First Local Area Products from the NOAA-15 Advanced Microwave Sounding Unit (AMSU)

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Objective and Relevance: The weather satellite NOAA-15 was successfully launched May 13, 1998, into a near polar orbit, carrying the first Advanced Microwave Sounding Unit (AMSU) sensors. The microwave sounding capabilities of AMSU allow for near all-weather penetration of various cloud fields, and the vertical profiling of atmospheric temperature and water vapor fields. By minimizing the influence of cirrus clouds (as compared with infrared sensors), the AMSU data are expected to improve the analysis of convection in data-sparse (battlespace) regions, and thus serve as a very useful tool in battlespace data-denied regions. Results of the first products produced by this sensor and disseminated to National Weather Service (NWS) offices via the Internet are presented. This work is the first semi-operational dissemination of near real-time polar microwave data into the NWS field offices. Operational uses of the data are highlighted.

Research Accomplished: AMSU is a next-generation microwave sounder and is similar to a combined DMSP SSM/T-1 and SSM/T-2 instrument, but with higher spatial resolution (Table 1). AMSU is a cross-track scanning, passive microwave sensor with 20 channels (Table 2). It is composed of two sounding instruments, AMSU-A (temperature sounder) and AMSU-B (water vapor sounder). Each sounder also includes several complementary microwave "window" channels from which geophysical parameters similar to those from the DMSP SSM/I instrument can be derived (Figure 1).

Table 1. Microwave Instrument Comparison[a]

Parameter	*SSM/T*	*MSU*	*SSM/I*	*AMSU-A*	*AMSU-B*	*SSM/T-2*
Satellites	DMSP	NOAA	DMSP	NOAA K, L, M	NOAA K, L, M	DMSP
No. of Channels	7	4	7	15	5	5
Frequency Range (GHz)	50.5–59.4	50.3–57.95	19.35–85.5	23.8–89.0	89.0–183.3	91.6–183.3
NEΔT (K)	0.4–0.6	0.3	0.4–1.7	0.25–1.20	0.8	0.5
Beam width	14°	7.5°	0.3°–1.2°	3.3°	1.1°	3.3°–6.0°
Best Ground Resolution (km)	204	110	12.5–50	48	16	48–84
Scan steps	7	11	64–128	30	90	28
Swath width (km)	2053	2347	1394	2179	2179	2053

[a]After Kidder and Vonder Haar (1995)

Table 2. Microwave Frequencies[a] (GHz) and Polarizations[b,c]

Channel	*SSM/T*	*MSU*	*AMSU-A*	*AMSU-B*	*SSM/I*	*SSM/T-2*
1	50.5H	50.30R	23.8R	89.0R	19.35H	183.3±3R
2	53.2H	53.74R	31.4R	150.0R	19.35V	183.3±1R
3	54.35H	54.96R	50.3R	183.3±1R	22.235V	183.3±7R
4	54.9H	57.95R	52.8R	183.3±3R	37.0H	91.7R
5	58.4V		53.6R	183.3±7R	37.0V	150R
6	58.825V		54.4R		85.5H	
7	59.4V		54.9R		85.5V	
8			55.5R			
9			57.2R			
10			57.29±.217R			
11			57.29±.322±.048R			
12			57.29±.322±.022R			
13			57.29±.322±.010R			
14			57.29±.322±.0045R			
15			89.0R			

[a]*Notation*: *x*±*y*±*z*; *x* is the center frequency. If *y* appears, the center frequency is not sensed, but two bands, one on either side of the center frequency, are sensed; *y* is the distance from the center frequency to the center of the two pass bands. If *z* appears, it is the width of the two pass bands. This pattern is easily implemented with radio frequency receivers, and it effectively doubles the signal (two pass bands instead of one).

[b]V = vertical, H = horizontal, R = rotates with scan angle.

