NASA Facts

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Goddard Space Flight Center
Greenbelt, Maryland 20771

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Tropical Rainfall Measuring Mission

A Rain Gauge in Space

Until now, measuring rainfall across the world has been a tough proposition. Temperatures and pressures have been much easier to measure because they vary continuously from one area to another. If we measure the temperatures at two places one mile apart, it is reasonable to expect that the temperature half way between the two places will have a value that is not very different from the temperatures at the two places you measured. The same can be said for pressure. Scientists say that atmospheric temperatures and pressures are *continuous* variables; however, when it comes to rainfall, things are different. It can be raining heavily at two places that are one mile apart while no rain is falling at a place that is halfway between. Rainfall is an unusual *discontinuous* atmospheric phenomenon.

The discontinuity of rainfall makes it very difficult to measure. Yet, rainfall is a part of the hydrologic cycle that sustains life on Earth, and it is critical to the world's populations. Rainfall provides water for our food and drinking supply, energy needs (e.g. dams and geothermal energy), transportation needs, and more. Furthermore, the weather that we are experiencing right now, regardless of where a person lives, is related to the amount of rainfall that falls between the latitudes of 23.5°N and 23.5°S, a region known as the tropics . It is well known that the atmosphere gets three-fourths of its weather-producing energy from the heat process associated with rainfall. Since the majority of Earth's rain falls in the tropics, tropical rainfall has a direct link to global weather patterns. Furthermore, weather extremes such as drought and floods are directly influenced by the frequency and consistency of tropical rainfall. This is compounded by the fact that a large fraction of the world's population and agriculture is in the tropics.

Clearly from a human perspective alone, there is a need to understand and quantify rainfall. From a science perspective, scientists also need a better understanding of not only the amount of tropical rainfall but the associated heating and variability. These variables are critical to the "big picture" understanding of climate change issues.

We already have discussed the difficulty in measuring rainfall. This problem becomes more difficult when you consider that the tropics are not one square mile, but thousands of square miles. If you add to this the fact that a vast portion of the tropics is ocean or inaccessible for rain gauge instrumentation, it becomes clear why NASA and its Japanese partners have

planned the Tropical Rainfall Measuring Mission (TRMM). TRMM can close some of the gaps inherent to the discreteness of rainfall or the vastness of the tropics. The observatory will carry a suite of instruments designed to measure rainfall. TRMM has an orbit inclined to the equator such that during the course of every month, it will come close to making measurements everywhere over the tropics and subtropics at all times of the day. TRMM will be the first satellite to carry a weather radar for measuring rainfall from space. It will provide vertical profiles of rainfall and its energy processes. Another vital TRMM instrument is a multi-channel microwave imaging radiometer similar to microwave instruments currently in use on defense meteorological satellites. Microwave radiometers "sense" rain over ocean regions. A visible/infrared (VIS/IR) instrument will also fly as part of the TRMM package to provide "camera like" images of rainfall systems as well as infrared images based on heat properties of clouds.

In effect, TRMM is a large "flying rain gauge" that combines the advantages of radar, VIS/IR, and microwave rainfall measuring techniques into one powerful platform. Whenever TRMM flies over an area covered by ground-based radar, it will be possible to compare TRMM's space-based rain measurements with more conventional ground-based measurements. The end results should be the most comprehensive set of quantitative tropical rainfall data in history.

Visit the TRMM Homepage at
http://trmm.gsfc.nasa.gov