HysplRI-TIR Cal/Val Approach

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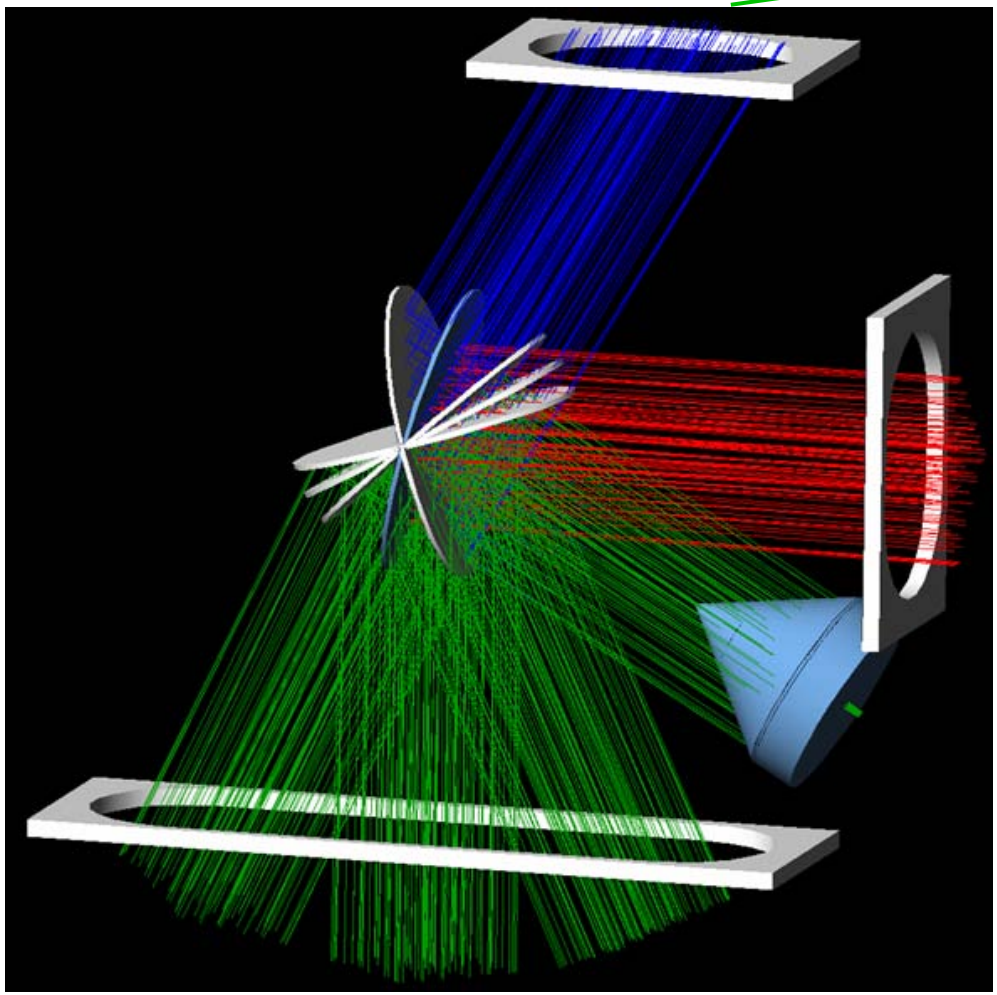
TIR Concept



Blackbody (V-Groove)

