PROGRESS REPORT

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VISSR Atmospheric Sounder (VAS)
Development and Performance Evaluation

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I. General

The past several months at SSEC have been spent on processing VAS data collected by interrupting VISSR operations, testing transparent MSI operations, and preparing for acquisition of the AVE/VAS Special Network data in the spring of 1982.

On December 9, 1981 P. Menzel and C. Hayden travelled to Suitland, Maryland to attend the R & D Council meeting where guidelines for VAS operations on GOES-5 were established. Generation of VAS data sets for scientific scrutiny was labelled as the highest research priority (normal operational commitments coming first). In addition a preliminary proposal to construct a video monitoring capability at Wallops, called the Wallops GOES Monitor, was presented to interested NASA and NOAA personnel. (The disposition of this work is still to be resolved.)

On January 18, 1982 P. Menzel travelled to Suitland, Maryland to attend the NOVA (NOAA VAS Assessment) Program Development Plan meeting. The VAS situation at the University of Wisconsin was presented; the science is ready for VAS operations, satellite access will be increased tremendously in 1982, but the opportunity for use of VAS research data in the operational environment may not be siezed fully because of financial constraints. VAS activities where additional money is critically needed were identified.

On February 8, 1982 J. Greaves and R. Arnold visited SSEC. After a McIDAS demonstration and a general VAS briefing, AVE/VAS Special Network data from February 6, 1982 was processed and displayed for their inspection. The proposed UW workload and funding were reviewed.

On February 10, 1982 P. Menzel and W. Smith travelled to Huntsville, Alabama to coordinate the transfer of satellite data to MSFC from SSEC and the ground based data to SSEC from MSFC for the AVE/VAS Special Network research. Early access to both data bases was stressed.

On March 10, 1982 P. Menzel travelled to Suitland, MD to confer with NESS and GSFC personnel regarding the transparent VAS schedule to be implemented spring, 1982. That schedule can be found in Tables 1 through 3.

UW processed data sets covering two specific severe weather cases were requested by and sent to GSFC in the past quarter. The July 20, 1981 storm over St. Louis was depicted on the VAS data processed for 1200, 1500, 1800 and 2100Z. Interesting weather centered on North Carolina was covered by the VAS data of July 13, 1981 at 1200, 1500, 1800 and 2100Z.

II. Data Processing

From November 1981 through January 1982, VAS data from GOES-4 was collected Tuesday mornings, (1015Z to 1135Z) over the Gulf of Alaska portion of the Limited Finemesh Model area. (LFM). This data was processed by UW/NESS into vertical distributions of temperature, humidity, and geopotential height. It has been implemented by NMC into their model to assess the impact of dwell sounding data products on synoptic scale numerical modelling. Although the study has just begun, early feedback from NMC is favorable. "The potential for the VAS data to significantly impact the LFM analysis system was demonstrated by comparing LFM analyses made with, and without VAS

TABLE 1

Half Hourly Duty Cycle (GOES-5) for TVAS Operations

Time (min)	Activity
01-15	Multispectral Image of lines 101-1500 (90N-40S) vis at 1 km 11.2μ at 7 km 6.7μ at 14 km or 3.9μ at 14 km 12.7μ at 14 km
15-18	Processor Data Load and Retrace of scan mirror
18-28	Dwell Image or Dwell Sound (see following table)
28-29[30]	Processor Data Load and Retrace
29[30]-01	Spare

TABLE 2

UW/NESS VAS PDL Recommendations for GOES-5 TVAS Operations

POL 1	2	3	4	5*	6	7	8	9	10
MSI	MSI	MSI	MSI	DS	DS	DS	DS	DS	DS
8	8	8	8	0	1	1	1	1	0
7	7	7	7	0	3	3	3	3	0
8	8	8	8	4	4	4	4	4	4
7	7	7	7	3	3	3	3	3	3
8	8	8	8	1	2	2	2	2	1
10	12	10	12	4	6	6	6	6	4
8	8	8	8	2	2	2	2	2	2
10	12	10	12	1	1	1	1	1	1
s8	s8	s8	s8	0	3	3	3	3	0
hs810	hs810	hs700	hs700	1	1	1	1	1	1
cn911	cn911	cn801	cn801	0	0	0	0	0	0
16.2m	16.2m	14m	14m	1	1	1	1	1	1
full	full	90°N-42°S	90°N-42°S	$s_1 6$	$S_1 6$	$S_1 6$	$S_1 8$	$S_1 6$	$S_1 6$
				$S_3 2$	$S_3 2$	$S_3 2$	$S_3 8$	$S_3 2$	$S_3 2$
				hs96	hs64	hs64	hs112	hs160	hs96
				cn400	cn324	cn444	cn400	cn400	cn584
				10.08m	9.92m	9.92m	9.8m	24.8m	10.08m
				44-27°N	49-36°N	36-26°N	45-26°N	51-23°N	27-14°N
				Dwell	Dwell	Dwell	Dwell	Dwell	Dwell
				Image	Sound	Sound	Sound	Sound	Image
				(north)	(north)	(south)	(venetian)	(Interrupt)	(south)

