

Status of CFLOS study using CALIPSO data

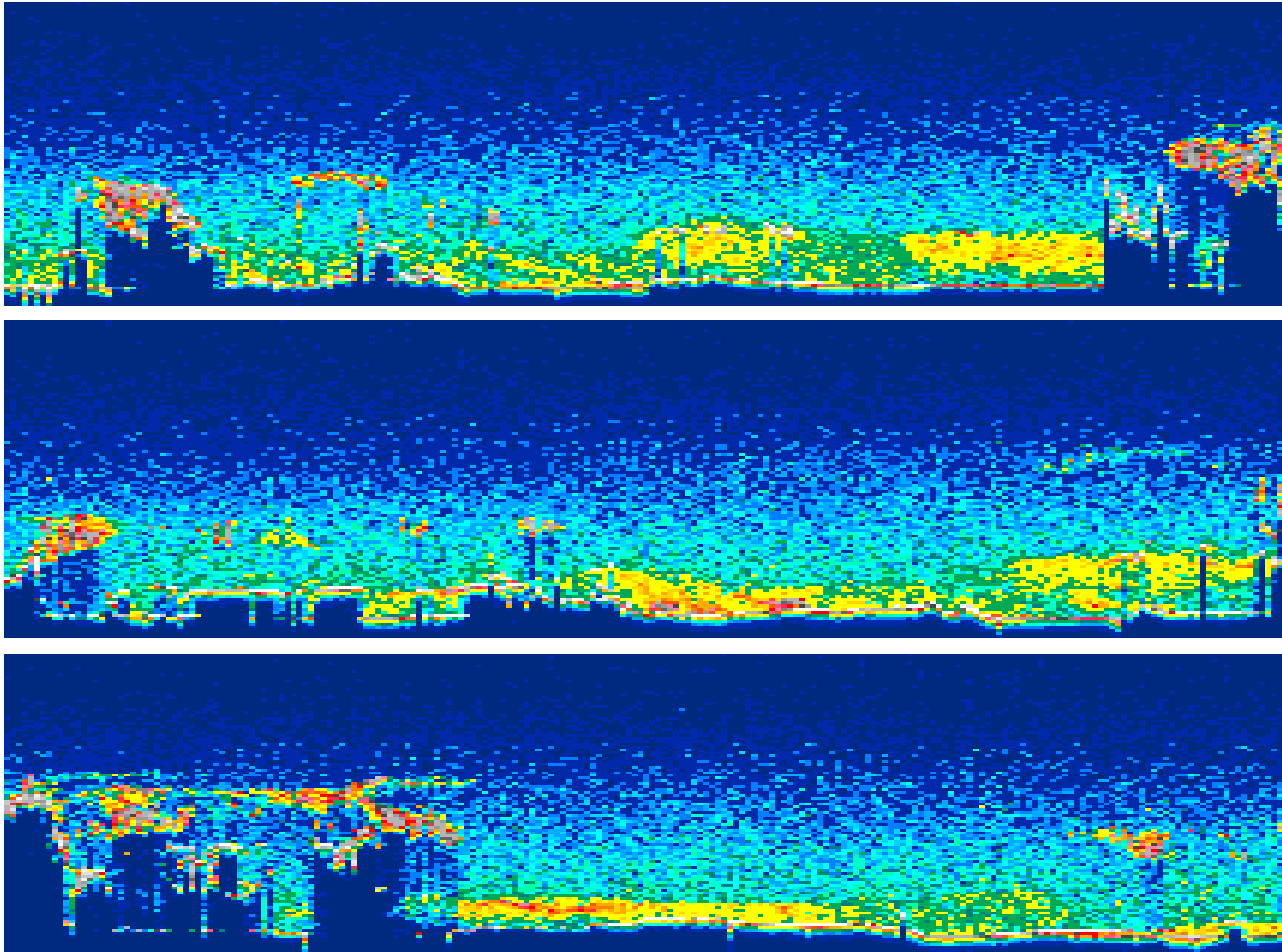
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WG SBLW

Destin, FL

January 27-30, 2009

CALIPSO



http://www-calipso.larc.nasa.gov/products/lidar/browse_images/show_calendar.php

CALIPSO/LITE ROSES07 study

The ROSES07 study is using both LITE and CALIPSO data to address the following four major issues:

- Cloud free line-of-sight (CFLOS) statistics for laser beam footprints (with particular interest in contiguous laser shot integration intervals),
- Global aerosol backscatter distributions with particular interest in their correlation with cloud and atmospheric dynamics,
- Conversion of observations at CALIPSO wavelengths to those pertinent to GWOS, the hybrid wind lidar (.355 and 2.01 microns); validation of aerosol backscatter distributions being used in NASA/NOAA OSSEs.
- Instrument trade studies relevant to the GWOS instrument concept using an existing Doppler Lidar Simulation Model

Overview

- Develop a state-of-the-art set of cloud free line-of-sight (CFLOS) statistics and atmospheric optical properties for space-based Doppler Wind Lidar (DWL) design using both LITE and CALIPSO data and use the Doppler Lidar Simulation Model (DLSM) to conduct basic trade studies that relate directly to laser design and scanning options.
- Effort is focused upon issues that are unique to the hybrid (coherent and direct detection combined) Doppler Wind Lidar being considered for the first USA mission. In particular, deriving 2 micron coherent performance from .532/1.06 μm CALIPSO data is non-trivial and is being modeled by Bowdle (UAH).
- Our revisit to the LITE data is in recognition of the fact that LITE was the most powerful backscatter lidar ever flown in space. Since the weak aerosol distributions are being investigated, the LITE data appears to be most useful.
- Simpson Weather Associates' (SWA) study of the CFLOS statistics from the ICESat GLAS (Geosciences Laser Altimeter System) data sets provides both the motivation and methodology behind this work