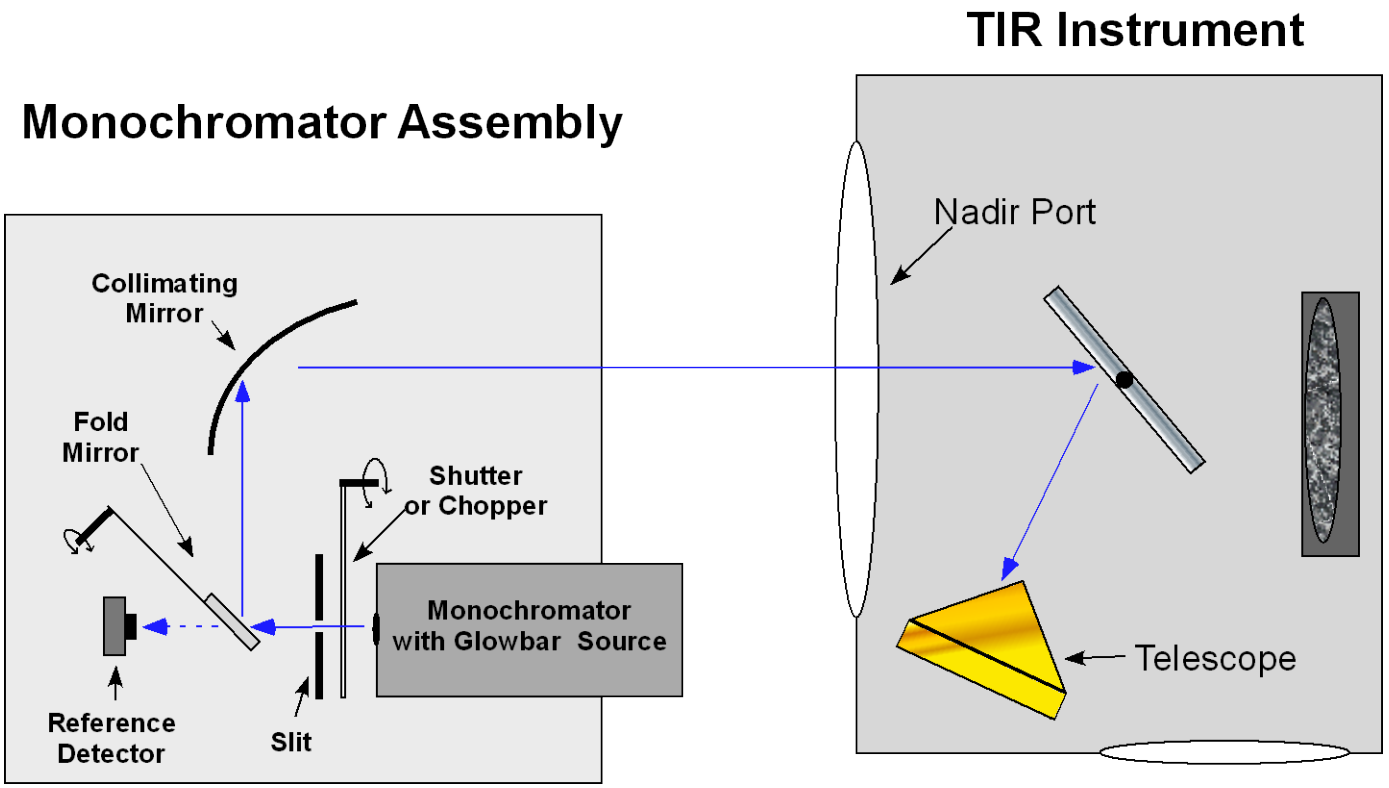
Space View

Earth View

Calibration Overview

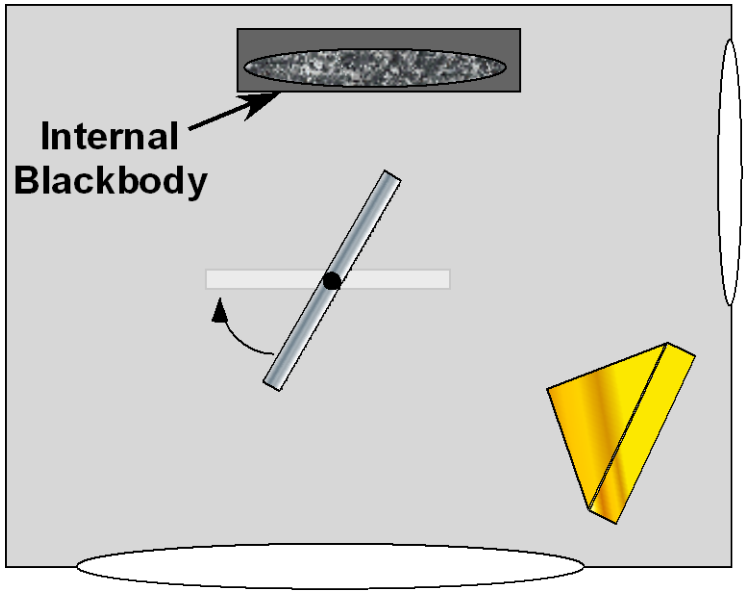
- Spectral Calibration
- Radiometric Calibration
- Spatial Calibration
- On-Orbit Calibration

Spectral Calibration with Monochromator



- Heritage (JPL) – PMIRR, TES, MCS, Diviner
- Straightforward approach with reliable results.
- Only a small number of pixels are measured at once. Very time intensive to measure all pixels over full spectral range.

Radiometric Calibration

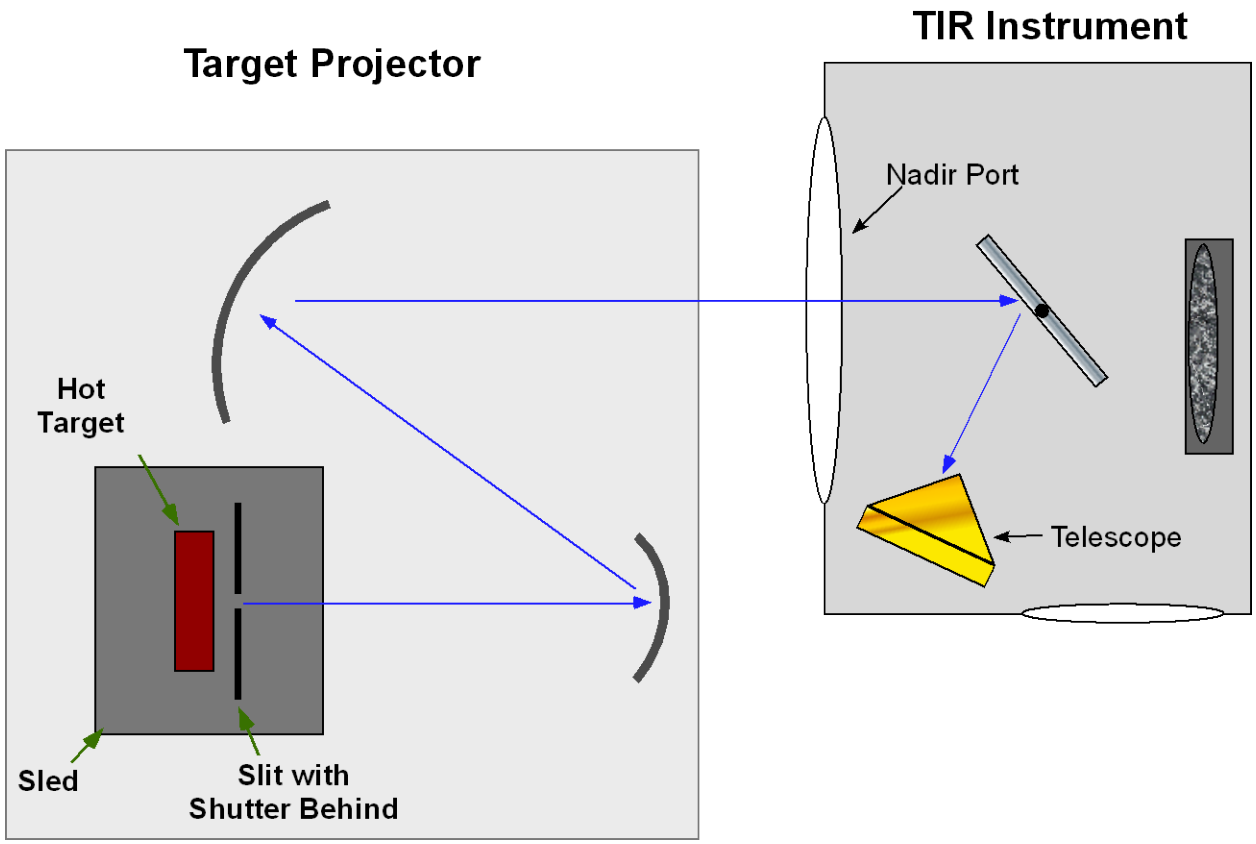


Cold Blackbody Source (LN2)

Variable Temperature Blackbody Source

- Performed in vacuum to prevent condensation on cold blackbody surfaces.
- Scan mirror rotates to scan between internal blackbody, cold blackbody, and variable temperature blackbody.
- Variable temperature blackbody is stepped over entire scene temperature range.
- System nonlinearities can be determined using measured spectral response and blackbody response.
- NETD determined by temperature response and noise level.

Spatial (FOV) Calibration



- For cross-scan FOV measurements (slit out of page), TIR scan mirror will sweep slit across focal plane.
- For along-scan FOV measurements (slit vertical on page), slit will be scanned in perpendicular direction (perpendicular to page) to map out focal-plane FOV.

