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Weather radar signatures derived from simulated volcanic plumes

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Explosive volcanic eruptions form ash clouds that pose a severe threat to aviation safety and to infrastructure on the ground. For the prediction of the plume track and ash fall it is necessary to know the characteristics of the initial plume in terms of its size, height and its particle concentrations and size distribution. The differentiation between ash particles, pure hydrometeors like ice crystals and aggregates is important because the ash signal can be obscured by the presence of water and ice in the plume. Since direct observations of volcanic plumes are nearly impossible, remote sensing techniques, like microwave weather radar, offer a unique tool to gain valuable information about the plume and its particles. In order to adequately test the retrieval algorithm for deriving the physical plume properties from radar signals, independent measurements of plume characteristics are required. Numerical modeling of the plume provides a unique opportunity whereby all physical parameters are known to very high temporal and spatial resolution without observational errors.

For this purpose we applied the plume model ATHAM (Active Tracer High Resolution Atmospheric Model) to the eruption of the Etna volcano in 2002. Radar reflectivities were calculated for the simulated volcanic plume under different assumptions and scenarios and compared to the corresponding available C-band radar observations.