General Comment: As the first part of a serial study of "high IWC-low Z_e" condition that coincide with jet engine power loss, this paper utilized the microphysical properties including IWC, mass size distribution, and derived Z_e sampled during 2010-2012 Airbus campaign to reveal the possible meteorological scenario for that condition. Surprisingly, consistency was found among documentation, in situ measurements, satellite retrieval, surface radar observations, and model simulations, which validate the common occurrence of "high IWC-low Z_e" condition. This paper is definitely suitable for publication because of its meaningful inspiration in aviation safety. However, a couple of improvements should be made in order to promote the quality of this study.

Major comments

1. In the title, the authors clarify that the "high IWC-low Z_e" condition happens in "near deep convection" regions. As a result, in the abstract and following discussion of Airbus sampling, "stratiform rain" becomes the major focus. The question then arises, how does the cloud classification work in this study? Figs. 13 and 14 demonstrate the separation of convective and stratiform on radar images, however without a detailed description of classification algorithm. Even for the same condition that Z_e less than 30 dBZ at 11 km (I assume this 30 dBZ value serves as the threshold of classification because it appears on 6 times related to cloud classification discussion throughout the entire paper), it could either be authentic stratiform or the vertical extension of weak convection, and only the examination of entire radar reflectivity column could separate those. The following figure gives an example of radar cross-section associated with UND CSA classification results sampled during MC3E campaign. Clearly, cloud classification can't separate weak convective and stratiform regions based on only near the cloud top Z_e values, because there is no significant discontinuity in Z_e between those two cloud types. Furthermore, the microphysical properties (even at temperatures < -20 ^{o}C) between convective and stratiform regions are quite different, and the readers could argue that the identification of "high IWC-low Z_e" condition could attribute to the weak convection was mistakenly classified as stratiform due to the lack of 3D cloud information.

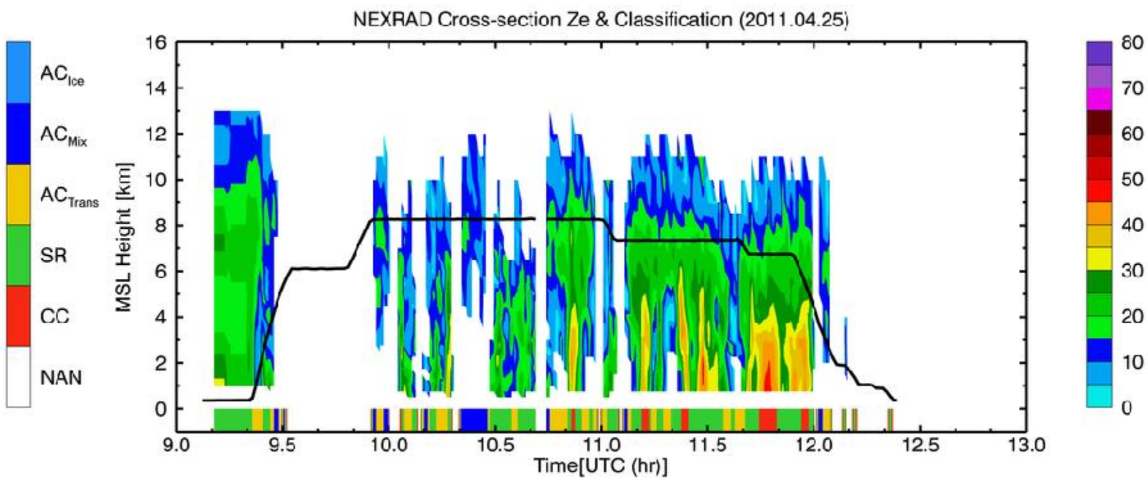

Figure 1. NEXRAD radar reflectivity cross section (contour above 0 km MSL, refer to the color bar on the right) along the UND Citation II track (black line), and UND CSA cloud classification results (contour below 0 km MSL, refer to the color bar on the left) on 25 April 2011 during MC3E campaign.

2. The morphology should be further discussed, because it is the key explanation of the "high IWC-low Z_e" condition. This study could be carried out from two aspects: (1) By examination of OAP images; (2) Rather than directly applying LH74 relationship to calculate IWC and Smith [1984] method to calculate Rayleigh radar reflectivities, various mass-dimensional relationships and corresponding area-dimensional relationships were developed for different ice crystal habits [Mitchell, 1996], and those relationships should be adopted for better estimation of IWC and Z_e values.

3. Contrary to the assumption that liquid contributions are considered negligible for temperatures colder than -20^{0}C, Rosnefeld et al. [2013] found the common occurrence of highly supercooled drizzle and rain near the coastal regions of the western United States even at colder temperature. There is still possibility of supercooled liquid droplets anywhere warmer than -40^{o}C, so rather than a fixed temperature threshold, phase separation is suggested if proper instruments are available (like icing detector, CDP, or hot-wire King LWC probe, etc.). Thus, the contamination from supercooled liquid droplets could be eliminated, because as the authors mentioned in the introduction, the role of supercooled liquid water was caused confusion.

