



ECOSTRESS

*ECOsysteM Spaceborne Thermal Radiometer
Experiment on Space Station*

**In-Flight Validation of ECOSTRESS at Lake
Tahoe and Salton Sea CA/NV, USA**

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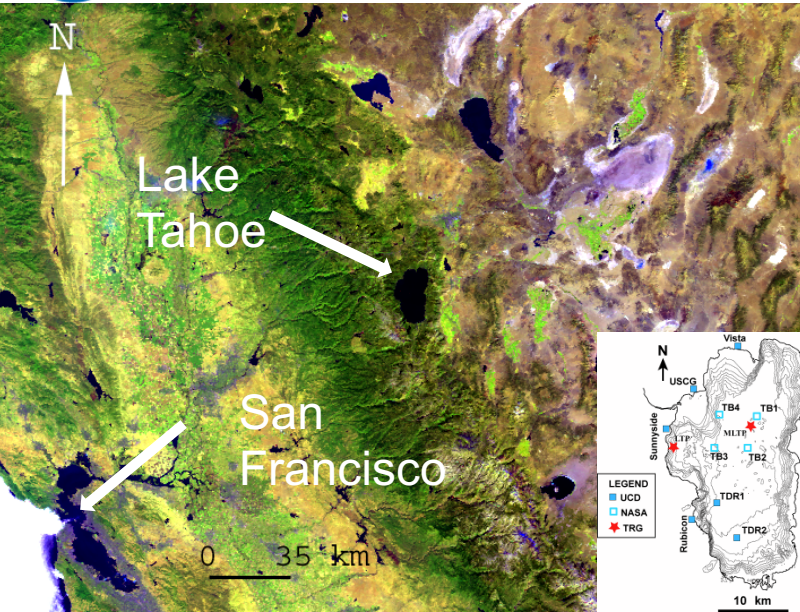
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Lake Tahoe, CA/NV, USA



Methodology:

- 4 buoys on large, high lake, each buoy is 1 km from shore and nearest buoy.
- Each buoy has custom thermal infrared radiometer operating 24x7 and associated meteorological measurements.
- Extract skin temperature from radiometer at time of overpass and propagate to top of atmosphere with radiative transfer model.
- Convolve to instrument system response functions and compare to satellite instrument measured value.

Custom radiometer calibrated to NIST-traceable blackbody

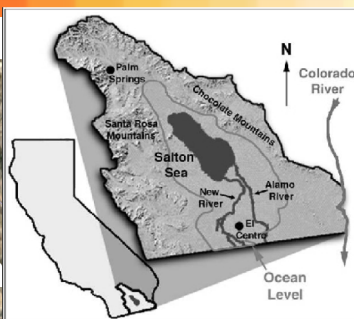




Salton Sea, CA, USA

Methodology:

- A mounted platform due to high salinity.
- The site has two custom thermal infrared radiometers operating 24x7 and associated meteorological measurements.
- Extract skin temperature from radiometer at time of overpass and propagate to top of atmosphere with radiative transfer model.
- Convolve to instrument system response functions and compare to satellite instrument measured value.



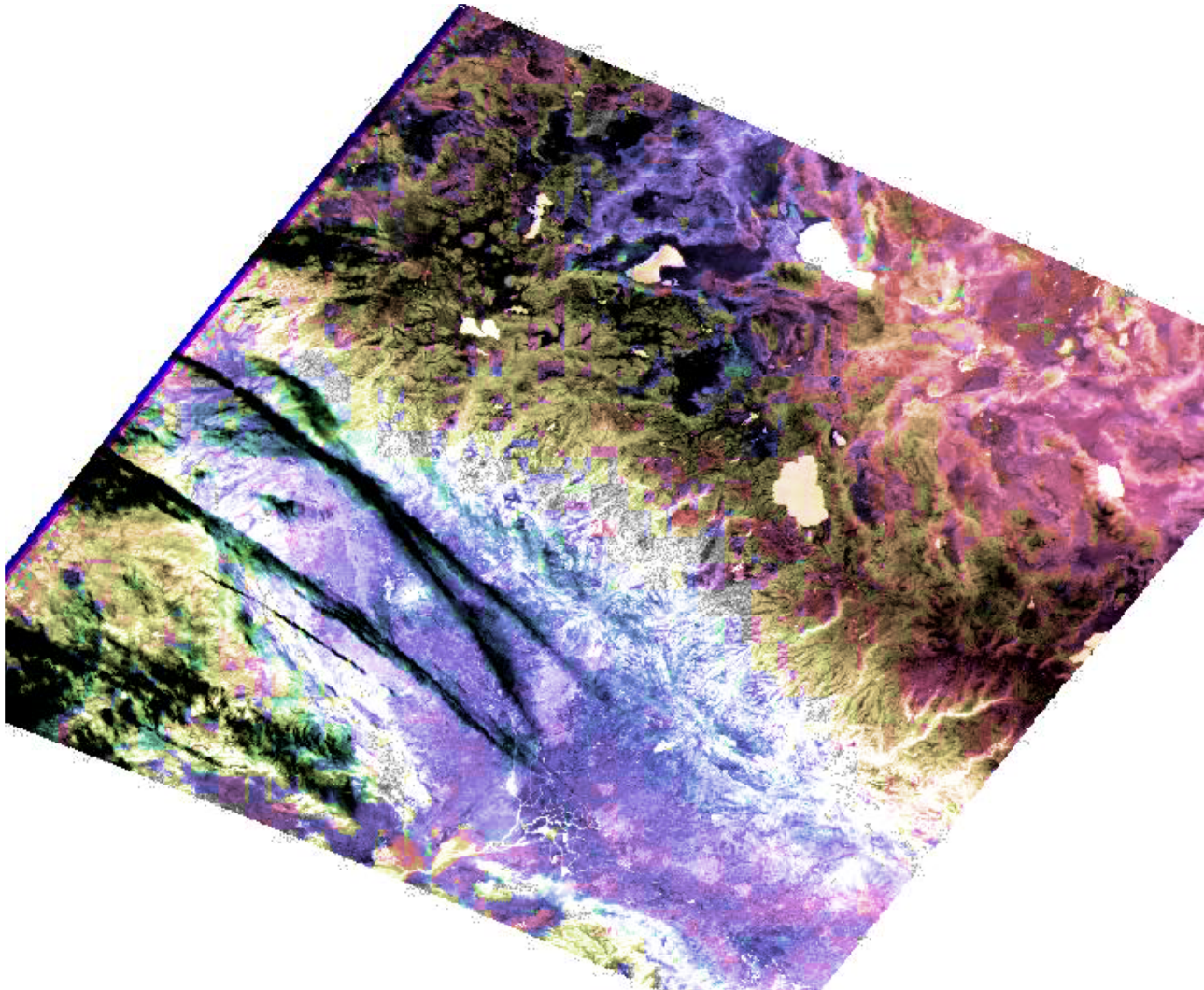
Custom radiometer calibrated to NIST-traceable blackbody



Large 60 km x 20 km
Low elevation -71 m
Available year round
(does not freeze in winter).
Homogenous compared with land.
Large annual temperature range ~4-35 C.
Good infrastructure and easy access.