LITE CFLOS study

The general conclusions of the LITE data analyses of cloud porosity for lasers were that:

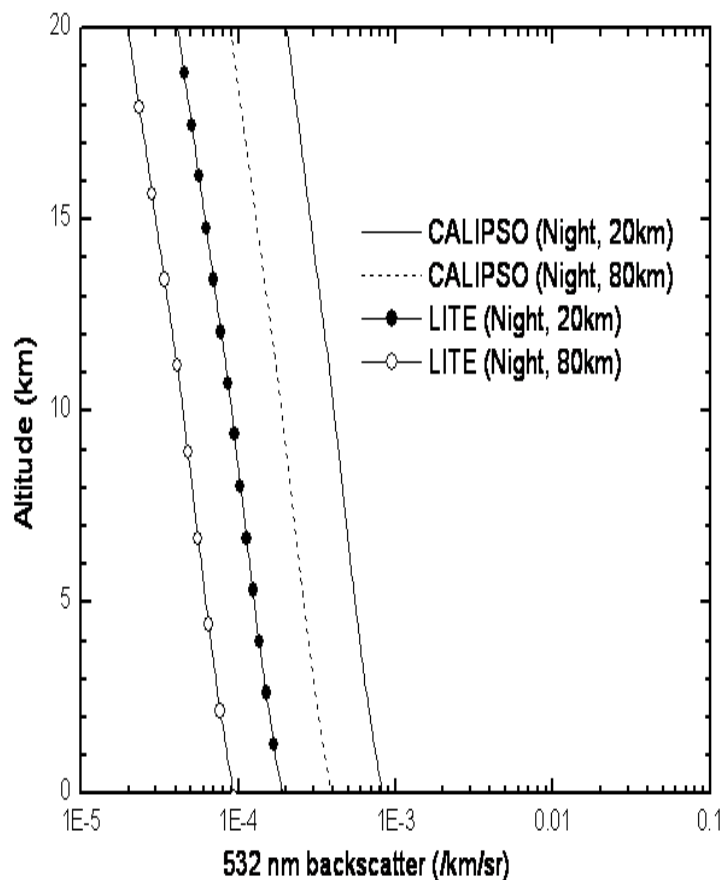
- The 532nm beam provided a ground return more often (~60 - 65%) than the current cloud climatologies based upon passive imagers suggested (~30-40%).
- More than 50% of the time that the lidar beam intercepted a cloud it also provided a ground return. In other words the porosity of the clouds to the LITE beams was on the order of 50%.

GLAS study summary

- 70 - 80% of the GLAS lidar samples involved some return from clouds (assumed that “no cloud/no ground returns” intercepted thick layers of optically thin clouds)
- 75 - 80% of the GLAS lidar samples detected the earth’s surface (adjusted for smooth water returns)
- When clouds were present, 25 – 40% of the time at least two layers were detected.
- Details on the ESTO GLAS study can be found at the following web site :
(http://esto.nasa.gov/adv_planning_studies_archive.html).

Minimum Detectable Backscatter

LITE vs. CALIPSO (532 nm, night, averaging to 20 km, 80 km)



At night, LITE 532 nm is more sensitive than CALIPSO 532 nm. Due to larger LITE FOV and filter passband, daytime performance is similar.

CALIPSO 1064 detector is better than LITE 1064 detector, so advantage of LITE is less than at 532 nm.



