Study Pollution Impacts on Upper-Tropospheric Clouds with Aura, CloudSat and CALIPSO Data

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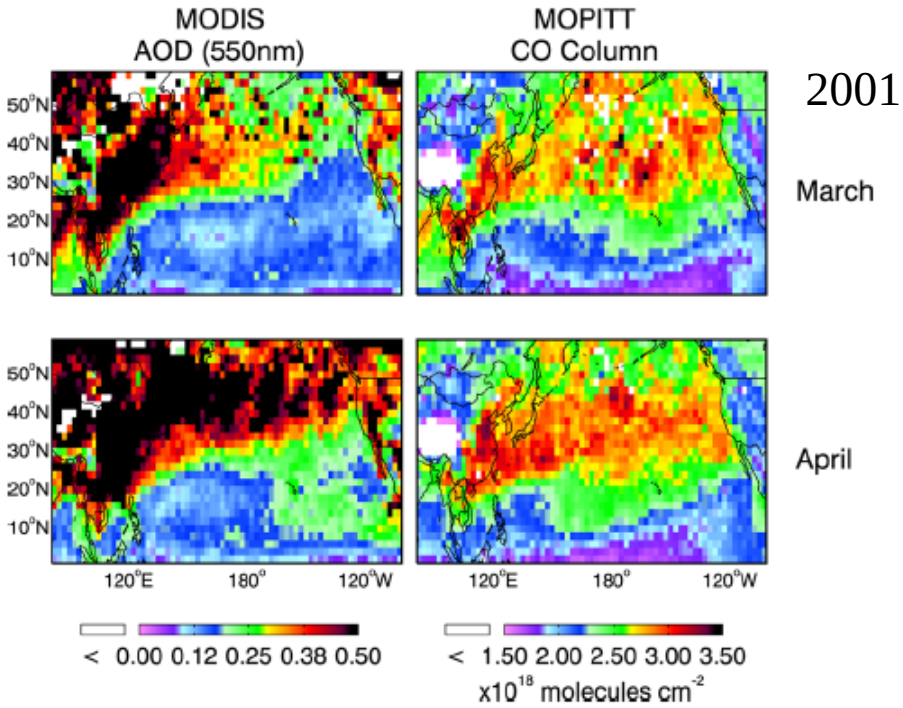
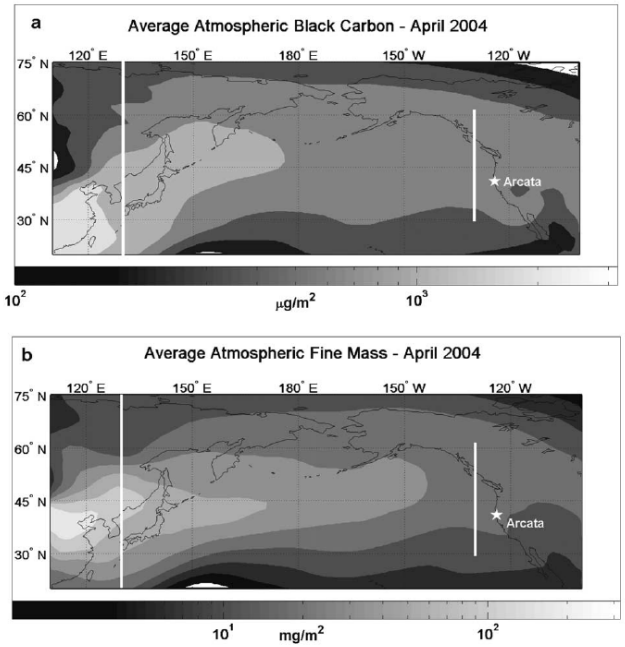
Thank MLS, CloudSat and CALIPSO teams for successful instrument operation and data processing

