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P1.7 The NOAA *Ron Brown's* Shipboard Doppler Precipitation Radar

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A Doppler Weather Radar Available at Sea

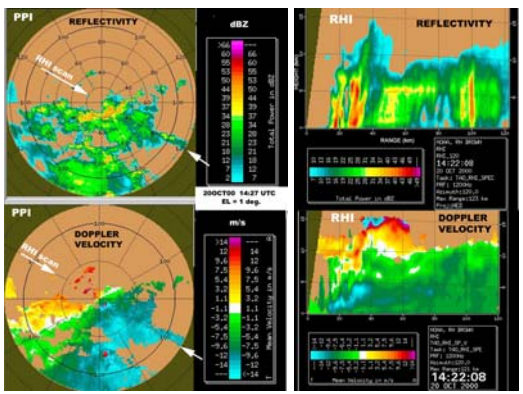
Oceans cover two-thirds of the planet's surface but remain data-sparse regions for weather and climate observations for obvious logistical reasons. A new tool for observing oceanic precipitation is the C-band Doppler weather radar on board the NOAA research vessel *Ronald H. Brown* (RHB). Commissioned in 1997, the RHB is among the world's most technologically advanced seagoing research platforms and the only ship in the U.S. civilian fleet to carry Doppler radar. The radar provides research-quality measurements of precipitation beyond the confines of land-based radar networks. Initial applications of the C-band radar data include studies of tropical rainfall, drizzling stratocumulus, monsoons, and validation of satellite-based rain estimates.

NOAA/ETL serves as instrument mentor for the radar, which was built and installed by Radtec Engineering, Inc. The radar is available to principle investigators on the ship's numerous annual cruises for a variety of marine studies sponsored by NOAA and other agencies. The ship is routinely outfitted with an impressive suite of oceanographic and meteorological research instruments that measure various environmental conditions, while the radar provides a wide-area context on precipitation and storms with resolution as fine as 75 m. In addition, the RHB commonly hosts several investigator-provided instruments for individual cruises that typically last about six weeks.

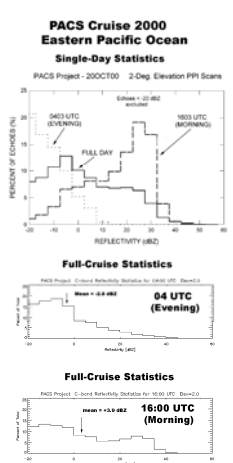
The C-band radar's beam is motion-stabilized by use of an inertial navigation system, which monitors the ship's attitude at 50 Hz and, through coordination with the antenna control system, compensates for ship motion to maintain the beam at the desired earth-relative elevation and azimuth angles. This feature provides accurate Doppler velocity data even in rough seas. PPI and RHI scans are available in programmable scan sequences or by manual control. Scan images of reflectivity and radial velocity are presented on a real-time color display, and post-processing data systems allow numerous more sophisticated radar products to be obtained at sea and following cruises.

Observations of Marine Precipitation

Continental storms have been studied extensively with land-based Doppler radars, but there has been a dearth of similar radars at sea. Consequently, relatively little is known about marine precipitation mechanisms, although their impact on civilization through climate energetics and land-falling coastal storms may be great. The Doppler radar onboard the *Ronald H. Brown* offers an attractive new avenue for studying these problems.



Research-quality storm reflectivity and Doppler velocity data are available from PPI and RHI scans (above) of the RHB C-band radar. Reflectivity statistics from this platform, such as in the PACS-2000 cruise data (right), can provide independent open-ocean validation information for assessing rainfall-estimation algorithms that are applied to data from satellite instruments.

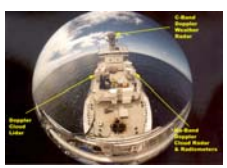


Reflectivity data statistics processed by Jessica Koury.

The C-band weather radar atop the central mast of the *Ronald H. Brown* research vessel.

Characteristics of the RHB Radar

Frequency: 5.595 GHz (C-band, wavelength = 5.4 cm)
Transmit Power: 250 kW peak
Transmitter: Magnetron
Antenna: 4.3-m diameter parabolic, center-feed dish within a 5.5-m radome.
Antenna Gain: 44 dB with –22 dB sidelobes
Beam Width: 1.0 deg., circular
Pulse Length: selectable, typical defaults are 0.5, 0.8, 1.4, and 2.0 microsec. (resolution = 75, 120, 210, 300 m).
PRF: selectable, 250-2100 Hz
Scans: PPI, RHI, sector, fixed-beam, with elevations from below horizon to near zenith.
Scan Rates: up to 36 deg/s (12 deg/s typical)
Polarization: linear horizontal; system is designed to allow future upgrade to dual-polarization.
Number of range gates: 1024
Maximum Unambiguous Range: 300 km at PRF=500.
Sensitivity: approx. –22 dBZ at 10 km range using 0.5 microsec pulse length.
Data System: Sigmet, Inc., RCP-02, and RVP-07 on HP Unix workstation.
Platform: 83-m oceanographic research ship.



Fisheye-lens view of RHB from bow tower. (Photo by Scott Sandberg)

A New Tool for Studying Oceanic Precipitation

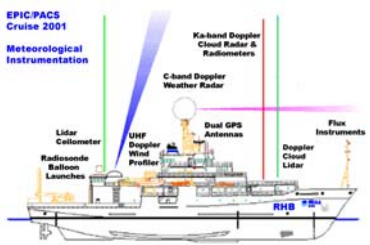
Major Capabilities:	Primary Uses:
•Ship-based	•Measurements of precipitation at sea
•Doppler	•3D storm structure and airflow
•Scanning	•Satellite and model validations
•Platform-motion-stabilized	

Instruments onboard the RHB

Oceanographic:
Bathymetric acoustic sounders
Ocean current profilers
Salinometers
Expendable bathy-thermographs (XBTs)
Conductivity-temperature-depth (CTD) array

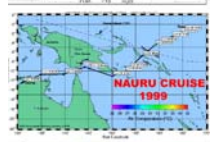
Meteorological:
C-band Doppler weather radar
UHF Doppler wind profiler
Radiosonde
Standard surface met package

Examples of PI-provided Instruments (EPIC cruise 2001):
Air-Sea Flux instrument package
Doppler cloud-profiling radar
Microwave and infrared radiometers
Doppler cloud lidar
Lidar ceilometer



RHB Cruises Using C-band Radar

Project	Year	Ocean	Sponsors
PACS/TEPPS	1997	E. Pacific	NOAA
INDOEX	1999	Indian	NOAA/NSF
JASMINE	1999	Indian	NOAA/NSF
Nauru99	1999	W. Pacific	NOAA/DOE
KWAJEX	1999	W. Pacific	NOAA/NASA
PACS	2000	E. Pacific	NOAA
EPIC/PACS	2001	E. Pacific	NOAA/NSF



Acknowledgments:

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