ETL Instrumentation on R/V Ronald H. Brown for the Nauru99 Campaign

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Introduction

The 1996 Combined Sensor Program (CSP) (Post et al. 1997) was a highly successful predecessor of Nauru99. It was a first attempt by Atmospheric Radiation Measurement (ARM) Program Science Team members to operate a comprehensive set of shipborne remote and in situ sensors in conjunction with a similar set of Atmosphere Radiation and Cloud Station (ARCS) instrumentation on Manus Island, Papua New Guinea. The Nauru99 campaign is a similar but broader campaign to be executed June 15 through July 19, 1999, in the vicinity of Nauru Island (0.5S, 166.9E), site of another tropical Pacific ARCS facility. Visit web site *http://www.etl.noaa.gov/nauru99/* for a complete description of scientific goals, the cruise instructions for the ship and scientists, interagency linkages, data policies, media coverages, etc.

The Nauru ARCS facility is more completely instrumented than the Manus facility was at the time of CSP. The same can be said of the ship's scientific sensors. Important additions to the instrument suite on the National Oceanic and Atmospheric Administration (NOAA) research vessel (R/V) Ronald H. Brown, missing from the Discoverer in 1996, are a 35-GHz cloud-profiling radar (identical to one on Nauru Island), an S-band precipitation radar, polarimetric radiometers, three lidar systems (specializing in aerosol, water vapor, and wind fields), and a C-band scanning weather radar. Furthermore, the Japanese R/V Mirai, with an instrument suite comparable to the Brown's, will participate in Nauru99, together with research aircraft (a Cessna 404 and a remotely piloted Aerosonde). The addition of these platforms enable the project to establish realistic single-column model (SCM) boundary conditions for this climatically-important region, to assess how both large- and small-scale properties of the atmosphere and ocean affect radiative balance, and to help determine how well island-based measurements represent open-ocean conditions.

Instrumentation

Table 1 lists the scientific sensors that will be on the Ronald H. Brown during Nauru99 together with the responsible organization and on board mentor.

Table 1.

Instrument	Comments	Org./Person
Surface Meteorology	T, P, ρ, V, 0.01 to 10 min average, Multiple Locations	ETL/Hare Ship/Tech
Ceilometer	Vaisala, 7.6 km max altitude, Not Stabilized, Stares Up	ETL/Hare
Radiosondes	2-8 daily, 20 mbar max altitude	ETL/Hare Ship/Tech
Radar Wind Profiler	0-3, 0-16 km modes, Stabilized	ETL/Hare
Surface Flux Sensors	Heat, Momentum, Moisture	ETL/Hare
Sea Surface Temperature	Skin, 10 cm, 5 m	ETL/Hare & Zorn Ship/Tech
K_a-Band Cloud Radar	35 GHz (8.6 mm), 20 km max alt., Doppler, Not Stabilized, Stares Up	ETL/Hazen
C-Band Precipitation Radar	6 GHz (5 cm), Scanning, Doppler, Stabilized	PSU/Verlinde Ship/ET
S-Band Precipitation Radar	3 GHz (10 cm), 16 km max alt., Not Stabilized, Stares Up	ETL/Hare
Total Sky Imager	Not Stabilized, Day and Night	PSU/Pavloski
FTIR	500-2000 cm^{-1}, Not Stabilized, Stares Up	ETL/Zorn & Hazen
2-Ch Microwave Radiometer	Column water, liquid and vapor, Not Stabilized, Stares Up, Tip Cals	ETL/Hazen
Scanning Microwave Radiometer	60 GHz, Temp Profiles in MBL, Air-Sea Temp Difference	ETL/Zorn
Infrared Radiometer PRT-5	11 μm, Sky Brightness & Cloud Base Temperatures	ETL/Hazen
Scanning Infrared Radiometer	14 μm, Temp Profiles in MBL, Air-Sea Temp Difference	ETL/Zorn
DABUL Lidar	0.523 μm, Aerosols Profiles, Not Stabilized, Stares Up	ETL/Lidar Scientist
Scanning Doppler Lidar	2.1 μm, Aerosols and Wind, Stabilized	NCAR/Wulfmeyer
DIAL Lidar	0.73 μm, Water Vapor Profiles, Not Stabilized, Stares Up	MPI/Lehmann
Aerosol Samplers	In Situ, 0.05 - 5.0 μm, Chemistry	PMEL/Kaufman

