University of Wisconsin TRMM Research Status Report

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Our major science goal is to derive the diabatic heating over the tropical oceans with a focus on the radiative component. Determining the radiative heating requires information on the atmospheric temperature and moisture structure and the vertical and horizontal distribution of clouds. Observations of the *outside* of the cloud (e.g., cloud amount) are crucial to radiative heating rates. Observations of the *inside* of the cloud (e.g., precipitation amount) are necessary for determining latent heating. Our approach to describing these cloud parameters has evolved from the cloud classification method of Garand. The original Garand scheme is again operational on the McIDAS (an example is shown in Figure 1). Several improvements to the scheme are presently being made.

The new approach combines pattern recognition with spectral signatures of clouds and the atmosphere. To improve upon cloud identification in the tropics, the 6.7 μm channel has been incorporated as a predictant for upper level cloud and upper tropospheric water vapor classification. In addition we have included the split window difference (11 μm minus 12 μm), to determine total water vapor content in clear sky and to aid in cloud identification and classification. Inoue has shown the utility of the split window in identifying convective cores. This textural/spectral identification scheme makes observations of the exterior of the cloud or its boundary. We also require information on the interior of the cloud. For this reason we are incorporating the DMSP SSMI measurements as an additional parameter in the cloud classification scheme for determination of the cloud internal structure. An example is shown in Figure 2, which depicts SSMI rain rate observations overlaid on the GOES IR (11 μm) window channel image of 15 September 1992.

While microwave channels are not available on the geostationary satellites, there are reasons for incorporating them in the retrieval scheme:

- The geostationary satellite observations primarily look at the *exterior* or boundary of the cloud. These parameters, which represent cloud amount, cloud emittance and cloud top altitude, are required in the radiative transfer calculations. Atmospheric radiative heating rates are also a function of the cloud *interior* properties, such as cloud water content. Including the SSMI as a predictor in our scheme, we plan to determine what exterior observations can be used to define the inside of the cloud.
- Various TRMM rain algorithms work best under different meteorological condition. For example, some work well in light rain conditions while others are designed for heavy rain rates. Pattern recognition from geostationary satellites can aid in the selection of an appropriate algorithm for the given weather situation.
- The geostationary satellite observations provide information for selecting appropriate averaging schemes in time and space. In our approach, the geostationary observations are to be used, on an image by image basis, to count the number of precipitating systems that were sampled by the TRMM satellite and those that were not. To accomplish this, observations of the outside of the cloud must be correlated with observations of the cloud inside. Such observations may also be used to study the life

