



CALIPSO Aerosol Optical Depth Comparison with AERONET



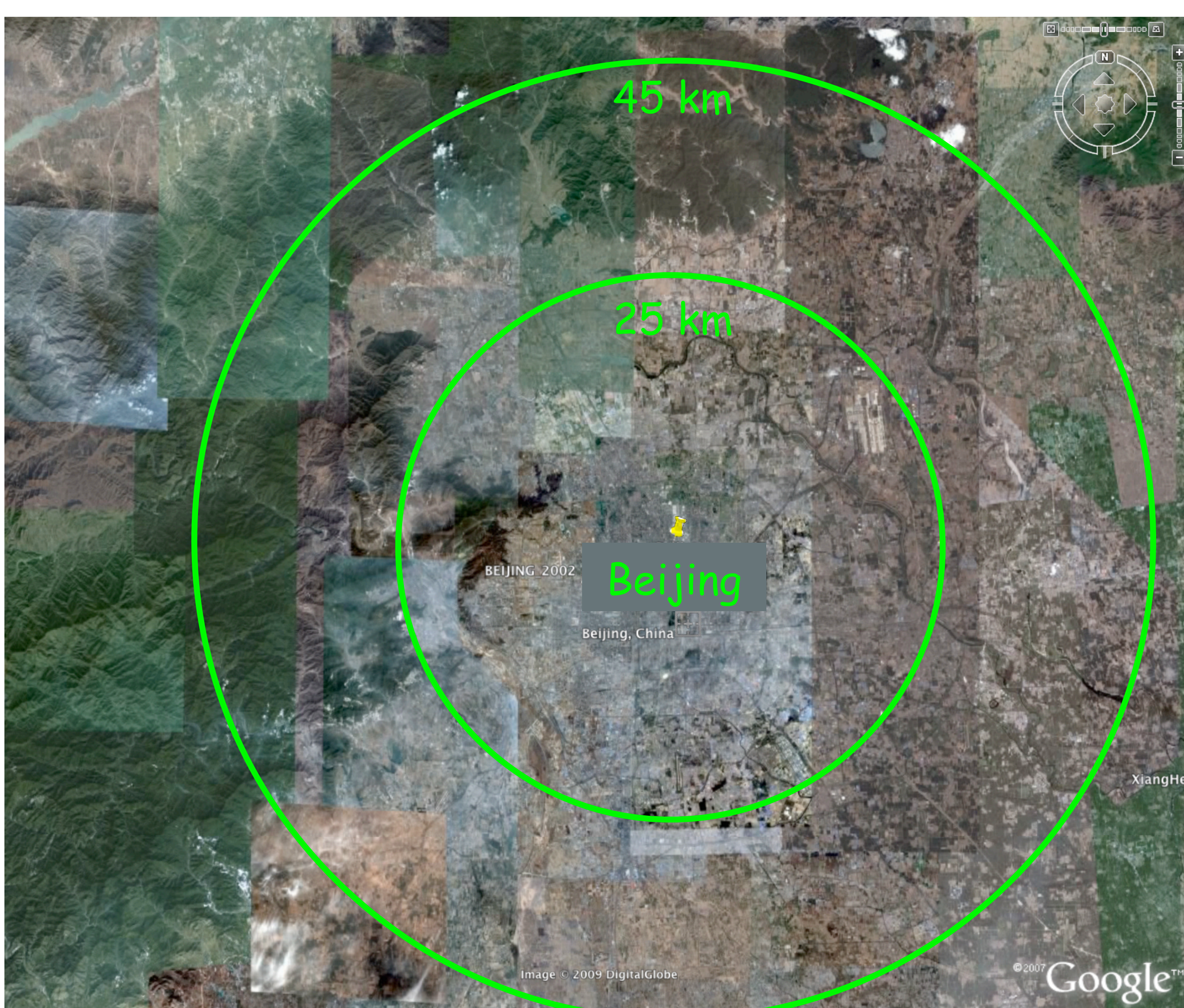
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Summary

Highly accurate measurements of aerosol optical depth (AOD) are routinely provided by the Aerosol Robotics Network (AERONET) of ~170 surface sunphotometers. We compared the CALIPSO column aerosol optical depths (obtained by summing all CALIPSO aerosol features) to the AERONET product for overpasses that occurred within 15 minutes and 85 km of the AERONET measurements (during 6/1/2006--9/30/2007). We binned our results by AERONET aerosol optical depth, and found that the average CALIPSO AOD is always lower than the average binned AERONET AOD.

