

**Progress Report**  
A NOPP Partnership for Skin Sea Surface Temperature  
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Andrew T. Jessup  
Applied Physics Laboratory, University of Washington  
1013 NE 40<sup>th</sup> St., Seattle, WA 98105-6698  
206-685-2609, [jessup@apl.washington.edu](mailto:jessup@apl.washington.edu)

web site: <http://cirims.apl.washington.edu>

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**Summary**

As part of the FY02 NOPP SST Topic, APL-UW is deploying two existing autonomous shipboard radiometer systems called CIRIMS. The calibrated skin temperature measurements will be used by our partners in the development of a prototype system for producing and evaluating a satellite-derived skin temperature product. In June 2003, the first CIRIMS unit was deployed on the NOAA R/V *Ronald H. Brown*. The second unit will be deployed on the University of Washington R/V *Thomas G. Thompson* in November 2003. The CIRIMS units have been modified to transmit data on a daily basis back to APL-UW via Iridium satellite telephone modem. The CIRIMS on the *Brown* has been operating properly. A web site has been established to provide information about past and current CIRIMS deployments and data access. Under separate funding, we have also installed two through-the-hull temperature sensors on the *Brown* at 2 m and 3 m depth. An identical set of through hull temperature sensors also will be installed on the *Thompson*.

**Installation on the NOAA R/V *Ronald H. Brown***

Under previous funding, the CIRIMS was deployed multiple times on the R/V *Ronald H. Brown*. For these deployments, the CIRIMS was mounted in the 10-m tower located near the bow, which was ideal because it provided a view of the surface well ahead of the bow wake and was not subject to heavy spray during severe weather. For this project, we have chosen to mount the CIRIMS on the flying bridge because the tower has been removed. The flying bridge location was chosen after careful analysis of the location of the wake using aerial photographs of the *Brown* as in Figure 1 and *in situ* measurements using a laser-based alignment system.

The CIRIMS consists of a sensor unit that is mounted on the deck to view undisturbed water and an electronics unit that is housed indoors and contains the acquisition and control hardware. The sensor and electronics units are connected by 100 feet of cable. Figure 2 shows the CIRIMS sensor unit on the starboard side of the flying bridge of the *Brown*. The sensor unit is mounted on a platform that is anchored via a standard twistlock stacker mechanism welded to the deck. The signal and control cables were passed through the existing cable feed-thru, indicated in Figure 2, to the ceiling in the bridge. The cables were routed through existing collars to the chart room, where the electronics unit was installed.

During the last drydock of the *Brown* in April 2002, we installed two thru-the-hull ports at depths of 2 m and 3 m below the mean water line, shown in Figures 3. The mechanism attached to the hull ports is designed to allow the sensors to be installed and removed with the ship in the water. The sensors are mounted in a cylindrical cartridge that slips into the ball valve assembly attached to the hull port. The cartridge is fitted with two O-ring seals with a spacing that provides a seal on both sides of the ball valve when fully inserted. In order to insert the sensor, the ball valve is closed and the end cap is removed. The cartridge is inserted to the point where the first O-ring seals and the ball valve is opened. The cartridge is then inserted fully so the first O-ring seals on the outboard side of the valve and the second O-ring seals on the inboard side. An expansion mechanism is used to fix the cartridge in position and the end cap is replaced.

Primary modifications to the ship were:

1. Welding twistlock mechanisms to flying bridge deck (Fig. 2)
2. Use existing cable feed-thru from flying bridge to chart room (Fig. 2)
3. Use of shelf space in chart room for electronics unit
4. Installation of thru-hull ports in bow thruster room (Figs. 3 and 4)
5. Routing hull sensor cables from bow thruster to chart room via ship cableways

The *Brown* typically spends most of the cruise season in the Atlantic with the exception of an annual cruise to service the TAO buoys along 95W. This year the *Brown* made a circumnavigation of the North Atlantic, which is shown in the ship track up to 10 November 2003 in Figure 4. This cruise season provided a wide range of latitude and temperature, as indicated by the colorscale of the ship track.

Figure 5 is an example of the weekly summary plots that are generated and posted on the web site. The influence of sky conditions on the bulk skin temperature difference is evident. The bulk skin temperature difference was much larger when the sky was clear on 6/20/03 than when it was cloudy on 6/24/03. We have found the availability of bulk temperature at the intermediate depths is very valuable in assessing the CIRIMS performance since the temperature at these depths more closely follows the skin SST than that at 5 m.

