CALIOP Level 2 Version 3 Algorithm and Data Product Updates

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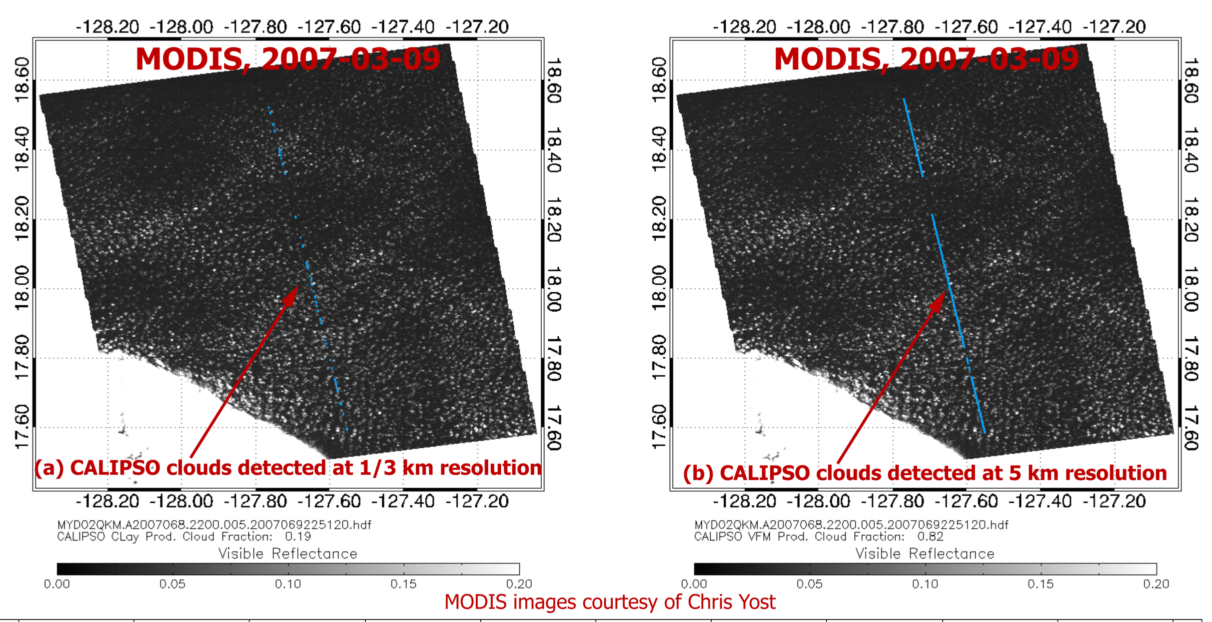
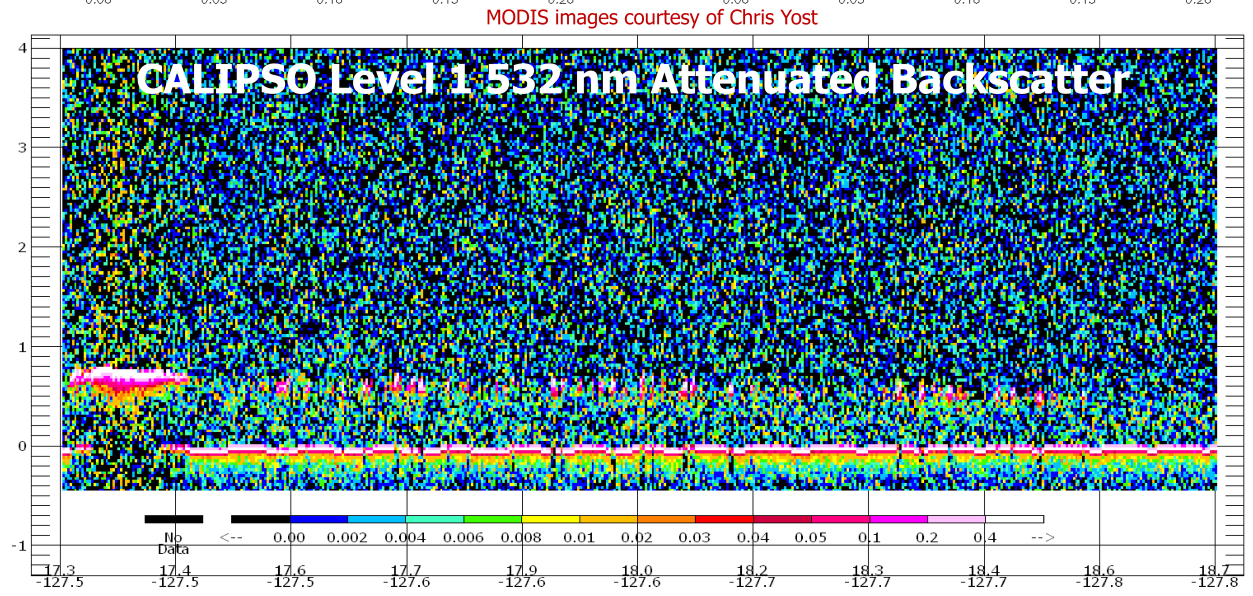
Bug  Fixes

