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Predicting the vertical distribution of particle number concentration using the 3-D regional CTM PMCAMx-UF: relevance of high altitude nucleation and transport and cloud properties

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The three-dimensional chemical transport model PMCAMx-UF was used to predict the aerosol number concentrations (N) over the Europe domain during May 2008. We implemented the more sophisticated approach called Tropospheric Ultra-Violet and Visible (TUV) radiative transfer model (NCAR, 2011) to treat the cloud effect on photolysis rates. The changes in Sulfuric Acid and particles number concentrations anticorrelate at the ground level (and below clouds) while correlate above clouds. This is because updated version of the model including TUV module simulates higher radiation above the clouds resulting in stronger new particle formation in higher altitudes which are eventually transported to lower levels. For example, mean-percent-differences are 9 and -41 % in N_3 and H_2SO_4, respectively, below clouds (cloudy regions with cloud optical depth τ >50 was chosen) and 12 and 210 % above cloud at May 5, 2008 12:00 UTC. The vertical profiles of particle number concentrations were evaluated against the measured data from EUCAARI-LONGREX campaign. Results indicate that the model is slightly overestimating the particles in nucleation mode range over the ground-level altitudes. However, the model shows a significant agreement with the measurements for the N_4 (i.e. particles larger than 4 nm) and also N_{10} over all altitude levels.