9.0 "Out of Thin AERI", *Post-Crescent* article by Rick VanGrouw

THE POST-CRESCENT

SCIENCE AND MEDICINE

Wisconsin's Best Newspaper

SUNDAY, JUNE 4, 2000

ONTACT
anGrouw,
projects editor
3-1000, ext 558
rick.vangrouw@thomnews.com

DID YOU KNOW?

Human growth hor
combined with a hi
diet significantly ea
symptoms of Crohn's dise
three-quarters of patients
moderate to severe cases,
found. Crohn's affects the
tract, causing persistent d
abdominal pain, bleeding
breakdown of the intestin

SUNDAY FOCUS

NEW TECHNOLOGY SHOWS PROMISE FOR PREDICTING WEATHER IN THE FUTURE

Out of thin AERI

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

John Short squinted at the Winnebago's side-view mirror and scratched his tropical print cap.

"A little more," said Brian Osborne, standing behind the motorhome, urging Short forward with his fingers.

Short tapped the accelerator. The motorhome lurched forward over trimmed grass in a clearing cut from northern Wisconsin oak and aspen trees.

"That's it," Osborne said.

Short jammed the 'Bago into park and shut off the ignition.

Short, a support technician, and atmospheric scientists Osborne and Wayne Feltz comprised a team of University of Wisconsin-Madison scientists on an outland junket to field-test an experimental weather-forecasting device.

The latest in a long series of experiments, the day's trial was to validate readings of a NASA Terra polar orbiting satellite due to pass overhead at 10:30 a.m.

The customized 1994 Winnebago housed a suite of meteorological instrumentation. A ceilometer shot a laser beam to the top of the atmosphere and back. A collection of instruments on the roof measured ground temperature, humidity, barometric pressure and wind. A launch system could send a weather balloon into the atmosphere.

TEAM LEADER Wayne Feltz monitors temperature readings on a laptop inside the "AERI-bago" mobile weather lab.

The center of attention, though, was a steel and aluminum box the size of a dormroom refrigerator tipped on its side, bolted to a hydraulic lift inches below the top of the motorhome behind the side door.

Called an atmospheric emitted radiance interferometer, or AERI, the instrument's technology was developed by UW scientists in the late 1980s, then licensed to a Canadian firm for commercial production.

Inside the 'Bago, team leader Wayne Feltz hunched over an IBM-770 laptop. He scrutinized jagged graphs that showed real-time readings of temperature and humidity in the air above the AERI-bago.

AERI can see two miles into the troposphere, a turbulent ribbon of atmosphere called the planetary boundary layer. Weather changes develop in the boundary layer, and AERI can see changes as they occur.

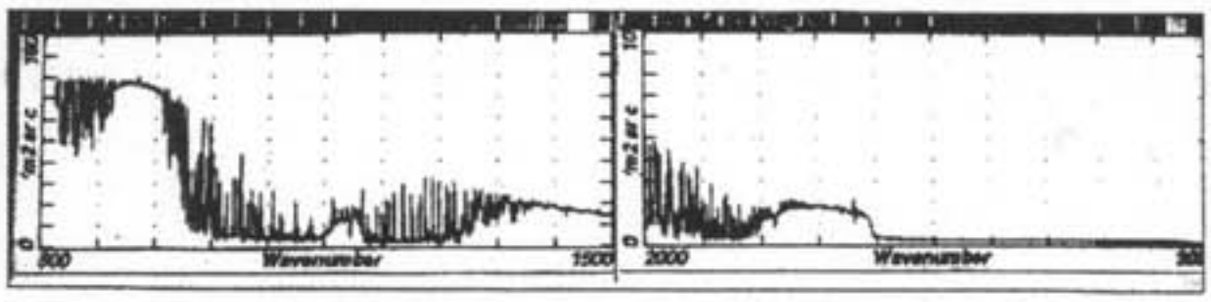
If warm air were to rise from a center of low pressure and threaten to break into the much cooler upper atmosphere, which would mean severe weather, Feltz would know it.

"We can monitor what's happening to the inversion, whether it's ready to break," Feltz said. Other than AERI, "There's nothing to monitor that with 10-minute time resolution."

AERI measures infrared radiation emitted by the atmosphere. Using a complex formula, AERI converts radiation data into accurate temperature and moisture readings – two important pieces of the weather forecasting puzzle.

Post-Crescent photos by Rick Van Grouw

SUPPORT TECHNICIAN JOHN SHORT gets ready to pour liquid nitrogen into the receptor of AERI, or atmospheric emitted radiance interferometer. The liquid nitrogen keeps the receptor at a constant minus 321 degrees Fahrenheit, unaffected by the surrounding environment. Computer graphs (below) measure a range of electromagnetic frequencies, which indicate temperature, water vapor levels and other atmospheric data.



The day of the experiment, the customized 1994 motorhome sat in a clearing near the western edge of the Chequamegon National Forest at the base of a 1,500-foot telecommunications tower. After two hours of work, the scientists realized they had parked the 'Bago too close to the tower's guy wires.

Short and Osborne pulled the mobile weather station forward.

Feltz, who grew up in Plover, describes himself as a life-long "weather weenie."

"I always wanted to be a meteorologist," he said. "Whenever there was a tornado watch, I'd be running around outside through the hail."

He attended Northland College in Ashland, 60 miles north on State 13 from the experiment site, and has been working with AERI since 1991.

Wearing a "Storm Chaser Conference" T-shirt, Feltz calibrated AERI for a day of measurements in the new location.

"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 forecast said it would be partly cloudy," Feltz joked. "Those damn 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 receptor, keeping it 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's as if you're looking straight up a three-kilometer-long pencil and this is what's going on overhead," Feltz 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 500 to 3,300 wavenumbers. Low frequencies, with wavelengths of about 20 microns, reflect temperature, and higher frequencies, 300 micron wavelengths, detect water vapor.

The whole detection process takes about 10 minutes – a vast improvement in time-resolution over weather balloons, which ordinarily launch once every 12 hours.

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 weather balloons and better spatial resolution than satellites, AERI technology has the weather world abuzz, Feltz said.

"We can't build a million AERIs and put them 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 one remote sensing instrument can measure every meteorological variable," Feltz said. "We have to find and use the best combination of technology."

For more information on AERI, visit the real-time data Web page at:
http://zonda.ssec.wisc.edu/~waynef/