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Comment

## ***Interactive comment on “SPARTAN: a global network to evaluate and enhance satellite-based estimates of ground-level particulate matter for global health applications” by G. Snider et al.***

**Anonymous Referee #2**

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SPARTAN: a global network to evaluate and enhance satellite-based estimates of ground-level particulate matter for global health applications Snider et al. Atmos. Meas. Tech. Discuss., 7, 7569–7611, 2014

This manuscript describes plans for a new global network which is intended to help apply satellite measurements to the effort of estimating PM<sub>2.5</sub> concentrations. The manuscript briefly discusses site criteria and sampling strategies and then focuses on the instruments that will be deployed as sites come on-line. Finally, they present a few results from the ground-based instruments from a prototype site.

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Interactive Discussion

Discussion Paper

General and science comments: Maybe I missed it. . .but it would be useful to provide a list of potential satellites this network will be used to enhance. Figure 1 mentions MODIS and MISR in the caption, but I think that is the only place where a specific satellite is named. Tied to that, in Figure 3 and a couple other places in the text there are variables with the subscript 'sat'. As far as I can tell this subscript refers to a measurement made with a ground-based instrument at the time of a satellite overpass. It might be helpful to distinguish satellite measurements from ground-based measurements at the same time as the satellite by using different subscripts (for example, 'sat' and 'sat\*' or something like that.

GAW and NOAA aerosol network observatories are highly instrumented sites in a wide range of locations and are often co-located with an AERONET sunphotometer. These sites make typically make measurements of aerosol light scattering at low RH. It would make sense to attempt to collocate some of the SPARTAN deployments at these sites in order to evaluate your 'dry scattering' estimates. These sites have personnel, power and often additional measurements which might enhance evaluation of SPARTAN results.

NOAA network sites making dry scattering measurements that are collocated with aeronet sites include: mauna loa, cape san juan, trinidad head, mount waliguan, egbert, appalachian state, mount lulin, gosan, bondville, cart\_site and barrow.

P7575 line 21 - '...calibrate nephelometer ...' calibrate seems like a strong word here. evaluation or constrain is probably better. It's a calibration if you know the answer, i.e., exactly how the filter based measurements can be transformed into scattering. but if you are going from a bulk measurement of aerosol chemistry from filters at weighing RH to scattering at RH close to ambient RH then you are making assumptions about particles size, refractive index and hygroscopicity.

P7578-7579 – discussion of filter samples. What about organics? what about organic material? Zhang et al., GRL VOL. 34, L13801, 2007 suggest that organics make up a

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significant fraction (25-75% of aerosol mass).

P7579 line 13 – mention of nephelometer angular range - how do you correct for the angular truncation? if the sampled air includes super micron particles the truncation correction can be very large (on order of 20-30%). (at least that's how big it is for TSI nephelometer with similar angular range - Anderson and Ogren, 1998.) Getting the truncation right is important if you are relating ambient scattering from the neph to ambient scattering from a satellite or somehow derived from AOD both of which wouldn't have truncation issues.

P7582 - discussion of  $\nu$  related to term one - it would be interesting to see whether the first term is always the most strongly related to ' $\nu$ ' and whether the relationship is that strong at other sites. i would recommend finding aeronet sites that are already collocated with dry nephelometer measurements and seeing how the relationship does. one site that would be easy to do this at is Bondville, IL. there is an aernet sunphotometer, a TSI nephelometer (operated by NOAA) and improve chemistry samples for PM2.5. That nephelometer operates at low RH so you would need to reverse eqn 1, e.g.,  $\text{bsp}_{\text{wet}} = \text{bsp}_{\text{dry}} * f(\text{RH})$

P7593 line26 - Do you have plans for checking the smoke stain reflectance values against results from instruments that measure light absorption/BC? having more black carbon-type measurements is something that would be very useful to the climate community, but they would need to be tied to something more familiar (PSAP, MAAP, aethalometer...)

Text editing/clarification type comments

P7571 – lines 23-24 this statement is vague/unclear w/o having read the paper.

P7571 – line 25 – what is the aerosol scattering vertical profile interacting with? this is unclear.

P7573 line 20 – 'inform' is a weird word choice...how about affect or influence or deter-

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mine?

P7573 line 28 – aeronet being used to validate satellite data - a reference or two here would be good.

P7574 line 7 – suggest changing ‘...midday aerosol measurements...’ to ‘...midday aerosol optical measurements..’

P7577 line 2 – ‘...to prevent their lower capture efficiency the...’ rephrase: ‘... to enhance their capture efficiency...’

P7577 line 18-20 - it's unclear to me why this sampling strategy increases retention time - you still are collecting some samples during the warm part of the day. it only seems like it would increase retention time for the 6:20-9:00 sample.

P7577 line 20-25 i would move the staggered sampling timing up to where you discuss avoiding day of week biases and before the discussion of volatilization. Presumably part of the staggered sampling time impetus is to avoid time of day biases.