The time series in Figure 6 illustrates the capability for underway measurements of the diurnal warm layer provided by the combination of the intermediate depth bulk temperature and the skin temperature. Beginning at about noon local time, a subsurface temperature gradient is apparent between the skin and 5 m. The skin temperature rises above the bulk temperature measured at 2 m near the time of maximum solar insolation and a wind speed minimum. Note also that the bulk temperature at 5 m shows a jump that is correlated with the ship's speed. This example also demonstrates the importance of understanding the effect of the ship's speed on the underway bulk temperature measurements.

On 8 August 2003, the temperature sensor at 2 m stopped working. We sent an engineer to meet the *Brown* in Pensacola, FL in October but were unable to remove the sensor. We plan to try again after the *Brown* returns to Charleston in December.

### **Installation on the UW R/V *Thomas G. Thompson***

An installation identical to that on the *Brown* will be done on the *Thompson* in November 2003, when she is in drydock for scheduled maintenance. The *Thompson* typically spends her cruise season in the Pacific. The current schedule is for the *Thompson* to leave Seattle in late 2003 for the Western Pacific, returning to Seattle in July 2004, then on the Galapagos Islands via Hawaii at the end of the year, as shown in Figure 7.

### **Distribution of Results and Data**

A web site (address above) has been established to provide background information and data distribution. In addition to data being gathered for the current project, we have also posted historical data. The data are available in the format specified for the MODIS validation software by Peter Minnett, University of Miami. We will present our latest results at the 2004 AGU Ocean Sciences Meeting in January.

### **Plans for 2004**

The CIRIMS on the *Brown* will be serviced during the winter in-port period in Charleston during December 2003 and January 2004. There is a possibility that the M-AERI will be on the *Brown* for a cruise in February 2004, which will provide an excellent opportunity for further cross-calibration. We anticipate continuous operational deployment for both CIRIMS units on the *Brown* and *Thompson* through the end of 2004.

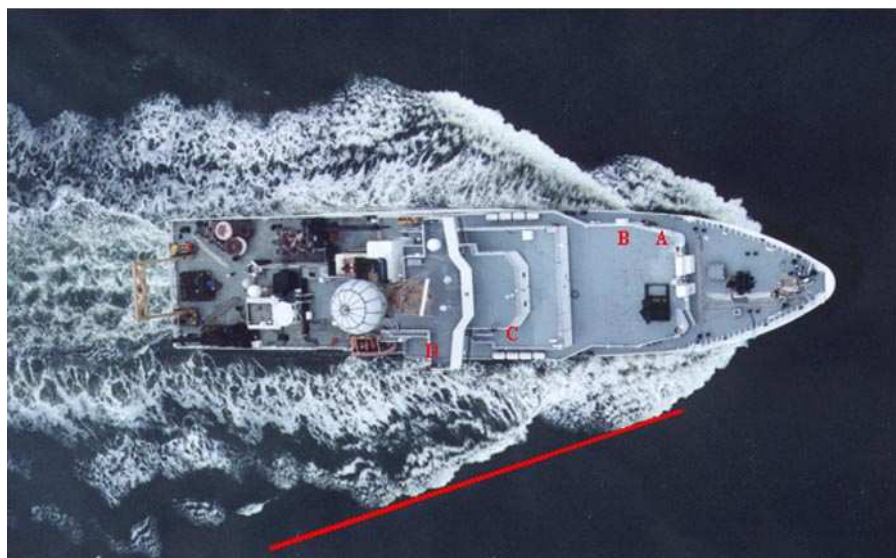


Figure 1. Aerial photograph of the *Brown* during its return to Charleston on 30 November 2002. This photograph was used to determine the suitability of the four potential mounting locations indicated by the letters A-D. We determined that the at an incidence angle of  $40^\circ$ , a view of the surface ahead of the wake would be achieved by mounting the CIRIMS approximately 12 feet above the deck at location D on the flying bridge.

