Nauru99 Ship and Buoy Intercomparison

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Introduction

The Nauru99 campaign was conducted in the tropical western Pacific Ocean near the site of the U.S. Department of Energy (DOE) Cloud and Radiation Testbed (CART) site on the island of Nauru in June-July of last year. The overall experimental design included the characterization of the island as a platform for the various long-term remote sensing systems and a comparison of the resident measurements at the array of Tropical Atmosphere Ocean (TAO) buoys nearby. This task required the use of two mobile platforms: the National Oceanic and Atmospheric Administration (NOAA) Ship Ronald H. Brown and the Japanese Marine Science and Technology Center (JAMSTEC) Research Vessel (R/V) Mirai. During Nauru99, the Brown and Mirai stationed themselves near the TAO buoys at 2 South/ 165 East and 0 South/165 East, respectively, for a period of approximately 7 days. In addition, the ships spent 4 days on station approximately 20 nautical miles apart within 15 nautical miles of the island. These days of multi-platform calibration and intercomparison are integral to the success of the Nauru99 mission. In addition to the suite of remote sensing systems, the ships' complement of instruments included those required to measure the mean meteorological conditions from the ships: wind speed and direction, air and sea surface temperatures, relative humidity, downwelling solar and infrared irradiance, and rainrate. Direct covariance measurements of the turbulent fluxes of heat and momentum were also

acquired from the Brown and the Mirai. We show comparisons between the mean meteorological measurements from the ships and the TAO buoys, and this information will provide a basis for cross-calibration of the various instruments.

Figure 1 shows the bow of the Ron Brown during the Nauru99 expedition, and the meteorological sensors were mounted on the jackstaff. Numerous remote sensing systems were also deployed on the ship, including three lidar systems, C-band, S-band, Ka-band, and wind profiler radars, ceilometer, and various radiometers. Interested readers should access the NOAA Environmental Technology Laboratory (ETL) Nauru99 web page at http://www.etl.noaa.gov/nauru99/ for more information.

Figure 1. Photo of the NOAA Ship Ronald H. Brown during Nauru99, showing the bow mast and various meteorological instruments. Also shown is the large C-band radar on the main mast.

Figure 2 shows a schematic of the "Large Triangle Configuration," which was employed for a period of 7 days during the expedition for buoy-ship intercomparison. Figures 3-8 present the result of the analysis of the ship and buoy data sets. Daily averages were computed for the mean meteorological measurements (wind speed and direction, solar irradiance, air and sea surface temperatures, and relative humidity).

