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DOE National User Facility in the Tropical Western Pacific

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Introduction

In July 2003, the Department of Energy's Office of Biological and Environmental Research designated the Atmospheric Radiation Measurement sites as National User Facilities and renamed them the ARM Climate Research Facility (ACRF). As a result, the former ARM Cloud and Radiation Test bed (CART) sites are now collectively called Climate Research Sites. Part of the conditions associated with funding for ACRF is that the ARM program must attract new users. Located in Australia, and the island nations of Papua New Guinea and the Republic of Nauru, the three Tropical Western Pacific (TWP) research facilities offer unique scientific opportunities to prospective users. Although the locations of the facilities pose significant logistical challenges, particularly the two island sites, the TWP Office addresses these issues so that prospective users can focus on their research. The TWP Office oversees the operation of these sites by collaborating with the governments of Australia, Papua New Guinea, and the Republic of Nauru. Local observers are trained to effectively operate and maintain the facilities, and the stateside TWP Office offers supporting resources including daily instrument monitoring; equipment shipping; inventory tracking; customs coordination; and a readily deployable technical maintenance team at relatively minimal cost to prospective users. Satellite communications allow continuous, near-real time data from all three stations. The TWP Office also works diligently to maintain good local government and community relations with active outreach programs. This paper presents the TWP research facilities as the valuable resources they are to the scientific community.

Logistical Support

To provide more research capability for the global scientific community, the ARM Program sites are now being made available to scientists and researchers worldwide. The resulting new ARM Climate Research Facility has enormous potential to contribute to a wide range of interdisciplinary science in areas such as hydrology, ecology, and climate change – to name only a few. First established in 1996, the ARM Climate Research Facilities in the Tropical Western Pacific today consists of three stations located at: Manus Island, Papua New Guinea; Nauru Island, Republic of Nauru; and Darwin, Australia.



Tropical Western Pacific Office
Los Alamos, NM

A network of people from around the world keeps the TWP stations operating continuously seven days a week, 24 hours a day. The TWP Office is located at Los Alamos National Laboratory, where a multidiscipline team provides engineering, technical, logistical, and administrative support. Potential users will find the TWP research facilities accessible and readily available for use with little preliminary work required. The administrative team at the TWP Office offers expert foreign travel assistance including flight, hotel, and rental car reservations; passport and visa information; and health and safety training.

Potential facility users will benefit from the current, continuous, long-term, quality data sets from over 25 instruments currently deployed by the operations team. Instruments established by visiting facility users could also be monitored daily by the TWP team in the same manner as the current suite of instruments. An on-line inventory database developed at the TWP Office is used to track the locations of instruments, spares, and parts, and is available to new facility users to ensure their instruments arrive safely at the facility they want to use. Users can depend on the TWP Office team to package, ship, and track all necessary equipment to install their instruments at any site.

Measurement and Instruments

Surface Radiation Balance

- Up-and-down looking pyranometers and pyrgeometers
- Sun-shaded pyranometer and pyrgeometer using solar tracker
- Normal incidence pyrheliometer
- Up-and-down looking 9-11 μm narrow-field-of-view radiometers

Surface Meteorology

- Temperature and relative humidity sensor
- Barometer
- Optical rain gauge
- Propeller vane anemometer

Cloud Properties

- High resolution micropulsar lidar
- Ceilometer (7.5 km maximum range)
- 35 GHz cloud radar
- Whole Sky Imager
- Total Sky Imager

Aerosol Optical Depth

- Multi-filter rotating shadow band radiometer (total, direct, and diffuse irradiance in six 10-nm channels)

Column Water

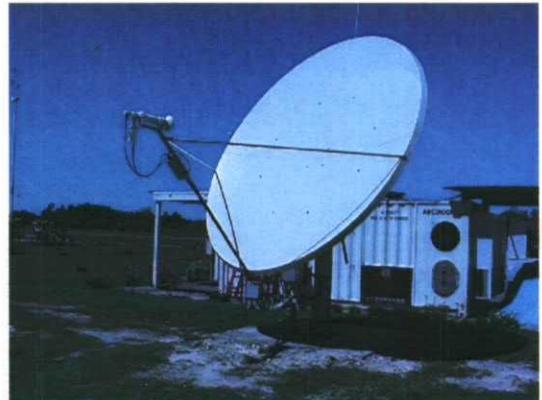
- Dual channel (23.8 and 31.4 GHz) microwave radiometer

