Preliminary Assessment of AMSR-E Snow Water Equivalent Values for Eastern Turkey

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EXTENDED ABSTRACT

Conventional methodologies cannot keep up with monitoring the rapid changing snow characteristics. Remote sensing (RS) provides convenient solutions to track these changes. Among various RS techniques, satellite imagery with its wide area coverage and frequent, repeated cycles provides the most cost effective solutions. Many successful applications of satellite imagery in snow monitoring have been performed since 1960s. With the launch of MODIS (Terra and Aqua) in 2000's, a new area in cryospheric RS applications became available with the improved spatial and temporal coverage properties that MODIS offers. Various global snow related products are obtained from MODIS (Hall *et al*., 2002). As snow products are derived, their accuracies and possible improvements in their production chain became the major concern. To provide an answer to these, validation test sites are needed to evaluate the accuracy of the algorithms.

Advanced Microwave Scanning Radiometer (AMSR-E) sensor on board Earth Observing System (EOS) Aqua satellite is a multi-frequency, dual-polarized microwave radiometer detecting microwave emissions from the Earth's terrestrial, oceanic surfaces and atmosphere. Data from this satellite enable the investigation of water and energy cycles. Additionally, "various geophysical parameters can be retrieved, including water vapor, cloud liquid water, precipitation, sea surface temperature, sea surface wind speed, sea ice concentration, and snow water equivalent." (Jaxa, 2007). AMSR-E also provides daily global snow water equivalent (SWE) data sets. As most of the RS products, validation of the derived outputs is one of the main concerns. Thus, validation sites are needed to quantify the algorithm errors, to determine the heterogeneity of the area under study and to verify different snow pack conditions. Various test sites in different parts of the world, including different land uses and different snow conditions, are needed to prove the applicability of a global SWE algorithm.

The purpose of this abstract is to provide an introduction to preliminary assessment studies of AMSR-E derived SWE with *in situ* data obtained from an area other than the algorithm is developed for. *In situ* field data are composed of snow courses. In these snow courses, snow depth, snow density and snow water equivalent measurements are performed on specific dates during the periodic field trips. The *in situ* points are distributed over a wide area in the eastern region of Turkey. This region is the headwaters of Euphrates and Tigris rivers and has many watersheds fed by melting snow in spring. Distributed nature of the *in situ* observation points over a wide region enables a regional scale evaluation of AMSR-E SWE data for possible different snowpack conditions.

The general trend of ground SWE observations were captured by AMSR-E with some over and underestimations. Relative agreement (RA), as proposed by Derksen *et al.* (2005), is used to provide a quantitative comparison of the *in situ* and AMSR-E derived SWE amounts. Equation 1

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represents the comparison of *in situ* value with AMSR-E derived SWE value that corresponds to where the *in situ* point falls in the respective pixel grid.

$$RA = \frac{SWE_{AMSR-E} - SWE_{in-situ}}{SWE_{AMSR-E}} * 100 \quad (1)$$

Figure 1 shows the relative agreement between the AMSR-E derived and the *in situ* SWE for the 2002/2003 winter period. The magnitude and the sign of the agreement change during the season. Figure 2 represents the difference between AMSR-E derived and *in situ* SWE where during the first half of the season overestimation of the AMSR-E SWE is dominant. On the other hand, underestimation is observed dominantly in the remaining half of the season.