Table 1. (contd)

Instrument	Comments	Org./Person
Satellite Receiver	GOES, NPOES, GMS, SeaWiFs, METEOSAT, WEFAX	ETL/Post Ship/Boland
Sun Photometer	Stabilized, 7 Ch, 0.4 -1.0 μm	PSU/Pavloski
Radiative Fluxes	Visible, Infrared, Direct, Diffuse, Upwelling and Downwelling, IMET	ETL/Hare BNL/Smith Ship/Tech
Rain Gauges	Ship's Instruments, Optical & Gravity	Ship/Tech
CO_2 Sensor	AOML/Wanninkhof	Ship/Tech PMEL/Murphy
Chlorophyll Sensor	Ocean Sampler	LVMMC/Aicher
Navigation, Ocean Sensors	Ship's Instruments, SCS	Ship/Tech

AOML - Atlantic Oceanographic & Meteorological Laboratory
BNL - Brookhaven National Laboratory
DABUL - Depolarization Aerosol and Backscatter Unattended Lidar
DIAL - Differential Absorption Lidar
ETL - Environmental Technology Laboratory
FTIR - Fourier Transform Infrared (spectrometer)
GMS - geostationary meteorological satellite
GOES - geostationary observational environmental satellite
LVMMC - La Vai Moana Marine Center
MBL - marine boundary layer
METEOSAT - meteorological satellite
MPI - Max Planck Institute
NCAR - National Center for Atmospheric Research
NPOES - National Polar Orbiter Environmental Satellite
PMEL - Pacific Marine Environmental Laboratory
SeaWiFs - Sea-viewing Wide Field-of-View Sensor Project
WEFAX - weather facsimile

Operations Plan

The Mirai will arrive in the vicinity of Nauru Island first (on June 17)**,** and it will proceed to a position near the island to facilitate sensor intercomparisons between the ship and island. Then the Mirai will steam to the Pacific Marine Environmental Laboratory's (PMEL's) Tropical Atmosphere Ocean (TAO) buoy at 0S, 165E. On June 23, the Ronald H. Brown is scheduled to arrive at the 2S, 165E TAO buoy. Its arrival will complete the "large triangle" configuration of the three measurement platforms for a 7-day-long period, as shown in the top of Figure 1. The purpose of this configuration is to assess the larger-scale spatial variability of climatically-important properties of the ocean and atmosphere, to provide high-quality measurements of SCM boundary conditions, and to allow SCM predictions to be validated.

At the end of the 7-day large triangle phase, the two ships will redeploy to new positions closer to Nauru for 4 days, as shown in the bottom of Figure 1, and called the "small triangle" configuration ~~o~~ne ideally suited for dual-Doppler scans of nearby convective storms by the ships' 5-cm-wavelength weather radars. If no convection is anticipated for 24 hours or so, the Ronald H. Brown will steam to the Mirai and undertake ship-to-ship intercalibration of common sensors. The Mirai will depart the area on July 5, at which time the Ronald H. Brown will take up a position very close to Nauru Island to begin intercomparison of its sensors with those on the island.

References

Post, M. J., C. W. Fairall, A. B. White, Y. Han, W. L. Ecklund, K. M. Weickmann, P. K. Quinn, D. I. Cooper, S. M. Sekelsky, R. E. McIntosh, P. Minnett, and R. O. Knuteson, 1997: The combined sensor program: an air-sea science mission in the central and western Pacific. *Bull. Amer. Met. Soc.*, **78,** 2792-2815.