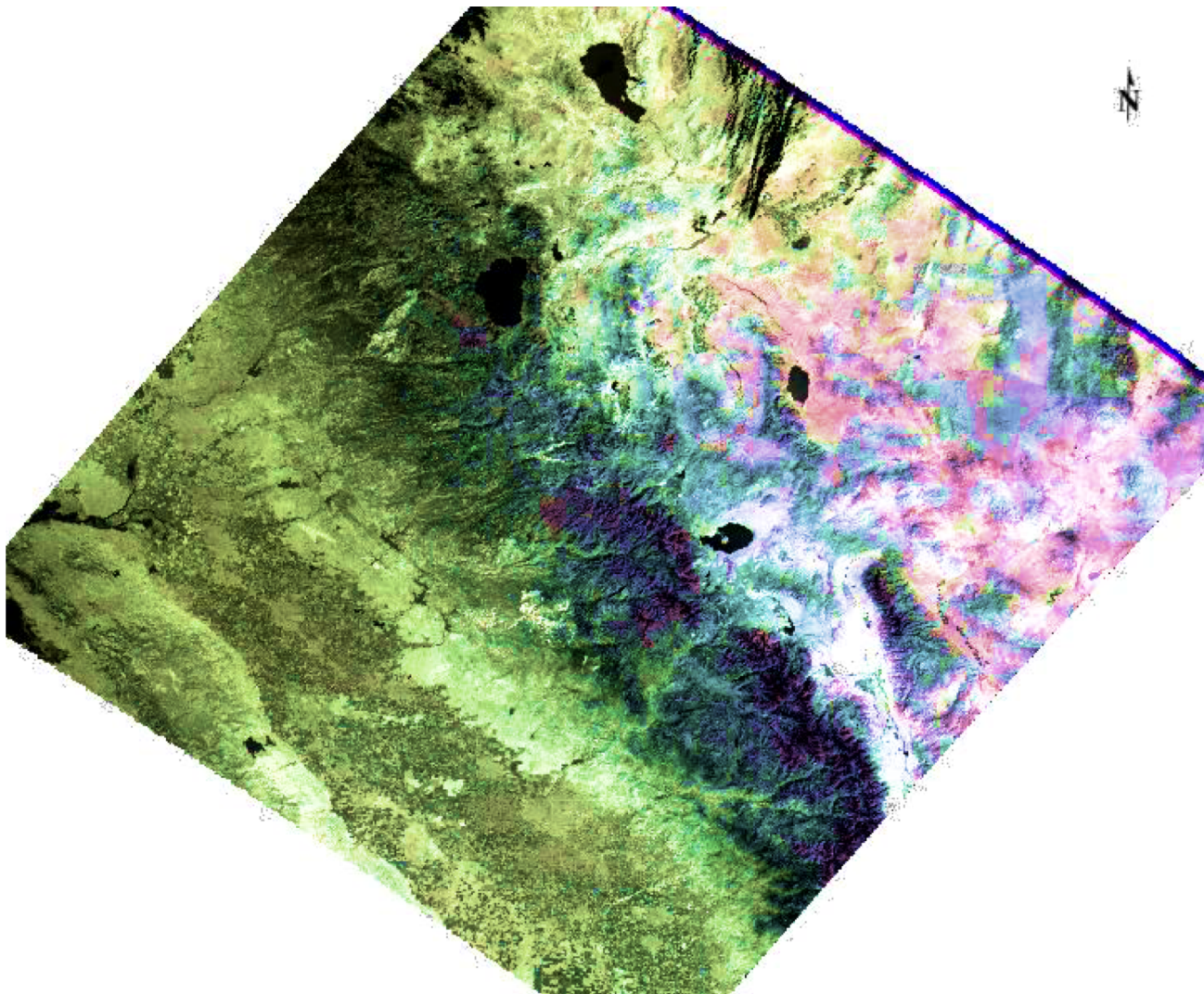


Lake Tahoe



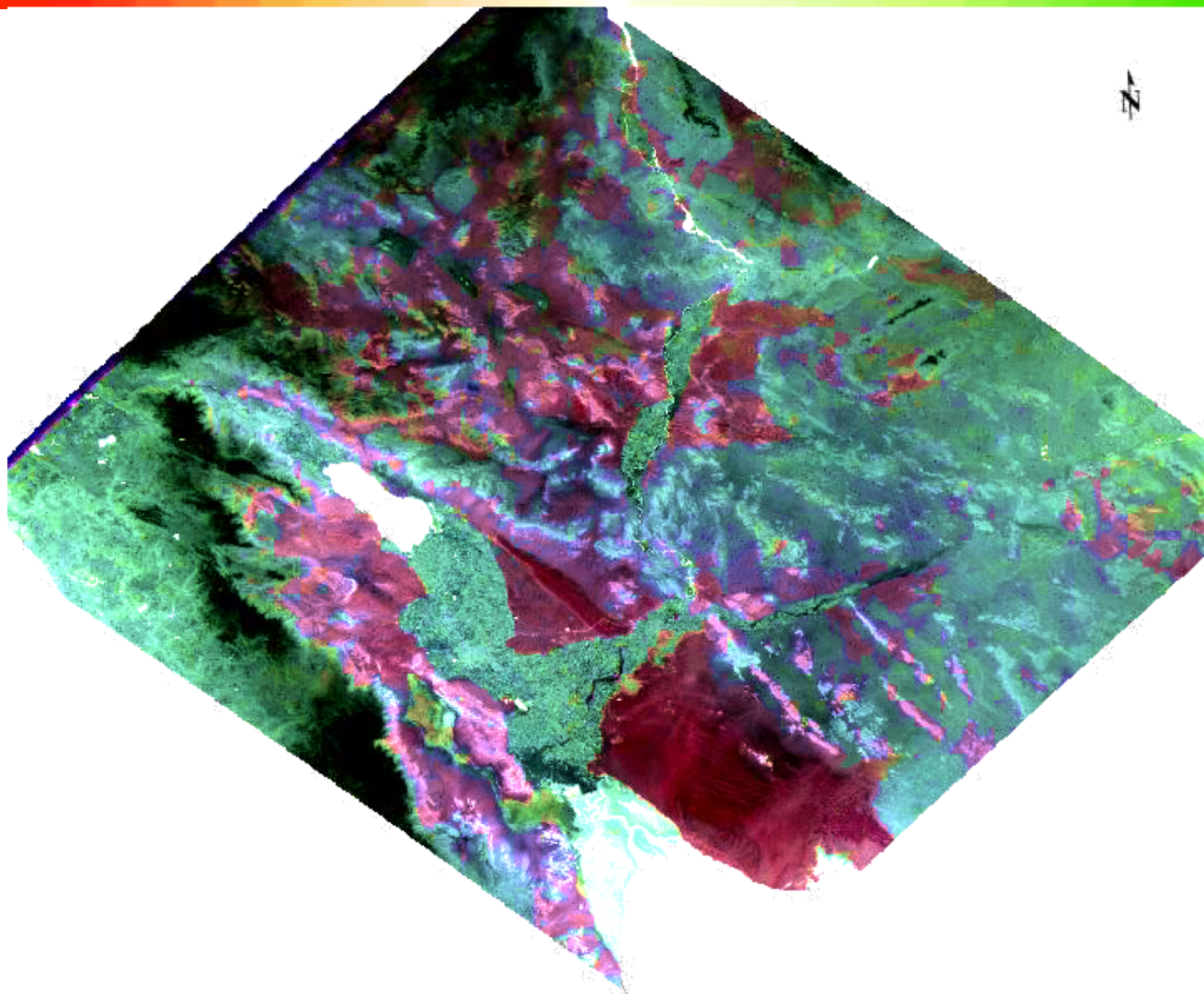


Lake Tahoe



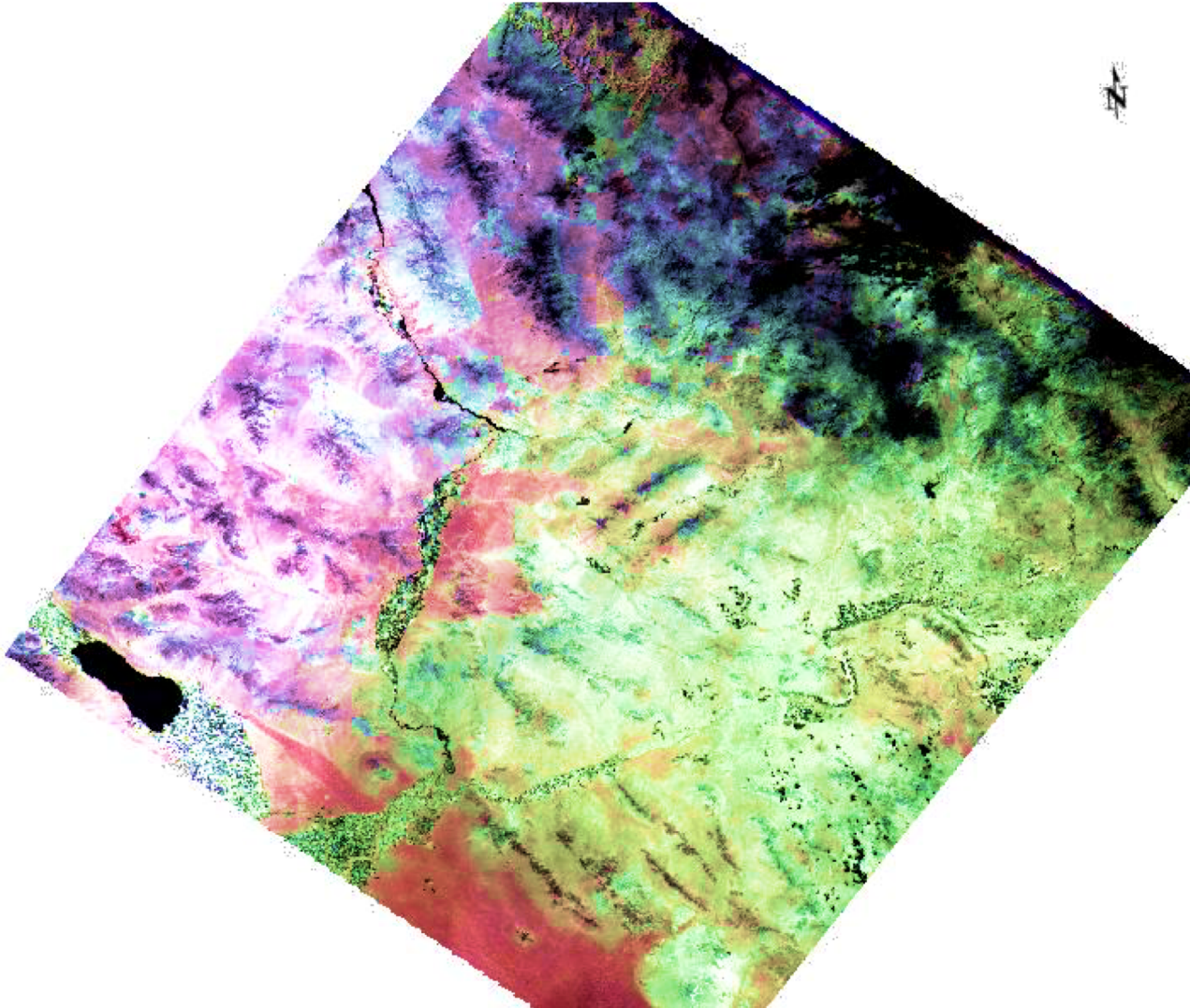


Salton Sea





Salton Sea





Validation Methodology

- Extract the bulk temperatures.
- Extract the radiometric temperature.
- Correct the radiometric temperature to skin kinetic temperature.
- Propagate the skin temperature to the satellite using a radiative transfer model and interpolated atmospheric profile.
- Convolve the propagated at-sensor radiance to the instrument response function to obtain the Vicarious Radiance (VR).
