

## ***Interactive comment on “An overview of meso-scale aerosol processes, comparison and validation studies from DRAGON networks” by Brent N. Holben et al.***

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This is an overview paper that introduces a special issue highlighting scientific results from the 13 AERONET DRAGON networks deployed around the world, beginning in 2004. The paper begins from AERONET, identifying the successes and limitations of the AERONET network. This discussion emphasizes the AERONET sky inversions of aerosol intensive properties and the lack of comprehensive validation or even comparison of these retrieved properties with in situ measurements. Then the paper introduces the DRAGON campaigns “. . .to foster collaboration and comparison of the remote sensing community and in situ community of measurements and retrievals of the intensive properties of aerosols. . .”. There is a short description of each individual

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DRAGON, location, aerosol type and typical loading. The third section provides an overview of each paper in the special issue including a brief mention of results.

These special issue overview papers are very difficult to write. On one hand, one does not want to duplicate any of the issue's individual research papers. On the other hand, the overview paper itself has to make a contribution to science in its own right. There are parts of the current manuscript that I feel are very strong, but there are other parts that should be strengthened before publication. I will identify myself in this review. This is Lorraine Remer. If the lead author would like more input into the paper structure or presentation, he can contact me directly.

Major comments:

(1) The motivation for DRAGONS needs to be expressed better. I see three statements as to the purpose for DRAGONS.

Page 3 Lines 29-32: The series of Distributed Regional Aerosol Gridded Observation Network (DRAGON) campaigns arose primarily as a means to foster collaboration and comparison of the remote sensing community and in situ community of measurements and retrievals of the intensive properties of aerosols such as single scattering albedo, particle size distribution, complex index of refraction, etc.

page 6 Lines 34-35: The philosophy of the DRAGON campaigns was to establish a high density of ground-based sun and sky scanning spectral radiometers within a local or meso-scale region to capture small-scale aerosol variations.

Page 15, lines 8-10: The initial concept behind the DRAGON campaigns was for more accurate satellite validation and focus on in situ versus remote sensing comparisons of aerosol optical, radiative and microphysical physical properties.

There is more emphasis on the first motivation, and very little emphasis on the second reason, and the third reason is not stated until page 15 of a 17 page paper. Yet, when you look at the list of DRAGON papers only two papers (the Schafer papers) represent

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a comparison between Cimel retrieved intensive properties and in situ measurements. Maybe three papers, if you count the Eck paper, but Eck et al., are identifying a specific aerosol nucleation process. By far, the most common use of DRAGONS have been by the satellite community to validate/compare their products, especially finer resolution products, or to otherwise make use of the tighter grid of Cimels to study spatial variability, shoot between clouds etc.

Another point is that some of the earliest DRAGONS (e.g. CATZ, TIGERZ) were primarily motivated as CALIPSO validation points and to characterize spatial variability of the CALIPSO measurement curtain. At least that is what is stated in the manuscript:

Page 7 Line 26: "in support of CALIPSO satellite borne lidar validation"

Page 7 Line 39: "The CATZ campaign was the first AERONET IOP to support CALIPSO aerosol retrievals"

Finally the first statement in the conclusion has to do with satellite validation, which is only an after thought in the list of motivations.

I'm going into this level of detail, not to be picky, but to illustrate that it is hard on a reader to be set up with a certain set of expectations, and then be presented by a whole bunch of stuff orthogonal to the original set of expectations. I strongly recommend that the manuscript be written from the beginning with the perspective that the motivation for DRAGON is 3-fold, giving equal emphasis for the need to understand aerosol spatial variability across various landscapes and aerosol types, and the need for validation of satellite aerosol products that are moving to finer resolution and more difficult applications (air quality) and locations (Indonesian cloud cover).

(2) Table 1 and Table 2 need better explanation.

Each table is very informative. But the switch from the five aerosol types to the specific fine/coarse designations needs better explanation. Why? I have more comments on details from these tables below.

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### (3) Conclusions.