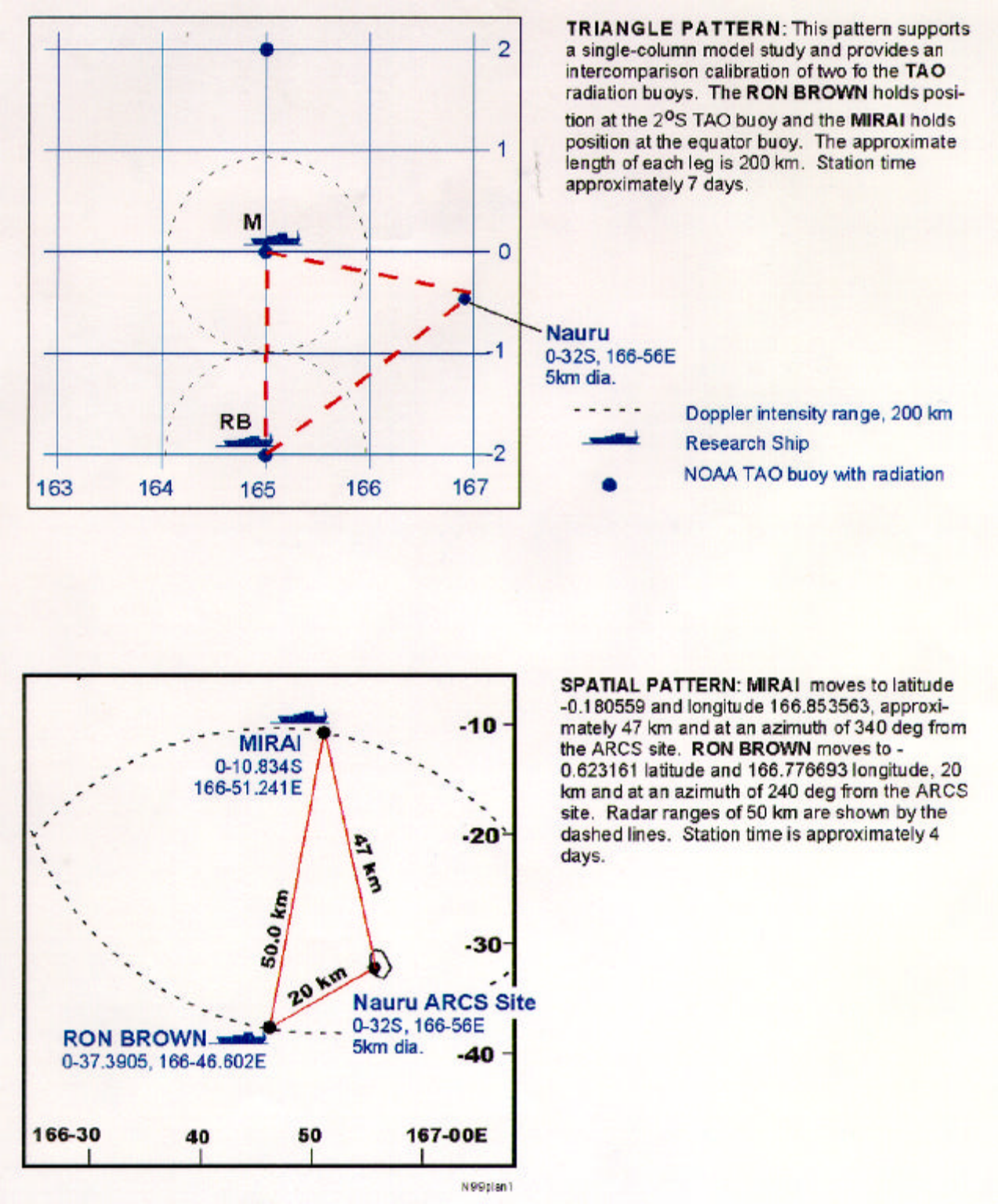

Figure 1. Nauru99 component triangle. Figure is courtesy of Mike Reynolds at Brookhaven National Laboratory.