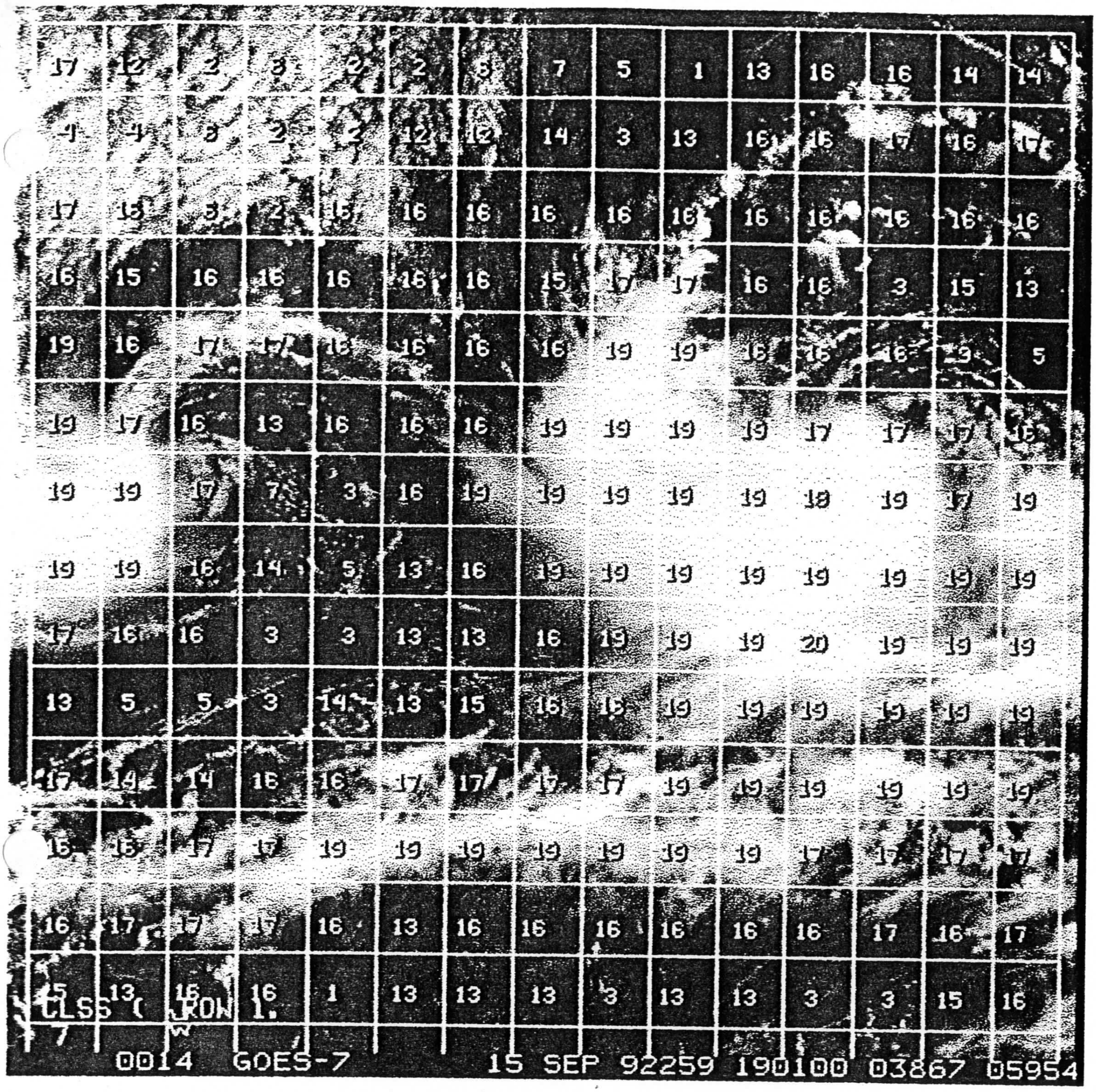
cycle of systems, leading to the development of a scheme to identify the stage of the convective system (e.g., development, mature or dissipating). Combing the SSMI with the GOES observations is a step to accomplishing this goal.

It is important to note, that application of our approach is best achieved with near real time access to the data. Near real time data access reduces storage costs, enables accessibility to a variety of data sets, and allows direct human input and experience into the analysis scheme by including knowledge of present weather situations. As the difference in access time between data sets increases, certain compromises need to be made. For example, given our present capabilities, we feel we can store (as opposed to archive) approximately 3 days of geographically limited GOES data. As the time between access to the GOES data and the TRMM data increases, there comes a point when the TRMM data cannot be directly used in the algorithm and must be incorporated after processing of the GOES data. Near real time data access is presently available on the McIDAS and includes satellite observations as well as other needed data sets, such as sea surface temperature and model output parameters. *Access to real time precipitation observations, such as those made from rain gage buoys, would be extremely valuable and is being pursued.*

Our effort so far has been to make new variables, which contain information on the atmospheric structure and information on the inside of the cloud, accessible to the classification scheme. During the time prior to the next TRMM science team meeting, we will undertake a preliminary investigation of the combined microwave and geostationary observations. The initial focus will be to ascertain which predictants in our scheme contain information regarding the structure of the cloud interior. This will be accomplished through analysis of several precipitating systems in the Pacific Ocean. We will then begin assessing how to incorporate microwave data. For example, it may be more efficient to have two classification procedures, one for the outside of the cloud and one for the inside, as opposed to one scheme.

Figure 1. Example of the Garand classification scheme as applied to GOES observations of the Tropical Pacific on 15 September 1992 at 1900 UTC.

Figure 2. DMSP-10 rain rate observations contoured over the GOES IR observations.



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CIMSS

October 14, 1992

Dr. John S. Theon
TRMM Program Scientist
NASA Headquarters
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600 Independence Ave. S.W.
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Dear John;

Enclosed is a progress report for Dr. Suomi's TRMM grant (NAG5-1586) which briefly reviews our progress since the last science team meeting. I believe Verne gave you better prints of the figures enclosed in this report. That was the second to last set that I had and so I've included copies that are not as good as the originals. If you need an additional set of originals I can send them along.

While I am not a member of the TRMM science team, I enjoyed the last meeting and learned many things about the TRMM program. I also have a better idea how Verne's TRMM program fits into the "bigger picture."

Sincerely,

Steven A. Ackerman
Associate Professor

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