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Numerical quantification of sources and phase partitioning of chemical species in cloud at the Puy de Dôme station

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The Model of Multiphase Cloud Chemistry M2C2, describing the chemical and microphysical evolution of clouds, has been applied to multiphase measurements available at the Puy de Dôme station for typical wintertime anthropogenic air mass. The comparison of the simulated ion concentration in cloud water to the measured ones shows a reasonable agreement. The analysis of the chemical species sources in cloud water shows an important contribution from nucleation scavenging of particles which prevails for nitrate, sulphate and ammonium. The simulated phase partitioning of chemical species in cloud are compared with measurements. Numerical results show an underestimation of interstitial particulate phase fraction compared to the measurements, which could be due to an overestimation of aerosol activated mass by the model. However, the calculated number scavenging efficiency for particles agrees well with the measured value of 40% of aerosol particles activated in cloud droplets. Concerning, the origin of chemical species in cloud water, the model reproduces quite reasonably the contribution of gas and aerosol scavenging estimated from measurements. Moreover, the simulation is also able providing the contribution of in-cloud chemical reactivity to cloud water concentrations, that cannot be obtained directly from the measurements.