CGMSXXX USA-WP-25
Agenda Item: II.3
Discussed in WG-2

2001/2002 Report on NOAA/NESDIS GOES Nowcasting Activities

Summary and Purpose of Document

A summary of nowcasting experiences with the GOES system. This is the USA response to Action 29.28

Action Requested: None

2001/2002 REPORT ON NOAA/NESDIS GOES NOWCASTING ACTIVITIES

Timothy J. Schmit [1], Gary Wade [1], and John Mecikalski [2],
[1] - NOAA/NESDIS/ORA
[2] - Cooperative Institute for Meteorological Satellite Studies
Madison, Wisconsin

1. Introduction

The nowcasting activities from the GOES imagers and sounders continue. Sounder products include cloud top pressure, atmospheric moisture and stability, skin temperature and total ozone. An experimental imager product has been devised to define "interest fields" for convective initiation.

2. Nowcasting with Soundings at Weather Forecast Offices

Soundings and Derived Product Images (DPI) continue to be made available to NWS Forecast Offices in realtime, assisting the forecasters with their short-term forecast responsibilities. Forecasters have found that the sounder profiles and DPIs are making significant positive impacts to their forecasts of location and timing of severe weather (such as thunderstorms). The products include moisture and atmospheric stability values such as Lifted Index (LI), Precipitable Water (PW), and Convective Available Potential Entergy (CAPE). Forecasters are finding the sounder products to be valuable operational tools, providing information on the vertical structure of the atmosphere, especially the moisture distribution, with a temporal and spatial resolution not available from any other source.

From 19 July through 30 August 1999, the NWS Office of Meteorology conducted daily assessments of the operational value of the GOES-8 and GOES-10 sounder products. Thirty-seven NWS forecast offices, four national centers, and the NESDIS Satellite Analysis Branch participated in the evaluation, providing a total of 638 responses. Forecasters used the sounder products to heighten their awareness of the potential of a wide variety of weather events, including severe thunderstorms, monsoon precipitation, and flash floods. Their responses showed that in over 79% of all active weather situations, the use of GOES sounder products led to the issuance of improved forecasts. In the words of a forecaster in Minneapolis, MN on 9 and 10 August 1999 who stated:

> "The Sounder Derived Product Imagery (DPI) helped a lot anticipating convective development over southern MN this evening. I looked through the DPI's over a few hours and saw a definite decreasing trend in the CINH (Convective Inhibition) from 19-21Z. It was only a matter of time before the convection fired into southern MN. Impressive CAPE values (3500-4500J/KG) and LI's -10 to -12 pointed to the possible severity of the convection. We received many reports of funnels/brief tornado touchdowns across south central MN as the convection went through. We were about ready to give up on any serious development...it was quite late (after 8pm CDT) before it developed. These products overlayed on surface maps/satellite/radar displays on AWIPS would be invaluable to the mesoscale forecaster."

Figure 1 shows the GOES-8 Sounder Convective Available Potential Energy (CAPE) values at 00 UTC on 10 August 1999. The axis of CAPE values greater than 2500 J/kg was depicted and extended from eastern Nebraska into southern Minnesota. CAPE values calculated from the 00 UTC radiosondes were too sparse to capture this feature. Just after 02 UTC an F-2 scale tornado (winds between 182 and 253 km h^{-1}) was reported in northern Iowa (Storm Damage Report 1999).

