In-Flight Validation of Mid and Thermal Infrared Remotely Sensed Data using the Lake Tahoe and Salton Sea Automated Validation Sites

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Outline

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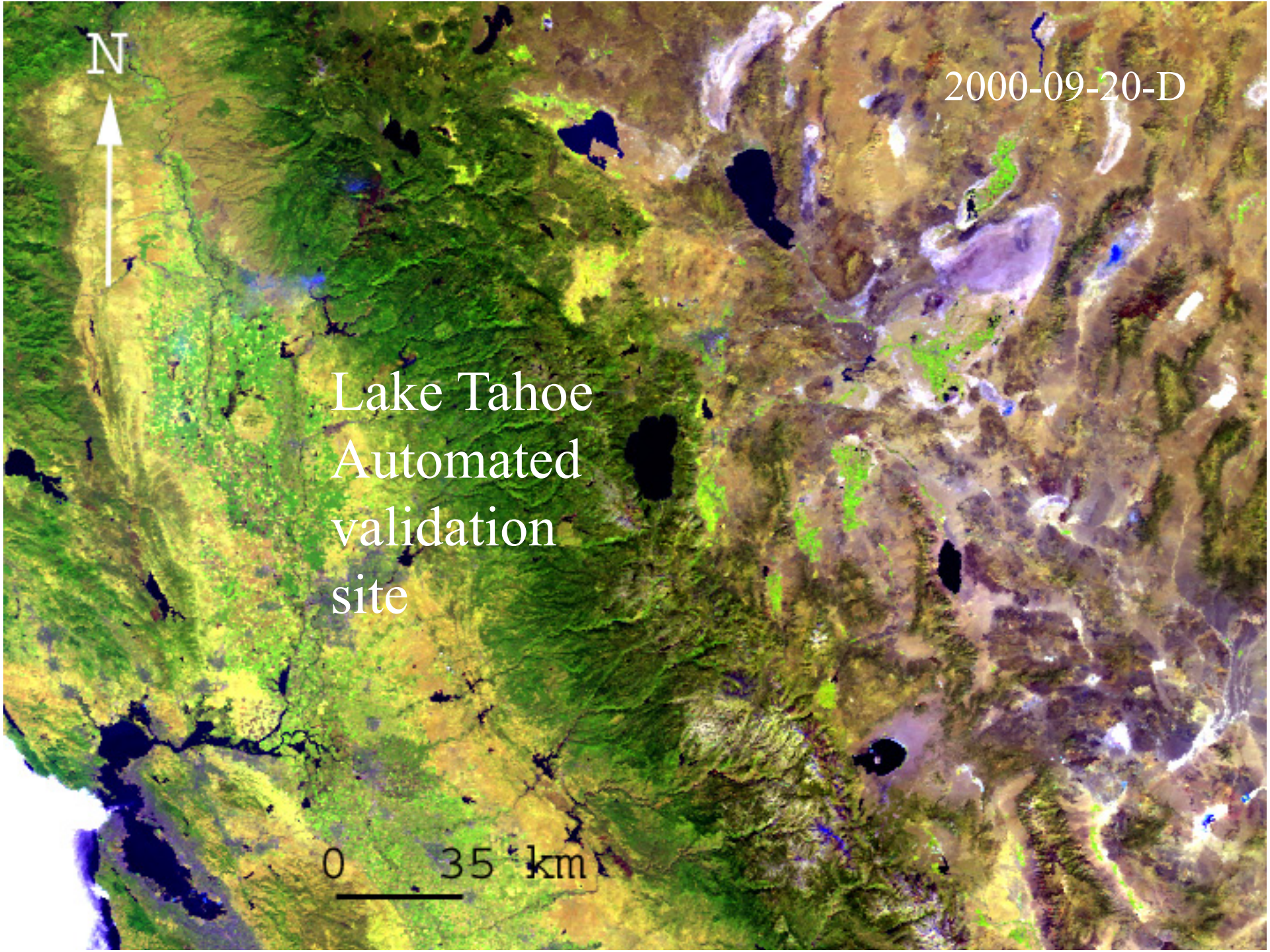
- Lake Tahoe Site: Layout and Measurements
- Salton Sea Site: Layout and Measurements
- Field Instrument Calibration and Cross-Cal.
- Data Reduction Methodology and Error Budgets
- Example results
  - MODIS
- Summary and Conclusions


N
2000-09-20-D
Lake Tahoe
Automated
validation
site
0
35 km

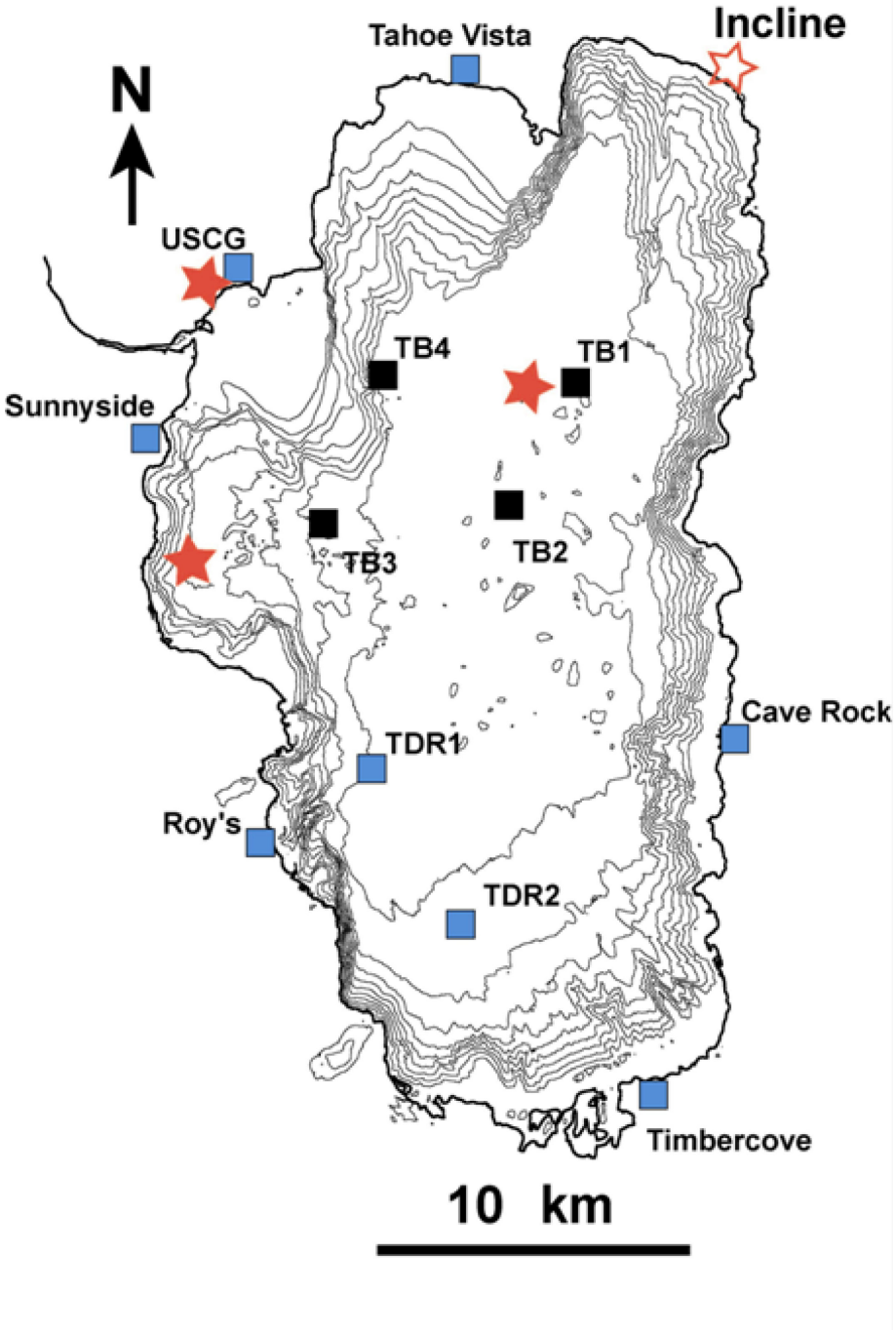
Why Lake Tahoe?

