

# Sea-Based Infrared Radiance Measurements of Ocean and Atmosphere from the ACAPEX / CalWater 2 Campaign

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## Marine-AERI

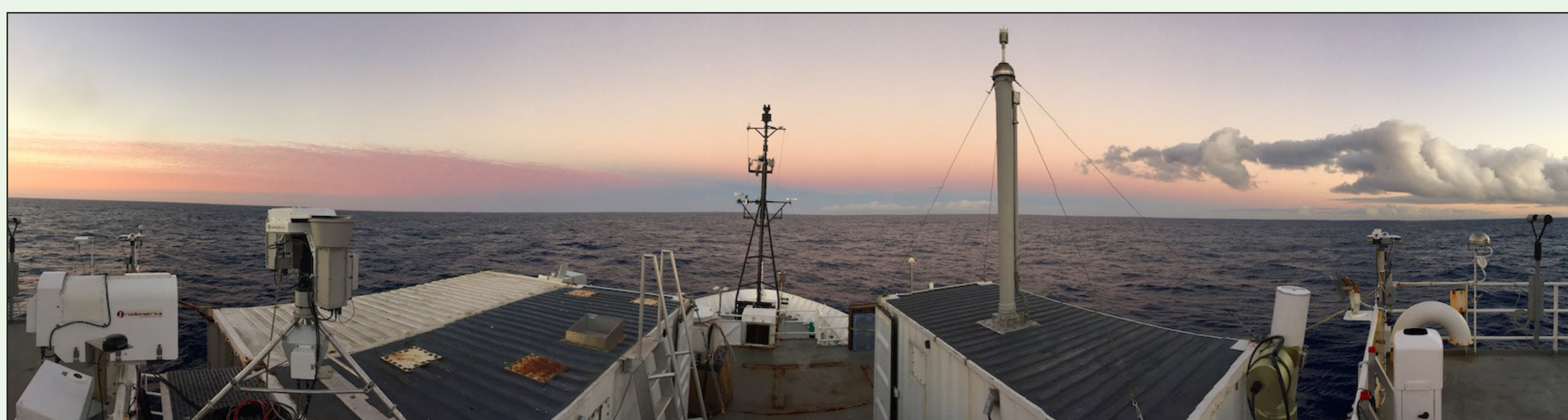
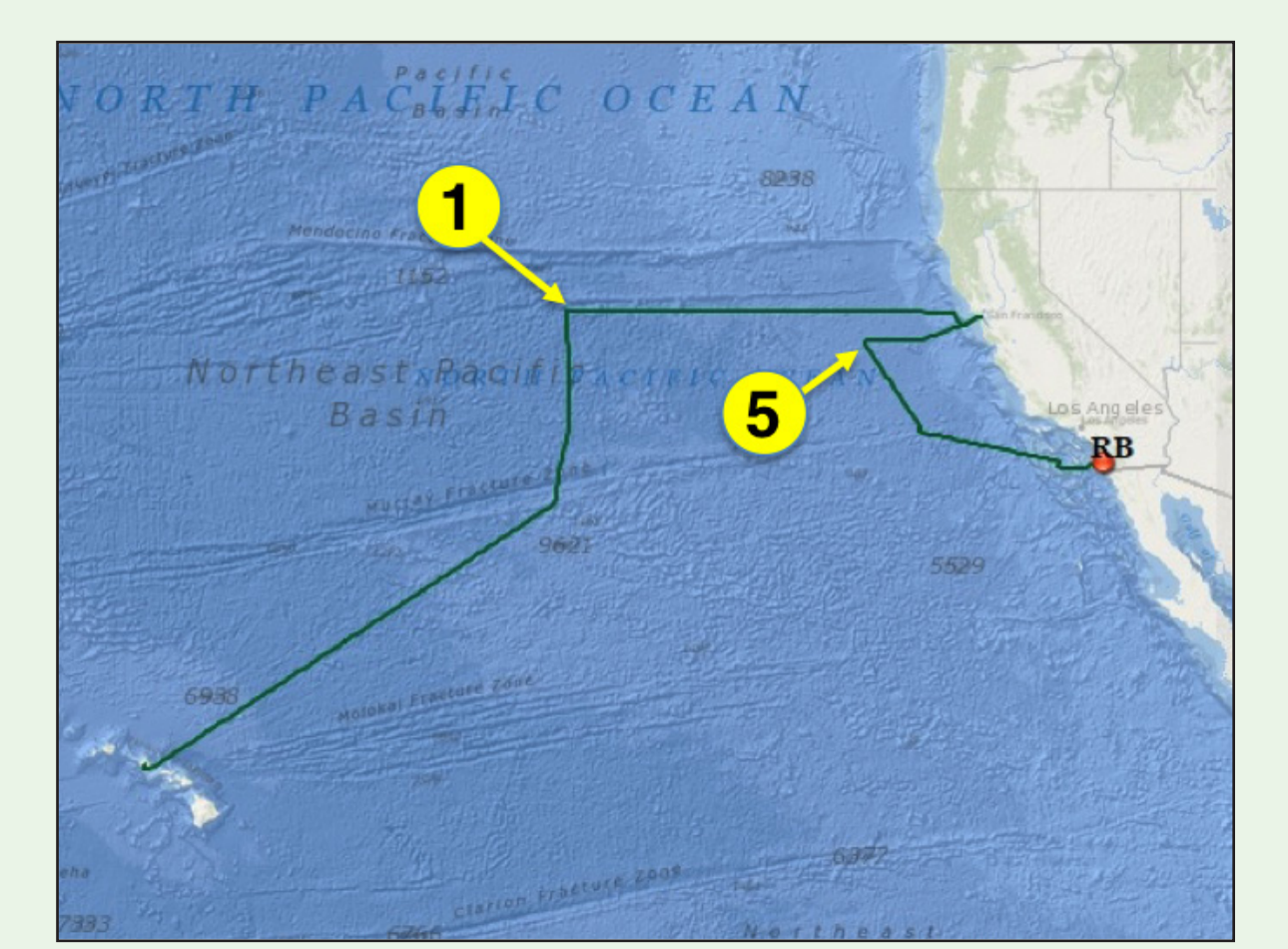
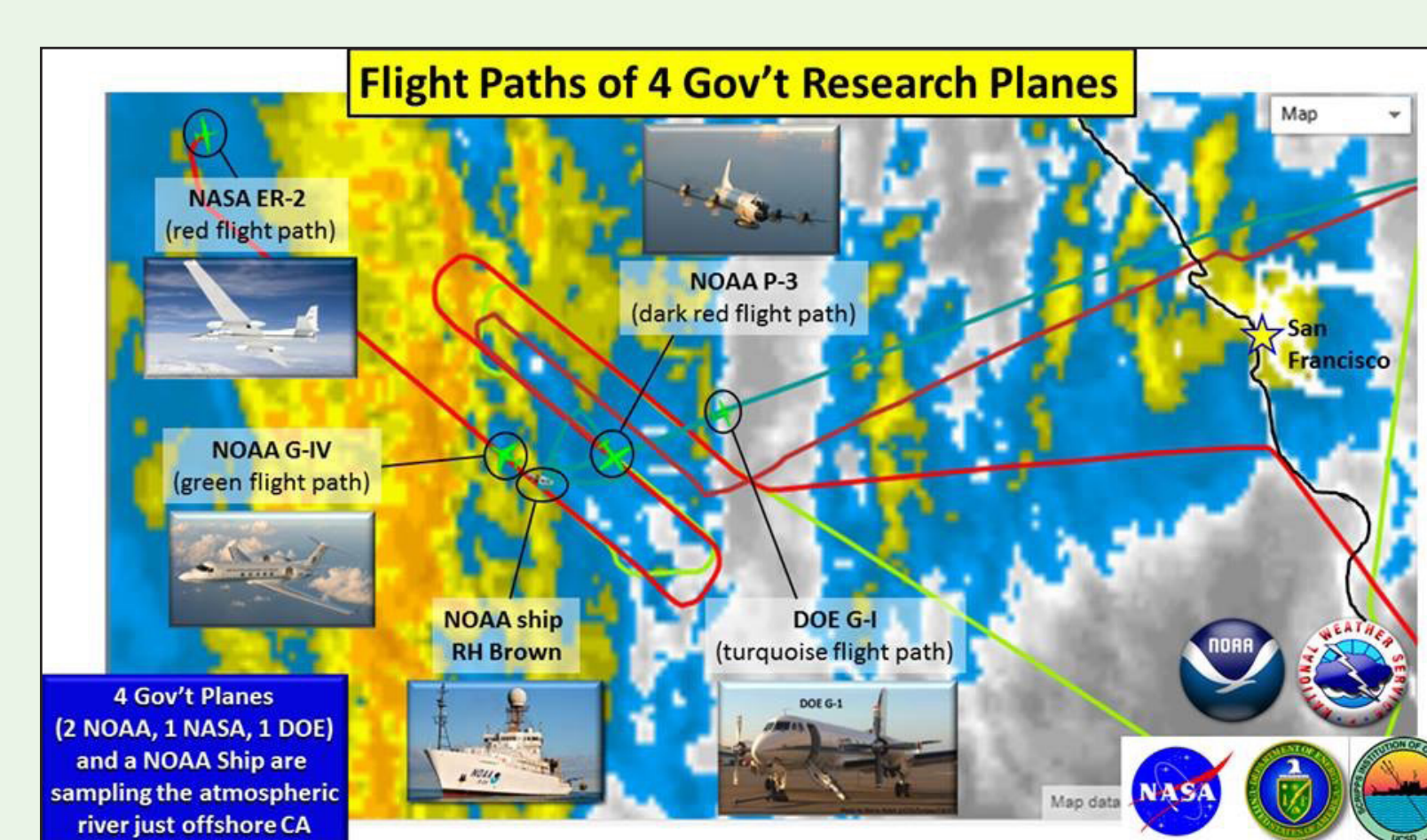
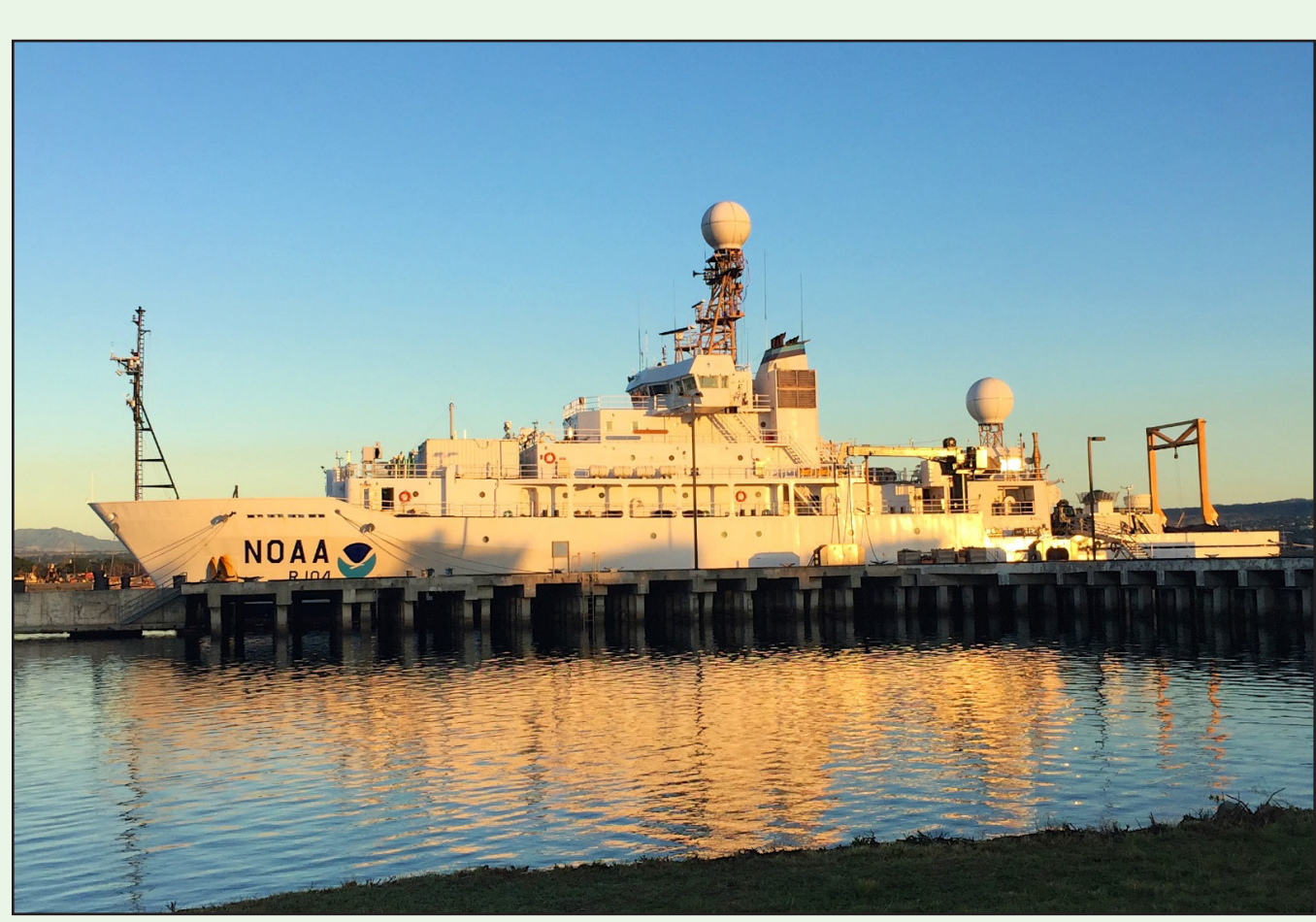
- A new ship-based Fourier transform spectrometer has been developed to measure the atmospheric downwelling and reflected infrared radiance spectrum at the Earth's surface with high absolute accuracy.
- Uplooking surface observations can be used to obtain vertical profiles of tropospheric temperature and water vapor, as well as measurements of trace gases (e.g. ozone, carbon monoxide, methane) and downwelling infrared spectral signatures of clouds and aerosols.
- Downlooking reflected observations can be used to obtain ocean skin temperature and surface emissivity.
- This instrument was designed and built by ABB Inc., based on the heritage of the Atmospheric Emitted Radiance Interferometer (AERI) designed by the University of Wisconsin Space Science and Engineering Center (UW-SSEC) for the Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) Program.
- Prior versions of the Marine-AERI (M-AERI) have been operated by the University of Miami for over a decade on research ships transiting the Atlantic and Pacific in support of NASA and NOAA satellite validation.



