DO SMOS BRIGHTNESS TEMPERATURES APPROXIMATE TO THE REPORTED 15KM DISCRETE GLOBAL GRID?

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1. INTRODUCTION

The Soil Moisture and Ocean Salinity (SMOS) mission is providing radiometric measurements at about 42km spatial resolution over the Earth surface [1, 2]. The oversampling of SMOS allows the 42km brightness temperature ($T_B$) data to be provided on a 15km hexagonal grid called the Discrete Global Grid (DGG). While this is purely convenience for representation, there is increasing desire to use this 42km $T_B$ data directly at the 15km DGG without the implementation of downscaling approaches such as those applied in [3, 4]. As a result, a persistent question is whether the actual 42km $T_B$ observation represents the 15km DGG sufficiently well, or whether downscaling approaches are a requirement for using these data at a higher resolution. To investigate this question, a 1km $T_B$ dataset from the Australian Airborne Cal/val Experiment for SMOS (AACES) is used to quantify the differences in $T_B$ between the observations at the 42km SMOS resolution and the 15km DGG. Consequently, a SMOS-like $T_B$ dataset is derived from AACES for the 42km SMOS footprint and compared to observed $T_B$ on the 15km DGG.

2. STUDY AREA AND DATA SETS

The Murrumbidgee Catchment in south-east Australia (shown in Figure 1) has varied climatic, topographic and land cover characteristics, with semi-arid conditions in the west to alpine conditions (including winter-time snow) in the east. The figure also shows the area coverage of the AACES field campaign [5] in 2010 across the Murrumbidgee Catchment. The airborne $T_B$ observations cover a 500 $\times$ 100km$^2$ area comprising the ten flight patches, with each being 50 $\times$ 100km$^2$. The AACES flight patches are aligned with the SMOS 15km DGG with each patch containing a minimum of four overlapping SMOS pixels of about 42km resolution [5]. The AACES campaign used the Polarimetric L-band Multi-beam Radiometer (PLMR) having the same 1.413GHz frequency as used by SMOS. The PLMR was mounted to scan the land surface at incidence angles of $\pm 7^\circ, \pm 21.5^\circ$, and $\pm 38.5^\circ$ to each side of the aircraft [5], with observations made coincident with the SMOS overpass. The airborne 1km L-band $T_B$ data was normalized to a common 38$^\circ$ incidence angle for direct comparison with the SMOS Level 1 $T_B$ data.

3. METHODS AND RESULTS

Using the 1km AACES data, the $T_B$ at the 42km SMOS footprint and the corresponding 15km DGG (as shown in Figure 1) are estimated according to equations 1 and 2 respectively. That is, the estimated $T_B^{42km}$ and $T_B^{15km}$ represent the aggregated 1km AACES data at the 42km footprint and the 15km DGG representation respectively.

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$T_{B}^{42\text{km}} = \frac{\sum_{i=1}^{n} T_{B}^{1\text{km}}}{n}$; \hspace{1em} n = \text{number of 1km grids within the 42km grid.}

(1)

$T_{B}^{15\text{km}} = \frac{\sum_{i=1}^{k} T_{B}^{1\text{km}}}{k}$; \hspace{1em} k = \text{number of 1km grids within the 15km grid.}

(2)

The comparison for the $T_{B}$ observation at 42km resolution and on the corresponding 15km DGG is shown in Figure 2. The root mean square error (RMSE) is 4.5K and 3.9K in the horizontal and vertical polarizations respectively. The horizontal polarization has a higher RMSE with associated maximum residual of 12.9K compared with 10.7K in the vertical polarization.

Fig. 1. Experimental area - the Murrumbidgee Catchment showing the AACES flight patches, the SMOS 15km DGG and 42km footprints (circles). Flight patch numbering starts with 1 at the left to 10 at the right.

Fig. 2. Comparison of AACES $T_{B}$ data at the 42km SMOS footprint against observations at the 15km DGG.
4. CONCLUSIONS

This study has quantified the overall difference (or error) that could be expected in $T_B$ when applying the actual SMOS observation with a footprint of about 42km at the 15km DGG. The evaluation found that the vertical polarization has a slightly better agreement, with a RMSE of 3.9K compared with 4.5K in the horizontal polarization. In summary, the findings show that the actual SMOS radiometric observations at 42km resolution could be used on the 15km DGG within an overall accuracy limit of about 4K.

5. REFERENCES


