

Jet Propulsion Laboratory
California Institute of Technology

The HypIRI Preparatory Campaign VSWIR Level 1 and Level 2 Products

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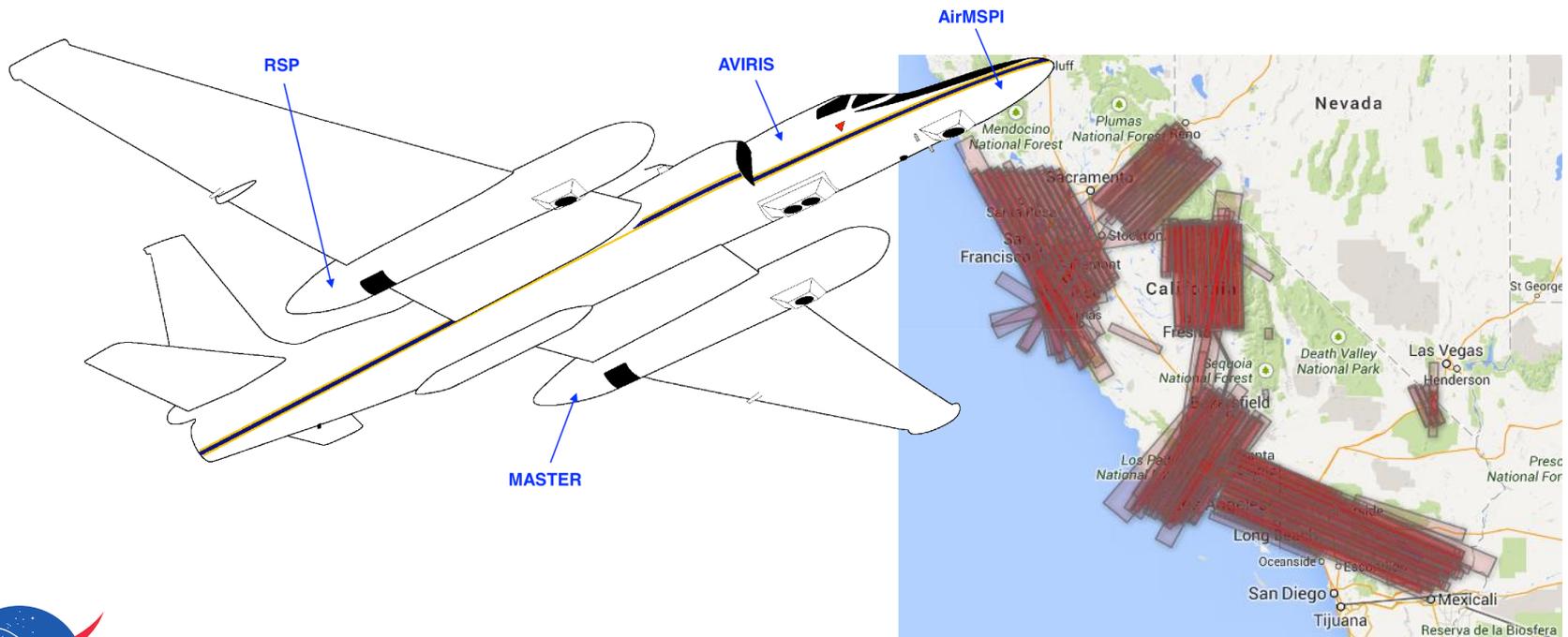
⁵ University of Utah

⁶ NASA Ames Research Center

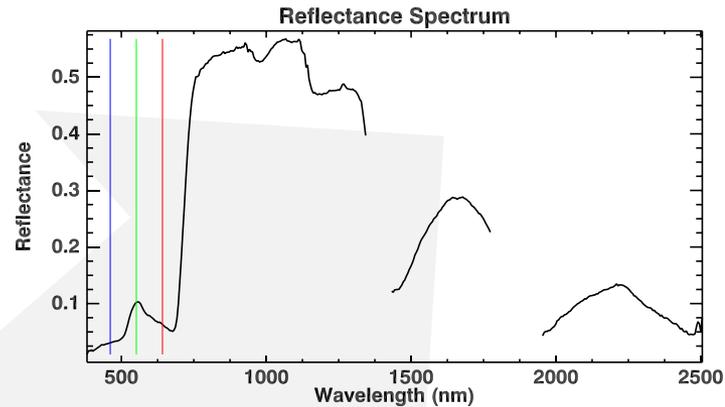
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Agenda