- Extract the image radiance derived using the On Board calibrator (OBC).
- Compare and contrast the OBC and VR Radiance values.



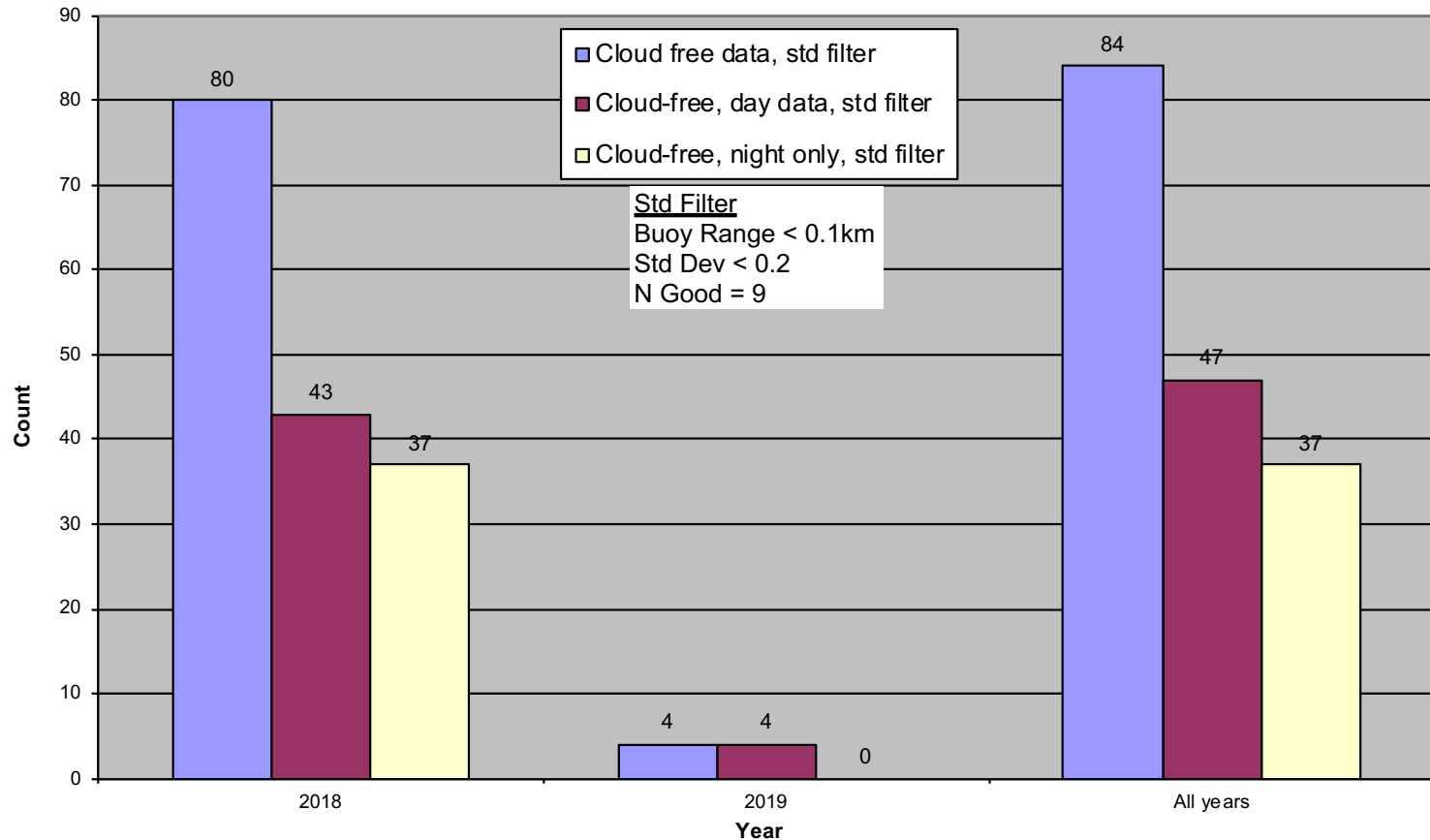
Standard Filters

- Cloud-free
- Within 0.1km of buoy
- Standard deviation less than $0.2 \text{ W.m}^{-2}.\text{um}^{-1}.\text{sr}^{-1}$
- Humidity less than 50%
- Neighboring pixels good



Number of validation points

ECOSTRESS Cloud Free Match-up Count by Year at Lake Tahoe and Salton Sea CY2018-2019, Std Filter,v1