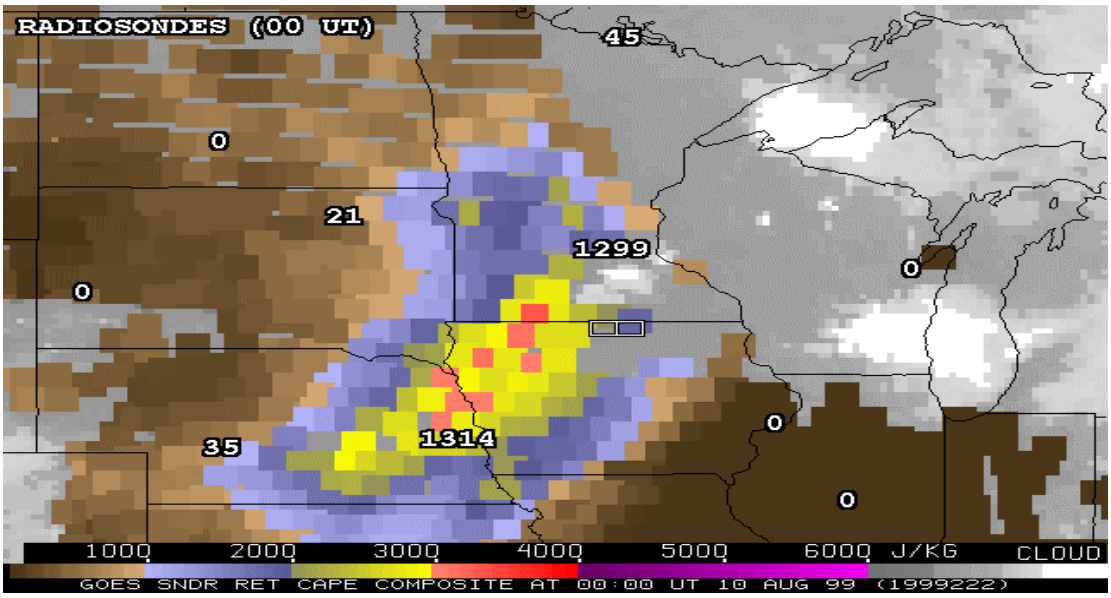

Figure 1. GOES-8 Sounder Convective Available Potential Energy (CAPE) values at 00 UTC on 10 August 1999.

Another example (Figure 2) of the a forecaster using GOES-8 Lifted Index and Total Precipitable Water Vapor products on 11 September 2000 is shown below where the GOES Sounder successfully diagnosed an axis of large atmospheric instability prior to heavy precipitation.

