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THE USE OF SSMI PRODUCT IMAGERY ON RAMSDIS

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Introduction

The use of Special Sensor Microwave Imager (SSMI) data from the Defense Meteorological Satellite Program (DMSP) satellites has been shown to be useful in measuring total precipitable water and surface wind speeds over oceans and rain rates over land and ocean (Ferraro and Marks, 1995; Ferraro and Grody, 1994; Kusselson, 1993; Alishouse, *et al*, 1990). The DMSP satellites are polar orbiters and have a resolution that is product dependent. The SSMI instrument uses microwave channels to observe the atmosphere. These channels are centered on 19 GHz, 22 GHz, 37 GHz, and 85 GHz and each has a signal from the horizontal and vertical polarizations (except that 22 GHz has only the vertical polarization). These channels can be combined to generate various product images. The main advantage of SSMI data is its ability to sense through clouds. A disadvantage is that data is available over a particular site only twice a day. The purpose here is to familiarize forecasters with how the SSMI products are generated and how they can be best used in the forecast office.

SSMI Product Generation

The raw data are ingested at the Navy facility in Monterey, CA and the products are then sent via FTP to a file server at NESDIS in Washington, DC. This is where they are converted into McIDAS format and put into composite images (in a Mercator projection) that contain data from the last 12 hours. These composites are generated every two hours and sent to the Western Region RAMSDIS server. The local RAMSDIS computer requests the composite images every two hours and saves them into a circular queue of image files where the newest image overwrites the oldest image.

SSMI Total Precipitable Water Product

The SSMI water vapor product is generated from a combination of the following channels: 19 GHz vertical polarization (19V), 22 GHz vertical polarization (22V), and 37 GHz vertical polarization. The output is in units of millimeters (mm) of total precipitable water (TPW) in the column observed by the satellite. The resolution of this product is 40 x 60 km. The accuracy has been found to be about 3 mm, when compared to sounding derived TPW. The SSMI TPW product is useful detecting areas of the atmosphere that are either high or low in moisture content. The product can be compared to model output to determine how well the model has located dry or moist tongues in the initial analysis, especially since data over the eastern Pacific is sparse. A study is being planned to determine how well the qualitative and quantitative values of total water vapor compare to other satellite products, soundings, and model output. The SSMI TPW product has the capability of sensing through clouds, which is not available from the GOES satellites (this is due to SSMI using passive microwave channels).

The TPW product output is only produced over water surfaces. Over land a surface moisture product is produced. This product is quite noisy and of little use in its present state. Research on better ways to produce this product is underway at numerous research labs across the country.

On RAMSDIS the TPW is represented using the following enhancement scheme:

Color	Total Precipitable Water
gray	0 - 12 mm
green	13 - 25 mm
yellow	25 - 50 mm
red	50 - 60+ mm

Regions of black enhancement indicate no data available.

SSMI Surface Wind Speed Product

The SSMI surface wind speed product is generated from a combination of the following channels: 19 GHz vertical polarization (19V), 22 GHz vertical polarization, and the 37 GHz vertical and horizontal polarizations (37V and 37H). These channels detect ocean surface roughness, which has been related to one minute wind speed (Hollinger, 1991). The output is in meters per second but is converted to miles per hour for display on RAMSDIS. The wind speed is calibrated to be valid at 10 meters above the ocean surface. The accuracy of the wind speed is about 5 mph (Hollinger, 1991). The resolution of the product is 29 x 37 km. This product can be of great use in determining the wind speeds associated with systems that are about to impinge on the west coast. The product gives only wind speed and not direction of motion. The data are a good complement to the ship and buoy reports that are available, which do give wind direction. The product is degraded by the presence of rain so these areas are not assigned wind speeds.

The product is only produced over ocean surfaces where rain is not occurring. The regions of rain over the ocean are highlighted in the imagery for informational purposes, but rain rates are not produced. Over land rain rates are produced and are included in the SSMI rain rate product.

On RAMSDIS the wind speed over the ocean is represented using the following enhancement scheme:

Color	Wind speed
Green	0 - 10 mph
Yellow	10 - 20 mph
Red	20 - 35 mph
Magenta	35 - 45+ mph

Regions of black enhancement indicate no data available.

SSMI Rain Rate Product

The SSMI rain rate product is generated from a combination of the vertical polarizations of the 19 GHz, 22 GHz and 85 GHz channels. Rain rates are in units of mm/hr and have a range from 0 to 25 mm/hr (0 to 1 in/hr). The resolution of the product is 29 x 37 km. This product can be of great use in determining the intensity of rainfall that is about to move inland. By comparing the SSMI rain rate product to the GOES IR images, one can determine which area(s) of the cloud are precipitating and then follow these features in the GOES IR image loop. This can help determine when precipitation may begin and how heavy it may be.

The rain rate product is generated over ocean and land; however, different algorithms are used over ocean and land. The rain rate is represented on RAMSDIS using the following enhancement scheme:

Color	Rain rate
Green	0 - 10 mm/hr
Yellow	10 - 15 mm/hr
Red	15 - 20 mm/hr
Magenta	20 - 25+ mm/hr

Regions of black enhancement indicate no data available. Over the ocean, the cyan enhancement indicates regions that are tagged as having rainfall.

Setting up RAMSDIS to ingest SSMI products

All the necessary command files, enhancements, and graphics have been downloaded to all Western Region RAMSDIS sites. To enter the SSMI ingest command into the ingest schedule, enter the following on the McIDAS command line (will show up on monochrome screen): BATCH SKEDSSMI.CMD. This command only needs to be run once and will set up the ingest of the SSMI products to the local RAMSDIS. The ingest will continue automatically, even after rebooting the machine. The SSMI product loops will be updated automatically when a new image is ingested. The loops are defined as:

Ctrl-F2	SSMI wind speed product
Ctrl-F3	SSMI total precipitable water product
Ctrl-F4	SSMI rain rate product

Please note that these products contain data from the last 12 hours and that the image time displayed on the image is the time of the composite product generation. In looking at the loop of images, one can tell when new passes are added to the composite image and are thus more recent.

NOTE: This Technical Attachment will be available on the Western Region Headquarters Home Page (http://ssd.wrh.noaa.gov/ssmita.html). The Home Page version will include examples of the SSMI products.

References

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