



Jet Propulsion Laboratory
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Spectral Dimensionality of the HypIRI campaign measurements

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Measurement Questions

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

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?



2014 HypSIRI Campaign Dataset

20 km altitude

20 m GSD

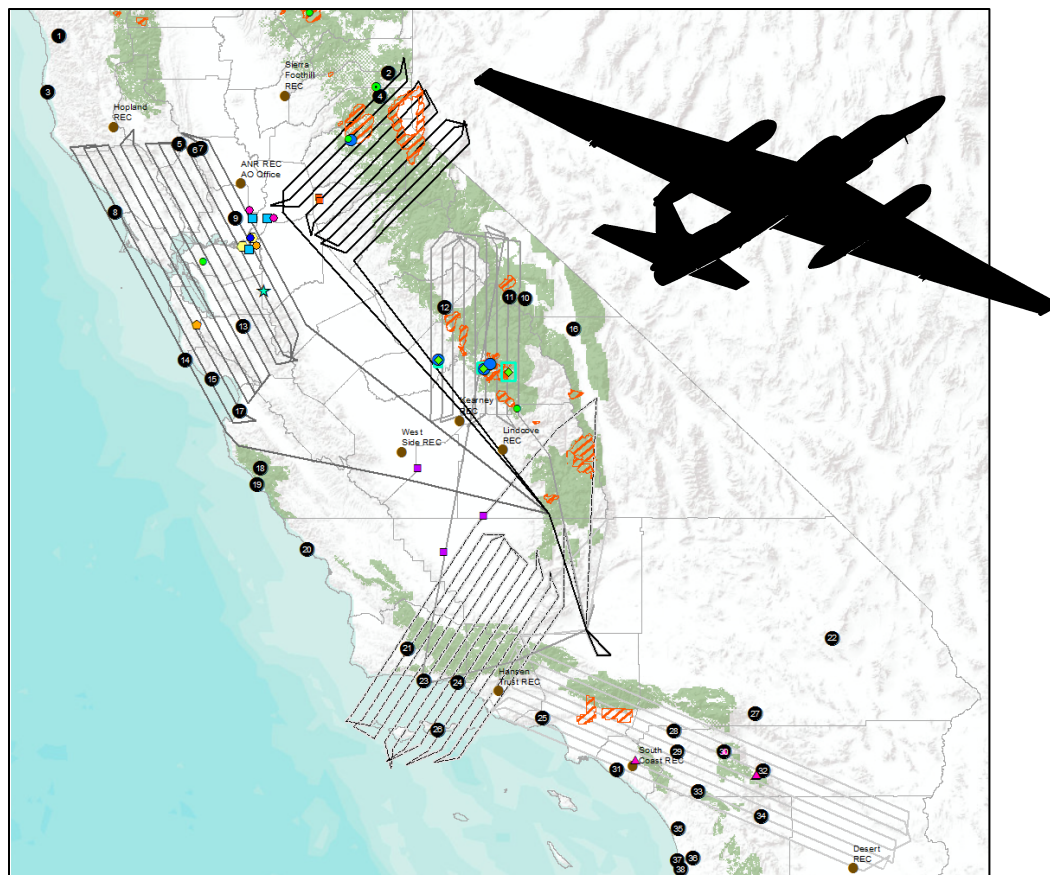
262 Flightlines

Diverse biomes

Diverse
elevations

1.12 TB of data

2.5×10^9 spectra



Method

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



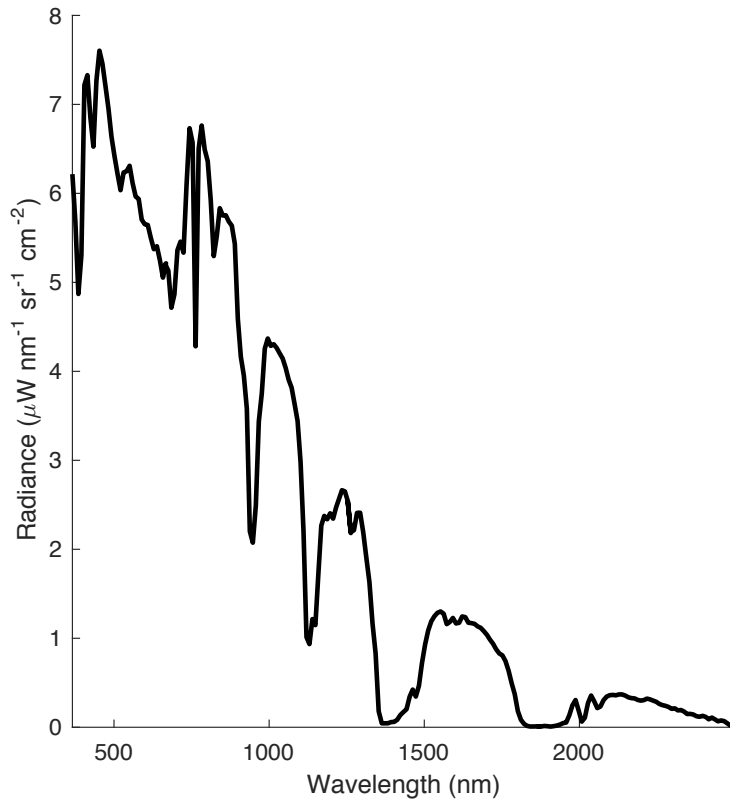
