

Nauru: The Second ARM Tropical Western Pacific Site

*W. E. Clements, F. J. Barnes, and L. Jones
ARM Tropical Western Pacific Program Office
University of California
Los Alamos National Laboratory
Los Alamos, New Mexico*

*M. Ivey
Sandia National Laboratories
Livermore, California*

*A. Koontz
Pacific Northwest National Laboratory
Richland, Washington*

*T. P. Ackerman and J. H. Mather
The Pennsylvania State University
University Park, Pennsylvania*

*P. Lefale
South Pacific Regional Environmental Programme
Apia, Western Samoa*

*A. Pitcher and J. Cain
Nauru Department of Island Development and
Industry
Nauru*

Introduction

The U.S. Department of Energy's Atmospheric Radiation^(a) Measurement (ARM) Program was created in 1989 as part of the U.S. Global Change Research Program to improve the treatment of atmospheric radiative and cloud processes in computer models used to predict climate change. The overall goal of the ARM Program is to develop and test parameterizations of important atmospheric processes, particularly cloud and radiative processes, for use in atmospheric models. This goal is being achieved through a combination of field measurements and modeling studies. Three primary locales were chosen for extensive field measurement facilities. These are the Southern Great Plains (SGP) of the United States, the Tropical Western Pacific (TWP), and the North Slope of Alaska and adjacent Arctic Ocean (NSA/AAO).

In the TWP locale, ARM is installing an Atmospheric Radiation and Cloud Station (ARCS) at three sites (Figure 1). An ARCS consists of an integrated instrument set that measures the surface radiation balance, surface meteorology, cloud properties, and some limited atmospheric quantities. In addition to the suite of scientific instruments, an ARCS contains data acquisition systems, monitoring and control systems, satellite communications, a backup electrical generator, a hydrogen generator for producing lift gas for balloon soundings, and other support equipment. The ARCS is housed in custom modified 20-foot sea containers, self-contained, and designed to operate semi-autonomously with a minimum of on-site support. The ARCS are built and tested in the United States and then shipped to the sites for installation.

(a) In the context of ARM, "radiation" refers to solar and terrestrial radiation (i.e., sunlight and radiant heat).

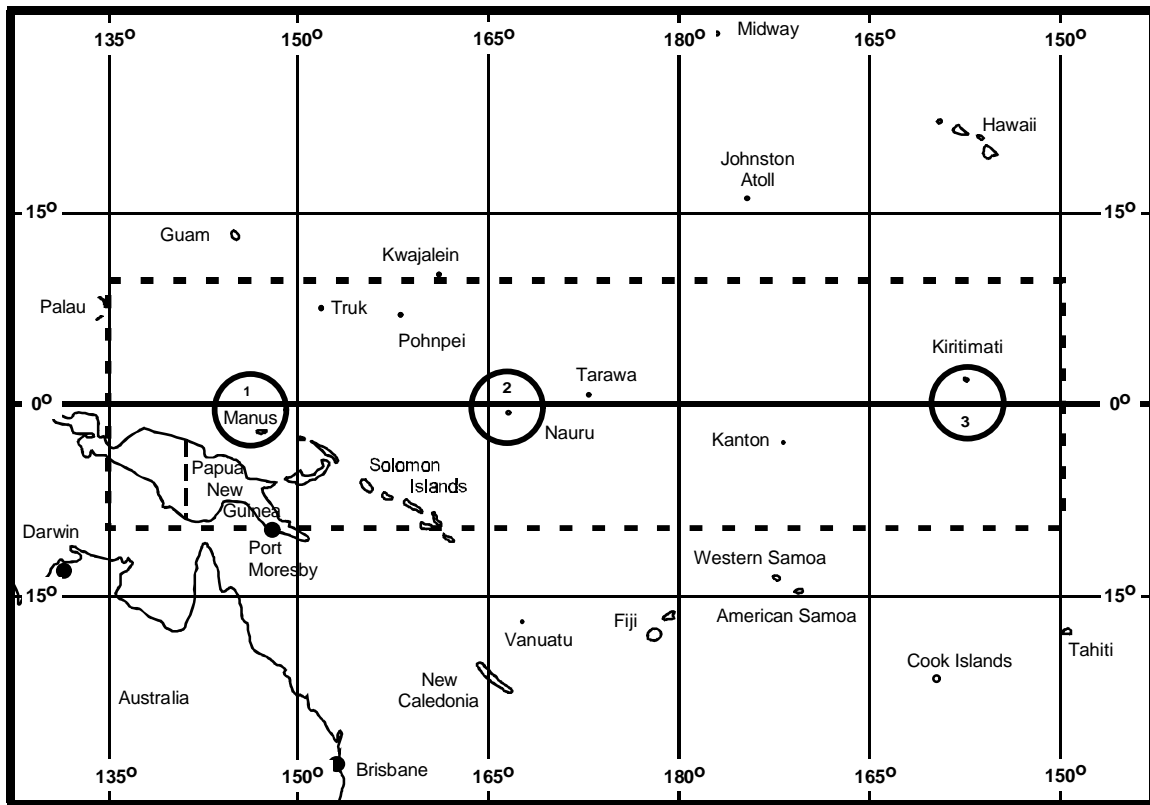


Figure 1. Equatorial Western Pacific region showing TWP locale (dashed area) and existing and proposed ARCS sites (circles).