[c]After Kidder and Vonder Haar (1995)

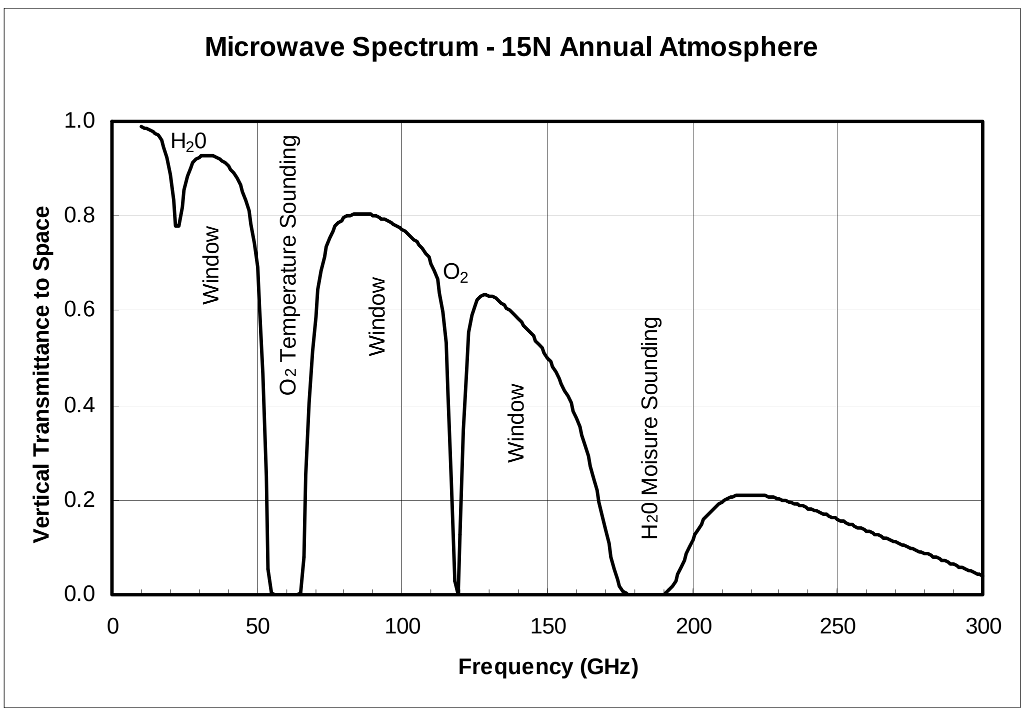

Figure 1. Microwave spectrum.

Data processing. AMSU data are downlinked to one of the two ground stations: one at Wallops Island, VA, and the other at Gillmore Creek, AK. The AMSU data are also transmitted in real time to users within sight of the satellite via the High Resolution Picture Transmission (HRPT) broadcast. Data from either Wallops Island or Gillmore Creek are processed by the National Environmental Satellite, Data, and Information Service (NESDIS) intoLevel 1B brightness temperatures. These data are further processed by NESDIS's Microwave Sensing Group to produce 5 parameters in addition to the 20 brightness temperatures. The products produced are shown in Table 3. Also, NESDIS's Soundings Team retrieve temperature and moisture soundings from the brightness temperatures.

Table 3. AMSU products produced by NESDIS's Microwave Sensing Group

Product	*Range/Units*
Total Precipitable Water (TPW)	0–60 mm
Instantaneous Rain Rate (RR)	0–35 mm/hr
Cloud Liquid Water (CLW)	0–6 mm
Snow Cover (SNO)	0–100%
Sea Ice Cover (ICE)	0–100%

CIRA Products. At CIRA, we acquire the ASMU brightness temperatures and products generated by the Microwave Sensing Group in Hierarchical Data Format (HDF). We convert them to McIDAS format and make them available over the Internet. To access the data, start with our Web site: *http://amsu.cira.colostate.edu*. Here you can find the three ways to access our data:

1. Using the File Transfer Protocol (FTP) download single-orbit files in McIDAS area format of any of the 20 brightness temperatures or 5 derived products. Figure 2 is an example of this type of data. At 89 GHz, ocean appears cold (black), and land appears warm (white). Glaciers, as on Iceland (near the center of the image) and Greenland (on the left edge), appear cold. Clouds and water vapor over the ocean appear milky.

