

Infrared Radiometers on Ships for the Validation of Satellite-Derived Sea-Surface Temperature



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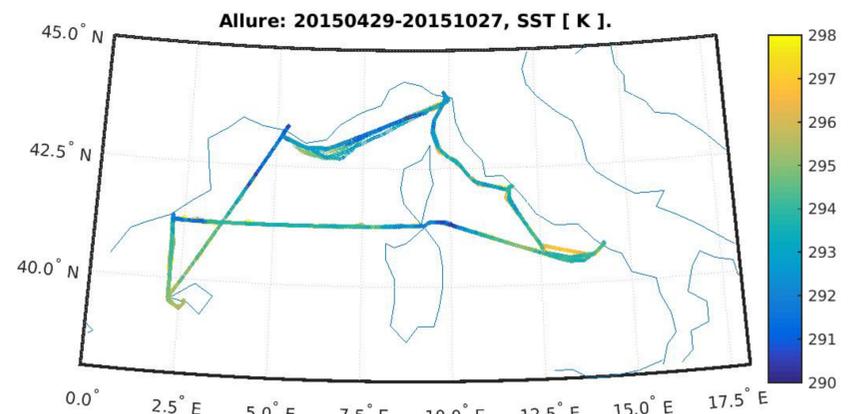
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Two **Marine-Atmospheric Emitted Radiance Interferometer (M-AERI) Mk2s** have been installed on two cruise ships of Royal Caribbean International, the *Allure of the Seas* and *Celebrity Equinox*. Both ships spent the summer of 2015 in the Mediterranean Sea and apart from status monitoring over a satellite link, the instruments performed well with a high rate of data return. The instruments were removed after the ships returned to the USA and were calibrated post-deployment, refurbished, and calibrated prior to redeployment. The *Celebrity Equinox* is operating in the Mediterranean Sea for the summer, while the *Allure of the Seas* remains in the Caribbean area. The instruments held their calibration very well during the deployments which lasted over a year and during which time were running autonomously.

An **Infrared Sea surface temperature Autonomous Radiometer (ISAR)** is deployed on the commercial ship M/V *Andromeda Leader* that plies between Japan and the USA. ISAR data are reported in real-time via an Iridium data link. The instruments have generally performed very well, retaining calibration and providing a high rate of data return. For validation results, see Poster 31, Minnett et al.

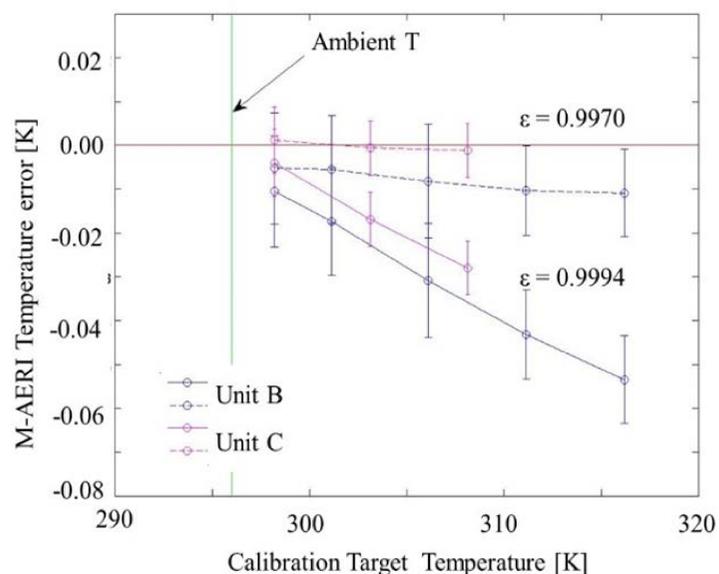


Installations of M-AERI Mk2 on cruise ships (yellow arrows). The instruments are inside hermetically sealed aluminum shipping crates, with the fore-optics on the sheltered, aft sides of the enclosures. The smaller boxes contain air-conditioning units to limit temperature and humidity variations in the instrument enclosures.



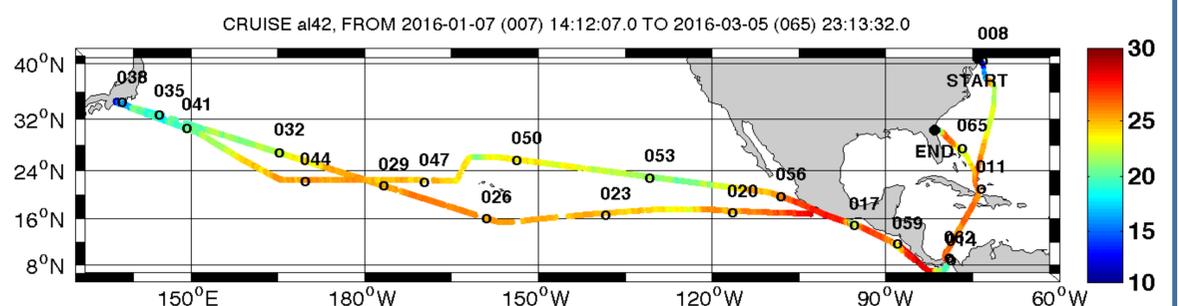
Tracks of the Allure in the Mediterranean Sea colored by the skin SST measured by the M-AERI, in K as shown by the scale at right. Multiple tracks are overlaid.

Before and after deployment the M-AERIs undergo a rigorous laboratory calibration against a NIST-traceable water-bath blackbody target.



Laboratory calibration results of two M-AERI MK2s (Units B & C) prior to recent deployments. The tilted lines, marked by $\epsilon=0.9994$, are indicative of an over-estimate of the blackbody cone emissivity. Reducing the emissivity estimate to 0.9970 largely removes the tilt. Note the tick mark interval on the vertical scale is 10mK. The cone emissivity will be established at the Fiducial Reference Measurements for Surface Temperatures Infrared Radiometry Workshop at the National Physical Laboratory, Teddington, London, UK.

An **Infrared SST Autonomous Radiometer (ISAR)** is running on the commercial ship M/V *Andromeda Leader* that plies between Japan and the USA. ISAR data are reported in real-time through an Iridium data link.



A recently completed track of the M/V *Andromeda Leader*, January 7 to March 5, 2016, colored by the skin SST measured by an ISAR according to the temperature scale at right, in °C.

As part of the CEOS-sponsored Fiducial Reference Measurements for Surface Temperatures, several radiometers will be mounted along-side the M-AERI on the *Allure of the Seas* in 2016 to make comparative skin SST measurements to assess the relative calibration accuracies.