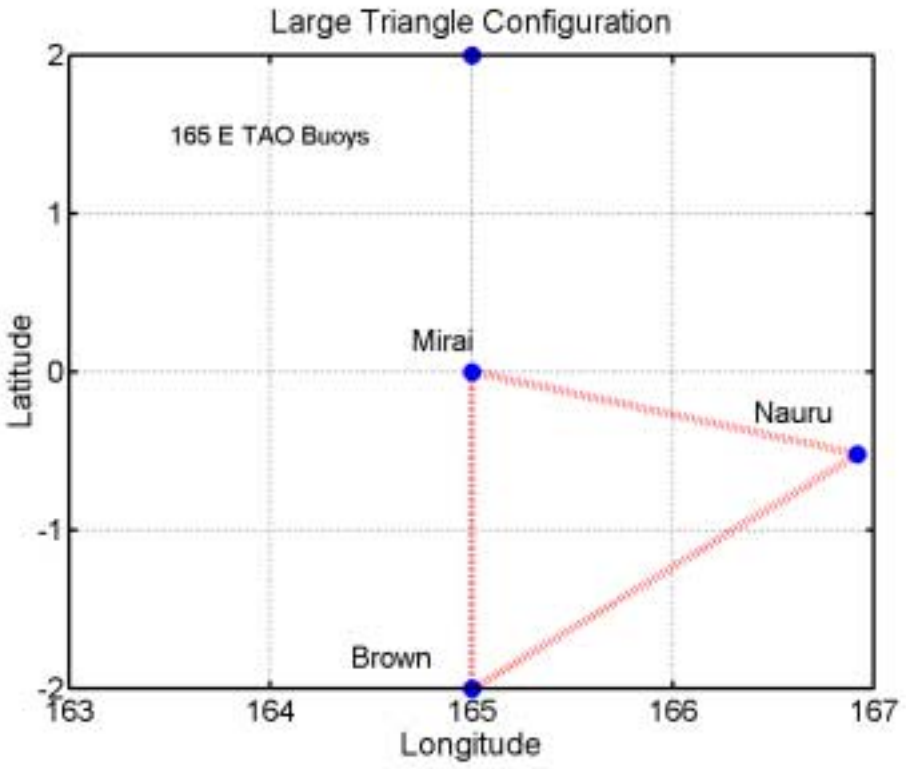

Figure 2. Schematic of the Large Triangle Configuration employed during the expedition to accomplish the intercomparison between the buoys (165E, 0N and 165E, 2S).

There are numerous discrepancies between the buoy and ship measurements. Most notable, is the remarkable difference seen in the air temperature measurements shown in Figure 5. Also, in Figure 8, we can see significant differences between the measurements of downwelling solar irradiance from the Ron Brown and those obtained from the buoy at 2 South. These differences would represent a significant error in any bulk flux model, for example.

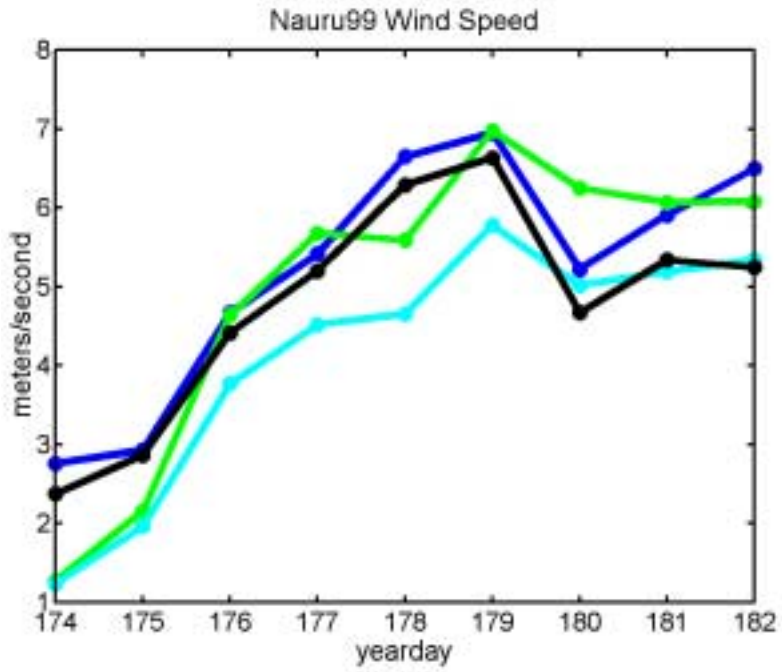

Figure 3. Daily-averaged wind speed from the buoy at 165E, 0N (blue), 165E, 2S (green), Ron Brown ETL system (cyan), and Mirai (black). Ship winds have been corrected to match the buoy measurement height.

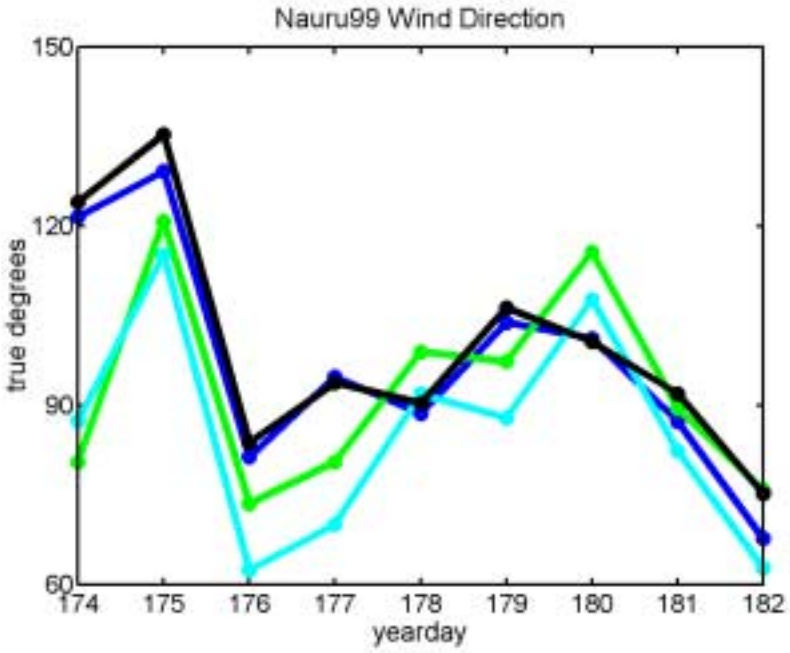

Figure 4. Daily-averaged wind direction from the buoy at 165E, 0N (blue), 165E, 2S (green), Ron Brown ETL system (cyan), and Mirai (black).

