The National Airborne Field Experiment 2006(NAFE'06) Dataset

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1. Introduction

The first dedicated soil moisture satellite, the L-Band Soil Moisture and Ocean Salinity (SMOS) mission, is to be launched in late 2007. It is important that carefully planned and executed field experiments in well instrumented basins be undertaken to provide data for fine tuning of the SMOS L-band passive microwave retrieval approach and its assimilation into operational schemes. The National Airborne Field Experiments (NAFE,) are a series of intensive field experiments conducted in different parts of Australia with the aim to provide airborne and ground data to address these issues. The first campaign was undertaken during November 2005 (NAFE'05) in the Goulburn River catchment.

The second campaign, NAFE'06, was conducted in the Murrumbidgee catchment, in south-eastern Australia, from 28 Oct to 20 Nov 2006. The intent of this experiment was to provide simulated SMOS observations supported by ground measurement of soil moisture and other relevant ground data for i) development of the SMOS retrieval algorithms, ii) developing approaches for downscaling the low resolution data from SMOS to 1km resolution, and iii) testing its assimilation into land surface models for root zone soil moisture retrieval.

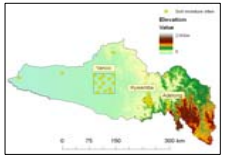
Fig.1 Location of the NAFE'05 and NAFE'06 study areas in South-Eastern Australia

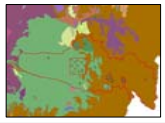
2. Objectives

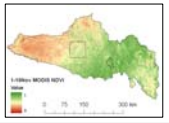
- ❑ Mimic a **SMOS pixel** (40 by 40 km)
- ❑ Provide multi-incidence data for SMOS **algorithm development**
- ❑ Provide simulated SMOS data every 2-3 days for **data assimilation**
- ❑ Provide 1 km surface soil moisture data for verification of **downscaling**
- ❑ Provide mixed pixels for analysis of **water body** effect on SMOS retrieval
- ❑ Provide data for analysis of **vegetation dew** and **surface rock** effect on retrieval

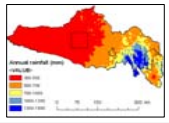
3. The Murrumbidgee Study Area

- CLIMATE: Semi-arid (W) to Alpine (E)
- LANDUSE: Grazing, cropping, intensive irrigation (W), native forest (E)
- MONITORING NETWORK
  - 39 Soil moisture profile stations (0-90cm)
  - 38 Meterological stations
  - 7 Stream gauges









4. The airborne facility

The Airborne Research Australia national facilities Small Environmental Research Aircraft (SERA) was equipped with the recently acquired Polarimetric L-band Multibeam Radiometer (PLMR) and a thermal imager. This new infrastructure allowed for the first time, very high resolution passive microwave (~50m) and land surface skin temperature (~1m) observations to be made across a large area. The aircraft flexibility in terms of payload allowed a range of other supporting data to be collected, including NDVI scanner,11MegaPixel digital camera and Lidar radar.

Fig 2: a) The Diamond ECO-Dimona Small Environmental Research Aircraft (SERA) platform, b) the cockpit with computer display of flight track and sensor output, and c) one of the two multipurpose instrument pods.

5. The NAFE'06 Study Area

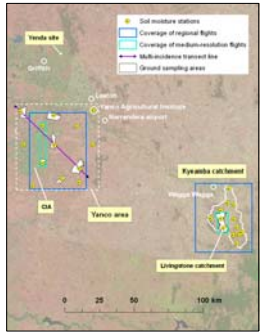


Fig.3. Layout of the NAFE'06 study area. The Boxes indicate the coverage of the experiment flights, while in shaded white the intensive ground sampling areas are indicated

Yanco area 60 by 60 km area, 13 soil moisture sites. 6 farms for intensive soil moisture and ancillary data ground sampling (soil texture, surface roughness. 1/3 of Yanco area is the **Coleambally Irrigation Area (CIA), with rice cropping.**

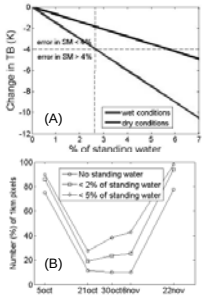


Fig.4. Estimated effect of partial standing water on brigthness temperature (A) and Number of PLMR pixels at 1km resolution affected by 0, 2 and 5% of standing waterin the CIA (B)

Kyeamba catchment 600 km^2 area, 14 soil moisture sites, 1 flux station, 2 stream gauges, network of additional stations and intensive soil moisture ground sampling in the Livingstone subcatchment.

