Scientists develop ecological early warning device

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Working with collaborators from around the globe, scientists at Los Alamos National Laboratory have developed a method for constantly measuring climate change impacts at ecosystem scales using the stable isotope composition of atmospheric CO_2 in plants. The method might someday serve as an early warning system for ecological collapse.

In research published recently in the journal *Plant, Cell and Environment*, Los Alamos scientist Nate McDowell and his colleagues describe how they used Tunable Diode Laser (TDL) techniques on open leaf gas exchange systems on plants to make the first continuous, high precision isotopic CO_2 flux measurements at the tissue scale. These so-called foliar isotope fluxes have allowed the researchers to discover new insights in plant carbon metabolism and foliar water/CO_2 interactions. Their work is a first step toward unraveling the important climate impact signals carried in atmospheric CO_2.

The TDL instrument allows assessment of these signals continuously (every minute of every day) by measuring atmospheric CO_2. When coupled with high performance computer models, the monitoring should allow researchers to forecast imminent vegetation stress in response to drought, water limitations for crops, etc.

In the course of developing the TDL technique, McDowell's team has produced the first and only long-term data set (3 years) of continuous measurements of the isotopic CO_2 exchange between a terrestrial ecosystem and the atmosphere. This unique data set is already providing

novel insights into how climate impacts ecosystem metabolism.

Laser based methods are being considered for use by the National Science Foundation as an early warning system as part of its NEON (National Ecological Observatory Network) initiative. The idea of an isotope-based early warning network using TDL is based on the fact that carbon and oxygen isotopes in the atmosphere are the integrated result CO_2 isotope fluxes between the biosphere and atmosphere. The carbon isotope patterns result largely from plant water stress, while the oxygen isotopes carry a signature of the water cycle.

In addition to McDowell, other members of the TDL device development team include Heath Powers of Los Alamos National Laboratory, Margaret Barbour of Landcare Research in New Zealand, Guillaume Tcherkez, of the Laboratoire d'Ecophysiologie Végétale in France, and Christopher Bickford and David Hanson from the University of New Mexico. The research was funded by the LANL's LDRD-Exploratory Research Program and its Institute of Geophysics and Planetary Physics program, both of which provide funding of high payoff, high risk science for predicting and solving national security problems.

Source: Los Alamos National Laboratory