SUMMARY OF THE NOVEMBER 4-5, 1998
GOES ASSESSMENT MEETING

The annual meeting convened at approximately 12:30 PM on Wednesday, November 4, 1998 in Room 14316 of SSMC2. The participants were

L. Uccellini (W/OM)
G. Dittberner (E/OSD)
J. Hawkins (E/OSD)
D. Gray (E/OSD)
R. Gird (W/OM22)
F. Mosher (W/NCEP/AWC)
J. Gurka (W/OM21)
B. Watkins (E/SP2)
J. Paquette (E/SP/SAB)
W. Sunkel (W/CR/MSD)
D. Chesters (NASA/GSFC)
D. Parrish (W/NCEP/EMC)
M. DeMaria (W/NCEP/TPC)
* D. Rotzoll (W/SR/SMG)
K. Schrab (W/WR3)
L. Hogan (W/ER3x4)
P. Donaldson (W/PR/HNL)
B. Motta (E/RA/CIRA)
R. Fennimore (E/SP22)
B. Meisner (W/SR3x1)
G. Mandt (W/OM2)
M. Allen (W/OH/NOHRSC)
J. Heil (W/OM22)
A. Noel (W/OM22)
C. Weiss (W/OM22)
G. Wade (E/RA/CIMSS)
M. Schichtel (W/NCEP/HPC)
D. Hillger (E/RA/CIRA)
R. Scofield (E/RA2)
R. Radlein (W/OM22)
J. Daniels (E/RA2)
M. Weaks (E/SAB)
L. Furgione (W/AR/ANC)
D. Helms (W/OM22)
G. Ellrod (E/RA2)
S. Ambrose (E/SP22)
S. Kusselson (E/SAB)
S. Bunin (E/OSD/Mitretek)
S. Johnson (ITT)
D. David Gregory (ITT)

* Participated by telephone

The meeting agenda follows:

Wednesday: November 4, 1998

12:30 PM: Welcome & Introduction — R. Gird

12:35 PM: OM Vision & Perspective — L. Uccellini

12:55 PM: NESDIS/OSD Update — G. Dittberner

1:10 PM: GOES Sounder Assessment Results (CIMSS) — G. Wade

1:25 PM: GOES Imager Assessment Results (CIRA) — D. Hillger

Review of GOES Assessment Results for 1998

1:40 PM: NESDIS/SAB — J. Paquette

1:55 PM: Spaceflight Meteorology Group — D. Rotzoll

2:10 PM: Break

2:25 PM: Eastern Region — L. Hermes

2:40 PM: Central Region — W. Sunkel

2:55 PM: Southern Region — B. Meisner

3:10 PM: Western Region — K. Schrab

3:25 PM: Pacific Region — P. Donaldson

3:40 PM: Alaska Region — L. Eikermann

3:55 PM: Office of Hydrology (NOHRSC) — M. Allen

Thursday: November 5, 1998

8:00 AM: NCEP (EMC) — D. Parrish

8:15 AM: NCEP (HPC/MPC) — M. Schichtel

8:30 AM: NCEP (SPC) — S. Goss

8:45 AM: NCEP (AWC) — F. Mosher

9:00 AM: NCEP (TPC) — M. DeMaria

9:15 AM: Break

9:30 AM: NASA — D. Chesters

9:45 AM: AWIPS/NOAAPORT — D. Helms

10:00 AM: Discussion of GOES-10 Science & Operations Test — J. Heil/A. Noel
- AWIPS/NOAAPORT Performance — D. Helms
- GOES-10 Science & Operations Test Results — G. Ellrod

12:00 Noon: Brown-bag Lunch:
GOES-“Next” Imager/Sounder Instruments — J. Hawkins

1:00 PM: FY99-00 GOES/AWIPS Issues — B. Motta/D. Helms/D. Gray
- AWIPS/NOAAPORT Feedback
- Image Enhancement
- Planned Product Improvements
    - o ITT New Image Processing Capabilities — S. Johnson

3:00 PM: Summary & Wrap-up R. Gird
- 1998 Report Feedback

3:30 PM: Meeting Adjourns

1. Dr. Louis Uccellini (W/OM-Director) set the tone for this year's assessment meeting by identifying the vision and challenges for upcoming GOES assessment activities. The digital GOES data, in combination with AWIPS and the new Class-VIII computers slated for NCEP, afford the NWS the capability to significantly improve forecast accuracy.

The challenge will be how to better utilize GOES sounder data both in the models and at field offices. A major portion of the effort will be developing methods to deliver better quality satellite products to field forecasters via AWIPS,Build 5.0. A focus of future assessment activities also will be on GOES sounder products - how do we use them now? and how will we use them in the future? Performance measures must be developed to objectively evaluate the utility of GOES sounder products.

2. Gerald Dittberner (NESDIS/GOES Program Manager) gave a summary of the operational status of GOES-8, -9 and -10.

- GOES-8 is operating at 75**°**W with a backup Earth Sensor.
- GOES-9 is operating at 105**°**W with a backup momentum wheel, and it's not healthy.
- GOES-10 is operating at 135**°**W in an upside down configuration and is working well.

GOES-L is tentatively scheduled for launch March 30, 1999. Gerry mentioned the three main constituent users of GOES products and services:

- Forecasters who now have, or will have AWIPS (NWS offices)
- Forecasters who will not have AWIPS (private sector, The Weather Channel)
- NWP community (NCEP, universities).

The GOES-N/O/P/Q series, scheduled for the next millenium, will fly experimental sensors that may be funded by NASA. These include:

- Lightning mapper

- Special events imager

- Volcano camera (VOLCAM).

GOES-N, slated for launch -2001, will carry batteries with sufficient capacity to resolve the power issue during eclipse periods.

