Interactive comment on "Microphysical properties and high ice water content in continental and oceanic Mescoscale Convective Systems and potential implications for commercial aircraft at flight altitude" by J-F Gayet et al.

Reply to Reviewer # 3

We thank the reviewer for his detailed review and valuable comments. The manuscript has been modified according to the suggestions proposed by the reviewer. The remainder is devoted to the specific response item-by-item of the reviewer's comments :

1. … Although the use of existing retrievals is necessitated by the fact that there are no in-situ measurements existing in such conditions, I think this caveat of the retrieved quantities and the corresponding large uncertainties should be better emphasized in the manuscript. These issues are mentioned in the manuscript, but can anything more quantitative be done to characterize these effects?

Section 5.1 (Ice water content) has been re-written in order to better emphasize the large uncertainties on retrieved quantities (see revised version of the manuscript) particularly regarding the comparisons between MCS IWC-Z scatterplot and the relationships obtained from in situ observations related to the continental convective cloud (26 May 2007). It is found that the relationships obtained from in situ observations related to the outflow cirrus observations (2007) roughly fit the retrieved IWC-Z relationships (C2B and DAR) This is a consistent feature since the retrieving techniques use forward model assumptions mainly based on experimental results obtained in anvils and/or outflow cirrus. On the contrary, for the core of the convective cell the IWC-Z relationship would produce much larger IWCs by about one order of magnitude than the more standard relationships. This feature is discussed in the revised manuscript via the unusual particle shape of numerous small ice crystals, the significant shortcomings which occur on IWC and Z derivations from in situ measurements and the systematic errors on in situ measurements due to the contamination by the shattering of larger ice crystals on the probe tips.

To better characterize these effects we refer to Matrosov and Heymsfield (MH, 2008) who analysed various cloud types and geographical regions. They concluded that the derived IWC-Z relations are likely to be applicable to a wide variety of precipitating cloud systems. This important result makes very interesting to superimpose on the MCS IWC-Z scatterplot the relationships obtained from in situ observations related to the continental convective cloud (26 May 2007).

It is concluded that new generation of cloud instruments with specially designed tips and electronics may now provide much more accurate in situ measurements (see for instance, Korolev et al., 2013). Therefore, relevant IWC-Z relationships should be obtained in order to better describe the core of deep MCS.

2. I should also point out that many of the papers that are referenced for the in-situ analysis (e.g., Ivanova et al. 2001; Knollenberg et al. 1993) consist of observations that are highly biased by the presence of shattered artifacts in the data. When these papers are referenced, caveats about the use of these data due to artificially high concentrations of small ice crystals should be noted.

The reviewer is right, past measurements carried out with former FSSP version should be affected by ice shattering effects. This caveat is considered in the revised version regarding the subsequent references. The Knollenberg's reference (1993) has been suppressed and a comment has been added in the introduction as the following :

… Although FSSP ice particle concentrations are generally overestimated due to shattering effects (see among others Korolev and Isaac, 2005) these unusual observations could be important regarding engineering issues related to the failures of jet engines and Pitot tubes commonly used on commercial aircraft during flights through areas of high ice water content (Lawson et al., 1998, Strapp et al., 1999 and Mason et al., 2006). …

The Ivanova et al. (2001) paper is cited because we refer to bimodal spectra which are often observed in warm thick midlatitude cirrus