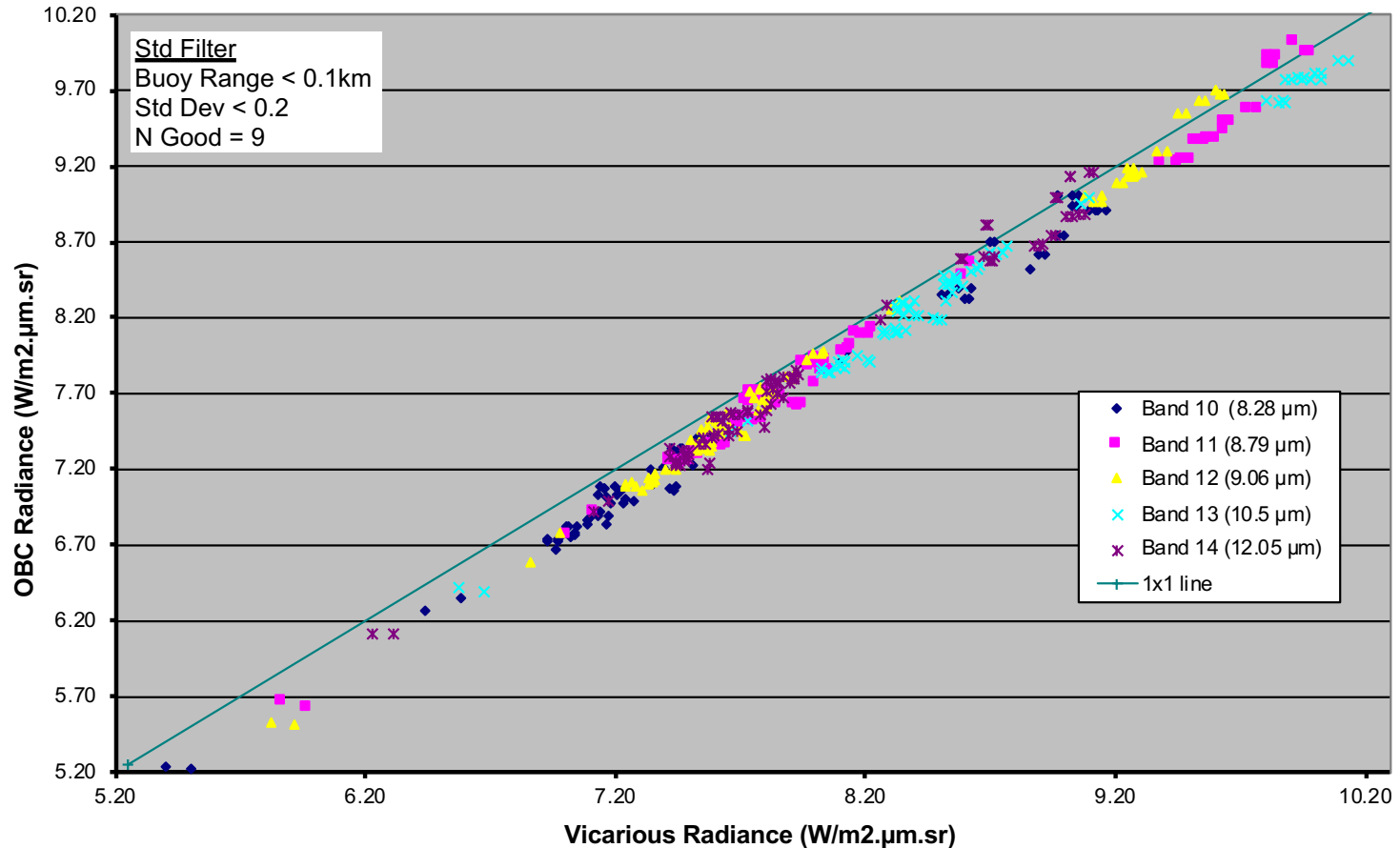


First clear acquisition was July 29, 2018.



Radiance Comparison

ECOSTRESS Vicarious and OBC Thermal Infrared Derived Radiances at L. Tahoe and Salton Sea CY2018-2019, Std Filter, v1

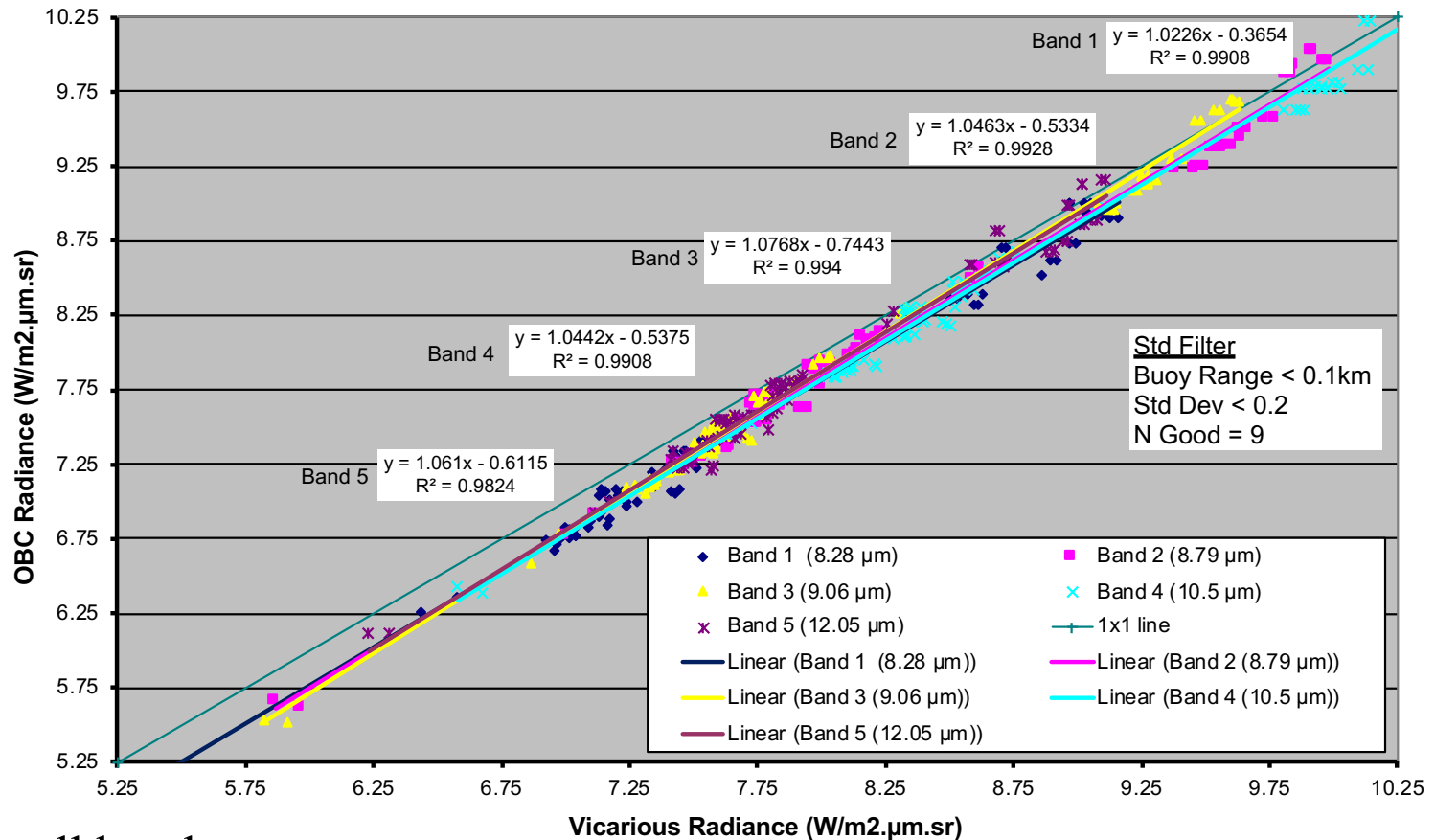


High radiance values from
Salton Sea



Radiance Comparison

ECOSTRESS Vicarious and OBC Thermal Infrared Derived Radiances at L. Tahoe and Salton Sea, CY2018-2019, Std Filter, v1



