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Bermuda to Charleston Transit (September 2 – 5, 2012)

Summary

The PNE/AEROSE research cruise originally scheduled for August 31 – Sep 30, 2012 was postponed due to mechanical challenges with the NOAA RHB propulsion systems. Consequently, the ship was redirected to return to Charleston, SC from St. George's, Bermuda rather than along the original project cruise track. The PNE and PMEL scientific parties largely departed prior to the westward transit. A smaller contingent from the AEROSE scientific team (five members), a scientist from the University of Miami, and an international visitor (Indonesian national) accompanied the NOAA Corps officers and crew on the transit to Charleston, SC to perform some background measurements and to provide educational and training experiences for the students and international visitor aboard the vessel. The AEROSE team conducted atmospheric and oceanographic measurements during the four-day transit that included 2 CTD casts, several radiosonde launches, one ozonesonde launch, aerosol sampling experiments, and measurements of atmospheric radiation, and SST measurements.

The officers and crew of the Ronald H. Brown made every effort to accommodate the relegated efforts and enabled a successful, albeit abbreviated, scientific and training endeavor in the subtropical North Atlantic Ocean. The CO (Mark Pickett), XO (Elizabeth Kretovic), and FOO (Paul Chamberlain) are to be commended for their efforts to keep everyone informed and up to date on the latest information relevant to the scientific operations. The lines of communication regarding the status of the vessel, underway operations, weather conditions, and accommodation requirements that arose after the cancellation of the PNE/AEROSE cruise were excellent. Ad hoc CTD casts were coordinated with the assistance of Lt. Chamberlain and NOAA AOML scientists and ably supported by the survey techs. This is a prime example of an endeavor that would otherwise have been a lost opportunity for training and data collection.

On behalf of the AEROSE Team I express our gratitude for all of their hard work and outstanding contributions to the abbreviated cruise. I recognize that the adjustments to schedule and operations were extremely short notice and came on the heels of some disappointing news regarding the vitality of the ship and the cancellation of the PNE/AEROSE cruise. I also acknowledge how much time and energy these assignments demand and I deeply appreciate all of the efforts to make it a great success. Jonathan Shannahoff's personal attention to detail was of great assistance to the CTD deployments and ensured that they were completed in a safe and timely manner. As always, it is great to know that we can count on the officers and crew of the NOAA Ronald H. Brown to go the extra mile.

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Scientific Background

The Aerosols and Ocean Science Expeditions (AEROSE) constitute a comprehensive measurement-based approach for gaining understanding of the impacts of long-range transport of mineral dust and smoke aerosols over the tropical Atlantic (Morris et al., 2006; Nalli et al., 2011). This project was initiated and led by scientists from the NOAA Center for Atmospheric Sciences at Howard University (NCAS). The project, involving international coordination of monitoring in Puerto Rico, Mali, the Canary Islands, and Senegal, hinges on multi-year, trans-Atlantic field campaigns conducted in collaboration with PNE project over the tropical Atlantic. AEROSE is supported through collaborative efforts with NOAA's National Environmental Satellite Data and Information Service, Center for Satellite Applications and Research (NESDIS/STAR) and the National Weather Service (NWS), as well as NASA and several academic institutions linked through the NCAS partnership.

The AEROSE campaigns (to date, comprised of eight separate trans-Atlantic Project legs) have thus provided a set of in situ measurements to characterize the impacts and microphysical evolution of continental African aerosol outflows (including both Saharan dust and sub-Saharan and biomass burning) across the Atlantic Ocean (Nalli et al., 2011). AEROSE has sought to address three central scientific questions (Morris et al., 2006):

1) How do Saharan dust, biomass burning aerosol, and/or the SAL affect atmospheric and oceanographic parameters during trans-Atlantic transport?

2) How do the Saharan dust aerosol distributions evolve physically and chemically during transport?

3) What is the capability of satellite remote sensing and numerical models for resolving and studying the above processes?