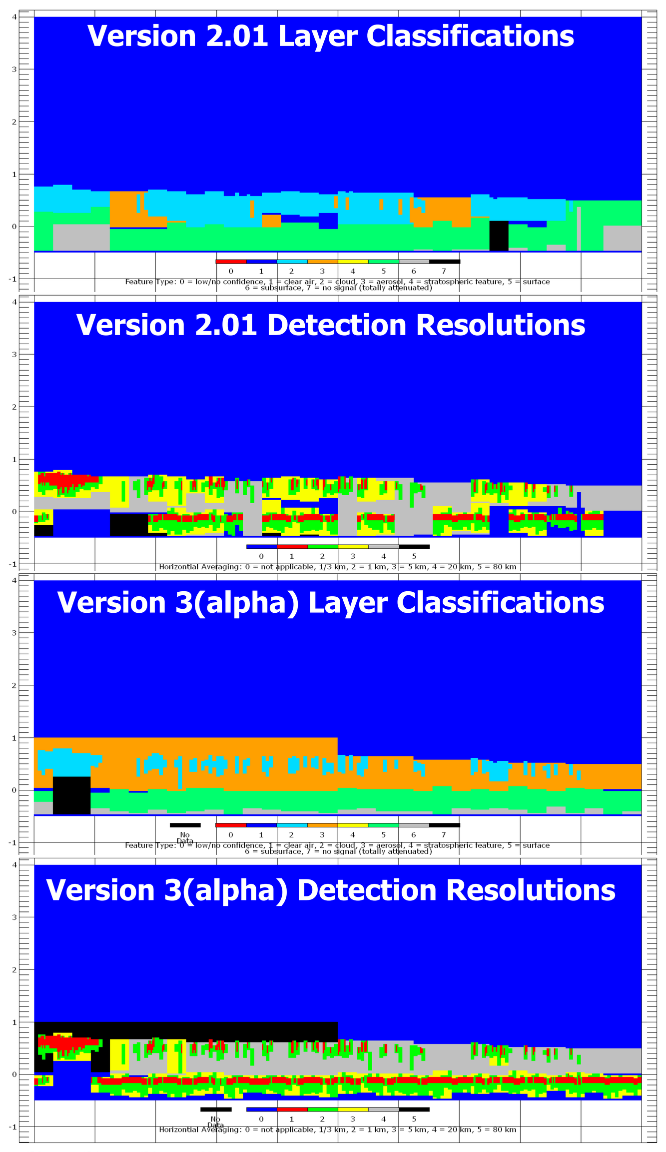


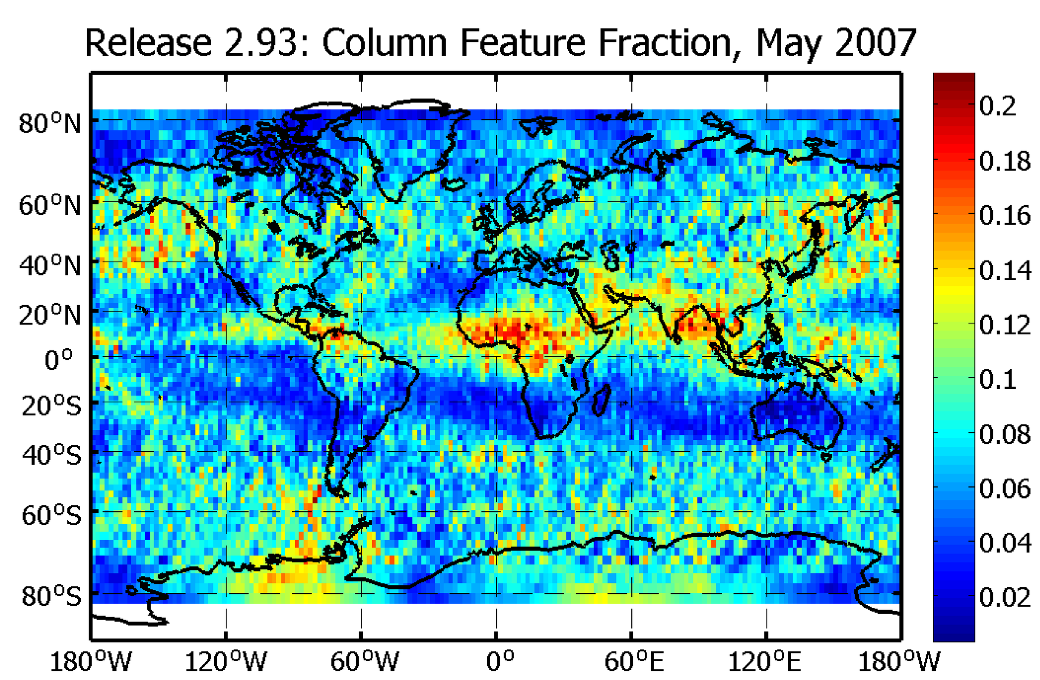


Serious Cloud-Clearing Bug Identified and Eliminated

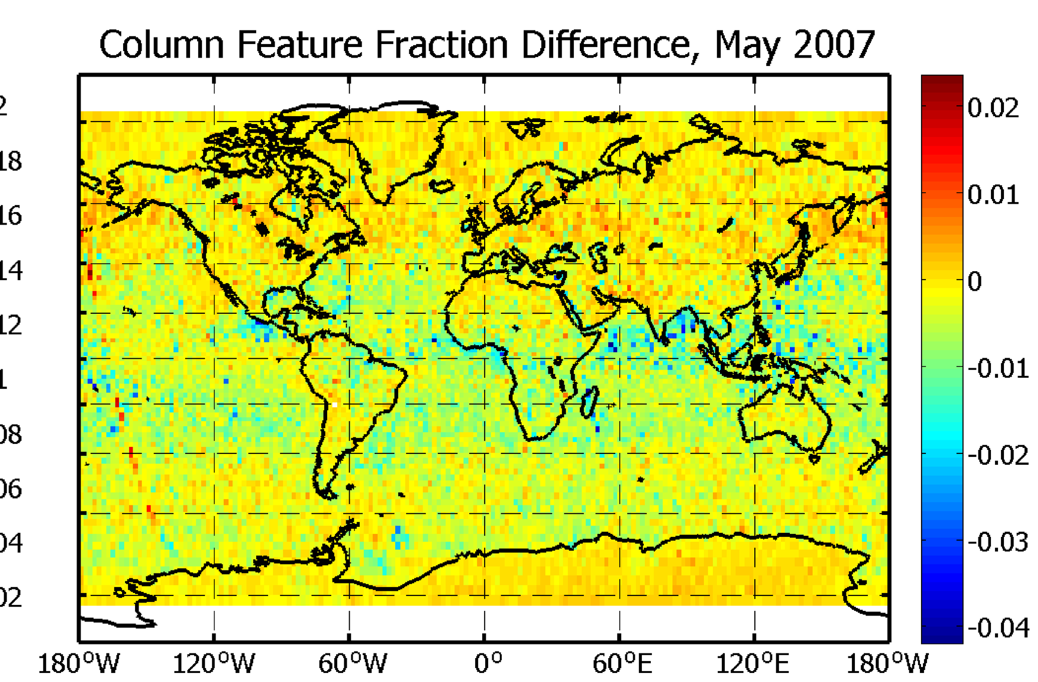
The MODIS images to the left are overlaid with CALIPSO cloud identifications (a) detected at single shot (1/3-km) resolution only, and (b) reported in the vertical feature mask (i.e., detected at all resolutions). CALIPSO's 1/3-km detection results are entirely consistent with the MODIS image. However, layers detected at coarser resolutions (1-km and above) are frequently misclassified as cloud. This situation is illustrated in the upper two panels to the right, which show the layer classifications and layer detection resolutions reported in the CALIPSO version 2.01 data products. Compared with the CALIPSO Level 1 image, shown at the lower left, the layer detection appears almost acceptable; however, the layer classification is rife with errors. This was determined to be strictly a coding error, and not related to algorithm design. The errors were traced to the cloud-clearing module, which, after removing high resolution clouds, failed to properly reaverage all relevant quantities used by the cloud-aerosol discrimination routines. The results obtained from the repaired code are shown to the right in the bottom two panels.