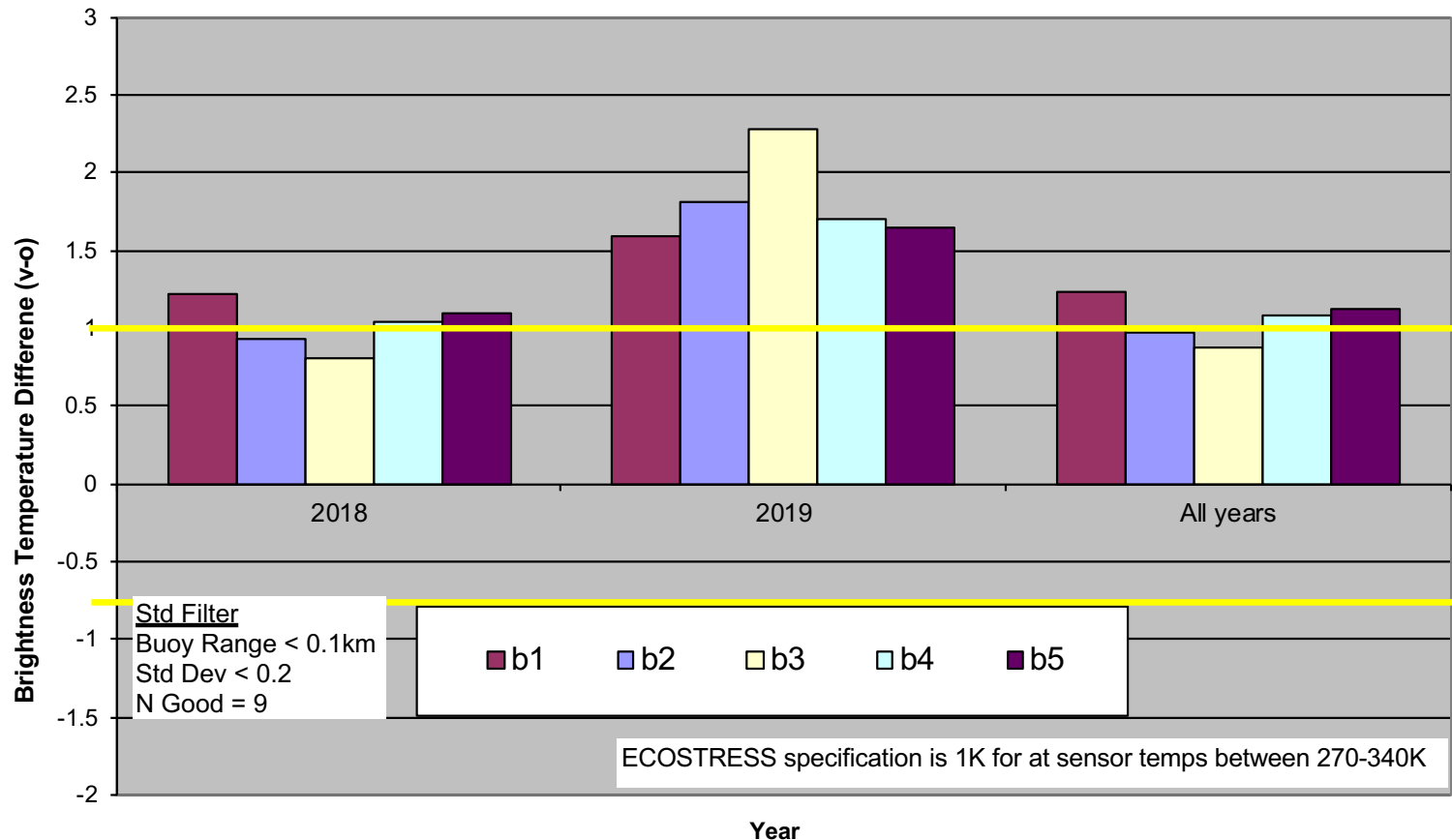
Offset in all bands.

R^2 is typically 0.98-0.99.



Brightness Temperature Comparison

ECOSTRESS Brightness Temperature Diff. in TIR Bands at Lake Tahoe and Salton Sea CY2018-2019, Std Filter, v1

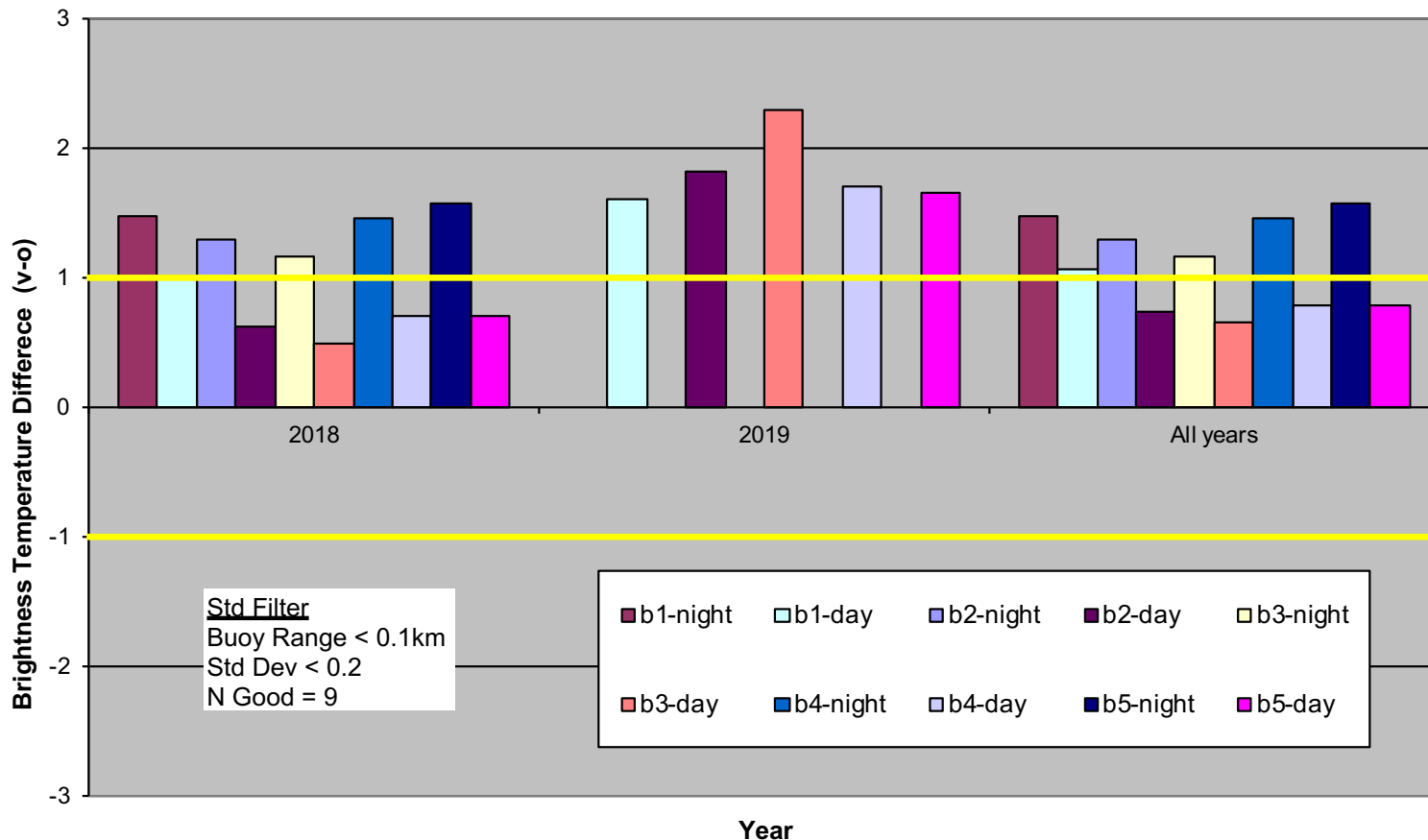


ECOSTRESS specification for 270-340K is 1K.



