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Atmospheric Measurement Techniques Discussions

Interactive comment on "Aerosol classification from airborne HSRL and comparisons with the CALIPSO vertical feature mask" *by* S. P. Burton et al.

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We thank the reviewers for their support and suggestions. Detailed responses to the suggestions by Referee #1 are given below.

First, the reviewer points out that the CALIPSO clean continental type is not a "fine aerosol type". Thank you for catching this. In the revised manuscript, we eliminate the phrase "fine aerosol types".

Next, on page 1819, the grammatical error "comparison with" is corrected in the revised manuscript.

As for the discussion of smoke, the reviewer's point is well taken. We acknowledge that aging is not the only factor affecting the lidar ratio or other observed optical properties of smoke. The HSRL-1 measurement record includes observations of smoke with a variety of lidar ratios, both high and moderate. Based on the limited sample of these measurements where the type is known from external information (that is, the cases that went into the "training samples" that the classification is based on), we observed empirically that the cases with lower lidar ratio tended to be those cases where the smoke was still close to the burning site and in the boundary layer. "Fresh smoke" is basically just a label and is somewhat provisional. We are interested in investigating the potential variety of causes for the differences in lidar ratio in our observations, by comparing with in situ measurements for example, but this work is outside the scope of this paper. For the current study, we describe the aerosol types from both the HSRL-1 and CALIOP classification algorithms to allow readers to judge when to expect agreement between them. The CALIOP aerosol scheme does not include a biomass burning type that has relatively low lidar ratios similar to the HSRL-1 fresh smoke type. Rather, there is only a single biomass burning type in the CALIOP classification, which is most appropriate for advected, aged smoke, and indeed has a high lidar ratio that corresponds with the HSRL-1 smoke (not fresh smoke) type. Our revision of this paragraph is shown below.

> The final type, fresh smoke, was based on known cases of fresh, visually distinct smoke plumes in the boundary layer close to the source, and classification results of this type usually indicate similar cases. These aerosols are also comprised of small spherical particles as indicated by the depolarization and backscatter color ratio measurements, and are primarily distinguished from other types by having lower lidar ratios (24–52 sr) than the pollution or smoke categories. This reflects similar findings by Alados-Arboledas et al. (2011) and Amiridis et al. (2009) who show that lidar ratio can be affected by the age of smoke. However, the optical prop-

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erties of smoke can depend on other factors besides age, and the label "fresh smoke" is an approximate description. There are other cases in the HSRL-1 dataset identified as fresh smoke that are not obviously associated with fresh smoke plumes, still under investigation. An initial comparison with in situ measurements shows new particle formation, which can be associated with sulfate or organics (S. Crumeyrolle, private communication, 2012), and which is therefore consistent with fresh smoke but does not rule out pollution-related aerosol. There is no equivalent type in the CALIOP aerosol classification scheme, which includes only a single biomass burning type.

Finally, the reviewer is correct that some abbreviations were not defined. We have corrected these in the revision.

In addition, we have found a slight error in the programming of the "Hybrid HSRL+CALIPSO Experiment" described in section 5. Fixing this error makes very small changes to the results presented here. Since this change is very small (a few percentage points for each of the type-by-type comparisons) and does not affect the discussion of the results in any significant way, we ask the editor's and reviewers' indulgence to allow us to make this additional correction that is not in response to any particular comment of the reviewers. The paragraph describing this experiment is copied below, with the changes shown in **bold**. We would also like to make a correspondingly small change to Figure 8.

The agreement from the hybrid HSRL-CALIOP retrieval compared to the HSRL-1 aerosol classification increases for some types and decreases for others, with respect to the previous comparison between CALIOP v3.01 and HSRL-1. Specifically, the best agreement is now in the polluted continental category. A large majority, 72 % **(71 %)**, of the layers identified as

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polluted continental by the hybrid system are dominated by the HSRL-1 urban type, which is greater agreement than the 54 % seen in the comparison of CALIOP and HSRL-1 classifications. Agreement in the smoke category also improves dramatically; 57 % **(51 %)** of the layers that the hybrid identifies as smoke are predominately smoke or fresh smoke in the HSRL-1 classification (up from only 13 %). On the other hand, agreement for the dust and marine categories decreases. Only 69 % **(68 %)** of the hybrid desert dust layers are considered dust or dusty mix in the HSRL-1 classification results (compared to 80 % for the comparison of the CALIOP and HSRL-1 classification results) and only 43 % **(42 %)** (compared to 62 %) of the layers identified by the hybrid as marine are dominated by marine in the HSRL-1 classification. For polluted dust layers, the comparison is still poor, with only 32 % **(33 %)** of polluted dust layers in the hybrid retrievals characterized as dusty mix in the HSRL-1 classification scheme.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 1815, 2013.

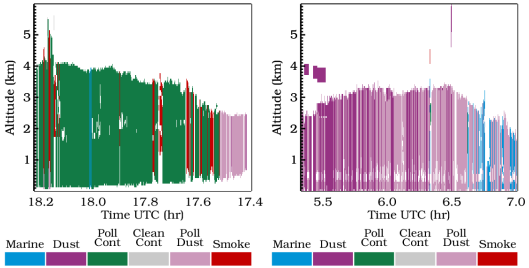

Fig. 1.

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Interactive Comment