LST Validation and Analysis

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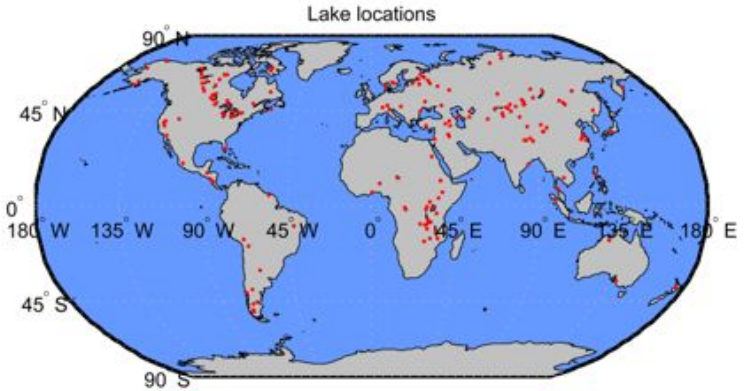
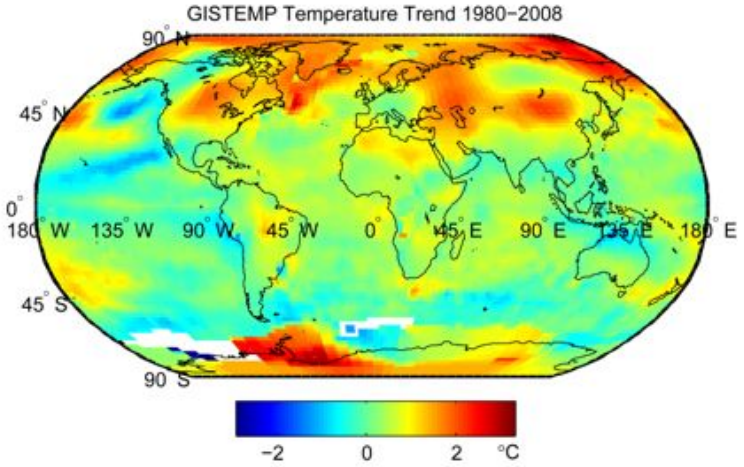
Outline

- Introduction
  - Why is validation so important
- Locations
  - Tahoe and Salton Sea, Pseudo-Invariant sites
- Results
  - MODIS
- Summary and Conclusions

Introduction

- The Idea
  - Temperatures of lakes and reservoirs have potential as good indicators of climatic trends
  - Existing in situ data is insufficient in space and time
  - Nearly 30-year record of satellite thermal infrared imagery available
- Project Objectives
  - Use satellite derived water surface temperatures to characterize the temporal thermal behavior of lakes and inland water bodies worldwide
  - Relate changes in the thermal behavior of the water bodies to global and regional climate change as indicated by surface air temperature data
  - Study sites: 165 large lakes worldwide
  - Case study: 6 lakes in California and Nevada

