Researchers discover plants are enormous water users

4 April 2013, by Steve Carr

UNM doctoral Scott Jasechko collects a water sample from the Santa Fe River near La Bajada. Credit: Zachary Lapointe

(Phys.org) —A new study published today in *Nature* by researchers at the University of New Mexico indicates the immense amount of fresh water used by plants and its movement during their life cycle has significant implications for future predictions about climate change.

The paper, titled "Terrestrial water fluxes dominated by transpiration," was authored by UNM doctoral student Scott Jasechko, under the mentorship of Regents' Professor Zach Sharp and Associate Professor Peter Fawcett, both from the Department of Earth and Planetary Sciences, and co-authors at the university and Canadian research organization Alberta Innovates.

According to the research, which was funded through a grant from the UNM Caswell Silver Foundation graduate fellowship program, fresh water used by plants during growth accounts for the largest movement of fresh water on earth and is more than 1.5 times the movement of water in all the planet's rivers. Also, the amount of water moved from land into the atmosphere by plants is five times greater than evaporation on continents.

"The study is important because it suggests research should focus on water transport in plants when assessing the availability of fresh water in a future, warming climate in order to better predict how much water will be available for drinking water, manufacturing and food production," said Jasechko, the study's lead author.

Water is transported from Earth's surface into the air either by evaporation or by plant "breathing," a process better known as transpiration. Until now, the amounts of fresh water consumed by evaporation and transpiration were not known and were lumped into a single term – evapo-transpiration.

"Each water molecule is made up of one part oxygen, two parts hydrogen," Jasechko said. "Some types of oxygen and hydrogen that occur in nature are slightly heavier and slightly lighter than others, these are known as isotopes. What we found useful in this study, is the different behavior of these isotopes during evaporation and transpiration."

The isotopes of oxygen and hydrogen were analyzed in water samples collected from large rivers and lakes, and these samples "remember" how much they have evaporated and transpired since falling from the sky as precipitation. Because of this difference we were able to separate evaporation – a physical process – from transpiration – a biological process – and calculate each water movement separately."

The researchers at UNM calculated the total amount of water that plants use on earth using a global dataset of water samples collected from Earth's largest rivers and lakes. The isotopes of oxygen and hydrogen within these samples "remember" the amount of evaporation and

transpiration since the water fell as precipitation. Results show that plants on land transpire 60,000 km3 of water each year – the equivalent of the flows of 10 Amazon Rivers (or 100 Mississippi Rivers or 1,000 Rhine Rivers) – and consume half of all the solar energy absorbed by Earth's continents.

"Transpiration is also intricately linked to the amount of carbon dioxide in the atmosphere – the most important contributing greenhouse gas to current climate warming," Jasechko said. "When plants transpire – or 'exhale' – water, they assimilate – or 'inhale' – carbon dioxide from the atmosphere."

By linking the ratios of water transpiration and carbon assimilation – or "plant breathing" – the researchers calculated both carbon uptake and water transpiration by plants. Water-Carbon "breathing" calculated in the study agreed with a multitude of other carbon uptake studies based on satellite and on-the-ground measurements. Examining the exchange of carbon and water provided a useful calculation check that produced identical results to the isotope-based calculation of transpiration, verifying the study's results confirming the large water transpiration rate findings.

"This study acknowledges the importance of plant life in controlling the amount of precipitation that ends up in our rivers," Jasechko said. "We also show that the water that is used by plants is vital to sustaining all life on Earth – including food production for humanity. The most fundamental resources for humanity are food, water, shelter and clothing. All of these needs – either directly or indirectly – require fresh water.

"To date, much of the focus has been given to potential changes in precipitation in a changing climate. What this study suggests is that changes to plants – via natural ecosystem shifts, land use changes, deforestation or other modifications – may be as important as changes to precipitation when it comes to future fresh water availability."

Provided by University of New Mexico

November 2019 from https://phys.org/news/2013-04-enormous-users.html