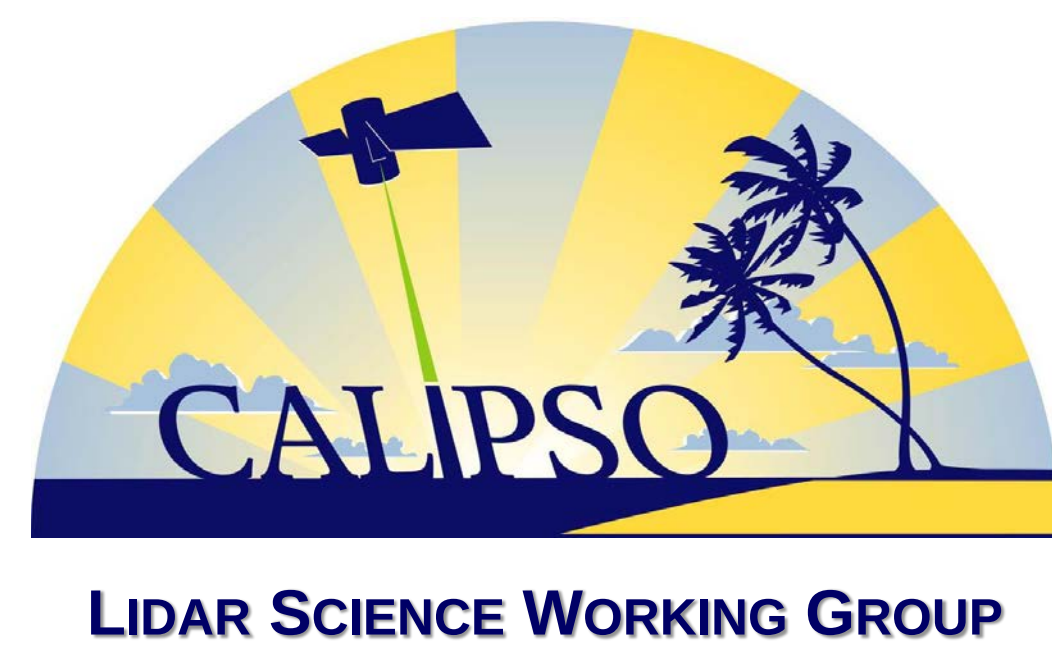
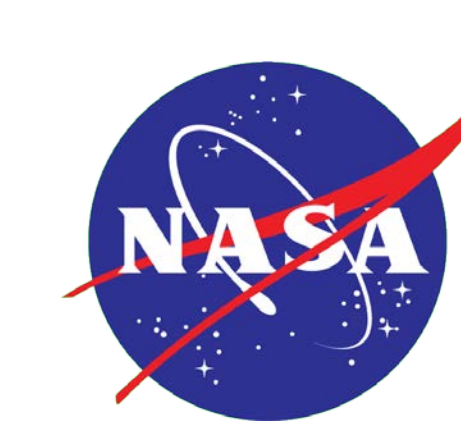




Improvements in CALIOP Smoke Optical Depth over Clouds

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Introduction

Smoke over marine stratocumulus is ubiquitous off the south west coast of Africa during biomass burning season. Past studies have shown that CALIOP overestimates the base altitudes of strongly attenuating smoke layers. This is because CALIOP layer detection operates on the 532 nm attenuated backscatter signal. Smoke strongly attenuates light at this wavelength, so CALIOP feature detection at times assigns a base altitude that is higher than the true layer base for optically thick layers. In order to improve the AOD for smoke over clouds, a new algorithm has been implemented in for an upcoming CALIOP level 2 data release that will extend the base altitudes of smoke layers over clouds. This poster summarizes the new *smoke base extension algorithm* and its performance.