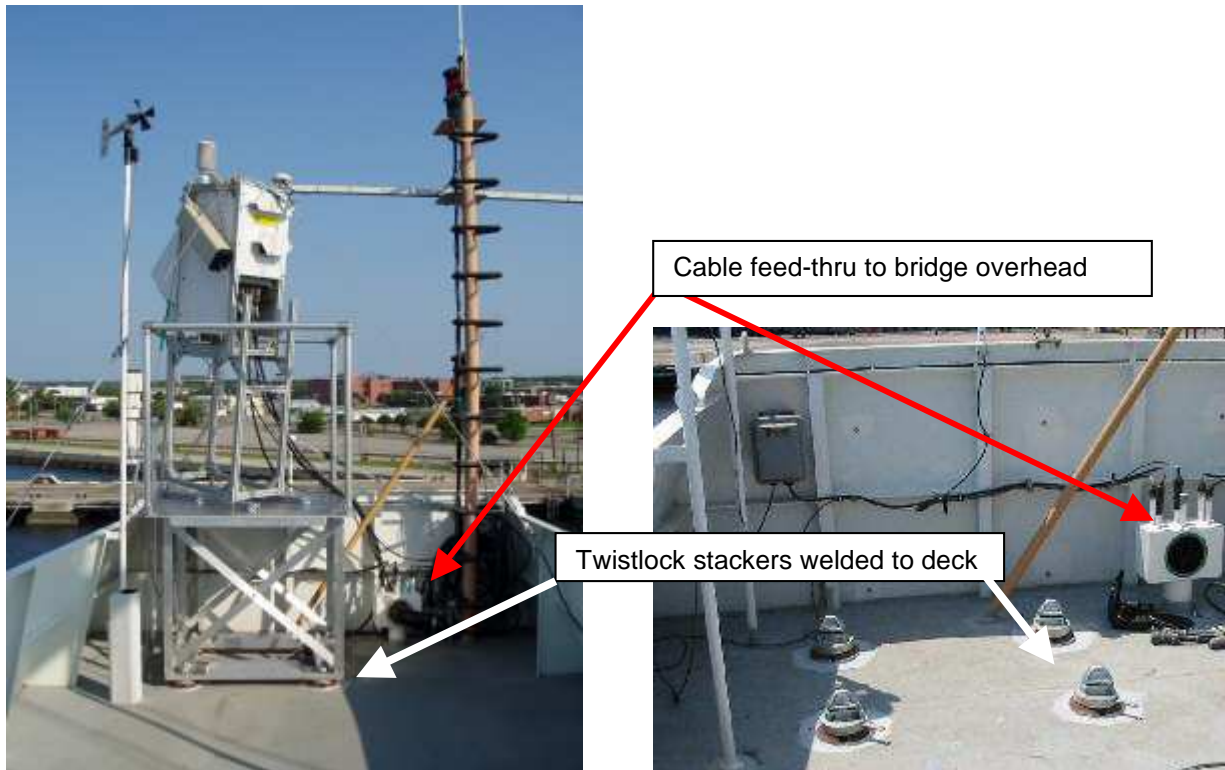


Figure 2. CIRIMS sensor unit mounted on platform attached on starboard side of flying bridge on NOAA R/V *Brown*. The platform is approximately 4' high and is attached to fittings welded to the deck. The cable feed-through to the electronics in located in the chart room is also shown.



Figure 3. Through-the-hull sensor ports located in the bow thruster room on the *Brown*. The ports are 2 m and 3 m below the water line.

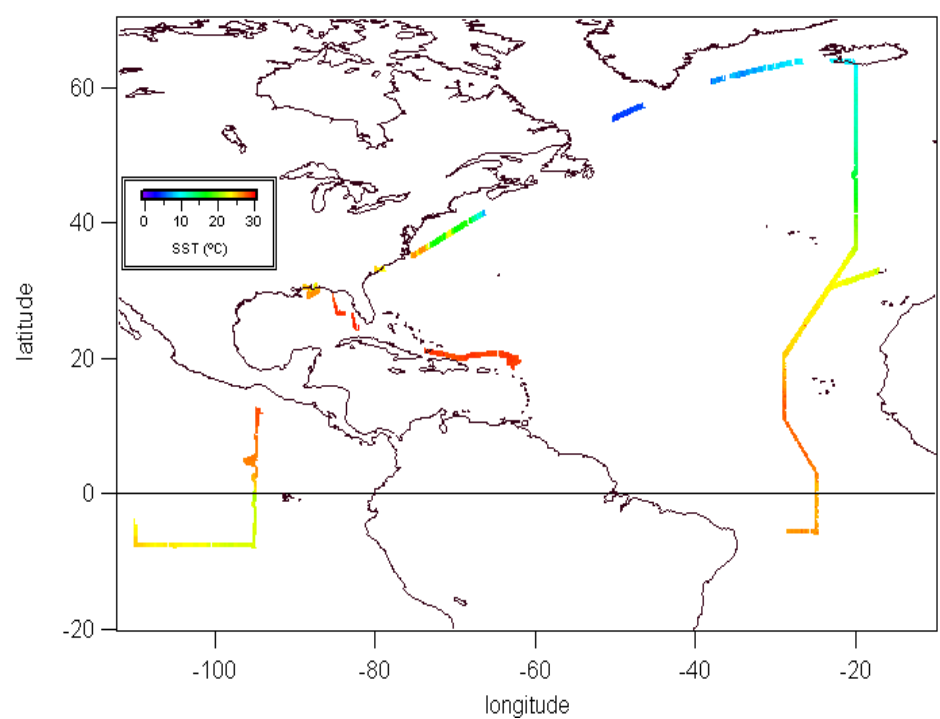


Figure 4. Ship track for the *Brown* from June through October 2003. The measured skin SST is indicated by the color of the track.

