A Final Report to the

National Aeronautics and Space Administration

for

Meteorological Satellite Products Support for Project COHMEX

Contract NAS8-36168

For the period of

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Submitted by

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1. INTRODUCTION

This report summarizes the participation under NASA grant NAS8-36168 by the Cooperative Institute for Meteorological Satellite Studies (CIMSS) in the COHMEX experiment. The period of CIMSS involvement spanned three years (1985-1988). The first year effort focussed on real-time support and satellite data collection during the field phase of COHMEX. Real-time satellite products were generated by CIMSS and made available to the COHMEX operations center via the on-site McIDAS workstation at MSFC. Work efforts following the field phase of COHMEX concentrated on post-processing of the real-time data sets, and generation of enhanced, research-quality satellite data sets for selected COHMEX core days. These satellite-derived data sets will augment the special COHMEX conventional data base with high horizontal and temporal resolution information. The COHMEX scientific community will examine these data sets for their usefulness in delineating important elements in the meteorological environment leading to convective activity. The data will also be useful in comparisons and calibration of experimental instruments flown during COHMEX (such as HIS and MAMS). Details of the raw satellite data collected, derived real-time satellite data and products, and the specially enhanced data sets are given in Appendices A and B.

In addition, a limited research effort was conducted using the CIMSS 4-d data assimilation system in conjunction with evaluating VISSR Atmospheric Sounder (VAS) and High-resolution Interferometer Sounder (HIS) data. The need to address the unique characteristics of new data types, and the problems they introduce into 4-d assimilation procedures is evident. The HIS instrument was flown aboard an ER-2 aircraft on several occasions during COHMEX. One of these flights, on June 15, was chosen for further study. Processed VAS soundings and COHMEX radiosonde data were also collected for this day. The case study included an evaluation of the HIS and VAS data and an impact study of the data on the assimilation system analysis. The details of this study are contained in a CIMSS report (copies available from Dr. Brian Goodman (608) 263-2268).

2. SUMMARY OF TASKS ACCOMPLISHED

A list and description of the tasks accomplished by CIMSS in support of COHMEX under this contract includes:

1) Real-time support of the COHMEX field phase. Through the McIDAS link between CIMSS and MSFC, conventional and satellite data were made available to the COHMEX operations center. Special satellite products were generated at CIMSS and made available which included VAS soundings, analyses and energy parameters; VAS derived imagery (lifted index stability and total precipitable water); cloud drift and water vapor motion wind sets; and TOVS soundings.

2) Collection, archival and distribution to MSFC of raw geostationary and polar-orbiting satellite measurements (VISSR, VAS, TOVS, AVHRR).

3) Generation, post-processing, and distribution to MSFC of special satellite-derived data sets (see Appendix A for details).

4) Generation, post-processing, and distribution to MSFC of specially enhanced, research-quality satellite data sets for five selected COHMEX core days (see Appendix B for details).

Unfortunately, the DMSP and AVHRR real-time ingest capabilities at CIMSS were not realized before the COHMEX field phase. As it turns out, the DMSP SSM/I instrument was not available anyway. AVHRR data was collected from archive tapes for the ten COHMEX core days and distributed to MSFC.

CIMSS had planned a research collaboration with MSFC involving 4-d data assimilation studies. Funding limitations, however, curtailed this endeavor and our efforts were confined to a case study comparing VAS and HIS analyses (discussed earlier in the text). It is possible that additional funding will be solicited in a separate proposal to conduct further 4-d assimilation experiments with the COHMEX data sets.

This report represents the completion of the tasks set forth by CIMSS in its COHMEX participation under grant NAS8-36168. Since satellite data was an integral part of COHMEX, we believe our involvement in COHMEX was important regarding production and dissemination of satellite data and derived products to the COHMEX scientific community. CIMSS was obliged to fulfill this task. In turn, CIMSS has benefitted from COHMEX by receiving a comprehensive mesoscale data set which is being used to help develop and test future planned satellite instruments and data, as well as data assimilation techniques.

APPENDIX A

Enclosed are two tables (Table A.1 and A.2) summarizing the routine real-time satellite data and derived products generated by CIMSS during COHMEX. The available times (UTC) for the first six items can be found in Table A.1, while the seventh item times are listed in Table A.2. A description of each product is given below (all available in digital format from CIMSS):

1) VAS soundings were produced nominally at 90 minute intervals. Horizontal spacing of retrievals is approximately 100 km. No soundings were generated during rapid scan operations (RISOP).