Example of Smoke Base Extension

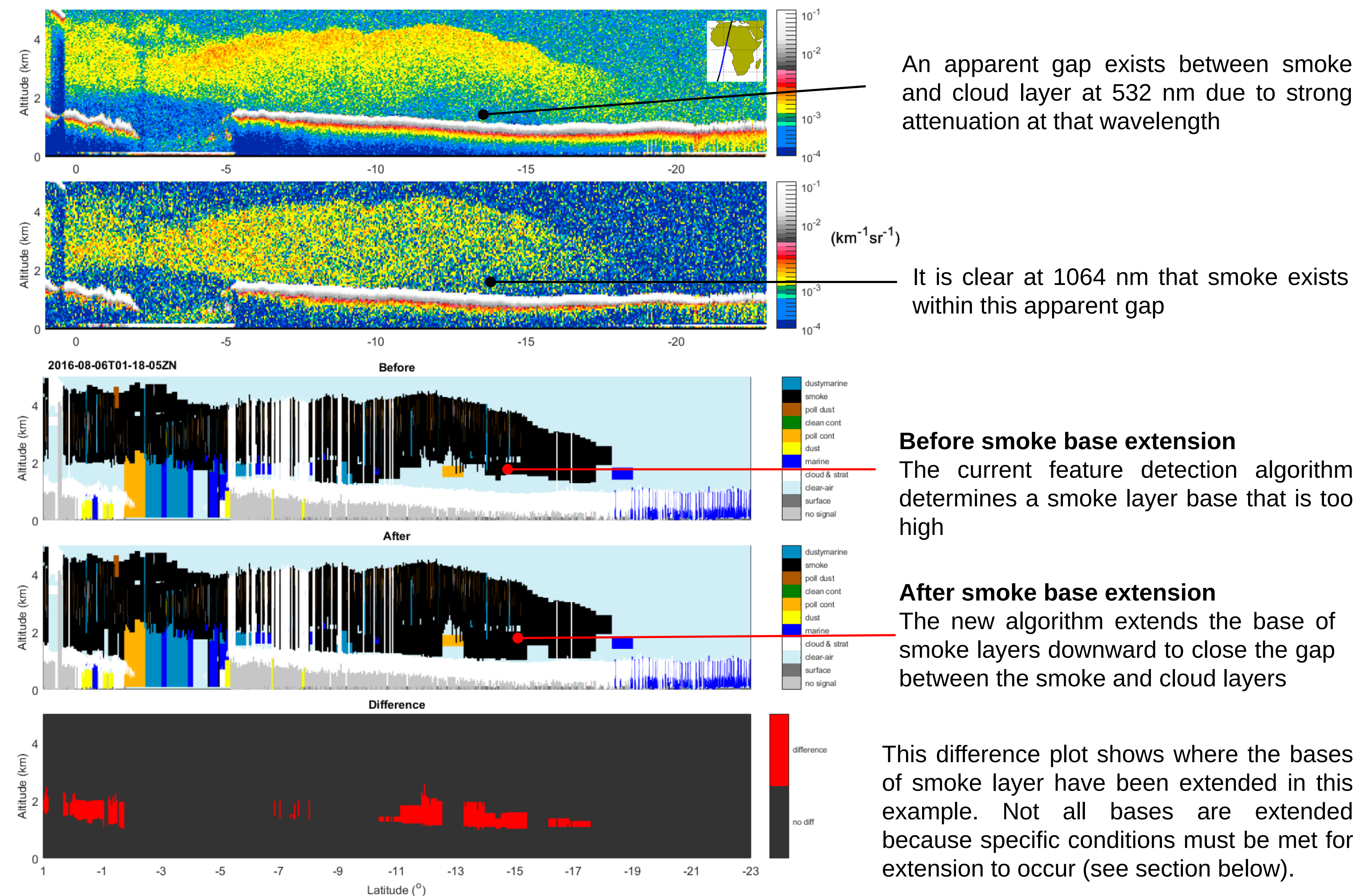


Figure 1. Example of smoke plume off southwest coast of Africa observed by CALIOP 2016-08-06 at 1:35Z. (a) 532 nm attenuated backscatter, (b) 1064 nm attenuated backscatter, aerosol type classification (c) before and (d) after smoke base extension, and (e) where differences exist between panels c and d.

Smoke Base Extension Algorithm

The base altitude for layers classified as smoke that exist above clouds will be extended downward to the range bin above the cloud top if the following criteria are met. These criteria ensure that the algorithm targets optically thick smoke layers over clouds as in the example above.