Many thanks to Chris Yost and members of the CERES team for bringing this ugly rascal to our attention.

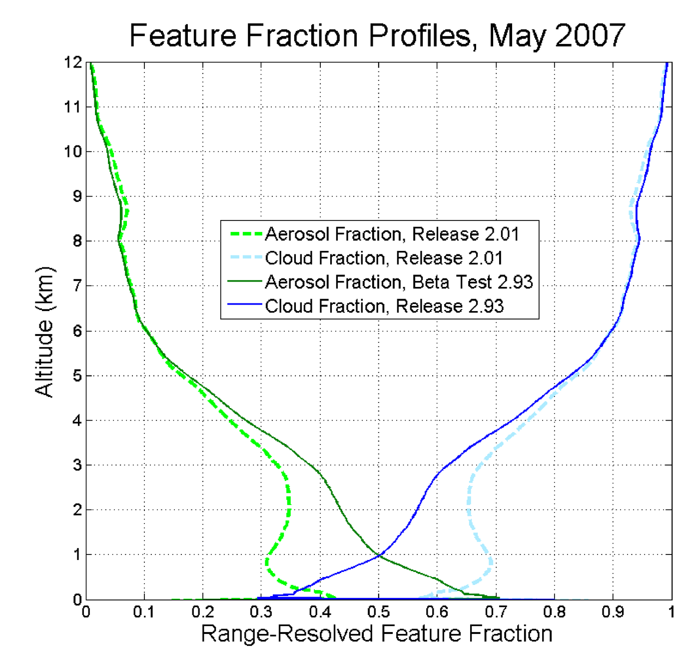




The plot above shows the version 3 'column feature fraction' detected for all data acquired during May 2007. Column feature fraction is simply the sum of the geometric thicknesses of all features (i.e., clouds, aerosols, and/or stratospheric layers) detected within a column, divided by the distance between 30-km (where the feature finder first begins scanning) and the local DEM surface elevation.