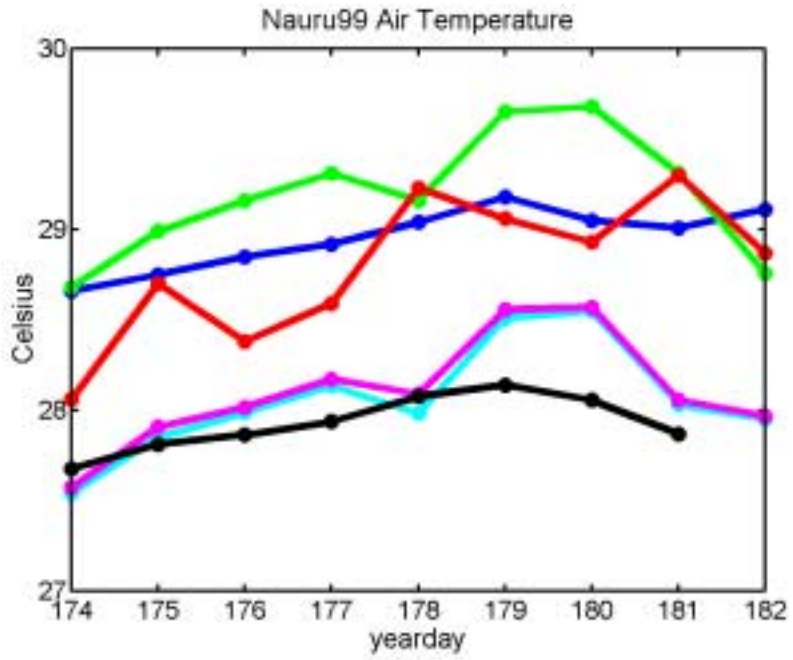

Figure 5. Daily-averaged air temperature from the buoy at 165E, 0N (blue), 165E, 2S (green), 165E, 5S (red), Ron Brown ETL system (cyan), Ron Brown ship system (magenta), and Mirai M-aeri system (black).

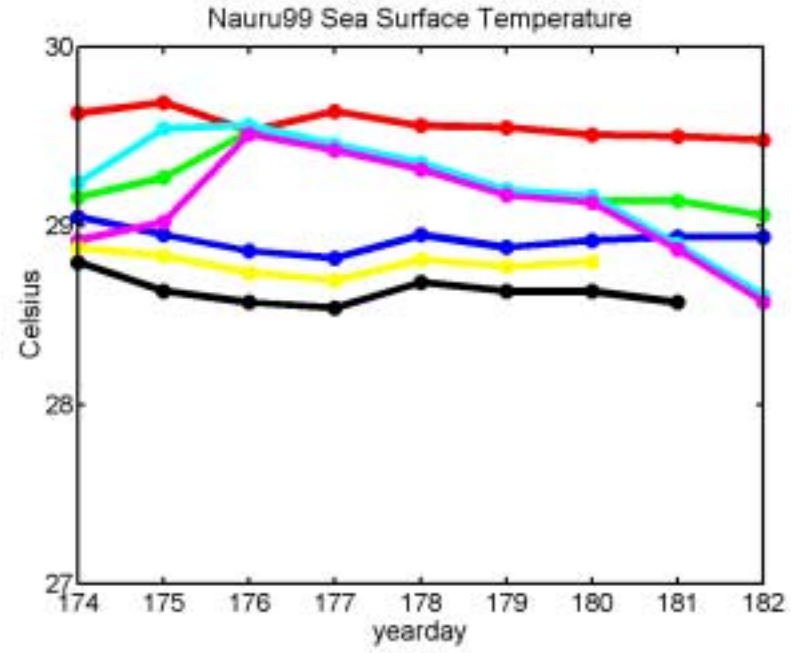

Figure 6. Daily-averaged sea surface temperature from the buoy at 165E, 0N (blue), 165E, 2S (green), 165E, 5S (red), Ron Brown ETL system (cyan), Ron Brown ship system (magenta), Mirai M-aeri system (black), and Mirai hat system (yellow).