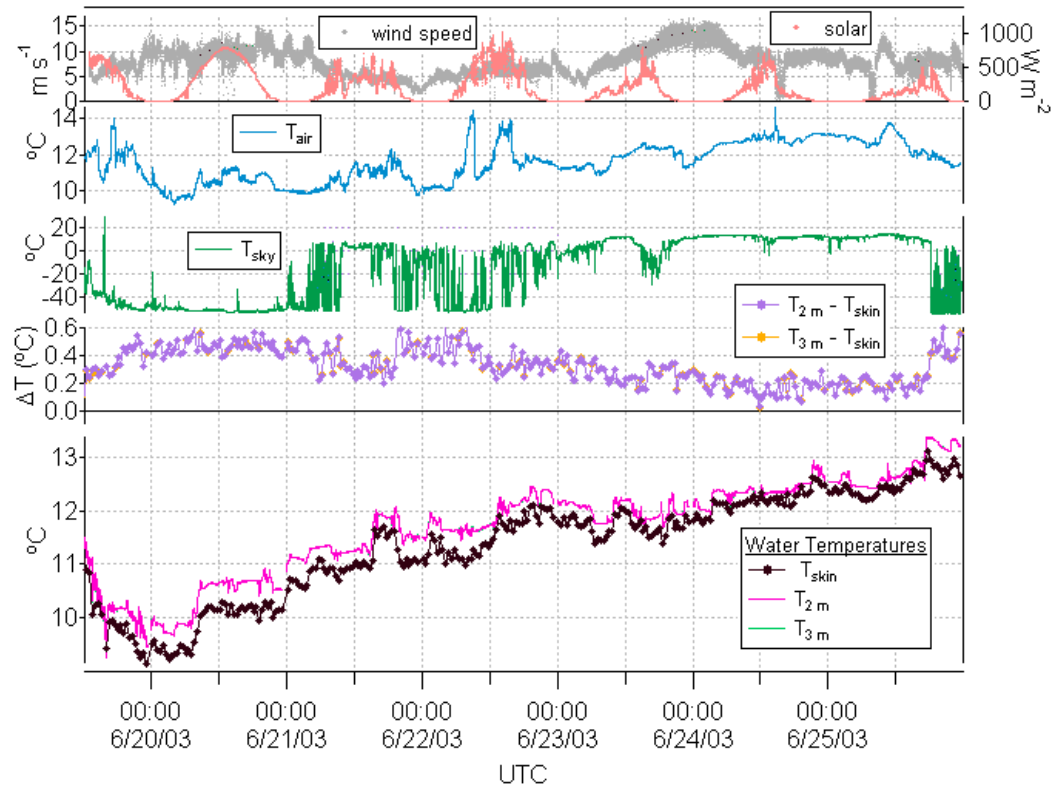


Figure 5. Example of weekly plots posted on web site summarizing skin and bulk temperatures and other environmental measurements supplied by the ship.