### Instrument specifications

Spectral range	520–3020 $\text{cm}^{-1}$ 3.3–19 $\mu\text{m}$
Max OPD	1 cm
Spectral resolution (unapodized)	0.5 $\text{cm}^{-1}$
Detectors	MCT, InSb
Detector temperature	77 K
View angle	Zenith, $\pm 45^\circ$ from the horizon
Angular field-of-view	46 mrad
Radiometric accuracy	1%
Spectral accuracy	5 ppm
Vertical resolution	30–300 m in lowest 2 km
Air temperature accuracy	0.1 K
Ocean skin temperature accuracy	0.1 K
Scene view duration	~20 s

## ACAPEX / CalWater 2 Field Campaign



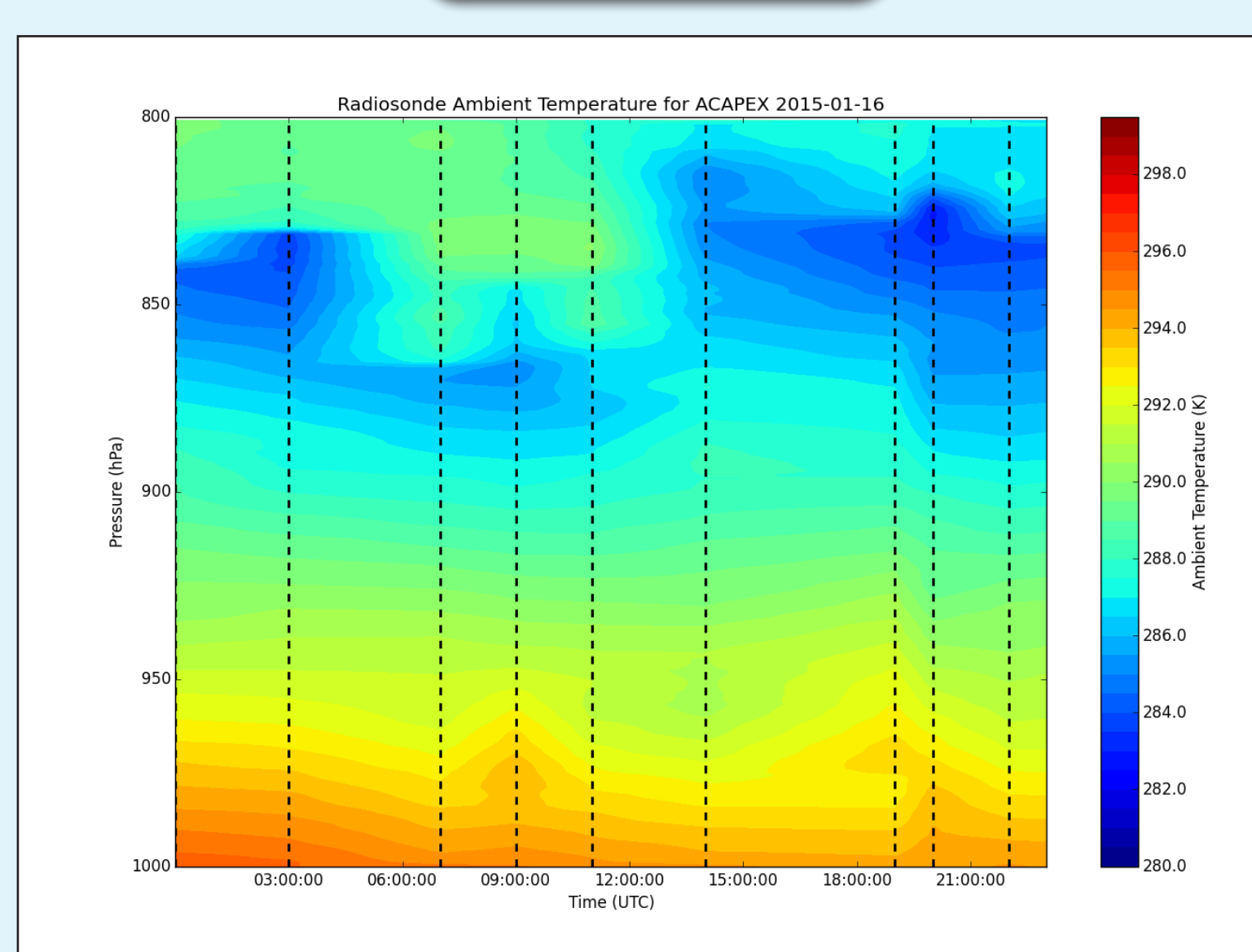
The primary goal of the field campaign was to study atmospheric rivers (AR), which transport moisture from the tropics to the mid-latitudes, and are responsible for the majority of precipitation on the U.S. west coast. Two significant AR events were encountered during the campaign. Coordinated observations were made with the DOE G-1, NASA ER-2, and NOAA G-IV, P-3 as well as the *Ron Brown*.