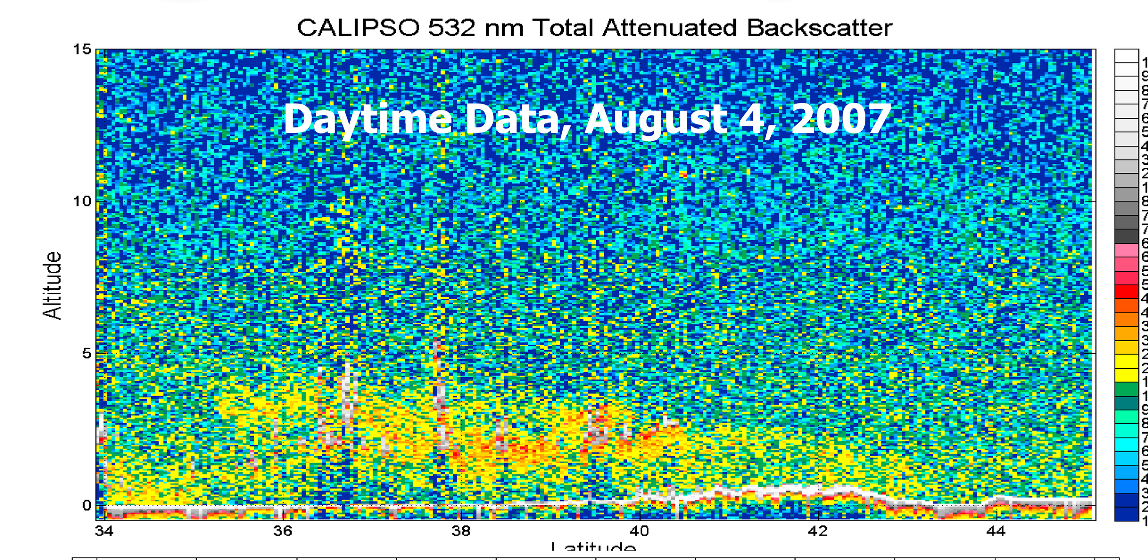


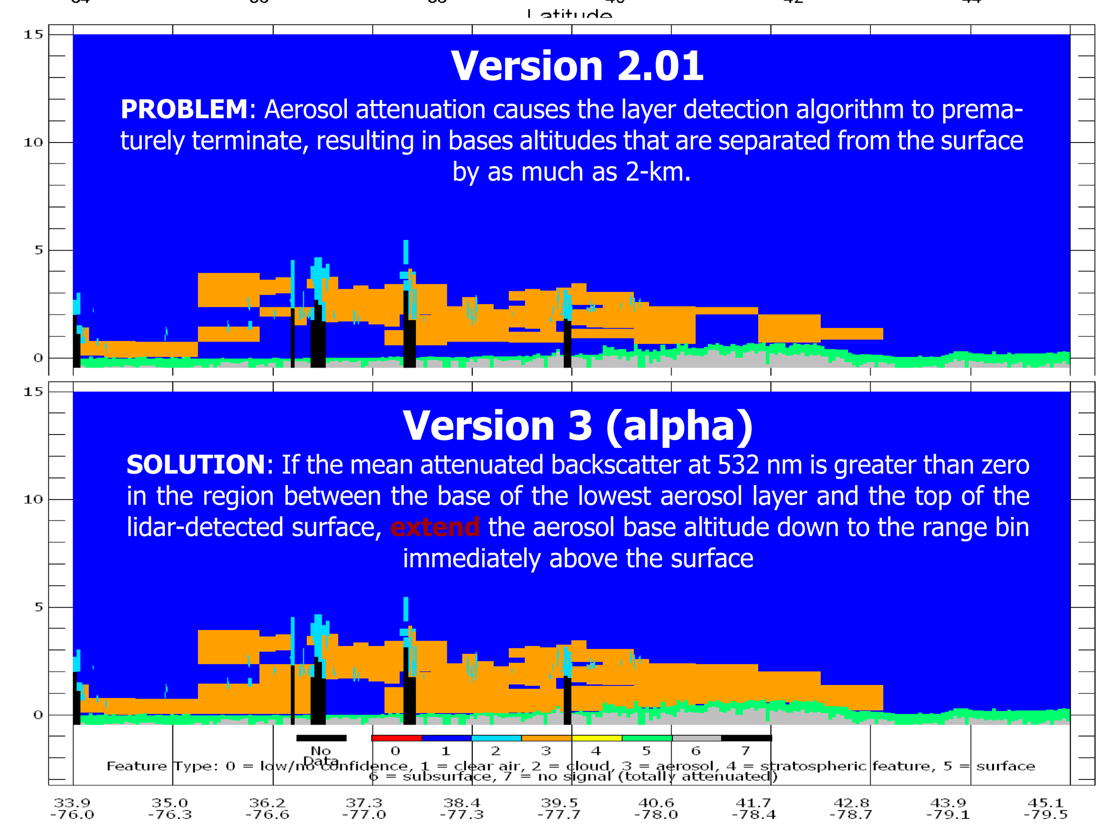
Here we see the difference in column feature fraction between version 3 and version 2. In general, there is little difference. However, the version 2 results were plagued with two bugs: an intermittent failure to correctly identify opaque layers, and the occasional erroneous reporting of 'phantom layers' beneath genuinely opaque layers. The combination led to overestimates of column feature fraction in multi-layer scenes. This effect is noticeable in throughout the ITCZ, where the detection of multiple layers is commonplace.