Method, continued

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 3σ eigenvalue noise cutoff

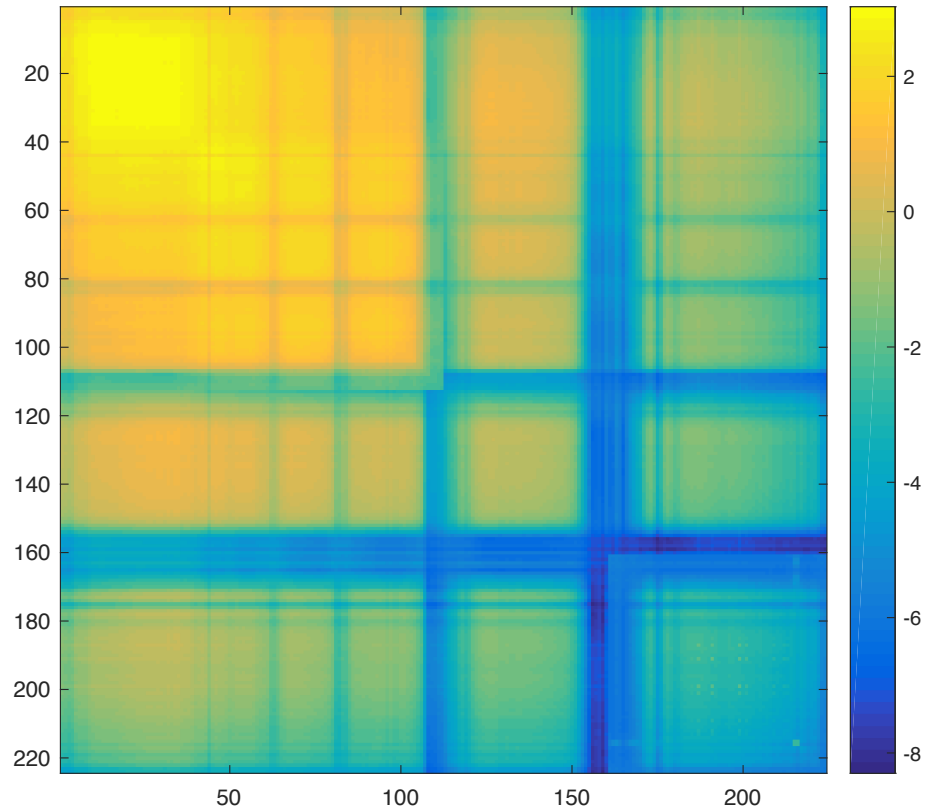


Mean and covariance structure

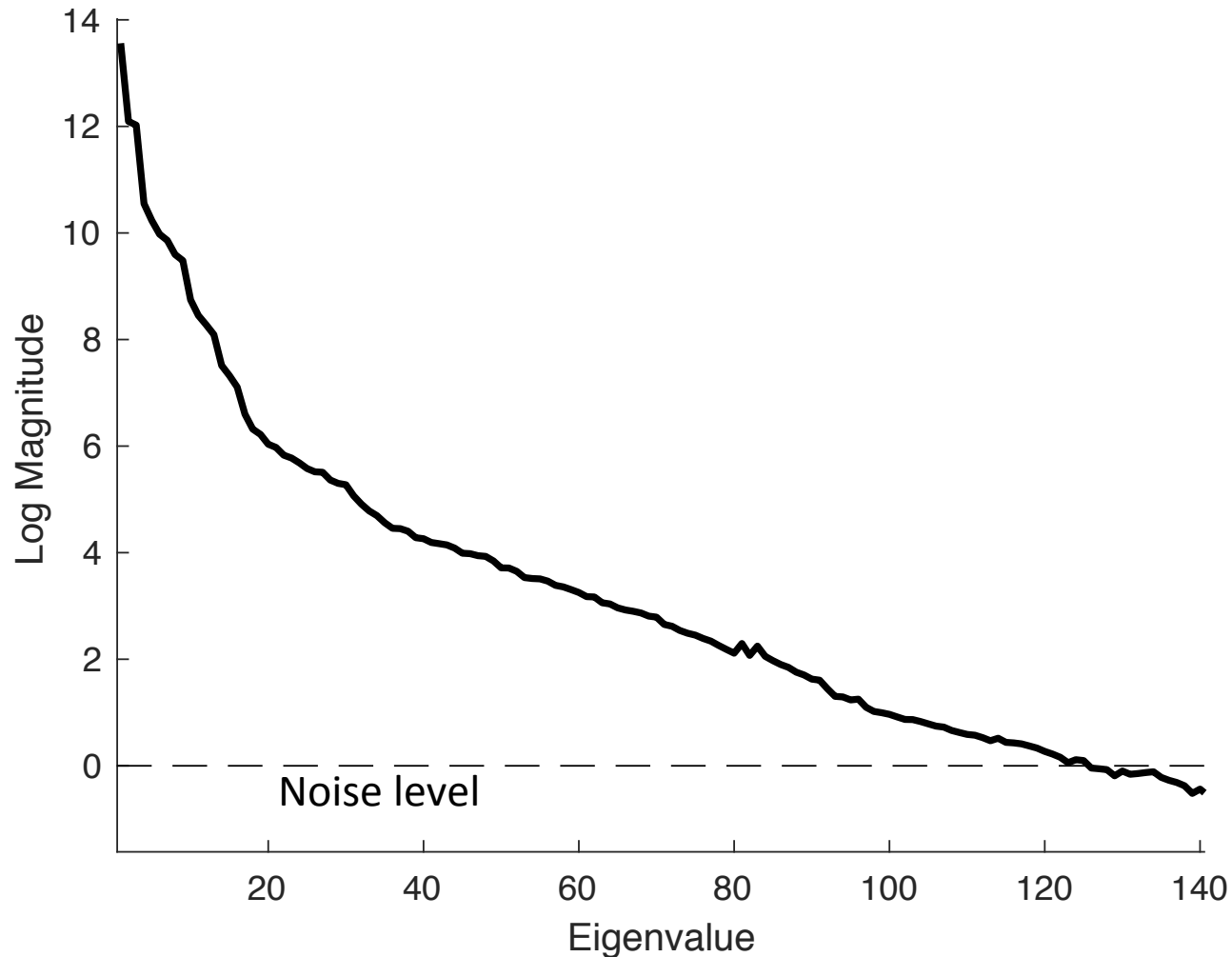
Mean radiance



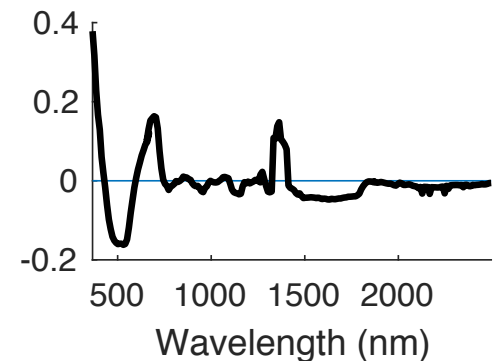
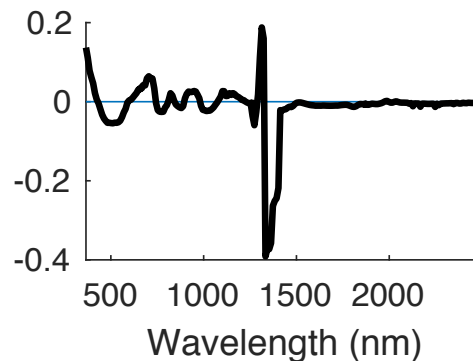