Is there any way that the authors can give real conclusions in this paper? Something like the Schafer result of a 0.01 bias in SSA retrievals. Are there any conclusions concerning the validity of AERONET retrievals of intensive properties (motivation 1). What about the spatial variability of aerosols? We've been quoting Anderson et al. [2003, JAS, 60, 119-136] now for 14 years. That conclusion was 100 km. There have been other papers since then calling into question a 100 km spatial length scale [e.g. Shinozuka and Redemann [2011, ACP, 11, 8489-8495]. Can the results from the special issue papers be synthesized "to suggest that the 100 km spatial length scale for aerosols is too simplistic a representation for the variety of aerosol regimes" or something better written than that. Finally, can the satellite validation papers be synthesized into some general statement, as well. Maybe something along the lines of "DRAGONS demonstrate that finer resolution satellite products can capture the mesoscale spatial variability of the aerosol, although also showing that modifications to satellite algorithms and assumptions may be necessary in order to achieve the required accuracy at these finer resolutions." I'm only writing from my own perspective. I have not read all of the papers.

Minor comments:

Page 2 line 12: more references to the literature are needed throughout the introduction. Each statement needs support, beginning from the first sentence.

Page 2 line 16. "is considered to be". The authors can make a stronger statement than that.

Page 3 line 13: again, references are needed to back up this paragraph

Page 3 line 37: "this issue" It is not clear what is the issue. I believe the authors mean that the AERONET retrieval products have not been validated for the breadth of aerosol types encountered and the full list of retrieved parameters.

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Page 4 lines 1-2: “Indeed, in addition to showing the paucity of comparison studies, it points to the need for a more accurate generic description of aerosol types beyond fine and coarse.”

Suggested rewrite: Indeed, in addition to showing the paucity of comparison studies, it points to the need for a more accurate description of aerosol types beyond these five generic multi-modal categories.

Page 4 Table 1 caption. Suggested rewrite:

Table 1. Principal intensive parameters measured by sun and sky scanning spectral radiometers for five aerosol types. Eleven published validations/comparisons of these retrievals against in situ measurements were made during field campaigns over the last 16 years; these are Ra=Ramanathan et al, 2000; Re=Remer et al., 1997; H=Haywood et al, 2003; L=Leahy et al., 2007; B=Bergstrom et al., 2003; Chand et al., 2006; E=Eck et al., 2010; Rp=Reid et al, 2003; Ru=Reid et al., 2008; S=Smirnov et al., 2003; Sc=Schafer et al., 2008; T=Toledano et al., 2011; O=Osborne et al., 2008 and J=Johnson et al., 2009. Note that most categories are incomplete, and most studies are regionally based, not updated for the current retrieval algorithm and/or not relevant to total column ambient retrievals.

Page 4 Table 1. What do + and – signs indicate?

Page 4 Table 2 caption. Suggested rewrite:

Table 2 The the aerosol types detectable from remote sensing (RS) techniques and compared with in situ field measurements. We show only those direct RS/in situ comparisons. Unlike Table 1, here the aerosol type describes the properties of the aerosols rather than sources. We acknowledge that aerosol typing is difficult and still subjective and and incomplete. (C=Corrigan et al., 2008; E=Esteve et al., 2012; Sc=Schafer et al., 2014, 2017 in preparation). Some studies appearing below are defined in Table 1.

Page 5 lines 15-16. I’m confused. The retrieval gives % sphericity. It can’t assume

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spherical models entirely.

Page 5 line 25. Typo: Ben-Ami

Page 6 line 20. There is no bold type in the table, though it is mentioned here.

Page 8 line 41. Is there a published reference for DISCOVER-AQ? There should be by now.

Page 13 line 6. SEAC4RS was 2013; KORUS-AQ was 2016. Shouldn't these sections be switched? Also shouldn't CATZ come before TIGERZ?

Page 13 line 25: it's should be its

Page 14 Table 3. Discov AQ should be DISCOVER AQ. I remember seeing it elsewhere without capital letters, but I don't see that no

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