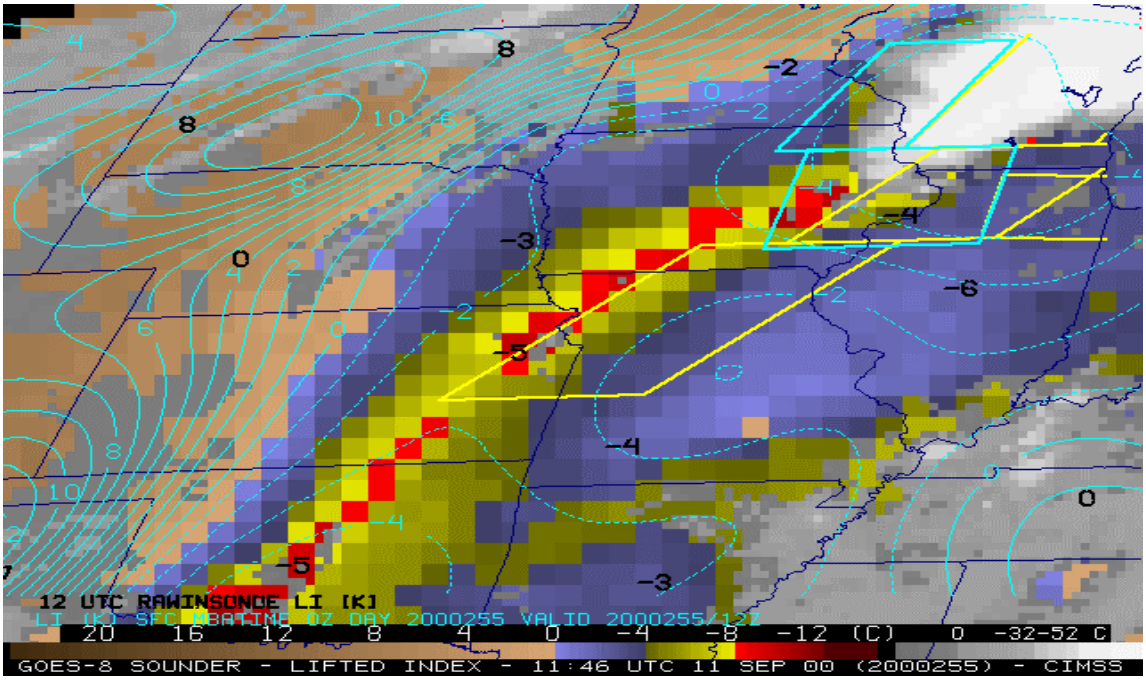

Figure 2. GOES-8 Lifted Index for 11 Sep 2000 at 1146UTC was used by the Hydro-meteorological Prediction Center in Camp Springs, MD to issue the following warning "Excessive rainfall potential outlook 11 Sep 2000 - GOES Sounder data shows that PWS south of the outflow boundary are in the 1.60 TO 1.70 inch range. The sounder data also indicates that the airmass to the west is continuing to destabilize. All the above argue for the potential for isolated 3 to 5 inch rainfall before the system starts shifting EWD."

A third example in Figure 3 has GOES depicting an axis of high atmospheric instability that LI delineates a subsequent storm track on 24 Jul 2000. See Weaver et al. (2002).

