P1.34 NEAR-REAL-TIME AMSR-E PRODUCTS AT NOAA

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1. INTRODUCTION

The NOAA/NESDIS AMSR-E Near-Real-Time (NRT) processing system was implemented under the Computer Sciences Corporation's (CSC) Central Satellite Data Processing contract. It uses the same NOAA/NASA resources and facilities as the NRT MODIS processing system and is designed to provide NOAA customers with rapid access to near-real-time meteorological information derived from the data captured by the AQUA satellite's AMSR-E instrument.

The Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E) is a passive microwave radiometer with six microwave channels ranging from 6.9 GHz to 89.0 GHz (with two polarization modes each) and spatial resolutions ranging from 50 km to 5 km. The instrument's capability to see through clouds makes it an important source of information for weather and climate studies.

Raw AMSR-E observation data is provided to the system by NASA on a near-real-time basis. The system converts raw data into brightness temperatures and further into a number of important geophysical parameters, including precipitation, sea and land surface temperature, ice concentration, snow water equivalent, surface wetness, wind speed, atmospheric cloud water, and water vapor.

The poster will describe a processing system structure, dataflow, and sample products, while described here in more details are the steps of product generation.

2. LEVEL 1A AND 1B PROCESSING

For each orbit the NRT system gets a pair of data files from NASA's EDOS (EOS Data Operations System): a Rate Buffered Data (RBD) file containing scientific data and a corresponding Ground Based Attitude Determination (GBAD) file containing geo-referencing data.

Data packets in the RBD and GBAD files have not been sorted in time order and contain both the "playback" (recorded by the onboard storage device) and direct broadcast data (real time transmission at the time of download). Upon arrival in the input directory of the NRT AMSR-E processing system, RBD and GBAD files are sorted into time order and are filtered to retain only the playback data. This sorted Level 0 data is further used to generate Level 1A data files. The Level 0 file name and times of the first and last scan of the scene are written into the "sorted" table of a MySQL database for reference during later processing.

By convention, Level 1A and Level 1B files contain observation data for one scene that is defined as a half-orbit, starting and ending at the poles. According to a file naming convention, a file name should contain the instrument identification, the start time of the scene, the orbit direction (ascending or descending), and the orbit and path number. The path number defines the sub-satellite track on the Earth and is used to identify the areas of interest.

To generate Level 1A and Level 1B files it is necessary to create a processing configuration file that contains the name of RBD and GBAD Level 0 file(s), the date and time of the pole crossing, orbit and path numbers, the name of the output file and other ancillary information.

The information about the AQUA satellite's location and orientation in orbit is extracted from AMSR-E Orbital Event files that are provided once a day by NASA. All the information needed to identify the AMSR-E scenes for the next day is written into the "scenes" table of the database.

The "scenes" and "sorted" tables are used to match a particular scene and the corresponding Level 0 file(s) that comprise this scene. If a file containing a particular scene or part of a scene has arrived, a record containing the scene and data file information is written into the "processed" table of the database.

The other information needed for processing is the Earth Orientation Parameters (EOPs) provided by the International Earth Rotation Service (IERS). This is available once a month and contains the EOPs in five-day intervals. Each day, EOPs are interpolated for the current date and stored in a file, the name of which is also written to the processing configuration file.

After a configuration file for a particular AMSR-E scene is created, a program provided by the Japan Aerospace Exploration Agency (JAXA) generates a Level 1A data file in HDF format. During the Level 1A processing the program deletes duplicated data packets, fills the missing packets with dummy data, calculates coefficients for converting raw data to antenna brightness temperatures, calculates longitude/latitude of observation positions, writes navigation data, sun position, incident angles, and so on. Then the same program creates a Level 1B HDF file using a Level 1A file as an input. The only difference between contents of the Level 1A and the corresponding Level 1B file is that the observation counts of the Level 1A file are replaced by the brightness temperatures. After the scene is processed, it is flagged as completed in the "scene" and "processed" database tables.

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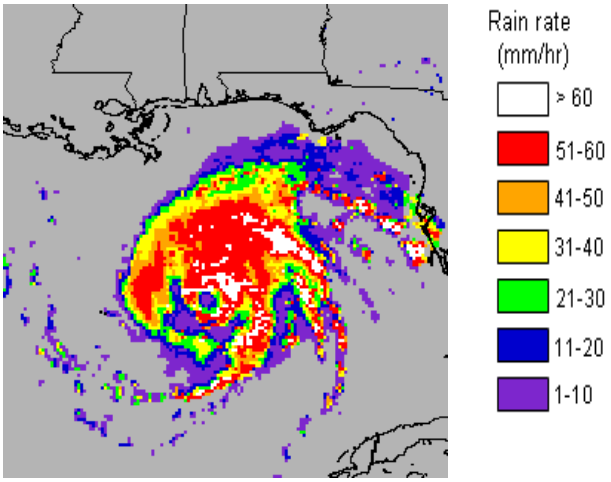
Level 1A and 1B files are used in the next step of processing as inputs for generating a Level 2A file. The Level1B files containing brightness temperatures are also stored on the project file server and/or transferred to user sites.