Vertical Structure of Atmosphere

- Rawinsonde (two launches/day)

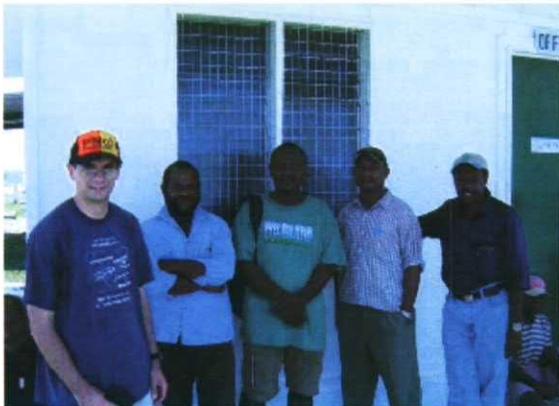
Atmospheric Emitted Radiation

- Atmospheric Emitted Radiance Interferometer (Nauru and Darwin)



International collaboration

A significant accomplishment of the TWP team has been to establish government relations in each country where the research facilities are located. Although Papua New Guinea and the Republic of Nauru are developing countries and often endure unstable infrastructure, the TWP research facilities continue to thrive as ARM and local government officials collaborate to continue the scientific work at hand. While on site, visiting scientists and researchers at the TWP research facility have full access to stable power; reliable communication via telephone, fax, and the Internet; site security; and dependable, 24-hour assistance from the stateside team



TWP site scientist and Manus observers



Nauru site observers

In collaboration with the PNG National Weather Service, the Nauru Department of Economic Development, and the Australian Bureau of Meteorology, the TWP research facilities are maintained on a daily basis by local observers who work for their respective governments. The observers are trained to operate and monitor the instruments on site, launch balloons twice a day, and perform troubleshooting as needed. Observers are in daily contact with the TWP site operations manager in the USA at Los Alamos National Laboratory. The observers at each site are readily available to assist visitors, and can be depended on for daily maintenance and status reports of any new instruments placed at the site.

Technicians from the Australian Bureau of Meteorology (BOM) manage the Darwin facility, and make frequent trips to the Nauru and Manus facilities to perform major repairs and maintenance that is beyond the capability of the local observers. The BOM team is an excellent resource for visiting scientists at any of the TWP research facilities as they are knowledgeable about a wide range of instruments, and are readily available to travel to the sites. The BOM team offers technical advice and instruction via telephone and email to keep the instruments operating, and reporting quality data.