Pollution in the Upper Troposphere

Heald et al. 2006

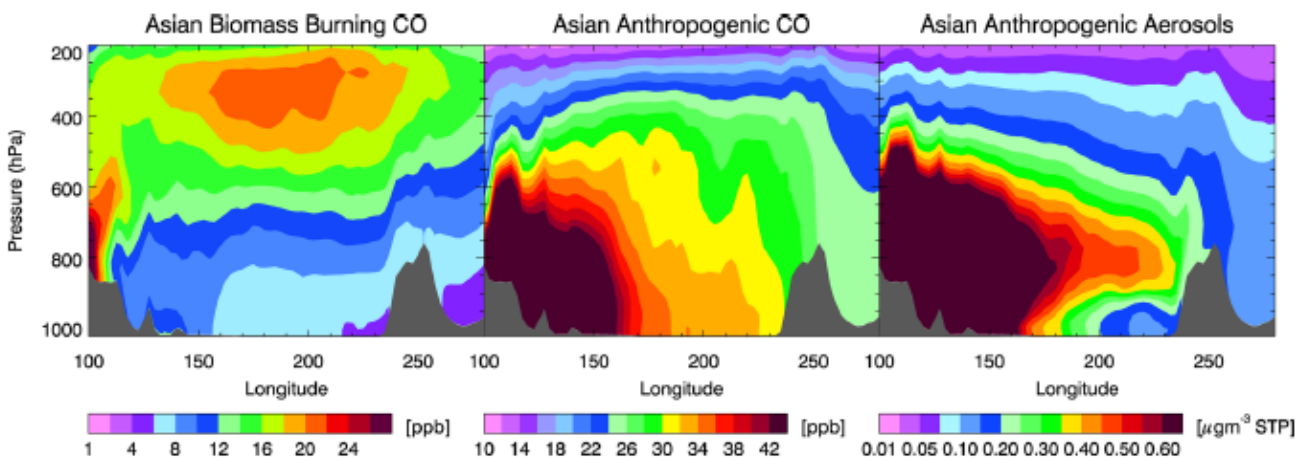


Hadley et al. 2007



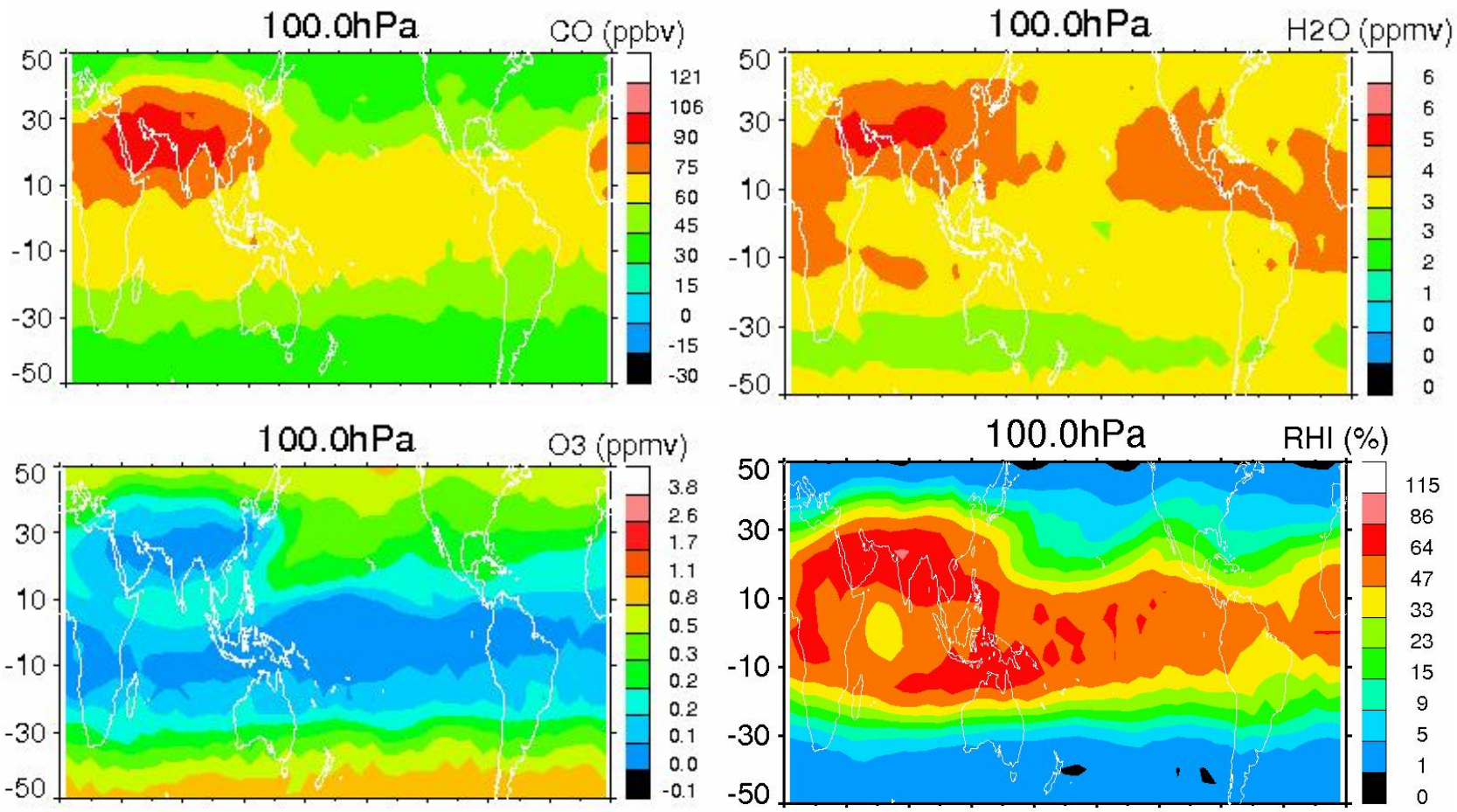