TABLE 3

UW/NESS Recommendation for 7 Hour TVAS Operation

Time	PDL	Coverage and Activity
1400	3,6	MSI (with 10), DS (north)
1430	4,7	MSI (with 12), DS (south)
1500	1	Full MSI (with 10), trilateration
1530	4,5	MSI (with 12), DI (north)
1600	3,10	MSI (with 10), DI (south)
1630	4,5	MSI (with 12), DI (north
1700	3,6	MSI (with 10), DS (north)
1730	4,7	MSI (with 12), DS (south)
1800	1	Full MSI (with 10,), synoptic
1830	4,5	MSI (with 12), DI (north)
1900	3,5	MSI (with 10), DI (north)
1930	2	Full MSI (with 12), trilateration
2000	3,5	MSI (with 10), DI (north)
2030	4,10	MSI (with 12), DI (south)
2100	normal VISSR	

data. In both cases (studied so far), introducing VAS data in the analysis increased the amplitude of the major height field features." The density of VAS soundings over the ocean was seen as a tremendous advantage over the sparsely spaced conventional ship reports.

Similarly, in the same time frame, UW/NESS has been forwarding VAS products (relative humidity, total precipitable water, geopotential thickness fields, gradient winds, and stability indices) derived from GOES-5 data gathered in the interrupt mode on a weekly basis to the National Severe Storm Forecast Center at Kansas City. They have performed a more detailed analysis of the VAS data impact on one day in particular (July 20 when severe weather occurred over St. Louis) and have concluded "while VAS data alone are insufficient to nowcast severe weather, the data can help to fine tune the forecast... If the SELS forecasters had had the moisture channel imagery as well as the sounding data, the initial watch...would have been more focussed (over the area of subsequent severe weather). The combination of VAS and conventional data will likely prove to be more useful than either data set alone."

Preparations for gathering the AVE/VAS Special Network data included a test day of data acquisition on February 6, 1982. Balloons were launched at 1100, 1700, 2300Z by personnel from TAMU and dwell soundings covering roughly 24° to 42°N were generated by GOES-5 at 1100, 1430, 1730, 2030, and 2330Z (the first two soundings were ingested from the cassette archive after incorrect year identification at Wallops frustrated real time ingest). Analysis of the satellite, ground and combined data is underway. On March 6, 1982 the first AVE/VAS day was called. Balloons were released at 3-hour intervals

starting at 1100Z. Soundings were accomplished at 1100, 1430, 1730, 2030, 2330, 0230, 0830, and 1100Z (0530Z was unavailable because of eclipse). This day was quite successful: the data was complete, the coverage was good, and the weather was interesting (a trough moved through the network during the period of data collection).

From February 8 to March 12, 1982 the transparent MSI mode of VAS operation was successfully tested using the VAS on GOES-5 and the transponder on GOES-3. Typically 90% of the scheduled images were sent; deviations from the schedule were caused by RISOP and SDB tests. Starting March 23, 1982 the transparent VAS mode of VAS operation for 7 hours per day (Monday through Friday) will be tested for several weeks. Expansion to 16 hours per day is expected in mid April.

III. VAS Instrument Support

Determinations of the VAS-E misregistration of images of the IR window channels (band 8 using HqCdTe detectors, band 12 using InSb detectors) and the visible channel were made from December, 1981 images of Baja, California. As with VAS-D it was found that the IR image is east (.40 mrad) and south (.16 mrad) of the visible image. The Detector Geometry parameters in the SDB were updated to reflect this information (the north south correction is impossible, but the east west correction has been implemented).

In January, 1982 Westinghouse modified the calibration algorithm at the SDB so that the ΔF scale factor is calculated dynamically (instead of determined empirically by UW periodically) whenever the scan mirror or the filter wheel position changes. After several days

of debugging by UW and Westinghouse, the new software version was made to work.

After discussions with personnel at GSFC (H. Montgomery, D. Chesters) it was confirmed that VAS-E shows no discernible radiometric bias with respect to gound truth radiosondes in any of the twelve spectral bands. VAS-D biases were also agreed upon; for the twelve spectral bands, VAS-D minus radiosonde yields (in ergs/etc) -2.0, -3.3, -3.1, -1.7, -0.6, -.05, N/A, N/A, N/A, N/A, -0.2, N/A (where N/A, not available, applies to the window and H_2O spectral bands).