WHAT IS OBTAINED From CALIOP/CALIPSO

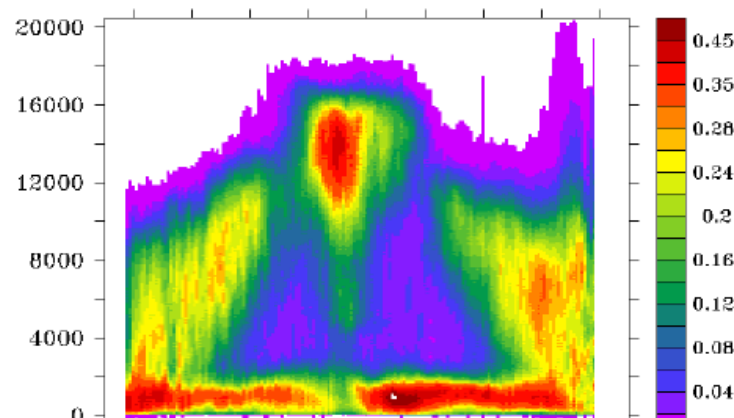
October 2006



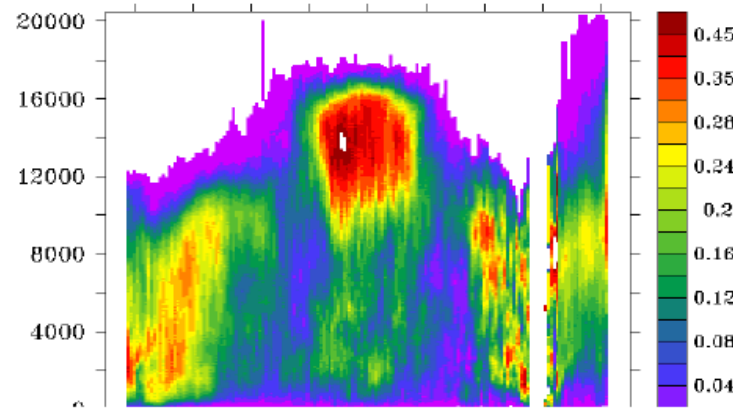
Centre National d'Etudes Spatiales

Night

Ocean

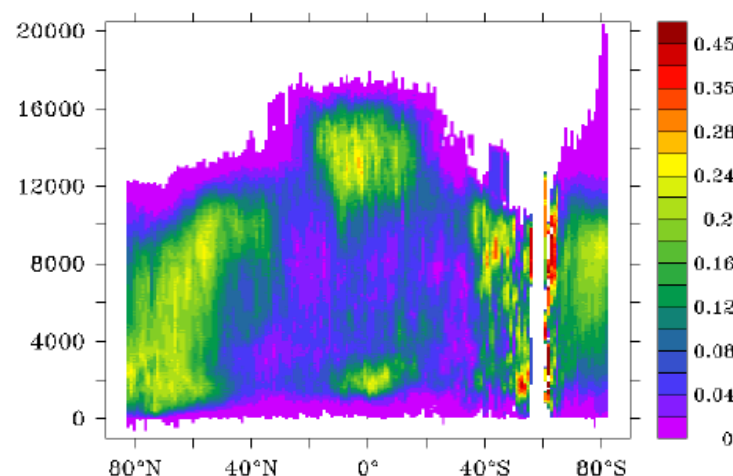
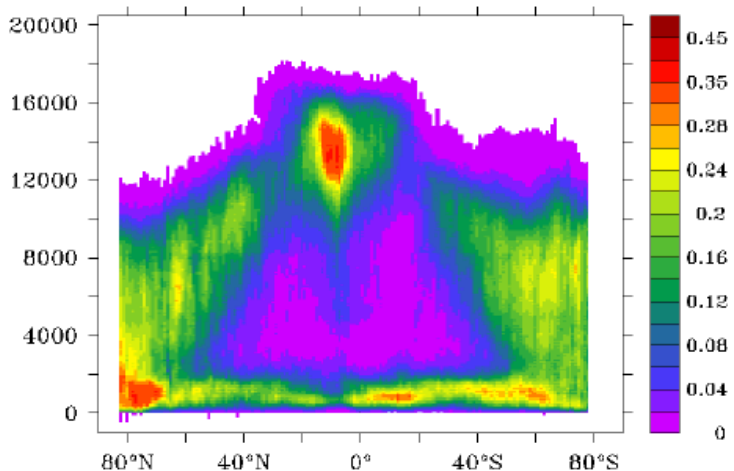


Land



Day

Calipso data v1.10



Earthcare workshop, ESTEC, 8 May 2007

Seze, Pelon, Flamant, Vaughn, Trepte and Winker



Night and day cloud cover

GLAS 50 days during the 2003 fall,
CALIOP August and October 2006



SCIENCE INFORMATION SYSTEMS

	Night				Day		
	GLAS	CALIPSO			GLAS	CALIPSO	
	2003	Oct	Aug		2003	Oct	Aug
Total cloud cover	78%	79%	76%		65%	75%	78%
high cloud	21%	23%	29%		20%	23%	20%
middle cloud	19%	12%	11%		23%	13%	15%
high + middle	10%	11%	13%		8%	12%	11%
low cloud	30%	34%	29%		37%	35%	36%
low cloud with other	20%	20%	18%		11%	17%	18%

