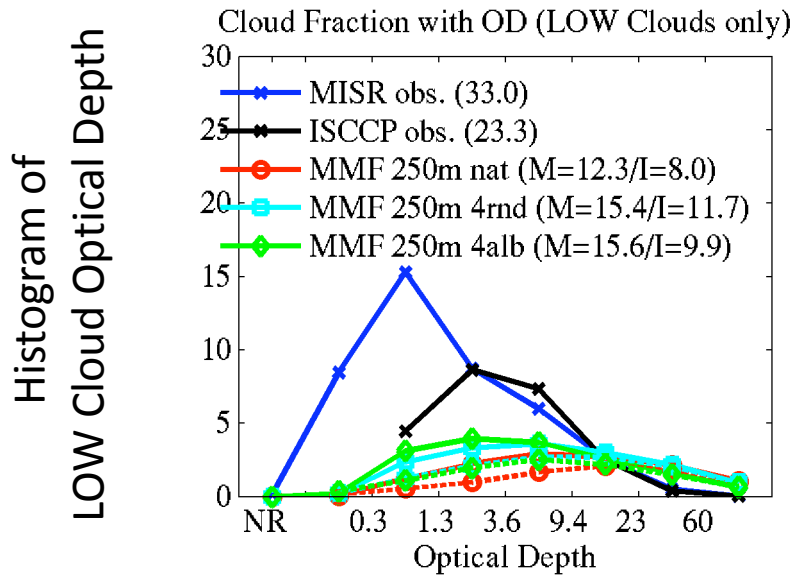
Taken from Zhao and Di Girolamo 2006 GRL

Scheme to Include effect of horizontal resolution on MISR & ISCCP Simulators ...

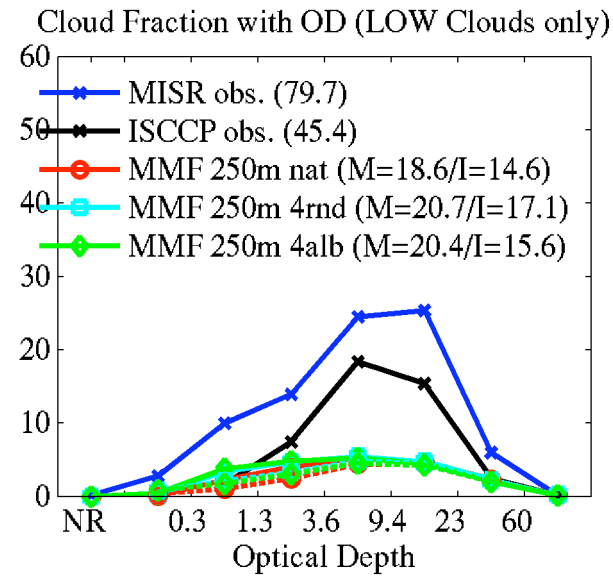


MMF-250m MISR & ISCCP Simulator Results (Native, 1 km extinction averaged, 1km albedo averaged)