3. GOES sounder assessment activities at the Cooperative Institute for Meteorological Satellite Studies (CIMSS) were summarized by Gary Wade (NESDIS/CIMSS). CIMSS employs the Internet as their primary method of disseminating realtime satellite data. Interesting examples and applications of *current* GOES data (including sounder products) are posted on the CIMSS GOES Gallery. A report on the "GOES-10 Science and Operations Test" is also included on the CIMSS web site.

Gary noted that a COMET CD module, "Satellite Meteorology: Using the GOES Sounder" was completed in August 1998.

4. Don Hillger (NESDIS/CIRA) reported on imager assessment work done at the Cooperative Institute for Research in the Atmosphere (CIRA). The GOES-10 Science and Operations Test yielded some interesting findings on the value of 5-minute data compared with 15-minute imagery. For both low-level thunderstorm outflow boundary interaction and overshooting top behavior, 5-minute imagery revealed structure and processes not discernible on the traditional 15-minute interval data. Also for fire monitoring, Don reported that an elementary fire detection technique found 55% more fires across Oklahoma on April 1, 1998 with 5-minute imagery than with 15-minute imagery.

Tropical storm work at CIRA included relating the asymmetry of cold cloud top areas detected on IR imagery to vertical wind shears within the storm. Vertical wind shears were estimated by averaging the high density wind vectors at different levels within the storm and subtracting out the storm motion.

CIRA produces two sets of U.S. climatology products on a monthly basis:

- CONUS areas produced from GOES-East and GOES-West visible and IR data (visible products produced during daylight hours, and alternate hours for the other channels).

    * all five imager channels - average, maximum, minimum, standard deviation cloud cover products

    * visible channel only - cloud frequency and percent cloud cover products.

- Wind regime climatologies calculated for small (120 x 320 pixels) areas centered around 114 AWIPS sites. At each site, calculations for 8 compass points using mean wind speeds and resultant directions (from PCGRIDS) through a 1000 to 700 hPa layer.

Don also discussed the development of three new imager products

- Visible albedo product

    * effectively enhances visible images (brightens dark areas caused by low sun angle).

- 3.9Fm albedo product

    * technique can be used day or night since albedo and emissitivity are related.

    * may replace the combined nighttime fog/daytime reflectivity product which uses different techniques day and night.

- Surface skin temperature product

    * eliminates atmospheric absorption in channel 4 in cloud-free areas.

Work is under way at CIRA to develop an algorithm to diagnose convective rainfall using all available data sources (satellite, radar, model output, etc.).

Upgrades to the RAMSDIS system included improvement of field site software to allow distribution of 5-minute data during the GOES-10 test period and another improvement to support GOES-10 data operationally. Four new RAMSDIS field sites and one research facility (ETL) were added during 1998.

On the AWIPS front, Don reported that as field sites now with RAMSDIS units received AWIPS, their units were redeployed to offices without access to digital satellite data. Full AWIPS deployment is scheduled for June 1999.

Training efforts included the completion of a computer-based learning module “Advanced GOES Imagery Applications” which has

been made available on the Web. A rewrite and upgrade of the module “An Introduction to GOES-8" is currently underway. COMET class lectures on GOES applications were given by CIRA four (three SatMet courses and one University Faculty Satellite Course) times during 1998. As part of the CIRA-RAMM team’s virtual laboratory, two GOES 5-minute operational datasets were added. This data documented spring tornado outbreaks across the southeastern states. Also plans are to continue Satellite Interpretation Discussions (formerly Picture of the Day) but more frequently than monthly.

The CIRA-RAMM team provided support in the form of GOES digital imagery to Costa Rica during the fire event of spring 1998.

5. NESDIS/Satellite Analysis Branch (SAB) assessment results were presented by John Paquette. SAB provides GOES support in three potentially hazardous environmental situations:

- Tropical cyclone monitoring

- Precipitation estimates (SPEs)

- Smoke (volcano/fires) detection/monitoring.

John explained how Imager channels 1 (visible), 2 (shortwave IR) and 4 (longwave IR) are utilized in fire and volcanic ash detection. In particular, SAB provided support to Florida state authorities during the wildfire outbreak in the Summer of 1998. Support (in terms of GOES products) was also given to Mexican and Central American authorities fighting those fires earlier in the year. Derived Product Imagery (DPI), comprised of combinations of Imager channels 2,4 and 5, has also proved useful for detecting and monitoring fire hot spots and volcanic ash.

A test of machine-generated SPEs from the Auto-Estimator was conducted from August 5 to September 18, 1998. Participants in this test included NESDIS/SAB and ORA as well as NWS/OM, WFOs and RFCs. Evaluation criteria included

- Product timeliness
- Estimate coverage
- Product utility operationally
- Auto-estimate verification
- Product content and format.

Results showed little or no improvement in product timeliness, but an overall improvement in coverage with an increased number of messages, indicating more events covered and more messages per event issued. Based on these findings, SAB

decided to begin using the SPEs generated by the Auto-Estimator operationally. A meeting will be scheduled to discuss test results and future operational products.

SAB provides tropical cyclone detection and monitoring support over most of the Atlantic and Pacific Oceans, Caribbean Sea and Gulf of Mexico to NWS and military tropical prediction centers. Visible and IR channels 2 and 4 from the Imager are the primary data used for this operation. IR imagery is particularly useful in locating exposed, low-level centers of tropical cyclones at night (channel 2) and for general tropical cyclone monitoring (channel 4).

6. Because of a conflict with an ongoing shuttle mission, Doris Rotzoll (NWS/SMG) participated via telcon. SMG primarily assessed GOES data in terms of how they were used in their operational support of missle and shuttle missions.

During the GOES-10 Operations and Science Test, SMG only participated from March 17 to April 3 because of a conflicting April 16 shuttle launch. However, during their evaluation period, the 5-minute GOES imagery provided a “significant contribution” to the prediction of low-cloud ceilings in two forecast simulations. For SMG, a big advantage was not only the higher frequency imagery, but a more consistent timing of the data which translated into improved tracking of features and easier loop updates.

