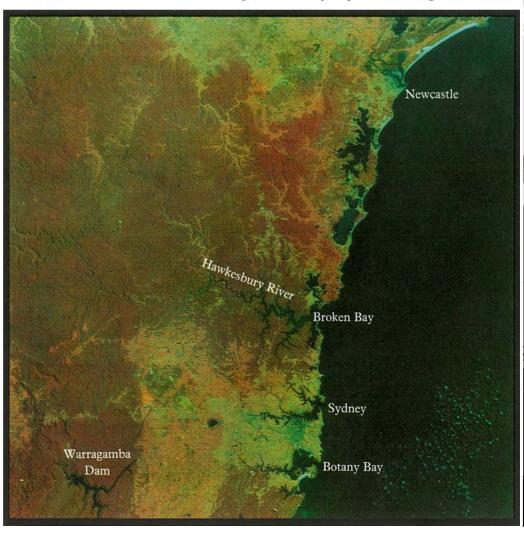
## What can satellites see?

Many applications have been suggested for satellites that can look down on the earth's surface and tell scientists what's below. Just a few environmentally useful ones are:

- ► water- and air-pollution mapping
- ➤ monitoring the health of natural vegetation and crops
- ► assessing the effects of bushfires
- ➤ monitoring the spread of cities and towns, open-cut mining, and other encroachments on the countryside

The first experimental U.S. Earth Resources Technology Satellite, ERTS-1, radioed back photographs taken in the visible and infra-red regions of the spectrum from 1972 to last year. Scientists in many countries, including Australia, received photographs and are assessing their usefulness. A project now under way in

An ERTS photo of the Sydney-Newcastle region.



America will draw these assessments together and attempt to work out, in costbenefit terms, how effective ERTS-1 has been and in what ways future satellites could improve on it.

The satellite's orbit takes it over almost the entire earth. Also it regularly retraces its tracks, which has enabled scientists to keep a watch on the ways the things they are interested in change with time. ERTS-1 orbits the earth 14 times a day. It takes about 10 minutes to cross Australia from north to south, and appears over any one point once every 18 days. Each picture it has sent back covers an area about 160 km square, and the smallest features that can be picked out are about 80 metres square.

The usefulness of an earth resources satellite depends on its ability to detect differences between the intensities of radiation of various wavelengths reflected from different surfaces. Therefore it is important to know what are the smallest differences that it can consistently detect. Also, to be able to interpret pictures from a satellite accurately, the interpreters need to know what variations can exist in the radiation reflected from essentially uniform surfaces.

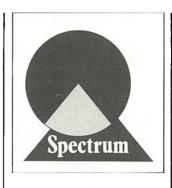
Research by Dr Mike Duggin and colleagues from the CSIRO Division of Mineral Physics in Sydney is helping answer these questions.

A major factor affecting a satellite's ability to show differences between surfaces is variations that occur in the amounts of radiation passing through the atmosphere. In extensive measurements of radiation reaching the ground on clear days near Sydney and Hobart, the scientists have recorded variations, due to changing atmospheric conditions, of up to about 10% during a day. A typical figure is 5%. These variations

are caused mainly by changes in concentrations of water vapour and particles in the air, and differ with different wavelengths.

Differences in reflection over basically uniform areas of sandstone near Sydney have also been measured. The scientists have found that things such as the slope of a surface, weathering, and moisture content can have significant effects. A typical variation figure is 10%.

The researchers plan to make further atmospheric measurements in outback areas of South Australia and New South Wales, to see if effects on transmission differ in dry, inland areas. They also



plan to measure variations in reflection over crops.

Information of the types they are gathering is essential for sorting out proposals for using satellite pictures that will work from those that won't. For example, somebody may want to map different types of vegetation in an area. If reflection from two species differs by 10% and atmospheric and surface differences cause variations of up to 15%, then the project isn't a starter.

There seems little doubt that satellites like ERTS-1 will prove valuable in many applications. However, only a very small proportion of the world-wide research effort associated with the satellite is going into basic studies like those of Dr Duggin and his colleagues. It is work that has to be done if people are going to be able to predict confidently in advance whether ideas that they have for using satellite photos will prove practicable. The alternative is a wasteful process of trial and error.

On the natural limitations of target differentiation by means of spectral discrimination techniques. M. J. Duggin. CSIRO Minerals Research Laboratories, Investigation Report No. 104, 1974. CSIRO and the Australian programme for the Earth Resources Technology Satellite (ERTS). M. J. Duggin. CSIRO Minerals Research Laboratories, Investigation Report No. 95, 1972.