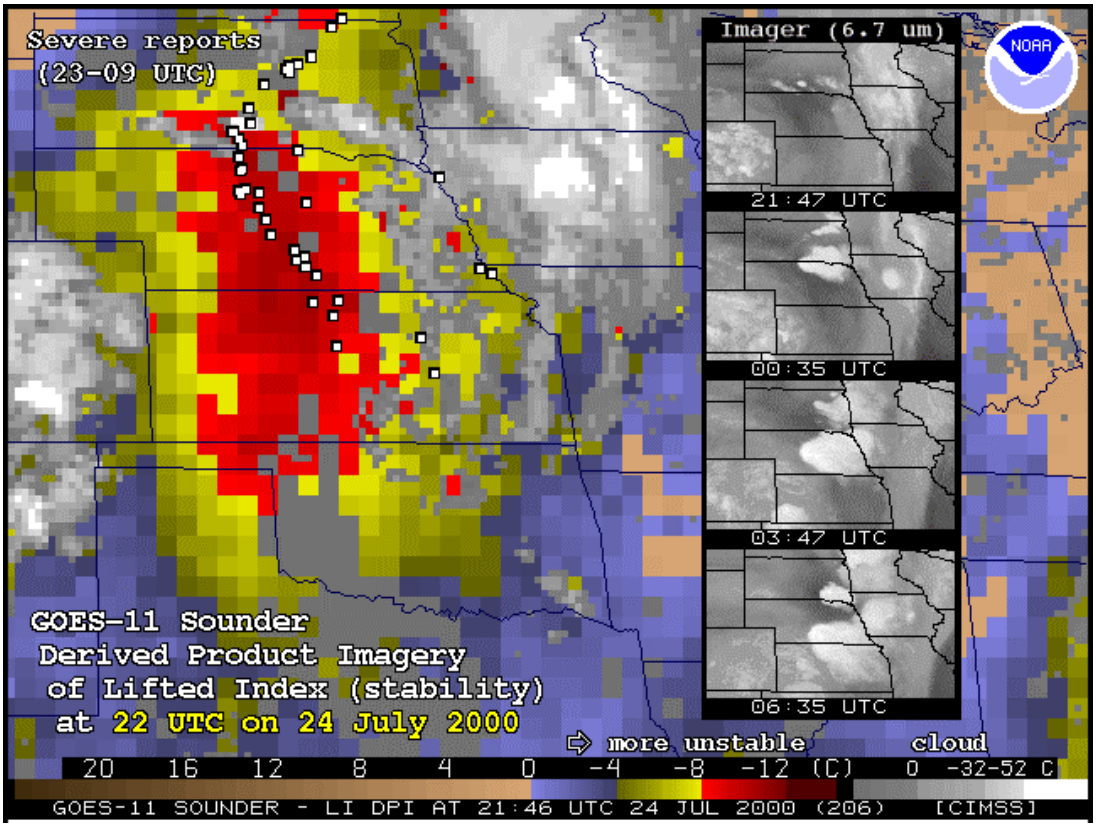

Figure 3. The GOES-11 Sounder depicted an axis of large atmospheric instability (red region) prior to a long lived super cell. The development is shown by a time sequence of the GOES-11 water vapor imagery. Subsequent sever weather reports illustrate the storm track.

3. GOES Sounder Nowcasting activities in 2002

Highlights regarding moisture/temperature retrievals and Derived Product Imagery (DPI) are:

- Maintained reliable production and improved web posting of hourly real-time DPI from the GOES Sounders, including cloud top pressure, atmospheric moisture and stability, and total ozone. [http://cimss.ssec.wisc.edu/goes/realtime/realtime.html]
- Implemented parallel 3x3 and single Field-of-View (**FOV**) DPI processing in March 2002. SFOV DPI generation uses the AVN first-guess and the 3x3 FOV DPI uses the Eta first-guess. Real-time animations are available allowing for comparison of (toggling between) SFOV and 3x3FOV DPI over the entire US domain.

And for clouds:

- Recently, to support the late spring 2002 IHOP field experiment, code was updated to increase the resolution from a 30 km averaged cloud product to a full resolution (~ 10 km) data set. In addition to GOES-8, single-fov (sfov) products were generated from the GOES-11 Sounder data for a portion of the IHOP period.
- Through the work of Dr. Stanley Benjamin (NOAA/FSL), initialization of the operational RUC forecast model with the operational GOES Sounder Cloud Product has demonstrated positive

impact to short term forecasts. The operationally produced sfov GOES sounder cloud product has been used in the RUC II model since mid-April 2002.

- Validations of the GOES Sounder cloud product with ground-based measurements have been extended at the DOE/ARM CART site.

4. GOES Imager Nowcasting activities in 2002

Monitoring convective initiation with the GOES Imager has the goal to develop methods to identify and quantify the precursors to convective initiation within (mainly) geostationary satellite imagery. The approach is to quantify the "interest fields" of convective initiation to better nowcast its occurrence. The emphasis is to develop methods for using geostationary data that best serve the needs of collaborators at NCAR operating the "AutoNowcaster" for thunderstorm nowcasting over land and oceanic regions. Highlights from the past year include

- Development of the major software infrastructure to accomplish the task of realtime and case study processing of geostationary satellite information, and other useful weather information, for identifying the important precursors of convective initiation.
- First output and display (web-based) capabilities of convective initiation interest fields for use in the NCAR AutoNowcaster expert system.