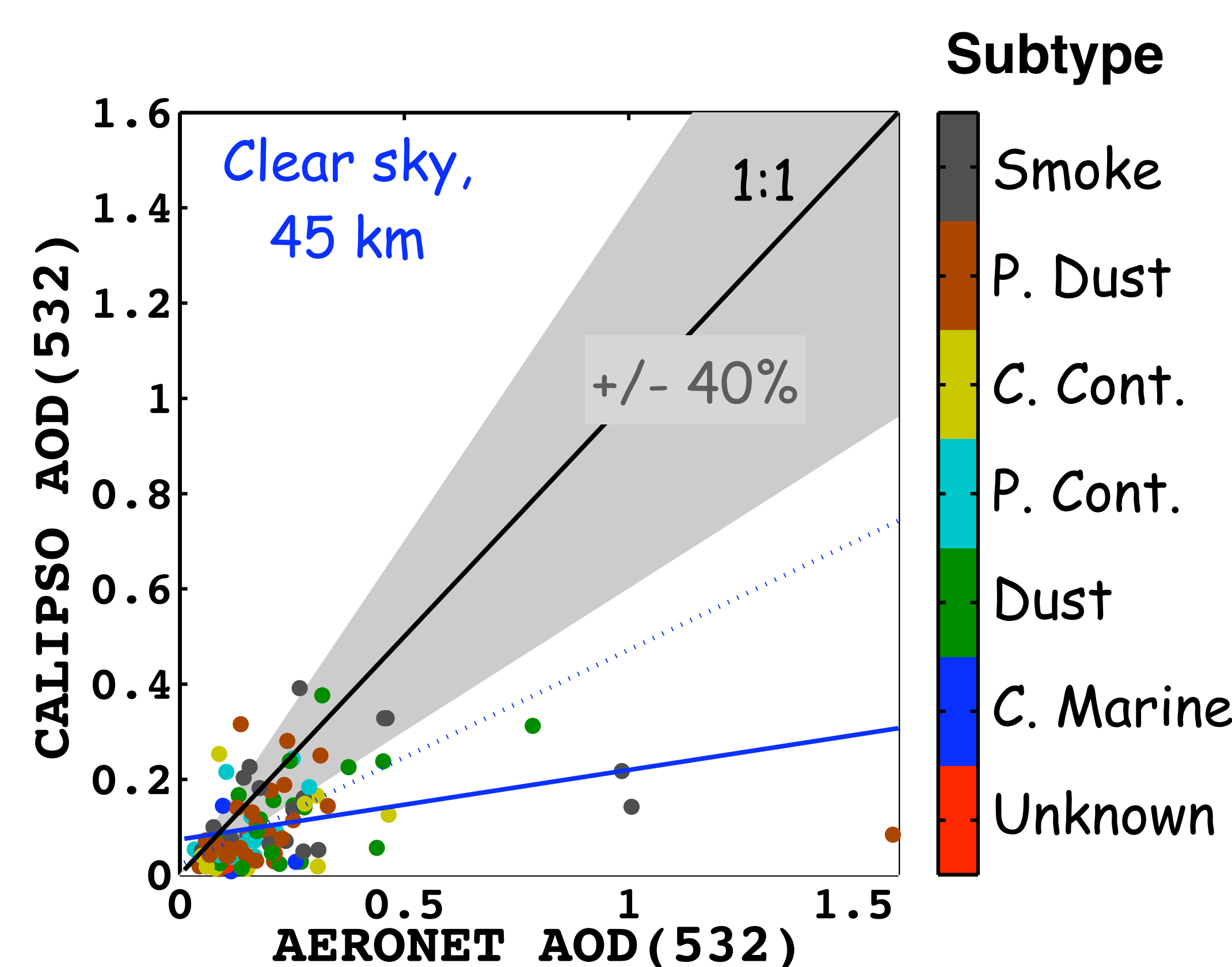
Approach

- AERONET Level 2 dataset (~170 sites), polynomial fit to 532 nm, 6/1/2006-9/30/2007.
- CALIPSO overpass times within 15 minutes of AERONET AODs.
- Considered maximum closest approaches of 25, 45 km.
- Used CALIPSO aerosol "features," and sum AODs of all detected features. No overlapping layers allowed.
- All Level 2 AERONET data is cloud filtered, but we considered both all-sky (i.e., CALIPSO detected at least one cloud layer) and clear-sky data in the CALIPSO database.
- Require DEM_Surface_Elevation within 100 m of AERONET elevation.
- Quality Controlled comparisons (i.e., require CALIPSO ExtinctionQC_532 = 0)



Instantaneous Comparison

Statistics for instantaneous comparisons indicate significant discrepancies for all aerosol subtypes. Also, statistics do not improve by filtering for low avg extinction ($< 0.05 \text{ km}^{-1}$) or for geometrically thin layers ($\Delta Z < 0.5 \text{ km}$).

