CONSTRUCTION OF AMSR-E LEVEL-1 PROCESSOR AND RETRIEVAL OF OCEAN PARAMETERS

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ABSTRACT

We have constructed a level-1 processor to generate brightness temperatures using the direct-broadcast data from the passive microwave radiometer onboard Aqua satellite. Although 50-minute half-orbit data, called a granule, are being routinely produced, to our knowledge, this is the first attempt to process about 10-minute long direct-broadcast data. We modified the processor designed for a granule to process the direct-broadcast data. After the modification, our brightness temperature product differs from the reference by 0.2K rms. Sea surface temperatures are retrieved to demonstrate the utility of AMSR-E.

Keywords: AMSR-E, Aqua, direct broadcast

1. Introduction

Aqua, launched in May 2002, is a major satellite mission of the Earth Observing System (EOS), an international program centered at the U.S. National Aeronautics and Space Administration (NASA). Among six sensors onboard Aqua satellite, in this paper we describe the processing of AMSR-E (Advanced Microwave Scanning Radiometer for EOS) sensor. For the first time among the direct broadcast community of AMSR-E, we have established the direct-broadcast system for generating brightness temperatures. Our system is based on the processor ADS (AMSR Data processing Software), developed by Japan's NASDA (National Space Development Agency). ADS was released to the public in June 2003 after 1-year of sensor verification. Consequently, AMSR-E data are available only through a few data centers in the world. Thus the spirit and the merit of direct-broadcast are not taken advantage of. In this paper we present (1) how to adapt ADS to process the direct broadcast data, (2) the comparison of the performances, and (3) the sample generation of level 2 products. We believe that this work is a valuable contribution to enhanced use of AMSR-E data.

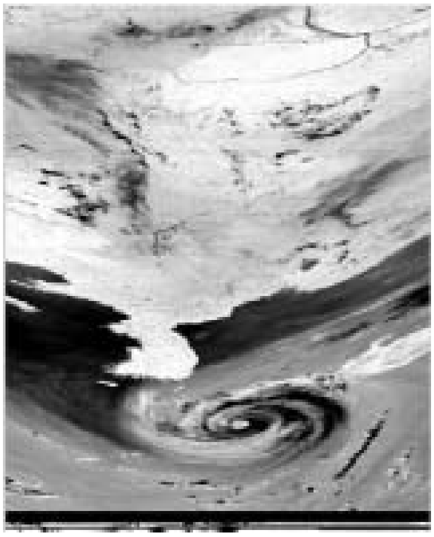
2. Brightness temperature retrieval

Retrieval of brightness temperature from AMSRE antenna counts is defined as level 1. The L1 processor is composed of radiometric calibration and geolocation units. The radiometric calibration converts the observational counts to antenna temperatures (and subsequently brightness temperatures) using two references for high and low temperatures. The geolocation comprises of several coordinate transformation from the sensor coordinate to ECR (Earth-Centered-Reference). The ancillary data and the precise time information are needed additionally to assign coordinates to each pixel.

The key changes of our system environment for brightness temperature generation from NASDA's system as follows. Full details are available in [1].

- Most important difference is in the length of data. NASDA's data are received by the EOS ground stations near the north pole, and therefore they are half-orbit data (a granule). However, local ground stations can collect only overpass data, which are about 10-minute long.
- Consequently correct CSM (Cold Sky Mirror) data are not available since correct CSM data at present time will be obtained 600 seconds later due to the viewing geometry. The unavailability of CSM data leads to differences in brightness temperature between our and NASDA product.

Fig. 1. Images showing the impact of dummy scan at the scene start (bottom).



- AMSR-E path number changes when Aqua crosses the equator in an ascending track. However, a granule covers from pole to pole. Therefore for an ascending scene, path number changes inside the scene. This rule makes the same scene over Korea acquire different path numbers between our and NASDA's product. Since landmask is selected using a path number in ADS, the path number error causes a wrong landmask. We modified ADS' algorithm to make two path numbers the same.
- Data quality at the beginning of data reception from a satellite is dubious because the matching between satellite antenna and ground station may be incomplete. This generates dummy garbage data at the scene start (Fig. 1). NASDA's ADS does not consider this situation since it is designed to process 50-minute long data. We have modified ADS' algorithm to avoid this 'dummy scan error'.

For verification we have performed pixel-to-pixel validation with NASDA L1B product as a reference. The results in Table 1 indicate the difference in brightness temperature of about 0.2 K rms and less than 0.05 K mean. We attribute the difference to two factors.

- During the radiometric calibration, the HTS and CSM data are averaged in time and across a scan. Since NASDA data are longer (50 minutes), the HTS and CSM values would differ from ours, and this would lead to differences in brightness temperature. This attribution is supported by the perfect agreement in L1A observation counts between the two products (Table 1).
- As explained before, our direct-broadcast data do not have correct CSM values. Incorrect use of CSM values results in about 0.7 K error over the ocean, and 1 K error over the land [2].

3. Retrieval of level-2 parameter

To demonstrate that AMSR-E can offer useful geophysical parameters, we have retrieved sea surface temperature (SST). A sample map of SST looks reasonable for July. We have not corrected for rain effects yet and thus SST is saturated when there are rain cells. In addition more accurate correction for the wind and atmospheric opaqueness is needed in the future.

4. Summary

We have constructed a level-1 processor to generate brightness temperatures, for the first time, using the direct-broadcast data from AMSR-E. Modification of NASDA's processor, which is designed for handling 50-minute granule, is necessary to manipulate the direct-broadcast data that are about 10-minute long. We have implemented the necessary modification that includes the correction to path/orbit numbers, the selection of land mask and the processing of dummy scans. Pixel-to-pixel verification exhibits our system performs well. The direct-broadcast processing system is automated to enable the near-real time generation of brightness temperatures.

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5. References

[1] Kim, S.B. et al. 2003: Brightness temperature retrieval using direct broadcast data from the microwave sensor on Aqua satellite, J. Korean Soc. Rem. Sens. Submitted.

[2] Imaoka, K. et al. 2003: Post-launch calibration and data evaluation of AMSR-E, *Proceedings of IEEE Geoscience and Remote Sensing*, Toulouse, France, in CD-ROM.

Table 1. Pixel-to-pixel validation with NASDA L1B product. Date of the scene: 20030722. Path: 204. Units are digital number for 1A and Kelvin for brightness temperature.

Chnannel	Ours –NASDA's			
	stdev	Mean	max	min
6V BT (L1B)	0.15	-0.03	0.5	-0.3
6V Observation count (L1A)	0	0	0	0
10V BT (L1B)	0.15	-0.06	0.3	-0.5
18V BT (L1B)	0.24	-0.02	0.6	-0.5
23V BT (L1B)	0.20	-0.02	0.4	-0.4
36V BT (L1B)	0.09	-0.05	0.2	-0.4
89BV BT (L1B)	0.15	-0.04	0.4	-0.4