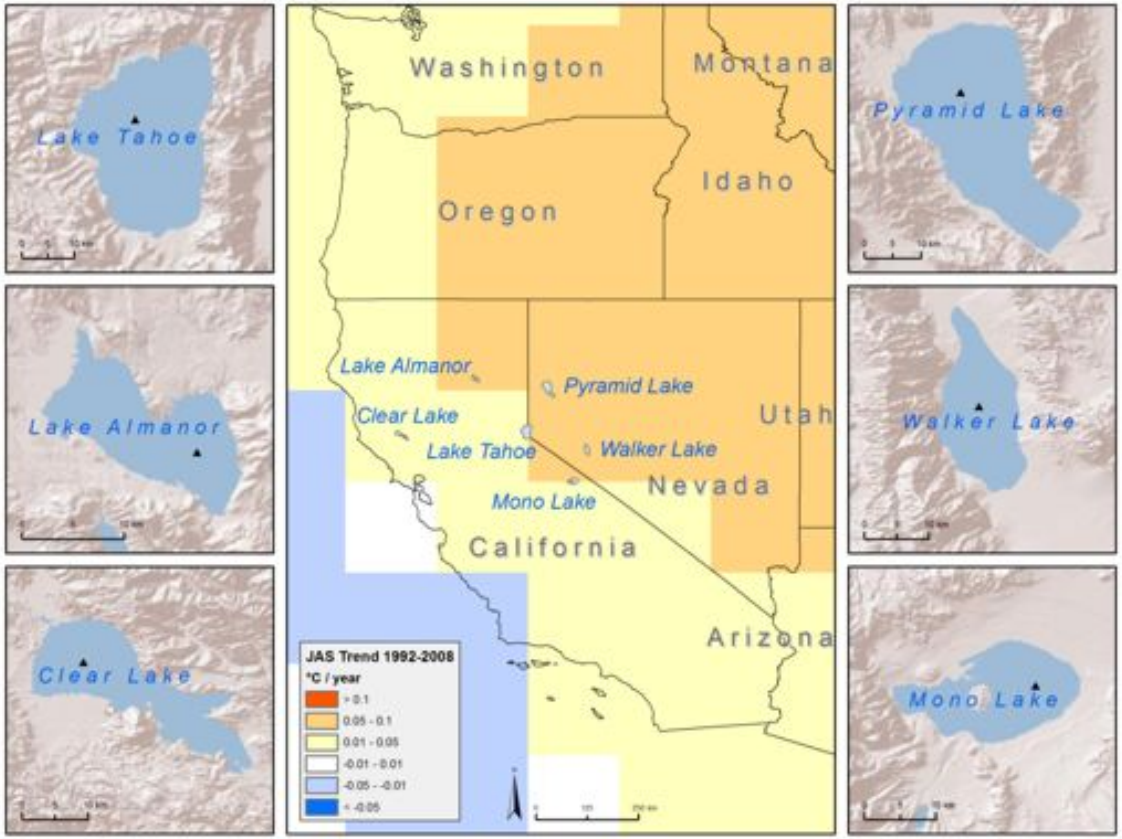




California/Nevada case study

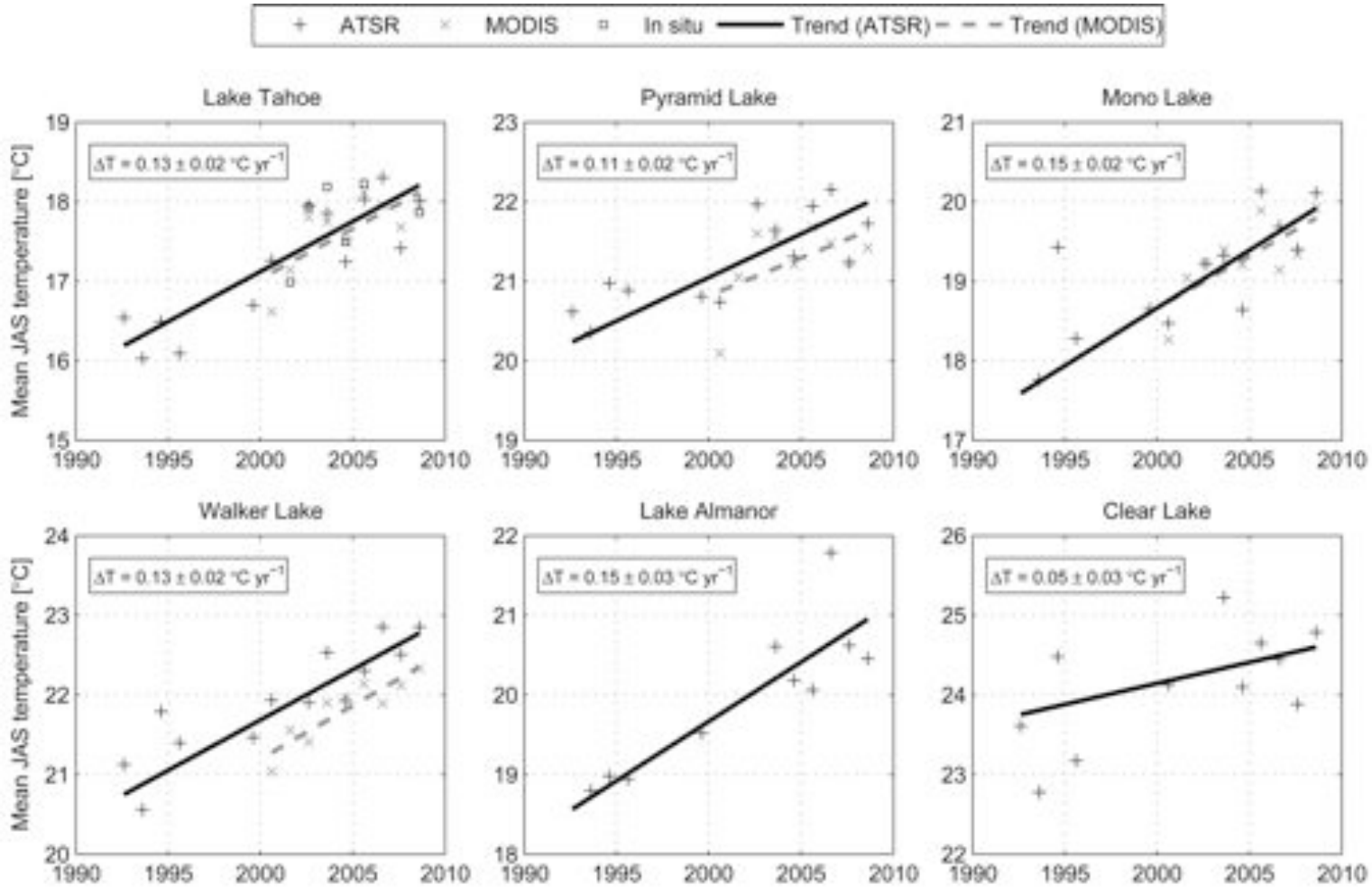
To develop the methodology, a preliminary case study was carried out for six lakes in California and Nevada.

In situ measurements at 4 buoys at Lake Tahoe were used to develop algorithms and validate the results



The location of the six test sites for the case study. The center panel shows the spatial lake locations and the GISTEMP (Hansen et al., 1999) summertime temperature change between 1991 and 2008.

Results:
Summertime (JAS) trends since 1991



Schneider et al. (2009), Satellite observations indicate rapid warming trend for lakes in California and Nevada. Geophys. Res. Lett., 36, L22402, doi: 10.1029/2009GL040846.

