

Using neutron-computed tomography techniques, scientist measure in-situ water content

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Scientists at the University of California in Davis present results from a newly developed non-invasive technique that uses thermal neutron attenuation to measure spatial and temporal distribution of water in soils. The study, published in the September-October 2008 issue of *Soil Science Society of America Journal* focuses on the McClellan Nuclear Radiation Center in Sacramento, Calif., developed by the US Air Force.

The McClellan Nuclear Radiation Center (MNRC) in Sacramento, CA was developed by the U.S. Air Force to detect corrosion and defects in aircraft structure using an imaging technique called neutron radiography. This technique is currently helping soil scientists understand the function of plant roots and their uptake of water and nutrients.

Scientists at the University of California in Davis present results from a newly developed non-invasive technique that uses thermal neutron attenuation to measure spatial and temporal distribution of water in soils and near roots at near 0.5 mm spatial resolution or higher.

The study, published in the September-October 2008 issue of *Soil Science Society of America Journal*, presents the theory and potential applications of thermal neutron tomography and evaluates its sensitivity, with particular attention to using this technique for the measurement of small-scale spatial and temporal variations in root water uptake. A single root water uptake experiment with a corn (*Zea mays* L.) seedling

demonstrated the successful application of neutron computed tomography (NCT), with images showing spatially variable soil water content gradients in the rhizosphere and bulk soil.

Unlike traditional methods for studying root systems, which are destructive, tedious, and difficult to interpret, neutron tomography is a non-invasive imaging method that measures the attenuation of thermal neutrons, much like photons in x- and gamma-ray techniques, to characterize material composition.

Although NCT techniques are routinely used in engineering, relatively little is known about their application to soils. Neutron imaging works especially well for substances that contain hydrogen atoms such as water, or other low atomic mass, neutron attenuating materials. The neutron source in this study was a Mark II TRIGA Reactor at McClellan Nuclear Radiation Center (MNRC) in Sacramento, CA. The reactor, which began operation in 1990, is the newest research reactor in the United States. It is also the highest power TRIGATM (Training, Research, and Isotope Production General Atomic) reactor in the United States.

Source: Soil Science Society of America

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