UW has been asked to recalibrate the radiometric data of Hurricane Jose gathered by GOES-5 but calibrated with GOES-4 parameters by the SDB. Work is underway to establish algorithms for this recalibration process.

IV. VAS Algorithm Development

A renewed effort was applied to the processing of partly cloudy soundings via the paired field of view techniques, and the algorithms can now produce retrievals comparable to clear air soundings where the true skin temperature can be accurately determined (if the cloud cover is sufficiently broken and if there is no cirrus). Acquisition of the partly cloudy soundings is an operator intensive effort and is restricted to the manual sounding mode. It has proved quite useful in improving the data coverage over the U.S. for the July 20, 1981 test case which is being used in a forecast impact study with the subsynoptic scale forecast model.

High resolution topography was introduced to the processing using a topography supplied by the U.S. Navy at a ten minute resolution. In

addition to terrain elevation the topography includes a characteristic to identify the type of terrain. Experiments are in progress to see if it is useful to include the terrain type in the collection of VAS measurements so that the surface contribution may be made uniform over all FOVS. Slight uncertainties in navigation suggest that this may be a somewhat ambitious undertaking.

A project to introduce time tendency terms into the calculation of winds from heights has been undertaken and the computer program is nearly complete. Initially three hourly VAS data will be used to estimate the isallobaric wind but hopefully one hourly data will be available in the future. The approach will be verified using the AVE/VAS Special Network raob data taken over Texas. One case, for March 6, 1982, is already being investigated.

First guess temperature/moisture profiles are currently obtained from time interpolated analyses and forecasts obtained from the NWC Limited Finemesh Model or Global forecasts. It is our intention to replace this method using forecasts and analyses generated locally using the most recent VAS data. Initially the forecast will be provided using the principle of conservation of potential vorticity on a restricted number of layers and the full temperature profiles will be obtained statistically from these layers. Considerable development and experimentation is required before such a scheme can be implemented.

Work is continuing on tracking water vapor images from VAS to produce wind vectors. These water vapor motions have been shown to correspond closely to the mean wind velocity of the 300-500 mb layer.

From studies with July 20, 1981 VAS data, the water vapor motions are especially useful around the jet where conventional winds are sparse.

V. Numerical Modelling

A case study for 20-21 July 1981, a day marked by vigorous convective storm development in eastern Missouri, is partway along. Mesoscale temperature/moisture soundings from VAS are available for that case. A modified version of the model code is being used, in which the Arakawa-Schubert convective parameterization scheme is replaced by a method of Kuo, shorter and simpler to code but with better apparent potential for handling convective rainfall. Two "optimum interpolation" NMC global analyses, for 12Z 20 July and 00Z 21 July, have been interpolated to the ANMRC grid as nesting datasets, as had been done with LFM analyses and forecasts in the 10-11 April 1979 case study. A 12-h control experiment, initialized at 12Z 20 July without satellite data blending, has been run, with 5-min time steps, and forecasts for 3 h, 6 h, 9 h and 12 h have been post-processed back to standard pressure levels for later microfilm display. It is also hoped to perform a companion run, initialized from 15Z with blending of VAS data, then run back out to 00Z, for data-impact comparison with the control experiment.

Another SESAME case study, for 19-20 April 1979, is also partway along, using the older version of the NCAR model code, and considered secondary to the 20-21 July 1981 case. It is hoped to run three 14-h forecasts, each initialized from 10Z 19 April using backward time extrapolation from space-interpolated LFM analyses for 12Z 19 April and 00Z 20 April, but with no FIB (ANMRC Field Information Blending)

in the forecast, FIB of 10Z TIROS-N temperature/thickness/moisture data in the second, and FIB of the above data plus 10Z TIROS-N winds in the third. Each analyses has been performed and saved, though only the control forecast has thus far been run.

An alternate version of the ANMRC analysis/model package is gradually being put on the IBM 360 computer in Suitland, mainly for economic reasons. Any substantial computing on the NCAR machines runs up steep costs (NCAR usage was free of charge until FY 1981, when NCAR instituted a user billing policy for most non-NSF-related projects as a cost recovery measure), whereas the IBM is free. An 81x61 subset of the 101x71 NCAR grid configuration is being used, in view of smaller available core on the IBM than on the CRAY. The analysis is able to run, with believable ballpark results, though without direct comparison to corresponding NCAR output as yet. The preprocessor can execute, though debugging is not yet complete. The model proper, based on the newer NCAR code (using the Kuo convective parameterization scheme), loads successfully, and is just now being tested out for execution on the 19-20 April 1979 case. Later job steps, such as post-processing, still remain to be put on the IBM.