Accidental breakthrough on the puzzle of atmospheric acids

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The blue haze which gives the Blue Mountains their name is a result of plants releasing a wide variety of oils.

In a classic example of an accidental scientific breakthrough a University of Sydney research team may have solved the mystery of why there is more non-industrial acid in air than anyone can explain.

"We did not set out to solve the longstanding question of why the atmosphere has twice as many acids produced by plants - that is organic

acids - than scientists have previously been able to account for," said the University's Professor Scott Kable.

"The troposphere, or atmosphere closest to earth, contains 90 megatons of organic acids, which is twice as much as current climate models predict. Our new insight should now be taken into account in climate modelling."

Professor Kable and his School of Chemistry colleague Dr Meredith Jordan are lead authors of the study published in *Science*.

When Sydneysiders remark on the blue haze which gives the Blue Mountains their name what they are seeing is a result of plants releasing a wide variety of oils.

Once sunlight acts on the oils it produces a haze which contains twice the amount of organic acid than atmospheric models would predict from a corresponding volume of plants.

"Organic acids in the atmosphere have an impact. They dissolve in water and acidify droplets, changing its pH value. Plant growth is very sensitive to water and soil pH," said Professor Kable.

The puzzle has been solved because of experimental research led by Professor Kable being supported by the theoretical modelling led by Dr Meredith Jordan.

"The compound we concentrated on was acetaldehyde, which is very common in the atmosphere. We were simply trying to understand what happens to it in the presence of light. A special form of acetaldehyde was synthesised by colleagues that allowed us to follow the chemistry at a level not previously attempted. We used a laser to imitate the action of the sun," said Professor Kable.

"Excitingly the resulting products were not what we had predicted but because these were laboratory results, conducted in a vacuum, we had to find out what would happen in the real world, in atmospheric conditions."

These results confirmed that the chemical transformation was producing high yields - 25 percent of acetaldehyde molecules were being transformed into vinyl alcohol, which in turn forms organic acid under the sun's action.

The chemical process is called keto-enol tautomerisation, where a hydrogen atom is transferred to a different part of a molecule to create vinyl alcohol.

"It is a very happy accidental result, in the best traditions of science, that our pure research has produced this outcome.

"Understanding the mechanism different organic acids are produced by is the key to understanding their apparent overabundance in the atmosphere," said Professor Kable.

"For rural regions and especially for regions with a lot of plant material, whether the Amazon Basin or our own hazy Blue Mountains, this a major step forward in understanding how plants interact with the atmosphere."

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