

NOAA Research Vessel Ronald H. Brown Participation and Operations During NAME

Draft: 4 March 2002

Walter A. Petersen¹, Robert Cifelli¹, Steven A. Rutledge¹

and

Christopher W. Fairall²

¹Department of Atmospheric Science
Colorado State University
Fort Collins, Colorado 80523-1371

²NOAA-ETL
R/E/ET7, 325 Broadway
Boulder, Colorado 80303-3328

i. Introduction:

A primary objective of the NAME Tier-1 observational network design (Fig. 1, NAME Science Implementation Plan) is to capture a representative, meteorologically complete set of observations describing the origination and variability of Gulf moisture surges (and transports therein), the Gulf of California low level jet, coupling of these phenomena to easterly waves and their relationship to subsequent pulsing in the Southwestern/Mexican Monsoon. Previous research discussed in detail in the NAME Science and Implementation Plan (<http://www.cpc.ncep.noaa.gov/products/precip/monsoon/NAME.html>; e.g., Stensrud et al., 1997, and Fuller and Stensrud, 2000) clearly demonstrates the need for *continuous* (i.e., 24 hours per day) and *coincident* (i.e., observed simultaneously) high resolution observations of convection, rainfall, surface heat fluxes, and tropospheric profiles of temperature, humidity and wind in the vicinity of the mouth of the Gulf of California (GC) (Fig. RHB1).

Aircraft and land-based instruments will not provide atmospheric measurements of sufficient temporal continuity or resolution *over the oceanic domain* of the southern GC region. One instrument platform that is able to satisfy the requirements of continuity and simultaneity for *all* of the aforementioned variables in the GC relative to NAME Tier-1 science goals is the NOAA Research Vessel, R/V Ronald H. Brown (RHB). This is the only vessel in the US research fleet with a calibrated scanning precipitation radar, capable of quantifying rainfall within 150 km of the ship (e.g., Petersen et al. 2002; <http://olympic.atmos.colostate.edu/epic/epic.html>) The RHB berths 25 scientists comfortably and an additional 7 scientists not so comfortably.

ii. Instrumentation aboard the RHB

The RHB is a heavily instrumented platform that functions as a floating “integrated” observational system. This observational system is well-suited to satisfying many of the NAME

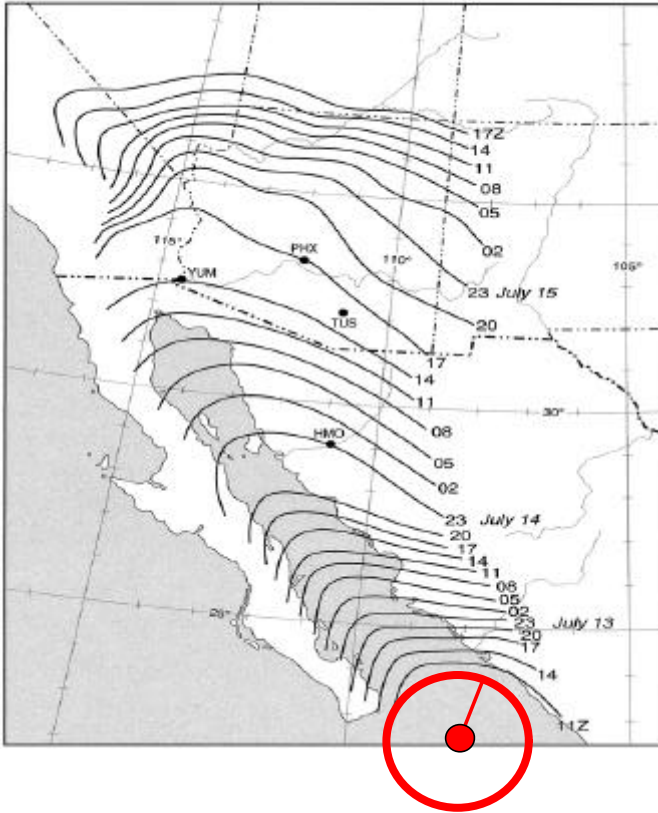


Figure RHB1. Isochronal analysis of a moisture surge originating at the southern end of the Gulf of California. The proposed position and approximate coverage radius of the RHB C-band radar during NAME is indicated in red. Figure adapted from Fuller and Stensrud (MWR, 2000) and Brenner (MWR, 1974)

science objectives. Instruments proposed for deployment aboard the RHB during NAME, constituting an integrated observing system include:

- a. *C-band Doppler radar:* This inertially stabilized Doppler radar (Ryan et al., 2002) will be used during NAME for describing and quantifying 4-D precipitation and/or storm structure (time-series, diurnal cycle, PDF's, intensity/duration statistics etc.) out to a range of ~150 km from the ship (e.g., Petersen et al. 2002; Cifelli et al., 2002; Boccippio et al., 2002; <http://olympic.atmos.colostate.edu/epic/epic.html>). It is anticipated that the RHB radar will be stationed near the center of the extreme southern end of the GC (Fig. RHB1), and will operate continuously (24-hours per day) to collect high temporal and spatial resolution (e.g., sector volume scans and surveillance scans, 250 m gate spacing, 21-25 elevation angles, every 5-10 minutes) precipitation and convective statistics. If desired, it may also be possible to temporarily move the radar to within 50 km of a NAME shore-based polarimetric radar, thus facilitating dual-Doppler operations and retrieval of both storm kinematics and bulk microphysics.
- b. *Wind Profiler:* The RHB carries an inertially stabilized three-Beam 915 MHz wind profiler. The profiler will provide a continuous monitoring of low and mid-level horizontal winds at a vertical spacing dependent on the operating mode but typically on the order of 100 m. The resultant sampling will provide a high-resolution dataset of

boundary layer and lower tropospheric winds for studying the southern extension/evolution of the GC low-level jet during periodic moisture surge events. For NAME the wind profiler will be operated with 3 range-gate mode settings to allow sampling of boundary-layer winds with high vertical resolution (35 60-m range gates), the melting layer (60 100-m pulse coded range gates), and to give some precipitation/cloud microphysical information (in deep convection 40 400-m range gates). The deep convection mode will complement the cloud radar (see below) which often is attenuated in strong local precipitation.

- c. *Soundings*: High frequency (e.g., 6-8 /day; TBD) atmospheric soundings (Vaisala MW-11 GPS system) will be collected for the duration of the IOP for sampling atmospheric thermodynamic and wind structure during different phases of the monsoon. Similar to the wind profiler, the sounding data will provide important information on the variability of environmental thermodynamic characteristics during easterly wave passages and moisture surge events. These soundings when combined with the wind profiler and C-band VAD wind profiles will give comprehensive, continuous, and accurate wind profiles, which are critical for characterizing the temporal variability of the low-level jet in the GC region. The sounding data collected at the location of the RHB can also be included in existing and planned sounding networks used for computing diagnostic budgets of heat and water vapor.
- d. *Cloud-radar/Microwave radiometer*: A vertically pointing Doppler Ka-band cloud radar (MMCR) with a collocated microwave radiometer will be deployed and operated continuously to measure profiles of cloud particle spectra (liquid and solid phase). The Doppler cloud-radar can also collect vertical motion statistics (indicators of cloud turbulence, entrainment rate, etc). ETL has developed an extensive set of algorithms to retrieve cloud/precipitation microphysical properties, which have proven valuable for evaluating the internal workings of numerical models. NOAA has a good database from the E. Pacific ITCZ just west of the NAME region from past PACS and EPIC deployments. The MMCR and wind profiler provide cross calibration references for absolute backscatter intensity for the G-band radar (useful for quantitative retrieval of rain rates from dBZ).
- e. *Rain gauges*: The RHB carries a suite of 10 rain gauges (siphon, optical and Haase) distributed at different locations around the ship. These gauges will provide a direct measurement of surface precipitation rate and accumulation.
- f. *Standard surface meteorological instrumentation*: Instruments located on the bow tower will measure standard meteorological variables such as temperature, pressure and humidity every 10 s.
- g. *Flux instrumentation*: ETL will deploy a seagoing package of flux and bulk meteorological instruments that will characterize the atmospheric boundary layer surface forcing and the total heat/moisture budget at the sea surface. The system has been deployed on the RHB for more than 10 field programs in the last 3 years. Further detail can be found at http://www.etl.noaa.gov/programs/epic/pdf/fairall_pacs_rpt_01.pdf. Direct and indirect turbulent fluxes, redundant solar and IR radiative fluxes, and very high quality bulk meteorology (wind speed, air temperature/humidity, and sea surface temperature) are obtained. The system also includes a cloud ceilometer, optical rain gauge, and fast CO2 flux sensors. Because of the coastal nature of this operation, we also recommend **that** surface gravity waves be measured.

- h. *Oceanographic instrumentation*: While the RHB is underway/deployed continuous measurements of temperature, salinity and current are collected as SOP (e.g., TSG, CTD, ADCP). Expendable Bathythermograph data (XBT) can also be collected if XBT probes are supplied by a user.
- i. *Other atmospheric instrumentation (TBD)*: More instrumentation can also be deployed if required/desired (e.g., mini-MOPA/DIAL scanning LIDAR, DABUL aerosol LIDAR, lightning detection/electric field equipment, aerosol counters etc.). These issues need to be addressed in future field campaign planning.

