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

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It is well-known that the CALIPSO retrieval algorithms take into account the surface type as one of the basic criteria used to determine the aerosol subtype. Three decisions based on the surface properties are made in the CALIPSO decision tree: (1) land vs. ocean; (2) snow/ice tundra vs. other type of surface; and (3) desert vs. other type of surface. Most aerosol classifications are possible both over land and over ocean (dust, polluted dust, biomass burning and polluted continental), whereas marine aerosol can only be selected over ocean and clean continental can only be selected over land. The aerosol subtype determines the lidar ratio, and hence the magnitude of the aerosol extinction coefficient. For a full description, see Omar et al (2009).

In the article by Kanitz et al, the effect of the land vs. ocean decision on CALIPSO retrievals is examined, in conjunction with the advection of marine aerosols over land. As expected, in this case a misrepresentation of the aerosols cannot be avoided, as the system is not allowed to use the marine subtype over land. The marine aerosol being the one that carries the lowest lidar ratio, the rather obvious consequence is that the extinction coefficient will be overestimated in this case. This could cause a bias in coastal regions.

Four hours of ground-based nighttime lidar data at Punta Arenas are compared to ~ 1 minute of CALIPSO data. This site was chosen because it is influenced entirely by marine aerosols, and the region surrounding it can be subdivided into both land and sea areas, offering an opportunity to verify the effect of the switch in aerosol type at the coastline. Not surprisingly, CALIPSO's classification algorithm fails to represent the marine aerosols over land, and the layers receive a classication as polluted continental or biomass burning (in both cases with a lidar ratio 3.5 times larger).

In addition, four months of ground-based lidar data are compared statistically to AERONET, and the effect of changing the lidar ratio (LR) is tested, showing how the larger LRs can bring a bias in the lidar data. After this, one year of CALIPSO observations at Punta Arenas are used to estimate the frequency of occurrence of the different aerosol subtypes, showing that the aerosol classification shows an unreasonably infrequent selection of the marine subtype.

After discussing Punta Arenas, the authors present four other similar patterns, in Mauna Loa, Tasmania, Ireland and Cuba. The effect of the discrepancies on solar radiation is also evaluated.

The research is of general interest, because CALIPSO is being used for global aerosol observations and climatologies, and the article is clearly written. I recommend its publication.

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Specific comments:

1. Westerly advection at Punta Arenas is dominated by the synoptic wind (see the meteorological description in the paper, page 1338, lines 1-7), and is therefore not a 'sea breeze'. Replace this term with 'advection from ocean to land' (abstract and article text).
2. Page 1335, lines 17-18: Ocean vs. land is not the only decision based on surface type in the aerosol classification scheme. Please briefly mention the other decisions based on surface type in the CALIPSO algorithms.
3. Page 1338, lines 8-10: add 'and further downwind from Punta Arenas' after 'Atlantic coast'.
4. Page 1338, lines 20-21: the words 'deficiencies' and 'corrupted' are too negative. I suggest a less negative wording. These are well-known limitations of the instrument, and not corruption of the data.
5. Section 2.2: The data analysis methods are unclear. Ideally, with a Raman lidar you would retrieve extinction and backscattering simultaneously and independently. However, lidar specialists are aware that the method may have limitations in daylight, and that other methods (e.g. Fernald-Klett) may have to be used at times. Some of the sentences suggest something like this, e.g. page 1339, line 5-6 stating that extinction is evaluated from backscattering using a lidar ratio (whereas for a Raman lidar it should be the other way around, and a LR should not need to be assumed). Clarify how the data are processed, and how this 'appropriate' LR is determined. Moreover, if the ground-based lidar permitted an evaluation of the LR of the marine aerosols, it would be very interesting to compare it against CALIPSO's assumed LR of 20 sr.
6. Page 1339, line 1: this sentence appears to be completely decorrelated with the rest of the paragraph.

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7. Page 1340, line 1: list all the CALIPSO aerosol subtypes.

8. Page 1340, line 5: CAD score threshold should be -90 rather than 90 (probably a typo).

9. Page 1340, line 6: 'contains particles', change to 'is likely to contain aerosols': (1) be possibilistic on the fact that the CAD score does a good job, and (2) clouds also contain 'particles' (droplets), therefore 'aerosols' is more appropriate.

10. Page 1340, line 22: as before, replace 'particle-free' with 'aerosol-free'

11. Page 1341, line 4: 'gave' → 'will show'; lines 6 and 7: 'are' → 'will be'; line 9: 'we finish' → 'we will finish'; line 12: 'is presented' → 'will be presented'.

12. Figure 3c-d and page 1342, line 3: the circumstance of aerosols below clouds should be tested at the stage of the initial data quality check. It would be advisable to discuss how the cloud affects the uncertainty on the underlaying aerosols.

13. Figure 3c and page 1342, line 10: it seems that the boundaries of the marine aerosols extend to more than just the region showing a water surface. This should however be impossible in CALIPSO. Please explain.

14. Page 1343, line 20: 'Fig. 5c' → 'Fig. 5d'

15. Page 1345, lines 1-3: provide a comment on the unreasonable result regarding aerosol classification at Punta Arenas. As presented now, this paragraph shows interesting data on what aerosol subtypes are detected. Moreover, it is clear from other parts of the paper that you would expect marine aerosols for most of the time. But you have not added any sentence linking the two, and pointing to this discrepancy. This makes it unclear.

16. Page 1346, line 17: 'SARE' → 'SARE, determined using libRadtran'

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17. Page 1348, line 11: ‘a case study’ → ‘this case study’

18. Page 1348, lines 22-23: could an aerosol transport model be usefully exploited for the CALIPSO aerosol subtyping, and thus for avoiding these abrupt changes of the LR at the coast line?

19. Page 1348, line 26: please describe the mixed marine aerosol type that you are proposing, and how it is to be determined in the CALIPSO decision tree.

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