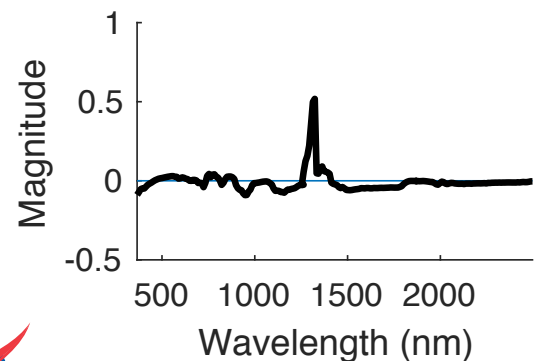
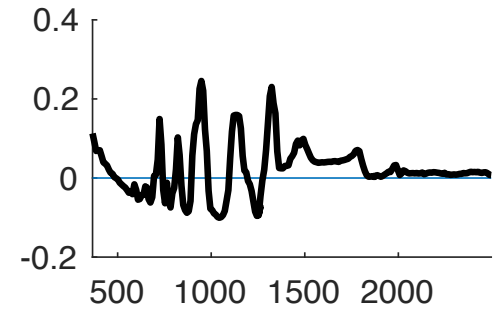
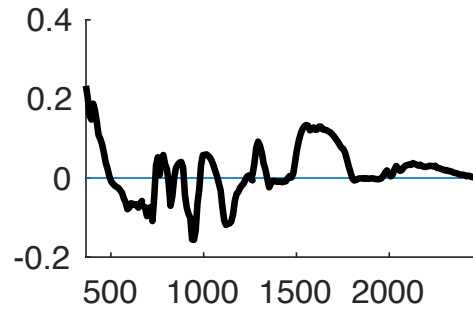
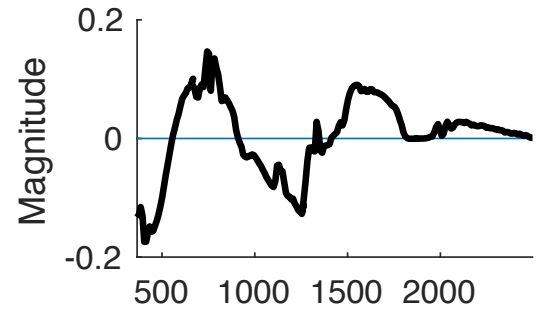
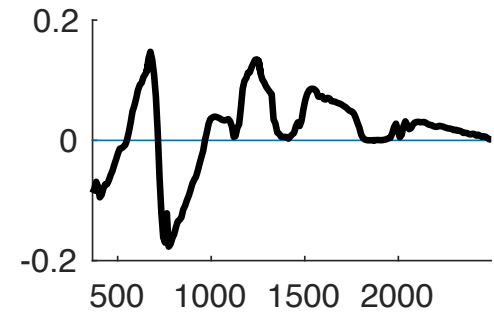
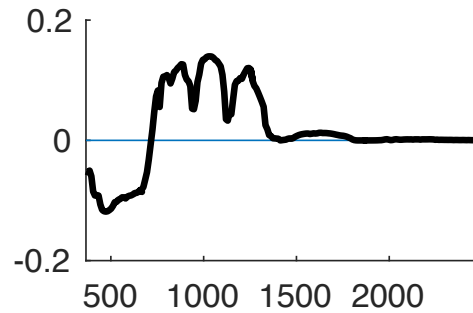
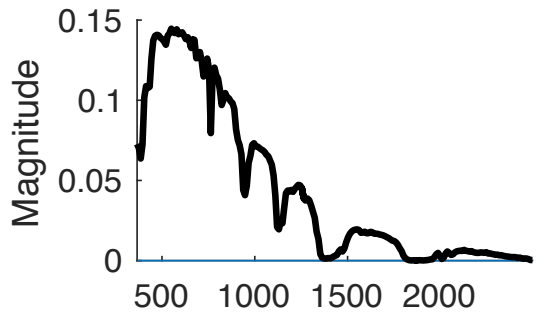
Covariance matrix