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California Institute of Technology
Pasadena, California

Validation Framework

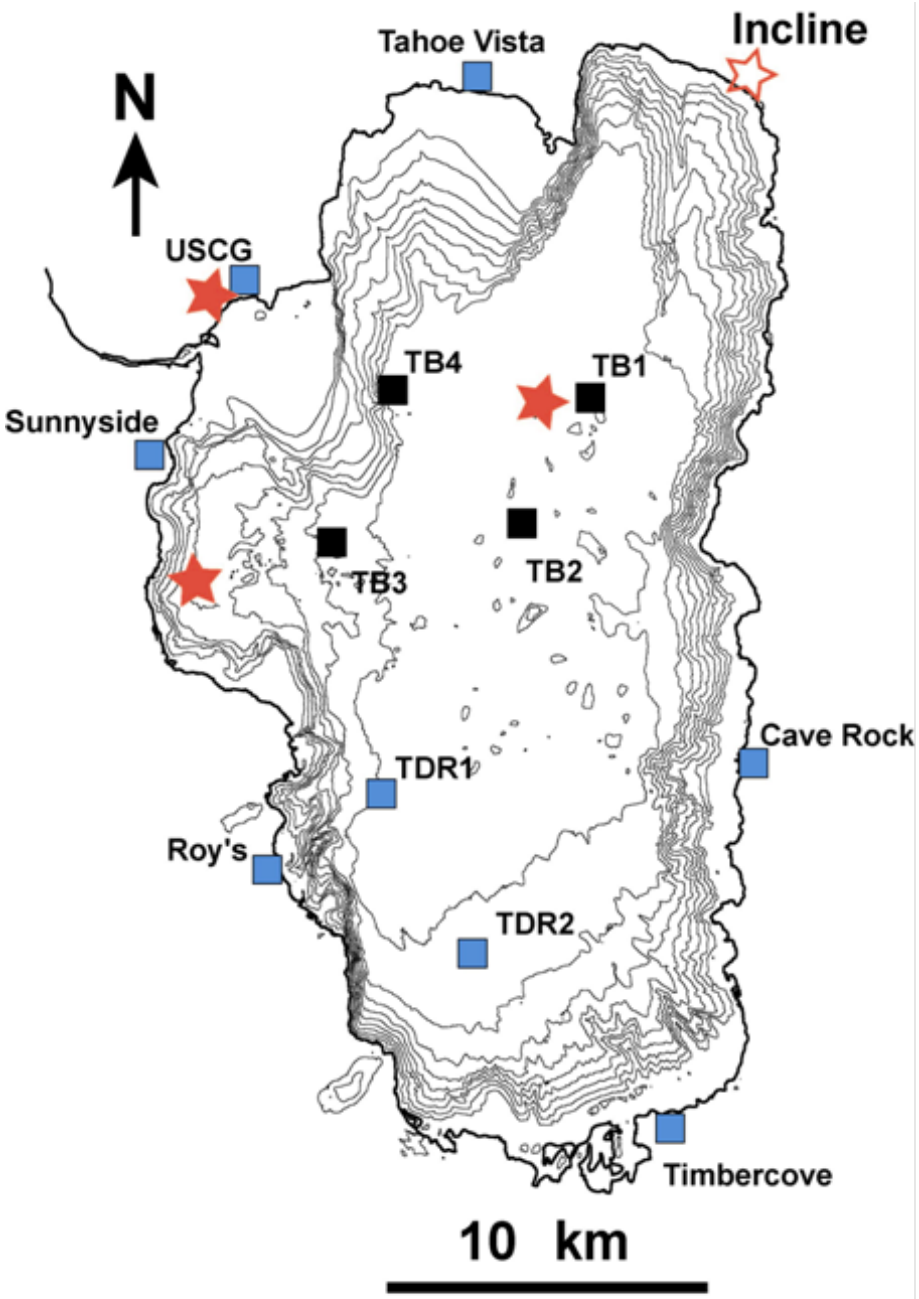
- Multi-Component Approach
- Monitoring of instrument outputs (BB performance etc)
- Cross comparison of HyspIRI radiance with other instruments (airborne and spaceborne, emphasize HyTES)
- Validation against in situ targets (Tahoe and Salton Sea)