In October, SMG supported the reentry portion of a French Ariane mission. The area of interest was limited to the central tropical Pacific. Since the flight occurred on October 20-21, GOES-10 eclipse and keep-out-zones limited data availability. SMG did provide mission support in the form of GOES-10 composite imagery of the Northern and Southern Hemispheres together with briefings at 18Z on October 20 and at 10Z and 12Z on October 21. With the help of favorable weather, most of the mission objectives were accomplished.

Because of the importance of weather support in general and satellite support in particular before and during a space shuttle launch, any missing GOES data can have a critical impact on the safety and success of a mission. Communication between NESDIS and SMG regarding data outages (routine and unscheduled) is essential. Doris reported that, in general, the flow of such information has improved; in particular, eclipse and maneuver schedules were cited. The Web has been an excellent source for satellite schedules and status.

Doris reiterated requests for a FAQ page, a glossary of operational satellite terms (e.g. keep-out-zones, single-chord

operations, etc.), and details on how satellite navigation is accomplished.

7. Laurie Hermes (NWS/ER) summarized GOES assessment work ongoing in the Eastern Region of the NWS. Laurie began with a rundown of the region's participation in the GOES-10 Science and Operations Test. She noted that the weather was generally benign during the test period and that GOES-10 data were not integrated with other data during the test.

Only two offices completed surveys during the test period, but results from these surveys showed GOES-10 imagery was useful more than 60% of the time in preparing TAFs and Nowcasts. Conversely, in issuing warnings and defining warning areas (including flash flood warnings) GOES-10 data were helpful 10% of the time or less. In part, these low scores for data use during warning situations can be attributed to the tranquil weather during the test period.

Some of the benefits of the GOES-10 imagery (as stated by forecasters) during the test included

- Identification of sea breeze, lake breeze and other terrain-induced boundaries sooner than with other data sources

- Monitoring of fog behavior in a more timely fashion

- Analysis of atmospheric motions.

Several negatives were also mentioned:

- GOES-10 imagery exhibited a greater parallax error than GOES-8 data

- GOES-10 IR temperatures were markedly colder than GOES-8 temperatures

- Navigation was off by . 8km over a portion of the images (n.b. INC was off during the test)

- Images loops were jumpy

- Forecasters could not integrate imagery with other data sources (GOES-10 data were not available via AWIPS or SAC systems).

Laurie summarized Eastern Region's findings from the GOES-10 Science and Operations Test as follows

- More lead time was needed for the region and offices to set up and coordinate meaningful evaluations

- Two offices experienced problems with the timeliness and reliability of RAMSDIS data

- Evaluations were limited to offices with RAMSDIS (5 sites)

- For future evaluations, have GOES data available on AWIPS and the SACs.

The Eastern Region also participated with NESDIS/SAB in an evaluation of machine-produced SPEs by the Autoestimator. Participants in this assessment included the Ohio River Forecast Center and NWS offices in Blacksburg, VA; Taunton,MA; Binghamton, NY and Wilmington, OH.

Participants were asked to complete surveys during the

assessment. The Ohio River Forecast Center completed 21 surveys while the Blacksburg, VA office filed 15 surveys. Five surveys were received from NWSFO Taunton, MA.

Results from the Autoestimator assessment revealed limitations in the satellite sensing of precipitation. The inherent resolution (4km) of the IR imagery along with limitations due to viewing angles were cited as shortcomings. Accuracy of precipitation amounts and location was also questioned as was the timeliness of the products.

As a result of the Autoestimator assessment, Eastern Region participants recommended the following

- Refine the algorithm to include:
    * information pertaining to terrain, winds, parallax error, model temperatures and moisture (i.e. drop-size distribution, etc.)
    * user-selectable accumulation periods (i.e. 30 mins, 3 hrs, storm total, etc.)
    * have an off-line version available for research and training.
- Changes to improve product timeliness:
    * have the capability run the algorithm locally on AWIPS
- Improve the user interface:
    * integrate the algorithm with rain gauge, WSR-88D and high resolution basin/terrain information
    * enhance data readout capability
    * enable local selection of display color tables.

Eastern Region participants felt that future evaluations should migrate from RAMSDIS to SAC/AWIPS/WHFS-like data formats and displays. Beyond formal assessments, a post-doc position should also be created to continue the quantitative product evaluations, perhaps looking into warm vs. cold season estimates and precipitation from convective vs. tropical vs. low-topped regimes.

In general, Eastern Region users of the QPEs continue to be enthusiastic about the possibilities of satellite precipitation estimates in all meteorological regimes.

8. NWS Central Region maintained an active role in GOES assessment during 1998. Warren Sunkel (NWS/CR) reported a wide

variety of satellite uses by Central Region offices.

GOES data (imager and sounder) provided an immense help in forecasting the off-season tornado outbreak of March 29 at Sioux Falls, SD. Rapid-scan imagery provided justification for the issuance of warnings even as radar seemed to indicate a weakening of the convection. In addition, sounder-derived products revealed an “explosive” pre-storm environment which led to fast actions by forecasters at the Sioux Falls office. Actions which may not have taken place in such a timely fashion if not for the GOES data.

At the Des Moines, IA forecast office, GOES sounder data played an instrumental role in at least three instances in determining where thunderstorms would or would not develop. Monitoring the trend in convective inhibition (CIN) was cited by Chuck Myers, at the Des Moines office, as the reason he removed thunderstorms from an evening forecast. Central Region forecasters did lament that because sounder products had to be downloaded via the Internet, they probably don’t get used as much as they should. Also, a “Catch 22" exists in that when sounder products would be the most useful, the forecast area is often cloud covered.