2) Imagery was derived from the VAS radiances (8 km resolution), which includes lifted-index stability and total precipitable water.

3) Gridded analyses of the VAS soundings at mandatory levels, of T, Td, and Z were produced at approximately 1.0 degree horizontal resolution.

4) Selected energy parameters (K index, Total-totals, buoyancy, etc.) were derived from the VAS soundings.

5) Cloud drift (IR and visible) and water vapor motion (6.7 micron) wind sets were produced.

6) NOAA-9 polar-orbiting data was collected and processed into TOVS soundings at approximately 100 km horizontal resolution.

7) Cloud top pressures and emissivities were processed using the VAS radiances up to three times per day between the morning and evening hours at approximately six hour intervals.

ATE	Sta-tus	VAS Soundings	Derived Imagery	Gridded Analyses	VAS Energy Parameters	Cloud Drift Winds	Water Vapor Winds	NOAA-9 Passes	NOAA-9 Soundings	NOAA-6 Passes
/27	Go	10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22,0	12,15,18,21,0	12,18	12,18	9,10,20,22	9,10,20,22	
/28	Go	10,12,15,16, 18,21,22,0	10,12,15,16, 18,21,22,0	10,12,15,16, 18,21,22,0	12,15,18,21,0	12,18, 23	23	10,20,22	10,20,22	11,13,23
/29		10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22,0	10,12,13,15, 18,19,21,22,0	12,15,18,21,0					0i
/30		10,12,13,15,16, 18,19,20	10,12,13,15,16, 18,19	10,12,13,15, 16,18,19	12,18,15					
/31		--	--	--	--					
/1		--	--	--	--					
/2		10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22,0	12,15,18,21,0					
/3		10,12,13,15,16, 17,19,21,22,0	10,12,13,15,16, 19,21,22,0	10,12,13,15,16	12,15,21,0					
/4		10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,21	10,12,15,16,18	12,15,18					
/5	Go	10,12,13,15,16, 18,19	10,12,13,15,16, 18,19	10,12,13,15,16, 18	15,18	12,18	12,18			
/6	Go	10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,0	10,12,13,15,16, 18,19,21,0	12,15,18,21,0	12,18		8,10,20,22	8,10,20,22	01,02,13
/7		10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16 18,19,21,22,0	10,12,13,15,16, 18,19,21,22,0	12,15,18,21,0					
/8		10,12,13,15,16 18	10,12,13,15,16, 18	10,12,13,15,16 18	12,15,18					
/9	Go	10,12,13,15,16, 18	10,12,13,15,16, 18	10,12,13,15,16, 18	12,15,18	12,18	12,18	8,10,19	8,10,19	
/10	Go	16,17	16	16	--	12,18	12,18	8,9,19,21	8,9,19,21	01,02,13 15
/11	Part	10,12,13,15	10,12,13,15	10,12,13	12		12			23
/12		10,12,13,14	10,12,13,14	10,13,15	12,15			9,11,21,22	9,11,21	02,12,14
/13		10,12,13,15,16, 18	10,12,13,15,16, 18	10,12,13,15,16, 18	12,15,18					
/14		10,12,13,15,16, 18,19	10,12,13,15,16, 18,19	10,12,13,15,16, 18,19	12,15,18					
/15	Go	10,12,13,15,16, 18,19	10,12,13,15,16, 18,19	10,12,13,15,16	12,15	16		20	20	
/16		10,12,13,15,16	10,12,13,15,16	10,12,13,15,16	12,15					
/17		10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,19,21,22,0	12,15,18,21,0	12	12	20	20	
/18	Part	10,12,13	10,12,13	10,12,13	12	12	12	19		