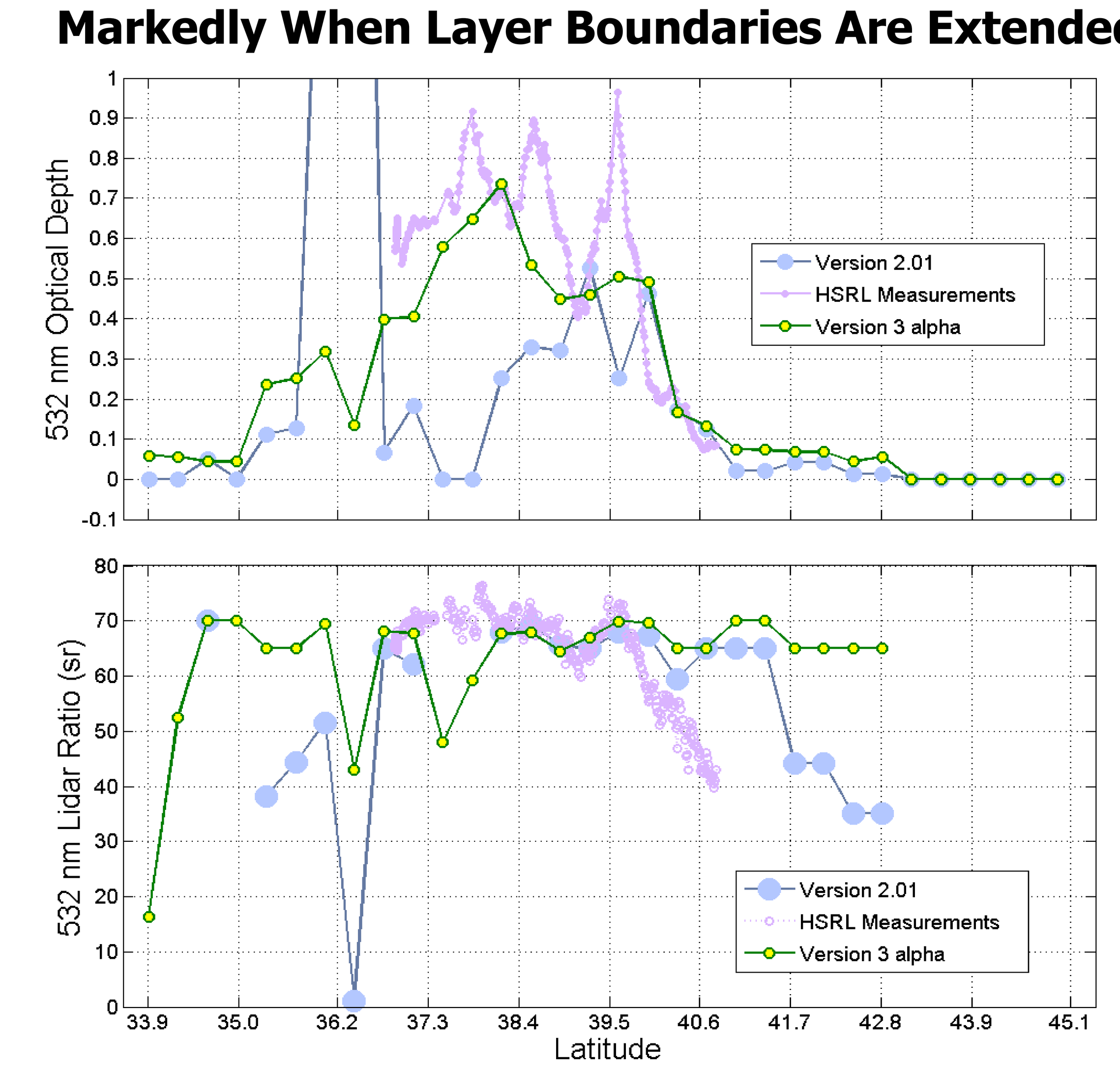
The net effect of the cloud-clearing and opacity bugs is illustrated in the diagram above, which shows the fraction of layers identified as clouds and the fraction of layers identified as aerosols for all altitudes between 0-km and 12-km, and for both the version 2 release and the version 3 alpha test. While the overall layer detection remains relatively constant (see the column feature fraction difference plot), the version 3 code classifies a significantly larger fraction of the layers below 4-km as aerosols. This change is entirely consistent with the results shown further above in the comparisons of V2 vs. V3 layer classification for a single scene. (Note: the aerosol base extension algorithm was not in place for these test results, and so the low altitude aerosol fraction can be expected to rise a bit further in the final data release.)

