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Three dimensional fog forecasting in complex terrain

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Fog in complex terrain shows large temporal and spatial variations that can only be simulated with a three-dimensional model, but more modifications than increasing the resolution are needed. For a better representation of fog we present a second moment cloud water scheme with a parametrization of the Köhler theory which is combined with the mixed phase Ferrier microphysics scheme. The more detailed microphysics produce many differences to the first moment Ferrier scheme and are responsible for reproducing the typically low liquid water content of fog. With explicitly predicted droplet number concentrations, sedimentation of cloud water can be modeled without a prescribed fall speed, which mainly affects the vertical distribution of cloud water and the end of the fogs life cycle. The complex topography of the Swiss Alps and its surroundings are used for model testing. As the focus is on the models ability to forecast the spatial distribution of fog, cloud patterns derived from high resolution MSG satellite data, rather than few point observations from ground stations are used. In a continous five day period of anticyclonic conditions, the satellite observed fog patterns showed large day to day variations with almost no fog to large areas of fog. This variability was very well simulated in the three-dimensional fog forecast. The simulations also demonstrate the need for high horizontal resolutions between 1 and 3 km. For model initialization the complex topography is actually a simplifying factor, as cold air flow and pooling are dominating the more uncertain processes of evapotranspiration or errors in the soil moisture field.