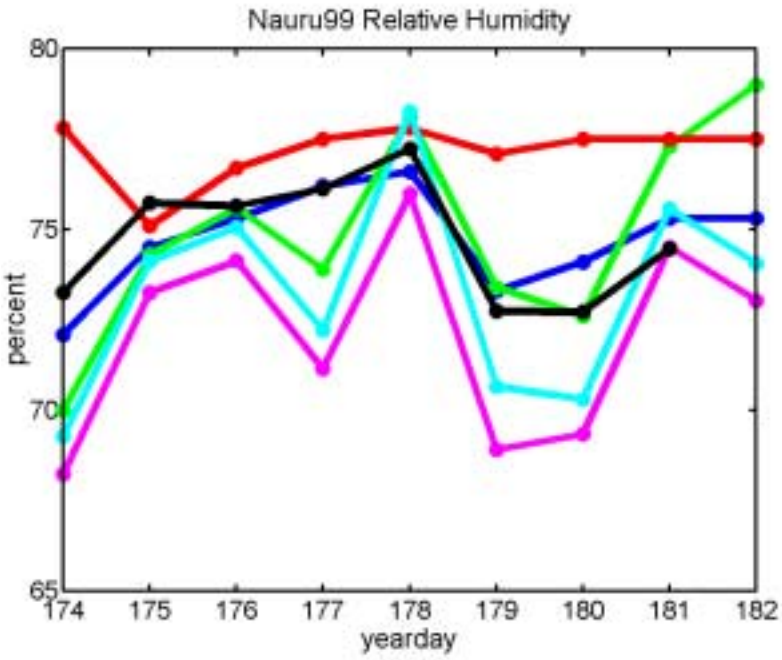

Figure 7. Daily-averaged relative humidity from the buoy at 165E, 0N (blue), 165E, 2S (green), 165E, 5S (red), Ron Brown ETL system (cyan), Ron Brown ship system (magenta), and Mirai National Center for Atmospheric Research (NCAR) system (black).

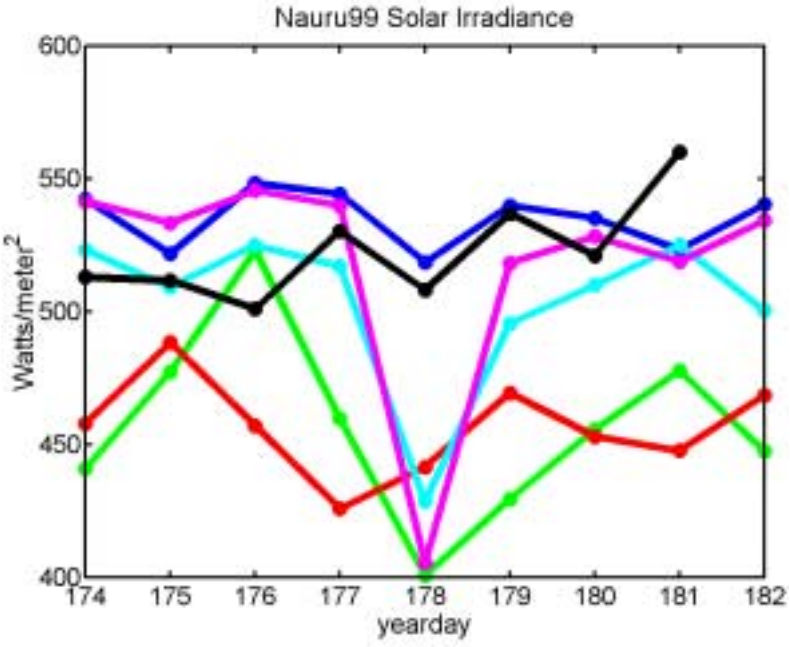

Figure 8. Daily-averaged downwelling solar irradiance from the buoy at 165E, 0N (blue), 165E, 2S (green), 165E, 5S (red), Ron Brown ETL system (cyan), and Mirai NCAR (black).