Spectral Dimensionality of the HyspIRI campaign measurements

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Measurement Questions

1. Is the HyspIRI preparatory campaign successfully balancing its spectral, spatial, and radiometric performance levels?
2. What can the AVIRIS data tell us about how to improve HyspIRI?

Science Questions

3. What patterns exist in the California data set as a whole?
4. At current performance levels, what are the dimensionalities and spectral subspaces spanned by the California data?
5. Can California be split into classes of backgrounds?
6. Which spectral regions and bands carry the information?

Adapted from Boardman & Green, 1999
2014 HyspIRI Campaign Dataset

- 20 km altitude
- 20 m GSD
- 262 Flightlines
- Diverse biomes
- Diverse elevations
- 1.12 TB of data
- $2.5 \times 10^9$ spectra
Method

1. Estimate NEDL using a calibration overflight of a homogeneous area
   – Shift-difference method
   – Ivanpah playa overflight
Method, continued

2. Accumulate mean vectors and inner-product matrices over all 2014 flightlines
3. Derive eigenvectors and eigenvalues
4. Normalize all values to NEDL to determine a conservative $3\sigma$ eigenvalue noise cutoff
Mean and covariance structure

Mean radiance

Covariance matrix
Eigenvalue Decay Profile

![Graph showing the log magnitude of noise level against eigenvalue. The graph has a downward trend indicating a decay profile.][1]

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[1]: https://example.com/graph_image.png
Top 9 Eigenvectors

Magnitude vs. Wavelength (nm)

Wavelength (nm)
PCA Projections of All Flightlines

[Graph showing PCA projections for PC 1, PC 2, PC 3, and PC 4.]
Spectral Diversity Map

Spring 2014

Dimensions
$3\sigma$ NEDL
Yosemite Spectral Diversity

Dimensions $3\sigma$ NEDL

April 2014

June 2014

October 2014

(overestimating noise?)
Thoughts...

• Comparable to Boardman & Green 1999
• Diversity of whole far higher than individual segments
• Highest diversity in urban areas and Sierra
• Spectroscopic measurements are the best way to fully measure the high-dimensional radiant light field
Thanks!

• NASA Earth Science Division and HyspIRI preparatory campaign
• The AVIRIS-C and AVIRIS-NG flight teams, including Sarah Lundeen, Ian McCubbin, and Charles Sarture.

AVIRIS-C data is available from http://aviris.jpl.nasa.gov
AVIRIS-NG data is available from http://avirisng.jpl.nasa.gov
Backup
Spectral Diversity Map

Spring 2014

Dimensions
$3\sigma$ NEDL