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Interactive comment on "Aerosol optical properties and instantaneous radiative forcing based on high temporospatial resolution CARSNET ground-based measurements over eastern China" *by* Huizheng Che et al.

Anonymous Referee #1

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General comments:

Chen et al. reported sunphotometer measurements of aerosol microphysical and optical properties and modeling of aerosol surface and top-of-the-atmosphere (TOA) radiative forcing (RF) at several ground stations of eastern China. This manuscript is poorly written and needs a major overhaul. In many places, discussions on the results are groundless without providing any backing evidence or appropriate references to the literature. Most of the discussions is too superficial to provide any value or interest to the aerosol-climate-change or air-pollution communities. The logical flow is confusing

and unnatural, with potential for improvement in the organization of sections. Some sections need to be rewritten and reorganized to remove redundancy, while additional information must be provided in a few places.

Detailed comments (Line number: L):

Title of the manuscript needs to be changed. Title implies that the study reports aerosol instantaneous radiative forcing, while monthly and annual RF are shown instead. Remove "instantaneous". "Temporospatial" is awkward. Consider using "spatiotemporal" instead. Even worse, the author mentioned nothing whatsoever in the manuscript about the purpose or the advantage of such high temporospatial data (more comments on this later on). "Seven sites" should not be treated as "high spatial resolution". Consider writing the full name of CARSNET in the title.

Abstract needs to be rewritten. The common flow of logic is to discuss the aerosol microphysical properties (size, refractive index) first, then optical properties (Kext, FMF, SSA, etc), and finally RF. This comment also applies to the main body text. I understand that the author is trying to follow the way how these variables are derived from the AERONET inversion algorithm. I do not think this is necessary. The result subsections need to be reorganized, combined, and shortened to make the paper more concise and less confusing.

L38: what wavelength is the AOD value? If it is 440 nm, why not use 500 nm or 550 nm to make the result more useful for the community and more easily comparable to past studies? Optical properties are wavelength dependent. Provide this information when introducing any variables at the first time.

L40: use the term "fine mode fraction" if that is what you mean here.

L43: The Pearson correlation coefficient is noted as R, not R^2 (which is called coefficient of determination).

L49-50, use volume fraction instead.

L52-54: reads like a method description (remove it), and what are the key findings?

L54-56: this statement is too general to be included in an abstract. Abstract is to present the most original and important findings of the study. Do not simply report the results as general statements. Writing an interesting abstract is a critical step to pass a peer review.

Section 1

Introduction needs to polished. Always write out the acronyms at their first appearance. This comment applies to the rest of the manuscript.

L92: it looks like the author wants to emphasize the advantage of using multi-site, multi-year, as well as three-minute-interval (L35) or high-frequency (L97) data; however, not in a single place of the manuscript the author discusses the advantage of such data. After all, all sites seemed to have similar aerosol characteristics. And all results are presented as monthly or annual means. Consider adding analysis of diurnal cycle and interannual variations, or exploring other unique aspects of the data.

Section 2.

L130: Given the high AOD (comparable to urban site), ChunAn is nothing like a background site. (L177)

L146-157: describe the assumptions of the inversion algorithms, some of which may not apply for eastern China. Also describe the accuracies of the inversion variables (which are essentially a remote sensing product).

L159-161: Need more descriptions on the technical details of radiative transfer calculations. For example, how is the atmospheric profile treated and where are the profile data coming from? How is cloud scattering treated? How are clouds and aerosols vertically distributed? How is the surface and TOA radiative forcing defined?

L162-172: Why not use Aqua? I understand that MODIS/Aqua is more stable and

has better calibration than Terra (corrects me if I am wrong). It seems that the author calculated AOD at 550 nm in order to validate MODIS. If this is the case, why not show AOD at this wavelength for the entire manuscript (e.g. Table 1)?

Section 3.

L177: from Table 1, Xiaoshan and Fuyang have far smaller observation samples than other sites. Why? Does this affect the comparability between the sites? ChunAn AOD is only 10% less than other sites. I would not say it is a representative background site.

L180-188: this part has serious redundancy. Rewrite it to be more concise.

L188-206: It is dangerous to use AOD solely as a metric for pollution (PM) or emission level. Keep in mind that AOD is an optical quantity (at a specific wavelength) and measures the light extinction of a vertical atmospheric column from the ground to TOA. The AOD difference between sites may not reflect the ambient pollution severity if some sites are affected by transported events. The AOD difference between cities may not reflect the emission sources if the meteorological conditions are so different to affect the dispersion and lifetime...The author needs a more solid analysis here.

L225-230: Another example of redundancy. Rewrite to be more concise.

L231-235: Another example of unconvincing analysis. Is the transported dust event verified? Please describe the specific events (2012-2015) rather than citing a climatological study. I suspect that fugitive dust from road traffic or construction activity is a more persistent and significant source for China's cities.

L241-250: The findings based on EAE are very similar to those from FMF (L222-235). Consider merging them to be more concise.

L322-334: SSA depends on two factors - particle size and composition. It is expected that coarse mode SSA is less than fine mode SSA. I do not see the need for two SSAs for fine and coarse modes, separately. This paragraph presents no new findings and can be removed.

L349-351: The real part of refractive index is related to scattering, while the imaginary part to absorption. Does the author mean to say spring dust absorption increases the imaginary part (not real part)?

L377-378: AAOD values have very large uncertainties (standard deviation is comparable to mean). Why? Given these uncertain estimates, it would be difficult to make a robust comparison between sites.

L392, this paragraph seems redundant as the later part from L416 discusses EAE and AAE links to aerosol types.

L430-432: explain why the YRD region is "completely different from north/northeast China"

Figure 10: really bad visualization. Consider other options, like histograms.

L483: do you intend to say "large surface reflectance (or albedo)"

Section 4 should be shortened. There is no need to repeat all results. There should be one or wo paragraphs discussing the implications of the most important findings.

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