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DATE	Status	VAS Soundings	VAS Derived Imagery	VAS Gridded Analyses	VAS Energy Parameters	Cloud Drift Winds	Water Vapor Winds	NOAA-9 Passes	NOAA-9 Soundings	NOAA-6 Passes
6/19	Go	13,15,16,18,19, 21,22,0	15,16,18,19,21, 22	18,19,21,22	15,18,21	12		8,9,19,21	8,19,21	0
6/20	Part	10,12,13,16,18, 19,21,22,0	10,12,13,16,18, 19,21,22	10,12,13,16,18, 19,21,22	12,18,21,0	12		9,19	19	
6/21		10,12,13,15,16	10,12,13,15	10,12,13,15	12,15					
6/22		--	--	--						
6/23	Go	13,15,16,18,19, 21,22	15,16,18,19,21, 22	12,15,16,18,19, 21,22	15,18,21	18		8,10,20	20	0,13,22
6/24	Go	10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,19,21,22	12,15,18,21	12	12	8,10,20,22	20,22	0,2,12, 14,23
6/25		--	--	--	--	12				
6/26	Go	10,12	10,12	10,12	--	12	12	10,20	20	
6/27	Part	10,13,15,16,18, 19	12,13,15,16,18, 19	12,13,15,16,18	12,15,18			10,19,21	19	
6/28	Go	10,12,13,15,16, 18	10,12,13,15,16, 18	10,12,13,15,16, 18	12,15,18		12	19,21	21	0,23
6/29		10,12,13,15,16	10,12,13,15,16	10,12,13,15,16	12,15					
6/30		--	--	--	--	12				
7/1		10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,19	12,15,18	12		19,20	19	
7/2	Go	10,12,13,15,16, 18,21,22,0	10,12,13,15,16, 18,21,22	10,12,13,15,18, 21,22,0	12,15,18,21,0	12	12	9,20		23
7/3	Go	--	--	10,13,15,16	--					
7/4		--	--	--	--					
7/5		15,16,18,19,21, 22,0	15,16,18,19,21, 22	18,19,21,22,0	15,18,21,0					
7/6		10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,19,21,22,0	12,15,18,21,0					
7/7	Part	10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,19,22,0	12,15,18,0	12	12			
7/8	Part	10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,19,21,22,0	12,15,18,21,0	12		19,21	19	23
7/9		10,12,13,15	10,12,13,15	10,12,13,15	12,15	12		19		01
7/10		10,12,13,15,16, 18,19	10,12,13,16	10,12,15,16	12,15,18	12		9,20	20	
7/11	Go	15,16,18,19,21, 22	15,16,18,19,21, 22	16,18,19,21,22	18,21			20	20	
7/12	Go	--	--	--	--			20	20	23
7/13		10,12,13,14,16, 18,19,21,22,0	10,12,13,16,18, 19,21,22	10,12,13,16,18, 19,21,22,0	12,18,21,0					

TE	Status	VAS Soundings	VAS Derived Imagery	VAS Gridded Analyses	VAS Energy Parameters	Cloud Drift Winds	Water Vapor Winds	NOAA-9 Passes	NOAA-9 Soundings	NOAA-6 Passes
/14	Go	18,19,21	10,12,13,15,16, 18,19,21	10,12,13,15,16, 18,19,21	12,15,18,21			20	20	23
/15	Go	10,12,13,15,16, 18,19,21,22,23	10,12,13,15,16, 18,19,21	10,12,13,15,16, 18,19,21	12,15,18,21	12		20	20	23
/16		10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22	10,12,13,15,16, 18,19,21,22	12,15,18,21	12				
/17	Go	10,12,13,15,16, 18,19	10,12,13,15,16, 18,19	10,12,13,15,16, 18	12,15,18			19	19	
/18	Go	10,12,13,15,16, 18,19,21,22	10,12,13,15,18, 19,21,22	10,12,13,15,18, 19,21	12,15,18,21			21	21	0,23
/19		10,12,13,15,16, 18,19,21,22,0	10,12,13,15,18, 22	10,12,13,15,16, 18,22,0	12,15,18,0			19	19	
/20	Go	10,12,13,15,16, 18	10,12,13,15,16, 18	10,12,13,15,16, 18	12			19,20		23
/21	Go	10,12,13,15,16, 18	10,12,13,15,16, 18	10,12,13,16,18	12,15,18			20	20	23
/22	Go	10,12,13,15,16, 18,19,21,22,0	10,12,13,15,16, 18,19,21,22	10,12,13,16,18, 18,19,21,22,0	12,15,18,21,0	12		20	20	01
/23		--	--	--	--			8	8	
/24		13,15,16,18	13,15,16,18	13,15,16,18	15,18	12	12			
/25		13,15,16,18	13,15,16,18	13,15,16,18	15	12	12			1
/26	Go	13,15,16,18	13,15,16,18	18	15,18			21	21	13
/27	Part	13	13	--	--			21	21	13
/28		13,15	13,15	--	--	12		21	21	14
/29	Part	13,15,16,18	13,15,16,18	18	15,18	12	12			13
/30		13,15,16,18	13,15,16,18	18	15,18	12	12	20	20	13
/31	Go	13,15,16,18	13,15,16,18	18	15,18	12	12	20	20	23
/1		13,14	13	13,15,16	--					

TABLE A.2

This table outlines the approximate coverage times (UTC) of the cloud top pressure and emissivity estimates processed during the COHMEX field experiment.