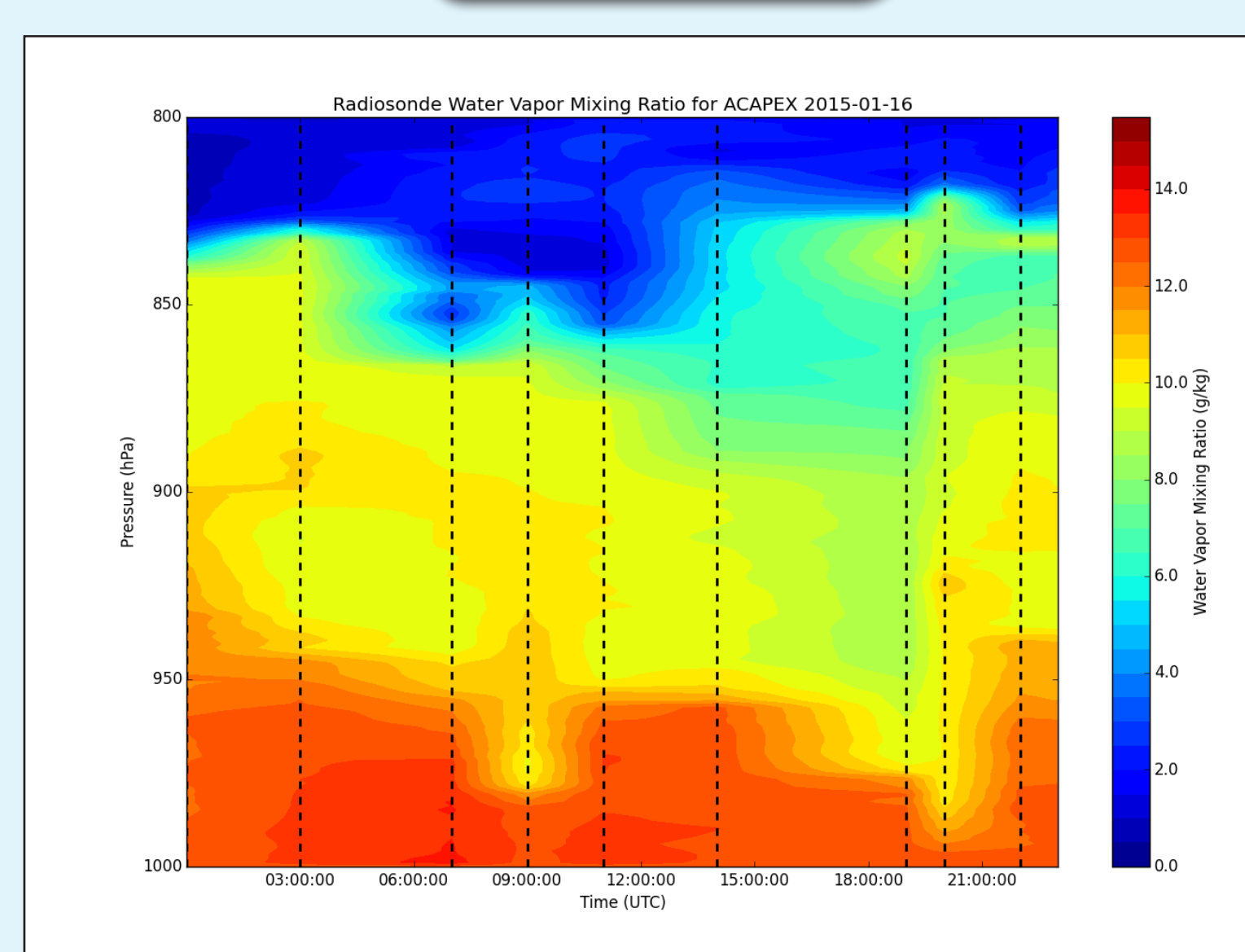
For its maiden voyage, the new M-AERI was deployed in the Pacific Ocean on the NOAA Ship *Ronald H. Brown*, the flagship and largest vessel in the NOAA fleet, as part of the DOE ARM Second Mobile Facility (AMF-2) during the ARM Cloud Aerosol Precipitation Experiment (ACAPEX) / NOAA CalWater 2 campaign in Jan-Feb 2015.

