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Interactive comment on "A bulk parameterization of melting snowflakes with explicit liquid water fraction for the COSMO model version 4.14" *by* C. Frick et al.

Anonymous Referee #1

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The authors publish a new method about numerical simulation of melting of snowflakes. The scheme is implemented into the NWP model, COSMO. Most of the numerical models have been applied for operational weather forecast involve a simplified description of the melting. Immediate shedding of melted water from the surface of snow and graupel particles is supposed in these models. This idea does not agree with the laboratory observations, e.g. Mitra et al. 1990 proved that the melted liquid water accumulated on the snowflakes. The author's numerical model corresponds with these observations. Following the result of Szymer and Zawadsky (1999) they developed a new bulk scheme to simulate the melting of snowflakes. However, the author used the amount of melted water as a prognostic variable instead of the critical diameter was

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suggested by Szymer and Zavadsky (1999). I agree with this modification, because the mass is a conserved variable. Beside the detailed description of the model, the paper involves two hindcast studies. The comparison between the 'standard' and the new scheme shows, that the more sophisticated simulation of melting improves the forecast of mixed phase precipitation. After minor revisions the paper is worth to be published in Geoscientific Model Development. Major comments: (i)Fig1a. shows the size dependence of the capacitance of dry and wet snow flakes. In my opinion the calculation of capacitance may be incorrect. Contrary to the plots in the figure the capacitance of the water drops should be the smallest (0.5*Deq), if the masses (or Deq) are the same. The physical base of this statement is: if masses are equal, the surface of a sphere is smaller than that of an oblate spheroid or that of a hexagonal plate. In my opinion the source of this problem is that the mass – size relation of m $\sim$ D2 is used for the melted particles as well. The problem can be solved if both the exponent and the multiplication factor (α) are given as a function of the liquid water fraction.

(ii)If I understand well the snow means the sum of melted water and ice core in Fig9b. I think it would be also interesting to plot a similar figure by taking into consideration the ice core only. Comparison this figure with Fig9a would show how the application of new scheme affects the melting rate.

Minor comments: The colors of contours in Fig 5. do not agree with text in the figure caption.

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