UNL's cosmic-ray neutron rover drawing interest from military, agriculture

By NICHOLAS BERGIN / Lincoln Journal Star Dec 8, 2014 (0)

Courtesy photo

Trenton Franz does field work with the cosmic-ray neutron rover in Australia.

Drive a cosmic-ray neutron rover out into a Nebraska bean field and you're bound to end up on the receiving end of a few questions fired by curious farmers.

"Most people realize the university can be up to some pretty wacky things, so they just write it off as that sort of thing," said University of Nebraska-Lincoln researcher Trenton Franz, a hydrogeophysicist and Robert B. Daugherty Water for Food Institute faculty fellow.

The cosmic-ray neutron rover may look at first glance like an unremarkable truck with a UNL logo, but secured to the covered bed is technology that has piqued the interest of both the agricultural industry and the U.S. military.

While its name sounds like it belongs in a 1950s-era comic book, the project is down-to-earth and on the cutting edge of precision agriculture. It’s a mobile soil moisture detector designed to measure and model how water moves through the ground.

For farmers faced with the specters of climate change and increasing irrigation regulations, the technology Franz and a couple of students are working on offers promise of more efficient water and energy use.

Farm implement companies can now build irrigation systems with nozzles that can be individually controlled -- it's called variable rate irrigation.

“You can water a center pivot in essentially 5,400 different zones. So if you knew how much water was in each of these 5,400 zones you could apply water in those with the current irrigation technology," Franz said. "But we have no idea what the actual distribution of water is in the soil in that kind of grid.”

His project could solve that.

For soldiers, moving tanks and heavy machinery across areas with little or no roads means dealing with mud. Franz’s cosmic-ray neutron rover could help the military make soil maps on the fly and better predict the time it will take to move equipment and troops.

Franz created the rover at a cost of about $150,000 by mounting sensors that measure subatomic neutron particles in the air onto a truck bed.

The sensors work by measuring neutrons. Cosmic rays travel from space through the earth’s atmosphere and neutrons are absorbed into the soil, but some escape back into the air. How much escapes depends on the soil’s hydrogen content, which largely depends on how much water it holds.

Measuring the neutrons above soil can provide a good estimate of the water below. Franz’s rover measures a 300-meter radius circle to a depth of 30 centimeters. Eventually, the equipment he is developing could be mounted on farm equipment, low-flying aircraft, tanks or dropped out of planes.

Franz worked with the sensor manufacturer, Albuquerque-based Hydroinnova, to design a bigger detector suited for ag purposes in Nebraska.

He and students have spent the past year working to develop parameters and algorithms to make it work better for the mobile application. Next year, they plan to take the neutron rover to west-central Nebraska, one of the state’s driest regions.

“We’ll be working with some producers to see how we can affect decisions with this information. It’s one of many factors that might go into when and how much to irrigate,” Franz said.

“We’re working with other folks in the Water and Food Institute on how to provide decision support with this new information.”

To help explore possible applications and continue research, Franz got a $50,000, one-year grant in September from the U.S. Army’s Cold Regions Research and Engineering Laboratory based in Hanover, New Hampshire, in association with UNL’s Great Plains Cooperative Ecosystems Studies Unit and coordinated through Kurt Preston, associate vice chancellor in UNL’s Office of Research.

For more information on Franz's research, visit http://go.unl.edu/69o5.