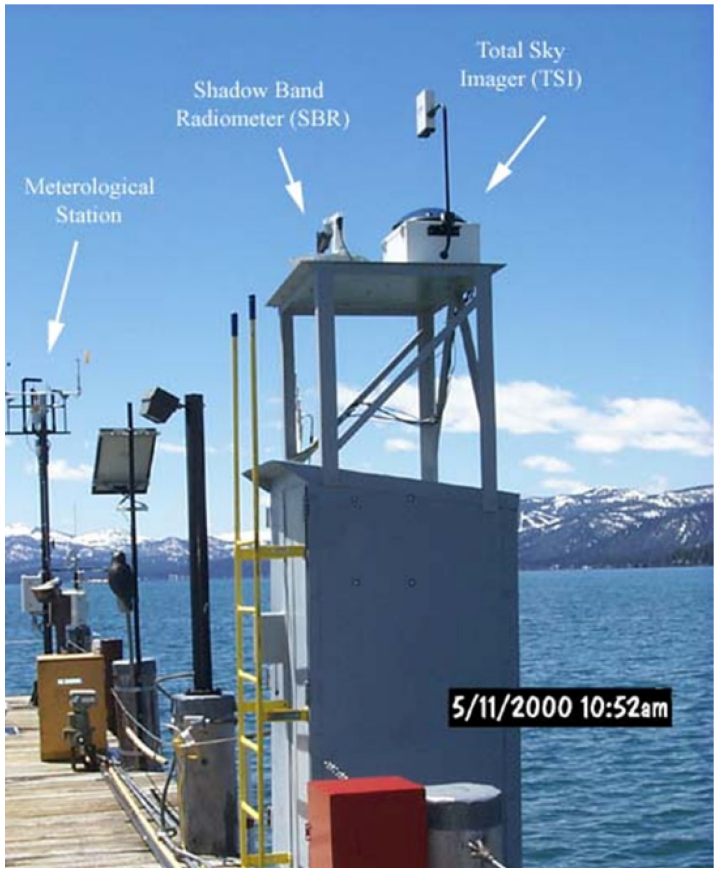
- Large 35 km x 16 km
- High 2 km
- Available year round (does not freeze in winter).
- Homogenous compared with land.
- Large annual temperature range 5-25 C.
- Freshwater (kind to instruments!)
- Good infrastructure and easy access.

Measurements

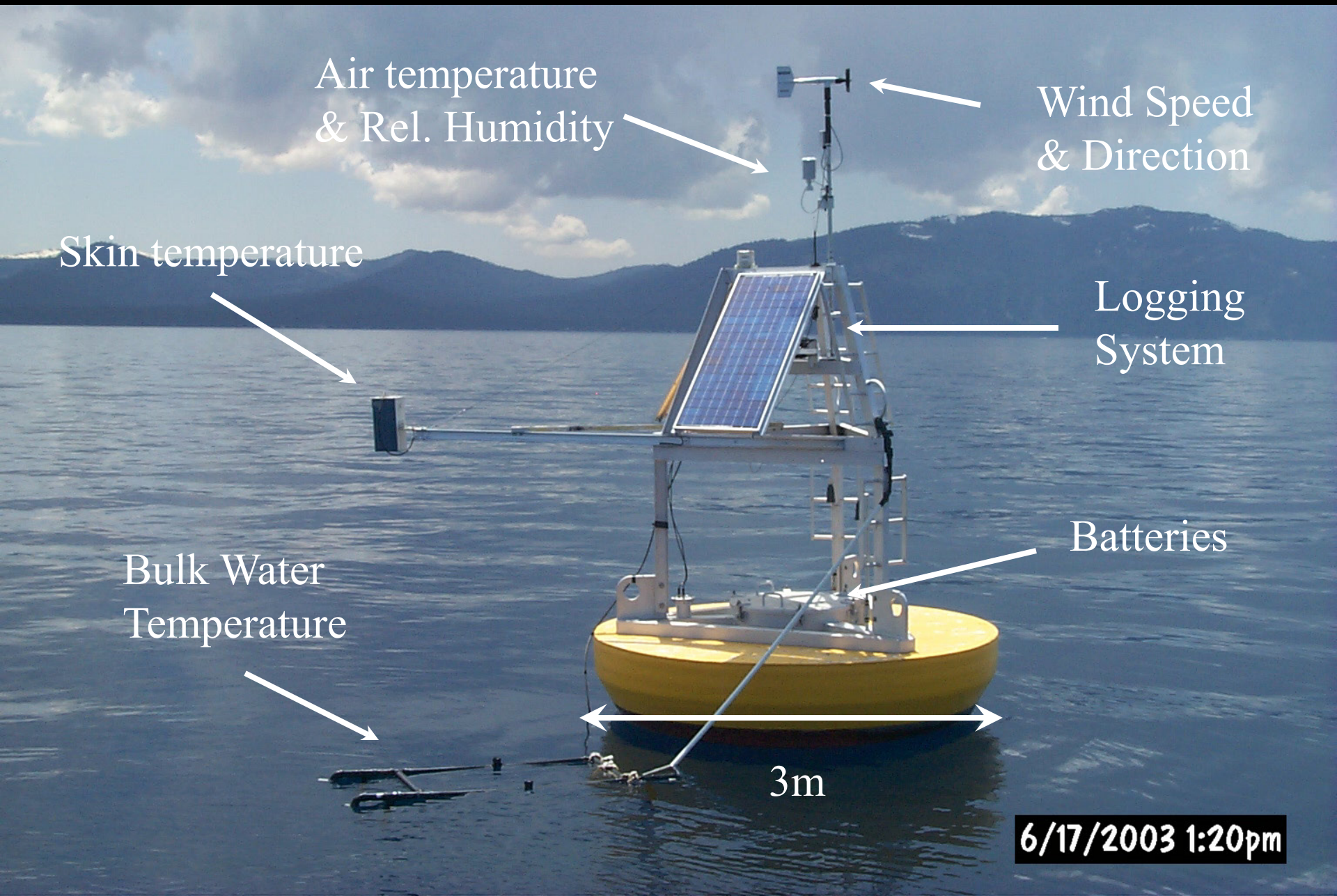
- Offshore
  - bulk temperature, skin temperature, air temperature, wind speed, wind direction, relative humidity, net radiation.
- Onshore
  - air temperature, wind speed, wind direction, relative humidity, short and longwave radiation (up and down), sky imager, aerosols, total column water.

Site Layout and Measurement Stations





TB3 Installed 11-04-2002



Why Salton Sea?

- Large 55 km x 24 km
- Low (at Sea Level)
- Available year round.
- Homogenous compared with land.
- Large annual temperature range 15-35 C.
- Large water vapor range
- Good infrastructure and easy access.