## M-AERI Results

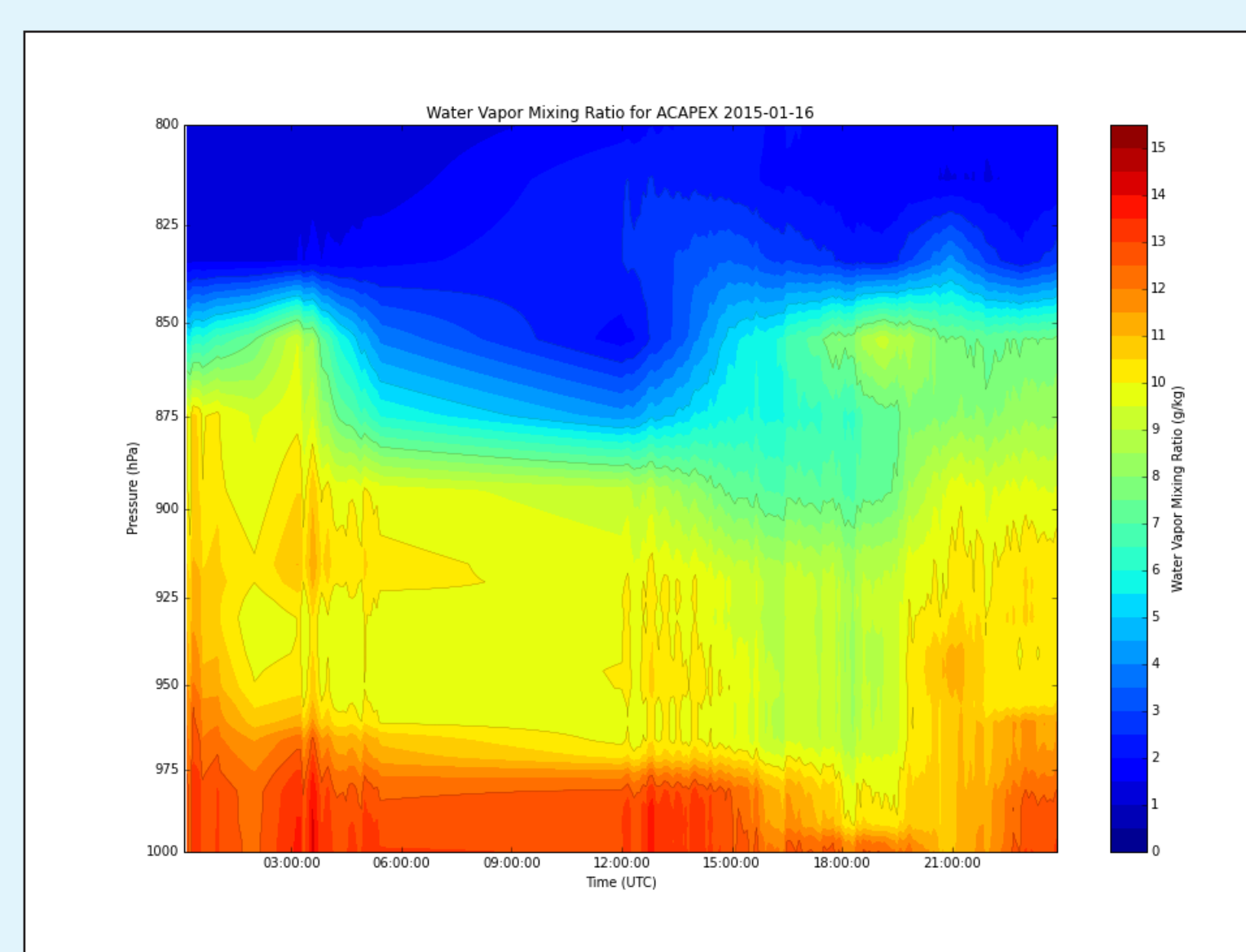
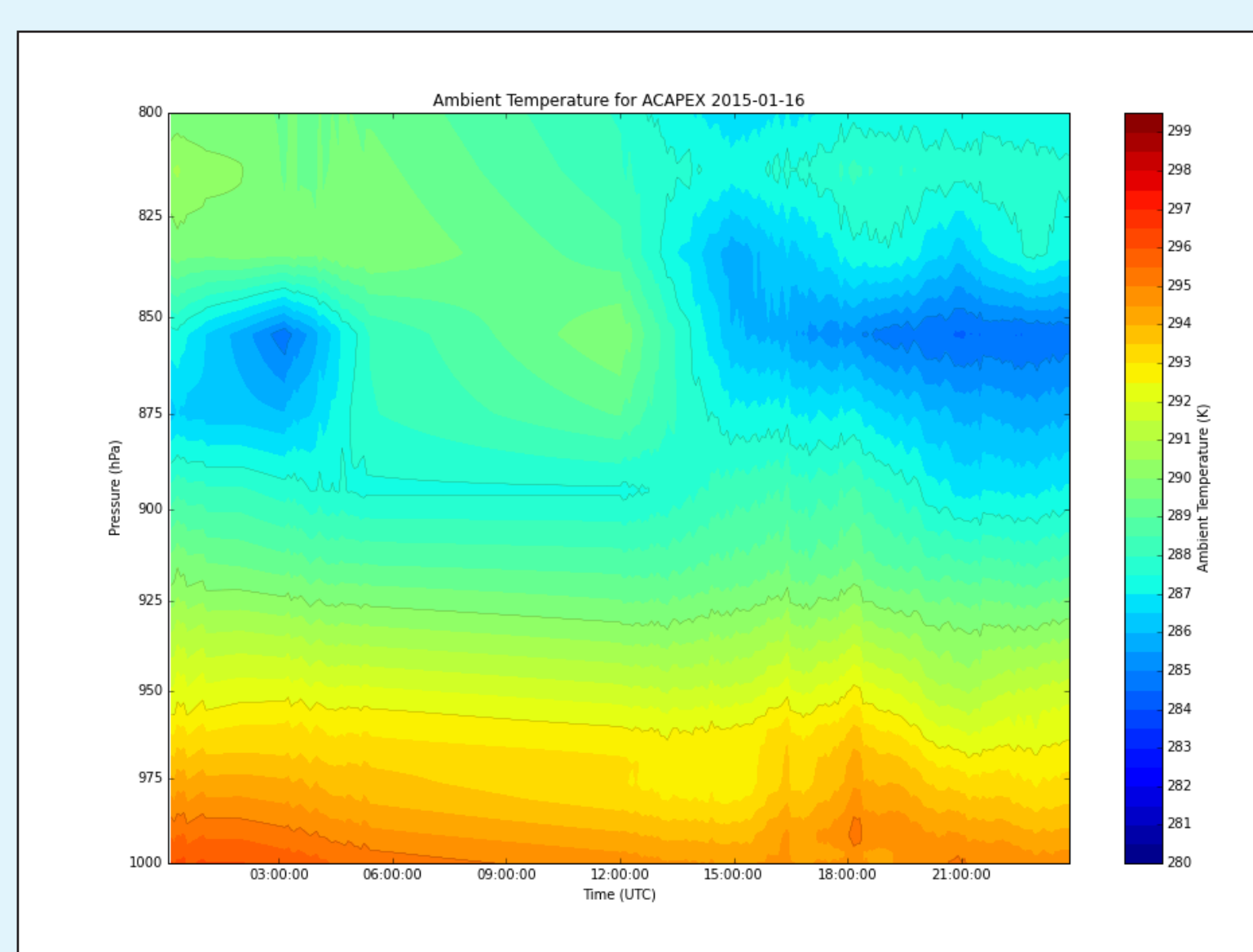
### Temperature