BC

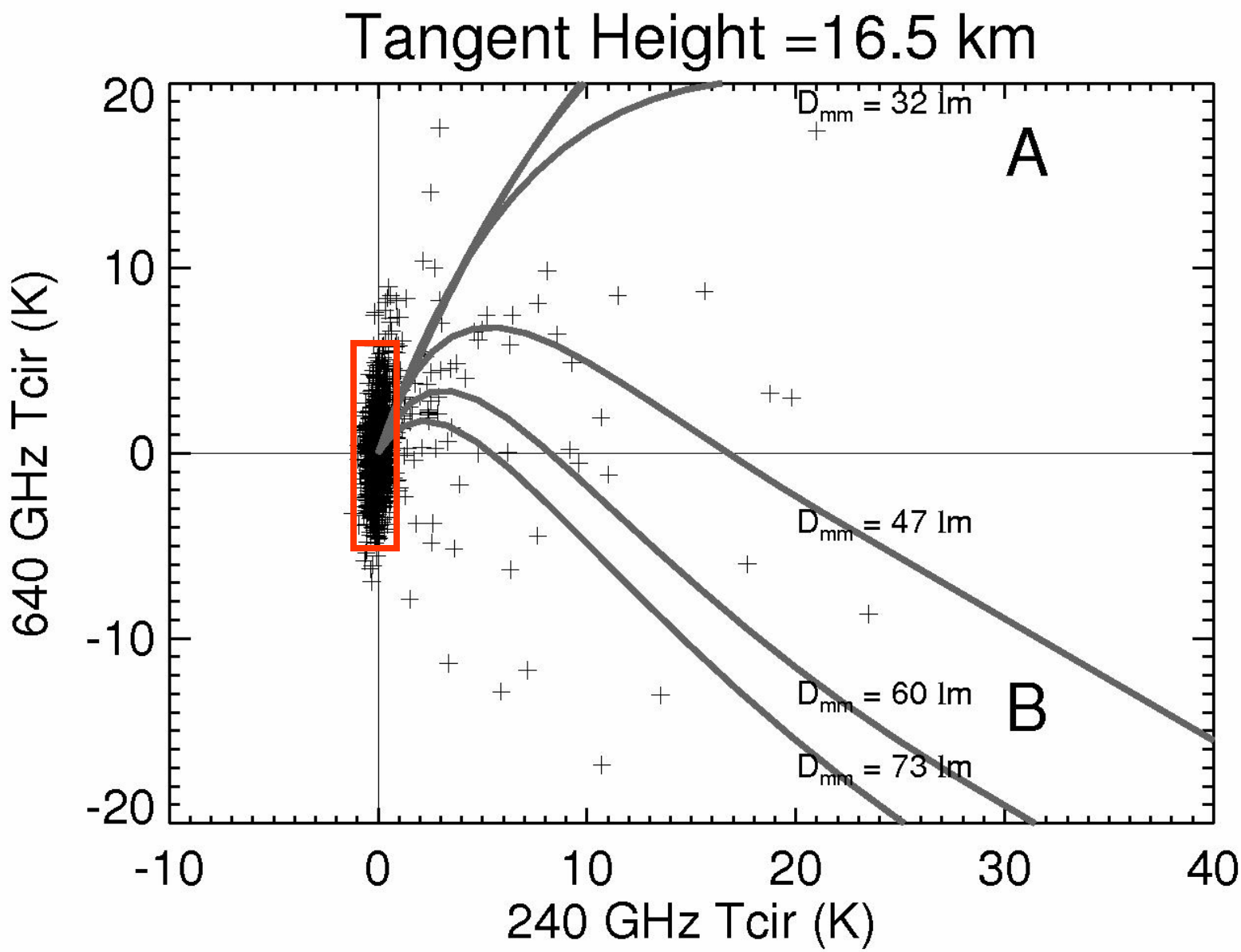
Fine-mass aerosols



Aura MLS Upper-Tropospheric Observations

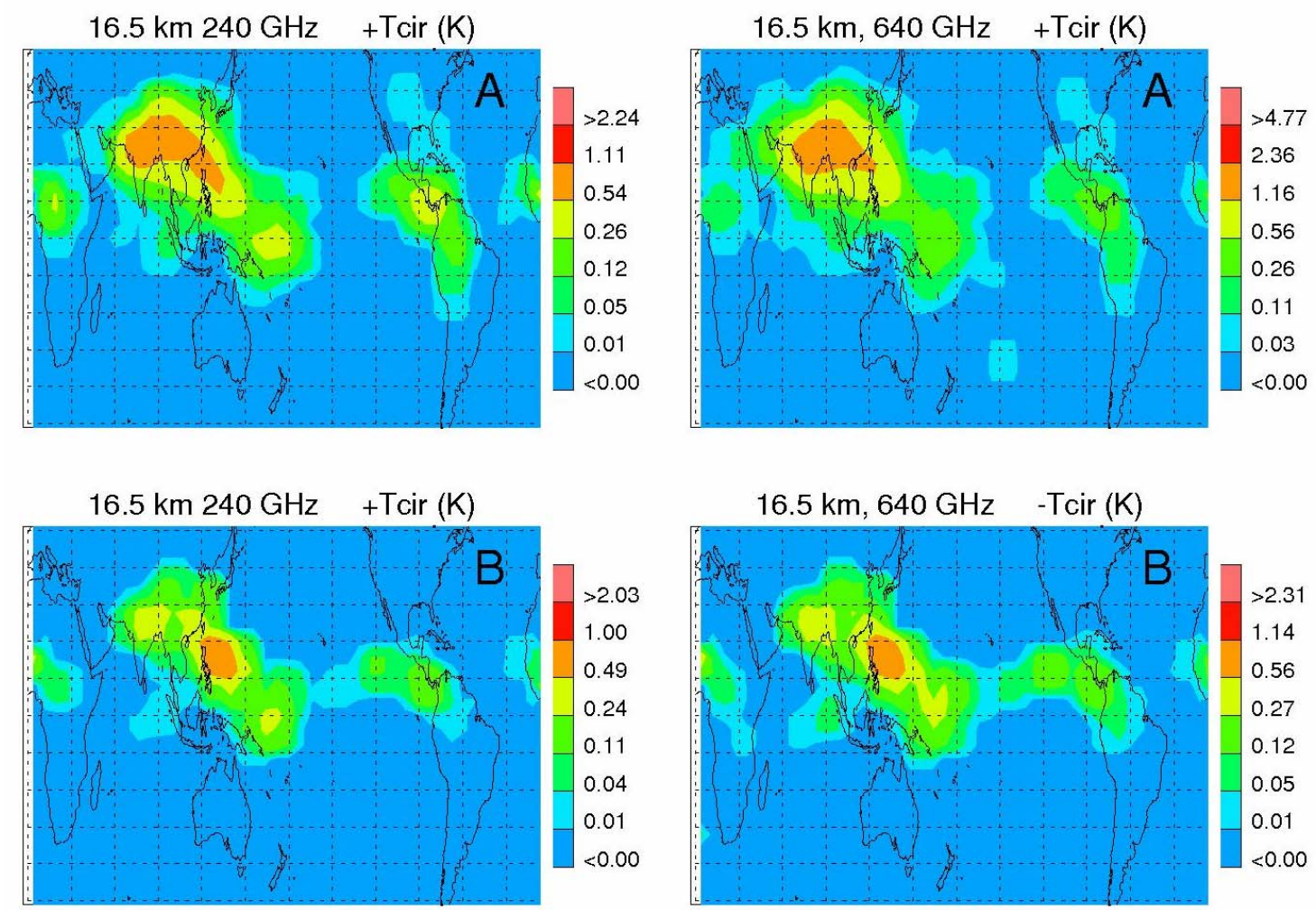