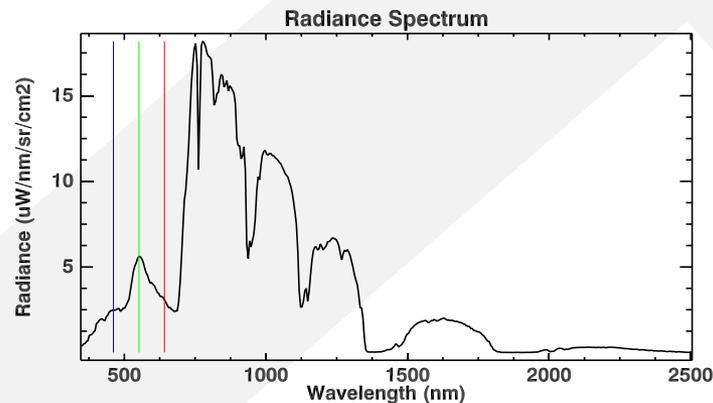
- **AVIRIS Product Definition and Algorithm Theoretical Basis**
- **Overview of the VSWIR HypsIRI simulated data**



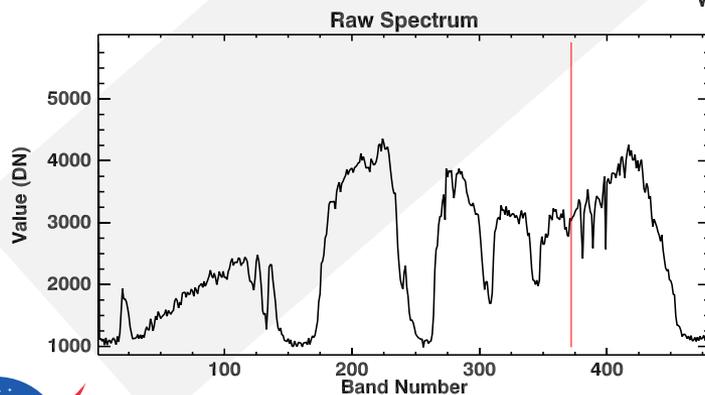
AVIRIS radiance / reflectance pipeline



Lambertian
Reflectance
(HDRF)



Radiance at
sensor
 $\text{mW}/\text{nm}/\text{cm}^2/\text{sr}$



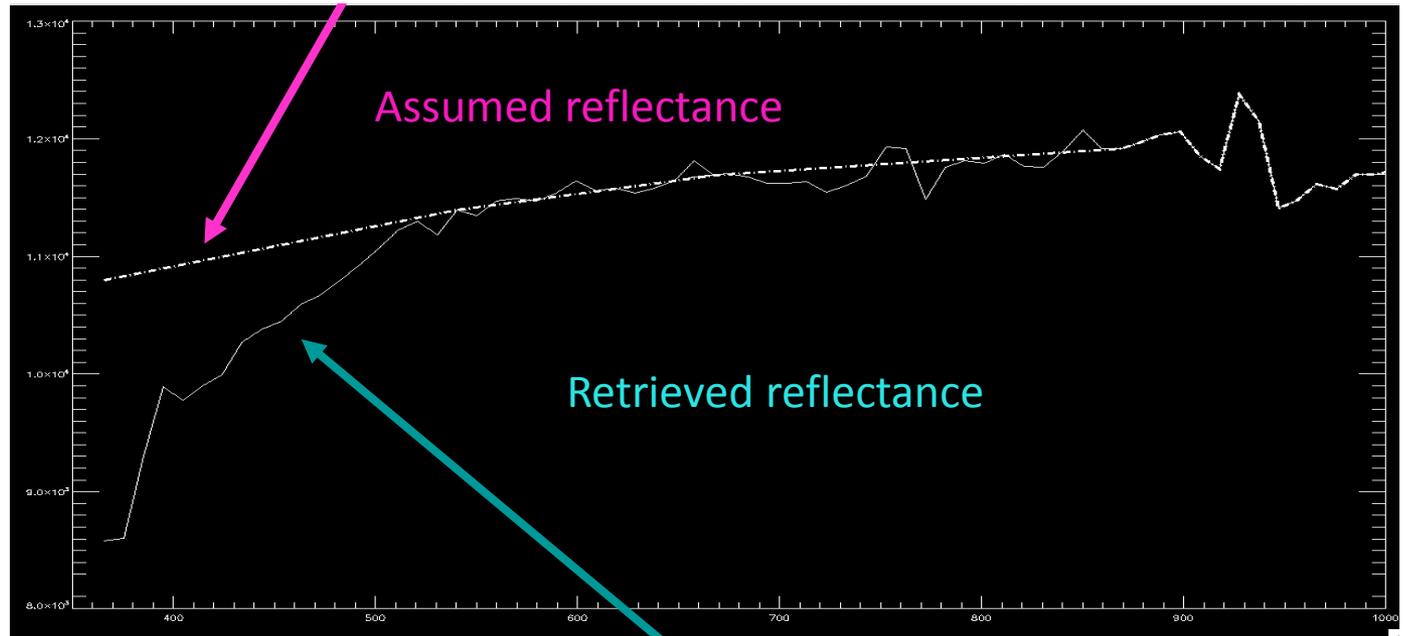
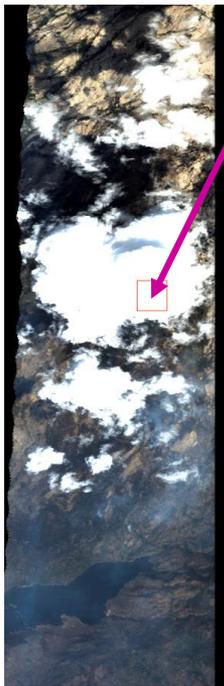
Raw Digital
Numbers