### Water Vapor



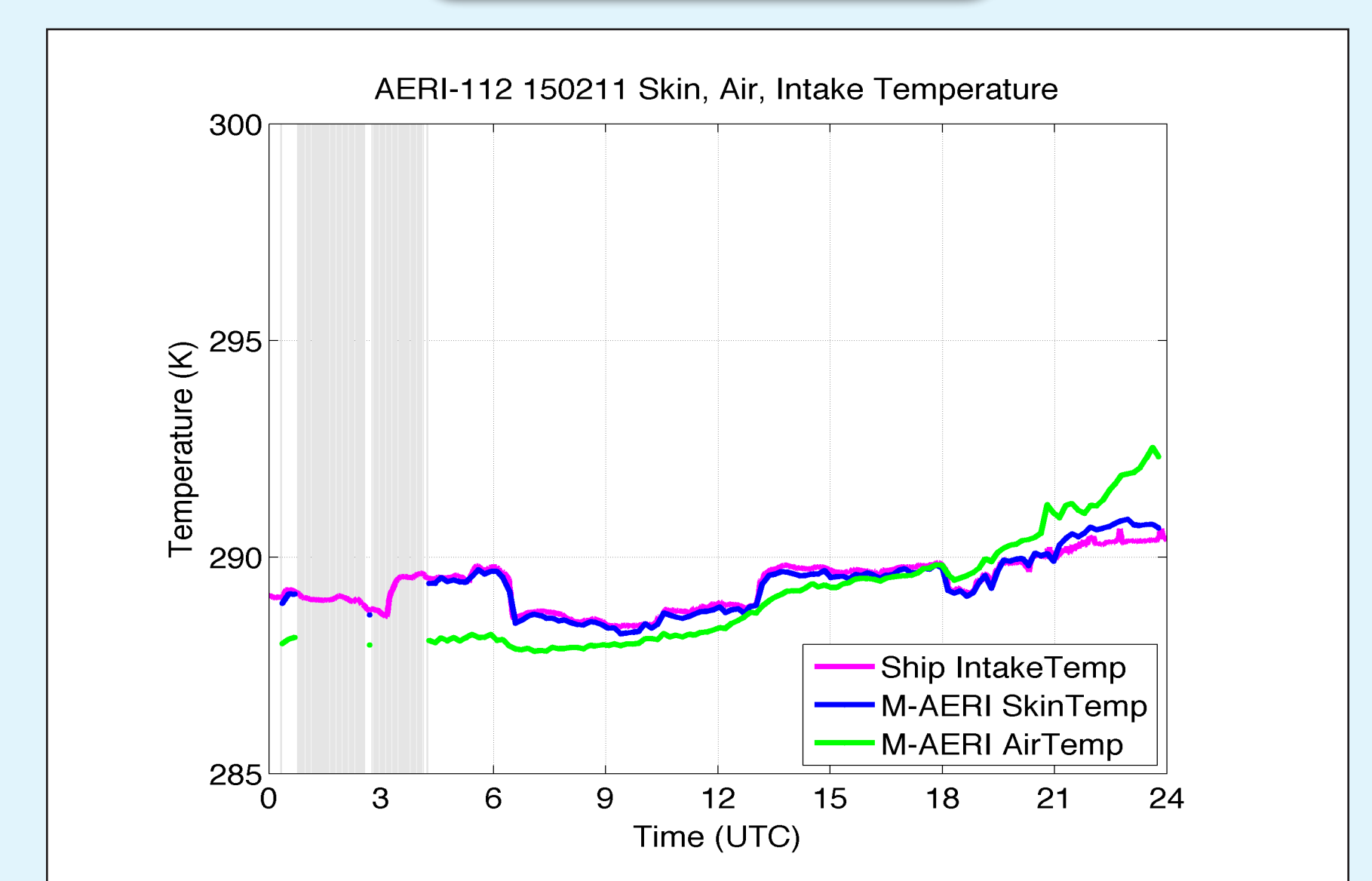
Sonde



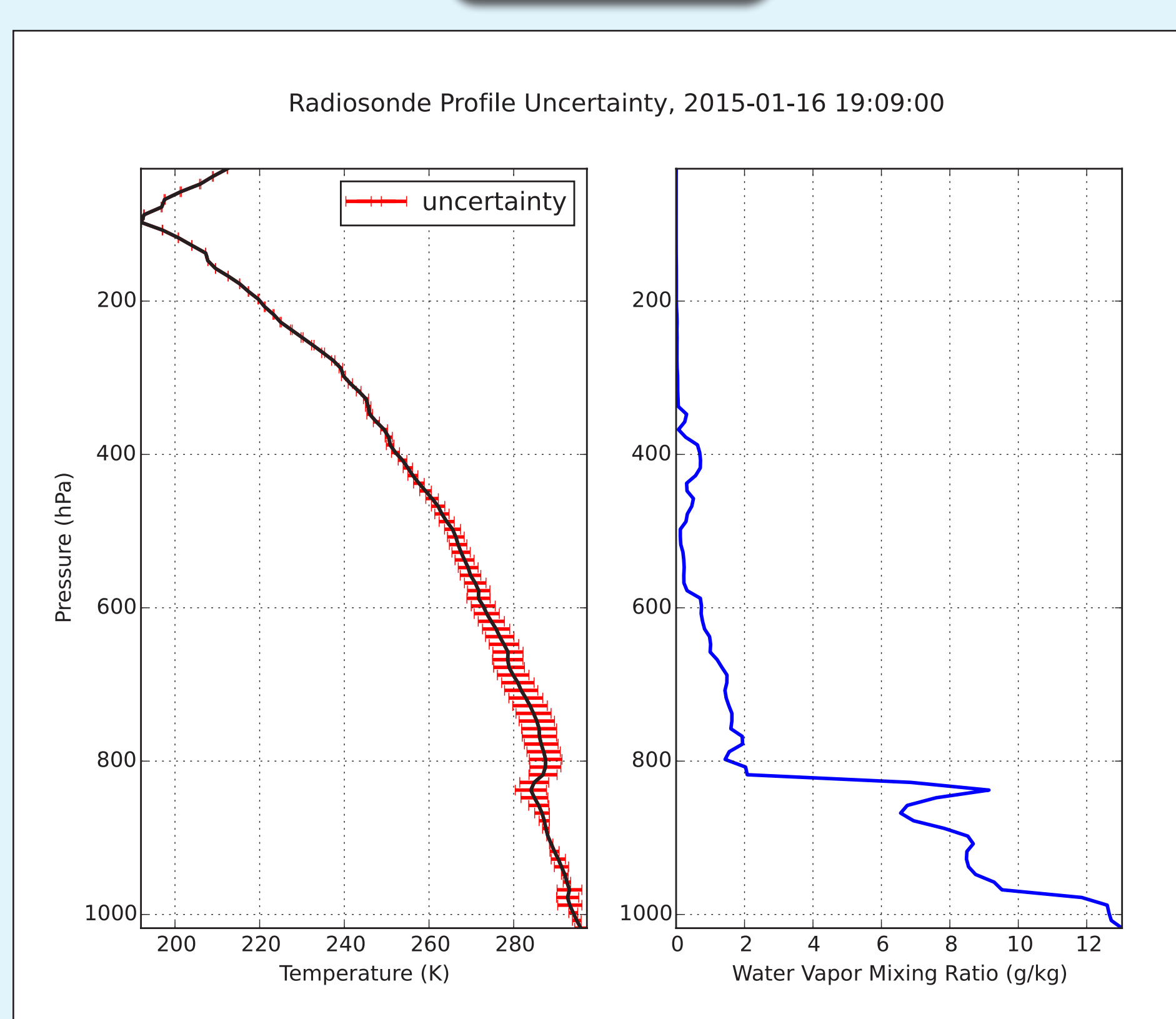
AERI

Comparison of time-height cross-sections of temperature and water vapor obtained by interpolating radiosondes (top) and retrievals from the M-AERI using the *AERIprof* algorithm (bottom). The variation in marine boundary layer height can be seen during the transit from Hawaii.