July 2006

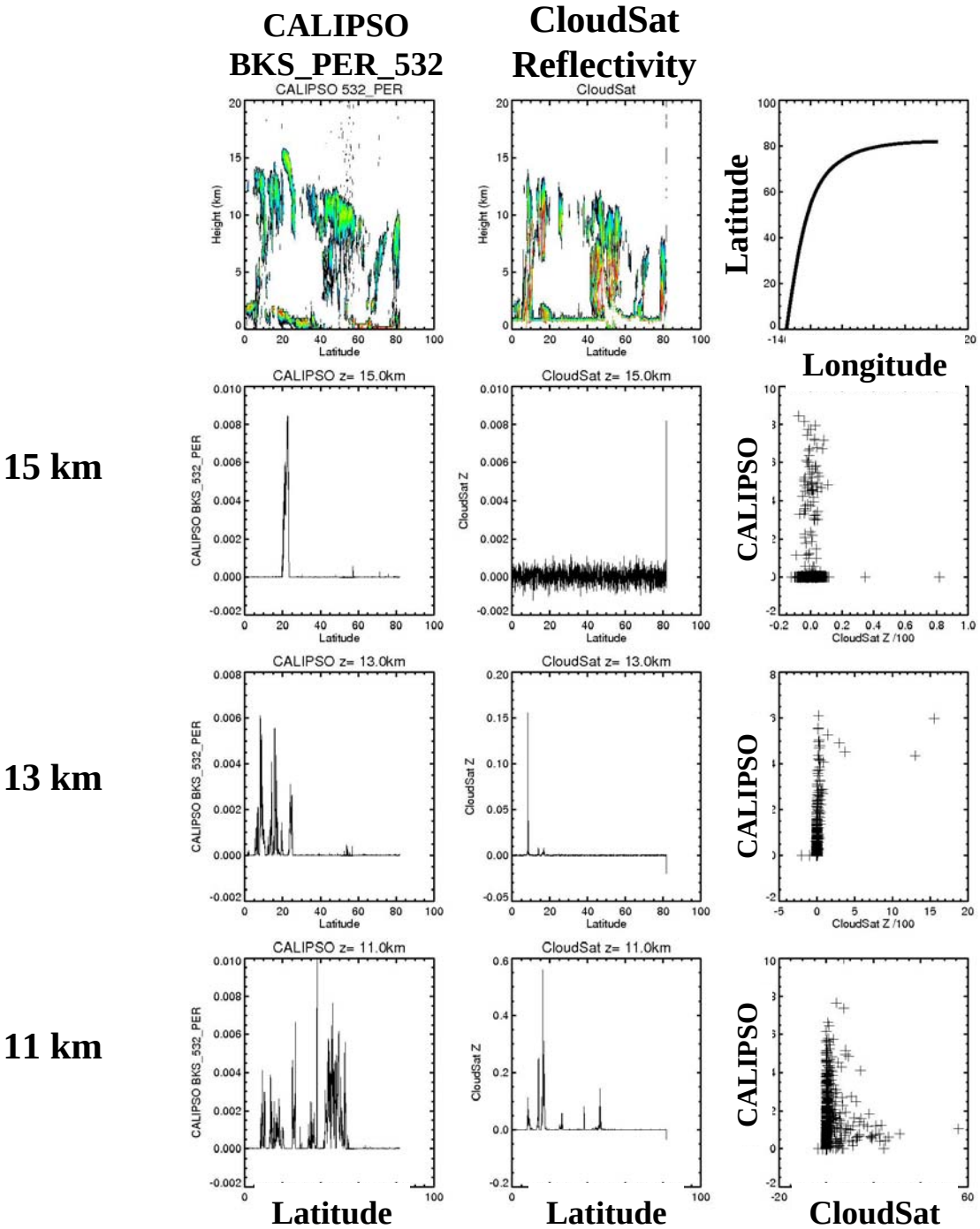



Tangent Height =16.5 km
640 GHz Tcir (K)
240 GHz Tcir (K)
20
10
0
-10
-20
-10
0
10
20
30
40
D_mm = 32 lm
A
D_mm = 47 lm
D_mm = 60 lm
B
D_mm = 73 lm

Small- and Large-D_{mm} Clouds:

from MLS 240:640 GHz Cloud-Induced Radiances (*Tcir*)