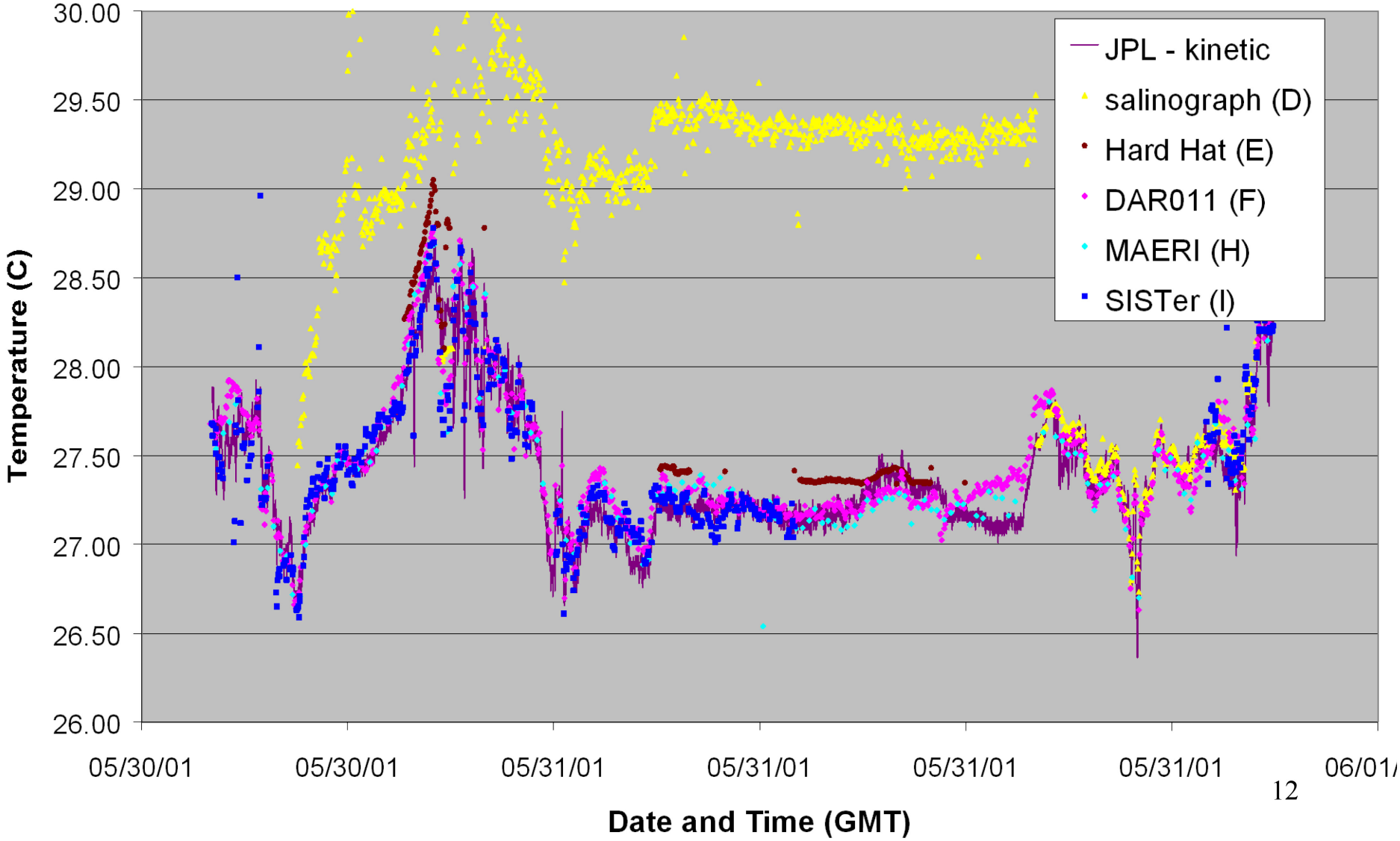
Salton Sea, Platform

Radiometer Calibration and Cross-Cal

Cross Comparison of Radiometers at Miami

New CEOS sponsored comparison early 2009 (March-May)

Cross Comparison of Radiometers at Miami

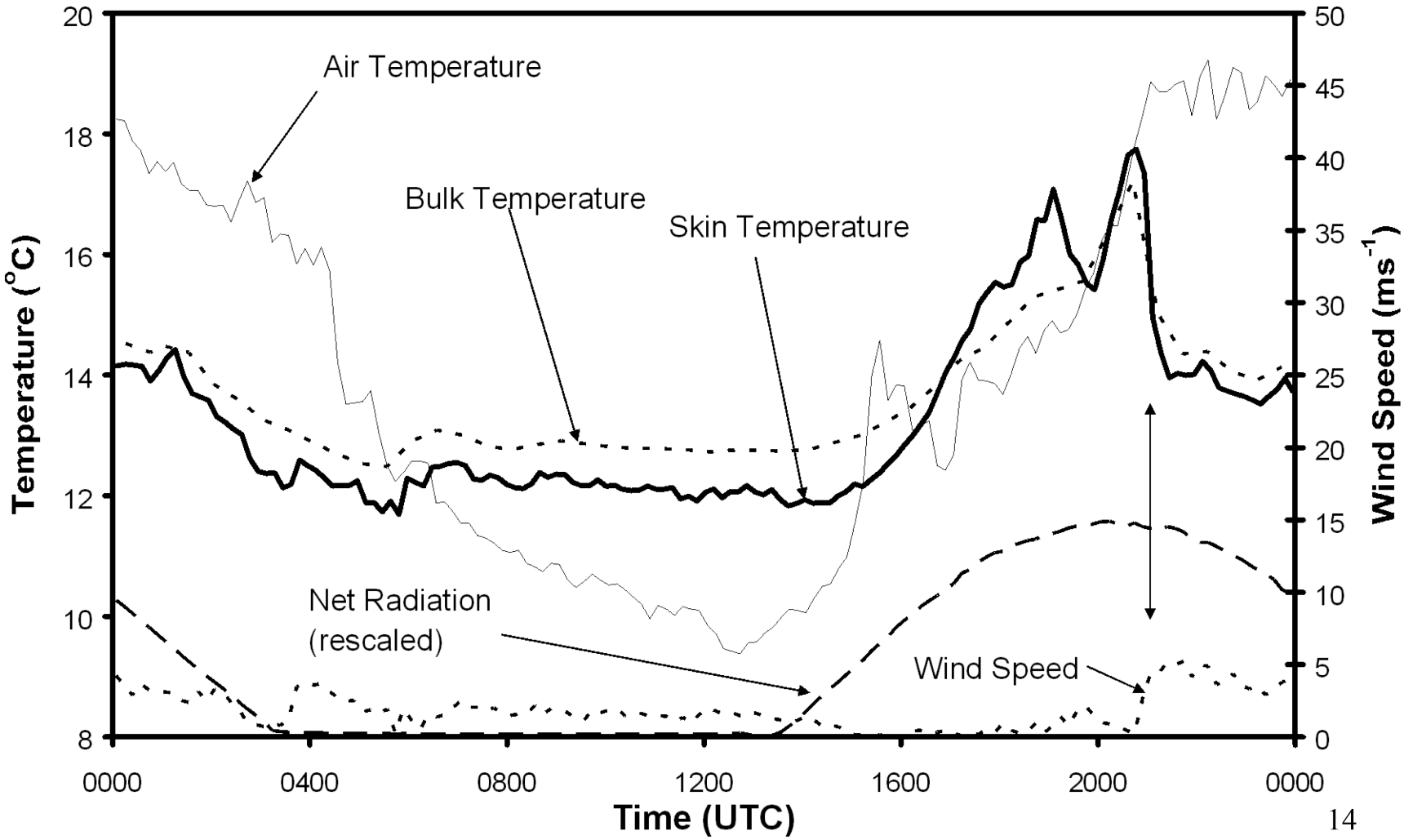


Means and standard deviations of the estimated skin SST differences between pairs of radiometers for the entire cruise period, and for each half of the cruise

