Climate models need deeper roots, scientists say

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By soaking up moisture with their roots and later releasing it from their leaves, plants play an active role in regulating the climate. In fact, in vegetated ecosystems, plants are the primary channels that connect the soil to the atmosphere, with plant roots controlling the below-ground dynamics.

“Most climate models assume that roots are shallow – usually within 6 feet of the surface – and that only the soil moisture near the surface can significantly impact the climate,” said Praveen Kumar, a professor of civil and environmental engineering at the University of Illinois at Urbana-Champaign. “Our research shows that it is not just the near surface, but also the deep reservoir of soil moisture that affect terrestrial heat and moisture processes in land-atmosphere interaction.”

A better understanding of this interaction, Kumar said, could lead to more accurate climate models and better predictability.

Using a land surface model, Kumar and graduate student Geremew Amenu are assessing the effects of deep roots on soil moisture and temperature redistribution. Three sites with different vegetation, soil and climate characteristics are being studied: the Mogollon Rim in Arizona, the Edwards Plateau in Texas and the Southern Piedmont in Georgia. Soil depths of up to 30 feet are being investigated.

There are two primary mechanisms by which deep-layer moisture affects the soil surface, Kumar said. First, its temporal variability sets

the lower boundary for the transfer of moisture and heat from the surface. And second, this temporal variability influences the uptake of moisture by the plant roots, resulting in the variability of the transpiration and therefore the entire energy balance.

“Our initial results suggest that this second mechanism is predominant, indicating that accurate specification of rooting depth in climate models will play a crucial role in improving predictability,” Kumar said.

Through the process of transpiration, plants remove heat from their immediate environment. The evaporated moisture is carried elsewhere, eventually to fall as precipitation, releasing heat in the process. Through this ongoing energy cycle, plants can influence the climate.

“The variation of soil moisture in the deeper layers is a long term variation that we believe will be highly correlated with long term variations produced by climate models,” Kumar said. “If we are right, we will have better predictability of climate over a longer period of time, to the extent that plants impact the climate system.”

Kumar and Amenu will present the latest results of their modeling efforts, and the implications for climate modeling, at the American Geophysical Union meeting in San Francisco, Dec. 5-9. Their work was funded by the National Oceanic and Atmospheric Administration.

Source: University of Illinois at Urbana-Champaign