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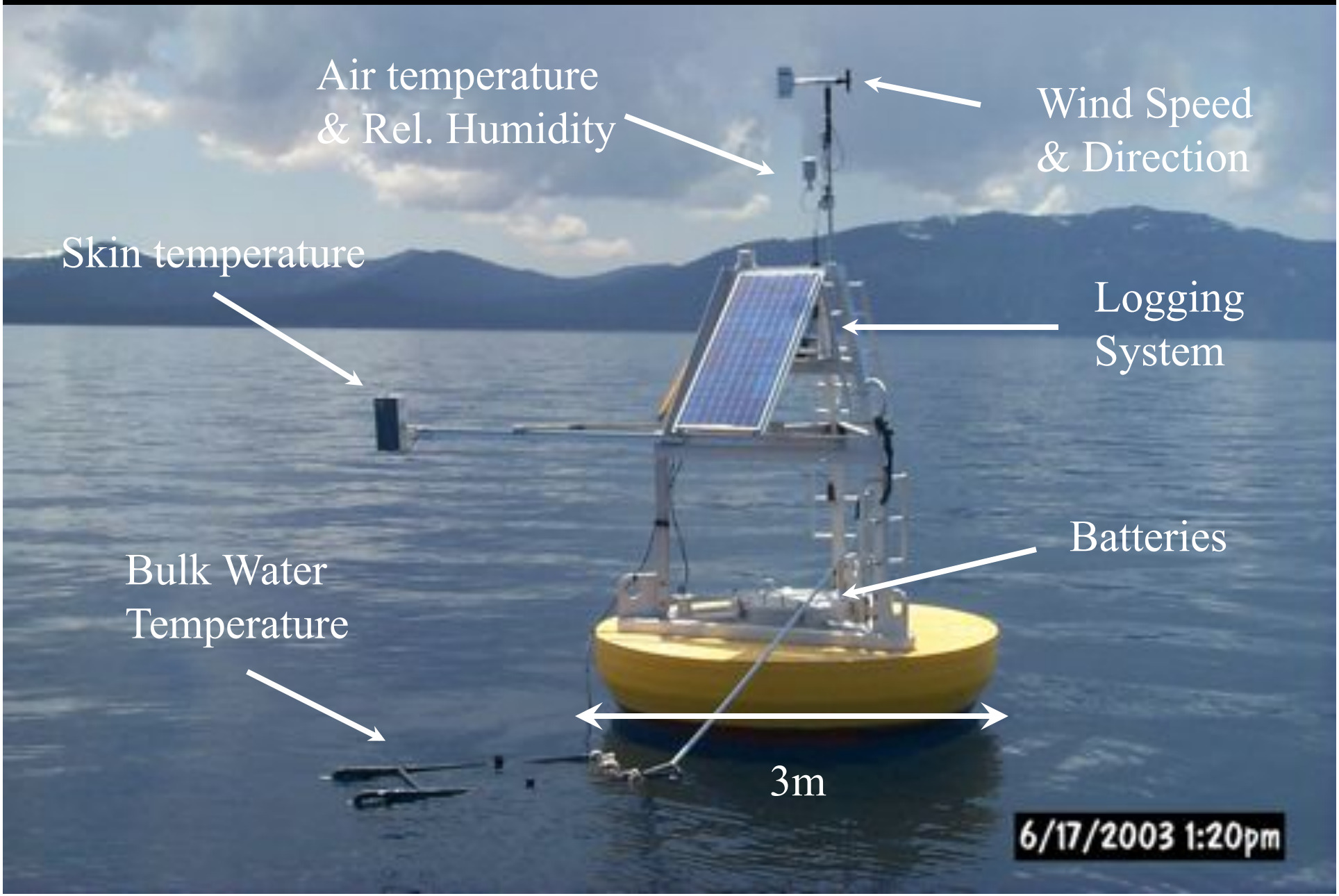
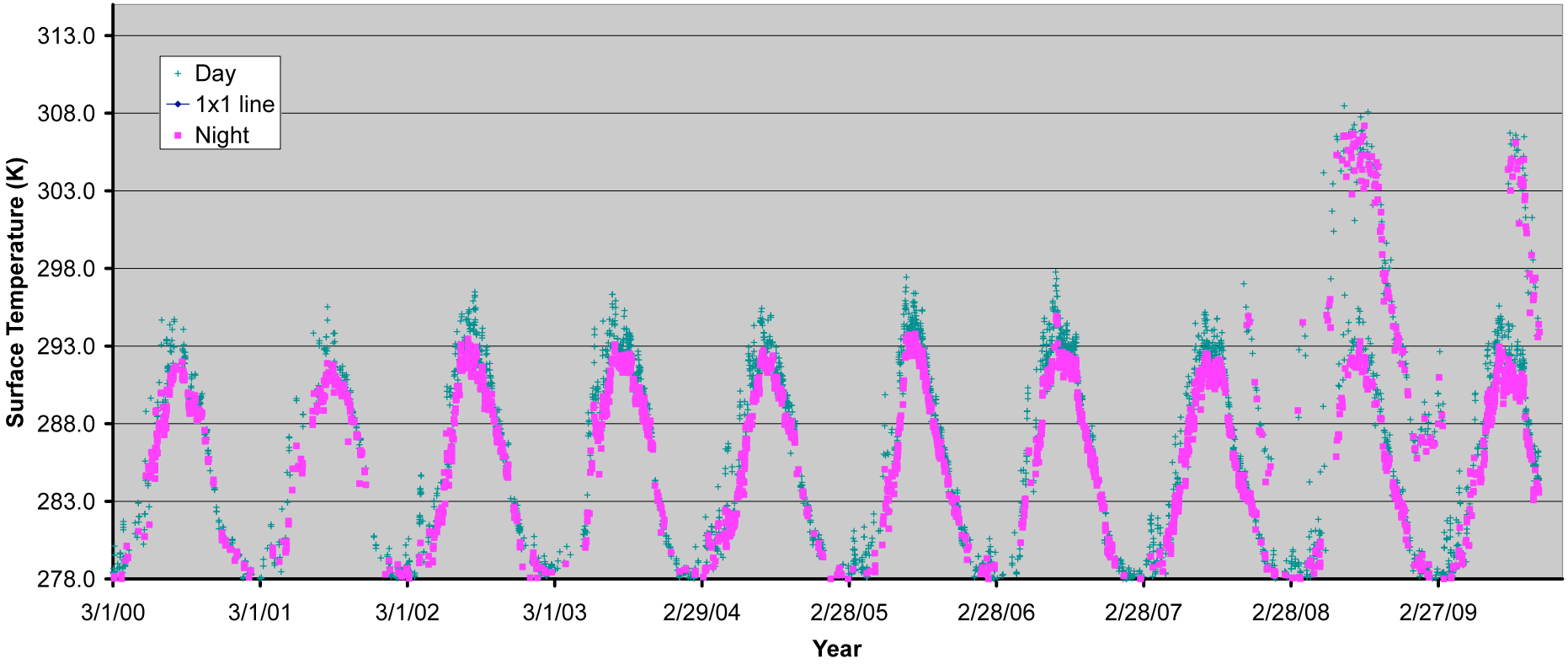
- Future Work

- 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.