Time	150.50 to 152.00			150.50 to 151.25			151.25 to 152.00		
Radiometer Pair	Mean (K)	Std.Dev (K)	N	Mean (K)	Std.Dev (K)	N	Mean (K)	Std.Dev (K)	N
MAE-ISA	0.002	0.135	80	0.005	0.135	69	–0.015	0.135	11
MAE-SIS	0.046	0.066	144	0.046	0.066	74	0.045	0.068	70
MAE-JPL	0.007	0.114	148	0.052	0.111	77	-0.042	0.096	71
MAE-DAR	-0.008	0.076	149	0.022	0.071	78	-0.041	0.067	71
ISA-SIS	0.038	0.101	79	0.030	0.101	67	0.085	0.093	12
ISA-JPL	0.026	0.142	81	0.027	0.141	70	0.018	0.150	11
ISA-DAR	0.007	0.114	80	0.019	0.112	69	-0.064	0.107	11
SIS-JPL	-0.048	0.099	144	-0.009	0.103	74	-0.088	0.078	70
SIS-DAR	-0.053	0.074	144	-0.019	0.054	74	-0.088	0.076	70
JPL-DAR	-0.014	0.103	148	-0.028	0.102	77	0.000	0.102	71

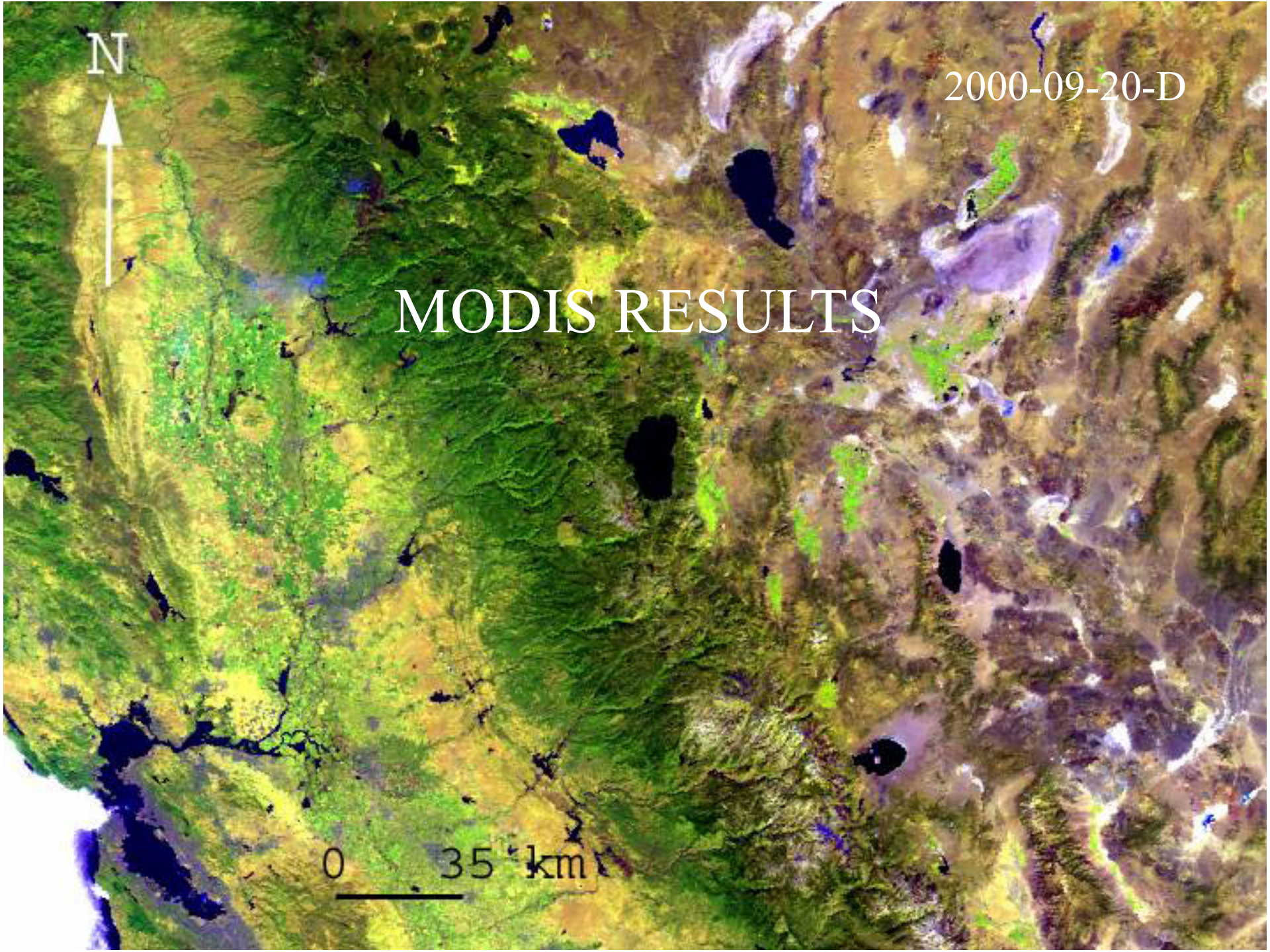
The Third International Infrared Radiometer Workshop to be held in Miami in the late spring of 2009

Variations in the bulk-, skin-, air-temperatures and wind speed on June 7, 2001 at L. Tahoe