4. Instead of number size distribution, mass size distribution is intensively investigated in this study, and the solid conclusion is derived that particles within the size range from 150 to 600 micron contribute a large portion of IWC, which is a very interesting feature associated with "high IWC-low Z_e" condition. However, mass size distribution is still a derived bulk property, and in this case it is roughly the second moment representation of original number size distribution. It would be nice that the authors could release the number size distribution information without any assumption imposed, because after gamma or exponential functions were fitted to observed number distribution, the fitted parameters could serve as indicators to testify the cloud classification algorithm used in this study, and comparison with previous stratifrom studies becomes easier.

5. If the "high IWC-low Z_e" condition commonly exists, does it mean there will be bright band of high IWC near the cloud top based on retrieval from radar observation? Surprisingly, even the IWC values were lower than this study, the discontinuity in Z_e-IWC relationship studies were found by Heymsfield [2005] (Figure 10) and further discussed by Wang [2015] based on in situ measurements of stratiform rain. From the following figure, the jump in IWC clearly takes place at the Z_e value range from 12 to 15 dBZ, and it was caused by the drastic changes in the overall shape of number size distribution as discussed by Wang [2015] in section 3.4 and Figure 10. This is another reason why detailed investigation of number size distribution is necessary.

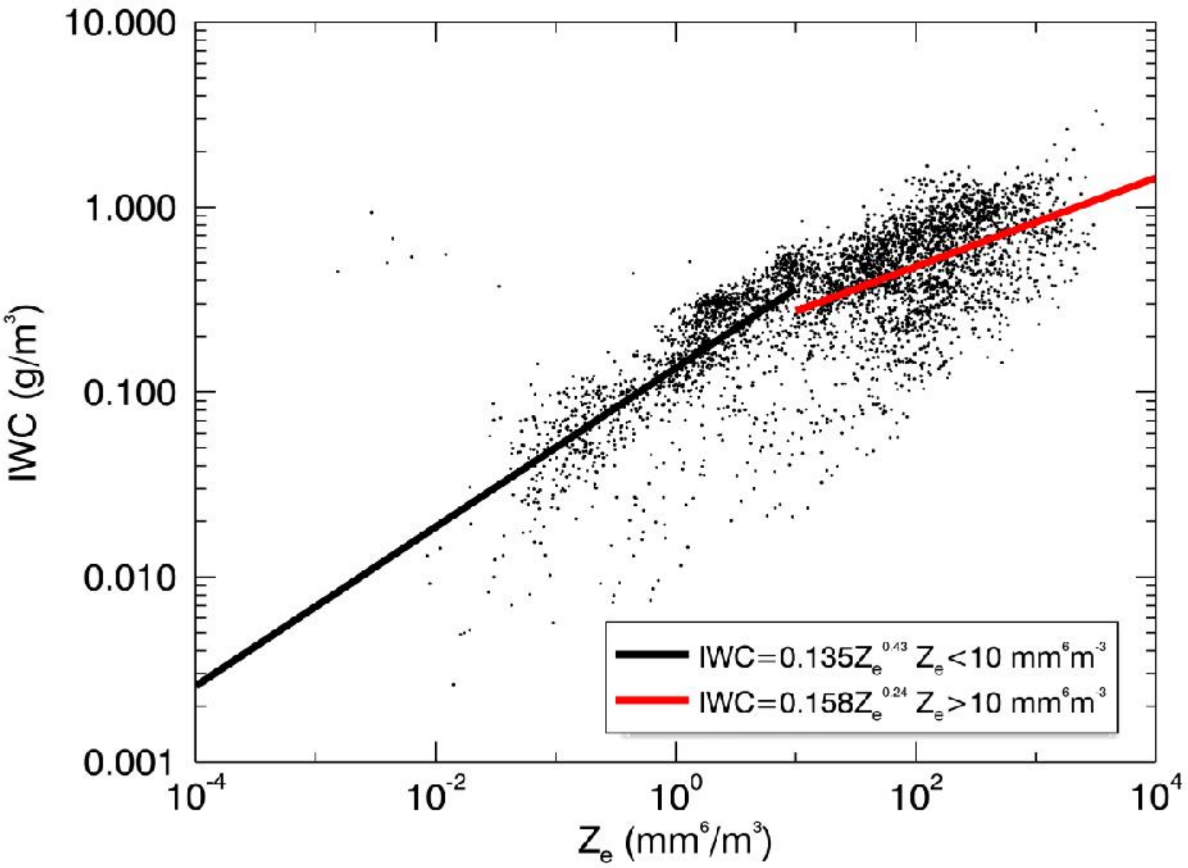

Figure 2. The Z_e-IWC scatter plot based on in situ observations from selected stratiform cases during MC3E campaign.

Minor comments,

Page 16509, line 9, ‘identifed’ should be ‘identified’.

Page 16521, line 26, ‘Reflecitivity’ should be ‘Reflectivity’.

Reference

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