

## ***Darwin: The Third DOE ARM TWP ARCS Site***

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### **1. Introduction**

The United States Department of Energy's (DOE) Atmospheric Radiation Measurement (ARM) Program began operations in its Tropical Western Pacific (TWP) locale in October 1996 when the first Atmospheric Radiation and Cloud Station (ARCS) began collecting data on Manus Island in Papua New Guinea (PNG). See Fig. 1.



*Fig. 1. TWP ARCS sites at Manus, Nauru and Darwin.*

Two years later, in November 1998, a second ARCS began operations on the island of Nauru in the Central Pacific. Now a third ARCS has begun collecting data in Darwin, Australia. The Manus, Nauru, and Darwin sites are operated through collaborative agreements with the PNG National Weather Service, The Nauru Department of Industry and Economic Development (IED), and the Australian Bureau of Meteorology's (BOM) Special Services Unit (SSU) respectively. All ARM TWP activities in the region are coordinated with the South Pacific Regional Environment Programme (SPREP) based in Apia, Samoa. The Darwin ARM site and its role in the ARM TWP Program are discussed below.

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## 2. Site Selection

The Darwin ARM site was chosen for both scientific and economic reasons. A location was required that would contribute to the scientific goal of the ARM TWP Program and where an ARCS could be installed and operated within budget constraints. A request for proposals was published. A competitive selection process was conducted and the Australian Bureau of Meteorology's Special Services Unit was awarded the contract. This contract calls for technical support for the Manus and Nauru sites, the operation of the Darwin site, and scientific collaboration.

The Darwin site affords the study of climate regimes that are of specific interest for ARM atmospheric radiation and cloud research. On a yearly basis, this area experiences a dry continental regime, a monsoonal regime, and the transitional periods in between that reflect abundant convective cloudiness. The Darwin site is imbedded in an existing measurement network, and includes the offering to ARM and the scientific community many related and beneficial ancillary measurements. In addition, the Darwin enterprise is associated with existing scientific programs of the Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organization (CSIRO), a rich research collaboration beneficial to all programs involved.

## 3. The Darwin ARM Site

The Darwin ARM site is located at 12.425°S, 130.891°E adjacent to the BOM Meteorology Office near the Darwin International Airport (Fig. 2). The center of the site



Fig. 2. Location of Darwin ARCS Site

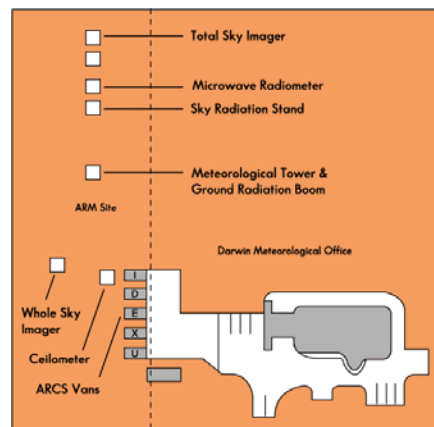


Fig. 3. Darwin Site Layout.

is at an elevation of 29.9m MSL. Site preparation began in September 2001 and the infrastructure was completed in January 2002. Instruments and the data system were installed during February and March. The Darwin site began formal operations on 1 April 2002.

As shown in the site layout of Fig. 3, the site consisted of a fenced area 50 by 180 meters. Within this perimeter are an instrument field, the ARCS vans, and a temporary operations office. A permanent operations office and workshop will be added in the future. Figure 4 shows the Darwin ARM site instrument field.



*Fig. 4. Darwin Instrument Field*

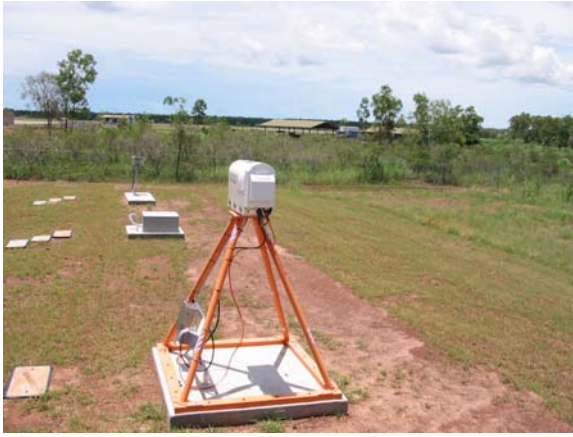
The site hosts the same standard set of ARCS instruments as on Manus and Nauru (See Appendix). Nauru has an Atmospheric Emitted Radiance Interferometer (AERI), a CIMEL Sunphotometer, and a Total Sky Imager (TSI) that are not implemented at Manus and Darwin. A TSI will be installed at Manus and Darwin in the future. A Balloon-Borne Sounding System (BBSS) is not deployed at Darwin as that data will be obtained from the BOM Observing Station next door to the site. Figures 5-8 show some of the instrument installations at Darwin.