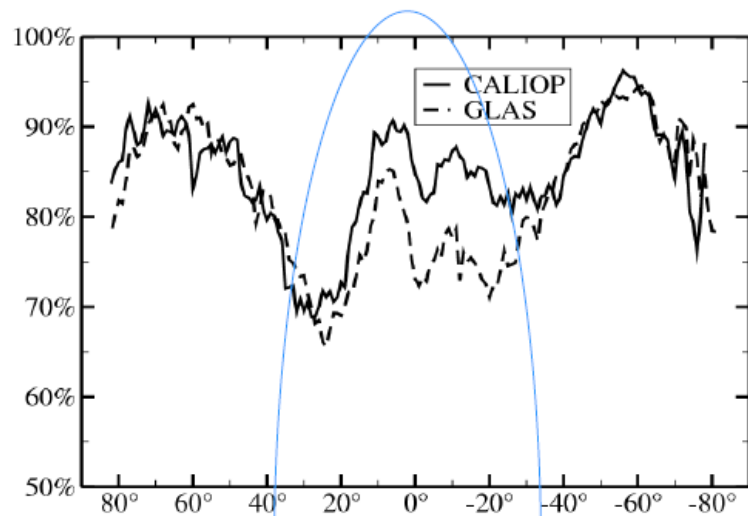
Low < 700 hPa

Middle : 700-400

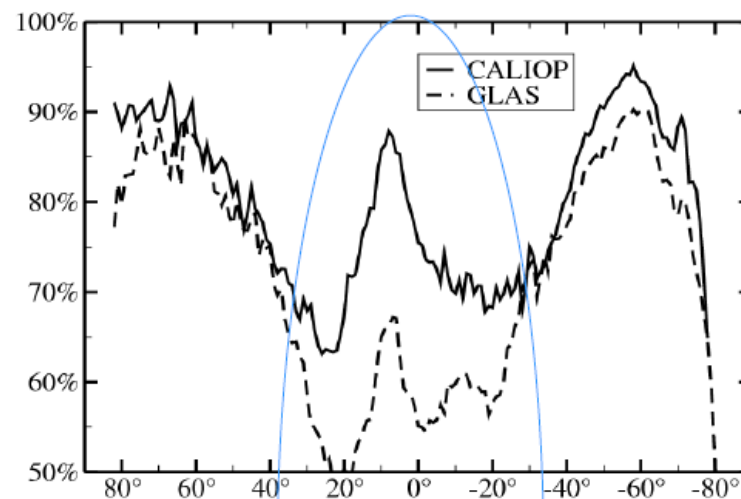
hPa

High > 400 hPa

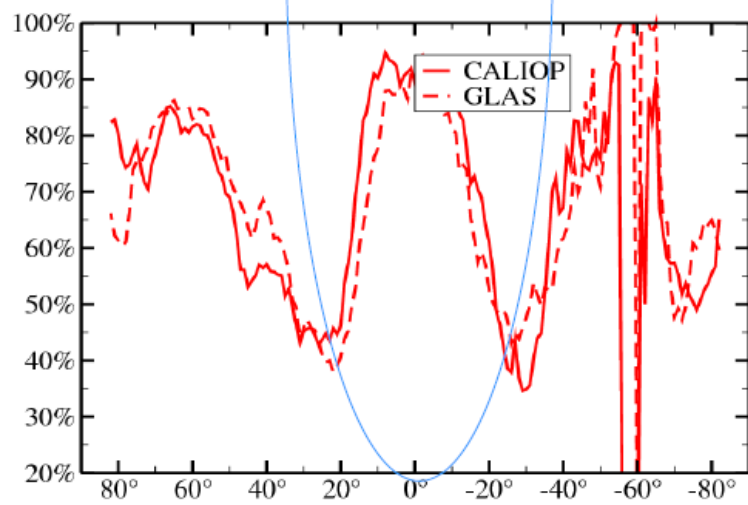
Night



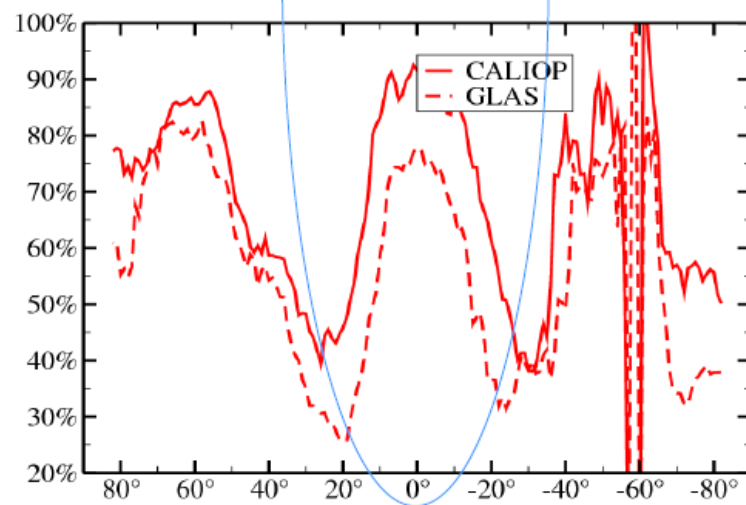
Ocean



Day



Land



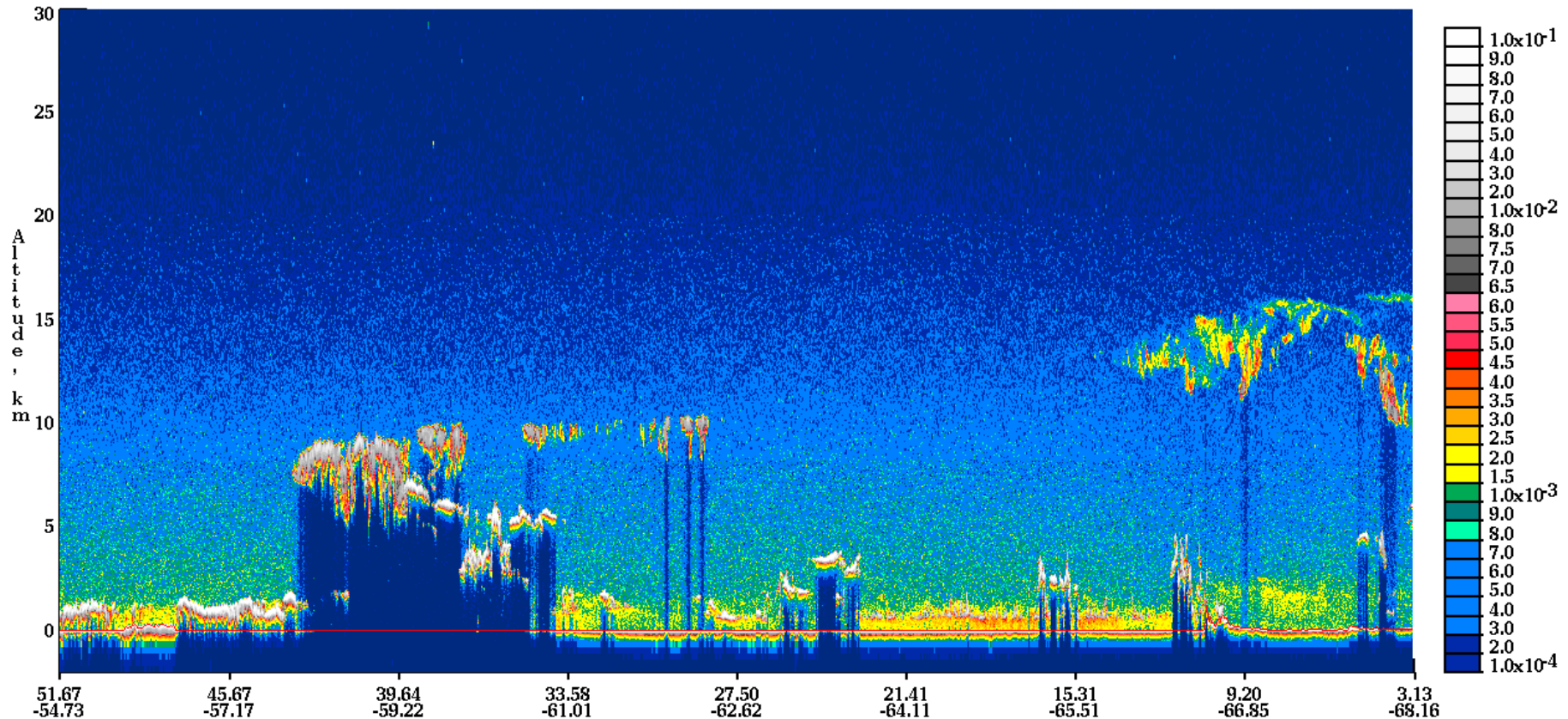