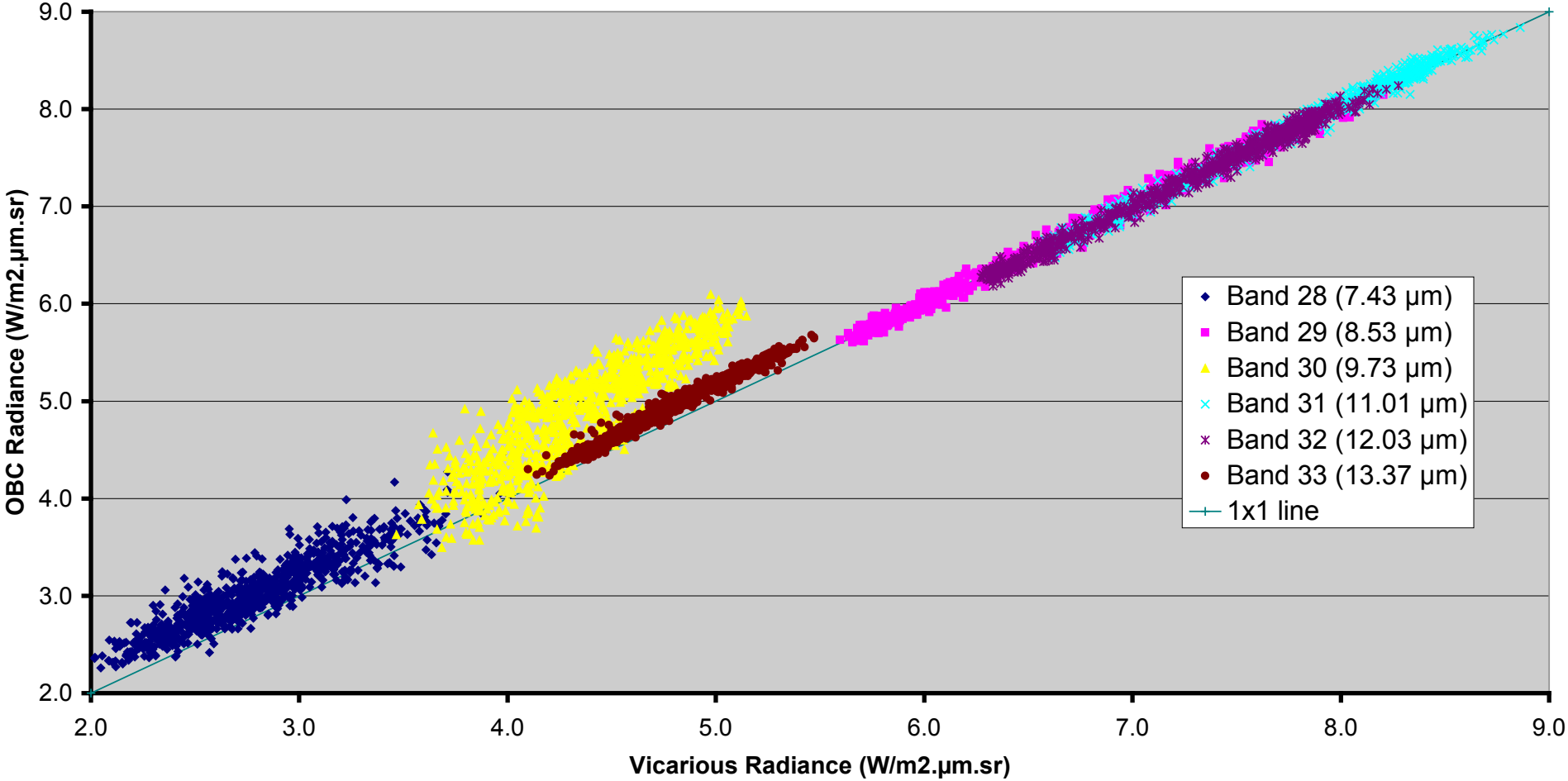


Data Reduction: Methodology For Radiance at Sensor Validation

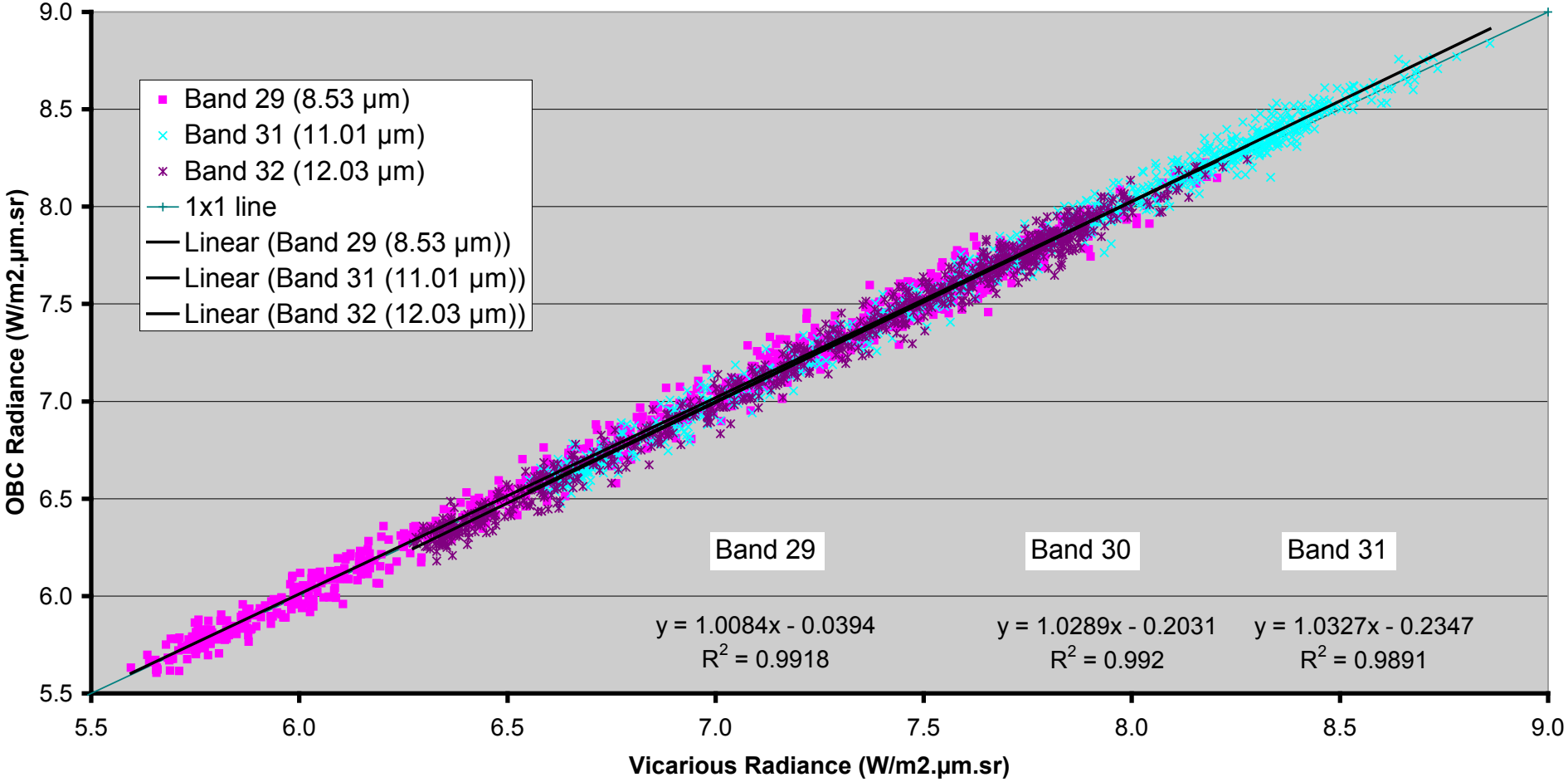
- Extract the bulk temperatures.
- Extract the radiometric temperature.
- Correct the radiometric temperature to skin kinetic temperature.
- Propagate the skin temperature to the satellite using a radiative transfer model and interpolated atmospheric profile.
- Convolve the propagated at-sensor radiance 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.


