## Supplimental Material



**Fig. 1.** Comparisons between Terra DB and AERONET 2000-2007 for diagnostic purpose for **(a)** all data, **(b)** data with very good QA quality globally. The red line is the linear fit line and the blue lines are the 95% confident interval lines. The color contour shows the fractional data density.



**Fig. 2.** Regional comparisons between Terra DB AOD and AERONET AOD 2000-2007 with only QA equal to "Very Good" for (a) Northwest America, (b) Northeast America, (c) South America, (d) Europe, (e) North Africa, (f) Southern Africa/Sub-Saharan, (g) East Asia, (h) Australasia, and (i) West Asia. The blue line is the linear fit line and the black lines are the 95% confident interval of the linear fit line.



**Fig. 3.** The differences in AOD between Terra AERONET and DB as a function of viewing angle over the study region for (a) total AOD without QA filter, and (b) AOD with "Very Good" QA. Data were averaged for every 10 degrees viewing zenith angle (except for 10 to 30 in Fig. S3b) and one standard deviation bars were shown.



**Fig. 4.** Comparisons between Terra DB AOD and AERONET AOD globally during 2000-2007 under cloud free conditions for (a) fine mode fraction smaller than 0.5 and (b) fine mode fraction greater than 0.5. The blue dots represent the averaged DB AOD for each AERONET AOD bins. The thicker black line is the linear fit line and the thin black line is the 95% confidence interval. The red dashed line is the 1 to 1 line.



Fig. 5. Comparisons between coarse and fine mode Terra DB AOD and AERONET AOD at  $0.55 \mu m$  globally 2000-2007 with albedo at 0.412  $\mu m$ . Each row represents data from a range of albedo: (a) and (b) are for albedo less than 0.05, (c) and (d) albedo ranges between 0.05 and 0.08, (e) and (f) albedo ranges between 0.08 and 0.11, and (g) and (h) are for albedo greater than 0.11. The left panel shows the coarse mode with the fine mode fraction less than 0.5, the right panel shows the fine mode with the fine mode fraction greater than 0.5. The blue line is the linear regression line, and the red line is the polynomial regression line.



**Fig. 6.** AOD bias ( $\Delta \tau_{A-M}$ , AERONET minus Terra DB AOD) as a function of the number of pixels used for retrieving Terra DB over the study region. The error bars indicate one standard deviation above and below the mean.



**Fig. 7.** Normalized  $\triangle AOD$  ( $\triangle \tau_{A-M}$  over Terra DB AOD) various with  $STE_{sfc}$  as a function of (a) surface reflectance at 0.412 µm, (b) DB AOD, and (c) aerosol type. The error bars indicate one standard deviation above and below the mean.



**Fig. 8.** Scatter plot of standard error threshold of Terra AOD versus Terra AOD at 0.55  $\mu$ m. Dots represent the averaged Standard Error (blue) of AOD and the 1.5 standard deviation (red) for AOD increments of 0.1 for AOD <0.5 and increments of 0.3 for AOD > 0.5. The blue lines and red lines show the linear fit of corresponding dots. (a) for DB AOD globally. (b) for DB AOD over the study region.



Fig. 9. Comparisons between Terra DB and AERONET AOD over the study region from 2002-2009, grouped by albedo  $(0.412 \ \mu m)$  ranges for the mixed aerosol type, (a) albedo less than 0.05, (b) albedo ranging between 0.05 and 0.08, (c) albedo ranging between 0.08 and 0.11, and (d) albedo greater than 0.11. The blue line is the linear fit line.



Fig. 10. Similar to Fig. 9 but for dust type aerosol over the study region.



Fig. 11. Similar to Fig. 9 but for smoke type aerosol over the study region.