TROPICAL RAINFALL MEASUREMENT MISSION

by

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It has long been noted that anomalies in the sea surface temperature (sst) in the tropics are strongly correlated with climate in the temperate latitudes on a seasonal time scale. The best known case is the El Nino-Southern Oscillation (ENSO) anomaly which has been correlated with a great many weather anomalies in the temperate regions. This correlation is presumed to occur because the sst anomaly produces an anomaly in the precipitation which, through its release of latent heat, produces global scale anomalies in the average atmospheric pressure and temperature fields. Our ability to measure the global sst and the atmospheric pressure/temperature patterns has made great progress. However, at this point, we measure rainfall, the putative connection between the two, very poorly.

The Tropical Rainfall Measurement Mission (TRMM) was conceived to fill this gap. The TRMM spacecraft would fly in a low inclination, (about 35 degrees), orbit which would concentrate the sampling in the very important tropical latitudes. The precession of such an orbit would enable observations at all times of the day over the span of a month which would permit corrections for the diurnal cycle of precipitation which is quite marked in parts of the tropics. The payload of the TRMM spacecraft, shown in the attached figure, is carefully designed to provide accurate measurements of rain. It consists of

microwave radiometers, a microwave radar and visible/infrared radiometer. The two types of microwave instruments provide direct measurements of the hydrometeors, each having strengths which compensate for weaknesses of the other. The vis/ir instrument provides a connection to the long-time series of vis/ir measurements from polar and Geosynchronous spacecraft which are currently the best available source of global rainfall estimates. The accuracy requirement on the measurement is estimated to be of the order of 1 mm/day for a 1 month average over a 5 degree square. An error model which combined both instrumental and sampling error suggests that the TRMM measurements will yield an accuracy of about 1.2 mm/day over ocean but degrades to about 1.7 mm/day over land.

The TRMM is currently in a phase A (feasibility) study. The principal scenario under consideration is that the government of Japan would provide the radar instrument and would launch the spacecraft; the United States would provide the remainder. The current target is for a FY90 new start approval and a 1994 launch date which would permit overlap with the Tropical Oceans Global Atmosphere (TOGA) program which ends in 1995.

The possibility of a Space Station follow-on for TRMM is also being studied. Activities are underway to produce three instrument proposals and a science proposal which would tie them together in response to the Eos Announcement of Opportunity.

The Microwave Sensors and Data Communication Branch is deeply involved in the TRMM. We were part of the team which developed

the original concept and continue to work on the Phase A study. We provide the principal expertise in the microwave measurement of precipitation and conduct research to develop algorithms for the retrieval of rain rates from the TRMM measurements.

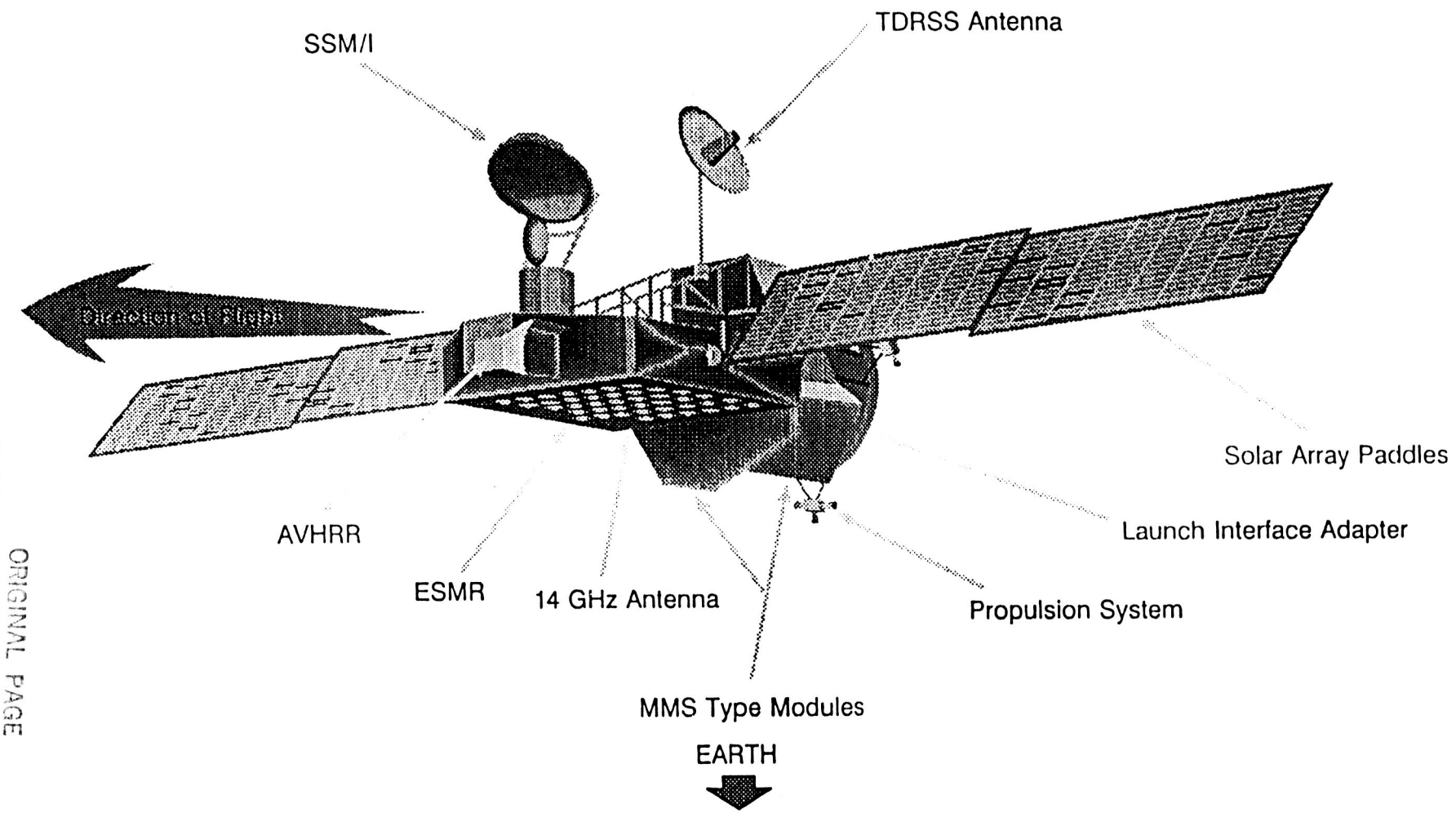

Figure 1. Tropical Rain Fall Mission (TRMM) Instrument Orientation