Gap distance requirement:

- The gap between the smoke layer base and cloud top must be less than 4.5 km at day and 3.0 km at night

Confirm that usable 1064 nm signal exists in the gap:

- The 1064 nm mean attenuated scattering ratio in the gap must exceed 2.0

Confirm that the aerosol layer being extended is smoke:

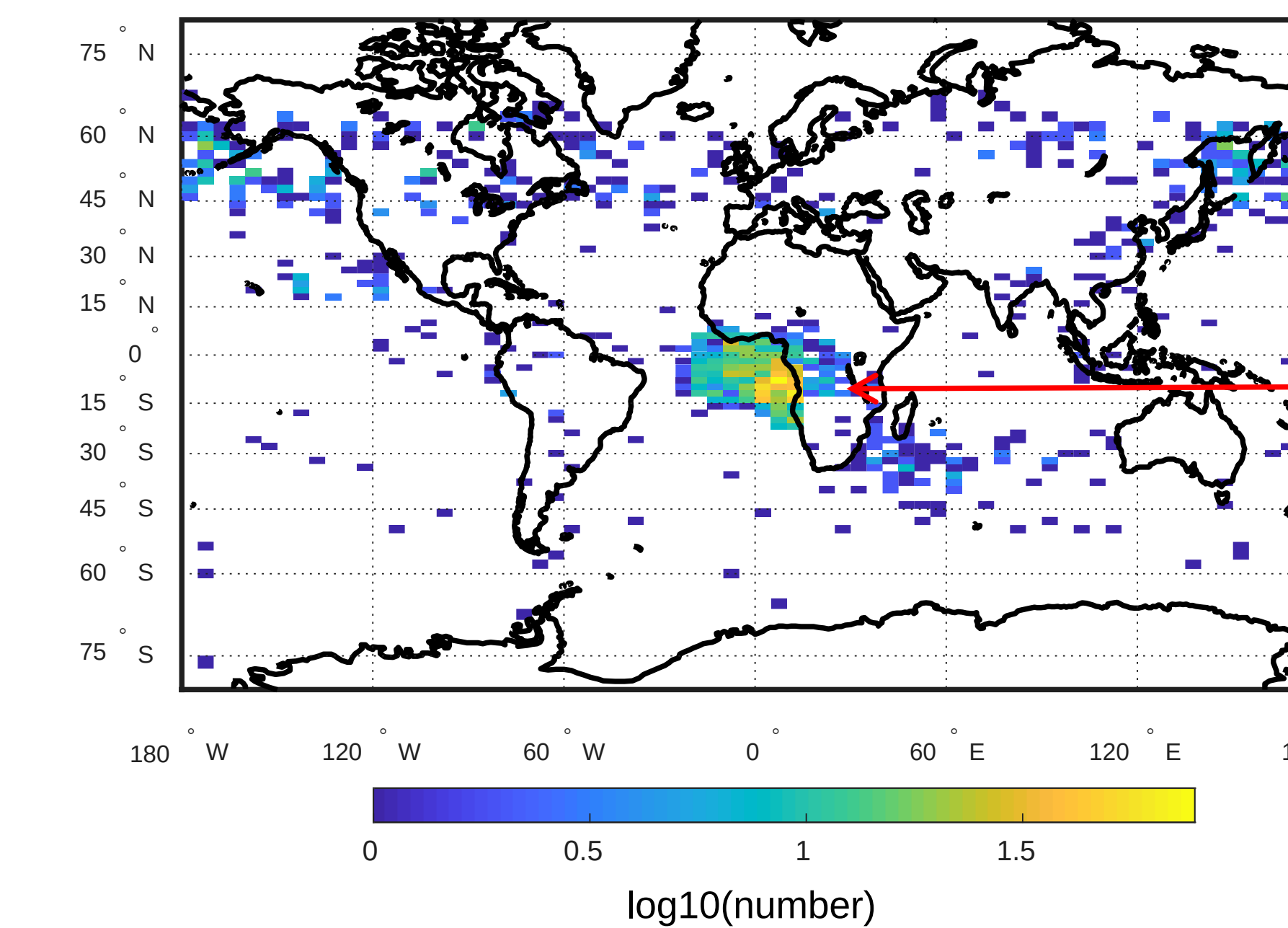
- The initial type classification must be smoke and the mean attenuated color ratio of the underlying cloud layer must exceed 1.4