The first TWP site on Manus Island, Papua New Guinea, and began collecting data in October 1996.^(a) The second site is located on the Island of Nauru in the central Pacific and began formal operations in November 1998. ARM is planning to implement a third site in the year 2000, possibly on Kiritimati Island in Kiribati. The newly implemented Nauru site is the subject of this paper.

The Nauru Site

Nauru (Figure 2), a coral island, is approximately 5 km in diameter and has a population of about 10,000. A 150-m to 300-m wide fertile belt surrounds coral cliffs that rise to 30 m and merge with a central plateau of phosphate-bearing rock. The highest point on the island is 65 m. The climate is tropical, tempered by sea breezes.

The ARM TWP site is located in the Denigomodu District on the western shore of the island at 0.522 °S, 166.913 °E near the General Hospital. The site elevation is 7 m mean sea level (MSL). Installation began in late September 1998 and formal operations began with the official opening

(a) The Manus site is operated in collaboration with the Papua New Guinea National Weather Service.

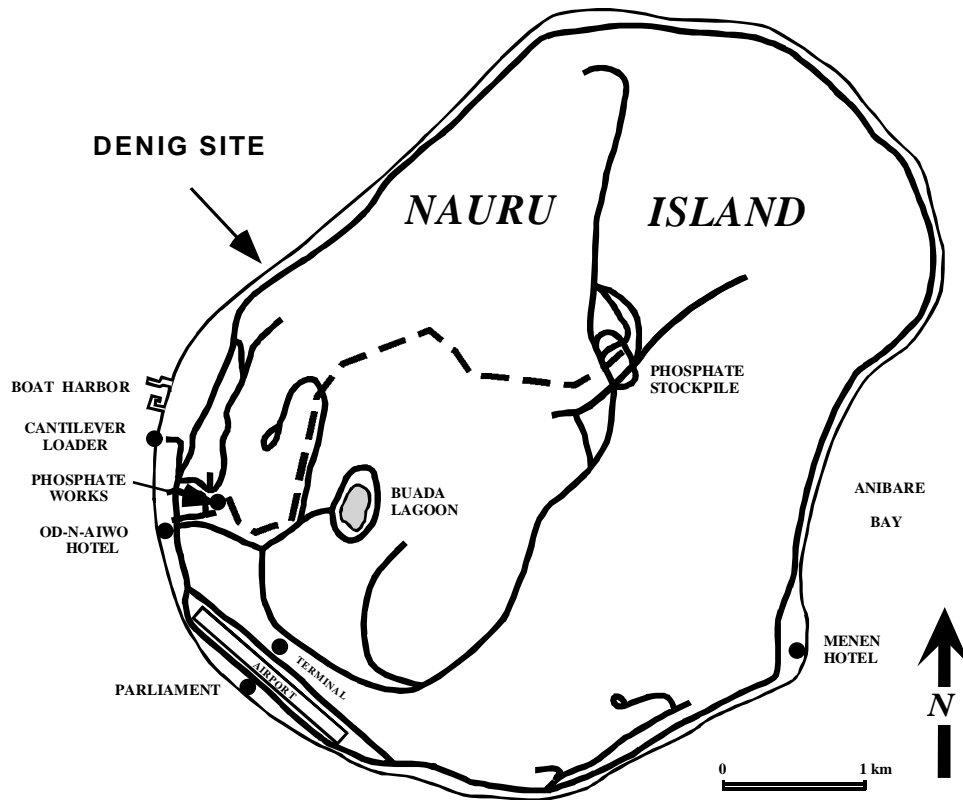


Figure 2. Nauru Island. The ARM site is located in the Denigomodu District on the western shore.

ceremony on November 20, 1998. The present suite of instruments at the Nauru site is given in Table 1. Figure 3 is a layout of the site, and Figures 4 and 5 are panoramic views shortly before the completion of installation.

Operations

The site is operated in collaboration with Nauru Department of Island Development and Industry. Four on-site observers perform the daily operations. Troubleshooting is conducted by phone, fax, email, and satellite links with TWP technicians and engineers in the United States. The TWP Regional Service Team (RESET) makes periodic visits to the site to perform calibrations, major repairs, and system upgrades.