*Fig. 5. ARCS Vans and Cloud Radar*



*Fig. 6. Sky Radiation Stand*



*Fig. 7. Microwave Radiometer*



*Fig. 8. Whole Sky Imager*

#### **4. Site Operations**

The Darwin site has three main functions: (1) to collect scientific data, (2) to serve as a base for maintenance of the Manus and Nauru sites, and (3) to serve as a source of ready instrument spares for the Manus and Nauru sites. A team of BOM technicians operates and maintains the site to insure a continuous flow of data, in addition to providing routine and corrective maintenance for the Manus and Nauru sites. The team's location at Darwin makes for more efficient maintenance of the other two TWP sites than could be accomplished from the United States. Instruments at Darwin are used to replace malfunctioning ones on Manus and Nauru. The broken instruments are then repaired and put back on line in Darwin. The Australian Bureau of Meteorology's Special Services Unit in Melbourne manages the Australian component of this collaborative effort.

#### **5. Scientific Oversight and Collaboration**

Our collaborative contract also provides for scientific oversight and collaboration. The Bureau of Meteorology Research Center (BMRC) in Melbourne is responsible for this component in collaboration with CSIRO. They will work closely with the TWP Site Scientist and TWP Program Offices to insure data quality, coordinate collaborative research, and the sharing of data. This effort is just getting underway. These activities will increase now that the Darwin ARM site is operational.

#### **6. Summary**

The DOE ARM Program's Tropical Western Pacific locale now has three Atmospheric Radiation and Cloud Stations collecting data. These facilities at Manus, Nauru and Darwin complete the compliment of measurement sites planned for the TWP. Operations of these sites will continue to be managed by the TWP Office at Los Alamos National Laboratory. The Australian BOM will provide the technical maintenance of all three sites as well as the day-to-day operation of the Darwin site. The collaborative arrangement with the BOM has made it possible to establish a third site in the TWP. It also provides for cost effective operations of all the sites.

## Acknowledgement

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## Appendix.

Table 1. ARCS Measurements and Instruments

<b><u>Measurement</u></b>	<b><u>Instrument</u></b>
<b>Surface Radiation Balance</b>	<ul style="list-style-type: none"> <li>♦ Up- and down-looking pyranometers and pyrgeometers</li> <li>♦ Sun-shaded pyranometer and pyrgeometer using solar tracker</li> <li>♦ Normal incidence pyrhelimeter</li> <li>♦ Up- and down-looking 9-11<math>\mu</math>m narrow-field-of-view radiometers</li> <li>♦ UV-B hemispheric radiometer</li> <li>♦ Broadband (solar and infrared) net radiometer</li> </ul>
<b>Surface Meteorology</b>	<ul style="list-style-type: none"> <li>♦ Temperature and relative humidity sensor</li> <li>♦ Barometer</li> <li>♦ Optical rain gauge</li> <li>♦ Propeller vane anemometer</li> <li>♦ Sea surface temperature measurement<sup>2</sup></li> </ul>
<b>Cloud Properties</b>	<ul style="list-style-type: none"> <li>♦ Cloud lidar (523 nm)</li> <li>♦ Ceilometer (7.5 km maximum range)</li> <li>♦ 35 GHz cloud radar</li> <li>♦ Whole Sky Imager</li> <li>♦ Total Sky Imager<sup>1</sup></li> </ul>
<b>Aerosol Optical Depth</b>	<ul style="list-style-type: none"> <li>♦ Multi-filter rotating shadow band radiometer (total, direct, and diffuse irradiance in six 10-nm channels)</li> <li>♦ Sunphotometer<sup>2</sup></li> </ul>
<b>Column Water</b>	<ul style="list-style-type: none"> <li>♦ Dual channel (23.8 and 31.4 GHz) microwave radiometer</li> </ul>
<b>Vertical Structure of Atmosphere</b>	<ul style="list-style-type: none"> <li>♦ Rawinsonde</li> <li>♦ 915-MHz wind profiler<sup>3</sup></li> </ul>
<b>Atmospheric Emitted Radiation</b>	<ul style="list-style-type: none"> <li>♦ Atmospheric Emitted Radiance Interferometer<sup>2</sup></li> </ul>

<sup>1</sup> – Currently at Nauru only; to be installed at Manus and Darwin in the future.

<sup>2</sup> – Nauru only

<sup>3</sup> – Operated in collaboration with NOAA's Aeronomy Lab