During the IOP months, the nominal operating mode for the RHB is expected to be that of a stationary platform (located at $\sim 22.5^\circ$ N 108° W), however, the RHB (and its suite of instrumentation) can also function as a mobile platform if required. This means that depending on the operational objective, the RHB could traverse the Gulf of California in either an east-west or north-south directions.

iii. Data distribution and archival

All datasets collected aboard the RHB during the NAME field campaign will be provided to the UCAR-JOSS Project Office for distribution and archival in two stages: 1) Preliminary datasets (not extensively quality controlled) from all instruments will be made available immediately following the field campaign; and 2) A quality controlled data set from each instrument will be provided to JOSS within one year of the end of the field campaign.

iv. Logistical Considerations:

The RHB has been formally requested for NAME participation (Dr. Chris Fairall of NOAA-ETL) for a 45-55 day period covering 15 July - 2 September 2004 (Table 1). Initial departure of the ship for the NAME cruise is being requested from either San Diego or Miami. In order to avoid any problems with customs in Mexico, we recommend *that all instruments to be operated during the IOP should be installed on the ship and tested while the RHB is at a U.S. port* (e.g., San Diego or Miami) just prior to the beginning of the field campaign.

Due to proposed NAME operations in the Mexican Economic Zone, it will be necessary to acquire permission from the Mexican government to operate instruments and collect data aboard the RHB during the field campaign. Experience from previous field programs suggests that the necessary measures for securing such permission be instituted as soon as possible (e.g., at least one year in advance of deployment). Cooperation and collaboration with Mexican operational/research activities (e.g., SNM and UNAM) may facilitate this process. Initiation of this activity is the responsibility of the person identified to be Chief Scientist on the RHB (currently Dr. Chris Fairall, NOAA-ETL). The Chief Scientist is also responsible for collecting health questionnaires from participants (30 days prior to departure) and submitting a draft of cruise instructions approximately 90 days prior to departure, with final instructions due 30 days prior to departure.

Given the proposed operating location of the RHB (lower end of the GC), the Port of Mazatlan, Mexico is a logical place to base logistical support for the ship *during* the NAME IOP.

In order to maximize the potential educational opportunities afforded by a platform such as the RHB, it is recommended that the scientific crew be rotated at approximately 15 day intervals during the field campaign (at the discretion of participating scientists). This should be easily accomplished by doing “touch and go” port calls in Mazatlan (~6 hour transit from the proposed fixed operating location) and a crew rest port call of several days scheduled in the middle of the field campaign (Table 1).

Table 1. “Strawman” schedule proposed for NAME operations, summer 2004:

15 July	RHB arrives on station, southern end of the Gulf of California (e.g., 107.5° W 22.5° N)
15 July – 29 July	Data collection, cruise 1
30 July	Mazatlan. Exchange scientific crew/resupply as required.
31 July – 14 August	Data collection, cruise 2
15 August – 18 August	Mazatlan. Ship’s-crew port call, exchange scientific crew/resupply as required
19 August – 2 September	Data collection, cruise 3
3 September	Mazatlan. End of NAME RHB participation

v. *Estimated budgets*

Estimated budgets cover a three year period and include participation in a 6-8 week NAME intensive field campaign (personnel, equipment, equipment installation/operation), data analysis, post field campaign travel (conferences, meetings etc.) and indirect costs/overhead:

- a. CSU: RHB C-band radar operation (24 hr/day) and sounding data collection (6-8 /day) ~550 K / 3 years (200 K year 1, 175 K years 2 and 3)
- b. NOAA-ETL: surface flux/meteorological equipment, cloud-radar and profiler operation ~600 K / 3 years (200 K per year).

vi. *References*

- Boccippio, D. J., W. A. Petersen, R. Cifelli and S. A. Rutledge, 2002: Diurnal cycle of convection in the East Pacific ITCZ during EPIC-2001. *25th Conference on Hurricanes and Tropical Meteorology*, American Meteorological Society, April 29-May 3, 2002, San Diego, California.
- Cifelli, R. C., W. A. Petersen, D. J. Boccippio, C. W. Fairall, and S. A. Rutledge, 2002: Ship radar observations of a developing hurricane in the East Pacific. *25th Conference on Hurricanes and Tropical Meteorology*, American Meteorological Society, April 29-May 3, 2002, San Diego, California.
- Fuller, R. D., and D. J. Stensrud, 2000: The relationship between tropical easterly waves and surges over the Gulf of California during the North American Monsoon. *Mon. Wea. Rev.*, **128**, 2983-2989.
- Petersen, W. A., R. Cifelli, D. J. Boccippio, and S. A. Rutledge, 2002: Convection and easterly waves observed in the eastern Pacific ITCZ during EPIC-2001. *25th Conference on*

Hurricanes and Tropical Meteorology, American Meteorological Society, April 29-May 3, 2002, San Diego, California.

Ryan, M, M. J. Post, B. Martner, J. Novak and L. Davis, 2002: The NOAA Ron Brown's shipboard Doppler precipitation radar. *6th Symposium on Integrated Observing Systems*, American Meteorological Society, Orlando, Florida, January 2002.

Stensrud, D. J., R. L. Gall, M. K. Nordquist, 1997: Surges over the Gulf of California during the Mexican Monsoon. *Mon. Wea. Rev.*, **125**, 417-437.