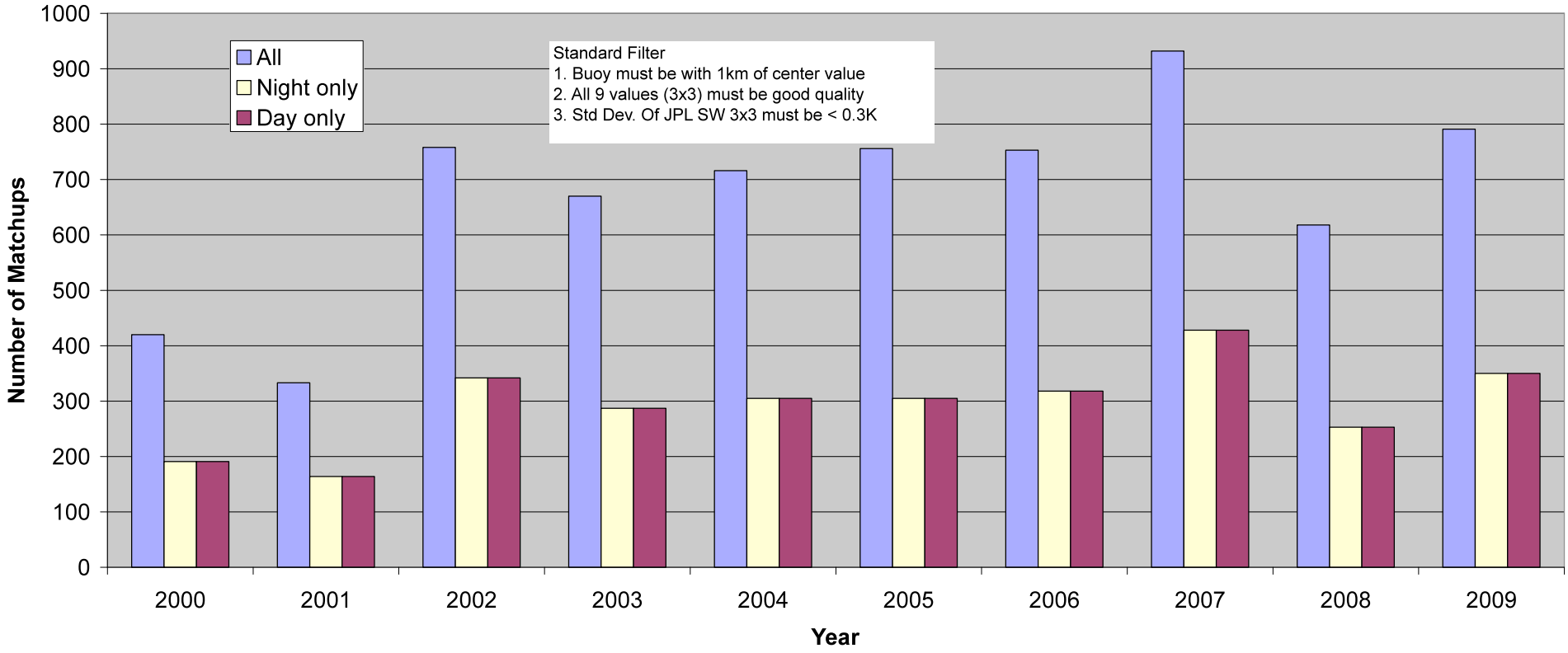
TB3 Installed 11-04-2002



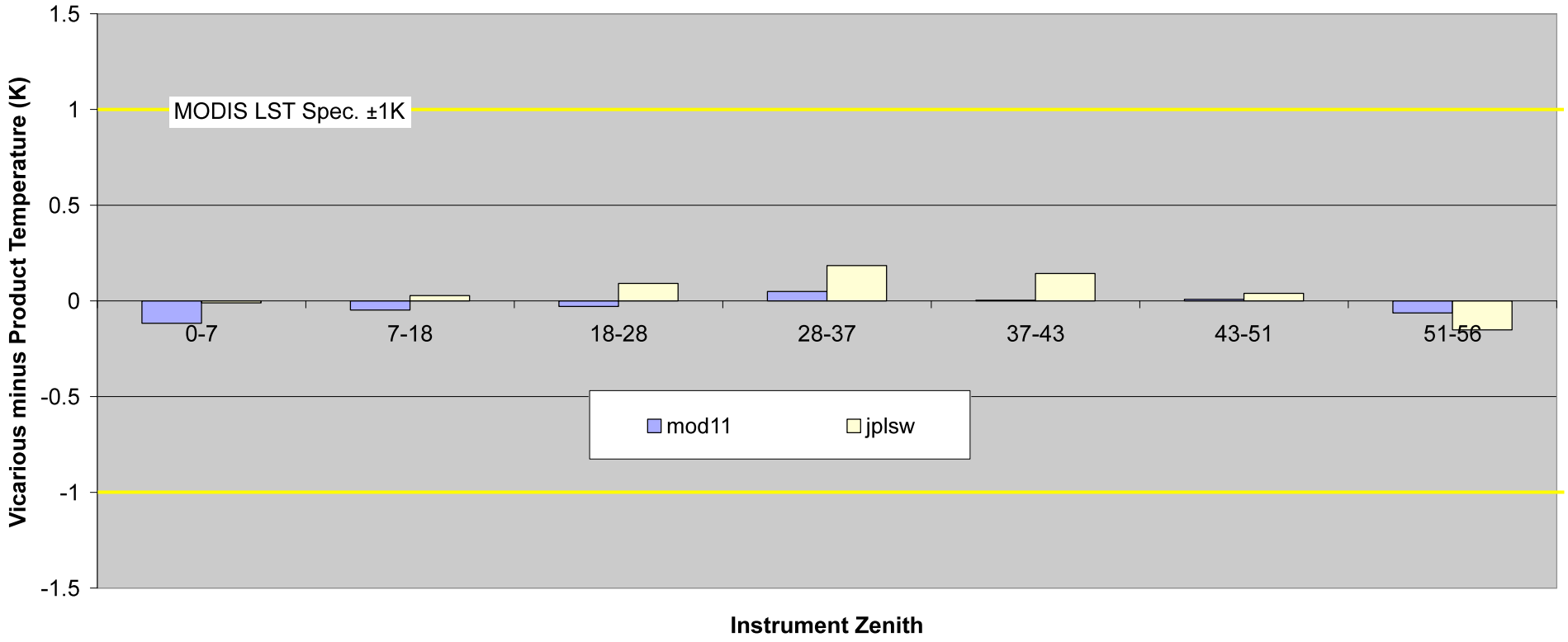
MODIS Terra Split Window Day and Night Surface Kinetic Temperatures at Lake Tahoe and Salton Sea CY2000-2009 v4-5.x



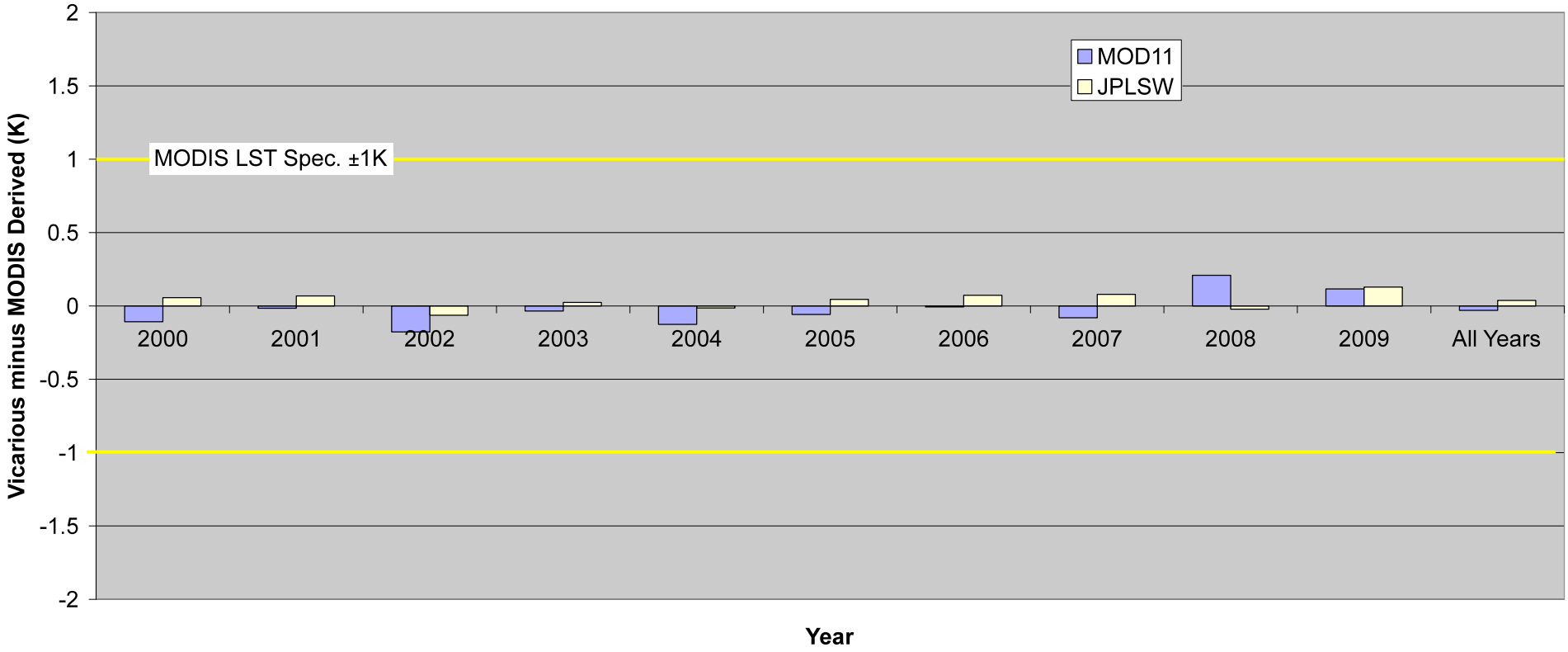
Cloud Free Filtered Statistics for MODIS Terra LST Products at Lake Tahoe and Salton Sea CY2000-2009, All Angles v4-5.x