Why? To limit the smoke-cloud gap distance to what is observed in the southwest Africa coast smoke transport region

Why? To ensure usable signal exists in the smoke-cloud gap

Why? To only extend optically thick smoke layer bases

Where are Smoke Layer Bases Extended?



A small number of extended smoke layer bases are associated with wildfire activity in northern hemisphere summer.

Most smoke layer bases are extended off the southwest Africa coast as expected.

Fewer smoke layers are extended during the daytime, but in similar locations.

Figure 2. Number of smoke layers extended (log 10) in August 2012 at night.

Changes in Smoke Optical Depth and Extinction Profile

CALIOP smoke optical depth increases over the southwest Africa biomass burning smoke transport region due to the base extension algorithm. Figure 3 shows the monthly mean smoke AOD increase for August 2012. Within the transport region denoted by the dashed box, the median AOD for smoke layers increases from XX to XX (+XX%).

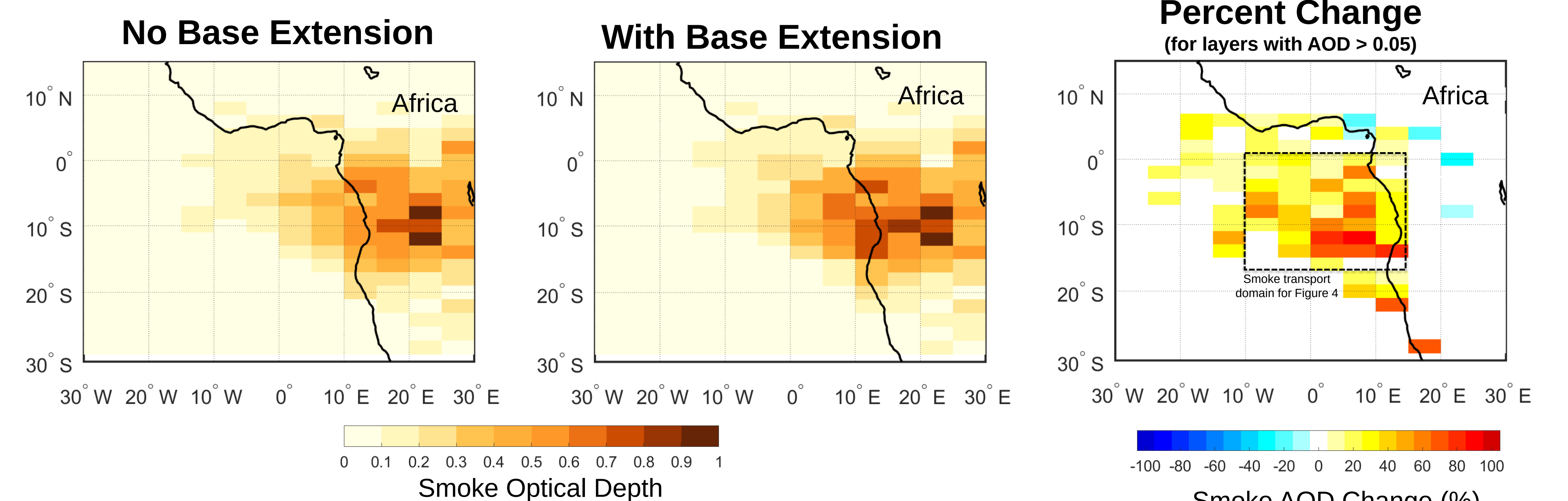
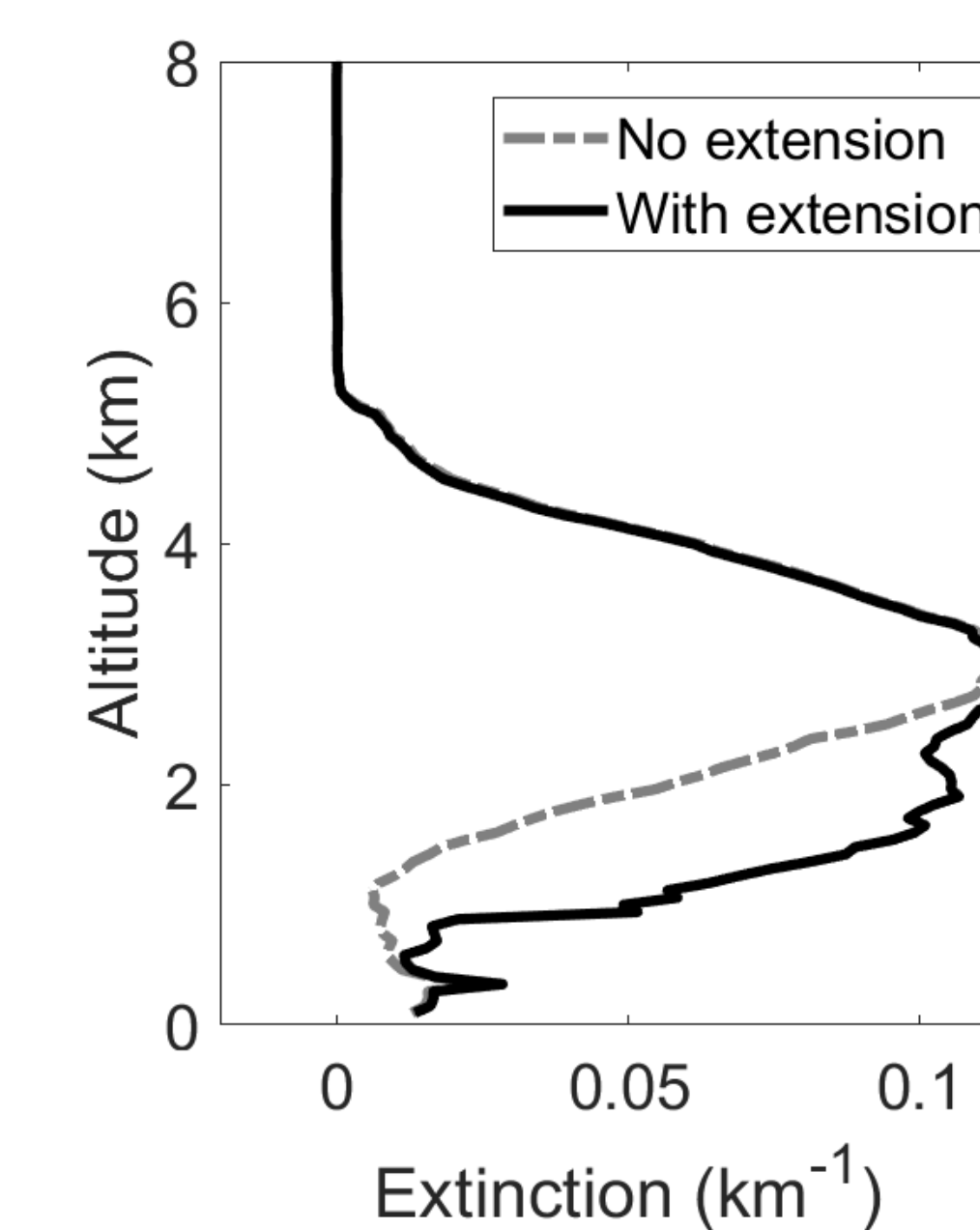


Figure 3. Monthly averaged optical depth of layers classified as smoke in August 2012 at night with and without smoke base extension.



The CALIOP smoke extinction profile for this month also indicates greater extinction at lower altitudes when smoke base extension is applied, as expected. The rapid decrease near 1 km corresponds to typical cloud top altitudes in this region. This change in profile shape suggests that the full depth of smoke layers above low-level clouds is now captured.

