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TITLE: WetNet: Using SSM/I data interactively for global distribution of tropical rainfall and precipitable water

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RESEARCH OBJECTIVES:

1. Use SSM/I to categorize, measure and parameterize effects of rainfall systems around the globe, especially mesoscale convective systems.
2. Use SSM/I to monitor key components of the global hydrologic cycle, including tropical rainfall and precipitable water, and links to increasing sea surface temperatures.
3. Assist in the development of efficient methods of exchange of massive satellite data bases and of analysis techniques, especially their use at a university.

SIGNIFICANT ACCOMPLISHMENTS IN FY 91/92:

Numerous tasks have been initiated. First and foremost has been the integration and startup of the WetNet computer system into the TAMU computer network. Scientific activity was infeasible before completion of this activity. Final hardware delivery was not completed until October 1991, after which followed a period of identification and solution of several hardware and software and software problems. The following accomplishments represent approximately four months work with the WetNet system.

1. A synoptic hydrological study has been planned and initiated to use SSM/I, GOES and operational synoptic information to document cold frontal intrusion into Central America. The "North American Cold Surge" has been defined in terms of its more intense Asian counterpart. A climatology of several years of events has been completed. Radiosonde and special surface observations have been obtained from the U.S.A.F. Environmental Technical Applications Center. Preliminary case studies are being identified and examined through GOES and SSM/I products available through the WetNet.

2. Planning activity has commenced on a project to define and document the hydrological variability of the Pacific ITCZ region. Our university library of OLR and TOVS has been augmented to overlap the SSM/I operational period commencing in 1987. The goal of this project is to resolve and correlate the

variability of cloud, precipitable water and precipitation variability along the equatorial trough and convergence zone of the Pacific. Linkages to and between synoptic, meso and planetary circulation systems are sought, as well as the mutual variability of satellite observed features. Use of Dennis Chesters' TOVS "water vapor data set " has been investigated. This work has been inspired by intercomparisons of satellite observations of tropical plumes, supported by the NASA Global Scale Program, and motivated by the data and analytical tools available through the WetNet.

3. A working hypothesis has been developed relating the frequency of lightning in mesoscale convective systems (MCSs) to the convective intensity. EJZ has reported preliminary results from a study of lightning frequency in the tropics, noting that during the GATE program, monthly rainfall was over 300 mm/month despite one thunderstorm day per month, on average. A more specific hypothesis is that vertical velocity in storm cores in the range of 4-8 m/s is the threshold necessary for lightning. We participated in plans for an atmospheric electricity component of TOGA-COARE.

4. We have initiated data collection with the TAMU 10-cm Doppler radar, and will be archiving data for providing to other WetNet PIs. Through our closely related work with NASA/TRMM, we are ready to archive data from the Houston WSR-88D radar. We have initiated case studies with Eric Smith (FSU), starting with well-documented hurricanes, like Hugo (1989), for the purpose of using SSM/I algorithms to identify the convective regions of MCSs.

FOCUS OF CURRENT RESEARCH AND PLANS FOR FY 92/93:

1. The study of the "North American Cold Surge" should be completed. Key findings should be the description of the interaction of synoptic and meso scale systems associated with frontal systems that approach the equator. Of particular interest is the rate of deterioration (air mass modification) of the synoptic features, both hydrological and kinematic, as the systems move southward.

2. Descriptive statistics should be collected for the Pacific ITCZ variability from SSM/I, OLR, TOVS and ECMWF analysis. Preliminary intercomparisons should be complete. A computational plan for detailed diagnostics should be complete. One component of this plan will be the quantitative definition of observed systems as well as the quantification of their behavior and mutual interaction.

3. The preliminary study of lightning frequency in the GATE and West African regions will be completed. The results should include quantitative documentation of the low lightning frequency in the tropical Atlantic oceanic air masses, and further refinement of the "threshold vertical velocity" hypothesis. The

remainder of the year will be devoted to obtaining direct measurements in TOGA COARE from lightning DFs, field mills on the DC8 and ER2, and radar data from the ships and turboprop aircraft. These data shouuld allow us to accept, reject or modify the hypothesis.

4. We shall undertake several case studies jointly with Eric Smith, using surface based and aircraft radar data to identify convective and stratiform regions of MCSs. We will then assess the ability of several SSM/I algorithms to distinguish between convective and stratiform regions. In addition, we will begin archiving data from the TAMU and Houston 10-cm Doppler radars for similar purposes. If we succeed in validating one or more algorithms with this "reality check", we plan to initiate surveys of MCS structure over a wide area of the tropics.

PUBLICATIONS:

Presentations:

McGuirk, J.P., 1991: Long term climatology of precipitable water from space, WetNet Science and Analysis Colloquium, Univ. of Calif.-Santa Barbara, February 19-22, 1991.

Zipser, E.J., 1991: High precipitation, no thunder (HPN) storms; How such "none-der-storms dominate tropical oceanic rainfall, Abstract, American Geophysical Union, p. 97, San Francisco, December, 1991.

----- and E. Smith, 1992: Hurricanes as viewed by SSM/I and radar: Preliminary look at case study opportunities, WetNet Science Meeting, Florida State Univ., Tallahassee, April 1992.