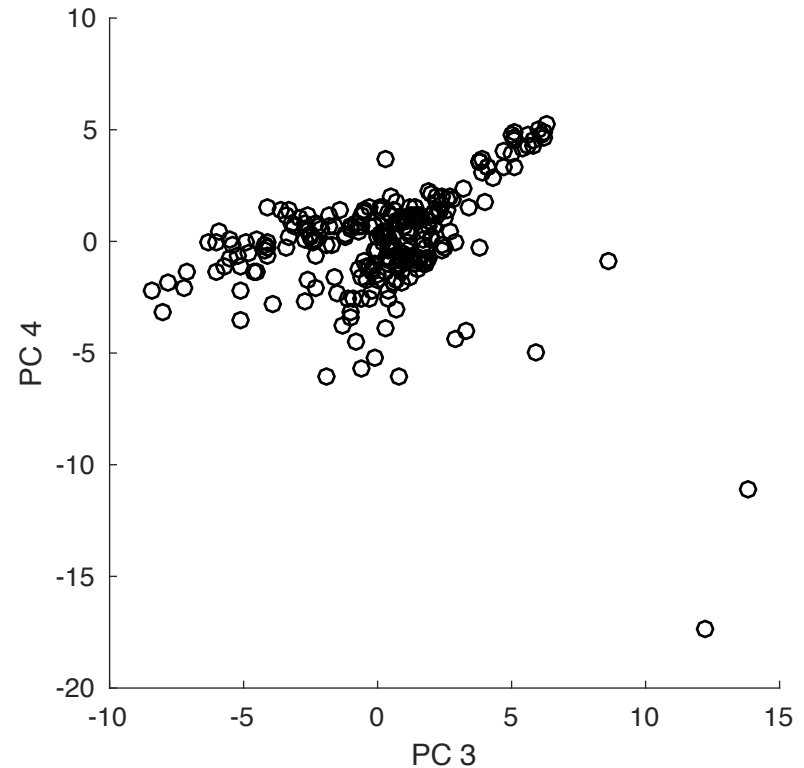
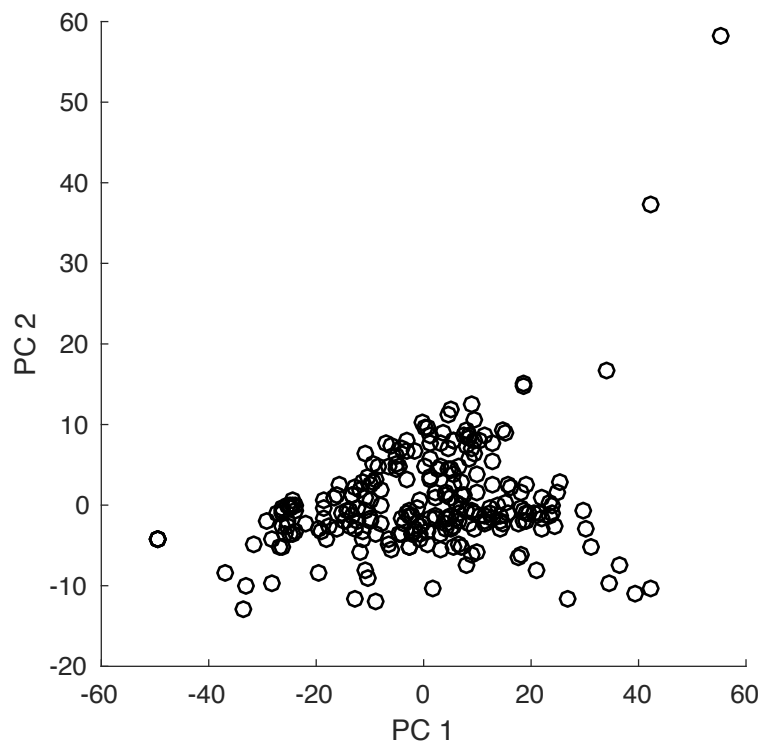
Eigenvalue Decay Profile