Darwin Technicians

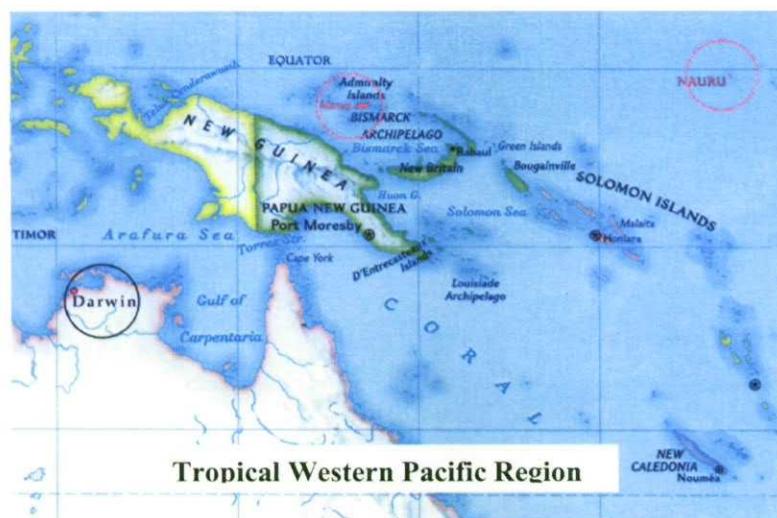
Community Relations

An important goal for the ARM Program is to promote basic science education and community environmental awareness at each of the ACRF locales. The TWP team works closely with ARM Education and Outreach to address the educational needs of the communities surrounding the TWP research facilities. The TWP research facilities are excellent resources for members of the surrounding community to learn more about climate research, and local educators are welcomed to tour the facilities with their students. The TWP team collaborates with government officials and ARM Education and Outreach to provide additional educational materials and resources to local schools and communities. The team's commitment to maintaining lasting working relationships with government officials enables ARM to continue its scientific research, and promote science education in the Tropical Western Pacific.

Research

At the three TWP research facilities, scientists have an excellent opportunity to explore various research topics because of the unique location of the sites. Manus is located in what is referred to as the tropical warm pool – an area of the Pacific that consistently has the warmest sea surface temperatures on Earth, supplying heat and moisture to the atmosphere above it. As a result, there is significant formation of deep convective cloud systems, which in turn produce high-altitude cirrus clouds that spread out over much of the region. Nauru is uniquely located less than one degree south of the equator, and directly in the path of the El Niño/Southern Oscillation phenomena, which has far reaching implications for weather patterns over much of the Northern Hemisphere, and possibly the entire globe. Australia's Northern Territory experiences a classic annual monsoon; convective clouds produced during the transitional periods; and aerosols caused by seasonal grassfires. Overall, the Tropical Western Pacific is a hot spot for climate research. Possible research questions to explore at the TWP research facilities are:

- Why are tropical cirrus clouds different than mid-latitude cirrus?
- What causes the tropical warm pool to move and change?
- Why are the low-level clouds different over Nauru than Manus?
- What are the effects of ocean microorganisms on sea-surface temperatures and winds?



Discovering the Pacific

Along with the scientific advantages of the Tropical Western Pacific locale, visitors can benefit from the rich cultural and historical aspects of the region.



Dancers from the Larrakia Nation, Australia

Nauru is an experiment in cultural isolation as its people adapted to life on a single island far from any other Pacific neighbors. Ironically, this small island provides the world with a valuable lesson in environmental stewardship as a large portion of the island is an open-pit phosphate mine close to exhaustion. The majority of the population lives on a small fringe 50m to 100m around the coast of the island. Despite economic and environmental problems, Nauru Island offers a unique experience. In addition to touring the island and learning about the historical background of the region, one can experience world class ocean fishing.

Manus Island, located off the mainland of Papua New Guinea, offers visitors a chance to see a culture still dependent on ocean fishing and subsistence agriculture in a tropical rain forest. With thousands of plant, mammal, and bird species, Manus is an island of discovery.

Visitors will also find relics of World War II, and learn the history of Manus while it was occupied by the Japanese.

“Australia’s Aboriginal people belong to one of the world’s oldest continuous living cultures. Over thousands of years they have successfully adapted to a changing environment and, more recently, survived the impact of European colonization. They have developed a unique way of life; a deep spiritual attachment to their country, a strong sense of community, and an ability to draw upon their traditions and respond to change in creative and innovative ways (South Australian Museum).” Due to the isolation of the continent, the wildlife in Australia is plentiful and unlike any found elsewhere in the world.



Nauru fisherman



WWII guns

Conclusion

The TWP Climate Research Facility is available for scientists to use now. With readily available assistance and support from the TWP team, users can begin their research almost immediately. Stateside support in the areas of travel, shipping, and daily instrument monitoring is currently in place, and international support from site observers and government officials is reliable. The successful maintenance of instruments currently located on-site is indicative of the TWP team's ability to accommodate visiting scientist and maintain their instruments. Furthermore, the locations of all three facilities are advantageous for researching a wide range of scientific questions, and the possibilities for discovery are endless.