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Atmospheric Measurement Techniques Discussions

Interactive comment on "Surface matters: limitations of CALIPSO V3 aerosol typing in coastal regions" *by* T. Kanitz et al.

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Response on reviews for: 'Surface matters: limitations of CALIPSO V3 aerosol typing in coastal regions' (Kanitz, et al. 2014)

Response on RC C177, Comments from Anonymous Referee 2

General:
Kanitz et al. have analysed CALIOP aerosol classification at coastal sites and concluded that due to the limitations in the CALIOP retrieval, the aerosol optical thicknesses are overestimated in these regions. The paper is well written and concise.

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Interactive Discussion
Discussion Paper

The issue with the surface-dependent marine aerosol typing in the CALIOP algorithm is evident, however, a numerical estimate of its effect has been missing. Therefore, I feel that the paper by Kanitz et al. brings new information to lidar research and I recommend its publication in AMT.

The largest shortcoming of the paper is the lack of extinction measurements from the ground-based lidar. This data would have enabled direct comparison with the CALIOP extinction profiles. However, the authors were able to make an convincing analysis by using the same lidar ratios as in the CALIOP retrieval.

The paper leaves some open questions, that should be addressed in the text before it can be accepted to AMT.

First of all, you should present the decision tree that CALIOP uses in the determination of the aerosol types. Please, explain in detail how the marine type is selected.
— In the introduction and throughout the paper we reference the main paper Omar et al., 2009, which gives a detailed presentation of the decision tree (Fig. 2). We emphasized the connection to this paper and added a more detailed reference to the relevant Fig. in Omar et al.
— adjustment in the text
Section 1: 'and smoke (SP=70sr)(**details of the aerosol type identification in Fig. 2 of** Omar et al., 2009; Lopes et al., 2013).

Why does the CALIOP retrieval choose mainly polluted continental, polluted dust and smoke aerosol types for the cases with marine aerosol over land? Why doesn't it select clean continental which would result in smaller overestimation in the AOD?
— The ground track of CALIPSO overflights crosses mainly grasslands, shrublands,

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and forests (Fig. 6, initial submission). Considering these three surface types, the decision tree in Fig. 2, Omar et al., 2009 indicates that clean continental aerosol is only possible, if the aerosol-layer-integrated backscatter coefficient is smaller than 0.0005. If this is not the case, polluted continental aerosol or smoke will be selected.
— We added this information to the discussion of Fig. 7.
Section 3.2: "**According to the measurements of CALIOP, clean continental aerosol, which is closest to the marine aerosol in terms of the lidar ratio (35 and 20sr) is of minor impact in the surrounding of Punta Arenas. The ground track of CALIPSO crosses mainly grasslands, shrublands, and forests (see Fig. 6). Considering these three surface types, the decision tree in Omar et al. (2009) indicates that clean continental aerosol is determined, if the aerosol-layer-integrated backscatter coefficient is smaller than 0.0005. If this is not the case, polluted continental aerosol or smoke are determined.**"

Figure 3d shows that CALIOP can classify some aerosol layers as marine over land? How can this be if the marine type is limited to sea surfaces only? Is it caused by the longer spatial averaging used for the thinner aerosol layers?
— Yes, it is caused by the spatial averaging. We mentioned this in the discussion on Fig. 7: "within the distance of the horizontal averaging in the CALIOP data algorithm off the water surface" (page 1344, line 18-20, initial submission). We added a comment for Fig. 3d as well. Section 3.1: " from land to ocean**, and in consideration of the spatial averaging in the CALIOP data**"

You suggest a new aerosol type for the CALIOP algorithm: mixed marine. How should it be defined in the retrieval and what kind of properties it should have (e.g. lidar ratio)? How far inland should this mixed marine be used and should it also be used over ocean near the coasts?
— A detailed proposal for this mixed marine aerosol is beyond this paper. The relevant spatial distribution of mixed marine aerosol may be first assessed with global

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aerosol transport models, that show the effect (aerosol amount and spatial distance) of ocean-to-land advection and land-to-ocean advection. The properties of the mixed marine aerosol needs to cover a mix of non-absorbing marine aerosol (20sr) and absorbing continental aerosol (e.g., 65sr). However, the CALIPSO science team is more capable to find the best solution.

What is the spatial extent of this overestimation in AODs by the CALIOP retrieval? I mean, how much is the global AOD overestimated due to this issue? And how much would the use of mixed marine aerosol type reduce this overestimation?
— In the presented paper, we added the 4 examples of coastal regions in the Pacific and Atlantic to attribute the relevance of the underestimated contribution of marine aerosol on a global scale. However, a more sophisticated approach would include a global aerosol transport model that is capable to assimilate CALIOP data and modified CALIOP data (with different contributions of marine aerosol in coastal regions). Such an investigation is beyond our work.

Specific comments:
Fig 3a: Is the length of the thicker red line correct (50S to 55S)? Other plots indicate that it should be from 52S to 54S.
— Figure 3a shows the ground track for Fig. 3b. Figure 3c and 3d represent the data subset as indicated in the white frame in Fig. 3b.
— adjusted in the text
Figure 3c presents the feature type mask of the data subset for the period indicated by the box with white frames in Fig.3b **(from 54 to 52S)**.

Fig. 4a: Mention in the text what kind of smoothing was used for the PollyXT and CALIOP backscatter profiles.
— The vertical resolution of PollyXT profiles is 30m. In the analysis the profiles are typically smoothed with a sliding-average window of 11 range gates. CALIOP aerosol

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backscatter profiles were taken from CALIOP L2 files with 60m resolution.
— adjusted in the text
Section 3.1. "backscatter coefficient at 532nm determined with PollyXT (green line, **30m vertical resolution with 330m vertical smoothing**) and CALIOP (black line, **60m vertical resolution**)."

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 1333, 2014.