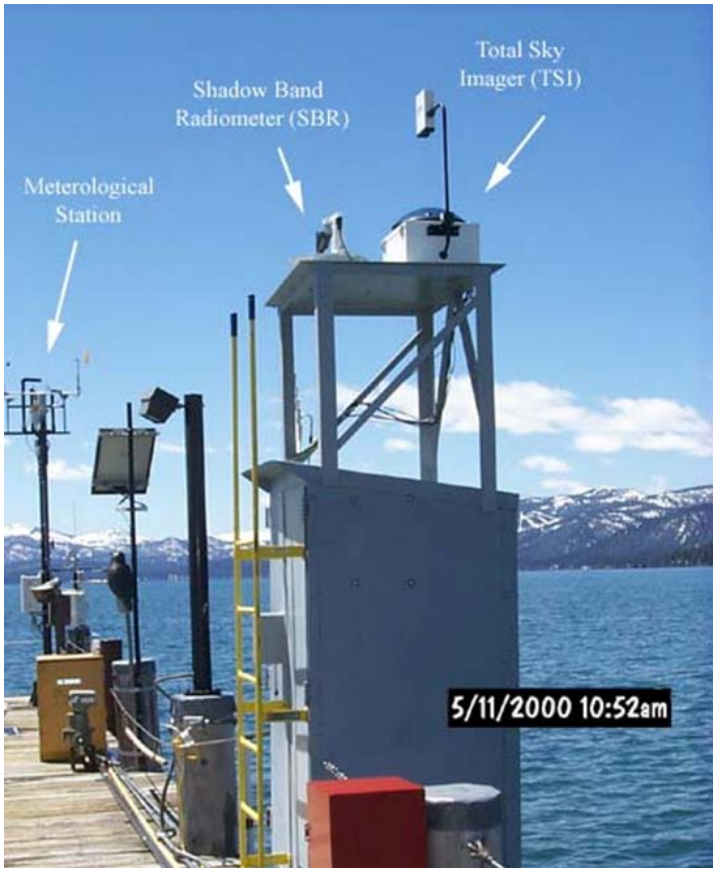
On-Orbit CalVal

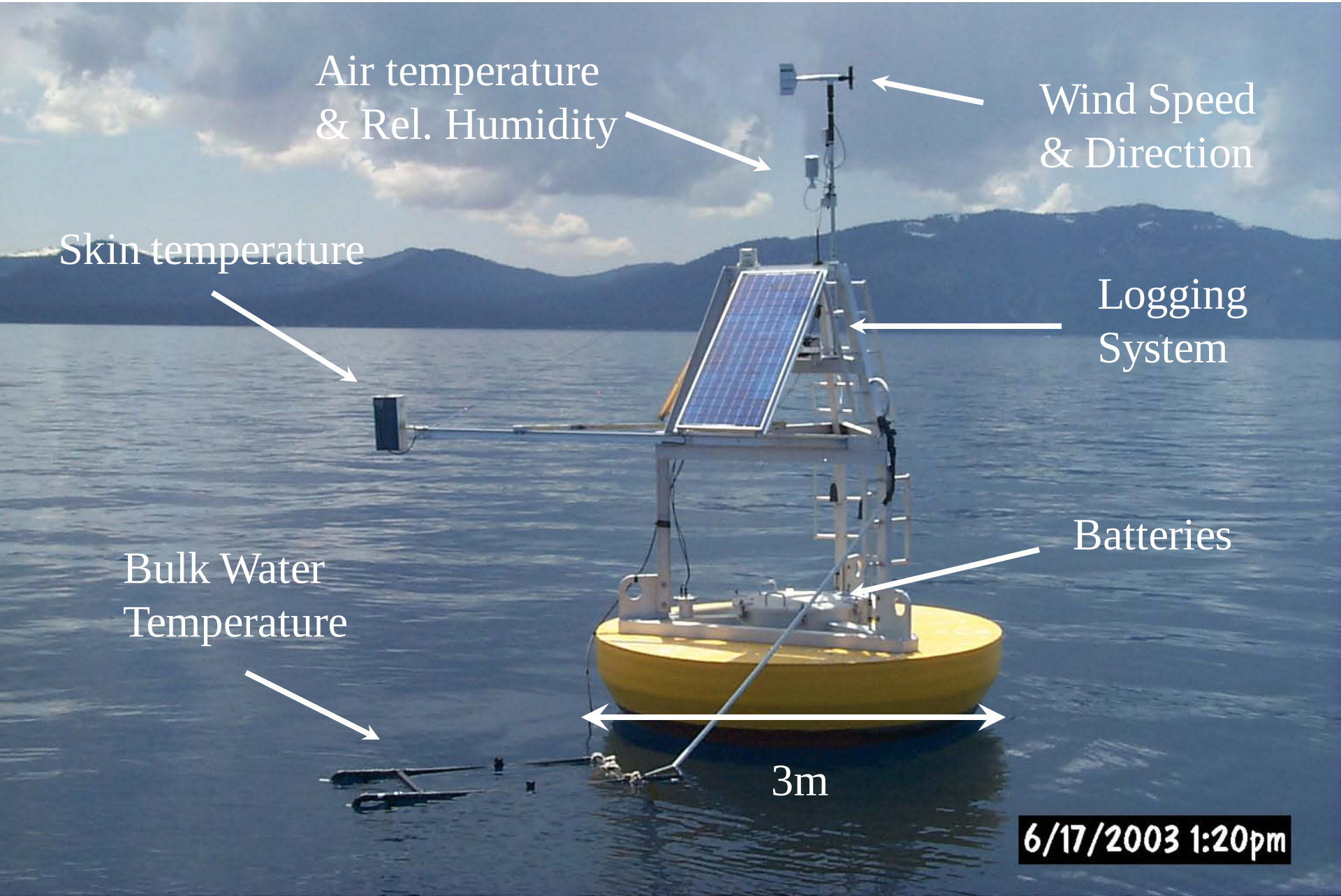
Lunar View	1 per month {radiometric}
Blackbody Views	1 per scan {radiometric}
Deep Space Views	1 per scan {radiometric}
Surface Cal Experiments	2 (d/n) every 5 days {radiometric}
Spectral Surface Cal Experiments	1 per year

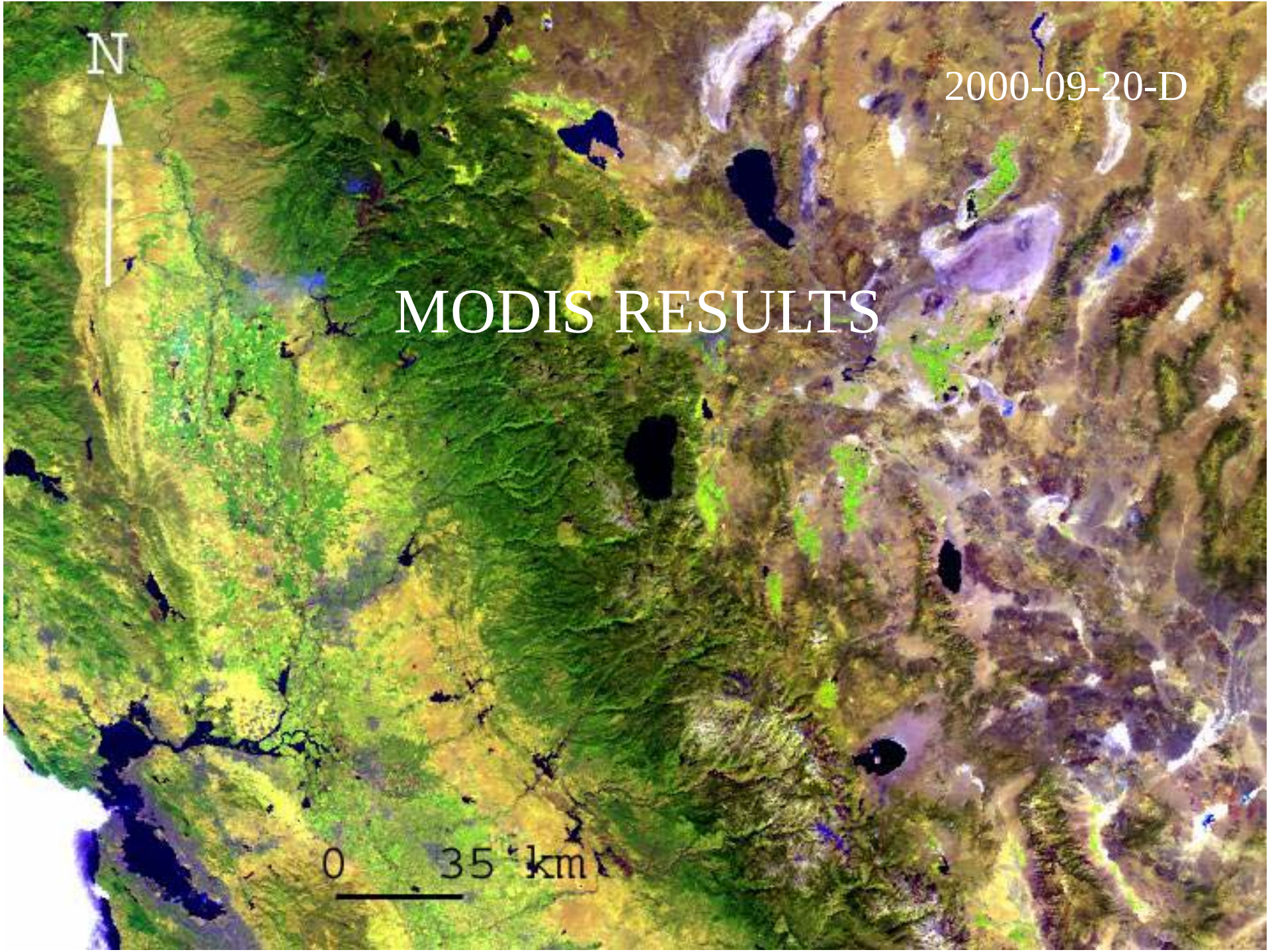
- Two-point calibration, using space and an ambient temperature blackbody, will be performed every 2.1 seconds.
- Detector specs limit 1/f noise over 2.1 second period. Optics/baffle design limits thermal drifts over 2.1 seconds.
- Data stream will include averaged values of space and blackbody readings for each pixel.
- Nonlinearities measured during ground calibration will be incorporated into calibration algorithm (performed on ground).