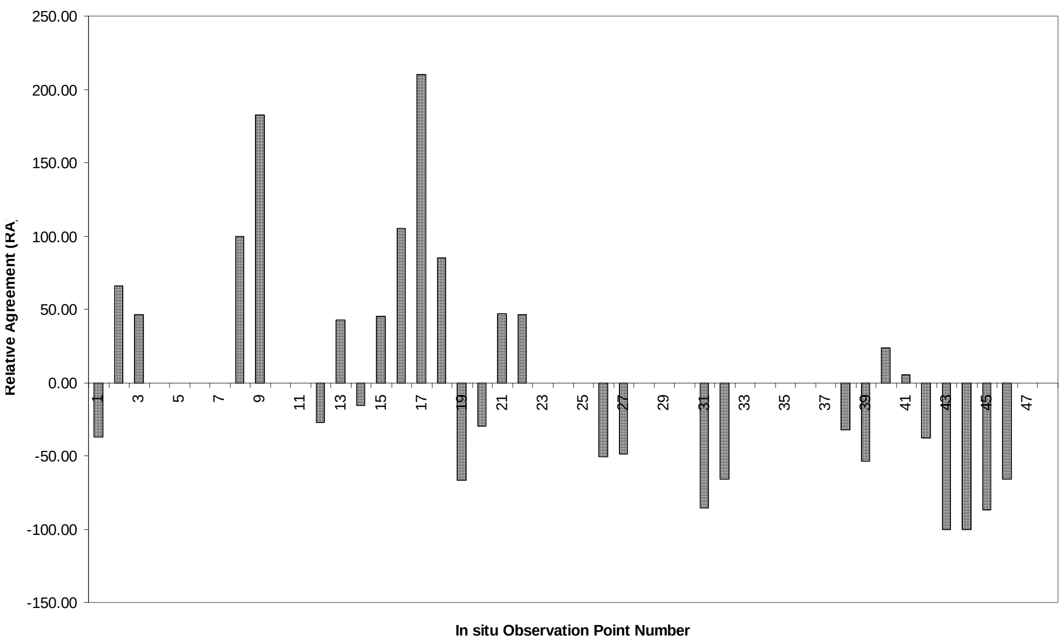

Figure 1. Relative agreements between the AMSR-E derived
and the in-situ SWE for the 2002/2003 winter period.

Some meteorological conditions at the field are also examined by considering the data of the nearest meteorological stations. The meteorological variables are supposed to provide key variables such as soil moisture, and temperature of soil, snow and air for the interpretation of the passive microwave brightness temperatures (Derksen *et al.* 2003).

In determining the SWE value from AMSR-E data, snow density values are needed. Most of the time, average values are utilized due to the limited data access. Thus it is assumed that possible improvements can be achieved if regional values are used. It is hoped that investigation of the regional snow density effect and taking the time wise variability of them into consideration, the accuracy of the AMSR-E SWE would provide further enhancements.

It is believed that present study will provide a starting point for the evaluation of AMSR-E SWE product for an understudied portion of the world. It is also assumed that better understanding of the factors influencing the accuracy of remotely sensed SWE data will provide better algorithms and enable more accurate SWE retrievals in the future.

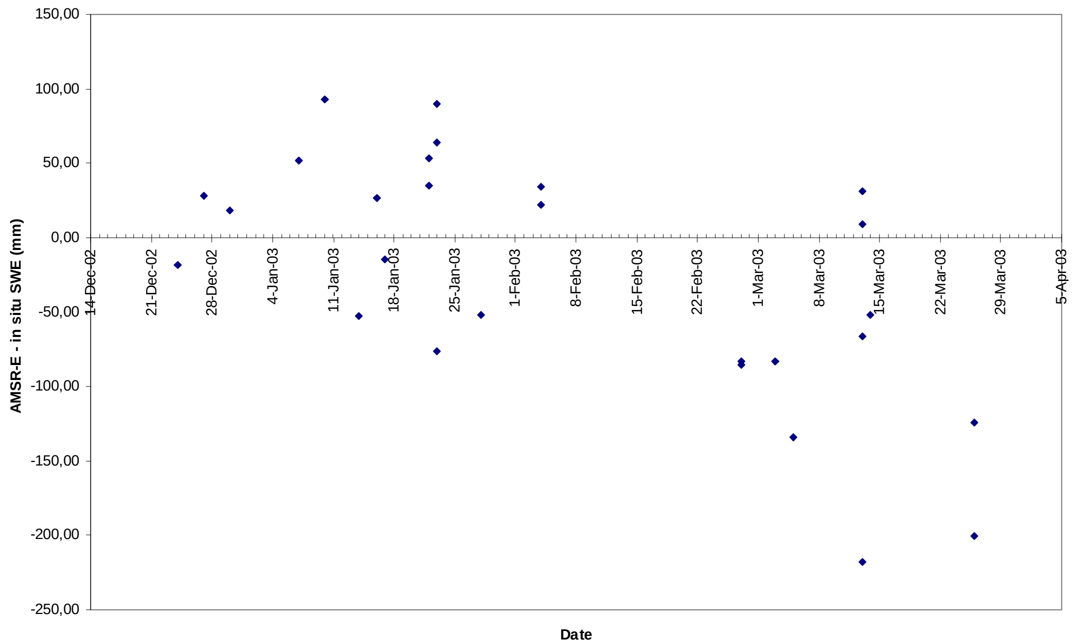

Figure 2. Timing effect on AMSR-E over/under estimations.

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