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Astonishing Discovery over the Amazonian Rain Forest

International research team has discovered huge amounts of unexpected organic aerosols over the South-American tropical rain forests

Isoprene, an organic compound generated in large quantities by natural vegetation, was originally thought not to be involved in producing atmospheric aerosols. It has now been found to be a potentially major player in this process. An international team of scientists from the Max Planck Institute of Chemistry, Mainz, Germany, the University of Antwerp, Belgium, the Ghent University, Belgium, and the University of São Paulo, Brazil, examined natural aerosols from the Amazonian rain forest, and has found that they contained two previously unknown compounds, which are photooxidation products of isoprene. These compounds are hygroscopic and could impact cloud formation, rainfall and climate (Science, 20 February 2004).

Isoprene is a volatile organic compound that is emitted in large quantities by forest vegetation. Its annual emission is estimated to be 500 million tons worldwide. But although isoprene readily oxidizes to form volatile products, popular wisdom held that it didn't form products that could contribute to aerosol particle formation. Intensive measurements over the Amazon Basin, however, revealed the presence of two novel 2-methyltetrol compounds. These compounds are formed in the atmosphere through reaction of isoprene with hydroxyl radicals. To exclude pollution of human origin, the measurements were performed during the rainy season in a remote location of the Amazon Basin. Wind trajectories showed that the air had traveled over several thousand kilometers of pristine tropical forest before being trapped and analyzed.

It is estimated that the photooxidation of isoprene results in an annual production of about 2 million tons of the new compounds. This represents between 5 and 25% of the organic aerosol formed by atmospheric photochemistry from biogenic precursors.

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Fig.: Emission of isoprene by the Amazon forest and oxidation into the 2-methyltetrol compounds (light grey circles represent atoms of carbon, light green circles hydrogen atoms, and larger dark green circles oxygen atoms).

Image: Max Planck Institute for Chemistry / Universities of São Paulo und Antwerpen

This discovery is a breakthrough because for the first time a link can be demonstrated between isoprene emitted by forest vegetation and formation of water soluble fine particles. These aerosol particles give rise to the formation of haze and reduce the visibility in forested areas. They have an effect on cloud formation and influence rainfall and climate.

Original work:

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Formation of Secondary Organic Aerosols Through Photooxidation of Isoprene

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