Day/night comparison

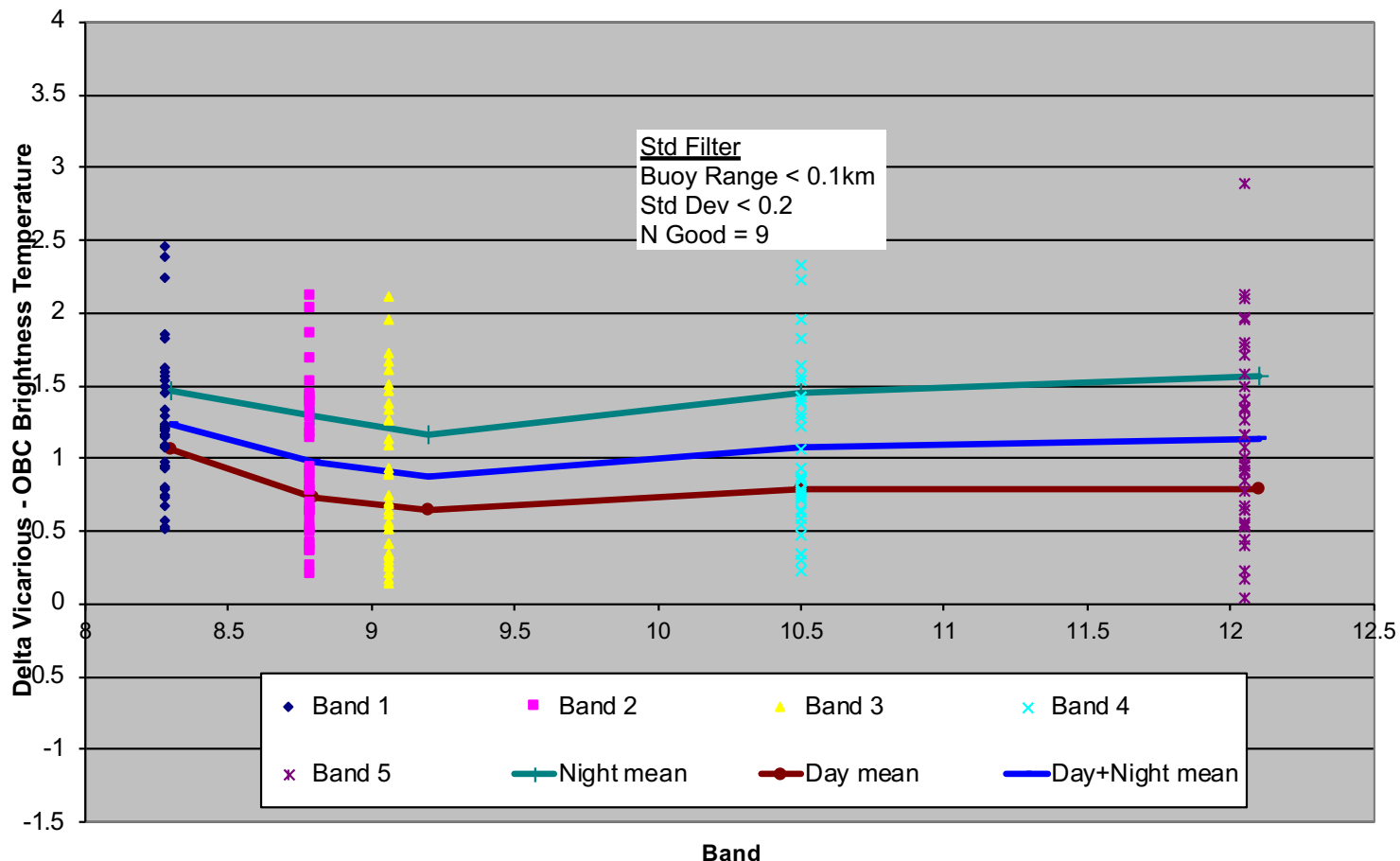
ECOSTRESS Brightness Temperature Diff. in TIR Bands at L. Tahoe and Salton Sea CY2018-2019, Std Filter, D/N sep. v1





Day/night comparison by wavelength

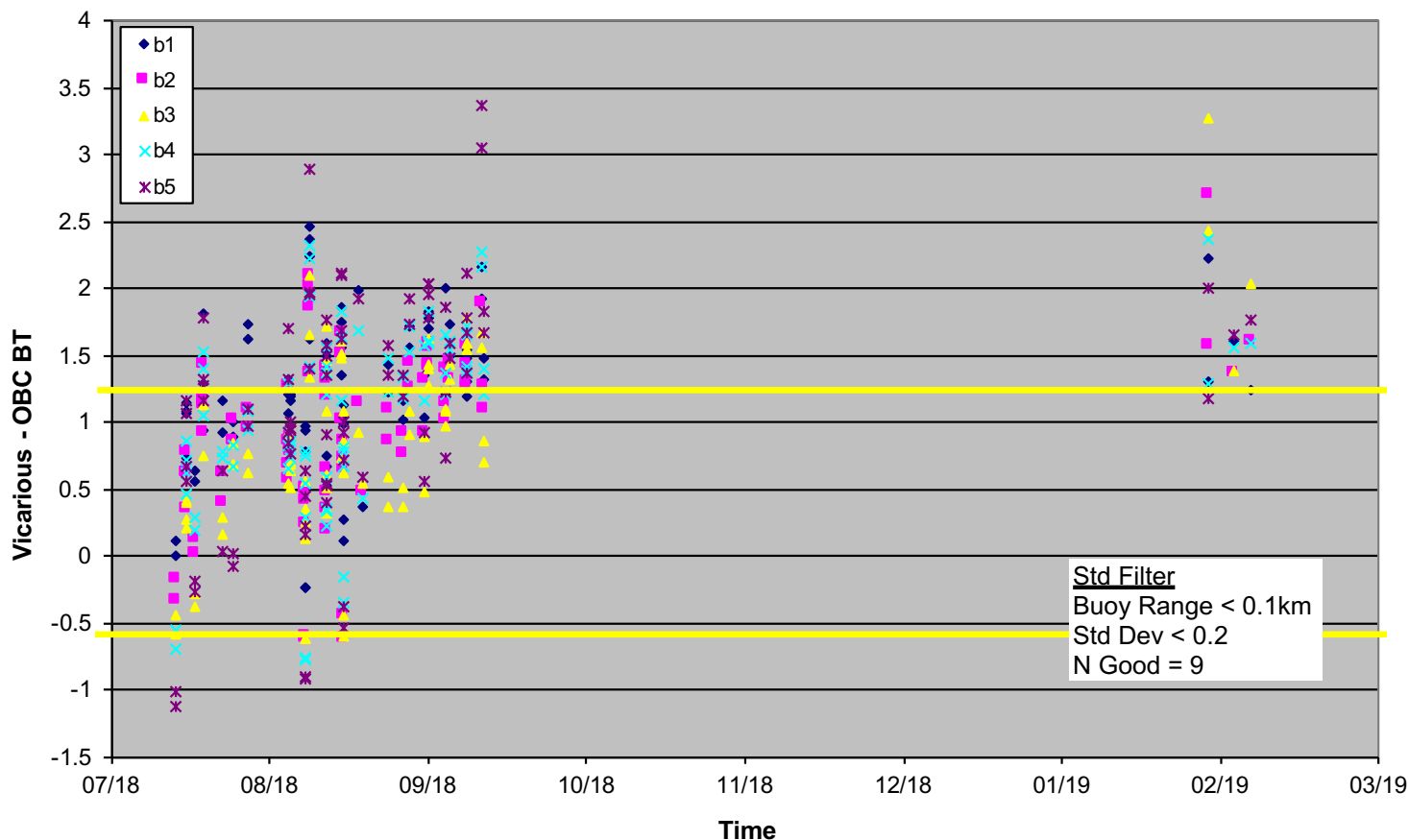
Delta Vicarious and OBC Brightness Temp. as a function of Wavelength, L. Tahoe and Salton Sea CY2018-2019, Std Filter v1





