SATCHELLE SOUNCING ACTIVITIES
AT THE
WESTERN AUSTRALIAN INSTITUTE OF TECHNOLOGY

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1. INTRODUCTION

This presentation outlines the scope and progress achieved on a number of satellite sounding projects at the Western Australian Institute of Technology in Perth.

2. TROPICAL CYCLONE RESEARCH

The application of TOVS data to the study of tropical cyclones off the NW coast has been in progress for the last 3 years. The MSU channels are used to study the upper level warming. HIRS channels are employed to define the environment away from the cyclone. The AVHRR channels provide cloud top temperatures and identify regions of high sea surface temperature. The latter and the associated high moisture flux are important precursors for tropical cyclone intensification over the ocean.

This work which is conducted jointly with Dr. A. J. Prata of the CSIRO Division of Groundwater Research and is described in more detail in a companion paper in this volume.

The efforts contributed by Mr. R. Hille and Mr. L. van Burgel to this project are gratefully acknowledged.

3. VAX-BASED TOVS PROCESSING

The ITPP version III has been installed on VAX750. Apart from temperature and moisture profiling we have been providing data to permit the production of atmospheric refractive index fluctuations. These are employed in microwave ray tracing and in studying radar beam propagation.

Some of this work has been conducted over the Southern Ocean where in situ surface data are non-existent. It is important to reinforce the conclusions of Smith et al. (1985) that the physical retrieval scheme in ITPP-III will produce large RMS errors if surface data (in situ or first guess fields) are not employed. Errors of some 4°C at the surface may affect the temperature profile up to the 300mB region.

In Figure 1 we provide an example of a profile retrieved without surface data from NOAA-9 orbit 6331 over Garden Island (33°S, 115°.7E) near Perth, Western Australia on March 6, 1986. The retrieval (at
0720 GMT) is compared to a radiosonde released at Garden Island at 0650 GMT. Serious problems are evident in the retrieval.

The afternoon pass in a coastal environment in summertime-like conditions poses particular problems. For example, the land/sea mix, possible afternoon sea breeze (depth ~ 500m), a temperature inversion above the sea breeze, possible superadiabatic lapse rates in the boundary layer over the land surface, and warm offshore flow of dry continental air overlaying the sea breeze cell, and finally convection and production of small cumulus cells in the coastal region.

The assistance of Mr. J. E. Davies in processing of TOVS data is greatly appreciated.

4. OCEAN CRUISE DATA

In March-April, 1985 an ocean cruise was undertaken from Perth to Broome to Indonesia and return.

Data recorded on this cruise included supporting sets of sea surface temperature (SST) measurements from a radiometer, bucket samples and a towed thermistor string. Additionally we have processed AVHRR data over the accessible cruise legs for SST's.

Ship meteorological data included air temperature, dew point temperature and surface winds. Radiosondes were releases from the ship and were selected to be as near as possible coincident with satellite overpass times.

Presently, we are using the AVHRR SST's as surface data input to the ITTP III to recover improved temperature profiles for comparison with sonde data.

An additional objective is verification of the performance of SST algorithms in the high water vapour regimes in the tropics.

This work is being undertaken jointly with Dr. J. Penrose, WAIT.

5. CLOUD TOP HEIGHTS

Mid-1986 we commenced a programme of cloud top height verification using the TOVS multispectral CO$_2$ technique and the WAIT Nd:YAG LIDAR.

The emphasis of this work is directed at thin cirrus in that these heights are frequently underestimated due to transmitted upwelling radiation indicating an apparently warmer cloud than its true temperature.

A LIDAR is able to detect cirrus cloud heights with an accuracy of order 7 meters. If the cirrus is thin, it is possible without difficulty to detect multiple layers.

This work is being undertaken jointly with Dr. S. Young, WAIT.
6. OZONE MEASUREMENTS

WAIT is one of the stations in the Global Aerosol Network established by the WMO. Dobson measurements taken at Perth are corrected for aerosol extinction as measured with the WAIT stratospheric LIDAR.

Using the ITTPP III, we intend routinely producing regional ozone estimates from the 9.6 micron channel and calibrating these products against the corrected Dobson measurements taken at Perth.

Shortly, we plan to produce superior ozone measurements from the SBUV instrument on the NOAA platform.

Apart from studying ozone fluctuations on a synoptic scale, we have been studying ozone anomalies arising from tropospheric folding events associated with frontal systems. These events are identified from warming in the troposphere coupled with an anomalously high ozone burden brought down from the stratosphere.

The LIDAR aerosol measurements are undertaken as a joint project with Dr. S. Young, WAIT.

7. PC-BASED PROCESSING

WAIT and the CSIRO Division of Groundwater Research have initiated a joint programme in the development of PC-based processing of satellite data.

Activities embrace TOVS processing, application of MSU to tropical cyclones and AVHRR processing. Transmitting data to remote users is an additional target.

Products from the above work will be used in a training programme in satellite meteorology also being developed on PC systems.

8. THE WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM (WASTAC)

Since 1980, HRPT data has been received on the WAIT campus using a facility developed jointly by WAIT and CSIRO. This installation is to be upgraded in early 1987 by installation of new reception equipment.

The new facility is being purchased and managed by a Consortium comprising WAIT, CSIRO Division of Groundwater Research, the Bureau of Meteorology and the WA Department of Land Administration. Data from the facility will be put into a permanent archive along with HRPT data archived on the older-facility.

9. AN AUSTRALIAN GEOSTATIONARY MET. AND OCEAN INSTRUMENT

In 1985 Australia's first geostationary satellites went into orbit. These were essentially communication satellites. Consideration of new platform (AUSSAT-II) for the mid-1990's is in progress.
Present plans have considered both imaging and sounding capabilities. A 0.6 meter diameter mirror, 35 spectral channels with a 1-2 km footprint are being evaluated.

Products derivable from the instrument which have been suggested include:

- temperature and moisture soundings;
- cloud height/cloud drift winds;
- low level water vapour/water vapour drift winds;
- ozone;
- near surface temperature and moisture soundings from superwindow channels;
- vegetation/land applications;
- multichannel SST's;
- ocean colour;
- high resolution interferometric soundings.

Development is at an early stage and it might be that international collaboration will be desirable and necessary if such a project is to eventuate.

10. CONCLUSIONS AND ACKNOWLEDGEMENTS

A range of projects underway are at WAIT using TOVS data have been described. Some of these activities benefit from using other data sources including AVHRR, LIDAR, etc. Much of this work has progressed only through the excellent efforts of colleagues with whom I have collaborated.

Support for this research has come from a number of sources including WAIT, the Marine Sciences and Technologies Grants Scheme, the Defense Research Centre (South Australia) and the Bureau of Meteorology.

The HRPT data used has been recorded by the Satellite Technology Unit within the WAIT Satellite Technology and Remote Sensing Centre. The efforts of Dr. D. Myers, Head of the Satellite Technology Unit are appreciated.

11. REFERENCES


04/ITSC/03
Problems with the retreival are evident.

Figure 1. Satellite and radiosonde returnals of temperature and dew point for a coastal environment in summer-like conditions.

Temperature °C

30 20 10 0 -10 -20

Pressure mB

1000 850 700 600 500 400 300

Garden Island
SONDE 06:50 GMT
SAT. 07:20 GMT
March 6, 1986
NOAA/A 6349 150