

A bibliography of research into satellite remote sensing of land, sea and atmosphere conducted in Western Australia

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Background to the bibliography

This bibliography on satellite and related remote sensing research in Western Australia covers both geological mapping for exploration and the monitoring of land, water, oceans and atmosphere. Publications related to exploration commissioned by the private sector and not publicly available have not been cited. The number of publications over time (Figure 1) reveals progressive development with alternate year peaks in recent years associated with the biennial Australasian Remote Sensing Conference.

The development of satellite remote sensing in Western Australia has been driven by the need of a small population to explore and manage efficiently a large and complex land surface. Western Australia's population of 1.7 million occupies a vast land area of 253 million hectares, with over 12,000 km of coastline and 40 million ha of continental shelf which covers part of Australia's exclusive

economic zone. The economy is dependent on mining and other primary industries, while environmental quality requires preservation of vegetative cover for maintaining bio-diversity and avoidance of desertification. Most of the land (93%) is under the ownership of the State. This State-owned land is allocated to conservation and timber extraction (17%), arid deserts, road reserves and foreshores (36%), pastoral grazing (37%), mining 3%, *etc.* Freehold land is only 7% and is used for agriculture (6%) and urban settlement (1%).

Unfortunately, 167 years of European settlement has caused much of the land, rivers and coastal waters to suffer degradation from bush fires, salinisation, erosion, disease, acidification, feral animals, eutrophication, siltation, pollution and resource depletion. Such degradation ranges from minimal to severe, but its actual extent and rate of spread is often not known because of the difficulty of monitoring the trends and changes over vast

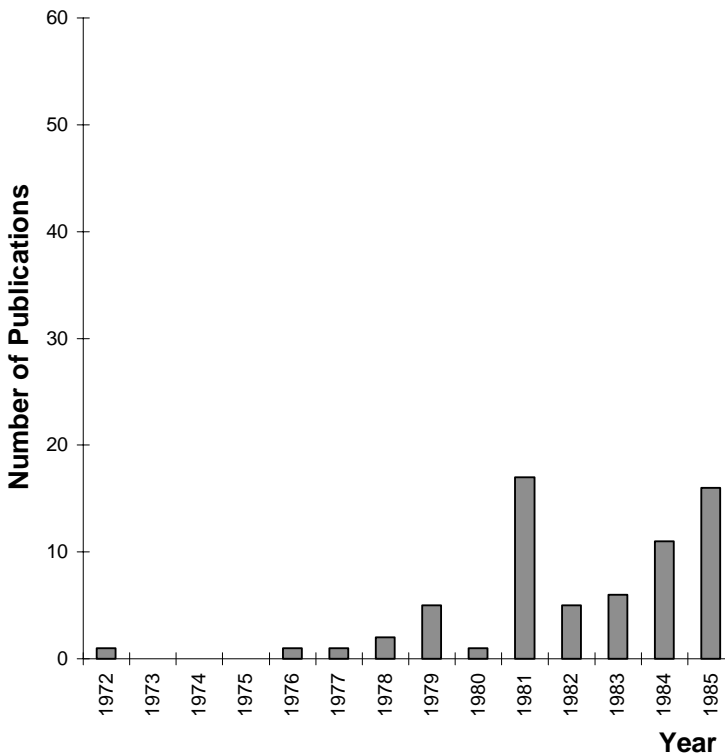


Figure 1. Progress of publications in remote sensing in Western Australia

areas. Absence of accurate information results in the problems being poorly managed. Therefore the Government in Western Australia needs access to comprehensive information on trends in land, water, atmosphere and coastal conditions to fulfill its environmental responsibilities. On land there is evidence of increasing use being made of satellite remote sensing to provide this information. Over the vast expanse of ocean there is evidence of use by marine scientists of satellite remote sensing for bathymetry, marine habitat mapping, estuarine water quality, ocean circulation and thermal structure, as well as by the fishing industry in fisheries operations. To maintain the continued discovery of new world class ore deposits under WA's deeply weathered regolith, new airborne geophysical and satellite remote sensing exploration techniques continue to be developed.

Commonwealth and State Government initiatives to capture the benefits of satellite remote sensing in Western Australia

The first operational earth resources satellite Landsat-1 was launched in 1971 and CSIRO formed a remote sensing group in Western Australia in 1974. CSIRO's initial emphasis was on spectral radiometry measurements in the visible and near infrared wavebands, which helped provide the bio-physical basis of multi-spectral remote sensing. Recognising the importance of multi-spectral data for mapping land surface features not captured by use of air photography, the WA Department of Lands and Surveys appointed remote sensing officers in 1975, who in 1983 formed the Remote Sensing Applications Centre (RSAC) within the Department of Lands and Surveys (later named Department of Land Administration, DOLA). Formation of RSAC focused remote sensing skills thus providing a resource base for the widespread use of this technology by a large number of Government agencies.

In the mid 1980s the CSIRO remote sensing group expanded as more disciplines saw research opportunities. Statisticians developed statistical classification of multi-spectral satellite data for mapping different land cover types and conditions. Geologists developed new satellite based methods to assist in geological mapping. Physicists applied space borne techniques for measurement of sea surface temperature and land surface evaporation. Biologists used satellites to measure biophysical variables from space such as biomass, crop yields and algal blooms. In contrast to the State's focus of its remote sensing efforts within DOLA, CSIRO's multi-disciplinary group is distributed across several Divisions and Institutes.

Universities

By the mid 1970s the first tertiary courses in remote sensing were being taught at the Western Australian Institute of Technology (later Curtin University of Technology) in the Schools of Electrical Engineering, Applied Physics, and Surveying and Land Information with assistance from CSIRO. One of the outcomes of this interaction was the development of an L band receiving station for the NOAA satellite. The first images were received in 1981, using a World War 2 bofors gun mount and oscilloscope to guide the receiving dish. This system was upgraded in 1987 and operations taken over by the WA Satellite Technology and Applications Consortium (WASTAC) of the Bureau of Meteorology, DOLA, CSIRO and Curtin University of Technology. Teaching of tertiary courses in satellite remote sensing now occurs in all WA Universities and at the College of Technical and Further Education (TAFE).

The Leeuwin Centre for Earth Sensing Technologies

Successful application of satellite remote sensing requires a diversity of skills. With scientists and funds scarce, early development of remote sensing in WA was marked by close collaboration between the different remote sensing groups within CSIRO, Curtin University, DOLA, Bureau of Meteorology and the private sector. In 1993, the importance of this collaboration was officially recognised when the Leeuwin Centre for Earth Sensing Technologies was built for \$5 million by the State Government on the CSIRO Floreat campus. The building co-located CSIRO's Remote Sensing Group, DOLA's Remote Sensing Services, Curtin University's Department of Applied Physics Remote Sensing Group, TAFE and World Geoscience Corporation, the largest airborne geophysical exploration company in the world.

The bibliography of papers, reports, theses and conference presentations listed here reveals a steady development in the application of satellite remote sensing to exploration and the management of Western Australia's renewable resources. The Leeuwin Centre brings together for the first time in Australia the three technologies of airborne geophysics, satellite remote sensing and geographic information systems. Co-location offers the opportunities to expand greatly the applications of satellite remote sensing through the synergy of the participating groups. After 20 years of development, WA now has for the first time the capability to map and monitor major environmental changes occurring in salinity, water quality, land productivity and native vegetation and use this information to enrol community support to tackle these problems. The challenge for these remote sensing groups is to create the synergy which will realise the full potential of the Leeuwin Centre and capture the benefits from the next generation of satellite sensors and associated technologies.

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