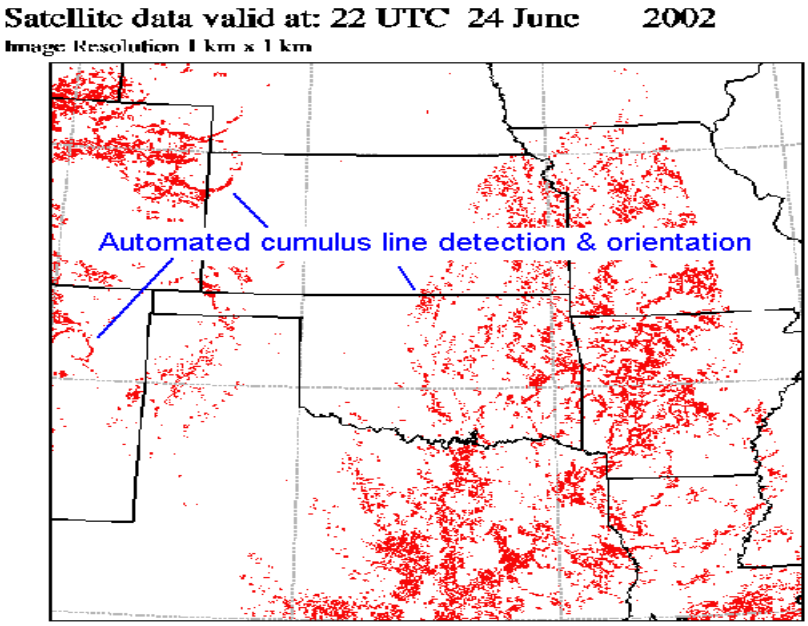

Figure 4. Automated cumulus line detection & orientation derived from GOES visible data.

In addition, the GOES-12 Imager enables CTP estimation with the 13.3 um data. With the GOES-8/11 series of GOES Imagers cloud height or cloud top pressures are available using either the IR Window Technique (Schreiner, et al; 1993) or the IR Window-Water Vapor Intercept Technique (Nieman, et al; 1993). By including a "CO_2" band (13.3 μm) among the suite of Imager channels on GOES-12 and beyond, the opportunity for more frequent (than the GOES Sounder) and accurate cloud products (than the previous GOES Imagers) is possible using the CO_2 Absorption Technique (CAT) (Wylie and Menzel, 1999). The CAT will provide more accurate calculations of Effective Cloud Amount (ECA) than currently available from the GOES Imager, more frequent and timely Satellite Cloud Products (SCP) in support of the Automated Surface Observing System (ASOS), and hemispheric coverage of the CAT for input to numerical prediction models.

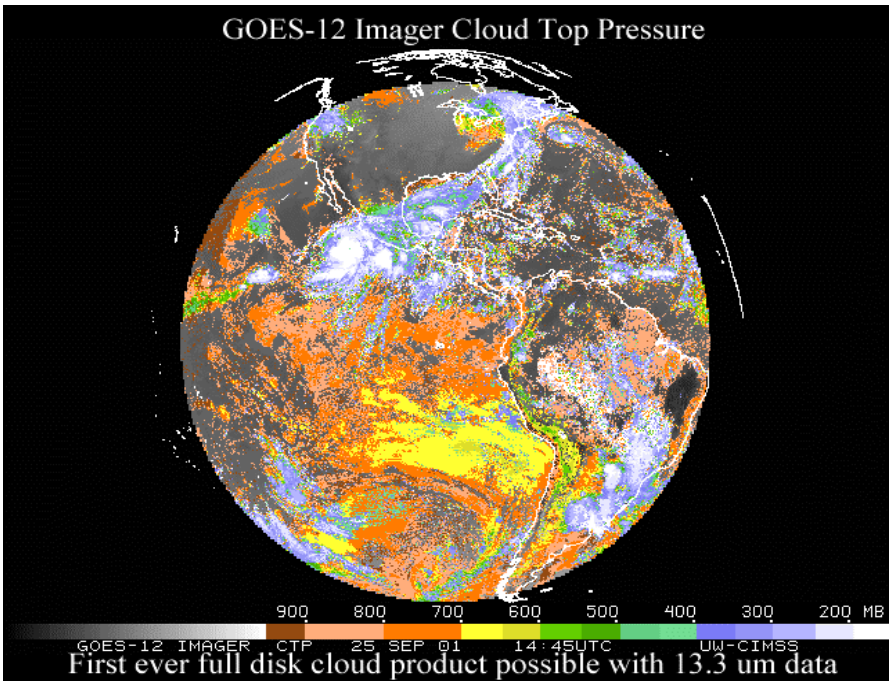

Figure 5. GOES-12 Imager Cloud-Top Pressure image using the 13.3 um data.

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