Development of AMSR and AMSR-E retrieval algorithms at EORC

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1. Introduction

The Advanced Microwave Scanning Radiometer (AMSR) is a multi-frequency, dual-polarized microwave radiometer that detects microwave emissions from the Earth's surface and atmosphere. Various geophysical parameters, particularly those related to water (H_2O), can be estimated from AMSR data. In addition to the proven parameters such as water vapor, precipitation, and sea surface wind speed, novel geophysical parameters, including sea surface temperature and soil moisture, are expected to be retrieved by using new frequency channels. The largest ever microwave radiometer antenna enables us to perform continuous global observation with high spatial resolution. Long-term records of AMSR measurements will play an important role in climate change monitoring as well as in providing indispensable information for understanding the Earth's climate system, including water and energy circulation. Near-real-time products will be used for investigating satellite data assimilation into weather forecasting models and will contribute to improving forecast accuracy. In this technical report, we will summarize the theoretical basis and descriptions of an each retrieval algorithm.

2. Algorithm Development

NASDA issued the first Research Announcement (RA) in October 1995 to solicit standard algorithms for ADEOS-II AMSR and GLI. Standard algorithms will be installed at the Earth Observation Center (EOC) to operationally produce Level 2 and 3 geophysical products. The AMSR sensor team was organized based on this announcement. After the decision of providing AMSR-E to the EOS PM-1 satellite, the team has also been responsible for AMSR-E standard algorithms. Retrieval algorithms for AMSR standard products have been evaluated and selected through an algorithm inter-comparison process by the AMSR sensor team. The inter-comparison procedure was mainly based on a comparison between in-situ or aircraft data and retrieved geophysical parameters from brightness temperatures of existing space-borne sensors such as the Special Sensor Microwave/Imager (SSM/I). Although the comparison showed little differences in the performance of algorithms, the day-1 algorithms (i.e. the algorithms at launch phase) and supporting PIs were selected based on this result (e.g. whether he or she could meet report and program deadlines). The AMSR algorithm selection board was held at EORC in May 2000. As a result of this board, the soil moisture product was re-defined as a research product at the launch phase due to the difficulties of accurate retrieval. For geophysical parameters with two algorithm candidates, one algorithm was selected as standard and the other one was positioned as a research algorithm. Current day-1 algorithm investigators are listed in Table 1. These day-1 algorithms will be used at EOC during the first six-months after launch. After the real AMSR brightness temperatures are obtained, this selection will be re-shuffled, and one algorithm will be selected based on its real performance. Through the 2nd Research Announcement, several PIs have joined the project as research algorithm investigators. These PIs will be added to the list at the next opportunity.

Table 1. Day-1 algorithms for AMSR and AMSR-E

Geophysical products	Standard	Research
Integrated water vapor	Takeuchi	-
Integrated cloud liquid water	Wentz	-
Precipitation	Petty	Liu
Sea surface wind speed	Shibata	-
Sea surface temperature	Shibata	Wentz
Sea ice concentration	Comiso	-
Snow depth	Chang	Koike
Soil moisture	-	Njoku, Jackson, Paloscia, Koike

3. Algorithm integration testing

EORC is responsible for proto-typing and testing the AMSR data retrieval system. We asked the algorithm PIs to submit their source codes for retrieval algorithms. Prior to this request, NASDA distributed the "common library," that is a kind of interfacing toolkit between the PI environment and the NASDA processing system. We can easily integrate PI source codes written using this common library into our processing system. During fiscal year 2000, we were provided the algorithms twice, corresponding to the distributions of different version of the common library. Since the AMSR has not flown yet, no real brightness temperatures are available to check the condition and performance of each algorithm. As the input data for the testing, we generated AMSR simulated brightness temperatures by using existing microwave radiometer data such as SSM/I and SMMR with slight corrections for incident angle and center frequencies. Radiative transfer calculations were also used for nonexistent frequency channels. Through the algorithm integration testing, we have confirmed that most of the algorithms functioned properly. Since the AMSR simulated data are not ideal, we have to wait for the real AMSR data to investigate algorithm performance. Sample browse images of the retrieval results are shown in Fig. 1.

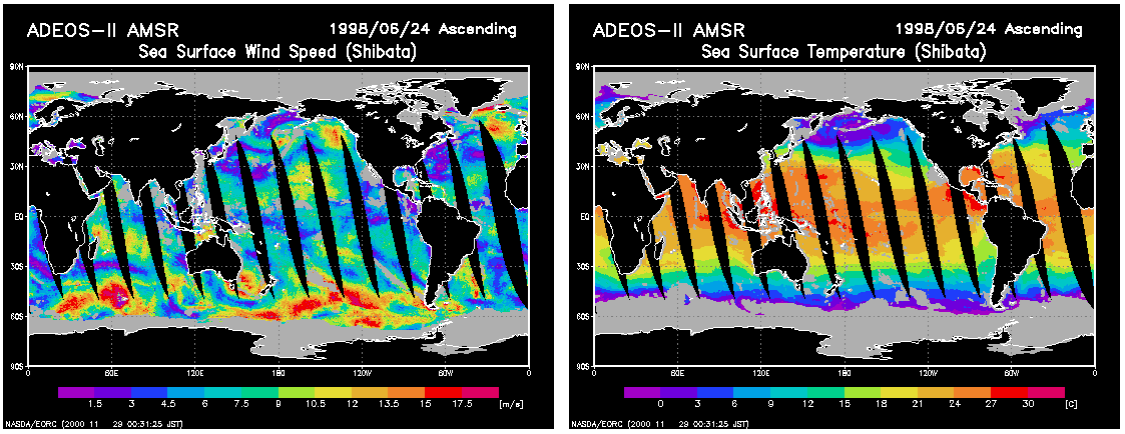

Fig. 1. Global images generated by AMSR processing system at EORC. Images of sea surface wind speed (left) and sea surface temperature (right) are shown as examples. Input data are AMSR simulated ascending passes on June 24, 1998.