

Nauru: The Second ARM Tropical Western Pacific Site

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Introduction

The United States Department of Energy's Atmospheric Radiation⁷ 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 of the United States, the Tropical Western Pacific, and the North Slope of Alaska and Adjacent Arctic Ocean.

In the Tropical Western Pacific (TWP) locale ARM is installing an Atmospheric Radiation and Cloud Station (ARCS) at three sites (Fig. 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 seacontainers, is 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.

The first TWP site is on Manus Island in Papua New Guinea and began collecting data in October 1996⁸. 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.

⁷ In the context of ARM, "radiation" refers to solar and terrestrial radiation (i.e., sunlight and radiant heat).

⁸ The Manus site is operated in collaboration with the Papua New Guinea National Weather Service

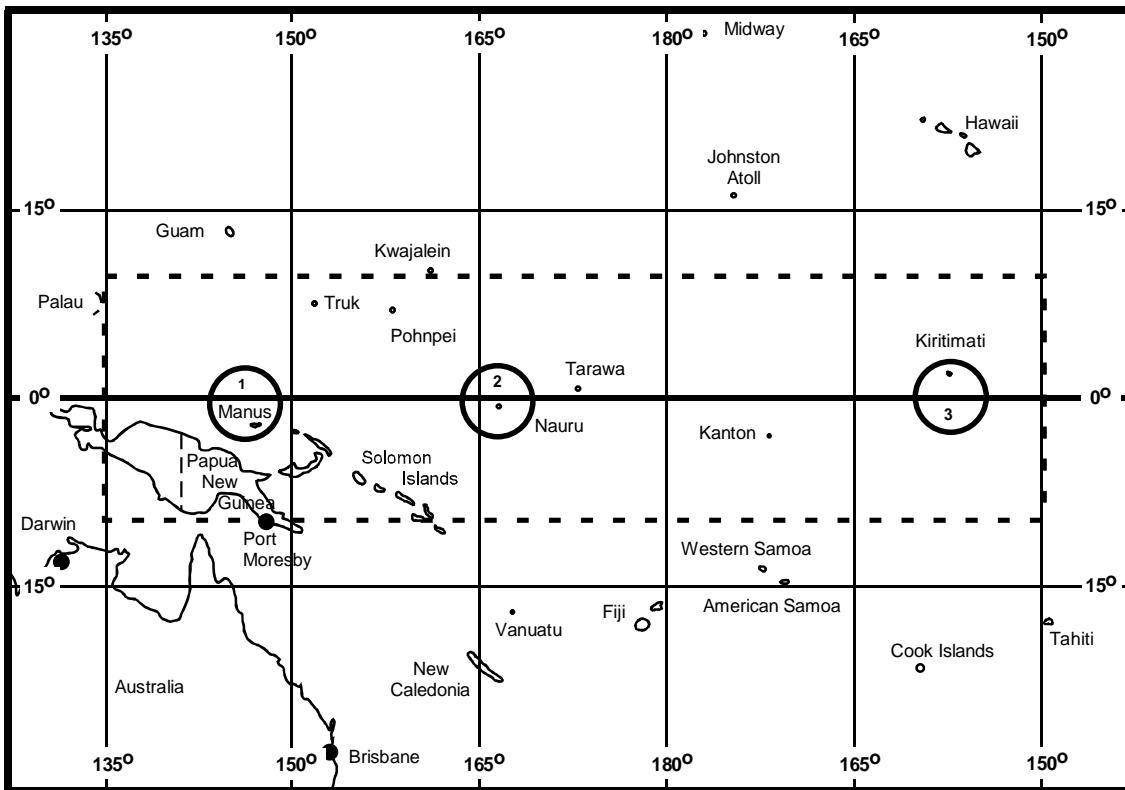


Fig. 1. Equatorial western Pacific region showing TWP locale (dashed area) and existing and proposed ARCS sites (circles).

The Nauru Site

Nauru (Fig. 2), a coral island, is approximately 5 km in diameter and has a population of about 10,000. A 150-300 meter wide fertile belt surrounds coral cliffs that rise to 30 meters and merge with a central plateau of phosphate-bearing rock. The highest point on the island is 65 meters. 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 7m MSL. Installation began in late September 1998 and formal operations began with the official opening ceremony on 20 November. The present suite of instruments at the Nauru site is given in Table 1. Figure 3 is a layout of the site and Figs. 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 onsite observers perform the daily operations. Trouble shooting is conducted by phone, fax, email, and satellite links with TWP technicians and engineers in the U. S. The TWP Regional Service Team (RESET) makes periodic visits to the site to perform calibrations, major repairs, and system upgrades.