Site Layout and Measurement Stations

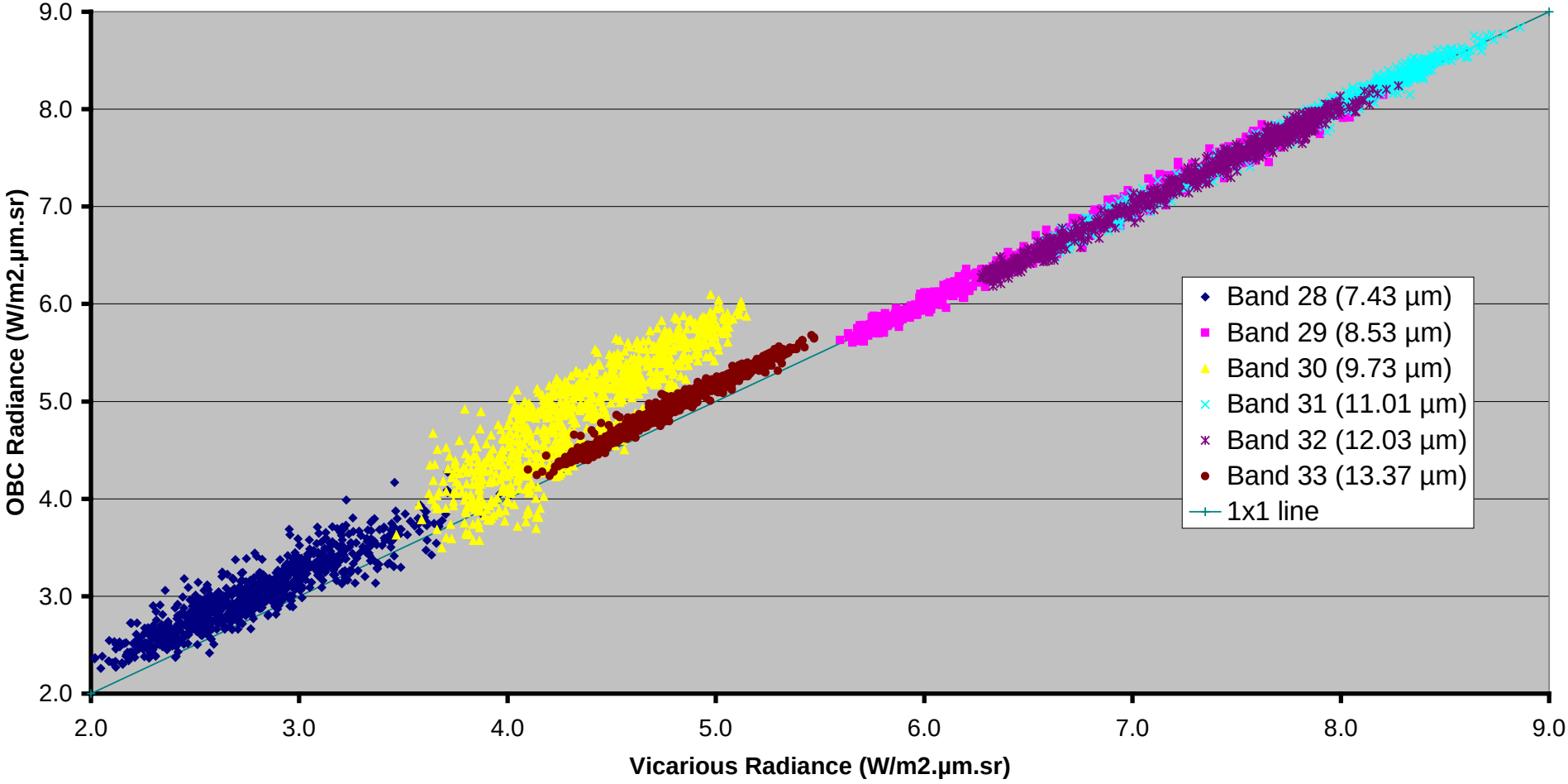




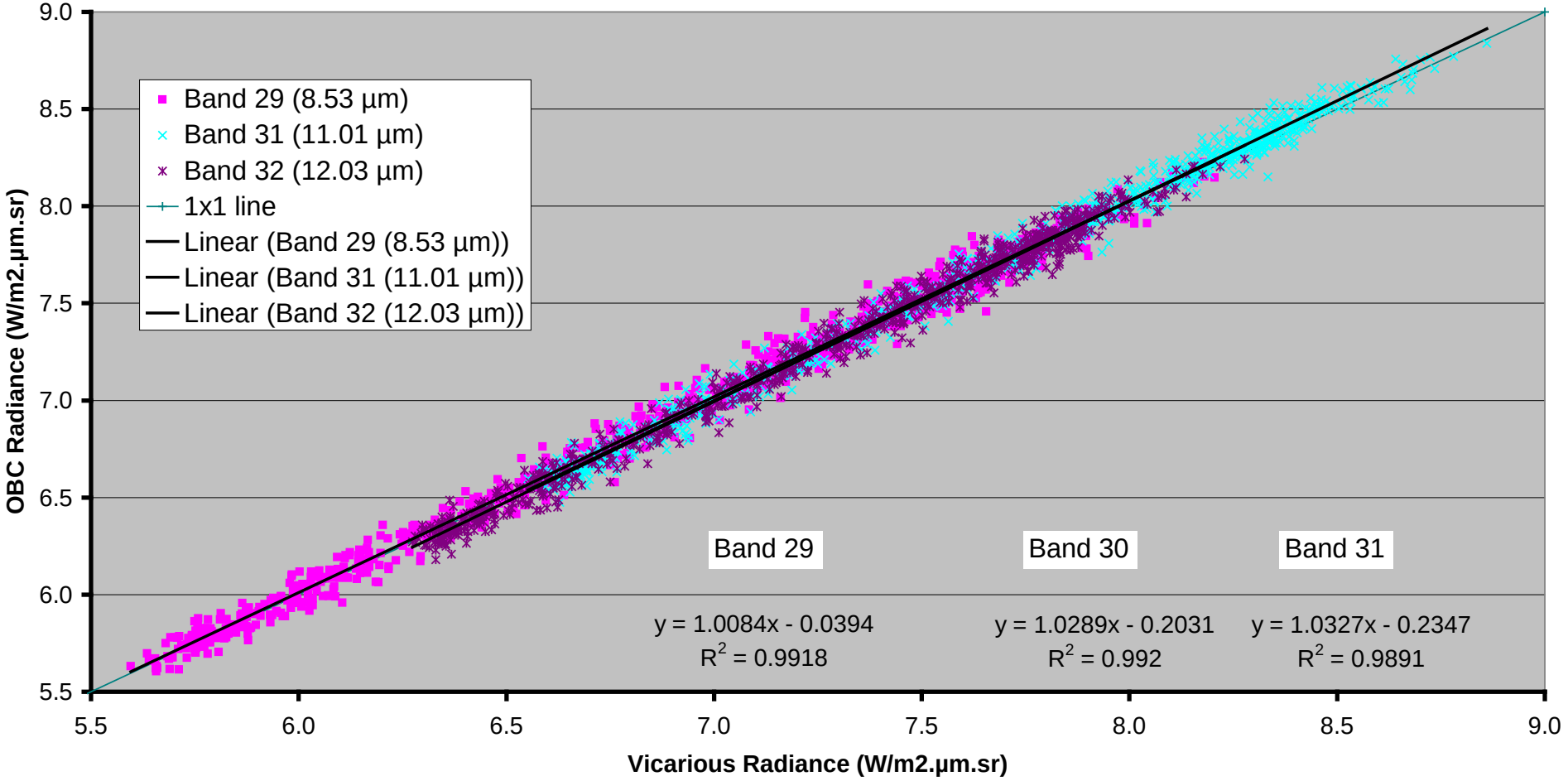

Air temperature
& Rel. Humidity
Wind Speed
& Direction
Skin temperature
Logging
System
Batteries
Bulk Water
