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Introduction of an extended snowflake melting scheme for the COSMO model

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The prediction of surface snowfall poses particular challenges to numerical weather prediction models and requires detailed knowledge of the involved processes. Particularly criticial is the accurate simulation of precipitation type (snow or rain) in case of near-surface temperatures slightly above 0°C, when falling snowflakes start melting. In this study, the major focus is on the microphysical treatment of the snowflake melting process in the COSMO model. The standard microphysics of the model assumes that snowflakes only consist of ice and that the water generated by melting snowflakes is instantaneously converted into rain. This simplification might lead to an accelerated melting process and to inaccuracies in the sedimentation of snowflakes. Also, with the standard scheme, no partially melted snowflakes can be represented by the model, which are essential, e.g., for the formation of "bright bands" as observed by radar.

In this study, a refined snowflake melting scheme for the COSMO model is introduced that allows the prediction of partially melted snow. This requires including the mixing ratio of meltwater of snow as a new prognostic variable and therefore new descriptions of various snowflake parameters as the sedimentation velocity and the ventilation coefficient. The concept of the novel parameterization will be introduced and results will be shown of idealized experiments with (i) an individual melting snowflake and (ii) a one-dimensional version of the COSMO model. Furthermore, first results of full COSMO simulations with the extended snowflake melting scheme will be presented. The mixing ratio of the meltwater of snow, which is introduced as an additional output parameter, can then be used for comparisons with radar observations of "bright bands".