Dan Baumgardt, from the La Crosse, WI office, is leading a Central Region effort to distribute GOES sounder products region-wide. Sounder products are to be retrieved from the CIMSS server at the University of Wisconsin and then distributed to Central Region offices over the frame relay network. Information to be sent in this fashion includes DPI, high-density winds and Autoestimator QPEs. Implementation has been scheduled for March 1, 1999.

Those Central Region offices with AWIPS deployed have noted a greatly enhanced GOES capability. Steven Kays (Topeka,KS forecast office) told of a winter storm warning situation whereby integrating GOES imagery, surface observations and profiler data onto a single graphic clearly showed a warning was not justified and it was cancelled. Similarly, Jeffrey Manion from the Kansas City forecast office says “It’s hard to imagine being without it (GOES data)”. “Most forecasters have at least two windows in AWIPS with satellite data running at all times”.

Case studies using GOES information have been worked-up at the Rapid City, SD forecast office. These cases include

- Black Hills blizzard (2/25-3/1, 1998)
- Grass fires near Philip, SD (3.9Fm IR used)
- Heavy rain event that led to flooding in Rapid City).

Alan Haynes, from the Pueblo, CO forecast office, has developed a tutorial which reviews forecasting principles using water vapor imagery.

General comments from Central Region forecasters concerning the SCPs were that they worked well, they were used continuously, cloud amounts were over-estimated during cold outbreaks and new sites were welcome.

9. Southern Region participation in the GOES assessment effort for 1998 was given by Bernard Meisner (NWS/SR). Upgrades of the region's satellite delivery system proved paramount in forecater's ability to use and evaluate GOES products. Deactivation of the SWIS/MicroSWIS data link and activation of the regional frame relay network at non-AWIPS sites brought the Southern Region into the age of digital satellite data. Data communications lines were also upgraded as part of this conversion.

GOES products sent to all offices included:

- 12 km IR
- 8 km water vapor
- 4 km IR sectors
- 4 km IR2 sectors
- 4 km VIS sectors (RAMSDIS)
- 4 km FOG sectors (RAMSDIS)
- 2 km VIS sectors.

GOES products sent to specific offices included:

- N Hem (IR, IR2, WV)
- Super Nat'l (VIS, IR, IR2, WV)
- P Rico Nat'l (VIS, IR, WV)
- P Rico Reg. (VIS)
- Hurricane Sectors
    * 1 km VIS
    * 4 km IR, IR2.

Bernard reported the results compiled on an assessment survey given to Southern Region participants. Some highlights of the survey findings were

- Visible and WV imagery were the data most frequently used

- Specific enhancement curves were frequently used

- Soundings were rarely used

- Derived products were infrequently used.

In addition, specific questions were asked of the forecasters pertaining to the utility of GOES data during recent forecast situations.

10. Kevin Schrab (NWS/WR) presented the GOES assessment results from the Western Region.

During the GOES-10 Science and Operations Test, ten images per hour were shipped to all 24 Western Region offices. RAMSDIS was used for data display. Approximately 90% of all available data were sent to the offices. The images were viewable 8-10 minutes after scan start. GOES-10 data sent to the NWSFOs were

- 1 km VIS
- 2 km VIS
- 2 km IR
- 2 km FOG/Reflectivity product.

GOES-9 data were employed at larger scales (i.e. 4 km WV, 4 km IR and VIS as well as 16 km WV and 16 km IR).

A 23-question survey was developed and sent to all participating offices. This survey, to be completed by forecasters at the end of each shift, was an attempt to determine the usefulness of GOES-10 data in normal day-to-day operations as well as in critical (warning/watch/advisory) situations. All the offices provided feedback on the survey.

In general, the survey responses indicated that the combination of the more frequent GOES-10 imagery combined with the 15-minute GOES-9 data was significantly more useful than GOES-9 data alone. More specifically, survey respondents reported the 5-minute GOES-10 images of marginal help during flash flood situations. In winter weather situations, GOES-10 data were deemed helpful, though forecasters indicated that it did little to increase lead time or refine warning/watch/advisory areas.

In convective situations, the value of 5-minute interval GOES-10 data came to the forefront. Forecasters said the imagery was useful in more than 90% of the cases and that the data aided in monitoring pre-convective environments, defining warning areas and increasing warning lead times. The data were not as useful for monitoring outflow boundaries and gust fronts.

The survey also asked forecasters to rate the value of visible and fog product images in monitoring fog and marine stratus. For both the visible data and the fog product, Western

Region forecasters indicated the data to be useful (the fog product slightly more than visible imagery).

Aviation forecasts were included in the survey. Responses showed that while the 5-minute images did help in composing TAFs and TWEBs and in amending TAFs, they did little for amending TWEBs.

GOES-10 data proved useful to forecasters in composing zone forecasts and nowcasts, but were of lesser value in amending zone forecasts. The feeling was, however, the 5-minute interval data made little difference in either composing or amending marine forecasts.

In summary, the Western Region questionnaire showed that 5-minute interval GOES-10 data were valuable in routine forecast situations and were especially helpful during critical weather events.

Offices with AWIPS voiced concern over several issues, including:

- Data limitations
    * product availability
    * product domain (picture edges)

- IR lookup table definition

- GOES data remapping

- Enhancement table setup

- Image compositing

- Image receipt during rapid scan operations

- LDAD use for image receipt.

11. Pete Donaldson (NWS/PR) presented GOES assessment activities from a Pacific Region perspective. As usual, the Pacific Region has a different slant on things than do most NWS entities: case in point - The GOES-10 Science and Operations Test. An advertised goal of this test was to investigate the impact of piping more-frequent data into forecast offices. However, in doing this over the CONUS, data availability was actually *reduced* to the Pacific Region.