GLAS october 2003 – CALIOP october 2006

Earthcare Workshop, ESTEC, 8 May 2007

532 nm Total Attenuated Backscatter

532 nm Total Attenuated Backscatter, /km /sr Begin UTC: 2009-01-25 06:09:07.9051 End UTC: 2009-01-25 06:22:36.6022

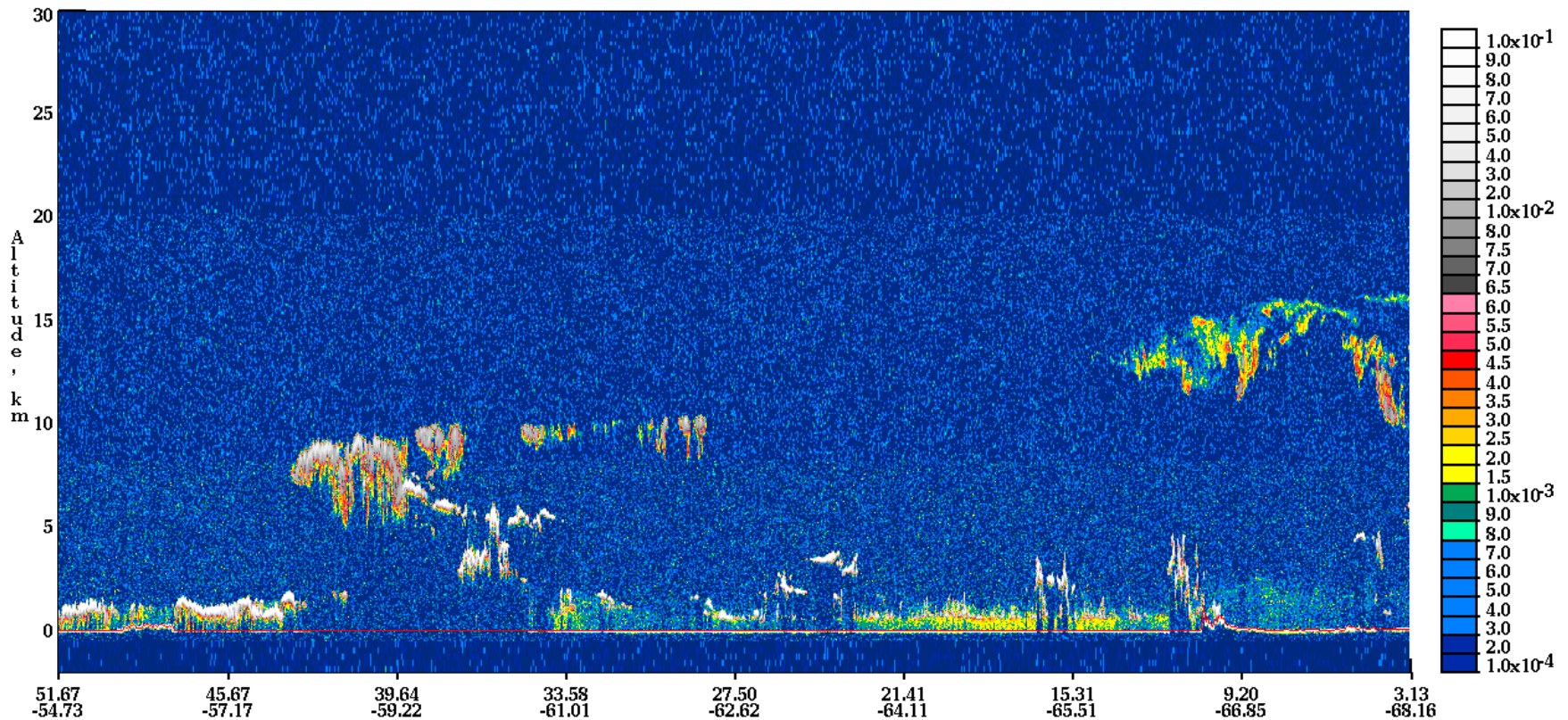
Version: 2.02 Nominal Image Date: 01/28/2009



