N95- 23948

# AIRSAR DEPLOYMENT IN AUSTRALIA, SEPTEMBER 1993: MANAGEMENT AND OBJECTIVES


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## 1. INTRODUCTION

Past co-operation between the NASA Earth science and Applications Division and the CSIRO and Australian university researchers has led to a number of mutually beneficial activities. These include the deployment of the C-130 aircraft with TIMS, AIS, and NS001 sensors in Australia in 1985; collaboration between scientists from the USA and Australia in soils research whcih has extended for the past decade; and in the development of imaging spectroscopy where CSIRO and NASA have worked closely together and regularly exchanged visiting scientists. In may this year TIMS was flown in eastern Australia on board a CSIRO-owned aircraft together with a CSIRO-designed $CO_2$ laser spectrometer.

The Science Investigation Team for the Shuttle Imaging Radar (SIRC-C) Program includes one Australian Principal Investigator and ten Australian co-investigators who will work on nine projects related to studying land and near-shore surfaces after the Shuttle flight scheduled for April 1994.

This long-term continued joint collaboration was progressed further with the deployment of AIRSAR downunder in September 1993. During a five week period, the DC-8 aircraft flew in all Australian states and collected data from some 65 individual test sites (Figure 1).

## 2. MANAGEMENT

The deployment preparations were directed by a management team comprising representatives of the CSIRO Office of Space Science Applications (COSSA); CSIRO Division of Exploration and mining; the University of New South Wales and the Australian Mining Industry Research Association, with NASA HQ and COSSA acting as the signatories for the mission.

In April 1993 a five-day Radar Image Processing and Applications workshop was held in Sydney for the participating investigators. In addition to presenting a theoretical background to the processing of multi-polarised data sets, the workshop sought to outline SAR calibration and ground sampling procedures; evaluate current applications of SAR in geology, vegetation, soils and soil moisture and sea-state investigations; examine the interferometric mode of SAR for surface mapping and to provide participants with hands on experience in basic image processing of radar data. Guest speakers and workshop leaders included Craig Dobson from the University of Michigan, Anthony Freeman from JPL and Fred Kruse from the University of Colorado.

During the deployment data was acquired for:

i) NASA/Australian collaborative projects;

ii) SIR-C calibration investigations;

iii) specific CSIRO-based research programs; and

iv) a series of individual investigations for government agencies and private sector sponsors.

Towards the end of 1994 an evaluation workshop will be held to discuss the results of the mission and allow individual investigators to present their findings.

## 3. SCIENCE OBJECTIVES

Radar remote sensing technology is comparatively untried, unresearched and unproven in Australian terrains. SIR-A and SIR-B data in the early 1980's did provide limited opportunities to investigate and map selected geological and vegetational patterns (Richards et al. 1987).

One of the major objectives of this deployment is to determine the contribution of AIRSAR and TOPSAR datasets to landform determination and structural mapping in regolith dominated terrains. One CSIRO research project sponsored by mineral exploration companies has the following aims:

i) To differentiate surficial regolith materials on the basis of their surface roughness and dielectric characteristics, especially weathered rock outcrop, lag gravels, soils and vegetation in both mafic and felsic terrains, and to quantitatively analyse the radar frequency information and the polarimetric signatures that describe each land component. Information describing these surface variables should allow recognition of the three fundamental regimes of a weathered landscape, that is residual, erosional and depositional. It is anticipated that the processed radar data will provide significant information concerning the degree of weathering, wind and/or water erosion processes, and on interpretation of patterns of sedimentation and relative disposition within the dispositional units;

ii) To display subtle geomorphological features (micro-relief) involving relief escarpments, drainage and various landforms which may be surface indicators of subsurface geological structures of exploration significance;

iii) To investigate the capability of polarimetric radar data to map sub-surface geometries and subtle hidden structures in areas of thinly-covered, gently dipping strata;

iv) To determine the optimum viewing and imaging parameters for future use of satellite and airborne radars for regolith-landform and geological mapping in the Australian semi-arid and arid zones; and

v) To generate high resolution digital elevation models of the study areas using TOPSAR radar interferometry. The models will be used to geometrically rectify the AIRSAR polarimetric and ERS-1 SAR data respectively and to assist definition of landform regimes, regolith characteristics, sources of materials and local regolith stratigraphy. These topographic datasets will be registered to other remotely-sensed, geological, geophysical and geochemical datasets and used for fault mapping and identification, terrain analysis and terrain processes analysis, and establishing geochemical dispersion processes and patterns.

Another major objective includes investigating the use of radar for vegetation mapping in forests, woodlands and rangeland environments and for testing models developed to account for the full interaction of backscatter from different tree morphologies over diffuse ground. A number of investigations are centred in the Northern Territory extending along a transect from near Darwin in the north to Katherine in the south. This transect provides a climatically determined gradient which brings a transition from wetlands, tropical forests and woodlands, savanna grassland to semi-arid and deserts. The accurate discrimination of these biomes and their boundary effects are seen as crucial to the spatial modelling of ecosystems at both a local and a global scale.

Land degradation processes associated with salinity and altered groundwater conditions will be studied in a number of sites throughout Australia. One site, Kerang in Central Victoria, will be used as a major calibration site for the forthcoming SIR-C mission as well as for hydrogeology.

