Missing link of cloud formation

August 11 2009

The discovery of an unknown hitherto chemical compound in the atmosphere may help to explain how and when clouds are formed. The discovery of the so called dihydroxyepoxides (an aerosol-precursor), is reported in this week's issue of *Science* by a team comprising of researchers from the California Institute of Technology (Caltech) and the University of Copenhagen.

Professor Henrik Kjærgaard from the Department of Chemistry at the University of Copenhagen calls the new compounds a missing link in the formation of clouds.

"We know that aerosols are important in the formation of clouds but, we didn't know much about how the aerosols themselves were formed. This new compound may be just what we were looking for," says the

professor who has recently moved from University of Otago, New Zealand to fill his new appointment in Copenhagen.

The new compound was originally found when a team of researchers from Caltech mounted a measuring device known as a Chemical Ionization Mass Spectrometer (CIMS) on an aeroplane, and flew it over the oaken forests of Northern America.

Maple Clouds

Next to methane, deciduous plants and trees such as oak and maple, are known to be the largest source of hydrocarbons in the atmosphere; an important factor in climate-change. As a result, the researchers went into the lab to calculate what occurs to the tree-released hydrocarbon known as isoprene, when it meets other compounds in the atmosphere.

Based on previous research, isoprene was expected to break down into smaller molecules. But previous research was done with air found over cities, where levels of the combustion by-product NOx are very high. And the chemicals formed when isoprene interacts with NOx do not easily form aerosols.

However, when subjected to air as found over pristine stretches of forest, the fate of the tree-released hydrocarbons turned out to be a very different one. Without the NOx to skew the process, isoprene unexpectedly degraded into the new compound: dihydroxyepoxide. This new compound appears to be extremely reactive and likely to form aerosols.

Clouds: Central to Climate Studies

The study detailed in this week's issue of *Science*, reports the laboratory

measurement of the isoprene degradation by hydroxyl radicals "the vacuum cleaner of the atmosphere". The detection of these epoxides as a significant final product in the isoprene breakdown was supported by isotope and theoretical studies, and corroborated the field measurements. The theoretical studies from Kjaergaard's group at the University of Otago, improved the CIMS technique and supported the chemical degradation mechanisms proposed.

Discovering a new and unexpected atmospheric compound in the air over forests is fundamental research. Nevertheless with manmade climate-change looming on the horizon, the research might find applications sooner that expected. The new aerosol-precursor may be extremely important when researchers attempt to compute projected climate change. "That means, that the new compound is a missing link in more that one sense", Professor Kjærgaard states.

"Clouds can retain as well as block the heat of the sun, so, if we don't understand what drives the formation of clouds, our climate-models are bound to be less than exact".

More information: This research was published in the August 7th issue of *Science* in the article "Unexpected Epoxide Formation in the Gas-Phase Photooxidation of Isoprene"

Source: University of Copenhagen