1064 nm Attenuated Backscatter

1064 nm Attenuated Backscatter, /km /sr Begin UTC: 2009-01-25 06:09:07.9051 End UTC: 2009-01-25 06:22:36.6022

Version: 2.02 Nominal Image Date: 01/28/2009



Vertical Feature Mask

Vertical Feature Mask Begin UTC: 2009-01-25 06:09:07.9052 End UTC: 2009-01-25 06:22:36.6022

Version: 2.02 Nominal Image Date: 01/28/2009

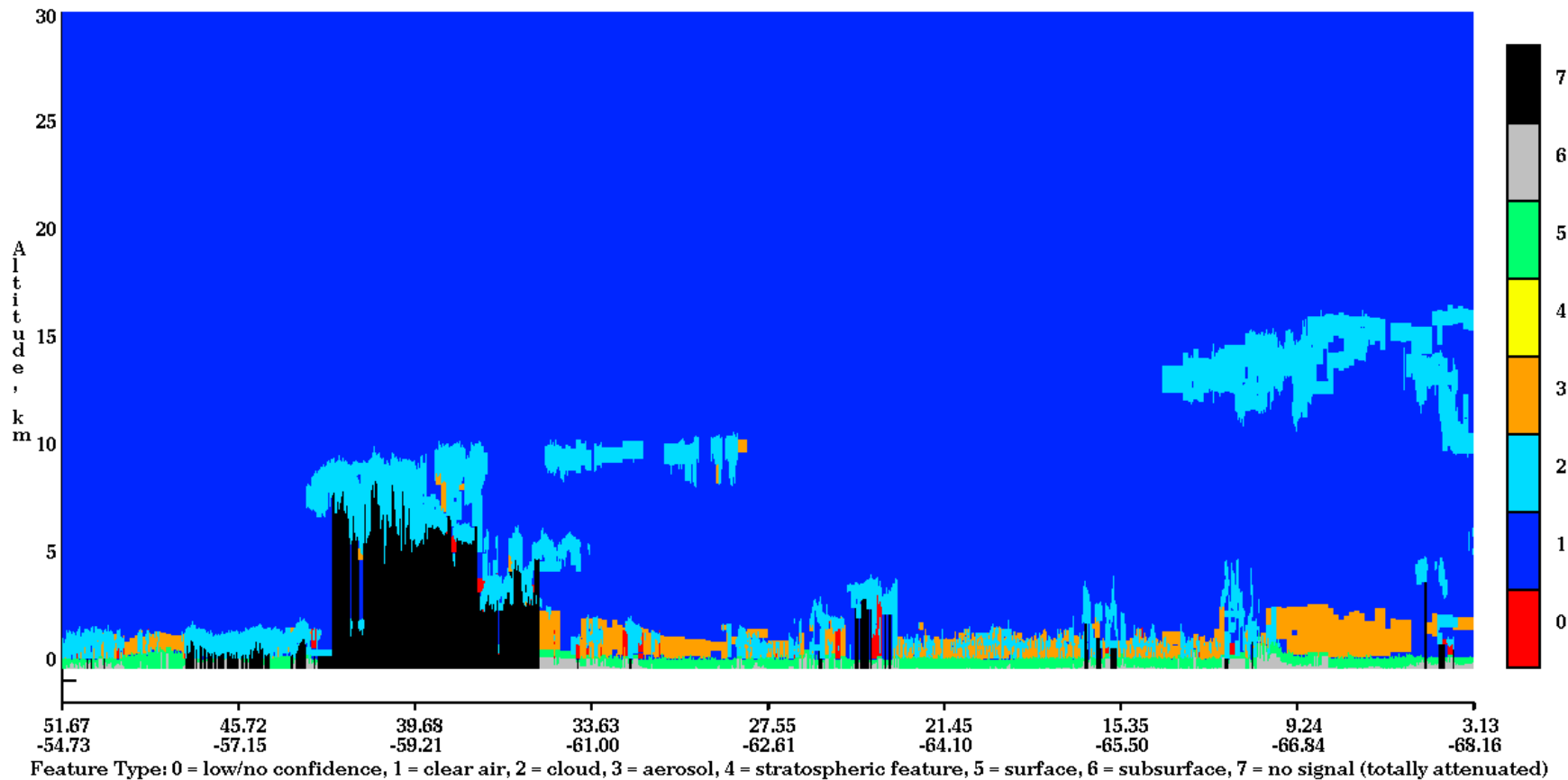


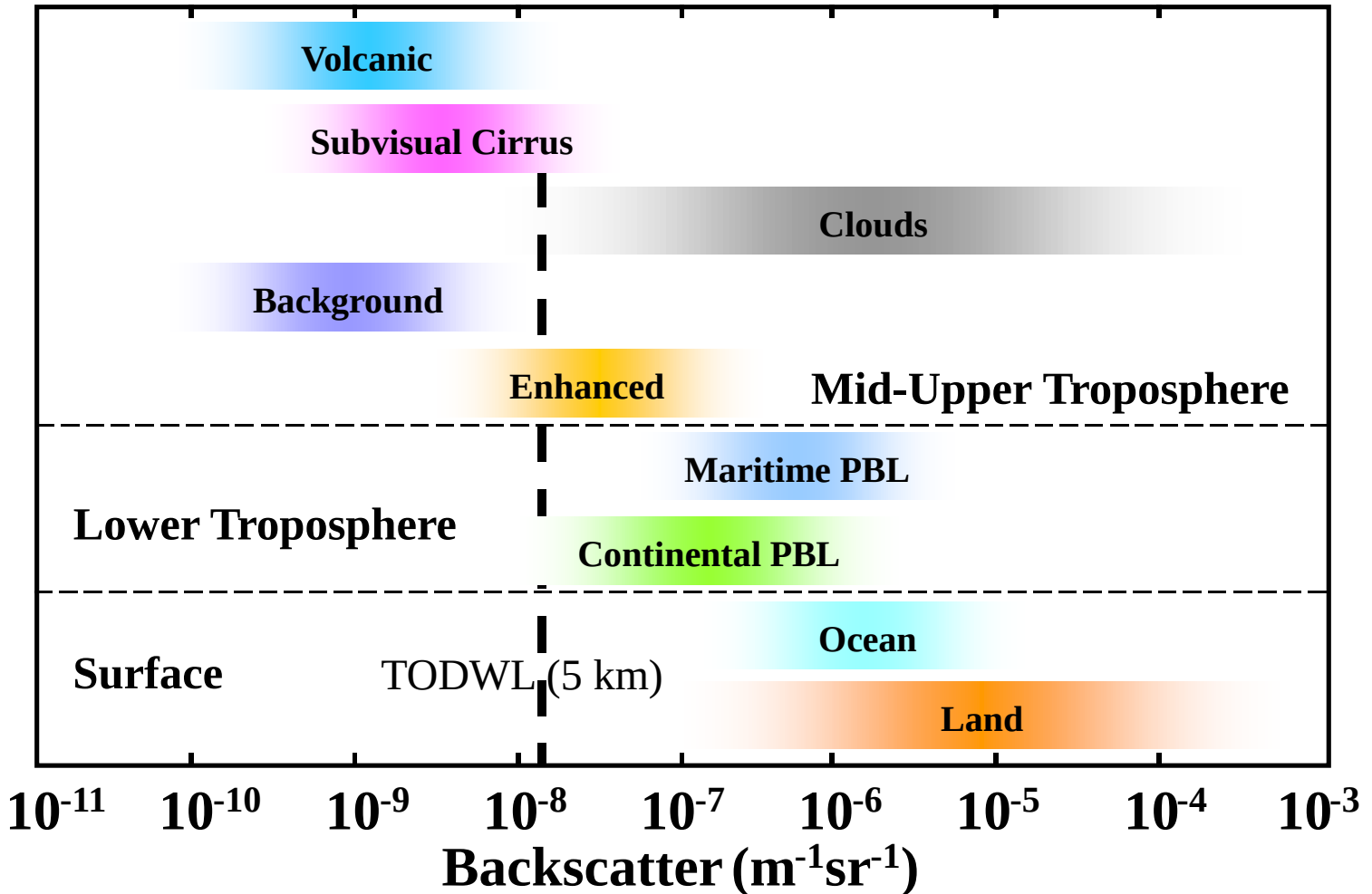
Table 1: CALIPSO 1 KM STATS

Percentage	0811_235056ZN	0812_003726ZD	0812_012946ZN	0812_021621ZD
% Clouds	58.6	79.9	69.9	74.2
% No Clouds	41.4	20.1	30.1	25.8
% Ground	67.4	39.5	52.5	43.2
% No Ground	32.6	60.5	47.5	56.8
% 0 cloud Layers	41.4	20.1	30.1	25.8
% 1 Cloud Layer	43.4	50.6	54.1	51.6
%2 cloud layers	12.4	22.8	13.5	17.6
% >2 cloud layers	2.8	6.4	2.2	4.9
% cloud_ground (total)	26.7	20.8	23.6	20.7
% cloud_noground (total)	31.9	59.1	46.3	53.52
% cloud_ground (cloud)	45.6	26.0	33.7	27.8
% cloud_noground (cloud)	54.4	74.0	66.3	72.2
%NOcloud_ground (total)	40.6	18.7	29.0	22.5
%NOcloud_ Noground (total)	0.7	1.4	1.1	3.3
%NOcloud_ground (nocloud)	98.2	93.3	96.3	87.1
%Nocloud_ NOground	1.8	6.7	3.7	12.9