Temperature
3m
6/17/2003 1:20pm


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

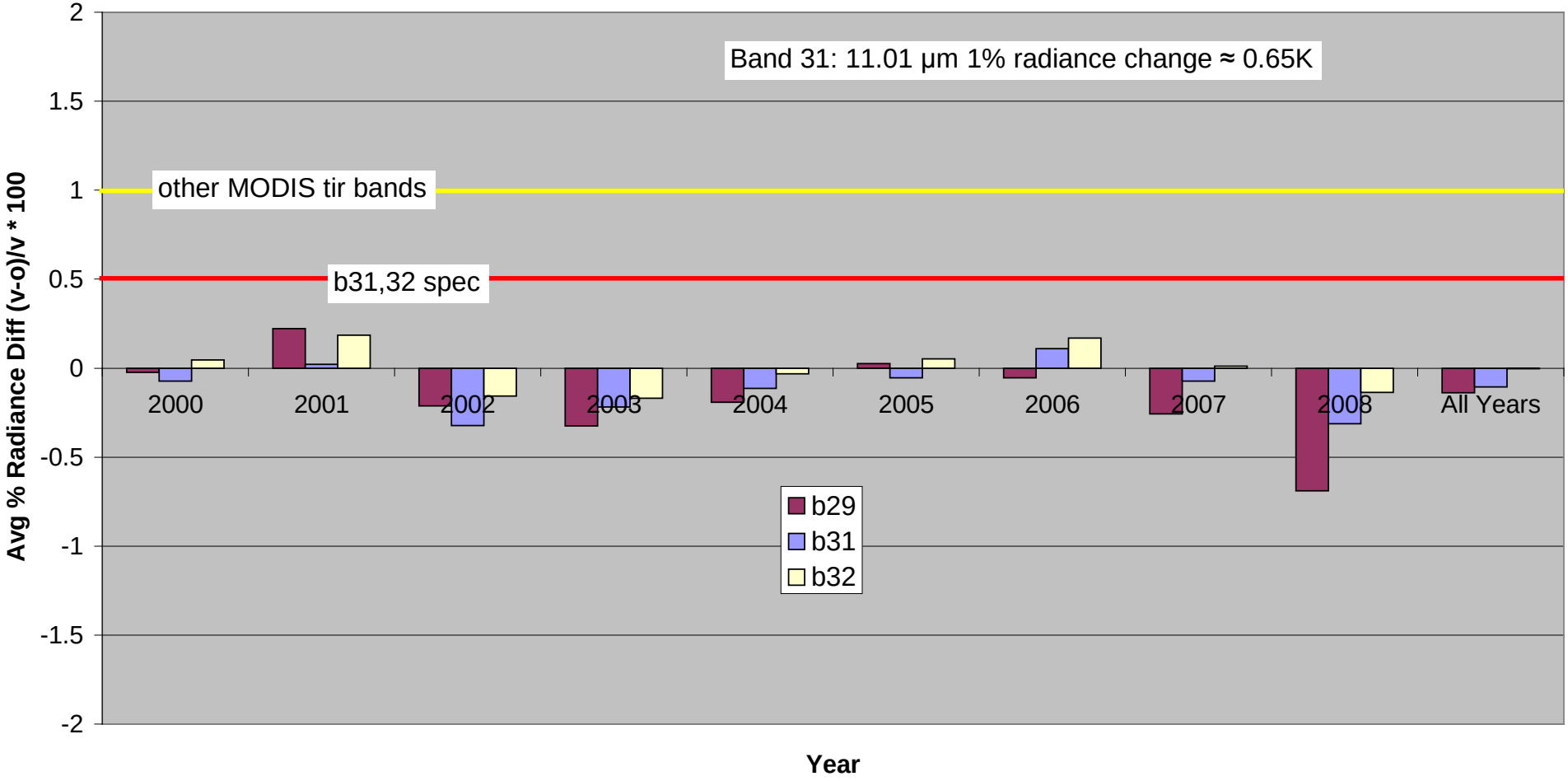
MODIS Terra Vicarious and OBC Thermal Infrared Derived Radiances at Lake Tahoe CY2000-2008, v4-5.x



