

This manuscript has two main parts. The first part introduces a new retrieval of aerosol single scattering albedo (SSA), asymmetry parameter (ASP), and surface albedo (ALB) from airborne aerosol optical thickness (AOT) and irradiance measurements. The second part illustrates the application of this method using data collected during the MILAGRO experiment. The retrieved parameters are applied to calculate aerosol radiative forcing efficiency (RFE), which is defined as the aerosol radiative forcing (RF) per AOT change ( $dRF/dAOT$ ). Although the manuscript demonstrates a lot of earnest work and includes important results, some revisions are needed.

### Aerosol forcing efficiency

p. 2751, section 20: “*We introduced and tested a new method that allows for the simultaneous retrieval of ... and aerosol forcing efficiencies*”.

The RFEs are not retrieved, they are calculated using the retrieved parameters.

Make the corresponding changes in a revised version (e.g., abstract and conclusions).

p. 2751, section 20: “*This method is useful when ... (a) the gradient of AOT is too weak.*”  
Similar statements are made throughout the text.

How can the RFE be estimated for a homogeneous case ( $dAOT \sim 0$ )?

Should one calculate  $dRF$  as a function of  $dAOT$  assuming that other parameters are fixed?

Take a “homogeneous” case from Table 1 and illustrate that.

### Retrieval of SSA, ASP and ALB

#### Algorithm

One can retrieve three parameters (SSA, ASP and ALB) using three observational constraints (e.g.,  $F_{abs}$ ,  $F_{0dw}$ ,  $F_{1up}$ ).

The authors retrieved four parameters (SSA,  $ASP_{up}$ ,  $ASP_{dw}$  and ALB) using four observational constraints ( $F_{abs}$ ,  $F_{0dw}$ ,  $F_{0up}$ ,  $F_{1up}$ ). Why?

Explain selection of the observational constraints and the need for two independent retrievals ( $ASP_{up}$ ,  $ASP_{dw}$ ) of ASP.

The following sentences are not consistent:

p. 2734, section 5. “*The aerosol single scattering albedo and asymmetry parameter are derived from the upward, downward, and net spectral irradiance above and below the layer by iteratively adjusting these two values in a radiative transfer model until the modeled irradiance converges to the measured irradiance ...*”

p. 2741, section 20. “*Figure 4 shows a flow chart of the algorithm where single scattering albedo, asymmetry parameter, and surface albedo are iteratively adjusted until the modeled irradiance converges with the measured irradiance.*”

Add “surface albedo” in the first sentence and replace “two” with “three”.

p. 2742, section 10. “*Repeat loops 1-3 until the values of SSA,  $ASP_{up}$ ,  $ASP_{dw}$ , ALB are stable.*”

How is “stable” defined?

### Sensitivity tests

Figure 4 shows errors in the retrieved SSA, ASPup and ASPdw associated with the AOT uncertainties. Do these uncertainties impact the retrieved ALB? How sensitive are the retrieved parameters (SSA, ASPup, ASPdw and ALB) to uncertainties in the observed irradiances?

Perform additional sensitivity tests (similar to Magi et al., 2008) and include corresponding plots (similar to Figure 4).

### Comparison with AERONET

Figure 6 shows AERONET-derived SSA and time series of the retrieved SSA (new method). Add new plots (similar to Figure 6) with other retrieved parameters: AOT, ASP and ALB.

### Notation

The usage of subscript “0” is ambiguous. It specifies (1) irradiances below aerosol layer (e.g., page 2740, line 3 from the bottom) and (2) retrieved values of SSA, ASPup, ASPdw (e.g., page 2743, section 15 and page 2744, section 10).

Use different subscripts for the radiative and optical properties.

### Figures and Table

Figure 6 includes the AERONET-retrieved SSA at the Tamihua station. The same symbol (Tamihua AERONET) is applied for two different latitudes. Why?

Figure 8 has two panels. The right panel is very busy.

Modify it. A modified version of Figure 8 could include three panels.

Table 1 is not complete.

A revised version should include other useful statistics, such as the retrieved ALB, dAOT, distance, uncertainties of retrieved parameters (SSA, ASP, ALB) and RFE. As an example, the authors can use Table 1 from Redemann et al. (2006).

### References

Redemann, J., P. Pilewskie, P. B. Russell, J. M. Livingston, S. Howard, B. Schmid, J. Pommier, W. Gore, J. Eilers, and M. Wendisch (2006), Airborne measurements of spectral direct aerosol radiative forcing in the Intercontinental chemical Transport Experiment/Intercontinental Transport and Chemical Transformation of anthropogenic pollution, 2004, *J. Geophys. Res.*, 111, D14210, doi:10.1029/2005JD006812.

Magi, B. I., Q. Fu, J. Redemann, and B. Schmid (2008), Using aircraft measurements to estimate the magnitude and uncertainty of the shortwave direct radiative forcing of southern African biomass burning aerosol, *J. Geophys. Res.*, 113, D05213, doi:10.1029/2007JD009258.