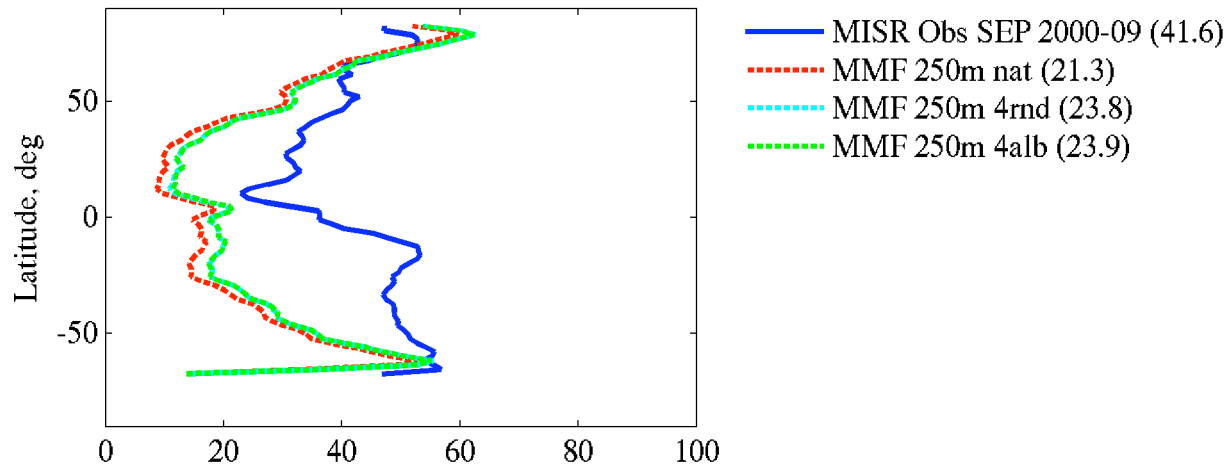
Hawaiian Trade Cumulus Zone



South American Stratocumulus Zone



Zonal Mean Low Cloud Amount



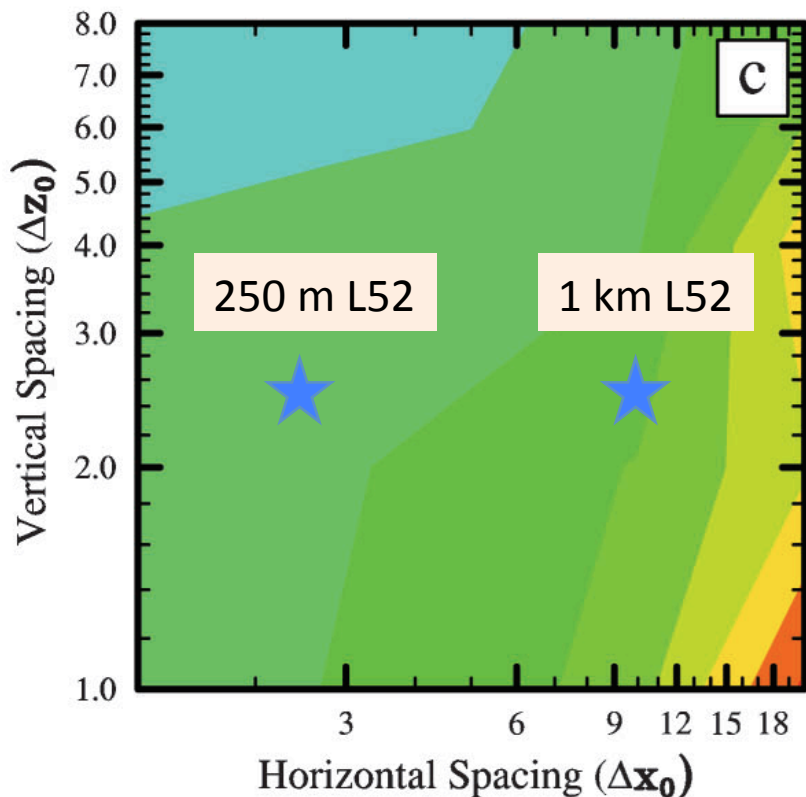
Final Remarks

- Accounting for resolution in MISR & ISCCP simulator does increase the cloud fraction and shift the OD distribution towards lower values.
- However the MMF 250m runs are still much too coarse to capture the small size of cumulus clouds and so the approach remains problematic at this resolution.

Expected sensitivity of cloud fraction to CRM grid spacing

Shallow Cumulus Cases
(BOMEX, RICO, ARM)

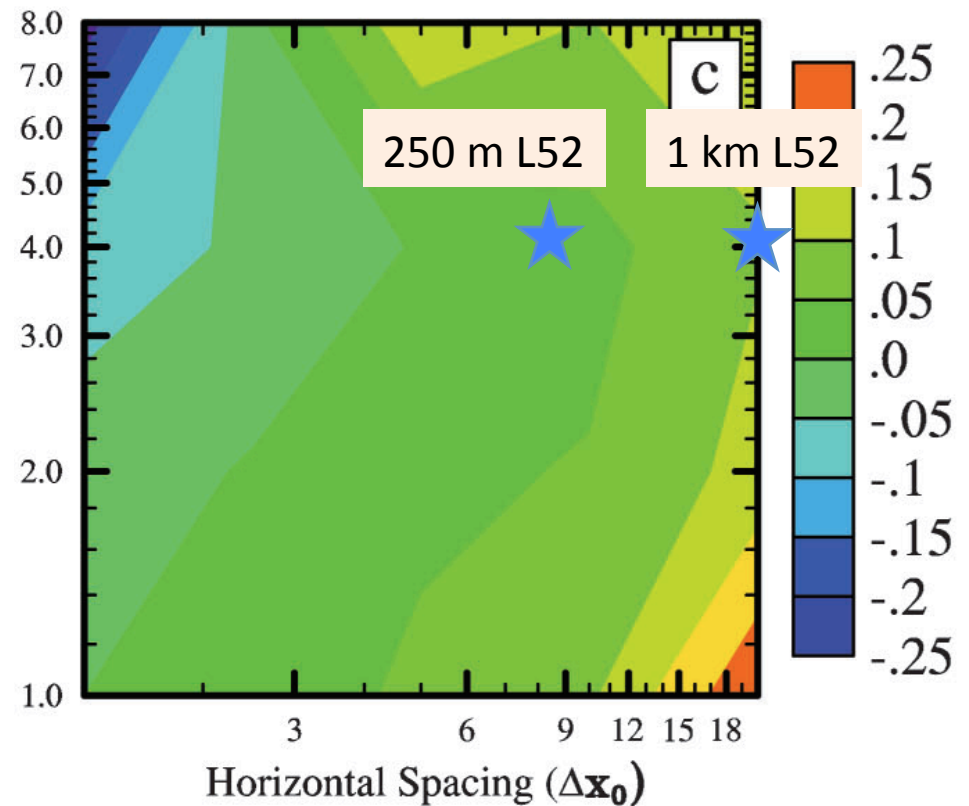
Column Cloud Fraction ()