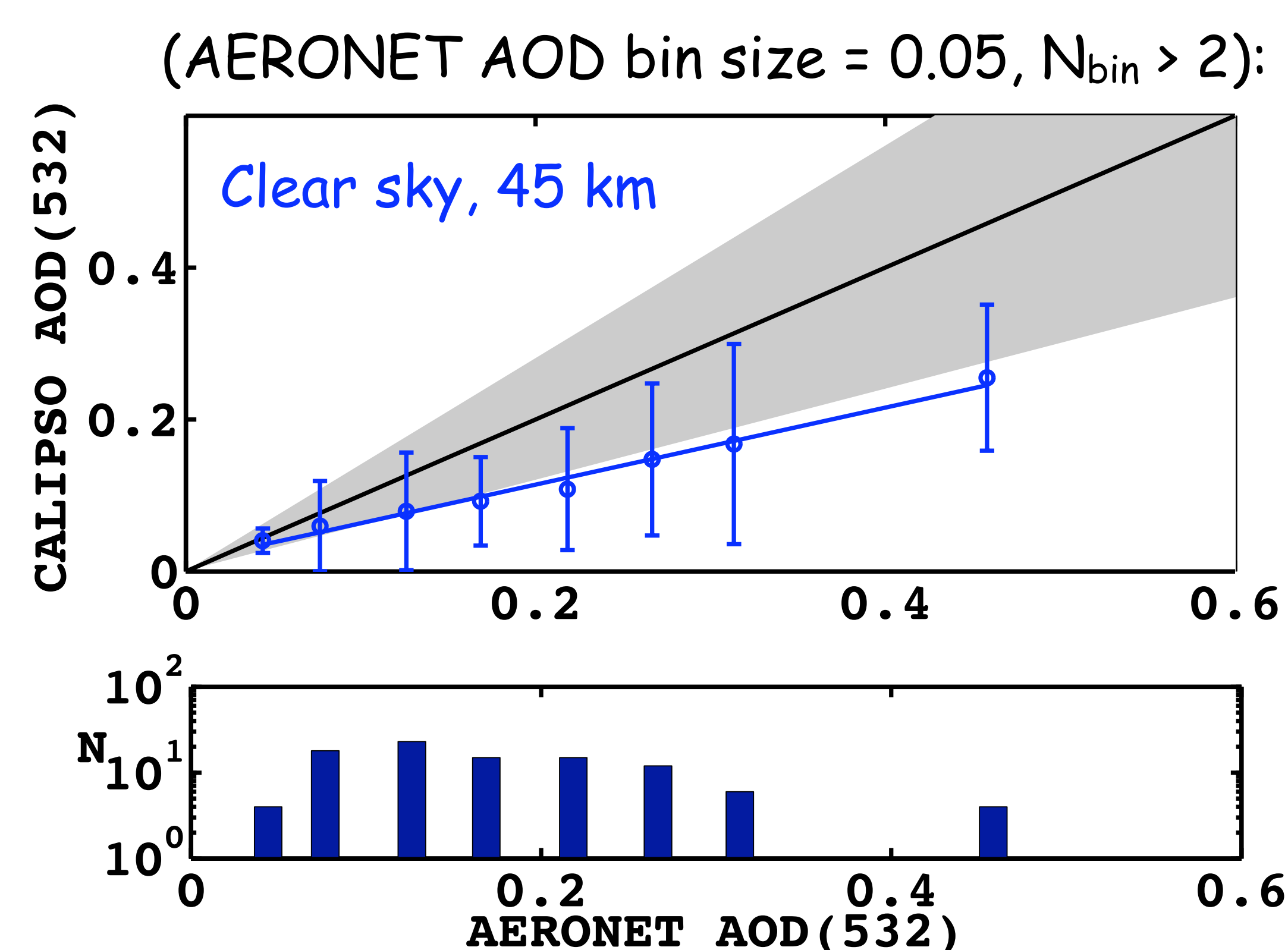


max dstnc	slope (all / clear)	intrcpt (all / clear)	corr coef (all / clear)	N
25	0.05 / 0.07	0.12 / 0.09	0.13 / 0.18	110 / 63
45	0.18 / 0.15	0.09 / 0.07	0.37 / 0.34	190 / 103
45*	0.34 / 0.45	0.05 / 0.02	0.32 / 0.51	175 / 99