With the demise of GOES-TAP on October 1, 1998, the Pacific Region became totally dependent on the HIPS direct readout system for satellite data. This will continue until AWIPS is deployed.

In addition, SWIS and MicroSWIS systems have been shut down. The Pago Pago office has its own direct readout capability while the three Hawaii WSOs are served by the Honolulu office through their HIPS system. The Pacific Region has individual antenna/receiver systems for GOES and GMS.

With the overall lack of weather data over the Pacific Region, satellite information takes on added value. A continuous flow of satellite data is essential for the NWS offices to successfully do their jobs. Therefore, it is no surprise that data outages can have serious impacts. Pete offered a few suggestions for ensuring data reliability for the future:

- Construct a second Command and Data Acquisition (CDA) facility at a site geographically removed from Wallops Island, VA. This would minimize data loss due to power interruptions because of solar interference, adverse weather, etc. at Wallops Island. Also, a single CDA location precludes any hope of a three-GOES operational system.

- Design a data transmission and formatting procedure that would send usable information to the direct readout sites in one step, rather than the cumbersome two-step process now employed. The added steps increase the opportunity for data to be lost.

- Work toward a more complementary GOES/POES system. With the apparent lack of emphasis on POES direct readout data, there is no backup polar data during GOES outages. POES schedules preclude data availability during GOES eclipse and keep out zone down times.

Pete pointed out that NWS satellite program responsibilities are laid out in WSOM, Chapter B-55 written in 1985. He suggested this chapter be updated or eliminated.

The Pacific Region feels strongly that the current GOES system does not support the current NWS mission “To provide weather and flood warnings, public forecasts and advisories for *all of the United States, its territories, adjacent waters and ocean area,* primarily for the protection of life and property.” Guam receives no GOES coverage, while the coverage over Wake Island, Midway and American Samoa is minimal. While recognizing the practical limits for providing data over these remote areas, the Pacific Region contends that improvements are possible, especially in determining requirements for derived products.

On a final note, Pete told of the importance of GMS data for

Pacific Region operations. As the Japanese Meteorological Agency migrates to GVAR satellites, this will result in more frequent scanning of the Japan area and restricting geographic coverage at the expense of the NWS Pacific Region. How does the NWS plan to deal with this potential data loss?

12. GOES data receipt continues to be an important issue for the Alaska Region. Laura Furgione (NWS/AR) began by stating her region's wishes to relocate the northern boundaries of imager products farther north to support Fairbanks and the Arctic coast (start data count sooner by a couple of seconds). In a like manner, GOES sounder data do not extend north of 50**N**, the Alaska Region requests sounder operations be extended to at least 60**N**. The belief is there are no technical limitations preventing such a northward extension of operations. The Alaska Region also feels they must be kept in the loop regarding any information pertaining to new GOES products and their applications on AWIPS.

Volcanic ash detection is an important activity for the Alaska Region. This will be seriously curtailed with the loss of channel 5 with GOES-M (tentatively scheduled for launch in 2001). This capability will not be restored until GOES-P in the 2010 time frame. In the interim, only GMS and the polar orbiting satellites will carry the necessary channels. The GOES sounder does not have sufficient resolution to fill the data loss (sounder resolution is 10 km at best and 1 km resolution is needed). Laura reported that the region feels this volcanic ash detection requirement has been disregarded by OM and NESDIS.

The Alaska Region stated they are not included or even considered when decisions concerning GOES are being made. It is felt OM is not responsive to field needs as evidenced by

- Overlooking or ignoring field interests without explanation or discussion
- Not informing the field of important OM/NESDIS issues
- Giving the impression, impact by the field is insignificant
- Asking for field reponse to issues in too short a time span.

In terms of rapid scan operations, the Alaska Region wishes to test and evaluate 7.5 minute imagery over their area. They wish to be part of the rapid scan decision process in general.

13. Milan Allen (NWS/OH/NOHRSC) portrayed NOHRSC's continuing reliance on GOES data to fulfill their snow-mapping

responsibilities. NOHRSC is unique in the sense that they purchase their satellite data from a vendor, Kavouras, Inc. They use imager IR channels 2, 4 and 5 for their snow-mapping work. In their mapping algorithms, they see a slight difference between GOES-10 and GOES-9 data.

The increase in IR resolution led directly to a dramatic increase in the generation of snow cover maps from 1996 through 1998. In fact, NOHRSC would like to see half-mile resolution in both visible and IR data.

14. GOES assessment at the national centers was the focus of discussions on the second day of the meeting. Mike Schichtel (NWS/NCEP/HPC) gave the status of GOES assessment at HPC. GOES data are provided to HPC by NESDIS/SAB directly. The imager and sounder data support HPC's forecast process by giving

- Better initialization of model fields

- An additional tool for forecasters to use in assessing model fields

- Additional insight into the severity of a weather event.

SAB provides the majority of satellite support to HPC. Six scheduled briefings are given each day. Because many of the HPC forecasters have limited experience using satellite data, SAB expertise is important for interpreting GOES data.

The synoptic situation over the southern plains on October 28, 1998 illustrated the value of GOES sounder data. The conventional analysis indicated no significant moisture across the southern plains. However, GOES-8 Lifted Index and Precipitable Water values showed evidence of a convective outbreak across eastern New Mexico and the Texas Panhandle. Rainfall amounts of over one inch verified from New mexico to Texas.

HPC views GOES data as an important information source. It gives HPC forecasters a "comfort-zone" with the knowledge GOES gives complete data coverage 24 hours per day.

Future assessment plans include finding additional case studies which demonstrate the value of GOES data in HPC operations. HPC is also eagerly awaiting the delivery of GOES data via AWIPS.

15. Dave Parrish (NWS/NCEP/EMC) highlighted the use and

evaluation of GOES data with regard to NWP at NCEP. GOES layer precipitable water, which became operational in the Eta analysis during September 1997, was discontinued for a four-month period (April - July 1998) after the discovery of data quality problems. The data were reinstated July 30, 1998. NESDIS implemented quality assurance procedures in a subsequent science upgrade of the precipitable water product.