Brightness temperature comparison by date

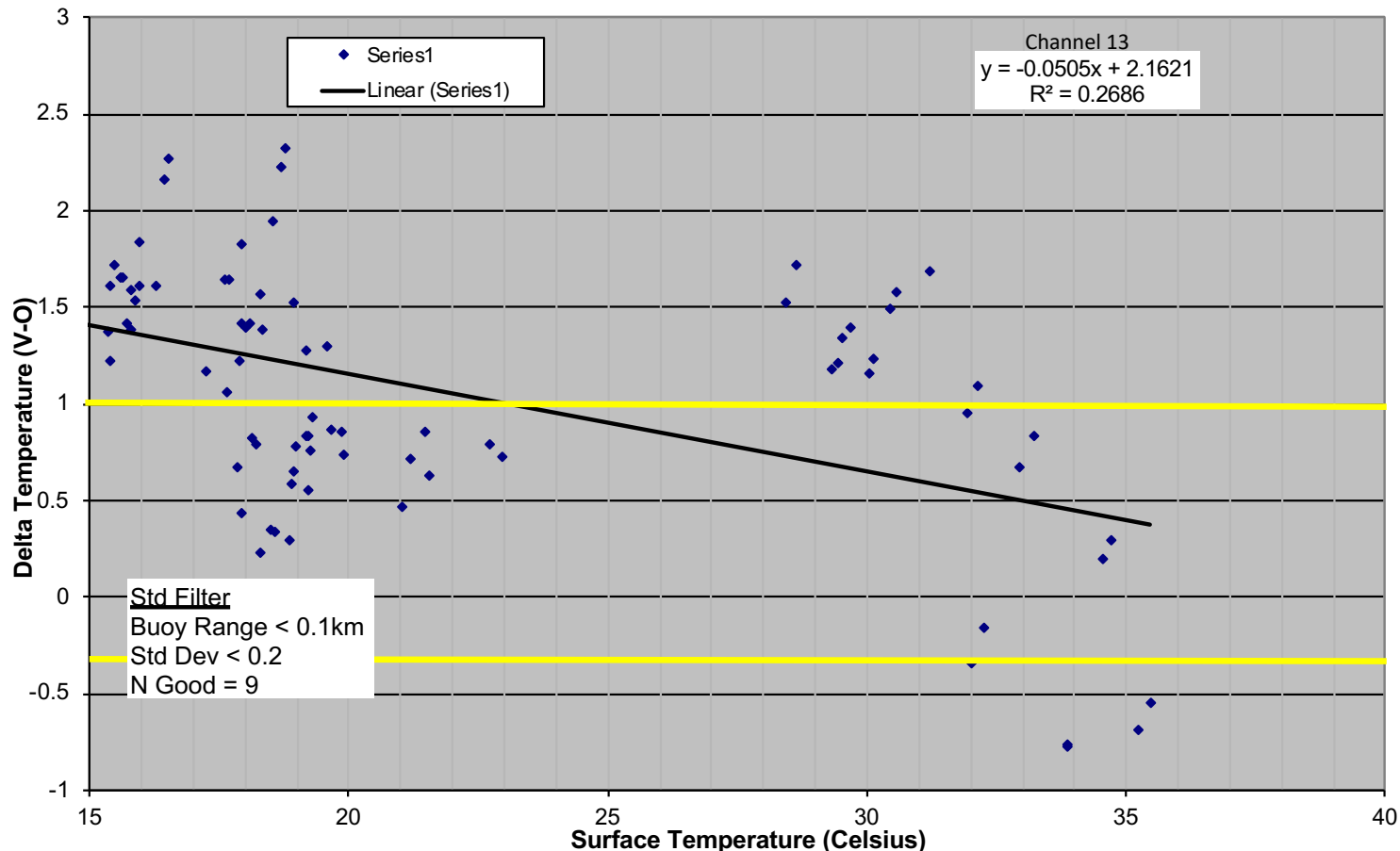
Delta Vicarious and OBC Brightness Temp. for ECOSTRESS (Day and Night) at L. Tahoe and Salton Sea CY2018-2019, Std Filter v1





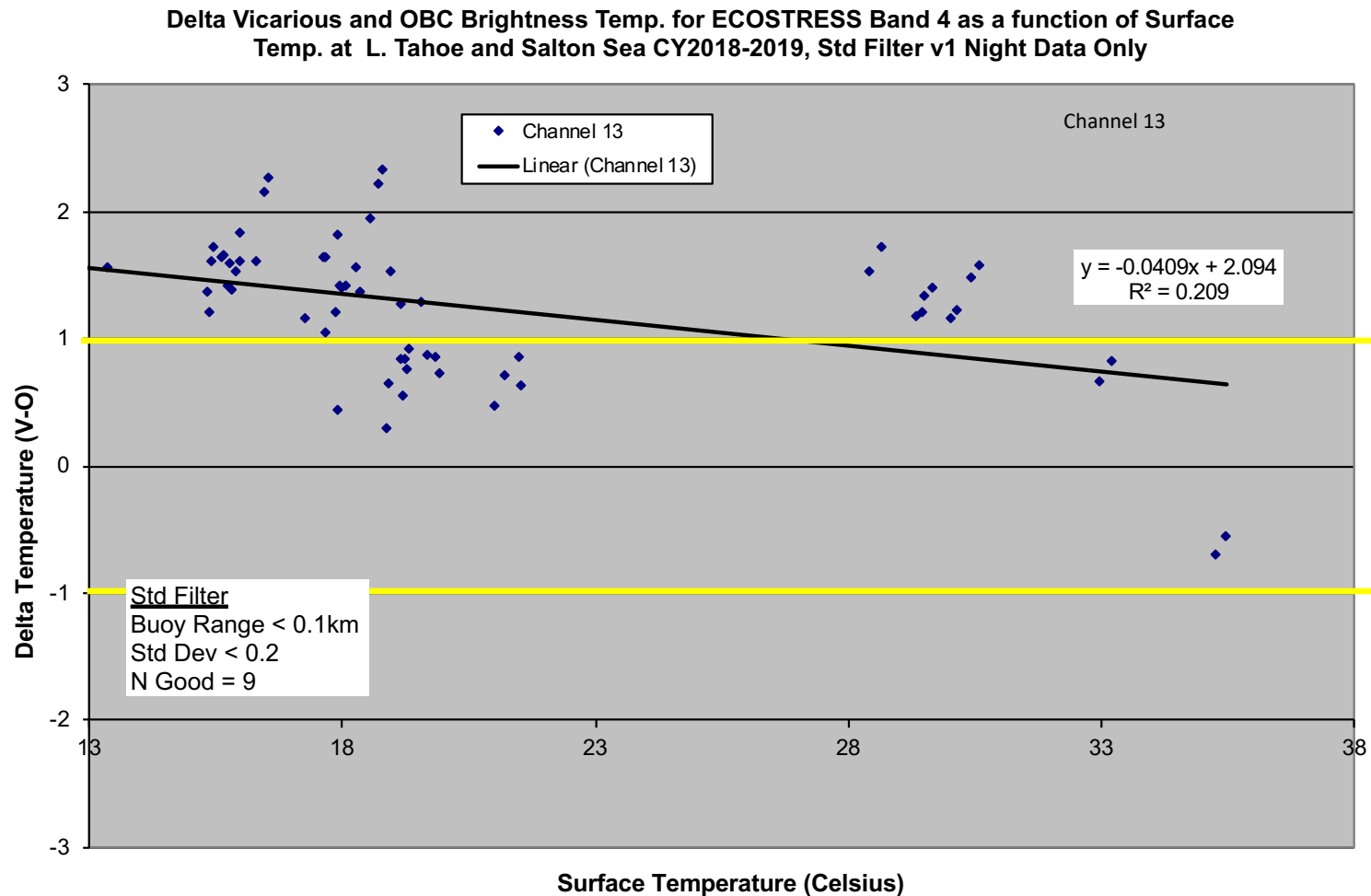
Bias by surface temperature

Delta Vicarious and OBC Brightness Temp. for ECOSTRESS Band 4 (Day and Night) as a function of Surface Temp. at L. Tahoe and Salton Sea CY2018-2019, Std Filter v1