*Maximum AERONET AOD = 0.6 for this row of stats

Linear regression of mean bin values

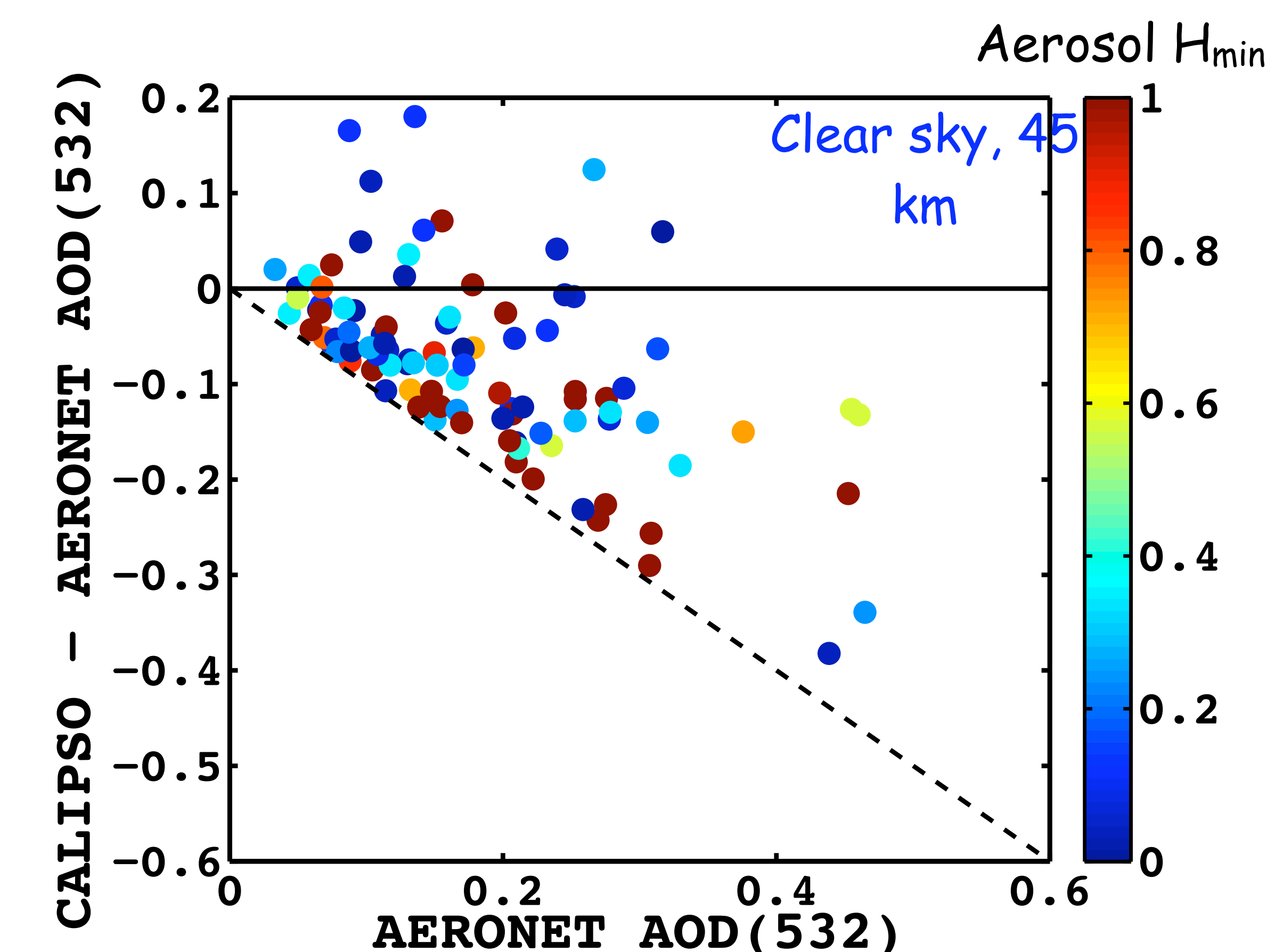
Statistics are tremendously improved for binned results (i.e., slopes and correlations are generally closer to 1 than for the instantaneous comparisons above). Nonetheless, all slopes still indicate a discrepancy greater than the 40% projected before launch (i.e., require slopes of 0.6-1.4).



max dstnc	slope (all / clear)	intrcpt (all / clear)	corr coef (all / clear)	N
25	0.44 / 0.53	0.05 / 0.01	0.79 / 0.93	110 / 63
45	0.17 / 0.51	0.09 / 0.01	0.85 / 0.99	190 / 103