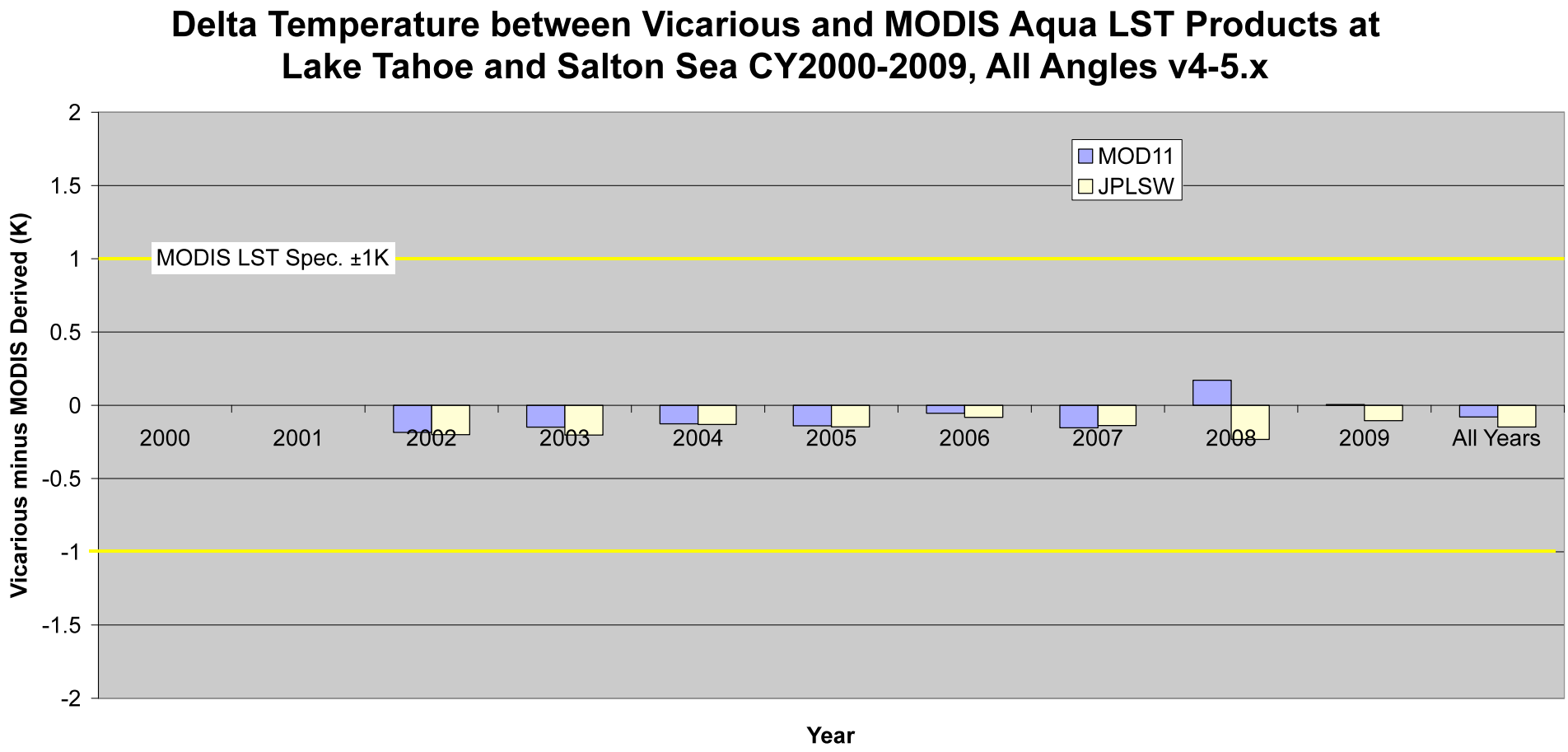


Delta Temperature Between Vicarious and MODIS Terra LST Products with Instrument Zenith at Lake Tahoe and Salton Sea CY2000-2009, v4-5.x