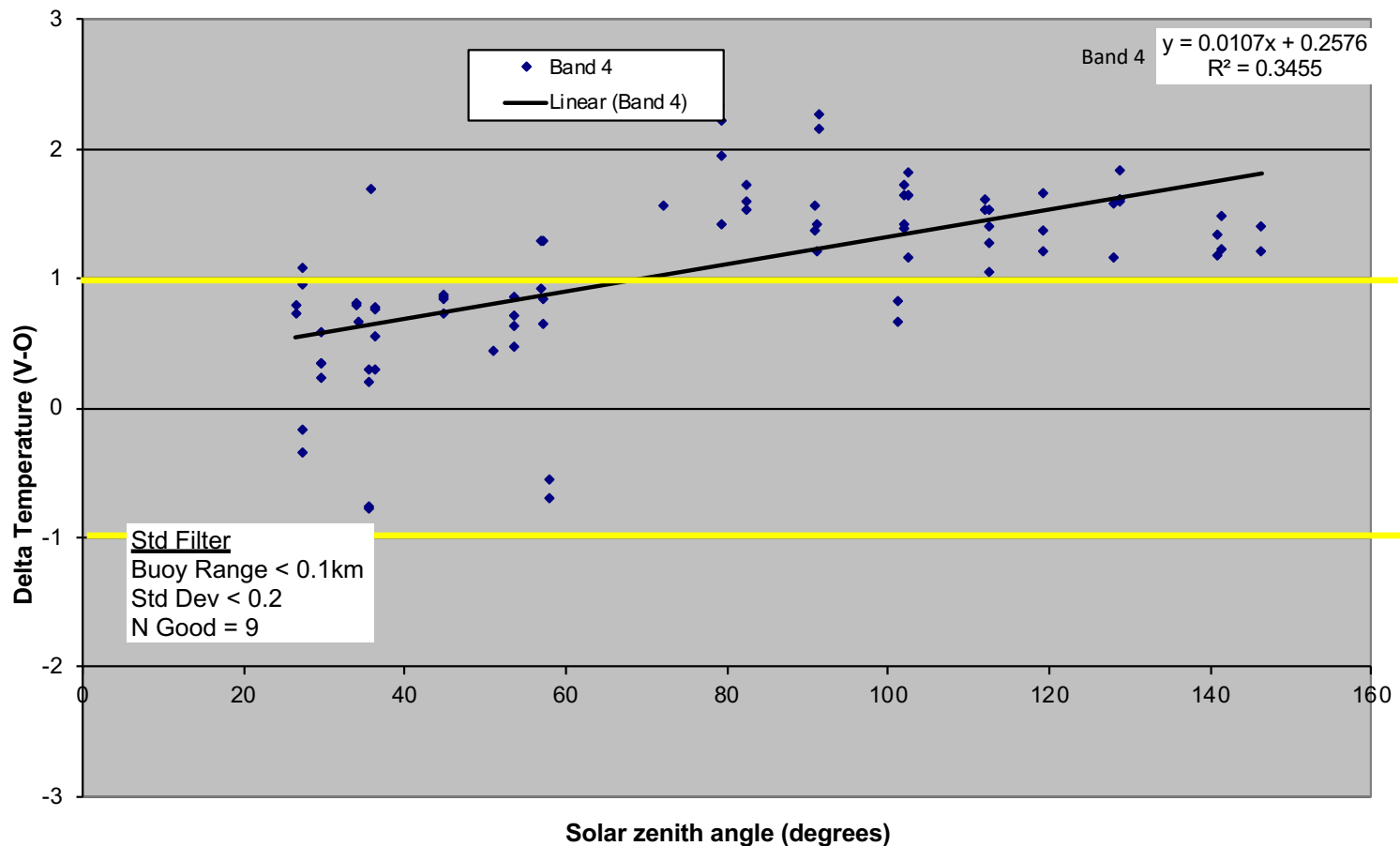
Bias by surface temperature (night)





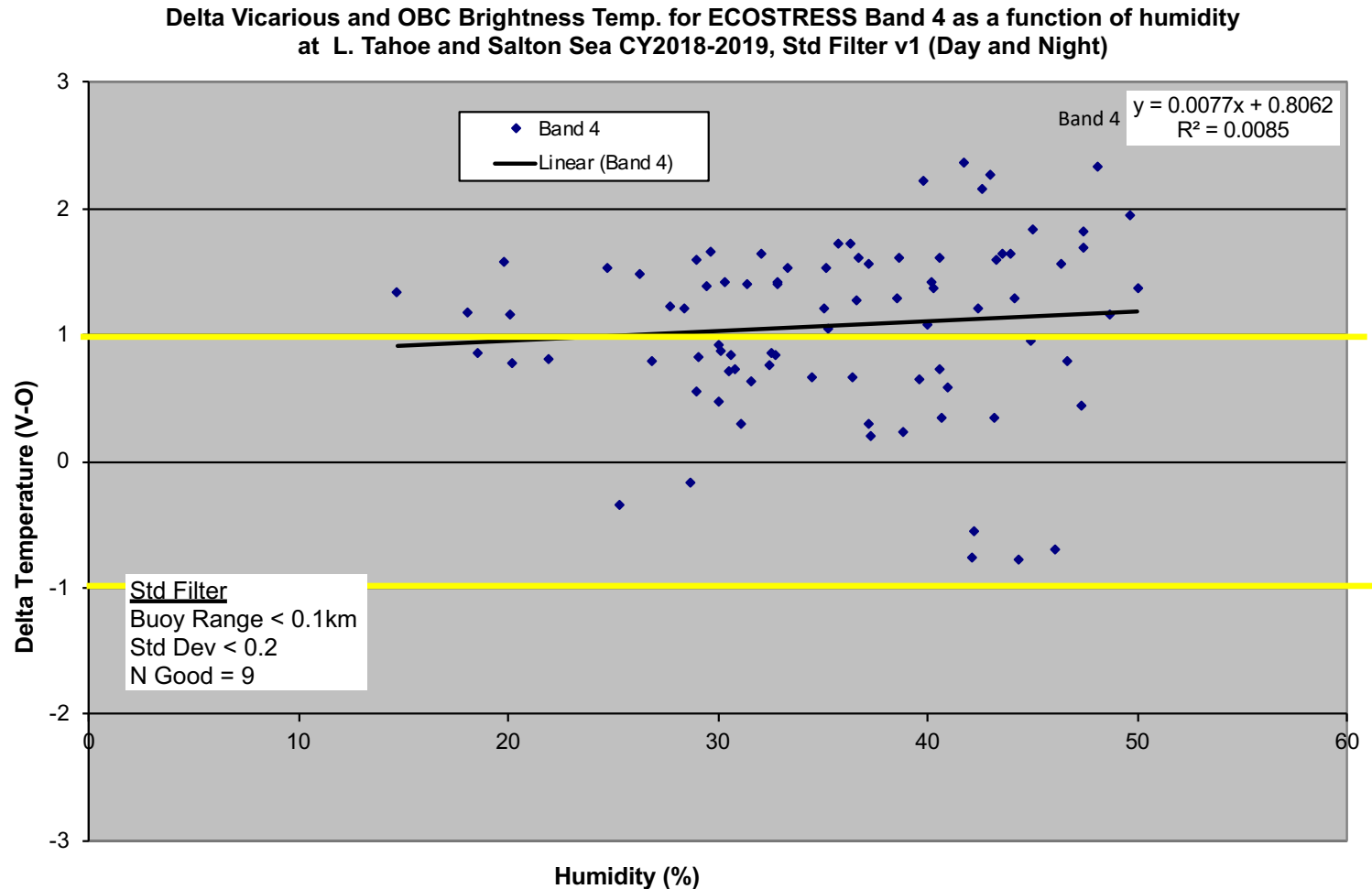
Bias by solar zenith angle

Delta Vicarious and OBC Brightness Temp. for ECOSTRESS Band 4 as a function of solar zenith angle at L. Tahoe and Salton Sea CY2018-2019, Std Filter v1 (Day and Night)





Bias by humidity





Summary and conclusions

- Lake Tahoe and Salton Sea automated validation sites used to assess radiometric accuracy of ECOSTRESS. Lake Tahoe Site established in 1999 and Salton Sea site in 2008.
- Multiple scenes validated with broad temperature range (~ 4 to 35 °C) from July 2018 through March 2019. Total number of validation points = 84.
- Daytime and nighttime validations have positive bias. (~ 0.7 K daytime, ~ 1.4 K nighttime)