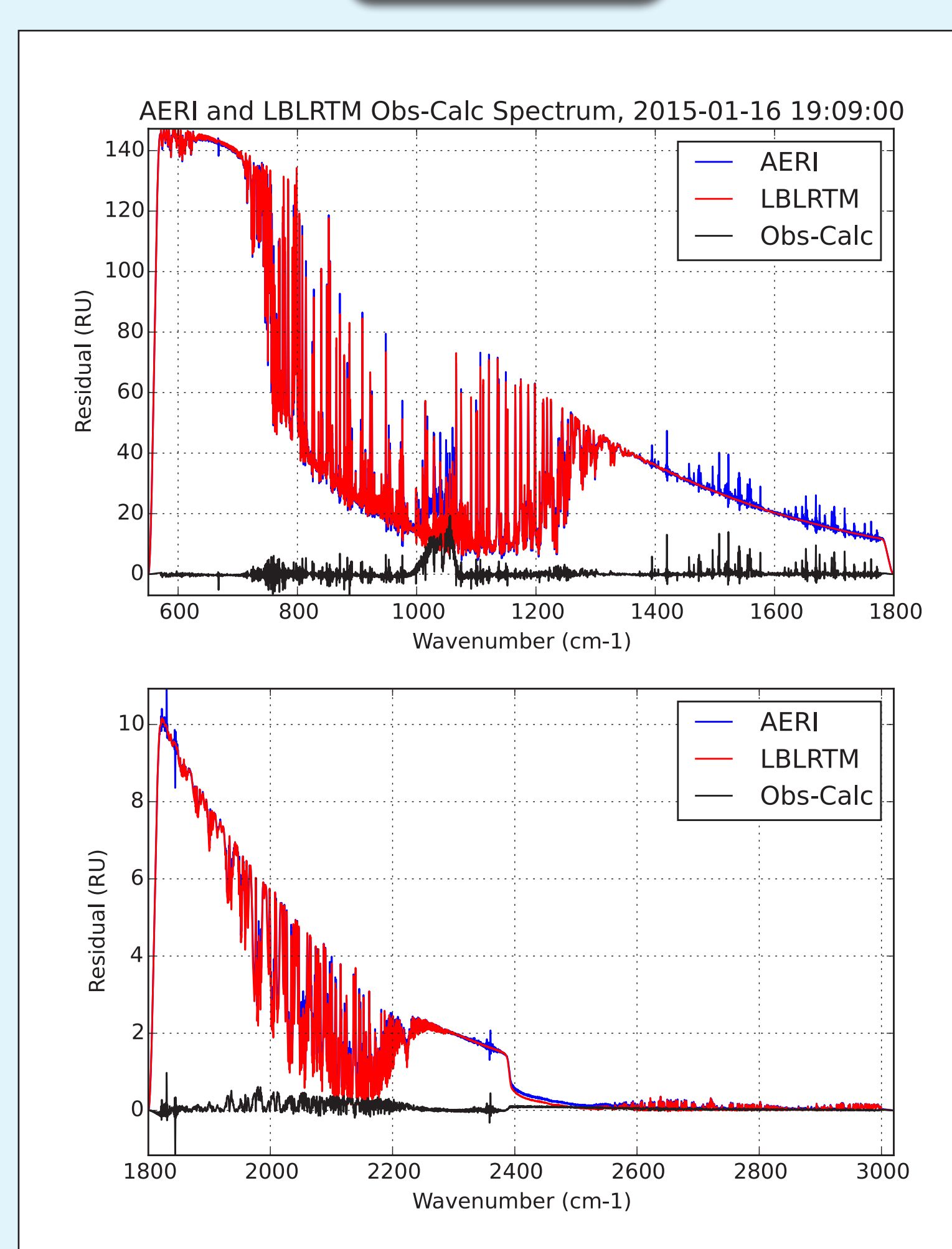
### Skin Temperature



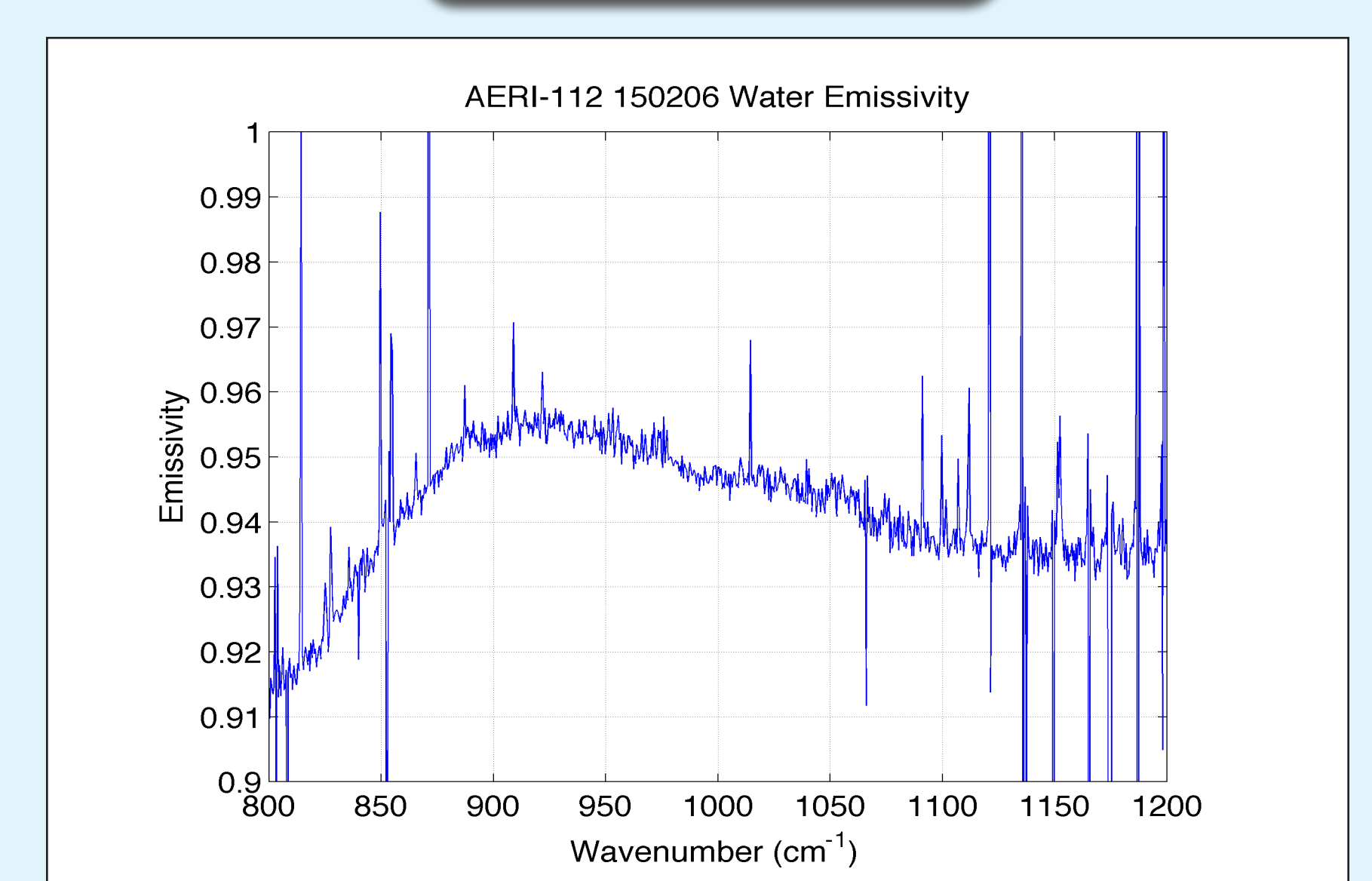
### Sonde



### Obs - Calc



### Ocean Emissivity



Temperature and water vapor profiles for a clear sky scene, obtained from a radiosonde (above). Radiative transfer calculation with LBLRTM and obs-calc comparison with the M-AERI observed radiance (above right). Radiance Jacobians from the OSS radiative transfer model were used to calculate the uncertainty in the atmospheric profile (error bars, above).

Retrievals of ocean skin temperature (top) and emissivity (bottom) from the M-AERI during ACAPEX.

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