Out of thin AERI

UW scientists test an experimental device that could change the way we look at weather

It takes about 10 minutes to get each radiance, he said. It takes about two radiances, or 20 minutes, to stabilize.

By 10 a.m., scudding clouds gave way to clear skies — good news for the AERI crew because the machine can't obtain temperature and moisture readings through rain or clouds. 

"The first one said it would be purely cloudy," Fritz joked. "Those darn meteorologists. They get it wrong unless it's happening outside the window, and then they get patted on the back.

Short poured liquid nitrogen into the AERI's receiver, keeping it at a constant minus 321 degrees Fahrenheit "so its temperature can't drift with the environment," he said.

AERI works by splitting infrared beams, splicing them back together and measuring the differences.

A hatch in the roof of the motorhome allows atmospheric radiation to enter the AERI. A mirror tilted at 45 degrees splits beams of energy and bounces them through the wide ends of two absolutely black, perfectly machined aluminum cones.

One cone, housed in a can the size of a cookie jar, is called the ambient blackbody. It stays at room temperature. The other cone, in another aluminum cookie jar, is called the hot blackbody. It is heated to 140 degrees Fahrenheit.

The energy beams radiate off mirrors at the point of each cone, then rejoin. Differences in the electromagnetic wavelengths of each beam describe the temperature and moisture content of the air above the Winnebago.

"It is as if you're looking straight up a three-kilometer pencil and this is what's going on overhead," Fritz said. "It sounds like magic.

The atmospheric data is fed into a computer and then plotted on graphs.

The graphs indicate the range of electromagnetic frequency, from 300 to 3,300 wavemembers. Low frequencies, with wavelengths of about 30 microns, reflect temperatures and, at higher frequencies, 300 micron wavelengths, detect water vapor.

The whole detection process takes about 10 minutes = a vast improvement in time-resolution over the 12-hour span of the old means.

Water and temperature in the atmosphere are important components of a weather forecast. Together with wind speed, wind direction and other climatic variables, this information helps forecasters see what's happening in the atmosphere and predict weather changes even before clouds form.

With better time-resolution than traditional balloons and better spatial resolution than satellites, AERI technology has the weather world abuzz, Fritz said.

"We can't build a million AERIs and put them up every 10 miles," he said. "But we can achieve that effect from space. The National Weather Service and NOAA are very interested in this technology. It takes 10 or 12 years of validation for it to catch on, but they're talking about deploying AERI on a future satellite.

AERI is only one of dozens of new technologies being developed to help forecasters increase the accuracy of their weather predictions.

No other remote sensing instrument can measure every meteorological variable," Fritz said. "We have to find and use the best combination of technology.

For more information on AERI, visit the website at http://www.aeri.wisc.edu."