Summary

ARM's second TWP site has been operating on Nauru Island in the Central Pacific since November 1998. The operation of the site is a collaboration between ARM and the Nauru Department of Island Development and Industry. In addition to the standard set of ARCS instruments, the site has an Atmospheric Emitted Radiance Interferometer, a hydrogen generator for producing lift gas

Table 1. Measurements and instruments at the Nauru Site.	
Measurement	Instruments
Surface radiation	<ul style="list-style-type: none"> • Up- and down-looking pyranometers and pyrgeometers • Sun-shaded pyranometer and pyrgeometer • Normal incidence pyrhelometer • Up- and down-looking 9-11μm narrow field of view radiometers • UV-B hemispheric radiometer • Broadband (solar and infrared) net radiometer • Atmospheric Emitted Radiance Interferometer
Surface meteorology	<ul style="list-style-type: none"> • Temperature and relative humidity sensor • Barometer • Optical rain gauge • Propeller vane anemometer
Cloud properties	<ul style="list-style-type: none"> • Cloud lidar (523 nm) • Ceilometer (7.5 km maximum range) • 35-GHz radar • Whole-Sky Imager
Aerosol optical depth	<ul style="list-style-type: none"> • Multi-Filter Rotating Shadowband Radiometer (total, direct, and diffuse irradiance in six 10-nm channels)
Column water	<ul style="list-style-type: none"> • Dual channel (23.8 and 31.4 GHz) Microwave Radiometer
Vertical structure of the atmosphere	<ul style="list-style-type: none"> • Rawinsonde • 915-MHz wind profiler with RASS^(a)
(a) Operated on topside by the National Oceanic and Atmospheric Administration's Aeronomy Lab.	

for the balloon soundings, and a remote balloon launcher for the safe launching of hydrogen balloons. The Nauru site will be the focus of the first ARM TWP campaign, Nauru99, to be conducted in June and July of 1999.

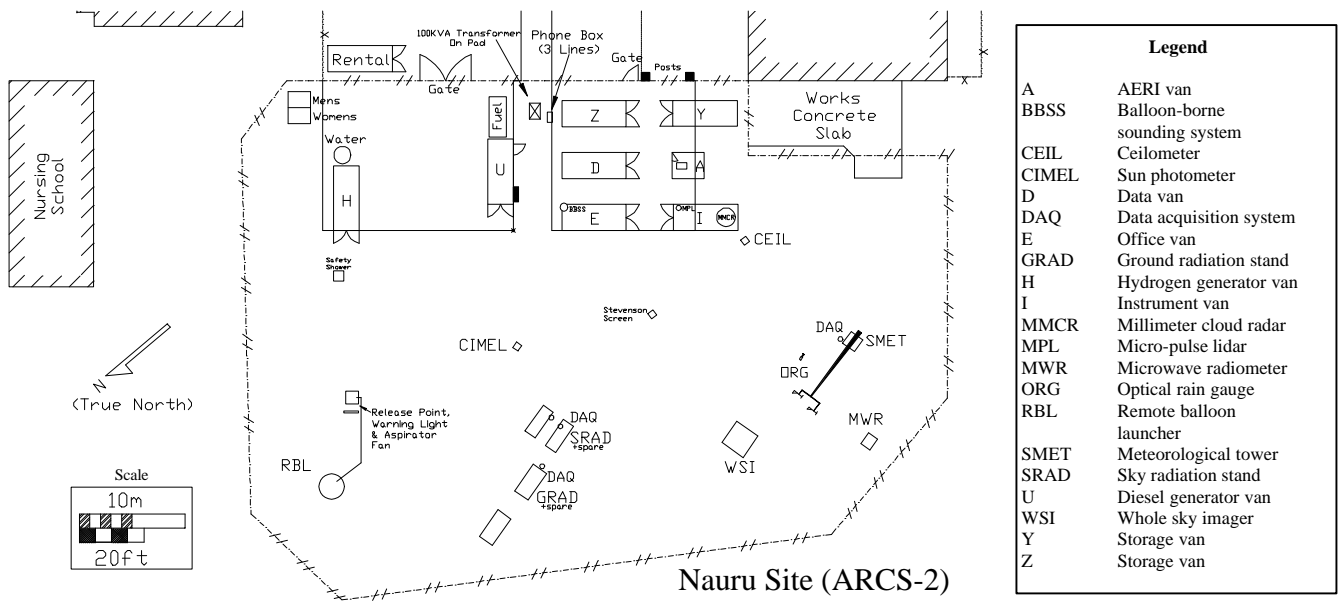


Figure 3. Nauru Site layout (see legend).



Figure 4. Panoramic view of site looking northeast to southeast (left to right).



Figure 5. Panoramic view of site looking southeast to northwest (left to right).