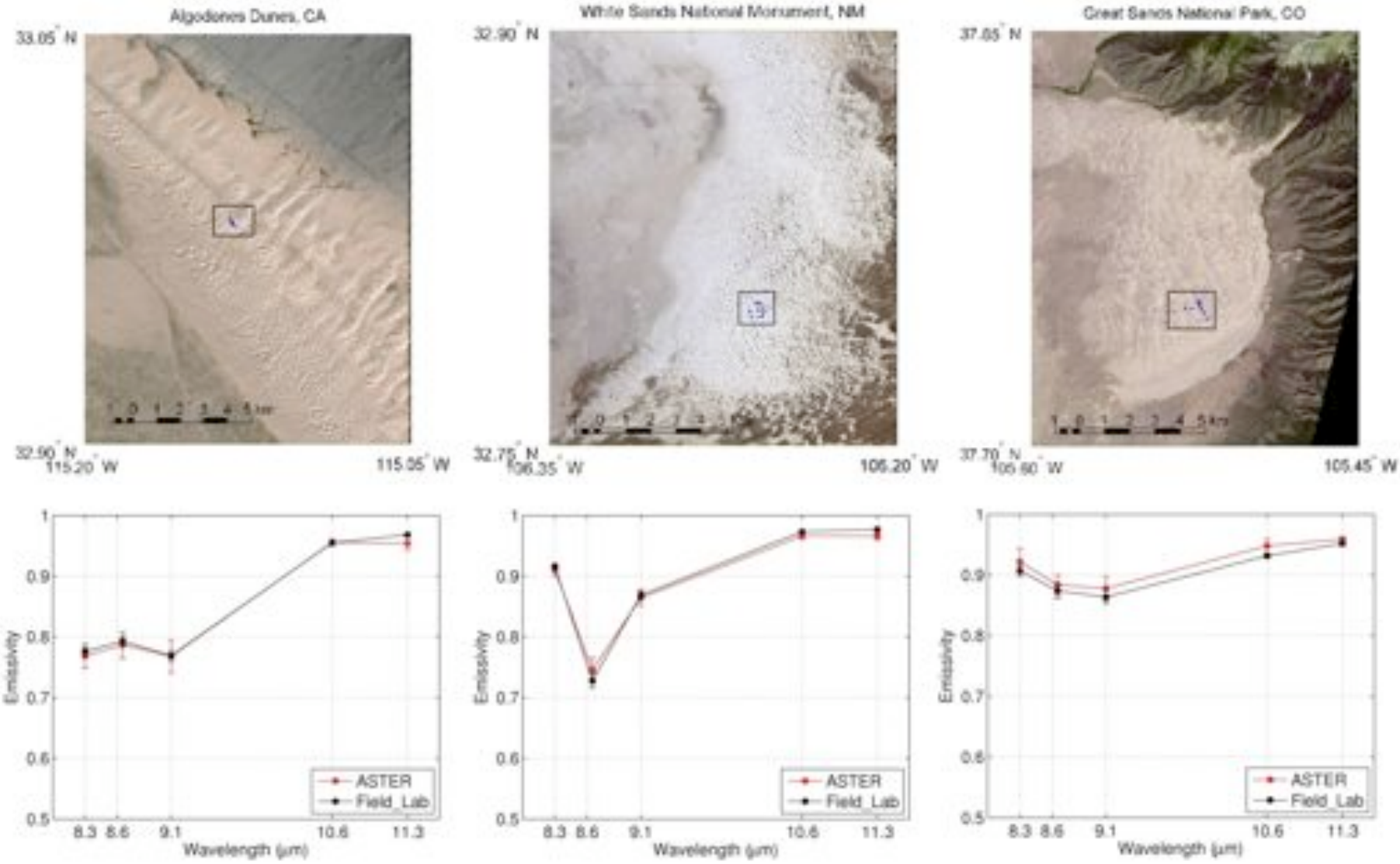


Delta Temperature between Vicarious and MODIS Terra LST Products at Lake Tahoe and Salton Sea CY2000-2009, All Angles v4-5.x



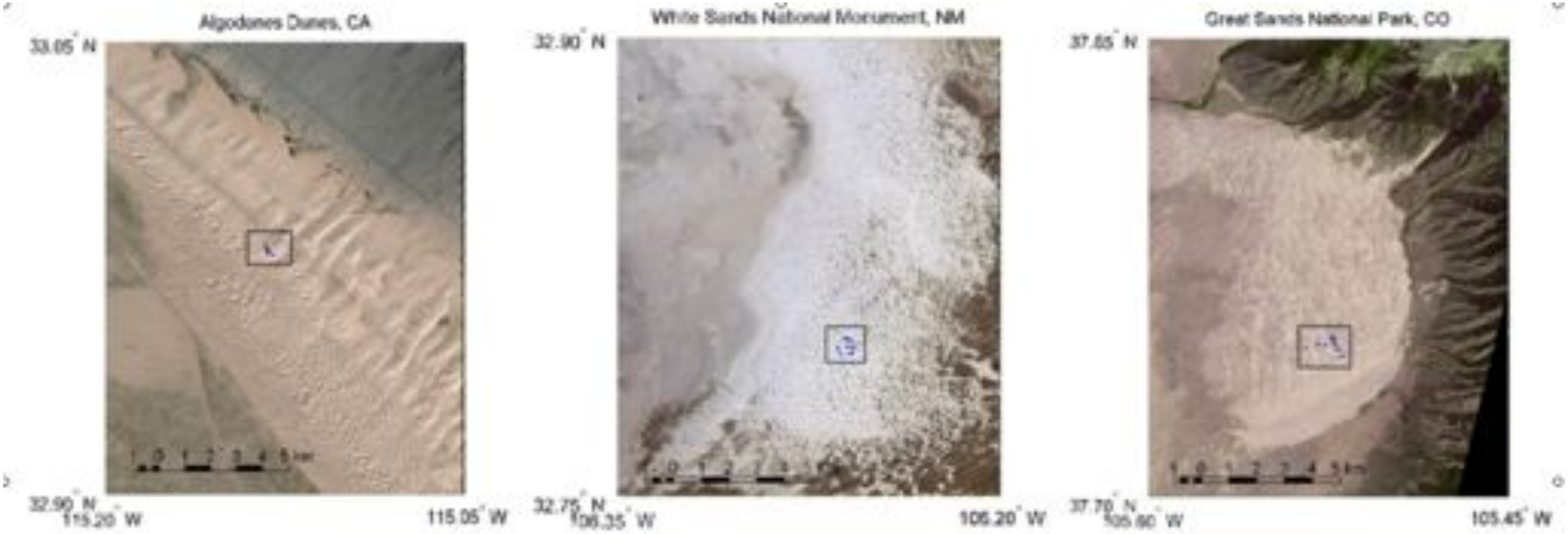

Delta Temperature between Vicarious and MODIS Aqua LST Products at Lake Tahoe and Salton Sea CY2000-2009, All Angles v4-5.x
Vicarious minus MODIS Derived (K)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
MODIS LST Spec. ±1K
MOD11
JPLSW
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
All Years
Year

