Plant Body Clock Observed in Tropical Forest Research

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Predictions of the ground-level pollutant ozone will be more accurate in future according to research published today (25 September) by environment scientists at research centres including the University of Birmingham in the journal Nature Geoscience.

Ozone is formed in the atmosphere when volatile organic compounds like isoprene – which is emitted by some plants - react with nitrogen oxides from car engines or industry. Ozone at ground level is very harmful to human health, may decrease crop yields, and is a greenhouse gas.

The research team, led by Professor Nick Hewitt at the University of Lancaster's Environment Centre, have found that the rate at which plants emit isoprene is influenced by their body clock or circadian rhythm.

This 24-hour circadian rhythm, which also controls leaf movement and respiration in plants, has never before been observed operating in concert in a stand of trees. This discovery alters current estimates of plant-derived isoprene emissions. Ground-level ozone concentrations, calculated using the new isoprene emissions, are then closer to observed concentrations, going some way to resolve a long-standing deficiency in computer simulation of ground-level ozone.

Rob MacKenzie of the University of Birmingham, who led the initial ozone modelling studies, said: "Using various models of atmospheric chemistry we show that this more complete understanding of the processes controlling isoprene emissions yields a better predictive capability for ground-level ozone, especially in isoprene-sensitive regions of the world."

These regions include the south eastern US, the Mediterranean, the Middle East, parts of South East Asia and Japan.

Professor Hewitt said: "We spend billions of pounds trying to control ozone – for example, by putting catalytic convertors in new cars in order to prevent emissions of oxides of nitrogen. This discovery of the circadian rhythm operating on the forest canopy scale is another step in better understanding ozone and improving our models of the atmosphere."

The researchers examined measurements of isoprene made above tropical rainforest and oil palm plantations in Sabah in Malaysia, carried out as part of a £2.5m UK/Malaysian scientific research project.

Eiko Nemitz of the UK Centre for Ecology and Hydrology said: "Our flux measurements show that emissions of isoprene are under circadian contro, strongly in the oil palm plantation and less strongly in the rainforest. These ecosystems therefore emit less isoprene than current emissions models predict."

Using computer simulations from the National Centre for Atmospheric Research in Colorado, the team then compared their simulated ground-level ozone with real-life ozone measurements at 290 atmospheric monitoring sites in the US. They found that their model accuracy significantly improved when it included circadian control of isoprene emissions.

The work was funded by the Natural Environment Research Council and the paper 'Ground-level ozone influenced by circadian control of isoprene emissions' is published as part of the Royal Society's South East Asian Rainforest Research Programme.

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