3. LEVEL 2A PROCESSING

To generate the AMSR-E geophysical products, brightness temperatures of the higher frequency channels of the Level 1B file need to be resampled to the footprints of the lower frequency channels. This allows scientific algorithms to use more than one data channel to generate a product. The file containing resampled brightness temperatures is identified as a Level 2A file, and is in HDF-EOS format.

There were no programs available at the beginning of the project for the creation of a Level 2A products that were completely suitable for use in the NRT processing. The only accessible Level 2A program was the one provided by Dr. Peter Ashcroft of Remote Sensing Systems (RSS). There were two obstacles in using it directly. First, it was written for the Windows OS using obsolete C and FORTRAN compilers while the NOAA's AMSR-E system is built in the UNIX environment. And second, it uses a calibration procedure that cannot be used in the near-real-time processing because the calibration coefficients are derived from other sensors



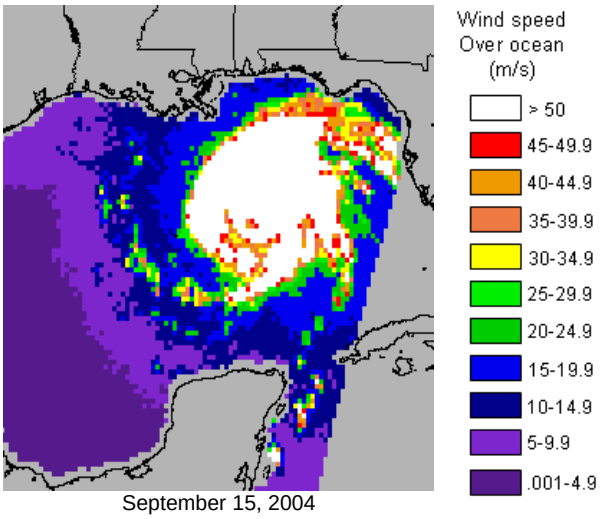
AMSR-E Image of Hurricane Ivan: Rain Rate.
Special Res.: 5.4 km; Channel 89.0 GHz
Source: http://nsidc.org/data/amsr/gallery/ivan.html

whose observational data does not become available until far beyond the NRT requirements (three hours from the time of observation). Besides, there is no consolidated opinion so far about the best calibration procedure to be used for the AMSR-E data. The research is still under way.

Therefore the following approach was chosen. First, the RSS software containing both C and FORTRAN subroutines was ported to the UNIX platform. Second, the brightness temperatures used for data resampling are taken from Level 1B files. It means that the NOAA NRT AMSR-E processing system uses the original JAXA's calibration procedure for producing Level 2A files instead of the RSS calibration. This approach was based on the facts that JAXA regularly improves their calibration, and that NOAA's NRT users are willing to accept the small difference between the JAXA's and RSS' calibration as a trade-off for getting near-real-time products. For example, the NOAA products become available for users within three hours of observation, while products produced by using the RSS's calibration are staged on the NSIDC website, http://nsidc.org on the fourth day after observation. The system starts the Level 2A processing immediately after a Level 1B file is processed. After a Level 2A HDF-EOS file is processed, the Perl script writes an entry about this file into the "products" database table to indicate that the system is ready to process the higher level AMSR-E geophysical products, Level 2 and Level 3 files.

1. LEVEL 2 AND LEVEL3 PROCESSING

A Perl script checks the "products" table of the operational database for a new Level 2A file available for processing. If there is one, the names of the new higher level products are created and written into the same table next to the name of this file. It triggers execution of all level 2 product executable scripts. The daily Level 3 products are generated after all the Level 2A files for the current day are created.



AMSR-E Image of Hurricane Ivan: Wind Speed.
Special Res.: 21 km; Channel 18.9 GHz
Source: http://nsidc.org/data/amsr/gallery/ivan.html

Currently in addition to Level 1A/1B and 2A products the NOAA's NRT AMSR-E processing system generates and distributes the following Level 2 and Level 3 geophysical products: L2_Land (surface type, surface soil moisture, vegetation water content, land surface temperature), L2_Ocean (sea surface temperature, wind speed, columnar water vapor, columnar cloud liquid water), L3_Ocean (same as L2_Ocean daily products for both ascending and descending passes), L2_Rain (rain rate, type and status), and L3_SeaIce (sea ice concentration, snow depth, sea ice temperature daily products). Some more products are coming.

All details about the products can be found on the National Snow and Ice Data Center (NSIDC): http://nsidc.org/data/amsr/order.html.

2. CONCLUSIONS

A new near-real-time processing system for production of a full suite of the AMSR-E products was created at NOAA/NESDIS. The system ingests the raw AMSR-E data and processes all levels of the AMSR-E products and distributes them to NOAA, NASA and military customers for production use.

A copy of this poster is located at http://www.osdpd.noaa.gov/MODIS/AMS/

3. ACKNOLEDGEMENTS

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