PLMR+ — Polarimetric L-band Multibeam Radiometer (+ Thermal Imager & Other Instruments)

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A new airborne facility for environmental, hydrologic, atmospheric and oceanic research providing high resolution measurement of soil moisture, temperature and salinity

Introduction

A new national facility for airborne remote sensing of key environmental variables is currently being developed through support of the Australian Research Council, Universities of Melbourne and Newcastle, Airborne Research Australia at Flinders University and James Cook University.

The new instruments will enable high-resolution mapping of near-surface soil moisture, land surface salinity and temperature, and ocean surface salinity and temperature, providing unprecedented detail on surface characteristics critical to our understanding and management of the environment. The small instrument size and weight enables use of a light aircraft as the observing platform, providing the research community with an affordable tool, hitherto unavailable.

The Facility

The facility includes:

- a dual polarisation L-band passive microwave radiometer with 50m resolution at 150m flying height, and
- a thermal infrared imager with 1m resolution at 150m flying height.

These instruments can be flown together with:

- a tri-spectral scanner (NDVI) with 1m resolution at 150m flying height,
- a meteorological package that includes eddy correlation measurements of evapotranspiration, sensible heat and CO_2 fluxes,
- a scanning lidar altimeter with 0.1m vertical and 1m horizontal resolution at 150m flying height for ground/vegetation elevation and structure,
- digital video, and
- high resolution (11 MegaPixel) digital stills.

The Platform

The aircraft platform has the following characteristics:

- payload 294kg,
- typical science payload 120kg,
- cruising speed 25-55m/s or 92-203km/h,
- range 4-8hrs or 800-1500km,
- ceiling 3km or up to 7km with oxygen,
- day or night VFR,
- extended operations over water – special conditions apply, and
- up to 2 crew (pilot/scientist + scientist) or maximum range/payload with 1 crew.

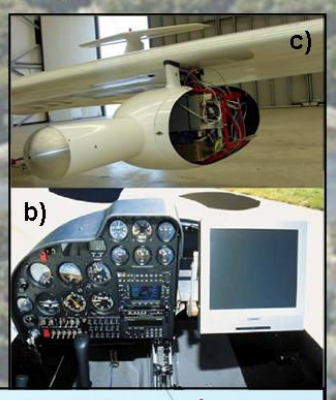

Fig 1: a) The Diamond ECO-Dimona Small Environmental Research Aircraft (SERA) platform, b) the cockpit with computer display of flight track and sensor output, and c) one of the two multipupose instrument pods with the turbulence probe, attitude system and tri-spectral scanner installed.

The PLMR and Thermal Imager

The thermal imager is presently being tested and the PLMR is scheduled for test flights in early 2005. We expect the facility to be available for general use from mid 2005.

The **Polarimetric L-band Multibeam Radiometer** specifications are:

- frequency/bandwidth: 1.413GHz/24MHz,
- V and H polarisations: single receiver w/ polarisation switch,
- 50m resolution data at 150m flying height,
- weight 46kg & size 91.5cm × 91.5cm × 17.25cm,
- NEDT and accuracy better than 1K for an integration time of 0.5s,
- 1K repeatability over 4 hours,
- incidence angles: +/- 7°, +/-21.5°, +/- 38.5° @ pushbroom, and
- rotatable by 90° (so can be configured to look fore/aft).

The **FLIRTS ThermaCam S60** thermal infrared imager specifications are:

- spectral range 7.5 to 13μm,
- 1m resolution data at 150m flying height,
- weight 2kg & size 10cm × 12cm × 22cm,
- accuracy +/- 2 °C or +/-2% of reading,
- thermal sensitivity 0.08 °C, and
- 80° × 60° FOV lens with 1.3mrad IFOV.

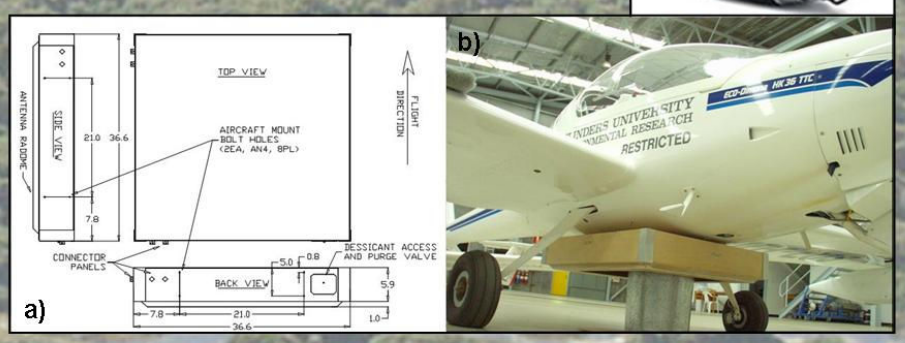

Fig 2: a) Design drawings for PLMR, b) a mockup of PLMR positioned under the SERA platform, and c) the ThermaCam S60.

The Science Questions

This infrastructure, which can be packed into a shipping container and used anywhere in the world, will be able to address the following science questions for soil moisture, soil salinity and ocean salinity:

- algorithm validation and development including multi-angular response,
- satellite validation – AMSR-E, SMOS, HYDROS, Aquarius etc,
- patterns, issues of scale and downscaling, and
- relationship with a range of other environmental variables.

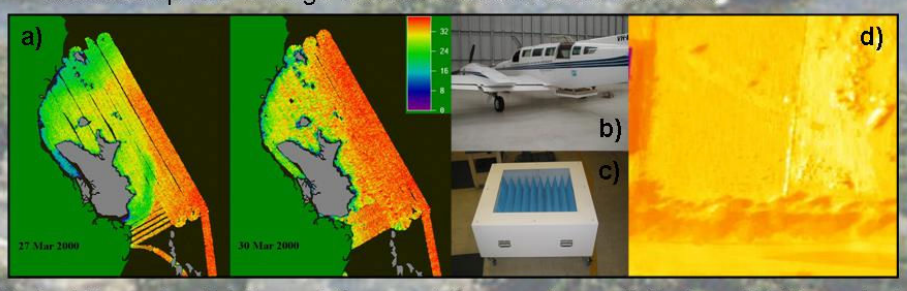

Fig 3: a) Example of high resolution coastal sea surface salinity from SLFMR, a single polarisation forerunner of PLMR, b) the old and heavy SLFMR under a Cessna 404, c) PLMR hot point calibration target, and d) a thermal map from the ThermaCam S60.