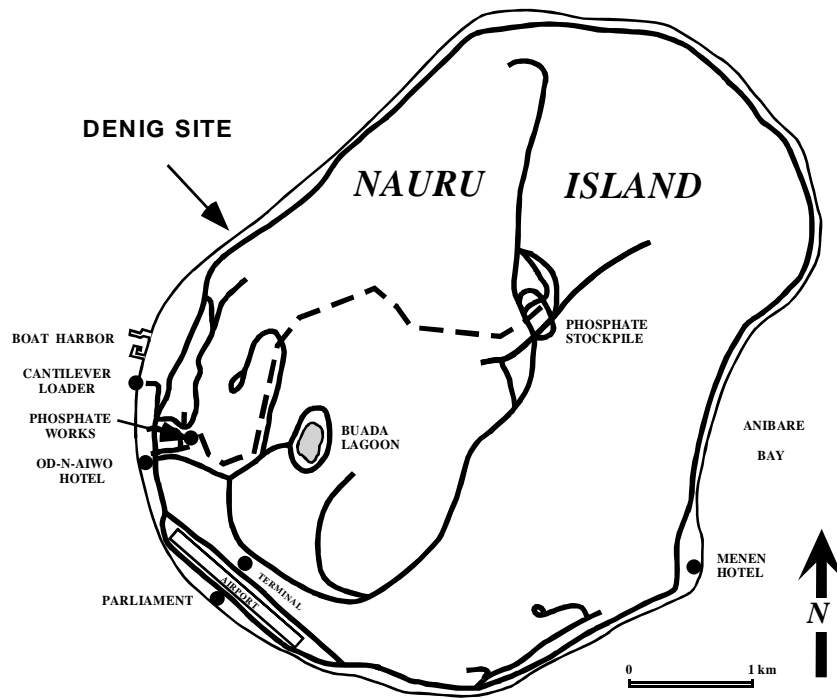


Fig. 2. Nauru Island. The ARM site is located in the Denigmodu District on the western shore.

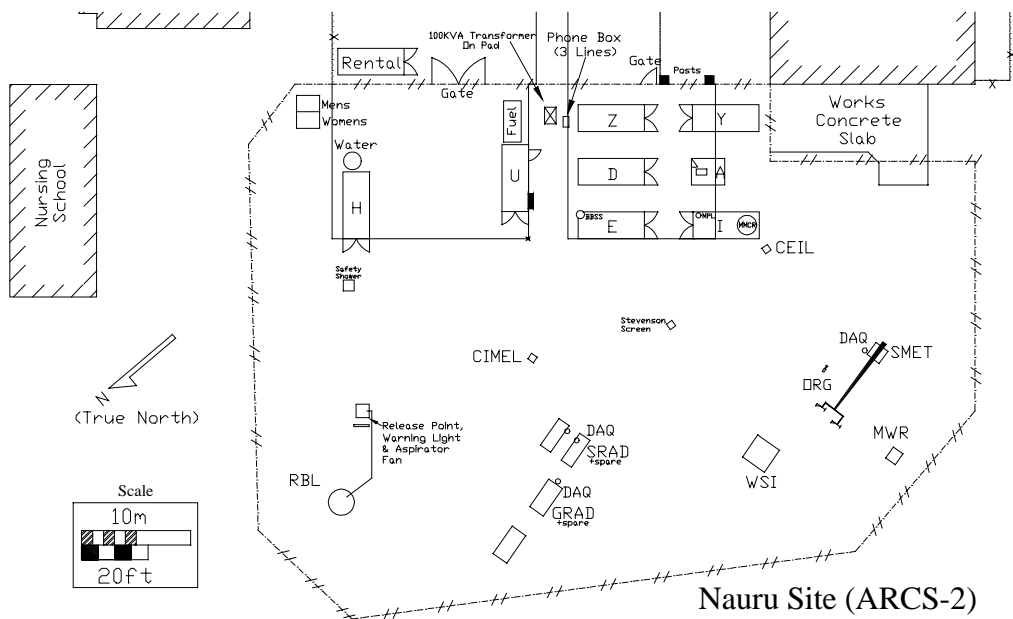


Fig 3. Nauru Site Layout. See legend below.

Legend for Fig. 3

A – AERI van
BBSS – Balloon-borne sounding system
CEIL – Ceilometer
CIMEL – Sun phtometer
D – Data van
DAQ – Data acquisition system
E – Office van
GRAD – Ground radiation stand
H – Hydrogen generator van
I – Instrument van
MMCR – Millimeter cloud radar
MPL – Micro-pulse lidar
MWR – Microwave radiometer
ORG – Optical rain gauge
RBL – Remote balloon launcher
SMET – Meteorological tower
SRAD – Sky radiation stand
U – Diesel generator van
WSI – Whole sky imager
Y – Storage van
Z – Storage van



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



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

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 pyrliometer • Up- and down-looking 9-11μm narrow field of view radiometers • UV-B hemispheric radiometer • Broad band (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 shadow band radiometer (total, direct, and diffuse irradiance in six 10 nm channels)
Column water Vertical structure of the atmosphere	<ul style="list-style-type: none"> • Dual channel (23.8 and 31.4 GHz) microwave radiometer • Rawinsonde • 915 MHz wind profiler with RASS^a
a - Operated on topside by NOAA's Aeronomy Lab	

Summary

ARM's second Tropical Western Pacific 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 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, Nauru 99, to be conducted in June and July of 1999.