2. Using McIDAS, access Mercator mapped images of the 5 products and 2 brightness temperatures (89 and 150 GHz) on CIRA's McIDAS server. (The Web page tells exactly how to do this.) Figure 3 is an example of such an image. It is a 150 GHz image of Hurricane Georges, and it shows scattering from ice at the top of rain bands. Note that the microwaves penetrate the central dense overcast to reveal the rain structure below. this is is one of AMSU's greatest advantages. Most National Weather Service (NWS) users of the AMSU data access them by this method.

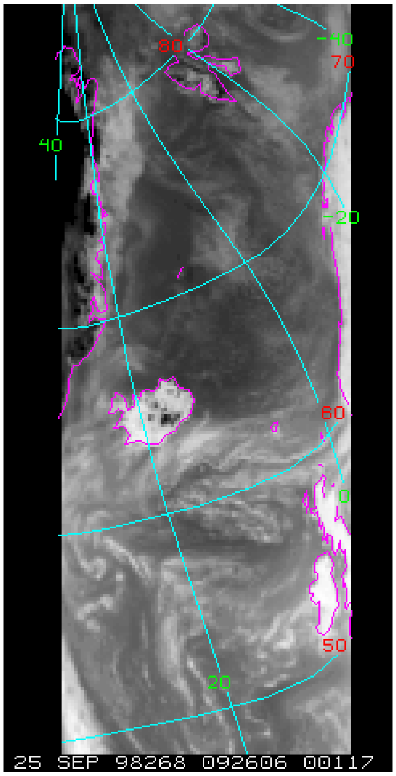

Figure 2. A portion of a single orbit of AMSU-B 89 GHz data.

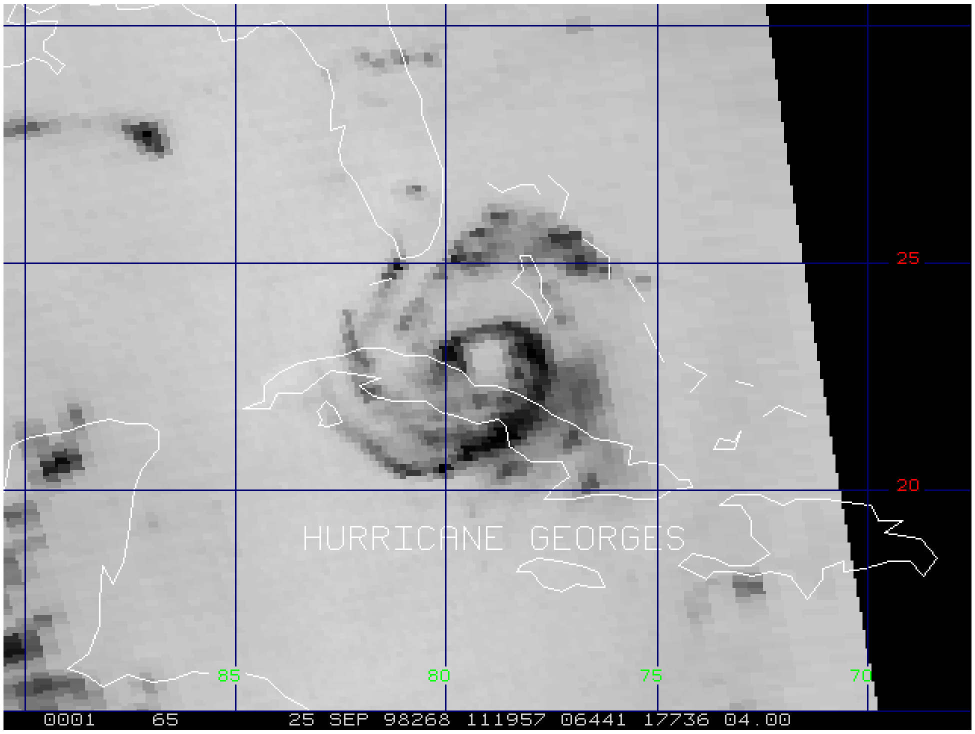

Figure 3. 150 GHz AMSU-B image of Hurricane Georges showing rain bands beneath the central dense overcast.