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



In previous presentations only showed nadir data (461 match ups as above) due to manual processing, now have more automated system allowing all clear data to be processed (5219 match ups)

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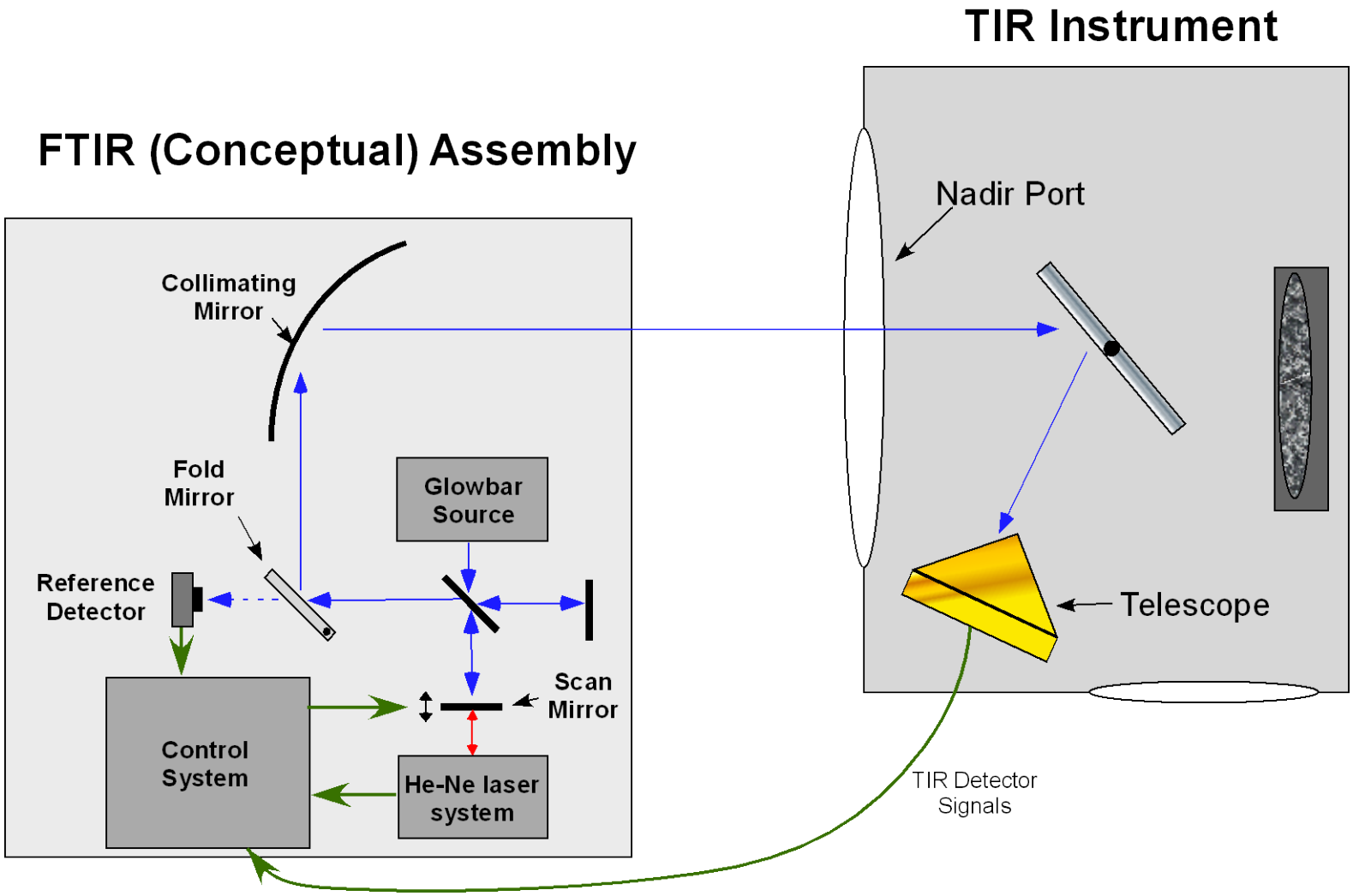
Summary and Conclusions

- Pre-flight
  - Spectral calibration
  - Radiometric calibration
  - Spatial calibration

- In-flight
  - Radiometric: 2 point (blackbody and space view)
  - Radiometric: lunar
  - Radiometric: ground sites, e.g. L. Tahoe

