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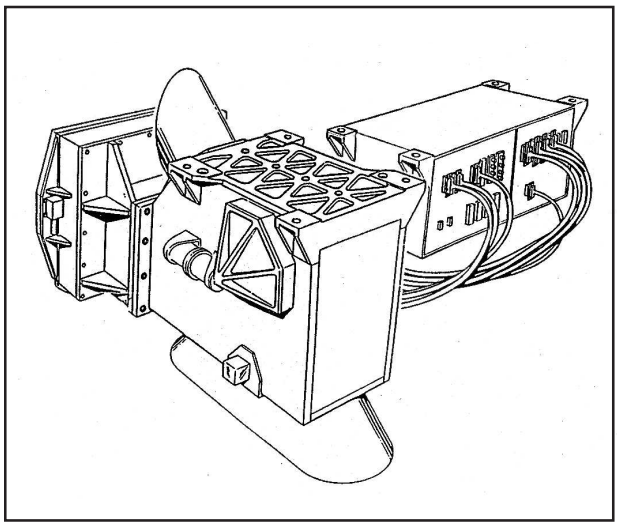
Tropical Rainfall Measuring Mission's Visible and Infrared Scanner

The Visible and Infrared Scanner (VIRS) is one of the primary instruments to be flown aboard the Tropical Rainfall Measuring Mission (TRMM) observatory. VIRS is one of the three instruments in the rain-measuring package and will serve as a very indirect indicator of rainfall. It will also tie in TRMM measurements with other measurements that are made routinely using the meteorological Polar Orbiting Environmental Satellites (POES) and those that are made using the Geostationary Operational Environmental Satellites (GOES) operated by the United States.



VIRS Instrument Assembly

VIRS, as its name implies, senses radiation coming up from the Earth in five spectral regions, ranging from visible to infrared, or 0.63 to 12 micrometers. VIRS is included in the primary instrument package for two reasons. First is its ability to deliniate rainfall. The second, and even more important reason, is to serve as a transfer standard to other measurements that are made routinely using POES and GOES satellites. The intensity of the radiation in the various spectral regions (or bands) can be used to determine the brightness (visible and near infrared) or temperature (infrared) of the source.

If the sky is clear, the temperature will correspond to that of the surface of the Earth, and if there are clouds, the temperature will tend to be that of the cloud tops. Colder temperatures will produce greater intensities in the shorter wavelength bands, and warmer temperatures will produce greater intensities in the longer wavelength bands. Since colder clouds occur at higher altitudes the measured temperatures are useful as indicators of cloud heights, and the highest clouds can be associated with the presence of rain.

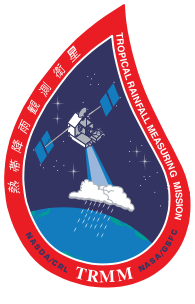
A variety of techniques use the Infrared (IR) images to estimate precipitation. Higher cloud tops are positively correlated with precipitation for convective clouds (generally thunderstorms) which dominate tropical (and therefore global) precipitation accumulations. One

notable exception to this rule of thumb are the high cirrus clouds that generally flow out of thunderstorms. These cirrus clouds are high and therefore "cold" in the infrared observations but they do not rain. To differentiate these cirrus clouds from water clouds (cumulonimbus), a technique which involves comparing the two infrared channels at 10.8 and 12.0 micrometers can be employed. Nonetheless, IR techniques usually have significant errors for instantaneous rainfall estimates. The strength of the IR observations lies in the ability to monitor the clouds continuously from geostationary altitude. By comparing the visible and infrared observations on the Tropical Rainfall Measuring Mission with the rainfall estimates of the TRMM Microwave Imager and Precipitation Radar, it is hoped that much more can be learned about the relationship of the cloud tops as seen from geostationary orbit.

VIRS uses a rotating mirror to scan across the track of the TRMM observatory, thus sweeping out a region 720 kilometers wide as the observatory proceeds along its orbit. Looking straight down (nadir), VIRS can pick out individual cloud features as small as two kilometers.

The Tropical Rainfall Measuring Mission is NASA's first mission dedicated to observing and understanding the tropical rainfall and how this rainfall affects the global climate. It is a joint mission with the National Space Development Agency of Japan. The primary instruments for measuring precipitation are the Precipitation Radar, the TRMM Microwave Imager, and VIRS. Additionally, TRMM will carry the Lightning Imaging Sensor (LIS) and the Clouds and the Earth's Radiant Energy System (CERES). These instruments can all function individually or in combination with one another.

TRMM is part of NASA's Mission to Planet Earth, a long-term, coordinated research effort to study the Earth as a global system.

More information on VIRS is available via the Internet at:

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