NCEP introduced GOES sounder radiances into the global system on June 15, 1998. Considerable optimization and debugging of the code was required along with five months of parallel testing to smooth out operations. Several issues confront sounder radiance inclusion into the Eta model. Operational use in the Eta will not occur before October 1999.

High density winds derived from the imager and sounder continue to be evaluated. Cloud track IR and water vapor winds from the imager became operational in the Eta system during December 1997 and in the global system April 1998. Visible winds, while still under evaluation, went into the operational data files in September 1998. Work to include winds from GMS is also underway.

A program to examine the usage of GOES winds in the global analysis is under development. This program is being undertaken with collaboration with CIMSS. Impact studies will be conducted using NORPEX and Hurricane Bonnie cases.

QPF studies indicated that performance improved where the models were modified to reduce rainfall where GOES data showed no rain. Additional quantitative precipitation estimates from SSM/I, NOAA/AMSU and TRMM were included. Although preliminary results are encouraging, much more work needs to be done.

GOES assessment plans for 1999 include:

- GOES sounder radiances
    * implementing into the Eta model
    * Beginning studies targeting radiance use over land.
- Imager and sounder high density winds
    * improving quality control procedures
    * developing “forward models” to more accurately represent measurements, e.g. vertical sampling, improved model error, etc.)

    * GMS winds

    * continuing development of sounder winds.

- QPF studies

    * continuing overall devlopment

    * instituting a global precipitation analysis using GOES, SSM/I and NOAA/AMSU data.

16. SPC did not send a representative to the 1998 GOES Assessment Meeting.

17. During 1998, AWC continued a series of success stories regarding their use of GOES data. Fred Mosher (NWS/NCEP/AWC) reported that a large portion of AWC's GOES assessment work centered on AWIPS spin-up activities.

AWIPS was found to be particularly useful in enhancing the Fog Product in a non-standard display. AWC forecasters determined that by displaying low clouds as white and high clouds dark, added to the effectiveness of the product.

Shortcomings of the current AWIPS build did prevent data from being optimally manipulated. For example

- Normalizing visible imagery for extended use around sunrise/sunset is not possible because solar zenith angle information is currently not available

- NCEP centers have global responsibilities, AWIPS however, does not operate on a global scale

    * a global composite image is produced using geostationary and polar (no DMSP) satellite data

    * remapping is possible with AWIPS (an equatorial Mercator projection image is produced). The major problem is the time difference of the polar data

    * animation ia also possible with AWIPS.

18. Mark DeMaria (NWS/NCEP/TPC) began his discussion by identifying the TPC's responsibilities and duties.

- Hurricane Specialist Unit

    * structure, track and intensity forecasts to 72

hours for Atlantic and East Pacific tropical storms

* issuance of watches and warnings

- Tropical Analysis and Forecast Branch

* Marine Desk: tropical cyclone classifications, high seas and wind/wave forecasts, satellite rainfall estimates

* Aviation Desk: SIGMETS,area aviation forecasts

* Analyst Desk: tropical weather discussions, tropical surface analysis.

TPC uses GOES-East and West data (visible, long- and shortwave IR and WV) on CONUS, Northern Hemisphere and full disk scales. Full disk images from GMS and Meteosat as well as SSM/I data, high density winds and vertical shear analyses round out the TPC satellite data suite.

GOES data play an important role in

- Tropical cyclone positioning

- Dvorak intensity estimates

- Synoptic/mesoscale feature identification for track/intensity forecasting

- Tropical wave/frontal locations for TSA

- Determining surface winds for high-seas forecasts

- Issuing convective and turbulent SIGMETS

- Detection of volcanic ash and African dust

- Quantitative precipitation forecasting.

Satellite data not utilized currently at TPC include

- RSO/SRSO (kills the data ingest from that satellite)

- GOES channel 5 (split window)

- GOES sounder products

- NOAA/POES data.

Future plans for satellite improvements at TPC center on

- Y2K upgrades to satellite data systems
- Replacing of PS2 display systems with AWIPS, McIDAS-X and PCs
- Modifying HIPS for RSO
- Obtaining sounder/IR data for quantitative intensity prediction
- Developing satellite-based algorithm to determine wind structures
- Developing tropical cyclone genesis parameter
- Improving satellite rainfall estimation
- Improving the utilization of polar orbiter data.

19. NASA continued its “cutting-edge” research using GOES data. Dennis Chesters (NASA/GSFC) showed the highlights of their 1998 work. NASA refined their computer processes for generating wind vectors from visible imagery. High-density winds on the order of 1,000,000 vectors per minute were calculated from 1-minute images of Hurricane Luis.

During the GOES-10 Science and Operations Test, concurrent full disk and smaller sector images, called “priority-interrupt”, can be scanned. Image combinations tested included

- Hourly full disk + a CONUS sector at 6-minute intervals
- Hourly full disk + a Gulf Coast sector at 1.2-minute intervals.

NASA is also supporting the research and development of an Advanced Geosynchronous Imager that, given current instrument size and weight limitations, could increase performance by a factor of 200. It also could replace the ITT instrument on a GOES-N-type platform.

The GOES Project at NASA continues to operate a web site dedicated to the operational GOES satellites. This GOES site contains the latest images and sounder data as well as archives of significant weather and environmental events as seen by satellite. Current satellite status and a list of frequently asked questions are also included.

20. A cornerstone of NWS modernization is the migration of operations to AWIPS, and the inclusion of GOES data remains a critical facet. Jim Heil (NWS/OM22) summarized the AWIPS/GOES status.