N
2000-09-20-D
MODIS RESULTS
0
35 km

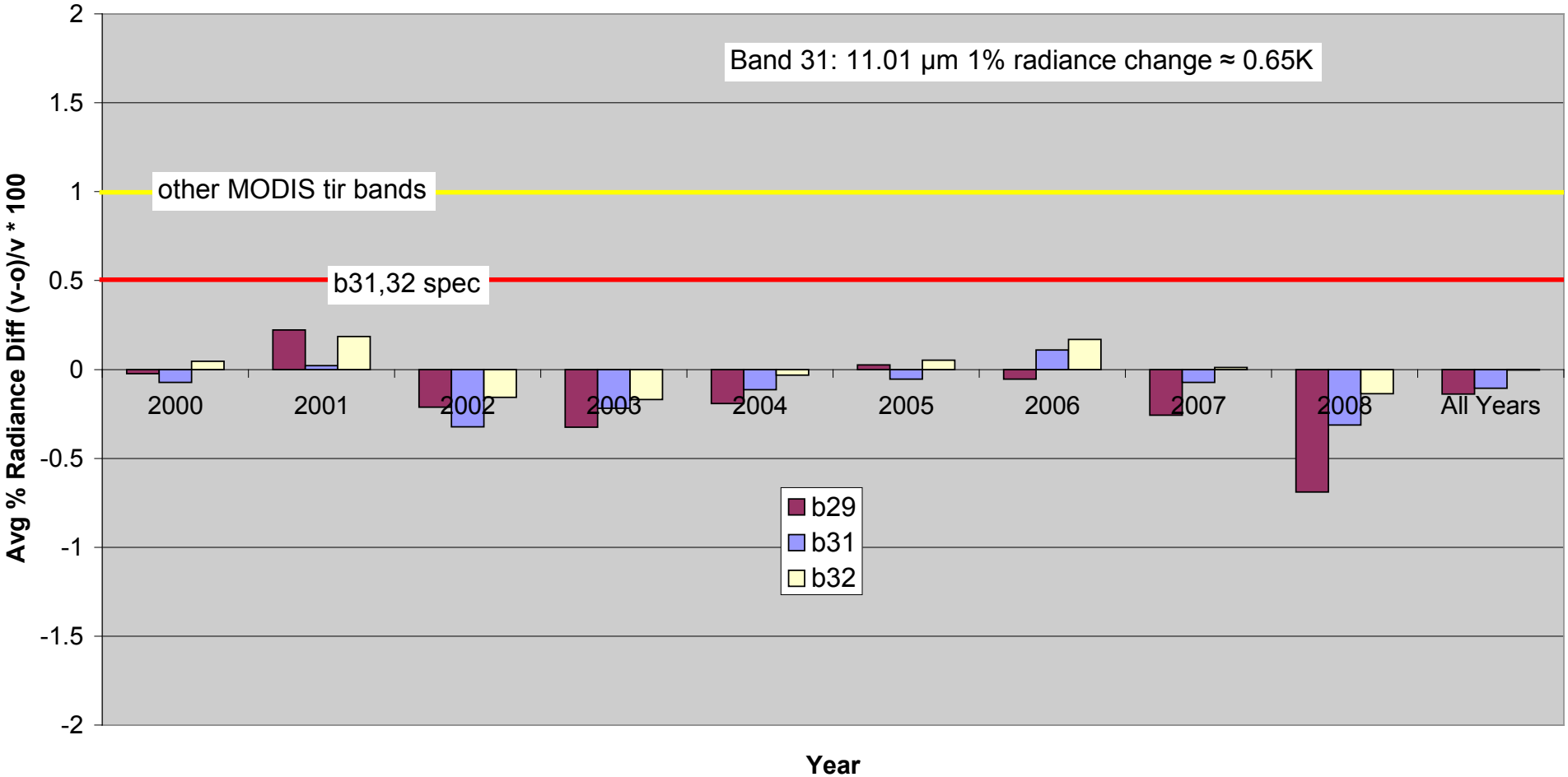
MODIS Terra Vicarious and OBC Thermal Infrared Derived Radiances at Lake Tahoe CY2000-2008, v4-5.x



MODIS Terra Vicarious and OBC Thermal Infrared Derived Radiances at Lake Tahoe CY2000-2008, v4-5.x

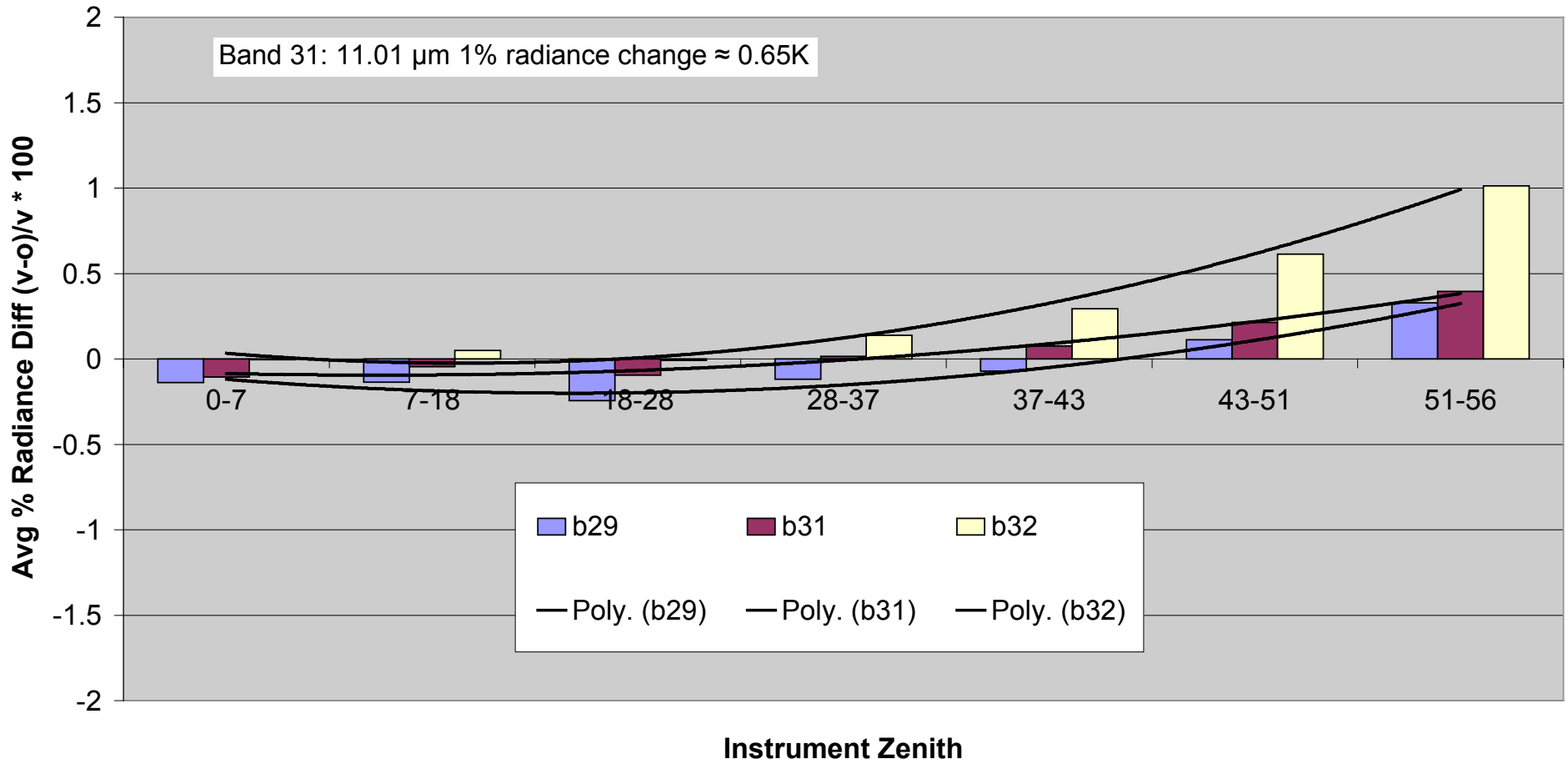


% Radiance Change in TIR Channels for MODIS Terra at Lake Tahoe CY2000-2008 vz0-7 v4-5.x