Top 9 Eigenvectors



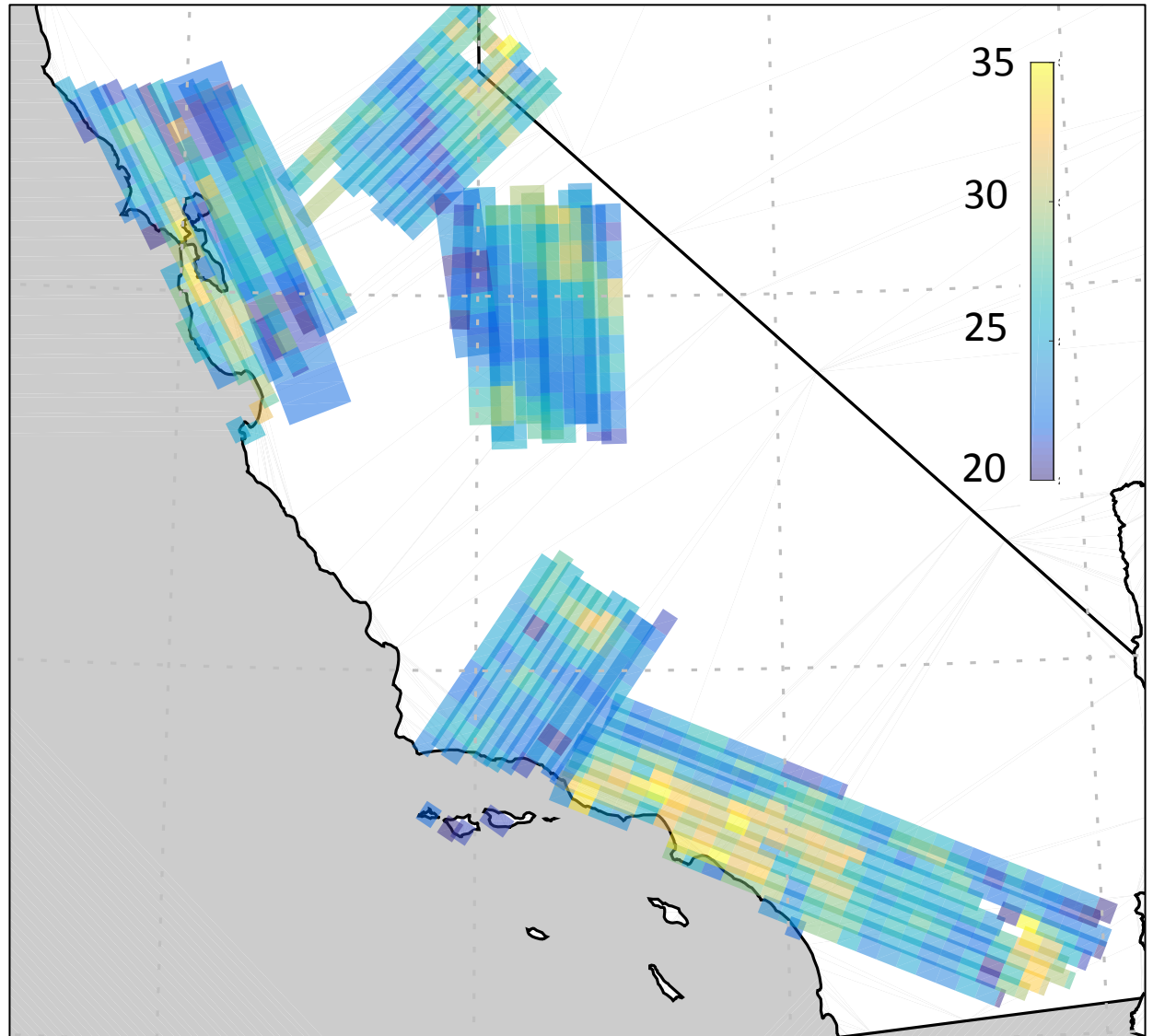
PCA Projections of All Flightlines



Spectral Diversity Map

Spring
2014

Dimensions
 3σ NEDL



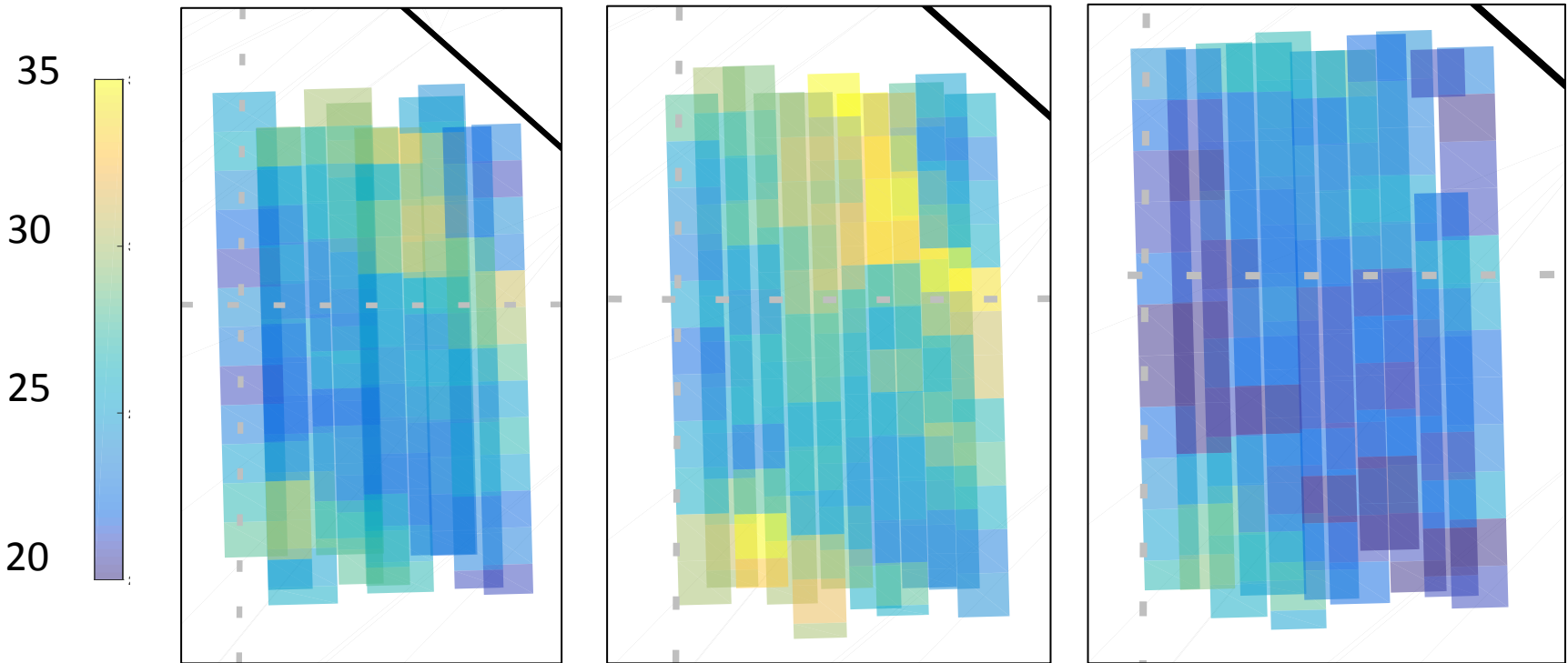
Yosemite Spectral Diversity

Dimensions 3σ 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 HypsIRI 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>





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Backup

Spectral Diversity Map

Spring 2014

