



New particle formation in rural areas – what is behind the story?

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New particle formation has been observed at almost all sites, where both particle number concentrations and size distributions have been measured. Although many field campaigns, laboratory experiments and new modelling approaches have led to increased understanding, detailed mechanisms responsible for the formation of new particles in the troposphere have still not been completely elucidated.

In MALTE (Model to predict new Aerosol formation in the Lower Troposphere) individually developed codes from different institutes around the globe merged into a one-dimensional model including aerosol dynamics, boundary layer meteorology, biology and chemistry in order to investigate the formation and growth processes of Secondary Organic Aerosols (SOA) under realistic atmospheric conditions. Our knowledge concerning the formation of very small particles or clusters is still limited. The question of which molecules are involved in the atmospheric nucleation processes remains controversial within the aerosol community. MALTE takes several hypothetical nucleation theories into account for the formation of secondary aerosols.

To test the different hypothesis concerning atmospheric nucleation we used data from several field stations in Europe, USA, Africa and Australia. Furthermore, we investigated the role of certain organic vapours in the particle formation processes during intensive laboratory chamber experiments at NCAR - National Centre for Atmospheric Research in Boulder, Colorado, USA.

Initial model simulations performed with the activation or kinetic nucleation mechanism predict nucleation rates that are strongly correlated with observed nucleation rates at background areas like boreal forest in Finland or somewhat more polluted areas east of Leipzig, Germany. In addition, many chamber experiments raise the possibility that organic vapours may form new particles by organic nucleation. Regarding the possibility that organic vapours can nucleate, as apparently observed in several chamber experiments, we estimated with MALTE that even with low SO₂ concentrations, sufficient sulphuric acid is generated to explain observed particle number concentrations via the activation or kinetic nucleation mechanism alone. To investigate the possibility for nucleation of organic vapours we included in MALTE a parameterization developed by Bonn et al. (2008). Calculated nucleation rates with the organic nucleation code for data achieved during a field campaign in USA and the chamber experiments at NCAR showed high agreement with the measurements. It is currently not possible to draw a final conclusion if nucleation of organic vapours in the real atmosphere is present and if yes how important it is compared to other nucleation mechanisms.