DATE		TIMES		
1 June	86152	13		
2	86153	13	19	00
3	86154	13	18	00
4	86155	13	18	
5	86156	13	19	
6	86157	13	19	00
7	86158	13	19	
8	86159	13	18	
9	86160	13	18	
10	86161	12	18	
11	86162	13		
12	86163	13		
13	86164	13	18	
14	86165	13	19	
15	86166	13	18	
16	86167	16		
17	86168	13	19	00
18	86169	13		
19	86170	13	20	00
20	86171	13	19	00
21	86172	13	16	
22	86173			
23	86174	13	19	23
24	86175	13	18	22
25	86176	14		
26	86177	12		
27	86178	13	19	
28	86179	13	18	
29	86180	13	16	
30	86181			
1 July	86182	12	19	00
2	86183	13	18	00
3	86184	11		
4	86185			
5	86186	15	18	00
6	86187	13	18	00
7	86188	13	18	00
8	86189	13	18	00
9	86190	13		
10	86191	13	18	
11	86192	13	19	
12	86193			
13	86194	13	19	00
14	86195	13	19	
15	86196	13	19	23
16	86197	13	18	00
17	86198	13	19	

TABLE A.2 (continued)

18	86199	13	19	22
19	86200	13	19	00
20	86201	13	18	
21	86202	13	18	
22	86203	13	19	00
23	86204			
24	86205	13	18	
25	86206	12	18	
26	86207	13	18	
27	86208	13		
28	86209	13		
29	86210	13	18	
30	86211	13	18	
31	86212	13	18	
1 August	86213	13		

APPENDIX B

Enclosed is Table B.1 outlining the specially-enhanced satellite data sets generated by CIMSS for five days (17 June, 19 June, 23 June, 8 July, 11 July) selected from the COHMEX core days. VAS retrievals and derived imagery were also generated for a sixth COHMEX core day (14 July). The enhanced data sets include:

1) VAS retrievals at 90 minute intervals during the pre-storm environments (late morning into mid-afternoon) with a horizontal spacing of approximately 75 km.

2) Derived imagery (total precipitable water and lifted index stability) from VAS radiance information at times coincident with the VAS retrievals.

3) Cloud drift winds from visible, infrared (11 micron), and water vapor (6.7 micron) imagery. One set per day usually centered around 1800 UTC.

4) Cloud top pressures and emissivities two to three times per day, derived from VAS radiance information.

The above information has been objectively and manually edited for quality control, and is available in digital format as McIDAS "AREA" and "MD" files, in a McIDAS PUT tape format. The VAS derived imagery (PW = vertically integrated precipitable water vapor and LI = lifted index stability) are stored as McIDAS AREA files for each individual time period with both the northern and southern dwell sounds used to derive the full imagery and combined into a single file. The VAS retrievals are stored as McIDAS MDfiles for each individual day in an ARET schema, where each individual time on a given day is stored as a separate row within the MDfile. The cloud top pressures and emissivities are stored as McIDAS MDfiles for each individual time period in a CLDH schema. The cloud and water vapor drift winds are stored as McIDAS MDfiles for each individual day in a VWIN schema. These 58 areas and 26 MDfiles have been written onto a nine-track tape (6250 bpi) labelled CMXVAS, which has been distributed to the MSFC Data Archive Center.

TABLE B.1

This table outlines the approximate coverage times (UTC) of the specially-enhanced satellite data sets generated by CIMSS for the subset of selected COHMEX core days.

DATE	VAS RETRIEVALS (Z,T,TD,PW,LI)	WINDS (VIS,IR,WV)	CLOUD TOPS (P,e)
17 JUNE	1300	18	13
(86168)	1430		19
	1600		00
	1730		
	1900		
19 JUNE	1430	18	13
(86170)	1600		20
	1730		00
	1900		
23 JUNE	1600	18	13
(86174)	1730		19
	1900		23
	2030		
	2200		
08 JULY	1300	12	13
(86189)	1430		18
	1600		00
	1730		
	1900		
11 JULY	1600	18	13
(86192)	1730		19
	1900		
	2030		
	2200		
14 JULY	1430		
(86195)	1600		
	1730		
	1900		
	2030		