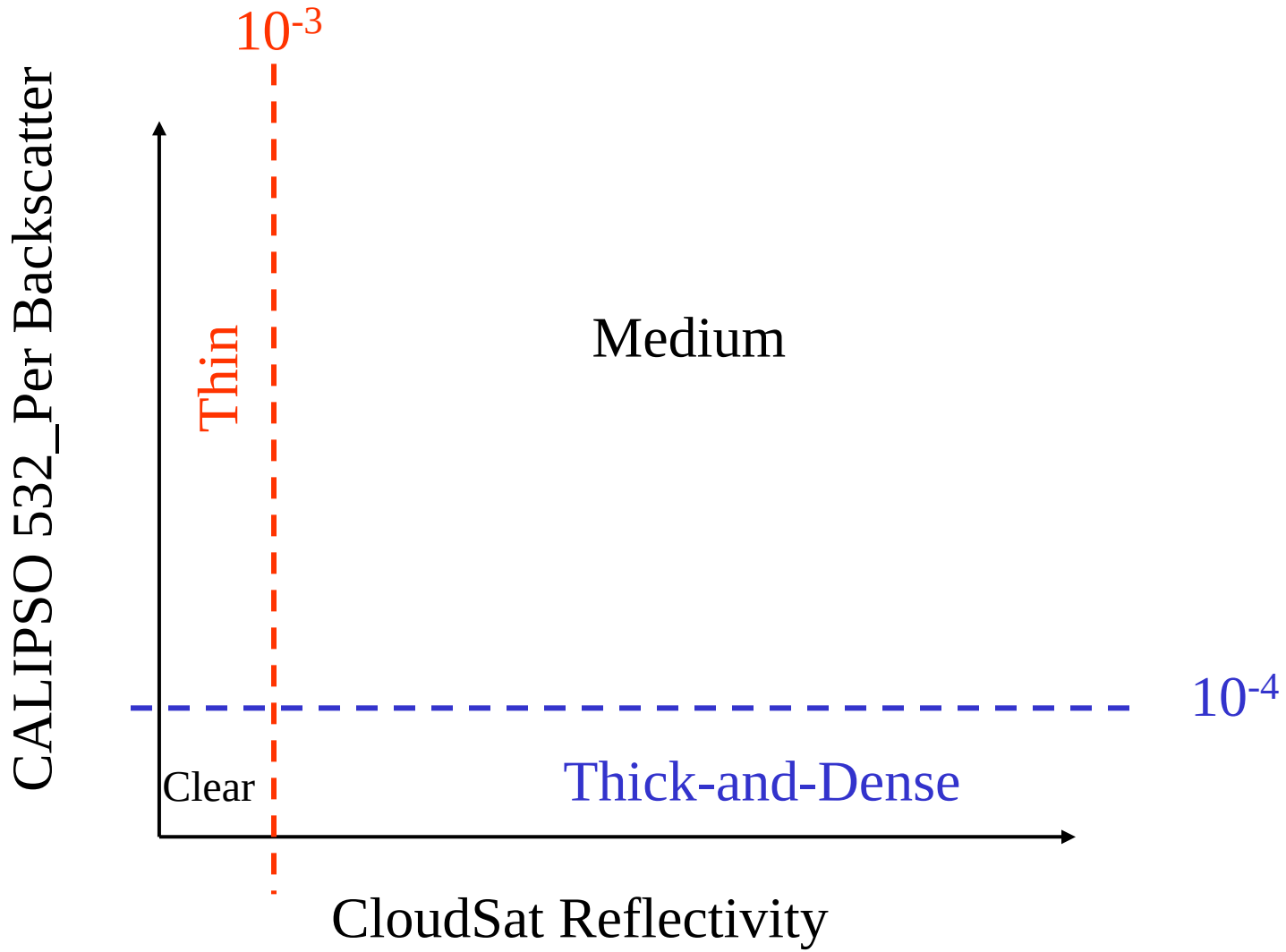


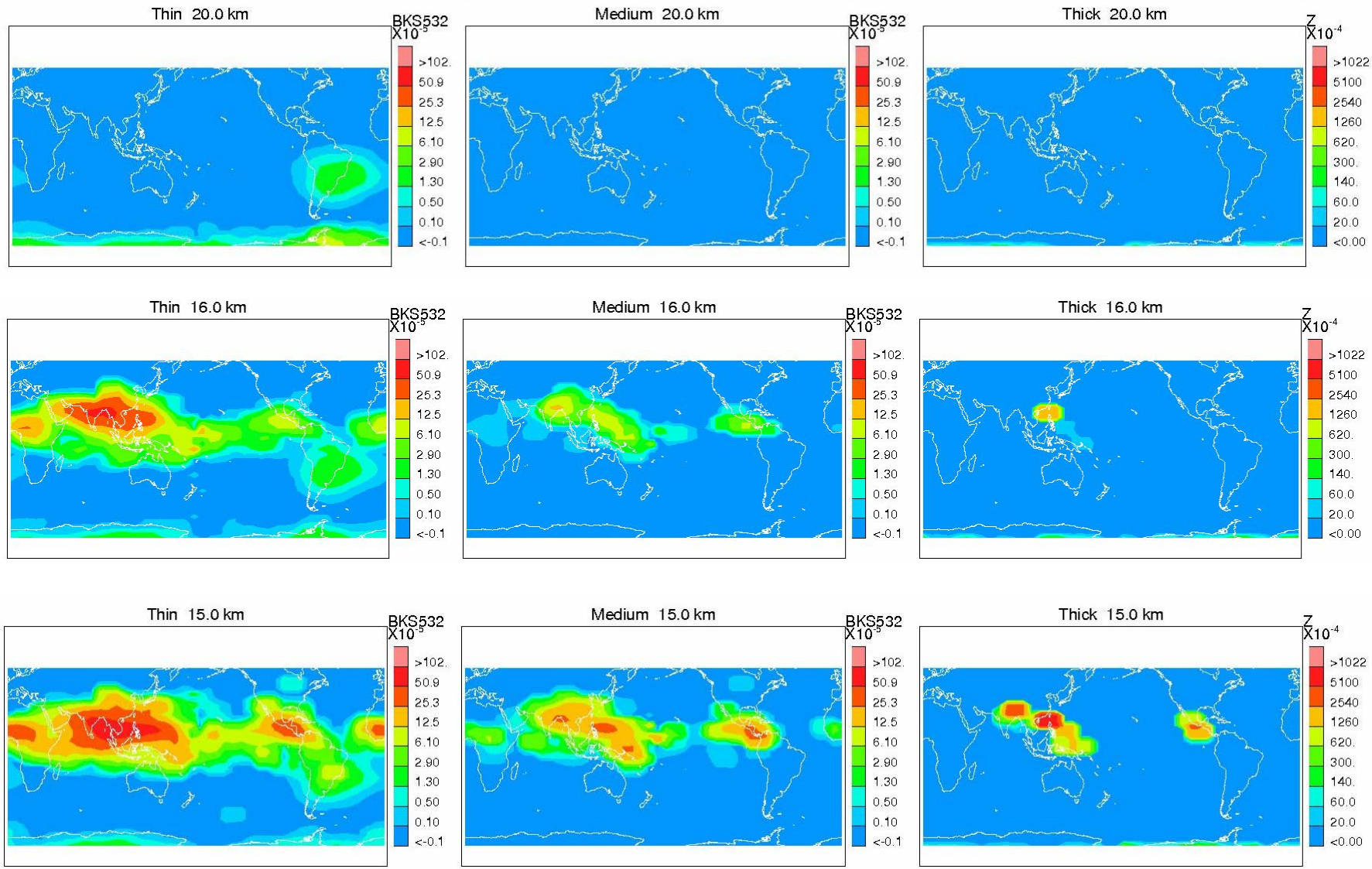
CloudSat-CALIPSO Data Selection, Averaging, and Collocation:

Nighttime data only;

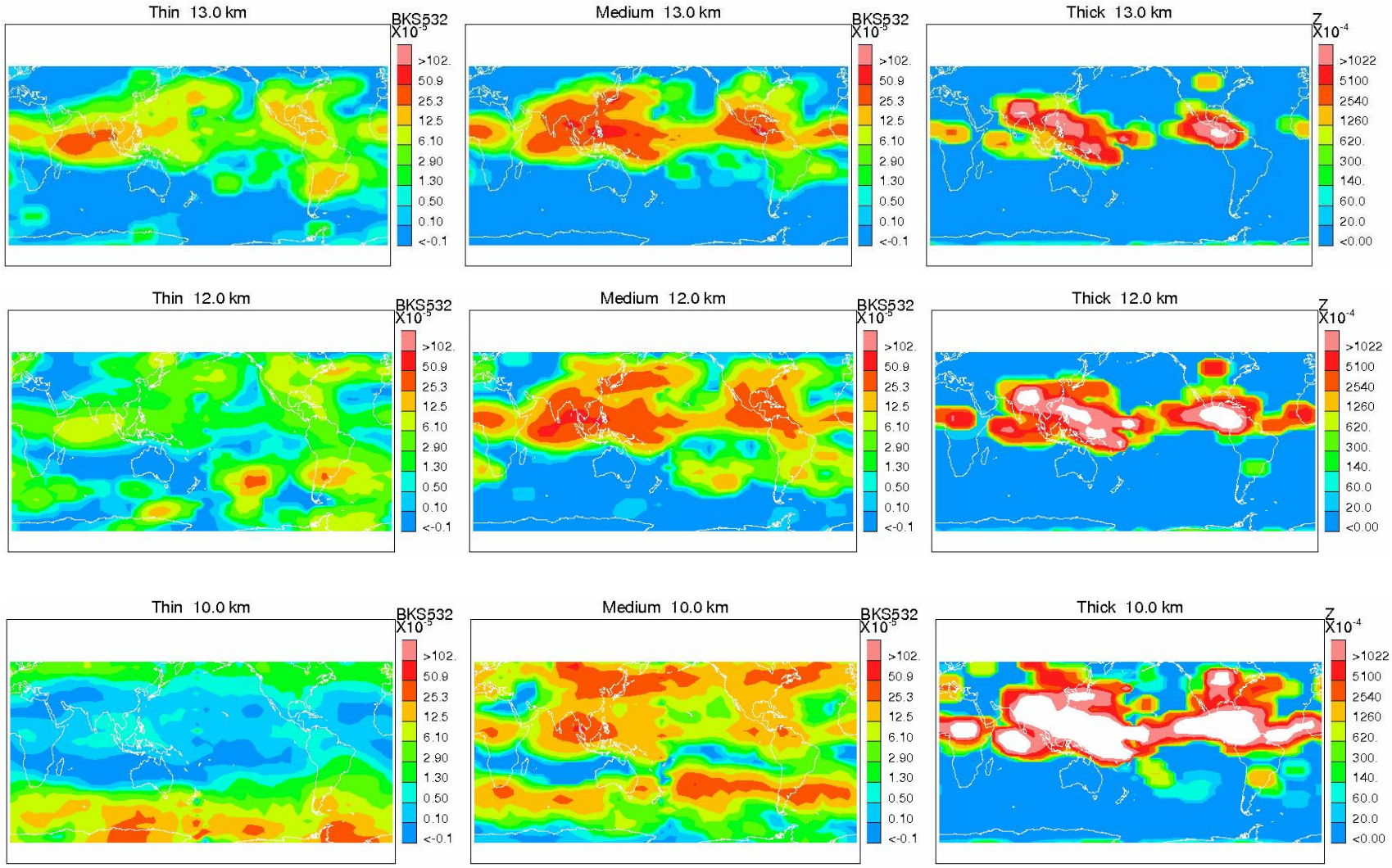
Along track:	5 km
Height:	0.25 km

Cloud Classification





“Thin Clouds” “Medium Clouds” “Thick Clouds”