Algorithm Updates





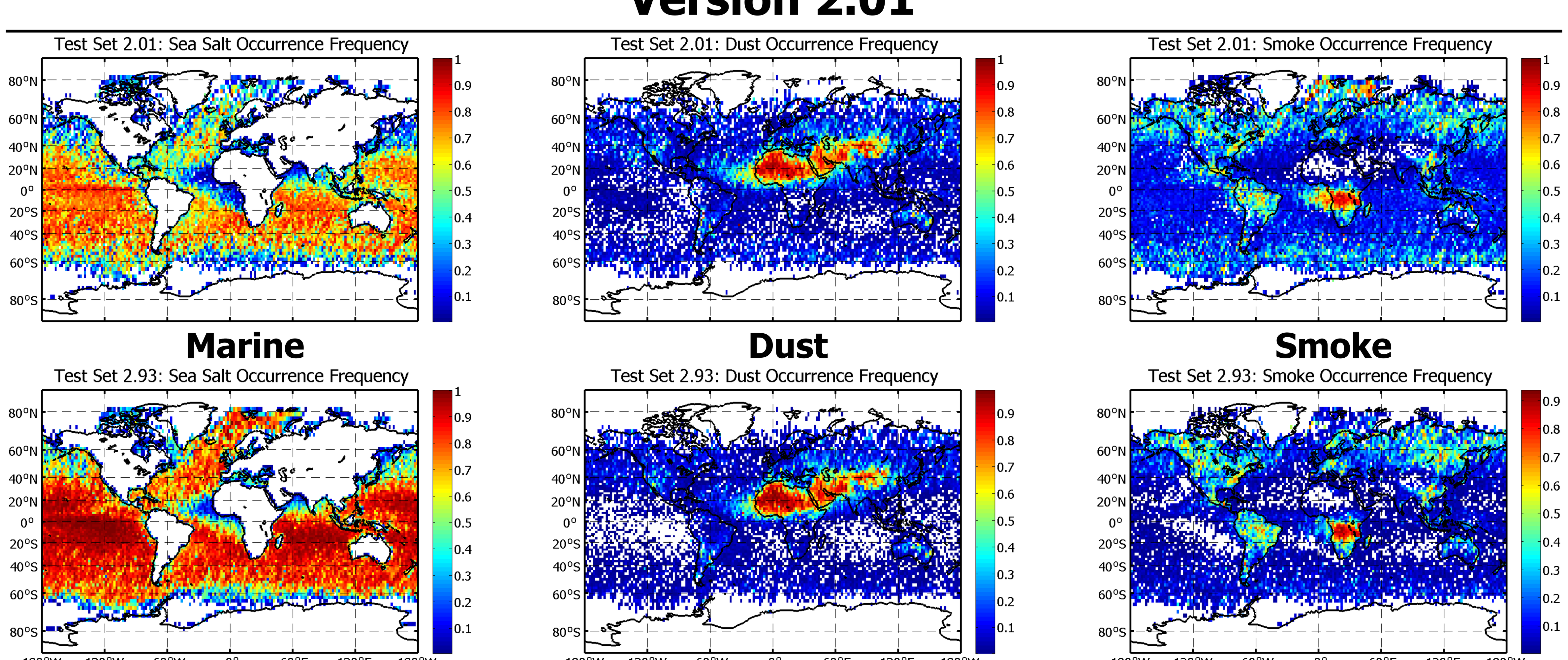
Aerosol Optical Depth Retrievals Improve Markedly When Layer Boundaries Are Extended



