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A mixed-phase precipitation simulation scheme that predicts different types of winter precipitation

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Winter storms are often associated with a wide variety of precipitation types. At temperatures near 0ºC, particles composed of both ice and water, called mixed-phase precipitation, can be formed as well as pure liquid and pure ice particles. Many of these types of precipitation, such as wet snow and freezing rain, can cause major problems to society. Currently, forecasting models use empirical techniques to predict precipitation types. The objective of the study is to focus on the physical mechanisms leading to the formation of precipitation types at temperatures near 0^{o}C in order to eventually develop physically-based techniques for their prediction. To address this issue, we used a double moment microphysics scheme originally developed for a summer storm. This type of scheme predicts the total concentration and mixing ratio for each category of precipitation defined in it. We modified the scheme by adding detailed calculations of the melting of snowflakes and the freezing of mixed-phase precipitation and we accounted for the occurrence of mixed-phase precipitation. Under the same environmental conditions, this new parameterization led to the production of a much wider, and a more realistic, range of precipitation types than possible with schemes not accounting for mixed-phase precipitation. In comparison with available observation of winter precipitation types, the scheme also showed strong consistencies. Overall, this semi-melted particle simulation scheme predicts many different types of winter precipitation, thus giving a more complete representation of microphysical processes that can lead to disastrous conditions in winter storms.