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 $\pm 7^o, \pm 21.5^o$, and $\pm 38.5^o$ 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° 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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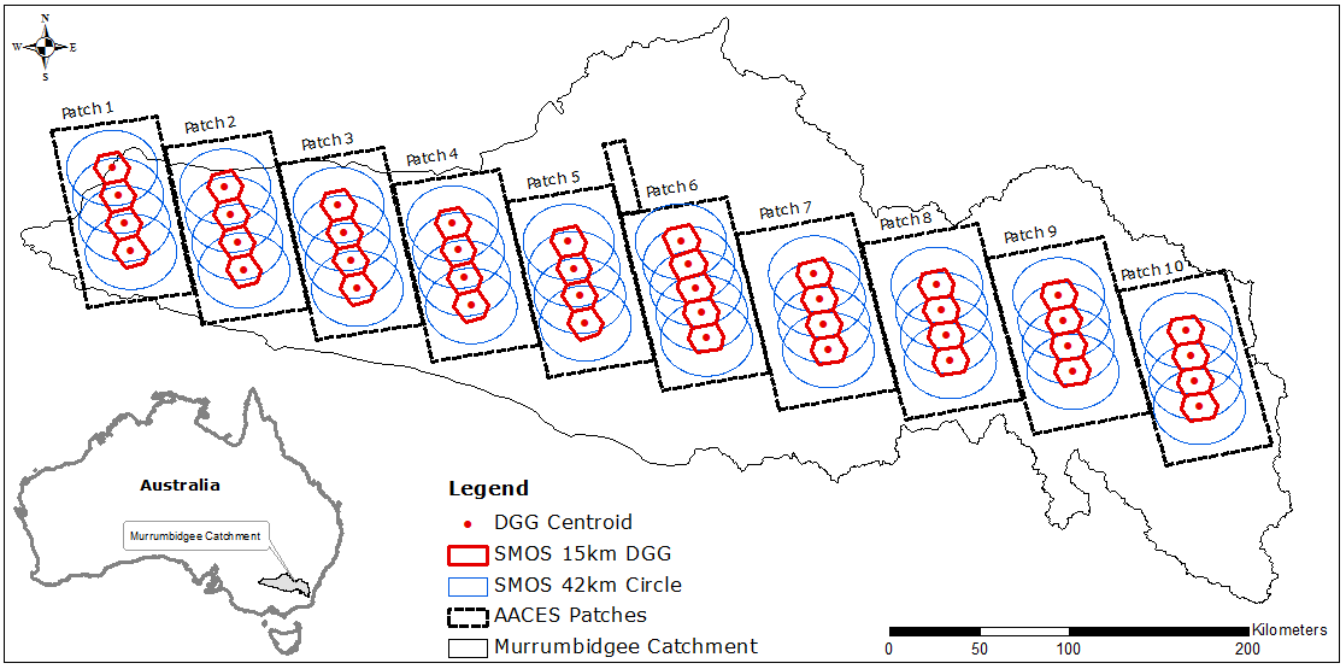

Fig. 1. Experimental area - the Murrumbidgee Catchment showing the AACES flight patches, the SMOS 15km DGG and 42km footprints (circles). Flight patch numbering starts with 1 at the left to 10 at the right.

$$T_B^{42km} = \frac{\sum_{i=1}^{n} T_{Bi}^{1km}}{n}; \qquad n = number\ of\ 1km\ grids\ within\ the\ 42km\ grid. \tag{1}$$

$$T_B^{15km} = \frac{\sum_{i=1}^{k} T_{Bi}^{1km}}{k}; \qquad k = number\ of\ 1km\ grids\ within\ the\ 15km\ grid. \tag{2}$$

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.

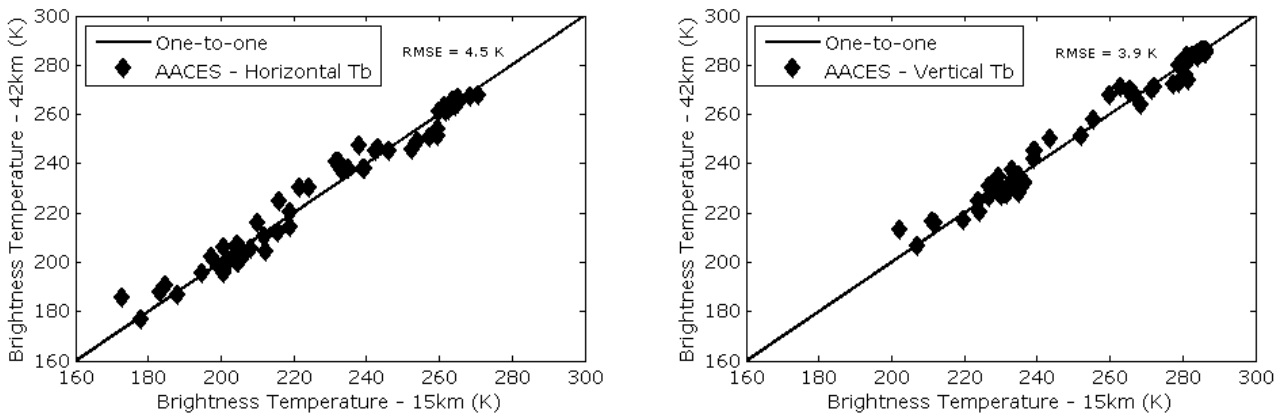

Fig. 2. Comparison of AACES T_B data at the $42km$ SMOS footprint against observations at the $15km$ DGG.

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

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