Due to the reduced number of days at sea and the altered ship track, the AEROSE team redesigned a strategy to focus on opportunistic measurements of outflows from the eastern seaboard of the US, boundary layer dynamics in the subtropical marine environment, and aerobiological transport both within the marine boundary layer and across the air-sea interface. Details of the measurements are provided below.

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Atmospheric Data

1. A total of five (5) radiosondes and one (1) ozonesondes were successfully launched during the cruise. Three of these measurements were scheduled to either coincide with specific satellite overpasses for the new NOAA/NASA NPOESS Preparatory Project satellite, launched last October, and currently undergoing its cal/val stage) to profile other interesting atmospheric features of the marine boundary layer connected to long-range air mass transport and convective mixing in the subtropical marine environment. Satellite validation is a critical component of the AEROSE data set and provides unprecedented mapping of atmospheric thermodynamics under various aerosol and moisture regimes.

   The radiosondes were effective in profiling the behavior of the marine boundary layer during an active period in the Caribbean and subtropics. The ship track also provided a unique set of observations within a dry air tongue that extended across the western Atlantic within the marine boundary layer region, resulting from outflows from the remnants of Hurricane Isaac over the southeastern US.

   Due to the reduced number of soundings and days at sea the data is primarily usable for integrating into the larger dataset. We will acquire the matchup granules (NUCAPS and official operational EDR products) and show them as isolated sounding matchups as a teaser for the actual PNE/AEROSE cruise postponed for January 2013. These data will also be combined with those acquired during the next AEROSE mission.

2. Continuous radiometric measurements employing short wave and long wave radiometers (UM-RSMAS) and the spectrally resolved M-AERI SST measurements were obtained throughout the cruise.
   Spectral measurements of the direct solar radiation were collected using a handheld sun photometer (NCAS). These latter data allow calculation of the columnar aerosol optical depth (AOD) and an estimation of the aerosol size distribution in the column. Students from AEROSE and the international visiting scientist collected over 500 of these measurements for clear sky conditions permitting direct line-of-sight to the sun.

3. A microwave radiometer and full-sky camera (UM-RSMAS) was operated continuously throughout the cruise. These data assist in characterizing the influence of cloud cover and properties on SSTs, radiative balance, and energy transfer in the lower marine atmosphere.

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4. Atmospheric sampling of ambient aerosols for off-line biological (both fungi and bacteria), chemical (total organics, heavy metals, cations and anions, and elemental distribution), and physical characterization were collected throughout the cruise using three instruments. A six-stage cyclone impactor was used for size-segregated sampling for offline chemical analysis. A sequential filter sampler was used for PM10 sampling and a single stage TSP aerobiological filter was deployed for microbial analysis of marine air masses. A total of twenty (20) filter samples were collected – two (2) MCE filters for microbial analysis, six (6) PTFE filters for general chemical screening of PM10, and twelve (12) glass fiber filters for chemical analysis.

   While no chemical analyses were performed on the vessel, we anticipate that the integrity of the filters are good and will be processed in the analytical labs in Washington, DC.

Oceanographic Data

Two CTD casts were performed using the AOML rosette. NOAA scientists Drs. Molly Baringer and Claudia Schmid facilitated this activity. Two 500-m casts were conducted on September 3 and 4. The casts provided a key instructional opportunity for both students in the AEROSE scientific party and for the visiting scientist. Seawater samples were collected at nine (9) depths (500-m, 400-m, 300-m, 200-m, 100-m, 75-m, 50-m, 25-m, and surface) in support of the development of improved understanding of air-sea exchange of airborne microbes and their transport in the mixed-layer. The CTDs were coordinated with satellite overpasses and their simultaneous radiosonde and ozonesonde launches. The CTD data will be processed in Howard University and coupled with RS-92s profiles of the lower atmosphere and shipboard meteorological data to conduct a study case of air-sea interactions and to project additional studies of this kind in the successive campaigns