Ongoing work centers on GOES product availability and improvement. On the new data front, a sample of what is under consideration for future AWIPS inclusion is:

- GOES imager data

- GOES sounder data

- Autoestimator QPE products

- WINDEX convective gust products

- POES, GMS and Meteosat data.

Issues concerning data domain and frequency of reports were also addressed. Some of the major issues are:

- Current operational data coverage and frequency do not meet the needs of NCEP and out-of CONUS sites

- Some CONUS sites require modifications to their satellite product suite to meet their needs (e.g. Seattle, Portland, OR)

- Results from the GOES-10 Science and Operations Test showed AWIPS limitations at 5-minute interval time steps; 1-minute interval data looms as the next technical hurdle (more details on this test are found in the following section)

- Support for a floater/special events sector.

The need for improvement in data processing also was expressed. A few of the more pressing matters include:

- The capability to write a high-resolution sector to disk during the broadcast of the full-resolution image (e.g. the Minneapolis office need not wait for the final scan over the Yucatan to begin to access the high-resolution imagery)

- Limit navigation errors by reducing the number of reprojections

    * re-examine and validate all software remapping

assumptions

* introduce parallax reduction option (satellite data must be sufficiently reliable to issue warnings based on imagery alone).

Lastly, the AWIPS program must have an efficient test and evaluation process in place for new or non-operational data. Satellite issues covered are:

- Requirements for visualization software

- Data distribution

    * bandwidth size

    * formats

    * security.

21. The GOES-10 Science and Operations Test, which ran from March 16 through April 12, 1998, provided a unique opportunity to assess the value of information gathered from rapid interval GOES imagery. It afforded many data users a totally new look at the atmosphere.

In one of the more significant weather situations during the test, the 5-minute interval, 4 km IR imagery showed evidence of cloud-top warming (indicative of a collapsing top) just before the Gainesville, GA tornado of March 20, 1998.

RAMSDIS and AWIPS were the primary display vehicles during the test period. For RAMSDIS, the overall data generation was reported to be very good. Internet and/or frame network connectivity is crucial to the utility of the data. Performance in this regard was good in the NWS Central and Western Regions, acceptable in the Eastern Region, but poor in the Southern Region. At the La Crosse, WI forecast office the 1 km visible imagery was used to enhance radar operations.

Because of start-up and localization problems, Denver and Salt Lake City were the only participating AWIPS sites. The Denver office indicated their AWIPS was able to keep up with the simultaneous increased WSR-88D and 5-minute interval GOES data loads.

Gary Ellrod (NESDIS/ORA) presented results from the science and operations test from a science perspective. The scientific goals of the test were:

- To evaluate the additional information from the rapid interval imagery compared with routine scanning for a variety of weather systems

- To determine if rapid scan imagery can complement WSR-88D data

- To evaluate the quality of GOES-10 imager and sounder data based on comparisons with other satellite data

- To generate derived products at higher frequencies from the GOES-10 imager or sounder to determine possible benefits

- To evaluate possible improvements in the derivation of winds and cloud heights using stereo images from two or more satellites.

The science and operations testing did reveal some significant findings. They include:

- All participants noted the overall excellent quality of GOES-10 data

    * GOES-10 data quality is overall on a par with GOES-8 and 9

    * on average, IR temperature comparisons of GOES-10 with GOES-8 are within 0.5**K**, but there were several cases when GOES-10 readings were colder than GOES-8

    * striping in GOES-10 IR channels 4 and 5 is less than observed on the same channels of GOES-8 and 9

    * investigations showed the high signal to noise ratios in some of the sounder shortwave bands allow single field-of-view retrievals to be generated.

- CIRA-RAMM noted improved analysis of severe storms with GOES-10 imagery

    * short-period cloud top temperature maxima/minima noted from GOES-10 during the Birmingham, AL tornado (April 8) and the Minnesota tornadoes could not be observed with GOES-8

    * lead time increased by 15 minutes in identifying

"enhanced-V" features in the cloud tops of the Alabama and Minnesota tornadoes

* improved identification of outflow boundaries that initiated tornadic storm in Illinois on April 7.

- Investigations of derived products were conducted by CIMSS, NESDIS/ORA, CIRA and SAB

  * QPEs from two strong, fast-moving convective systems provided higher accuracy and greater detail from 5-minute interval data than from 30-minute data

  * the GOES-10 data allowed for better observations of cell mergers, overshooting tops and boundary interactions

  * optimum time intevals for calculating wind vectors were determined for visible (5 minute), IR (10 minute) and WV (10-30 minute) images.

  * the number of quality wind vectors doubled when the optimal interval visible and IR data were used

  * better quality (higher correlation) stereo winds were produced from a combination of GOES-10 and GOES-8 images.

  * fire detection over Oklahoma on April 1 increased by 55% by using 5-minute interval data versus 15-minute interval IR data

  * the sea surface temperature product improved due to less IR striping in the GOES-10 data

  * DPI (LI, TPW, CTP) and fog products from GOES-10 were of high quality; frequent interval soundings led to slightly better coverage.

- FSL evaluated GOES-10 data as a complement to WSR-88D data

  * AWIPS displayed both satellite and radar data in 4-bit (16 gray shade) format - insufficient for valid analysis of impact of satellite data

  * satellite data provided little impact

    - o overlapping radars resulted in some coverage reduction

    - o few cases were analyzed

  * the Denver forecast office's evaluation of GOES-10 data on AWIPS, Build 4.0 indicated the data were:

    - o effective for overall utility

    - o adequate for access speed and reliability.

22. A brown-bag seminar on future GOES instrumentation was presented during the noon hour Thursday by Jamie Hawkins (NESDIS/OSD). Jamie told of NESDIS plans to develop an Advanced Baseline Sounder (ABS) and an Advanced Baseline Imager (ABI) to fly on future GOES spacecraft.