For individual smoke layers, the AOD increase after base extension and that the largest increases occur when the change in layer base is also large.

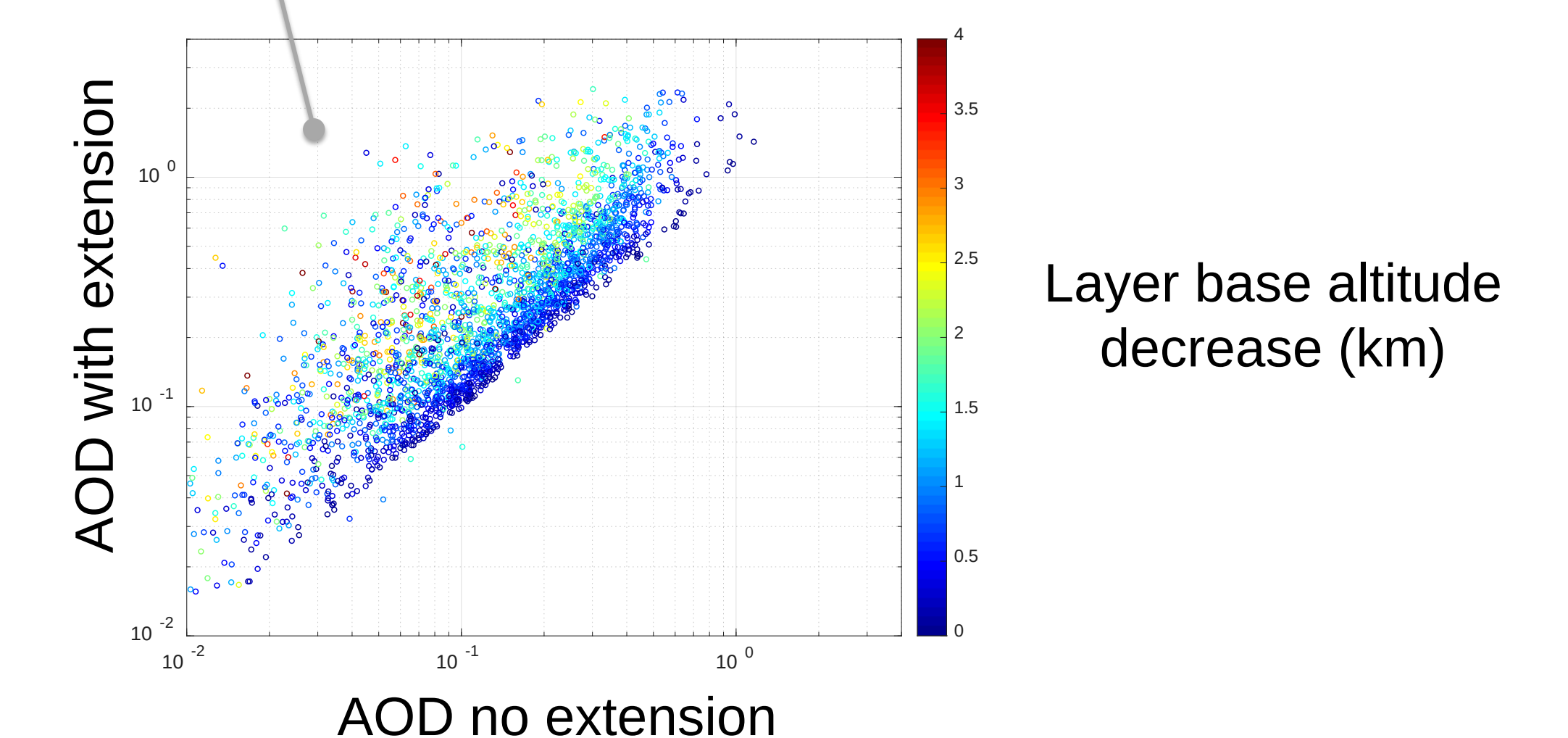


Figure 5. AOD for individual smoke layers before and after base extension during August 2012 at night for the smoke transport region outlined in Figure 3. Colors indicate the distance that the base was extended.