Configuration Changes

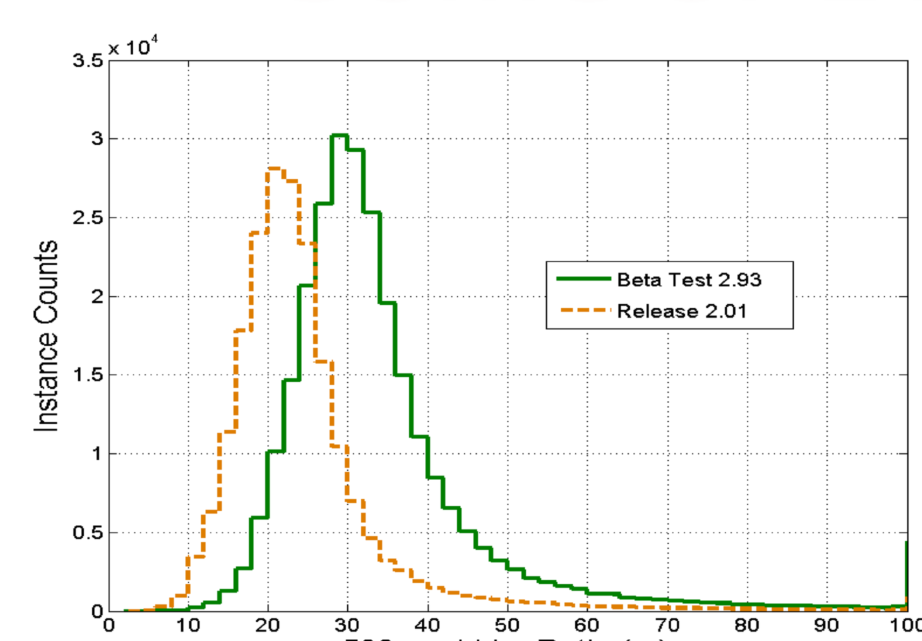
Revised threshold values in the aerosol subtyping algorithm now generate a more realistic global distribution of aerosol types. For example, in version 2, dust and smoke were frequently identified in the southern Pacific Ocean. As shown below, these erroneous classifications are greatly reduced in the version 3 results, and marine aerosols now dominate the region. The data plotted is an amalgam of all measurements made during January, May, and August 2007.

Version 2.01



Version 3(alpha)

Some of Everything



To increase the frequency of constrained extinction retrievals for cirrus clouds, we devised a new "cirrus stitching" algorithm to merge vertically adjacent layers detected at multiple spatial resolutions. As a consequence, we have achieved a 30% increase in the number of lidar ratios we retrieve by applying the transmittance constraint technique to cirrus cloud measurements. More importantly, because the optical depth of the cirrus is now measured, rather than estimated using a default lidar ratio, the extinction retrievals in underlying aerosol layers are more robust and accurate.

The table to the right compares descriptive statistics for all cirrus cloud lidar ratios retrieved from the version 2 analyses and the version 3 alpha test using all data acquired during January, May, and August of 2007. A bug in the version 2 code caused an incorrect value of the cirrus cloud multiple scattering factor to be used in the retrievals, resulting in lidar ratios that were too low by ~50%.

	Release 2.01	Test Set 2.93
minimum	4.9 sr	5.2 sr
maximum	249.7 sr	249.9 sr
median	21.5 sr	30.3 sr
mean	23.7 sr	34.4 sr
standard deviation	12.5 sr	18.9 sr
skewness	5.5 sr	5.0 sr
sample count	199,790	263,591