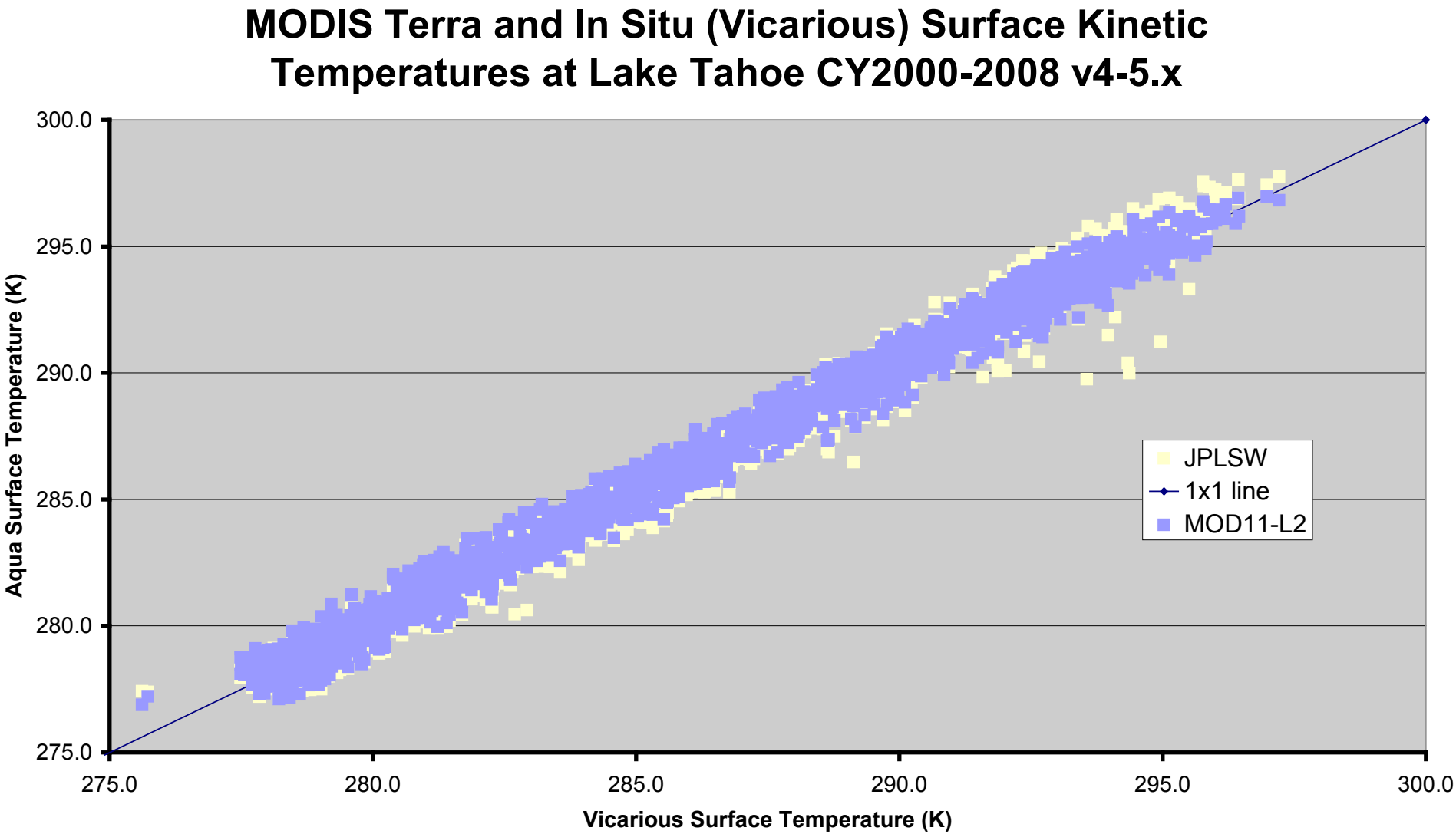


~5000 matchups over mission

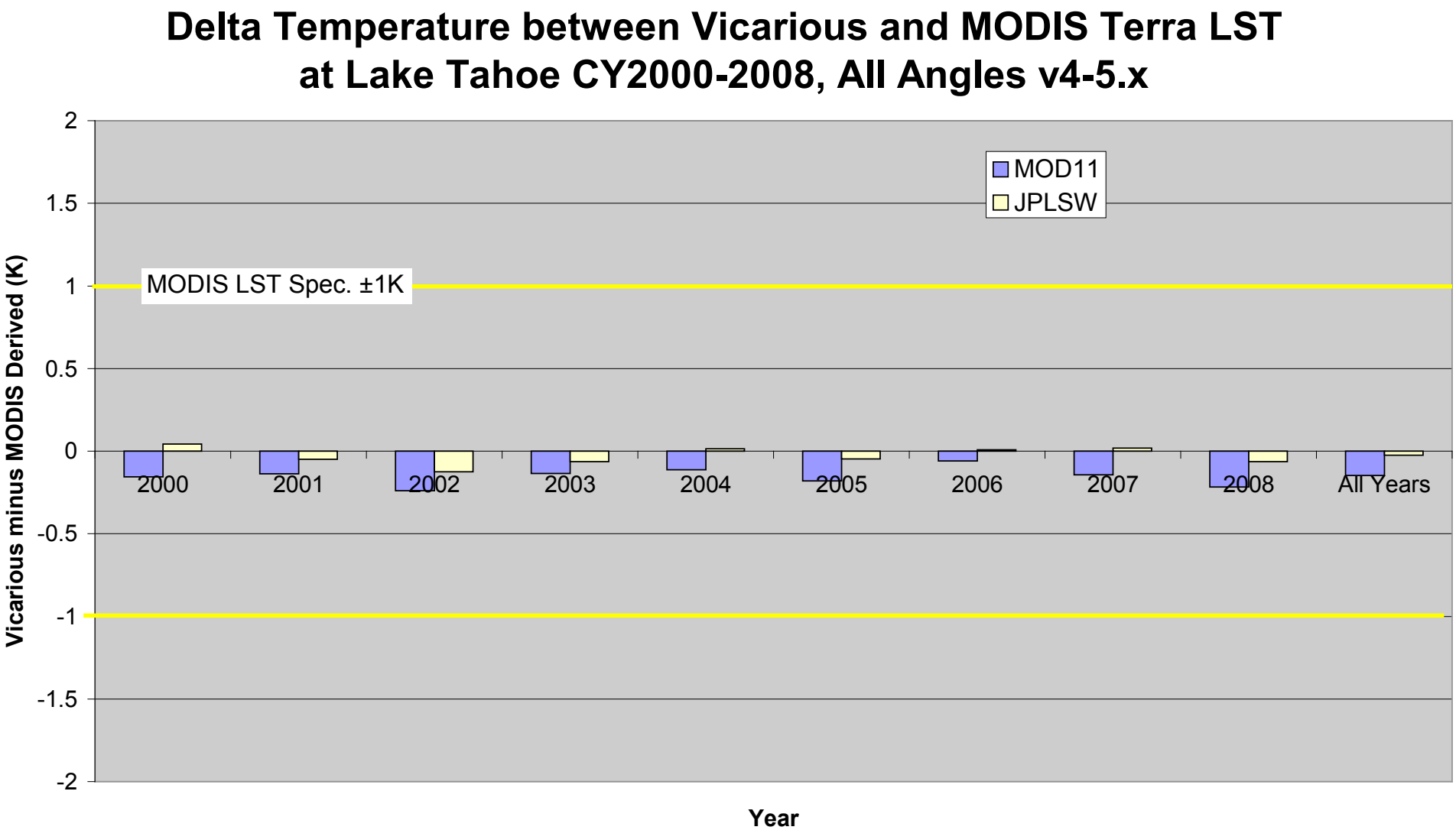
% Radiance Change in TIR Channels for MODIS Terra with Instrument Zenith at Lake Tahoe CY2000-2008, v4-5.x