P7577 line 27 ‘...we reduce the sampling time between 15% and 100%...’ does a 100% reduction mean no sampling?

P7577 line28++ ‘During the staggered air samplings the collocated nephelometer measures particle light scattering continuously.’ i would rephrase this sentence: ‘Unlike the filter measurements, the collocated nephelometer measures continuously.’

P7579 line 20 - ‘The inlet is a 10 cm length of copper tubing ending with a plastic bug screen.’ have you calculated losses in the nephelometer inlet?

P7580 line 12 - using one number for hygroscopic growth seems fraught with peril! Also, do you apply constraints or eliminate data for hours when there are large changes in RH?

P7580 line17-18 ‘Hourly nephelometer scatter as measured by the nephelometer, is approximately proportional to PM2.5 mass (Chow et al., 2006),’ does the Chow paper

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refere to dry or ambient scattering.

P7581 line1 'mean of dry aerosol scatter' change to 'mean of dry aerosol scattering'

P7581 line 4 'prediction accuracy was 1  $\mu\text{gm}^{-3}$  +17%' 17% of what?

P7581 ongoing evaluation - as mentioned previously - should also compare at sites with dry nephelometer measurements and if possible absorption measurements. again - gaw and noaa network sites seem like a good partner in this endeavor..

P7582 line1 - why interpolate to 550 to match satellite AOD measurements? Should explain

P7582 line 4 ... 'daily-varying concentrations of nu in ...' i am uncomfortable with calling 'nu' a concentration even though the units work out. i recommend changing the word 'concentration' to 'value'

P7582 eqn 4 - is the parameter you are calling bsp,sat really the bsp from the nephelometer at the time of the satellite overpass? if that is not the case, then the statement that the second term only requires the nephelometer is incorrect.

P7582 line 15 'The second term describes. . .' this term doesn't describe diurnal variation it just helps account for it.

P7582 line 17 – adjusting to 550 nm - what is the point for doing this? AERONET doesn't measure at 550 nm and neither does your nephelometer, so presumably it's the satellite that is at 550 nm. should state this.

P7582 line 19 – 'nonlinear regime' what do you mean by non-linear regime? is this referring to  $\text{RH} > 80\%$  or  $\text{scattering} > 1300 \text{ Mm}^{-1}$  or both?

P7572 line 20 'The third term is the inverse of the mass scattering efficiency and related. . .' I would suggest adding in the word loosely (or very loosely?) when talking about how the third term is related to aerosol composition.

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P7582 line 23 ‘We find that nu is most. . .’ change to ‘We find that, in Beijing, nu is most. . .’

P7583 line1-2 –‘. . . weakly related to diurnal variation in atmospheric scattering (second term Eq. (4),. . .’ Anderson et al., 2003 used lag-autocorrelation to investigate mesoscale aerosol variability. they found R values (not R2) of around 0.3 for 24 h lag for several sites so it’s not surprising there’s not much relationship between bsp,1h and bsp,24h, especially once you add in a diurnal cycle in RH. Anderson et al ‘Mesoscale Variations of Tropospheric Aerosols,’ J. Atmos. Sci., 60, 119-136, 2003.

P7583 line27++ ‘nu appears to be closely related to the ratio of ground-level atmospheric scattering to column AOD. . .’ you would expect this if as you cited earlier Chow et al., 2006 found scattering proportional to and pm2.5

P7584 line27 – Angstrom exponent should be capitalized and have the appropriate diacritical marks.

P7587 – appendix A - again, check out tad anderson 2003 paper about mesoscale variability. in addition to looking at changes in aerosol properties with time he also looked at changes in aerosol properties as a function of length scales.

P7588 line3-4 - comparison with yang - presumably your measurements were made at the same time (seasonally) as yang’s measurements... or there is no seasonal variability in the two components (which seems unlikely).

P7591 line7 – clarify that DustTrak, Aurora, and Dyllos instruments are also nephelometers. were these instruments operated at ambient conditions?

P7591 line13 – ‘. . .nephelometer signal saturated during extreme pollution events (PM2.5 >400  $\mu\text{gm}^{-3}$ ).’ – provide the scattering value corresponding to this pm2.5 value.

P7593 line26 - Do you have plans for checking the smoke stain reflectance values against results from instruments that measure light absorption/BC? having more black

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carbon-type measurements is something that would be very useful to the climate community, but they would need to be tied to something more familiar (PSAP, MAAP, aethalometer...)

P7600,P7601 – these tables are hard to read – could you make every other line italic? Or add spacing between sites.

P7606 Figure 3 – the plot is labeled as ‘AODsat’ you should make it clear here and in text that AODsat relates to the AERONET retrieved AOD at the time of the satellite overpass, rather than the AOD from an (unnamed) satellite.

P7610 Figure A4 - need to do better job cropping figure.

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