A joint NASA/Australia project in the Great Sandy Desert region of Western Australia will use both AIRSAR and TOPSAR data for detailed reconstruction of Australia's palaeoclimate and palaeohydrology during the Late Quaternary period. It is anticipated that these datasets will assist in:

* mapping ancient shoreline ridges defining the extent and height of former lakes;

* mapping lacustrine units and distinct flood sedimentation units such as slackwater deposits; and

* identifying levee systems of prior streams and the presence of strandline deposits within dunal corridors.

TOPSAR will be crucial for determining local slope, reconstructing the drainage network and modelling flood estimation and extent, surfrace run-off and landform development.

## 4. CONCLUSIONS

The Australia deployment has provided a core group of Australian researchers an exciting opportunity to exploit the unique capabilities of both AIRSAR and TOPSAR datasets. The benefits of radar remote sensing technology to earth system sciences now depends on the regular availability of these precision datasets from operational spaceborne systems.

## 5. REFERENCES

Richards, J.A., B.C. Forster, A.K. Milne, J.C. Trinder, and G.R. Taylor, 1987, "Australian multi-experimental assessment of SIR-B (AMAS). Final Report to NASA and JPL, March 1987," pp. 11 plus appendices.

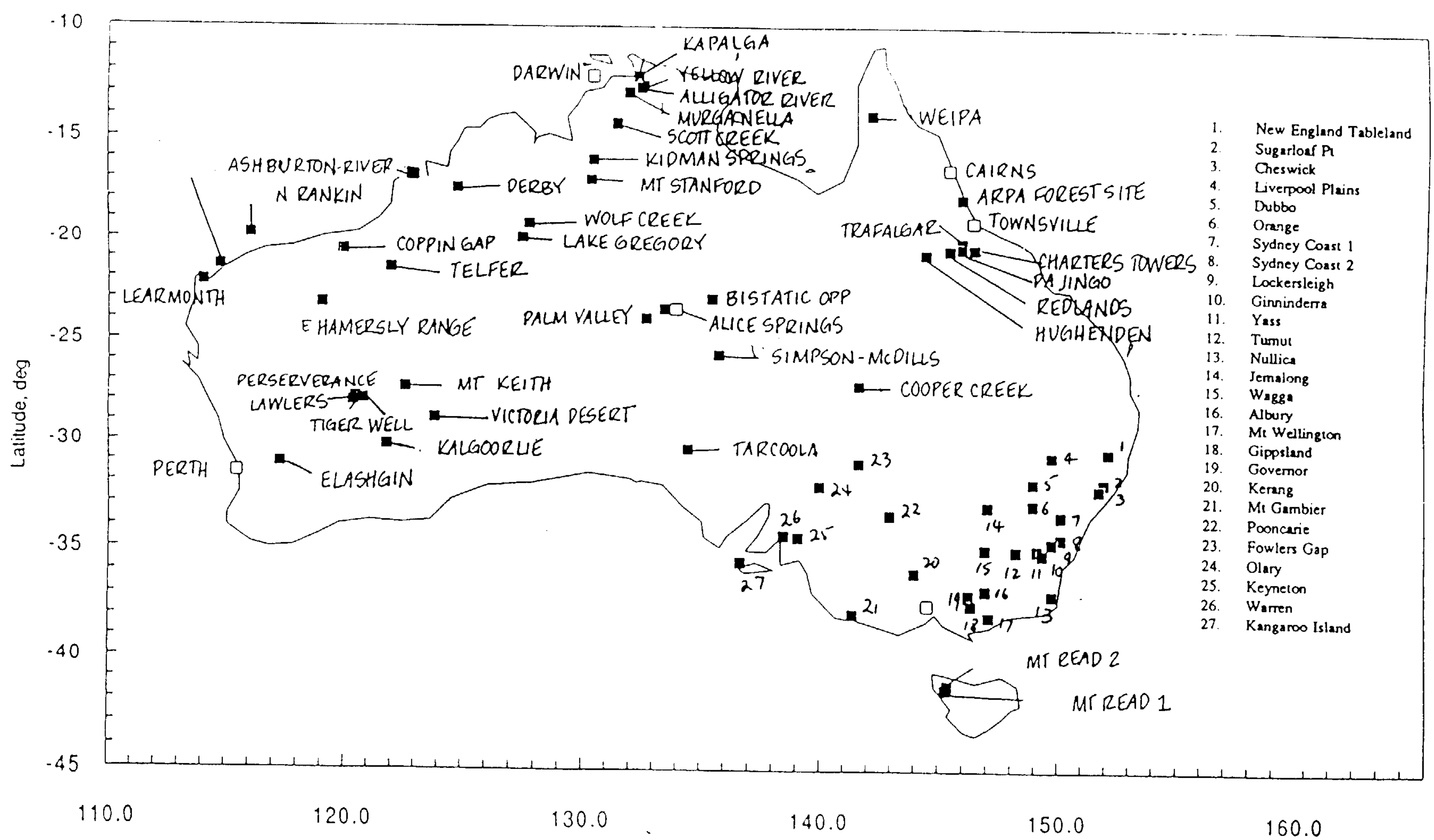


Figure 1. Location of AIRSAR Test Sites for the Australian Deployment, September 1993. Sites in South-eastern Australia.

Site names for South-eastern Australia are listed at the side.