Testing of soil water compartmentalizing indicates it is widespread among many biomes

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(Phys.org)—A trio of researchers with the University's of Saskatchewan and Calgary, both in Canada has found evidence that backs up a theory that has suggested that soil water is compartmentalized. In their paper published in the journal *Nature*, Jaivime Evaristo, Scott Jasechko and Jeffrey McDonnell describe how they carried out their study and their surprising results.

Common sense suggests that when it rains, water makes its way down into the soil—some of it is pulled into plants, some evaporates and some makes its way to rivers or streams or down into the water table—in a fairly uniform way. But now it appears that is not exactly the case, the results of fieldwork done by the team in Canada show that water is actually segregated between evaporation and transpiration in some soil areas and groundwater and streams in others—and it appears to be widespread among many types of biomes.

As the researchers note, recent work by teams conducting studies in Oregon and Mexico suggested that water compartmentalizing was occurring, but the idea had not been tested. They sought to do that themselves to find out if water really does segregate naturally because if it does, that would likely have a big impact on water management schemes. To test the idea, they checked soil samples from 47 different sites for hydrogen and oxygen isotopic levels. That allowed them to see that many plants use water in the soil that is not part of the water that makes its way into streams and groundwater reservoirs—very clearly suggesting compartmentalizing. They also discovered that 80 percent of their samples showed that water from precipitation that would up in groundwater and streams, was different from precipitated water found in soils that plants were using, also clearly indicating compartmentalizing.

What the researchers still do not understand, however, is the nature of the compartmentalizing—does water exist in tiny channels bound for an underground reservoir, for example, right near a plant that is dying of thirst due to a lack of water in the soil around them? The researchers do not know, but theorize that it is possible that water from different types of storms behaves differently once it hits the ground. More work will have to be done to better understand what is really going on.

More information: Global separation of plant transpiration from groundwater and streamflow, *Nature* 525, 91–94 (03 September 2015) DOI: 10.1038/nature14983

Abstract
Current land surface models assume that groundwater, streamflow and plant transpiration are all sourced and mediated by the same well mixed water reservoir—the soil. However, recent work in Oregon1 and Mexico2 has shown evidence of ecohydrological separation, whereby different subsurface compartmentalized pools of water supply either plant transpiration fluxes or the combined fluxes of groundwater and streamflow. These findings have not yet been widely tested. Here we use hydrogen and oxygen isotopic data ($^2H/^1H$ (δ^2H) and $^{18}O/^{16}O$ ($\delta^{18}O$)) from 47 globally distributed sites to show that ecohydrological separation is widespread across different biomes. Precipitation, stream water and groundwater from each site plot approximately along the $\delta^2H/\delta^{18}O$ slope of local precipitation inputs. But soil and plant xylem waters extracted from the 47 sites all plot below the local stream water and groundwater on the meteoric water line, suggesting that plants use soil water that does not itself contribute to groundwater recharge or streamflow. Our results further show that, at 80% of the sites, the precipitation that supplies groundwater recharge and streamflow is different from the water that supplies parts of soil water recharge and plant transpiration. The ubiquity of subsurface water compartmentalization found here, and the segregation of storm types relative to hydrological and ecological fluxes, may be used to improve numerical simulations of runoff generation, stream water transit time and evaporation–transpiration partitioning. Future land surface model

parameterizations should be closely examined for how vegetation, groundwater recharge and streamflow are assumed to be coupled.