

# New research results change the understanding of atmospheric aerosol properties and climate effects

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Terrestrial vegetation and atmospheric photochemistry produce large amounts of fine particles in the atmosphere, thereby cooling Earth's climate. According to new research published in the Oct. 14 issue of *Nature*, the physical state of the fine particles produced by coniferous forests is solid, whereas previously scientists have assumed that these particles were liquid. The new findings have major implications for our understanding of particle formation processes, for the transformation of particles in the atmosphere and for their effects on climate.

Atmospheric fine particles affect the Earth's radiation balance by interacting with [solar radiation](#) and by participating in cloud formation. Biogenic [volatile organic compounds](#) are key players in new particle formation processes. Hence, terrestrial vegetation has an important role as the newly formed particles cool our climate. The [chemical composition](#) of such secondary organic aerosol (SOA) particles formed from volatile compounds emitted by vegetation is very complicated and only limited information on the phase state of SOA particles has been available. Thus the scientific community has tried to understand the chemical composition and physical characteristics of SOA particles in order to better understand their climatic implications and also to enable more accurate predictions using global climate models.

Until now, biogenic SOA particles have been represented as liquid droplets in global [climate models](#). But according to the new research

published in [Nature](#), the physical state of SOA particles formed in coniferous forest is solid, most likely glassy soon after their formation.

"One can figure these [aerosol particles](#) as tiny children's glass marbles," says Professor Thomas Koop from Bielefeld University, Germany.

The experimental research has been conducted by the group of scientists from Finnish and German universities and institutes (Tampere University of Technology, University of Eastern Finland, Finnish meteorological institute, University of Helsinki, Bielefeld University, and Max Planck Institute for Chemistry). The discovery was made in University of Eastern Finland's experimental laboratory designed by Dr Jorma Joutsensaari.

In the experiments, fine particles formed from volatile compounds emitted by scots pines were studied under controlled conditions, and additional measurements were carried out in a coniferous forest in Hyytiälä, Finland.

The research results were achieved using a new method developed at Tampere University of Technology by Dr Annele Virtanen.

"The method is based on collecting particles by impaction on metal substrates. If the particles are solid, they bounce off the surface whereas liquid particles do not bounce but adhere to the substrate," says Virtanen.

## **The results will re-direct the atmospheric fine particle research**

The new findings will change many features of the understanding of particle behavior in the atmosphere as the physical state of the particles influences their ability to absorb and release water and other gaseous

compounds, as well as their ability to act as cloud or ice nuclei. The solid state affects also the aging and lifetime of the chemical components of air particulate matter by reducing the rates of diffusion and reaction in the particles.

"There have been some discrepancies in previous research results related to SOA particle characteristics, which might be explained by the solid state of the particles. Without doubt our results will re-direct the SOA related research worldwide," comments Professor Ari Laaksonen from Finnish Meteorological Institute.

**More information:** Annele Virtanen, Jorma Joutsensaari, Thomas Koop, Jonna Kannosto, Pasi Yli-Pirilä, Jani Leskinen, Jyrki Mäkelä, Jarmo Holopainen, Ulrich Pöschl, Markku Kulmala, Douglas Worsnop, Ari Laaksonen: "An amorphous solid state of biogenic secondary organic aerosol particles" *Nature* (14th October, 2010).

Provided by Tampere University of Technology

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