Thin 13.0 km
BKS532
X10^-5
>102.
50.9
25.3
12.5
6.10
2.90
1.30
0.50
0.10
<-0.1
Medium 13.0 km
BKS532
X10^-5
>102.
50.9
25.3
12.5
6.10
2.90
1.30
0.50
0.10
<-0.1
Thick 13.0 km
Z
X10^-4
>1022
5100
2540
1260
620.
300.
140.
60.0
20.0
<0.00
Thin 12.0 km
BKS532
X10^-5
>102.
50.9
25.3
12.5
6.10
2.90
1.30
0.50
0.10
<-0.1
Medium 12.0 km
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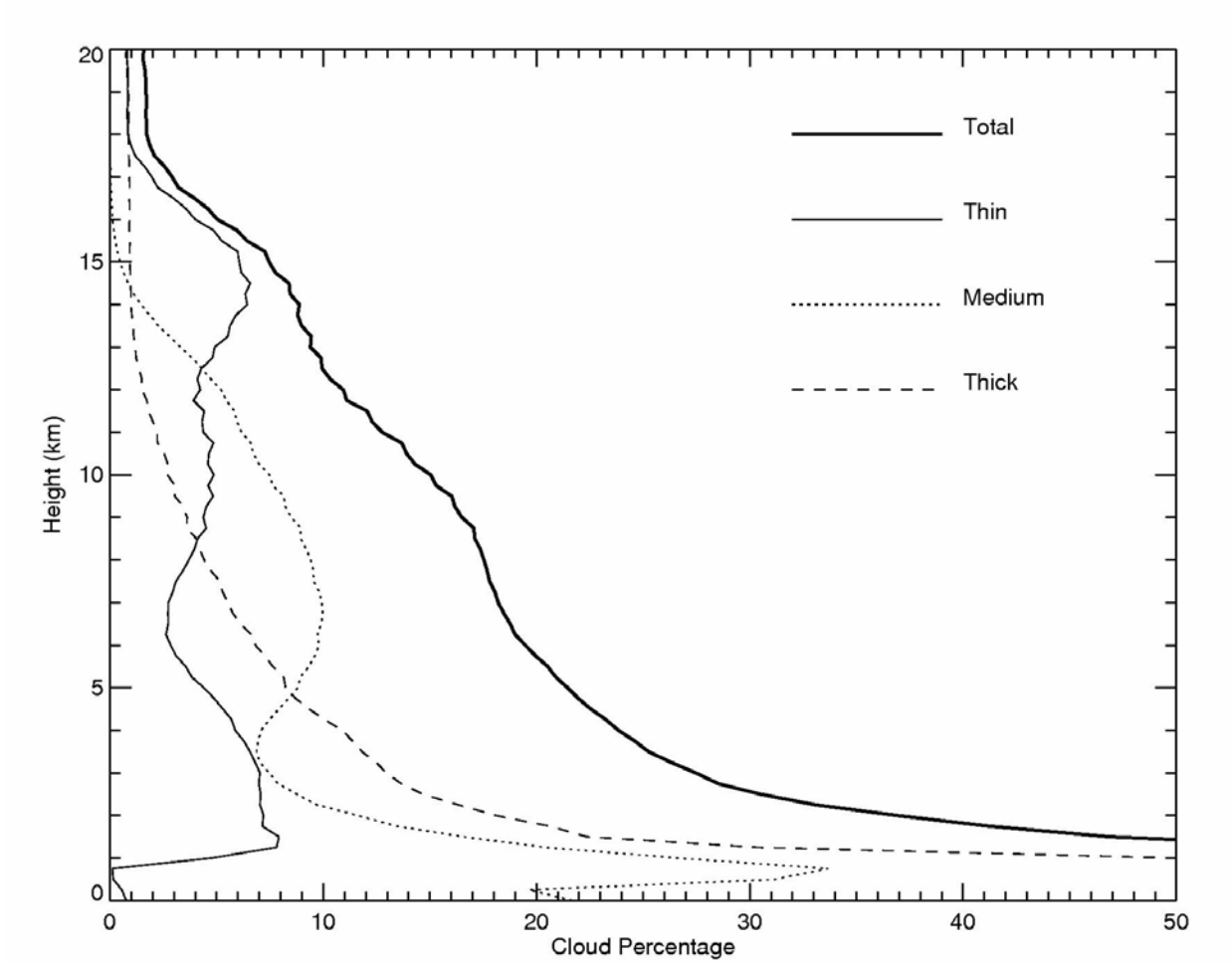
X10^-4
>1022
5100
2540
1260
620.
300.
140.
60.0
20.0
<0.00

Cloud Statistics of CloudSat and CALIPSO:

Implication to the Radar-Lidar Retrievals



Summary

- Signatures of pollution impacts on upper-tropospheric clouds in MLS, CloudSat, CALIPSO data.
- Complementary sensitivities of MLS (240:640 GHz), CloudSat and CALIPSO to upper-tropospheric clouds.
- Careful analysis required to sort out microphysical changes from dynamical changes.