Base line: $dx, dy=100m, dz=40m$

Stratocumulus Cases
(ATEX, ASTEX, DYCOMS RF01 & RF02)

Column Cloud Fraction ()

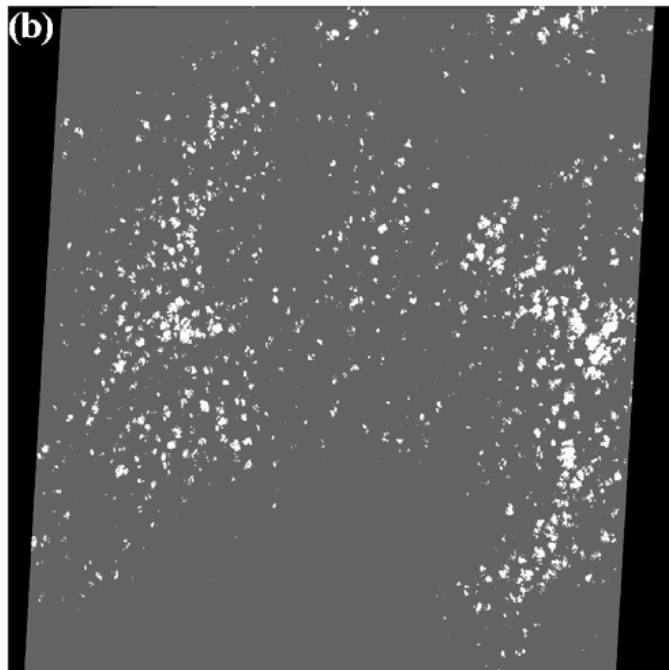


ASTEX Base line: $dx, dy=50m, dz=25m$

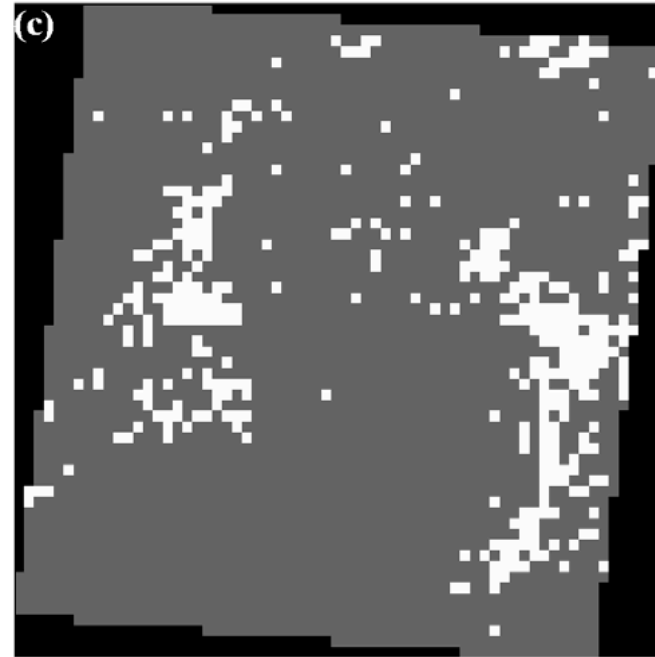
Contour plots taken from Cheng et al. 2010 JAMES

This is a known issue with the observations ...

ASTER Cloud Mask 15 m



MISR Cloud Mask 1100 m



ASTER Scenes : 124

ASTER 15 m CF = 8 %

ASTER 1100 m CF = 50 %

MISR CF = 44 %

Taken from Zhao and Di Girolamo 2006 GRL