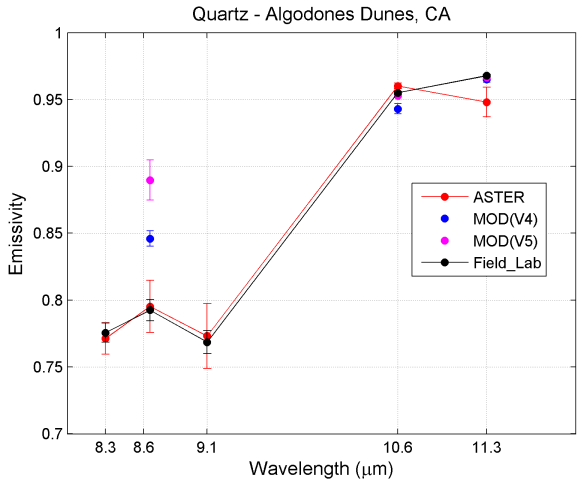
Validation of North American ASTER Emissivity Database (NAALSED)

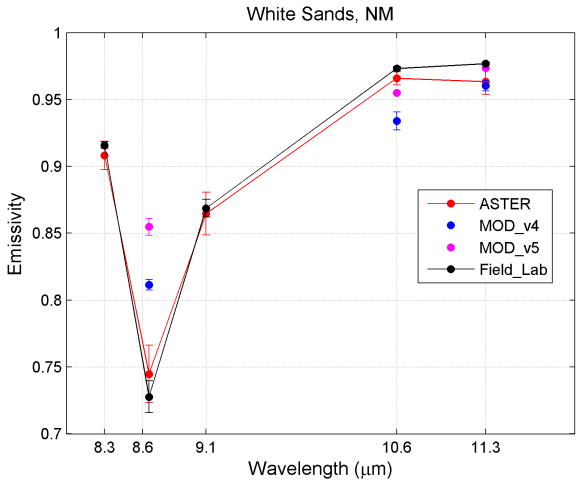


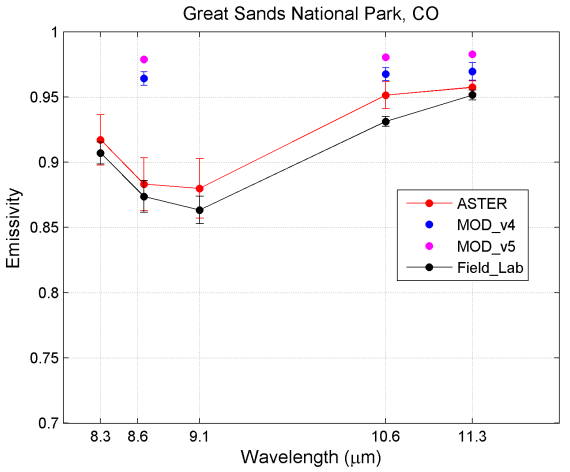
Hulley, G. C., Hook, S. J., and A.M. Baldridge, (2009), Validation of the North American ASTER Land Surface Emissivity Database (NAALSED) Version 2.0, *Remote Sensing of Environment*, 113, 2224-2233

MODIS Emissivities are over-estimated









Summary and Conclusions

- Established automated sites for validating thermal infrared data at Lake Tahoe CA/NV and Salton Sea CA. Lake Tahoe Site has been operating since 1999.
- Measurements made at the site include skin- bulk- air-temperature, wind speed, wind direction and net radiation at multiple locations every 2 minutes. Multiple locations (4 buoys) allow validation of several points within a scene.
- Validated data from multiple instruments including, AATSR, ASTER, MODIS (Terra, Aqua), Landsat 5 and Landsat ETM+, MTI.
- Results so far for MODIS indicate:
  - MODIS algorithm works extremely well over water
  - MODIS algorithms have some issues over arid and sem-arid areas. Version 4.1 better than 5.0
  - MODIS algorithms have some issues over wet surfaces. Version 4.1 better than 5.0

