AN AIRBORNE SIMULATION OF THE SMAP DATA STREAM

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1. INTRODUCTION

The Soil Moisture Active Passive (SMAP) mission [1] under development by NASA is scheduled for launch in 2014. This soil moisture and freeze thaw dedicated mission will be the first to provide soil moisture globally at ~9km spatial resolution with a 2-3 day repeat, by combining L-band radiometer data at ~36km resolution with L-band radar data at ~3km resolution. The rationale is that an improved spatial resolution and accuracy can be achieved through the unique combination of high resolution but noisy radar data with the more accurate yet lower resolution data from the radiometer. However, given that this is the first satellite mission to take this approach, the algorithm developments to date have been largely based on synthetic studies and a few airborne data sets, typically for areas smaller than a SMAP radiometer pixel. Consequently, this study will simulate the expected SMAP data stream using airborne simulator flights of an entire SMAP radiometer pixel, for use in pre-launch algorithm validation under a range of conditions.

2. STUDY SITE

The site chosen for this study is the Yanco area of the Murrumbidgee Catchment located in south-eastern Australia (Fig. 1), extensively monitored for soil moisture with in-situ stations since 2003 (see www.oznet.org.au). The site has a total of 13 profile soil moisture (top 90cm) stations, and was recently augmented with a further 24 surface only soil moisture sensors. These additional sensors were distributed across the site such that there were multiple sensors at the radar pixel scale (3km), the radar-radiometer pixel scale (9km), and the radiometer pixel scale (36km), whilst also representing the

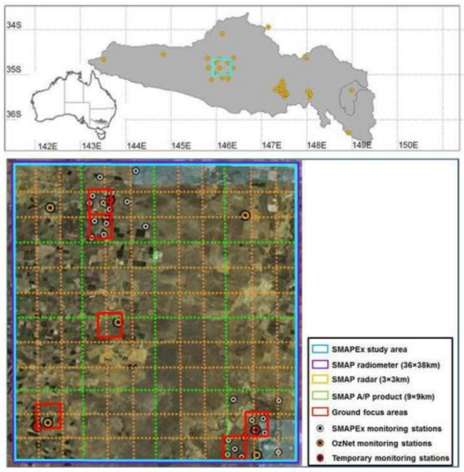

Fig. 1: Overview of the SMAP pixel simulated by airborne data showing a ~36km resolution radiometer pixel, the 3km radar pixels and 9km radar-radiometer downscaled pixels.

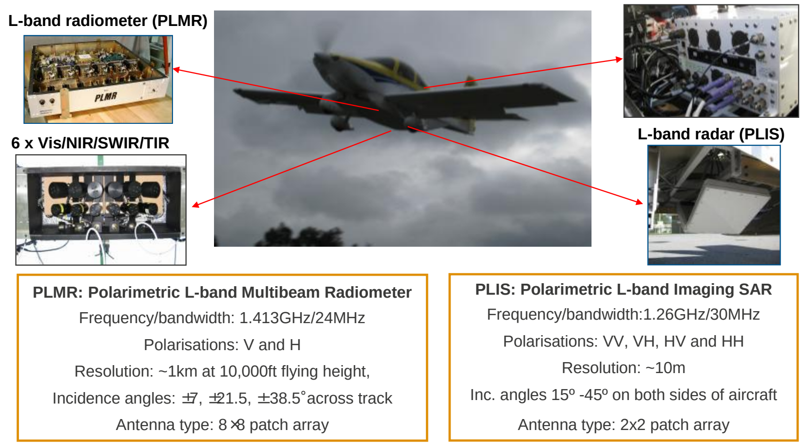

Fig. 2: The SMAP simulator.

diversity of land cover. This SMAP "Test-Bed" is characterised by flat topography with grassland and a mix of irrigated and non-irrigated crops.

3. DATA

The radar and radiometer data used to simulate the SMAP data stream has been acquired by the SMAP simulator shown in Fig. 2 through a series of seasonal field campaigns (Soil Moisture Active Passive Experiments, SMAPEx) across approximately a year: SMAPEx-1 from 5th to 10th July 2010, SMAPEx-2 from 4th to 8th December 2010, and SMAPEx-3 from 5th to 23rd September 2011 [2]. The flights simulating the SMAP mission were conducted at 10,000ft flying height across the entire 36km SMAP pixel with a 2-3 day temporal repeat, giving a total of 3 flights for each of SMAPEx-1 and 2, and 9 flights for SMAPEx-3. Additional target flights were also conducted to deal with the issues of incidence angle normalisation, spatial scaling and azimuth variations. Moreover, extensive ground data on soil moisture and vegetation were collected concurrently with the flights for validation of soil moisture retrieval studies.

4. METHODS

Data collected by the SMAP simulator have a ~10m and 1km resolution for the radar and radiometer, respectively. Flight lines were undertaken in a north-south direction, meaning a constant east-west azimuth for the sensor looking directions but a range of across-track incidence angles. As SMAP uses a conical scanning mechanism to map out its swath at a constant 40° incidence angle with spatial resolutions of 3km and 36km for the radar and radiometer respectively, it is necessary to i) normalise the incidence angle of the simulator data, ii) upscale the spatial resolution from 10m to 3km for the radar and 1km to 36km for the radiometer, and iii) confirm that no azimuth effects are expected relative to the conically scanned radar data. Consequently, procedures are being developed and tested using data from a series of target flights undertaken specifically for this purpose. A series of 1km resolution soil moisture maps derived from the radiometer data are also under development, for validation of soil moisture products (radar-only, radar-radiometer and radiometer-only) derived from this simulated SMAP data stream using the SMAP mission algorithms.

5. CONCLUSIONS

An airborne data stream is being developed to simulate that expected from the SMAP mission, both in terms of spatial resolution and temporal repeat. This data set covers a 1-week period in winter, 1-week period in summer and a 3-week period in the spring growing season. A soil moisture product at 1km resolution is also being derived from the passive microwave radiometer observations for use in development and testing of the SMAP mission algorithms for radar-only, radar-radiometer and radiometer-only soil moisture products.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

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