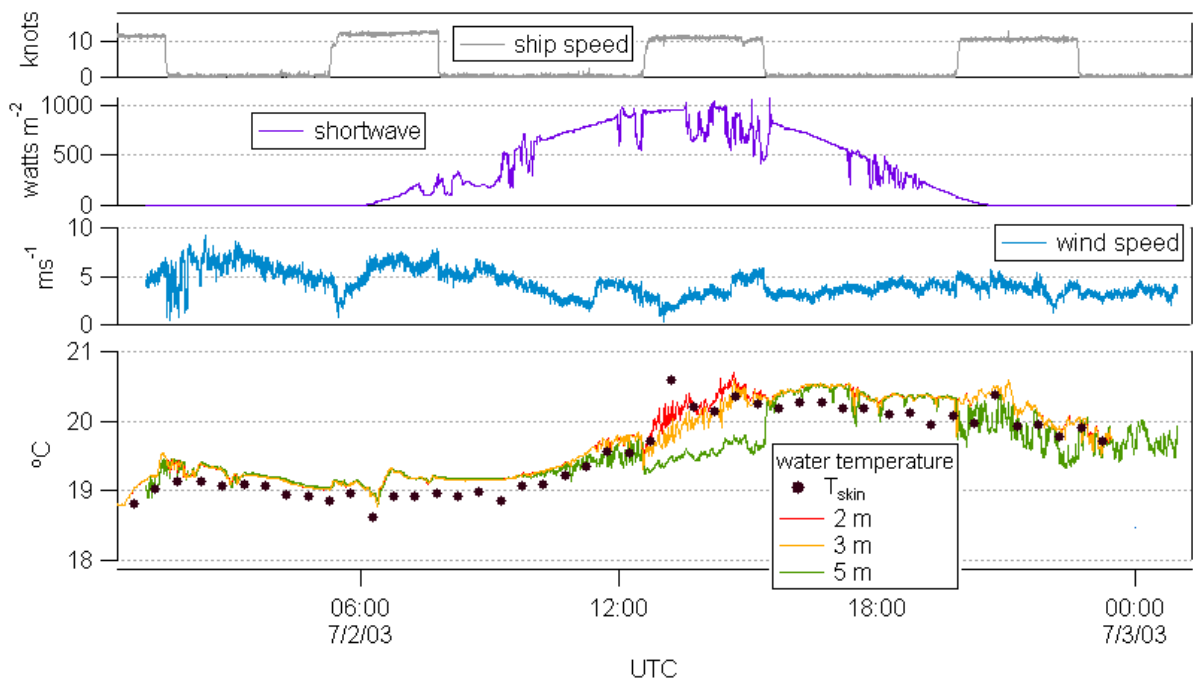


Figure 6. Time series of ship speed, solar insolation, wind speed, and skin and bulk temperature from 2 July 2003 showing underway measurement of the diurnal warm layer.

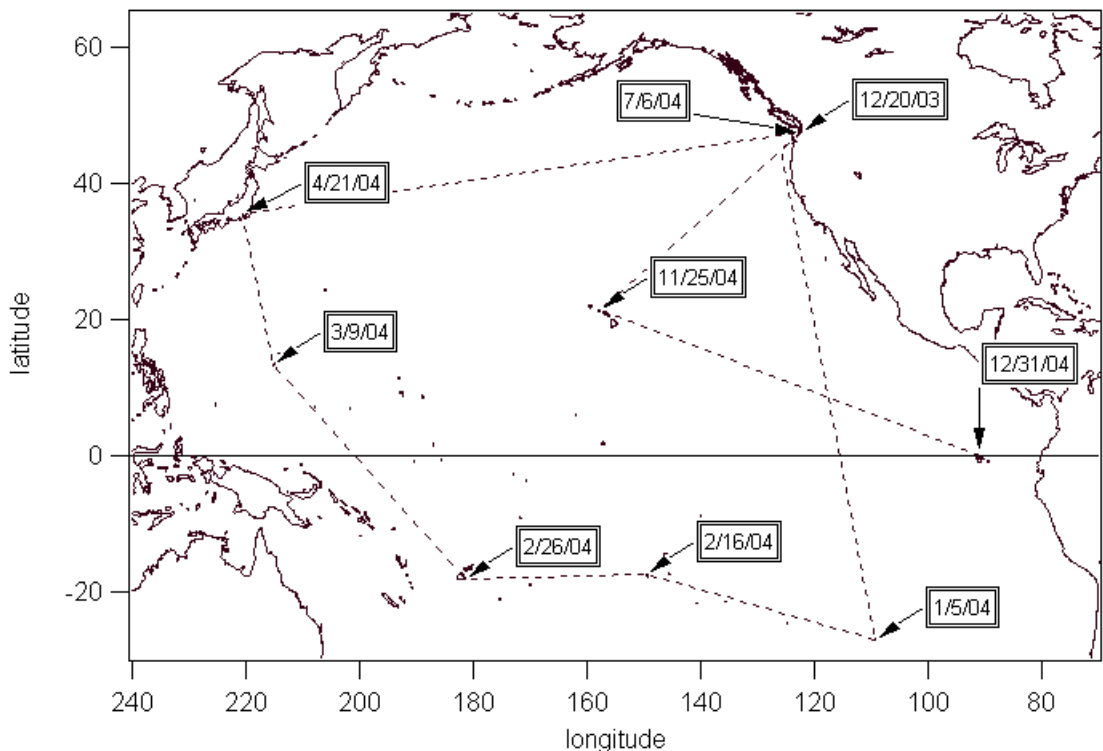


Figure 7. Scheduled *Thompson* cruise track for 2004 season, beginning 20 December 2003 in Seattle. Order of destinations are as follows: Easter Island, Tahiti, Fiji, Guam, Yokohama, Seattle, Honolulu, and the Gallopogos Islands.