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Interactive comment on "Probabilistic model of shattering effect on in-cloud measurements" *by* V. Shcherbakov et al.

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First of all it should be underscored that the comment example uses as the input data not only the actual size distribution of particles in the atmosphere but also the size distribution of cloud particles that are assumed to remain free of shattering and the size distribution of cloud particles that were shattered. If one applies the terms of our probabilistic model (PM) to the comment example, then: (i) one larger and one smaller particle is equivalent to the n0(d) distribution of the PM, (ii) one smaller particle (the subset 1) is equivalent to the n1(d) distribution of the PM, and (iii) one larger particle (the set 2) is equivalent to the n2(d) distribution of the PM.

The set 2, i.e., the equivalent to the n2(d) distribution, is the source of fragments.

In other words, the comment example begins with the PM scheme outlined in Section 2.1 of the ACPD paper. The main difference is that the PM scheme considers the probabilities p1 and p2 as functions of the inlet- and particles diameters.

As a matter of fact, Fig. 3 of the comment is in total agreement with Fig. 6 of the ACPD paper. The errors are nonlinear functions of the effective diameter of fragments. And, the errors in numbers of particles are higher than the errors in the extinction. Moreover, if the input data of the comment example are used, Eqs. (10) and (15) of the ACPD paper give exactly the curves and the values of Fig. 3 of the comment. The equations of Section 2.2 and the comment code (Fig. 2) are based on the same relationships between integral microphysical parameters. Thus, it is reasonable that they give the same results when the input data are the same.

Section 2.2 of the ACPD paper provides analytical equations that express the effect of shattering in terms of integral microphysical parameters. The main objective is to obtain expressions that are as simple as possible in order to assign the key parameters that govern the efficiency of ice shattering. It is seen from Eqs. (2) and (5) that the ice water content (IWC) of cloud particles that were shattered depends on fourth and fifth moments (not directly on the effective diameter deff0) of the actual size distribution n0(d) of particles in the atmosphere. In that sense the term "depend on the shape of the size distribution" is used in the text of the ACPD paper. As a consequence, the analytical expressions of the errors are too complex. To the contrary, when the integral parameters Ext2 and deff2 are used, Eqs. (10), (12) and (15) contain the characteristics that have clear meaning for the scientific community. We recall that deff2 and Ext2 are, respectively, the effective diameter and the extinction of the n2(d) distribution, i.e., of cloud particles that were shattered.

The corresponding explanation will be added to the end of Section 2.2 of the revised paper.

As for numerical experiments that investigate the dependence on the effective diameter of the set of particles that gets shattered, a code like the comment code (Fig. 2 of the comment) and the equations of Section 2.2 lead to the following relative errors:

dENTOT = 0.5*{(d2/deffF)**3-1.0},

dEXT = [d2**2/(d1**2+ d2**2)]*{(d2/deffF)-1.0},

where d1 and d2 are the diameters of the smaller and the larger particle, respectively. All fragments have the same diameter deffF in the comment code. (The results of the comment code can be expressed as equations because the random numbers generator RAND is used just to vary the input parameters, i.e., the number of fragments.) It is reasonable that the errors dENTOT and dEXT depend, first of all, on the diameter d2 of the larger particle that was shattered. We recall that d2 is equivalent to the deff2 of the PM.

The authors prefer do not include this simple investigation into the manuscript. At the same time, the authors hope that the paper became better understandable when the connection of our results with the comment example is established.

The extinction efficiency Q equal to 2 is assumed according to the large particle approximation. For very small spherical or nonspherical fragments, Q can have the value about two times higher. This leads to increasing of the shattering effect. This text will be added to Section 4.1 of the revised paper.

The abstract and the conclusions will be revised. The following text will be added:

The model is simple, wholly probabilistic (physical processes are not considered), and a number of simplifications and assumptions are used, i.e., all cloud particles and all fragments are supposed to be spheres, the spatial distribution of all ice fragments is hypothesized to be homogeneous, the fragments which go inside the inlet only originate from the particles that have to be sampled and are shattered, the conservation of mass holds true, the width of the tip of the inlet is assumed to be a negligibly small

quantity, the extinction efficiency has a constant value (equal to 2) even for the smallest fragments.

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