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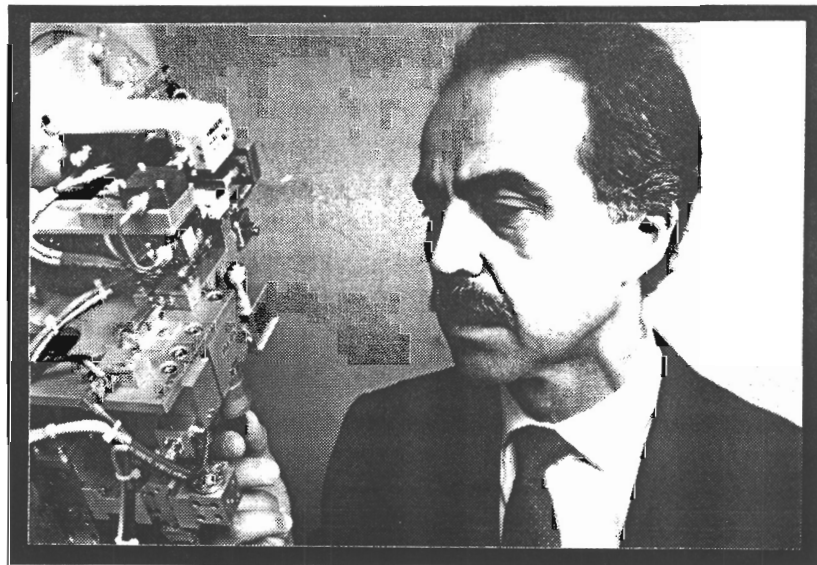
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FOUR-FREQUENCY MICROWAVE RADIOMETER MEASURES PRECIPITATION TO HELP NASA IMPROVE UNDERSTANDING OF CLIMATE & WEATHER

Engineers at the Georgia Tech Research Institute (GTRI) have designed and built an Advanced Microwave Precipitation Radiometer (AMPR) that will help NASA scientists gain a better understanding of how rainfall variations affect the Earth's climate and weather.

The research will ultimately lead to better computer models of the Earth's climate system -- and to more accurate weather forecasting.

Part of NASA's "Mission to Planet Earth," the radiometer is providing information scientists will use to select the instruments that will be placed on future satellites. Information from the AMPR will also help scientists better interpret the data produced by radiometers located on satellites such as the



Senior Research Engineer Joe Galliano inspects the Advanced Microwave Precipitation Radiometer (AMPR) which is being used by NASA to study storm systems. (Color slides or B&W photographs available)

Special Sensor Microwave/Imager (SSM/I), which was placed into orbit in 1987.

The AMPR is believed to be the first single aircraft instrument able to simultaneously measure and image four different microwave frequencies. It has already been flown aboard a NASA ER-2 aircraft, where it gathered information on storm systems.

"One of the major elements of 'Mission to Planet Earth' is understanding how the Earth's climate structure works," explained Dr. Roy W. Spencer, space scientist with NASA's Earth Science and Applications Division at the Marshall Space Center in Huntsville. "We know that an important part of the climate fluctuations involve variability

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in rainfall patterns, so we are developing methods for measuring rainfall from Earth-orbiting satellites."

The radiometer's ability to image four different frequencies is allowing NASA scientists to study and compare how well each frequency measures precipitation. That information will also help select the instruments to be placed on a tropical rain measuring (TRM) satellite scheduled for launch in 1997, Spencer explained.

High-resolution data provided by the AMPR will help scientists interpret the lower-resolution precipitation

The AMPR can simultaneously measure and image four frequencies, and uses just two antennas to make the measurements.

information they receive from satellites, which can continuously scan large areas.

In addition to precipitation measurements, the device can also measure winds over the ocean surface, snow cover, soil moisture levels and vegetation characteristics, Spencer said.

Microwave radiometers are commonly used to gather atmospheric information. What makes the AMPR unique is its ability to simultaneously measure and image four different microwave frequencies, explained Joe A. Galliano, a senior research

engineer with the Georgia Tech Research Institute.

AMPR uses just two antennas to receive the four frequencies: the highest three sharing one antenna and the lowest frequency using a second antenna. With the exception of the three-frequency antenna, the radiometer was designed and built at GTRI.

A radar system produces images by sending out a microwave signal and then measuring how that signal is altered and reflected by the objects it encounters.

Unlike a radar, a radiometer does not transmit a signal, but instead measures how objects like raindrops and ice particles emit and reflect thermal microwave radiation, explained Galliano. By comparing the microwave radiation from the rain or ice against the land or ocean around the rain system, the precipitation radiometer reveals the internal structure of the rain cloud.

Molecules in the atmosphere tend to absorb certain frequencies, while signals of other frequencies pass through relatively unaffected. Scientists use these relatively transparent "window channels," to make atmospheric measurements of rainfall.

"Radiometers can measure anything in the atmosphere that is of interest," said Galliano. "The frequency you choose depends on what you are trying to measure."

Because it is only measuring naturally emitted radiation, the AMPR was designed to provide high gain and low noise. And because the temperature at 65,000 feet is minus 40 degrees Celsius, the instrument also had to be designed to function reliably in harsh conditions, Galliano noted.

With its four frequencies -- 10.7, 19.35, 37.1 and 85.5 GHz -- the AMPR can provide a thorough picture of rain systems below it. Since the atmospheric absorption of microwave signals is less at lower frequencies, the 10 GHz signal travels closer to the Earth's surface, but produces lower resolution. The higher frequencies such as 85 GHz produce better resolution, but cannot penetrate as far down into the rain system.

"You don't have the same resolution at the lower frequency that you do at the higher frequency, but you do see farther down into the atmosphere," Galliano explained. "The combination of these four frequencies gives you more flexibility. You get a good vertical distribution into the storm to tell you what's going on."

Information about the AMPR was presented to the 15th International Conference on Infrared and Millimeter Waves in Orlando, Florida on December 10. Funding for this work was received under NASA contract NAS8-37142.

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