Yenda site is composed of two adjacent vineyard blocks of 14 and 12 ha, 10 soil moisture sites, 3 Bowen ratios, 1 stream gauge. Ground sampling

6. Aircraft Mapping

- ❑ "Regional" PLMR data over 2 SMOS type pixels every 2-3 days;
- ❑ "Multi-incidence" PLMR data over Yanco transect twice a week, alternatively at 6am and 6pm;
- ❑ Specific flights at higher resolution (CIA, Livingstone, Yenda);
- ❑ 2 NDVI scanner, Lidar and digital camera flights (star and end)

Flight Type	Altitude (ft)	PLMR Mode	Coverage	Pixel Spatial Resolution (m) PLMR	TIR	NDVI	Lidar
Regional Yanco	10,000	Mapping	40x55km	1000	20	N/A	N/A
Regional Kyeamba	10,000	Mapping	40x55km	199	20	N/A	N/A
Multi incidence Yanco	5,000	Multi incidence	75x1km	500	10	N/A	N/A
Medium-resolution CIA	2,500	Mapping	5x32km	250	5	N/A	N/A
Medium-resolution Livingstone	2,500	Mapping	7x15km	250	5	N/A	N/A
High-resolution Yanco	500	Mapping	75x1km	50	1	N/A	N/A
High-resolution Yenda	500	Mapping	160.80km	50	1	N/A	N/A
NDVI/Lidar/aerial photos Transect	2,500	N/A	75x1km	N/A	N/A	0.25	0.25
NDVI/Lidar/aerial photos CIA	2,500	N/A	5x32km	N/A	N/A	0.25	0.25

Regional Data

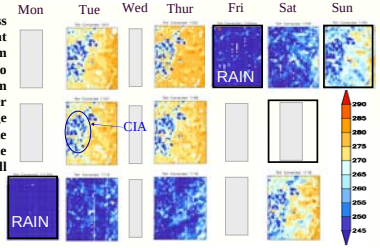


Fig. 5. Brigthness temperature maps at regional scale and 1km resolution over Yanco for the period from October 31 to November 18. The bold edge represent changes to the planned flight schedule because of rainfall conditions

CIA

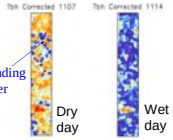


Fig.6. Examples of the 250m resolution brigthness temperature maps over the CIA to analyze the effect of water bodies on soil moisture retrieval

High Resolution

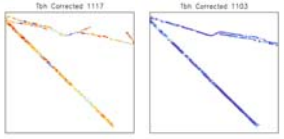


Fig. 7. Example of 50m resolution brigthness temperature map over the Yanco transect for November 17

NDVI

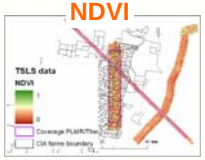
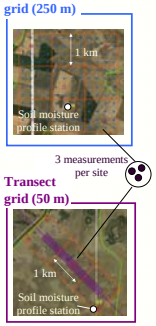


Fig.9. Calculated NDVI from Tri-spectral scanner for the Yanco transect and CIA.

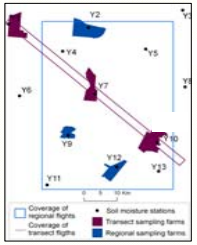
Lidar

Fig. 8. Laser Scanner Image of the Yanco transect area. Image displays surface elevation with 20cm accuracy

7. Soil Moisture Sampling Strategy



- ❑ 3 farms per day
- ❑ 1 team per farm
- ❑ 1 Hydraprobe® Spatial Data Acquisition System (HDAS) per user



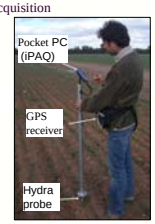
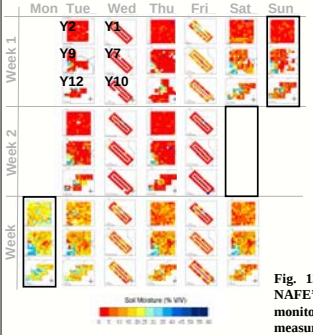


Fig.11. The HDAS acquisition system developed at the University of Melbourne

8. Soil Moisture Data



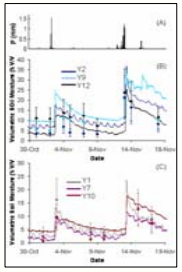


Fig. 12. Top 5cm soil moisture during NAFE'06. Continuous line represent monitoring stations, Dots indicate measured spatial mean and standard deviation for (B) regional and (C) transect ground sampling days.

Participants

Jeffrey Walker, Elizabeth Botha, Gilles Boulet, Jan Balling, Micah Bell, Aaron Berg, Yunming Chen, Richard deJe, Clara Draper, Carmen Gomez, Jorg Hacker, Mohsin Hafee, Dionne Hansen, John Hornbuckle, Ruud Hurkmans, Tom Jackson, Jon Johanson, Jetse Kalma, Yann Kerr, Edward Kim, Vadim Kuzmin, Venkat Lakshmi, Philippe Maisongrande, Lynn McKee, Olivier Merlin, Iliana Mladenova, Peggy O'Neill, Rocco Panciera, Walter Rawls, Steen Savstrup-Kristensen, Victor Shoemark, Neils Skou, Sten Soebjaerg, Greg Summerell, Ryan Teuling, Jessika Toyra, Rodger Young