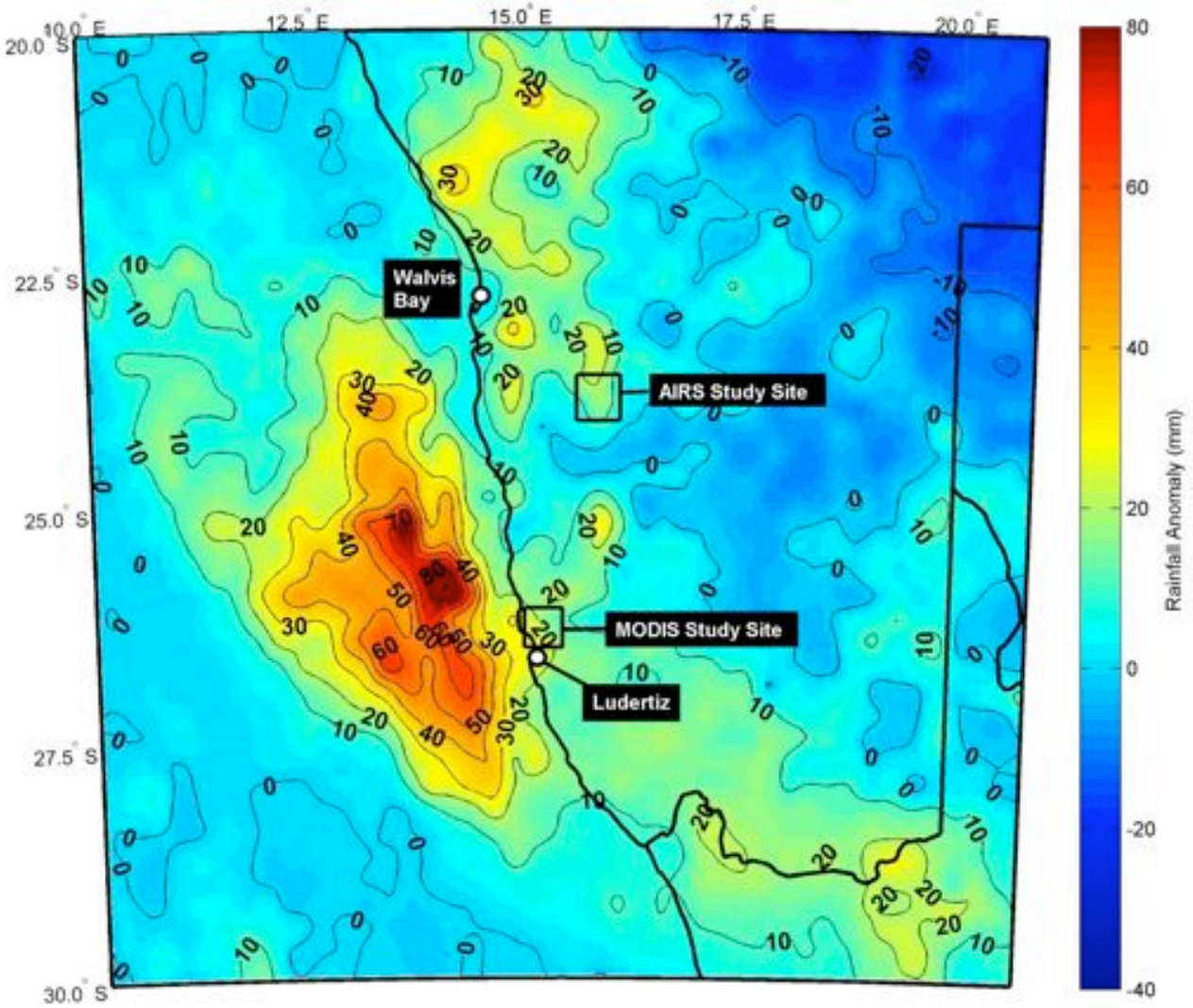
Backup

Namib Desert Rainfall event during April 2006

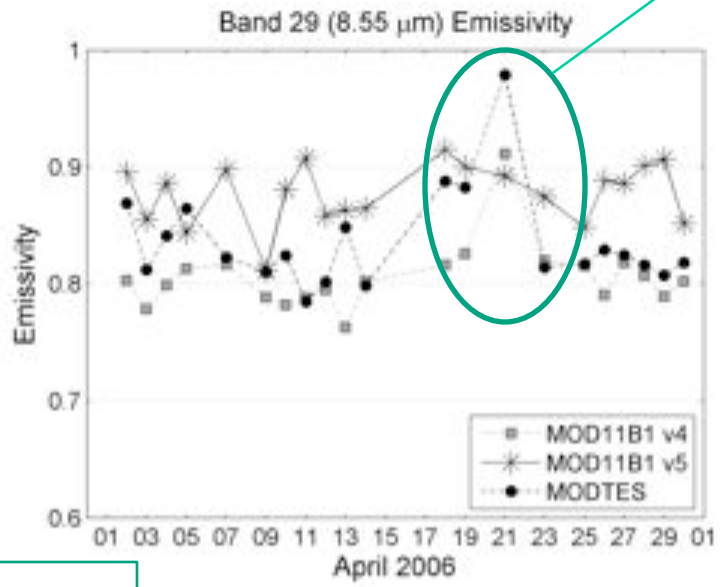
From 16-22 April 2006, almost **100 mm** rain was recorded at Luderitz – **6 times the long-term annual rainfall average!**

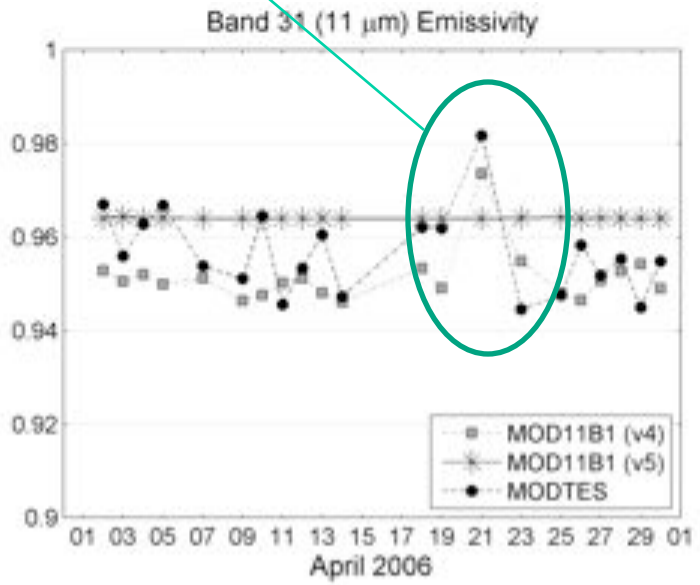
Muller et al. (2008) found that wet conditions over Southern Africa during this time resulted from a combination of La Niña event and warming of the southeast Atlantic Ocean.

TRMM rainfall anomaly for April, 2006 (mm)

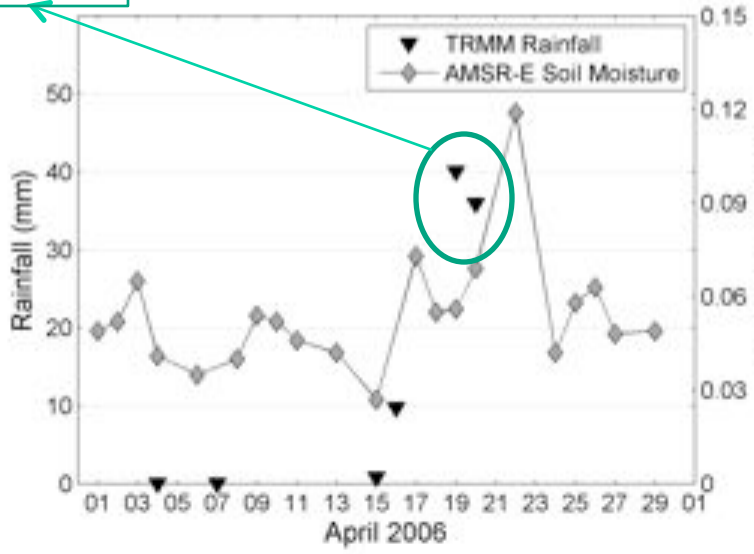


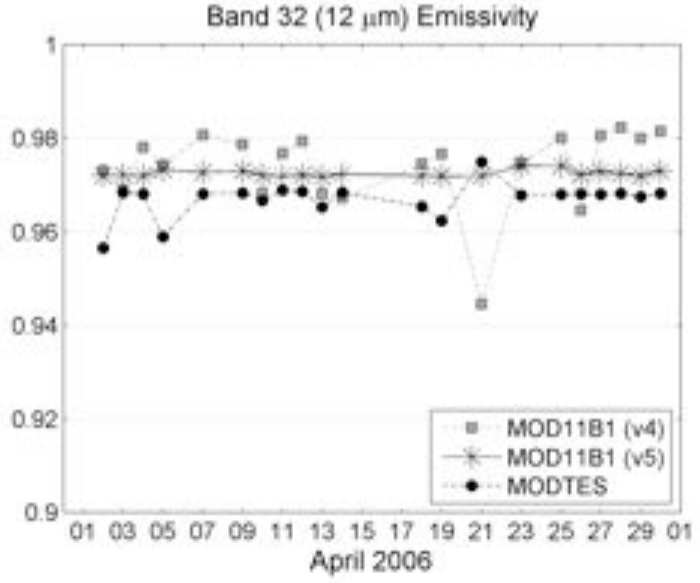
Increase in Emissivity





TRMM Rainfall





Namib Desert