The ABS design would be an interferometer with the following features:

- Meets NWS requirements for geostationary temperature and moisture retrievals

- Performance would significantly exceed that of GHIS

- Could fit in smaller space than current GOES sounder

- No technology-pushing areas

- Based on Lincoln Lab analysis (who has a long history in interferometry expertise).

Likewise, the ABI is also designed to meet operational NWS requirements without pushing the limits of current technology. Some of ABI's specifications include:

- Seven IR channels with a 2 km horizontal resolution

  * 1.6Fm, 3.9Fm, 6.7Fm, 7.5Fm, 10.7Fm, 12.0Fm and 13.3Fm are the wavelengths proposed

- Visible channel would have 0.5 km resolution

- Routine data frequency would be 4 full disk and 12 CONUS images per hour

An ABI with full capabilities could be built to fit within the

current GOES imager envelope.

23. A discussion of GOES/AWIPS issues for FY99 - 00 highlighted the final afternoon of the 1998 GOES Assessment Meeting. Robin Radlein (NWS/OM22) described what could be expected from AWIPS during the upcoming year. She said the Build 5.0 software release would occur in September 1999 at the earliest and that the 5.1 and 5.2 releases are scheduled to follow at six to eight month intervals. Upcoming efforts will emphasize enhancing certain data types at the local offices. Satellite data under consideration include DPI and high-resolution winds. A workshop, scheduled for January 1999, will address, among other AWIPS issues, the matter of broadcasting satellite data and model output on separate Satellite Broadcast Network (SBN) channels.

Priorities will flow in a “bottoms-up” manner (i.e. field sites through the regions to headquarters). Input from the field will be collected via the Internet through the NWS/AWIPS Operations and Services Home Page.

24. Brian Motta (NESDIS/CIRA/RAMMT) described some of the work being conducted at CIRA dealing with ingesting and processing of GOES data in an AWIPS environment. A fundamental issue remains the data format - data from NESDIS is 10-bit, while AWIPS requires 8-bit data.

Characteristics of GOES data in AWIPS:

- GINI data ingested and processed at NESDIS then remapped to a Lambert Conformal Projection true at 25**N**N (Polar Stereographic Projection for Northern Hemisphere and Alaska sectors)

- The 6.7Fm water vapor imagery was truncated at both the warm and cold ends of the temperature scale. This problem will be addressed in the near future.

25. A very interesting insight into future image processing and data display was presented by Dave Gregory and Steve Johnson of ITT Industries, Inc. ITT has developed a technique whereby currently unused oversampled data can be utilized in an image to extract additional information, resulting in a sharper, more detailed picture. This same technique has been demonstrated to NESDIS and NASA.

26. In the meeting wrap-up session, Ron Gird (NWS/OM-Satellite Program Leader) emphasized the importance of GOES data assessment through AWIPS at the forecast offices. A GOES Assessment Matrix was introduced as a streamlined and

efficient method to enlist forecaster involvement in the assessment process. The matrix, to be completed at the end of each forecast shift, is an array with a list of forecast office products displayed on the abscissa and a satellite product list on the ordinate. Forecasters will be asked to determine the impact of particular AWIPS-generated satellite products on the products issued during their shift. Each impact will be assigned a number (e.g. 0 to 4) indicating its value. Impacts can range from significantly negative to significantly positive; A "not applicable" response can also be entered. The OM-Satellite Program hopes to receive approval for this assessment approach from forecast office and regional levels.

The meeting adjourned at 3:30 PM, Thursday, November 5, 1998.

27. A summary of action items follows:

1. Develop NWS GOES assessment goals for 1999 (data use and data impact). **Action: NWS/OM-Satellite Program** - *June 1999*

1a. Create GOES assessment performance measures. **Action: NWS/OM-Satellite Program** - *June 1999*

2. Solve GOES gridding problem on AWIPS. **Action: NWS/OM-Satellite Program, NWS Eastern Region** - *Action Closed: Correction will be implemented September 1999*

3. NWS Western and Pacific Regions have asked the northern edge of GOES sectors shifted farther north for improved satellite support. **Action: NWS/OM-Satellite Program, NWS Western Region** - *Action Closed: Northern extension will be implemented May 1999*

4. NWS Pacific Region noted that a WSOM chapter dealing with satellite program responsibilities is woefully outdated, determine if this chapter needs updating or elimination. **Action: NWS/OM-Satellite Program** - *Action Closed: WSOM chapter eliminated*

5. NWS Alaska Region has requested the northern boundary of GOES sounder products be extended to 60**N**N from its current position at 50**N**N. **Action: NESDIS/OSD / Don Gray** - *Action Closed: NESDIS cannot comply; useful sounder products cannot be generated north of 50**N**N latitude. Sounder products from NOAA's polar orbiting satellites can be obtained at the following NESDIS Web site*
http://poes.nesdis.noaa.gov/posse/

6. Improve RSO support (including decision process)to NWS Alaska Region. **Action: NESDIS/SSD, NWS/OM-Satellite Program** - *September 1999*

7. Investigate data ingest conflict at TPC between RSO and routine data. **Action: NWS/OM-Satellite Program** - *Action Closed: RSO ingest conflict resolved with Y2K issues April 1999*

8. Add priority interrupt capability to GOES-L checkout schedule. Action: **NESDIS/OSD / Gerry Dittberner** - *Action Closed: Checkout of priority interrupt capability planned for July 1999*

9. Publish GOES-10 Science and Operations Test document. **Action: NWS/OM-Satellite Program, NESDIS/OSD / Don Gray** - *May 1999*

10. Develop a GOES/FAQs list (ongoing action from last year). Action: **NESDIS/OSD / Gerry Dittberner** - *Action Closed: A GOES FAQs list now exists on the CIRA/RAMM/VISIT Web Page.*
http://www.cira.colostate.edu/ramm/visit/goesfaq.html