Overview

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- Calibration Requirement
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- Calibration Experiment
  - Leoncito
  - Arizaro
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- Summary
Objective

- Evaluate the on-orbit calibration of Hyperion

- Acquire measurements to allow the establishment of the on-orbit calibration of Hyperion
  - Leoniceto, near Mendoza
  - Arizaro, near Salta

- Work with Argentina colleagues for the validation and calibration of SAC-C

CALIBRATION REQUIREMENT

- Imaging spectroscopy data must be spectrally, radiometrically and spatially calibrated in order to:
  - Derive physical parameters from measured radiance
  - Compare data acquired from different regions and from different times
  - Compare and analyze imaging spectroscopy data with data acquired by other instruments
  - Compare and analyze data with results from computer models
CALIBRATION REQUIREMENT

- Calibration bottom line
  - Calibration only counts when measuring real data that will be used to answer the real questions of interest.
  - Three months can be spent calibrating a sensor in the laboratory only to find that the flight data are NOT calibrated.
  - Calibration in the flight environment is all that counts.

AVIRIS Performance

Excellent calibration and high precision (SNR) are required for NASA Code Y science

- AVIRIS calibration is within 96% of an independent prediction
- AVIRIS SNR ranges from 1000 to 500 in the continuum regions of the spectrum
AVIRIS 2001 Argentina Campaign

Testing Off Road Transportation
Optical Depth Measurements
Leoncito, Argentina, 010122

(Clear Stable sky)
Preliminary Calibration Experiment Results
Leoncito, Argentina, 010122, 2000m

Hyperion Image
Leoncito, Argentina 010122
Leoncito Summary

- Leoncito is an excellent optical remote sensing calibration site with good atmospheric and surface conditions.
- At the time of the Hyperion acquisition the SWIR focal plane was not functioning.
- On-orbit calibration analysis has focused on the Arizaro data set.

AVIRIS Image Arizaro, Arg 010207

Calibration Target
Arizaro Calibration Target Measured Surface Reflectance

Calibration Target Arizaro, Argentina 010207
The surface is highly variable at the 20 cm scale, but uniform at the 2 meter scale and greater

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50:50 Agreement 0.2%
Arizaro Surface

- The surface is highly variable at the 20 cm scale
- But uniform at the 2 meter scale and greater
- The surface has the highest most uniform spectra reflectance ever encountered by the JPL team
Optical Depth Measurements
Arizaro, Argentina, 010207, 3700m

Arizaro Team
Arizaro Atmosphere

- Clear Stable sky

Preliminary Top-of Atmosphere Radiance
Arizaro, Argentina 010207

![Graph of Preliminary Top-of Atmosphere Radiance](image)
Hyperion Image Arizaro 010207

Raw Hyperion Data
Arizaro, Argentina 010207
Scene Based Estimate of Hyperion SNR

Arizaro Calibration Experiment

- Comparison of predicted radiance to Hyperion measured radiance
Comparison of AVIRIS and Hyperion Data Calibrated To Radiance

Ratio of Predicted over Hyperion Radiance for Arizaro 010207
Adjustment of Hyperion Calibration
Factor 1.1 in VNIR and 1.2 in SWIR

Ratio Predicted over Hyperion Radiance after adjustment
Laboratory Comparison of Radiometric Standards

Arizaro Calibration Experiment

• This preliminary analysis indicates Hyperion is underreport the radiance by 10 and 20 percent in the VNIR and SWIR spectrometers respectively.

• A 10 percent value is consistent with uncertainties in the ground calibration data.

• A full swath analysis is planned
Arizaro Calibration Experiment

- On orbit spectral calibration analysis

Note asymmetry between predicted radiance and Hyperion radiance at 760 nm
Spectral agreement in VNIR is improved with 1.2 nm shift

Note asymmetry between predicted radiance and Hyperion radiance at 2000 nm
Spectral agreement in SWIR is improved with 1.5 nm shift

Arizaro Calibration Experiment

- Analysis of atmospheric absorption bands in the Hyperion data indicates that for the Arizaro experiment a shift of 1.2 and 1.5 nm is need in the on-orbit spectral calibration of Hyperion in the VNIR and SWIR spectrometers.
Future AVIRIS and Hyperion Full Swath Spectral Matching

- The following slides give an example of the AVIRIS spectral interpolation algorithm for Hyperion on-orbit calibration validation.

- This is required to explore Hyperion cross track characteristics with the AVIRIS underflight data.

- This algorithm uses MODTRAN to interpolate AVIRIS data to 3 nm spectral resolution. These data may then be convolved to Hyperion data characteristics.

MODTRAN Constrained for AVIRIS atmosphere
Rogers Dry Lake, CA

AVIRIS Measured Spectrum
Summary

Two Hyperion underflight calibration experiment were successfully carried out in Argentina

Leoncito
Arizaro

Analysis has focused on the Arizaro data. Initial analysis shows a 10 and 20 percent under reported of radiance in the VNIR and SWIR spectrometers respectively

Analysis of the spectral calibration shows a 1.2 and 1.5 nm shift in the on-orbit spectral calibration of the VNIR and SWIR spectrometer respectively.

These are preliminary results. Final results are expected to be published with the Hyperion special issue journal

AVIRIS Contributions

- AVIRIS and Imaging spectroscopy are providing the basis for a step forward in Earth remote sensing in the solar reflected spectrum
  - Based in the physics and chemistry of spectroscopy
  - Based in the general problem of unknowns and measurements
  - Based in the advance of optical, detector, dispersion and computer technology
Information

- rog@spectra.jpl.nasa.gov
- All AVIRIS Workshop Proceedings On-line at website
- AVIRIS Workshop March 2003