Table 2: CALIPSO 5 KM STATS

Percentage	0811_235056ZN	0812_003726ZD	0812_012946ZN	0812_021621ZD
% Clouds	67.6	89.2	80.4	86.1
% No Clouds	32.4	10.8	19.6	13.9
% Ground	69.5	42.9	56.8	46.8
% No Ground	30.5	57.1	43.2	53.1
% 0 cloud Layers	32.4	10.8	19.6	13.9
% 1 Cloud Layer	32.3	27.4	38.6	34.8
%2 cloud layers	13.7	23.4	20.5	21.4
% >2 cloud layers	21.6	38.5	21.3	29.9
% cloud_ground (total)	37.5	32.7	38.0	34.6
% cloud_noground (total)	30.1	56.5	42.4	51.4
% cloud_ground (cloud)	55.4	36.6	47.4	40.2
% cloud_noground (cloud)	44.6	63.4	52.7	59.8
%NOcloud_ground (total)	32.0	10.3	18.9	12.2
%NOcloud_Noground (total)	0.4	0.5	0.8	1.7
%NOcloud_ground (nocloud)	98.8	95.2	96.1	87.9
%Nocloud_NOground (nocloud)	1.2	4.9	3.9	12.1

Natural Variability of 2 μm Backscatter



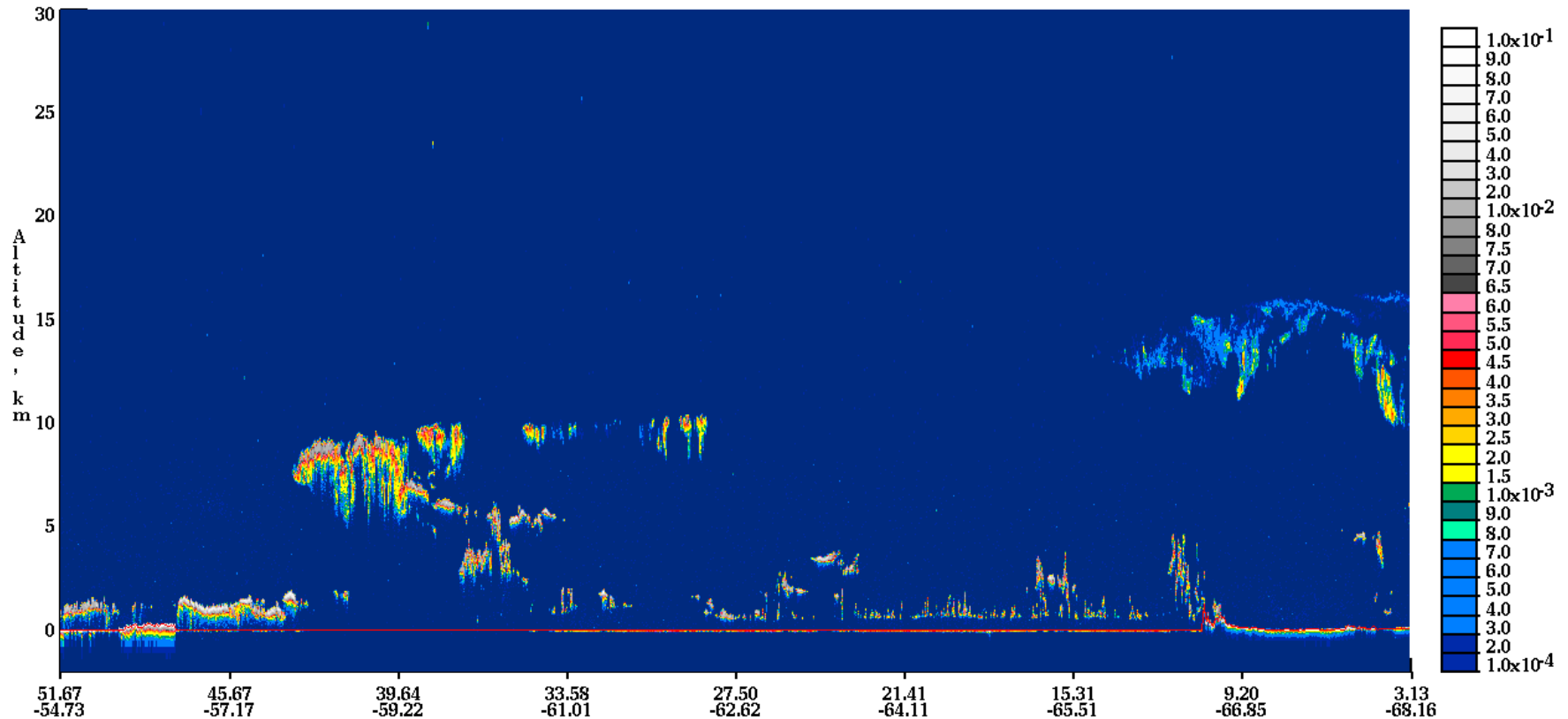
Summary

- Basic cloud coverage and CFLOS statistics completed except for 333m product
- Currently examining CALIPSO overpasses of TPARC/TCS08 cases where P3DWL was scanning both up and down.
- Backscatter portion of study is in progress. Exploring ways to determine distribution of “background” vs “enhanced” aerosol regions.

532 nm Perpendicular Attenuated backscatter

532 nm Perpendicular Attenuated Backscatter /km /sr Begin UTC: 2009-01-25 06:09:07.9051 End UTC: 2009-01-25 06:22:36.6022

Version: 2.02 Nominal Image Date: 01/28/2009



Depolarization Ratio

Depolarization Ratio Begin UTC: 2009-01-25 06:09:07.9051 End UTC: 2009-01-25 06:22:36.6022

Version: 2.02 Nominal Image Date: 01/28/2009