Backup

Spectral Calibration with FTIR



FTIR Spectral Calibration

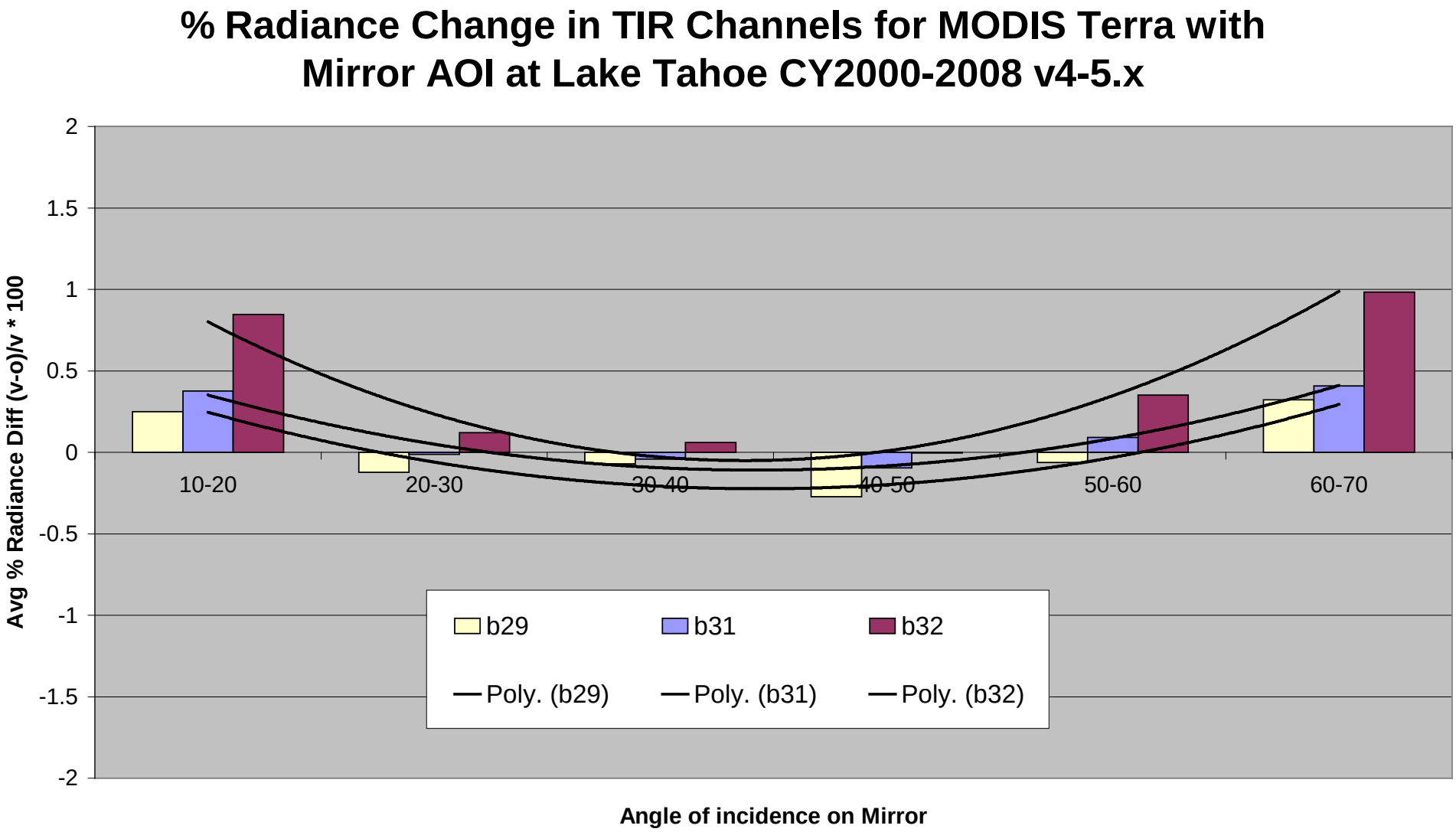
Heritage:
- AIRS
- OCO

Advantages:
- All pixels and wavelengths measured simultaneously
- Automatic spectral calibration to Helium Neon laser standard wavelength (632.8nm)

Disadvantages:
- Requires stepping of FTS to be synchronized with sampling of TIR detectors, or cumbersome post analysis.

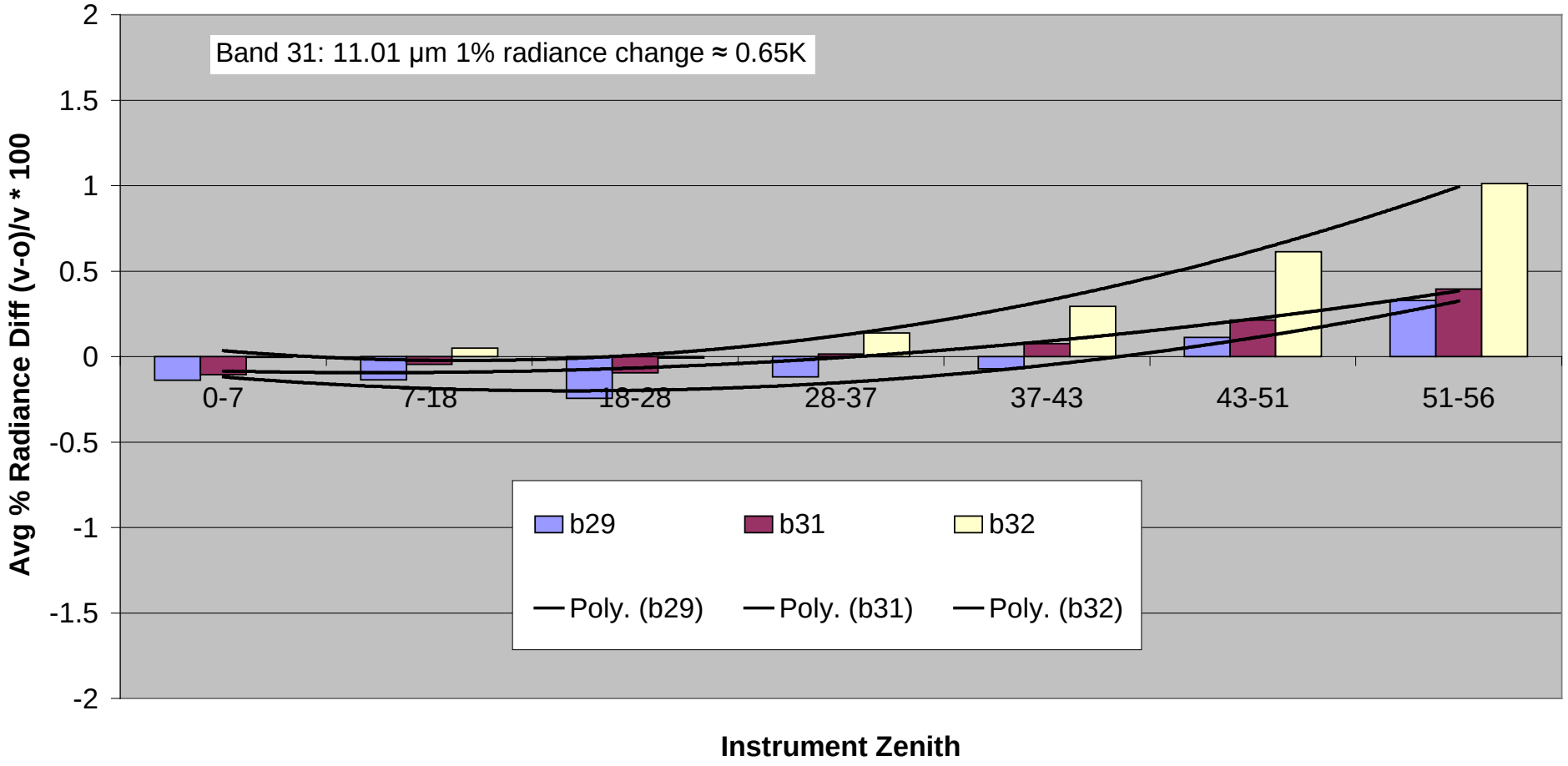
Calibration of Blackbody Source

- Cavity temperature will be determined using NIST-traceable sensors.
- NIST Thermal Infrared Transfer Radiometer (TXR) may be used to compare blackbody to NIST standard blackbody.



Low and high angle of incidences correspond to low and high viewing zeniths

% 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.