Atmos. Meas. Tech. Discuss., 8, C315–C318, 2015
www.atmos-meas-tech-discuss.net/8/C315/2015/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Joint retrievals of cloud and drizzle in marine boundary layer clouds using ground-based radar, lidar and zenith radiances" *by* M. D. Fielding et al.

Anonymous Referee #1

Received and published: 16 March 2015

General comment:

The authors present a well described technique to separate the contribution of cloud and drizzle from measurements with Sun Photometer, cloud radar and microwave radiometer. This is realized by means of an optimal estimation approach. The approach sounds reasonable, but I see some limitations and sources for uncertainties not well represented. Also some additional questions and comments popped up during reading. I would nevertheless recognize my comments as minor. Basically, the manuscript is suited for publication after the following comments have been considered in a revised version.

Content-related comments:

General: It should be emphasized that the retrieval of the MWR is not valid anymore, when multiple cloud layers are present. This is also the case for the sky radiance measurement which is in addition affected by cirrus clouds. To my feeling the short note on that issue in Line 31-32 on Page 23 does not sufficiently emphasize this limitation.

P2-L18-20 : Cloudsat has 500-m vertical resolution. How will it help to resolve drizzle processes in Sc clouds?

P4-L9-11: Please provide references or manufacturer information for the used instruments. I was hoping to find that information in the reference to Lewis & Teixeira 2014, but this reference was not listed in the reference list.

P4-L24: To my knowledge there is no attenuation retrieval presented in the paper of Illingworth. -Sun Photometer: - How does pitch-and-roll of the ship affect the zenith radiance measurement? What happens to the measurement of a vertically pointing Sun Photometer when drizzle reaches the ground as it happened in the MAGIC case study (Fig 13) at around 20.1 and 20.5-20.6 UTC?

- What information on the transition region between cloud and drizzle will the method reveal? Can there be conclusions drawn on (auto-)conversion rates?

-What does an error of 10-20 g/m^2 (see abstract) in the cloud water path mean, when it is contained in the drizzle instead of the cloud or vice versa. Distribution an additional 10-20 g/m^2 into the drizzle may result in more precipitation. Distributing it into the cloud will produce increased optical depth. Can the effect be estimated based on the used size distributions and size-fall-velocity relationships of Beard (As described in Sec. 5.2.2)?

-Sec 3.3.2 – attenuated backscatter. First, the shown formulation (eq 15 and 16) is different compared to the common one. In the present case it does not include the molecular extinction and backscatter coefficient (as, e.g., CALIPSO). Better refer to

it as the 'liquid water attenuated backscatter coefficient'. Second: Aerosols can produce quite significant backscatter coefficients which can easily be in the same order of magnitude as the values produced by drizzle. Can the error of an aerosol-increased attenuated backscatter on the drizzle retrieval be estimated for different aerosol loads? E.g., taking the aerosol loads of the two LES studies as reference? (see next question). -P 13 – 2nd Paragraph: Into what kind of size distribution are the aerosol particles distributed? What is the resulting aerosol backscatter of these aerosol concentrations? What is the ratio between the aerosol backscatter and the drizzle backscatter in the model (A question that is related to the previous comment)?

- Another comment on attenuated backscatter within clouds: Signal attenuation and detector responses (afterpulsing) are huge problems, when an aerosol-optimised lidar system is used for low-cloud observations. Was this problem considered in the data analysis? P15, L7-8: Is there a reference to the vertical structure of Nc?

- Sec. 4 – LES Simulation: How do the modelled droplet size distributions fit to the assumed logarithmic (cloud droplets) and gamma distributions (drizzle)? Would it be possible to separate droplets that formed according to Koehler theory (vapour diffusion) from droplets that form by autoconversion?

P24-L19: What are these 'additional difficulties of ship-borne observations'? How does the drizzle retrieval method of O'Connor 2005 perform in comparison to the presented one?

Writing style:

P1-L 17: 'clouds'

P2-L16: 'clouds'

P7-L15: 'assumptions'

P7-Eq 1: Is it the same equation as previously used by Frisch? Maybe it's worth to mentioning this.

P9-L12: '. . .within the cloud . . .'

P14-L8: '. . .define the cloud . . .'

P23-L10: '. . .lead to a retrieved. . .'

P24-L1: '. . .non-drizzling clouds . . .'

P25-L6: . . .retrieval of . . .

Figure 1: Can constrained and relaxed mode be marked in the scheme?

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 1833, 2015.