3. Using a Java-capable Web browser, browse the Mercator-mapped images. Figure 4 shows the window in which the data appear. In this case, TPW is displayed. The image has been annotated. Note that this browser is active. The "hot cursor" shows the data values below the cursor. This last way of viewing the images may be the best for field use because allows interaction with the data, and it is nearly platform independent.

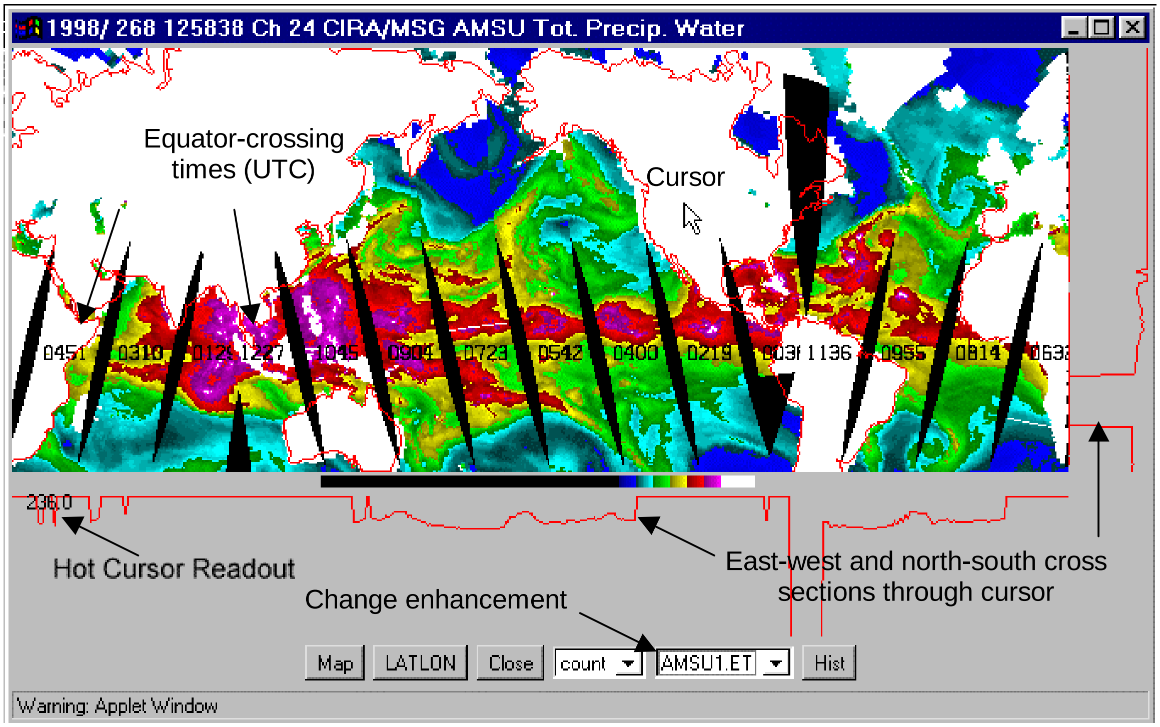

Figure 4. Java-based display of AMSU data suitable for field use.

Conclusions and Recommendations: Near real-time access to microwave observations is a major advance in satellite meteorology. It will improve National Weather Service forecasts, and if the data can be made available to him, it promises aid the military field forecaster as well.

BIBLIOGRAPHY

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Kidder, S. Q., and T. H. Vonder Haar, 1995: *Satellite Meteorology: An Introduction.* Academic Press, San Diego, 466 pp.

Microwave Surface and Precipitation Products System (MSPPS) Home Page, http://orbit18i.nesdis.noaa.gov/