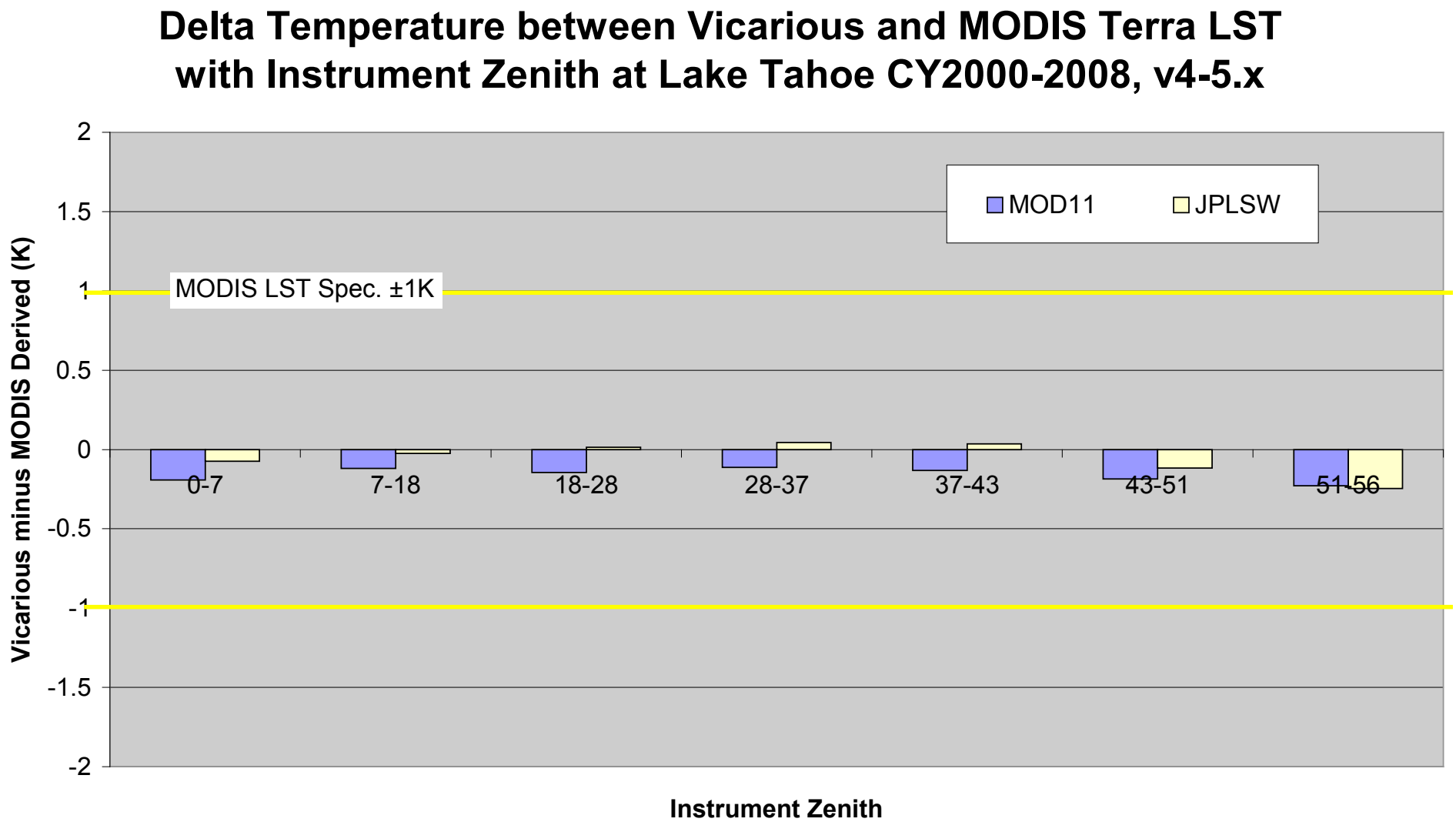
Error increases with view angle. Most likely cause is change in emissivity with viewing zenith. Note increased path length in atmospheric correction was corrected.



MOD11 and Std Split Window

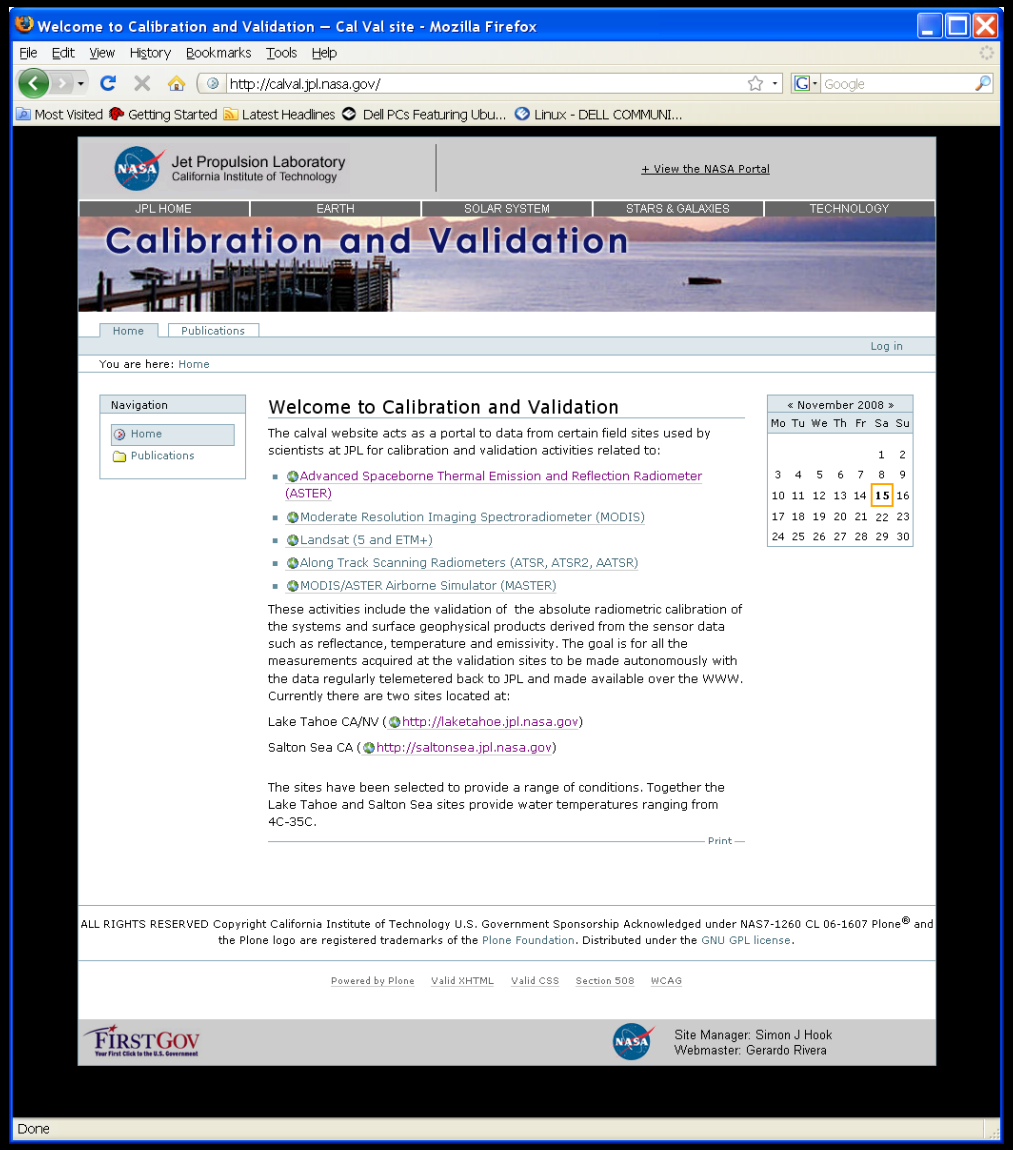


MOD11 algorithm performs extremely well at Lake Tahoe



MOD11 algorithm includes correction for view angle effects and performs well at high view angles

http://calval.jpl.nasa.gov



Summary and Conclusions

- Lake Tahoe CA/NV automated validation site was established in 1999 to assess radiometric accuracy of satellite and airborne mid and thermal infrared data and products. Water surface temperatures range from 4-25 C.
- Salton Sea CA automated validation site was established in 2008 to broaden range of available water surface temperatures and atmospheric water vapor test cases. Water surface temperatures range from 15-35 C.
- Sites provide all information necessary for validation every 2 mins (bulk temperature, skin temperature, air temperature, wind speed, wind direction, net radiation, relative humidity).
- Sites have been used to validate mid and thermal infrared data and products from: ASTER, AATSR, ATSR2, MODIS-Terra, MODIS-Aqua, Landsat 5, Landsat 7, MTI, TES, MASTER, MAS.
- Approximately 10 years of data available to help validate AVHRR