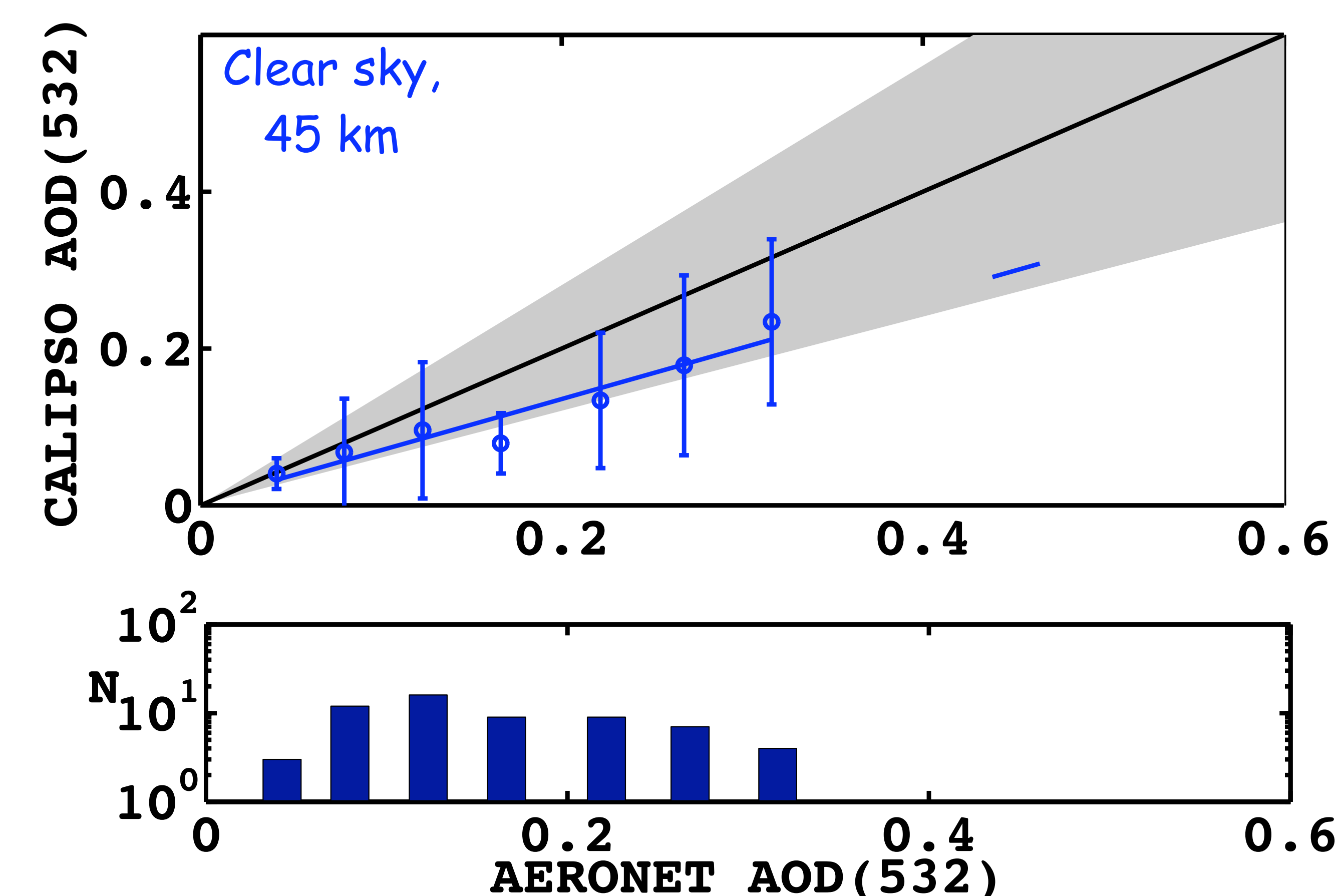
CALIPSO often misses significant optical depth

Mean and median differences between CALIPSO and AERONET comparisons are -0.11 and -0.08 (103 points).



Does this happen when CALIPSO misses aerosol layers near the surface?

Subsetting the CALIPSO retrievals so that the minimum altitude of the lowest aerosol feature is $< 0.5 \text{ km}$ produces slopes within the pre-launch projections (i.e., 0.6-1.4).



max dstnc	slope (all / clear)	intrcpt (all / clear)	corr coef (all / clear)	N
25	0.77 / 0.73	0.01 / -0.01	0.82 / 0.87	58 / 39
45	0.49 / 0.65	0.04 / 0.00	0.73 / 0.96	91 / 62

Conclusions

Averaged CALIPSO AODs are always lower than binned and averaged AERONET AODs. However, the CALIPSO averaged AODs are within pre-launch projections ($\pm 40\%$) when the CALIPSO dataset is subsetting for aerosol base heights less than 0.5 km.