[Gao et al., 1993;
Green et al., 1998]



L1 Radiance calibration

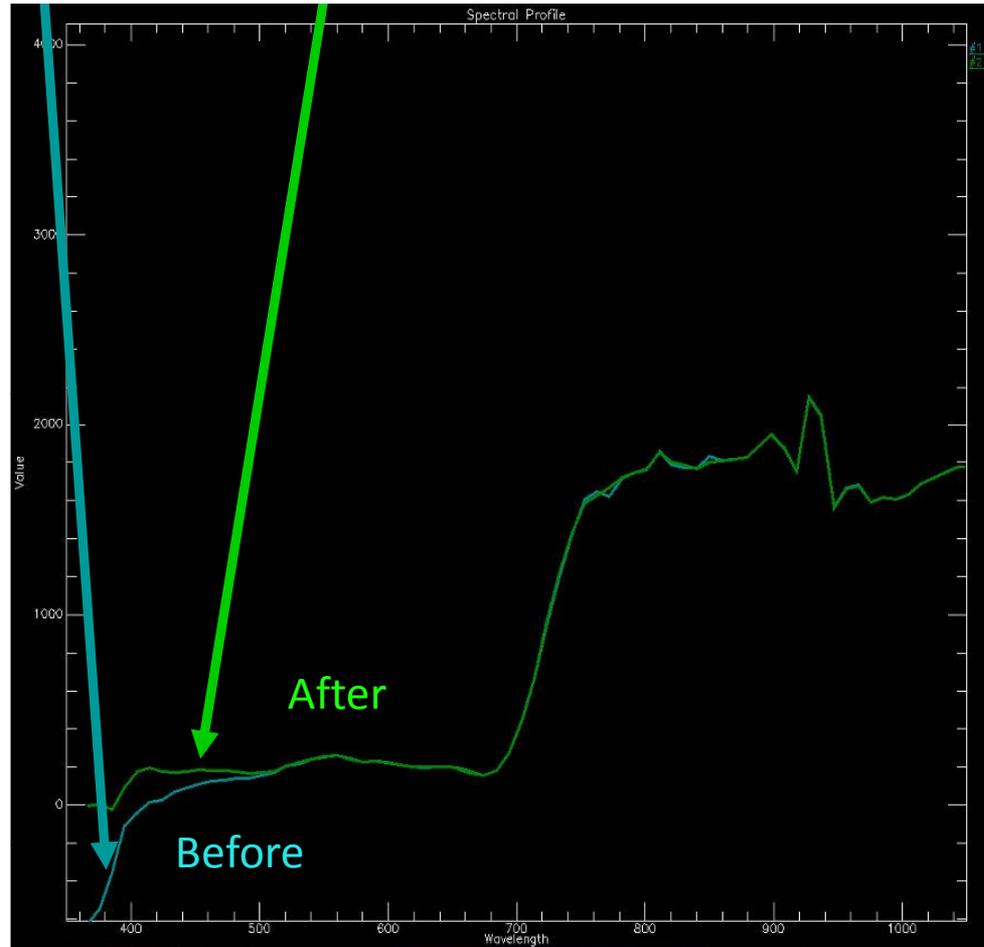
- Based on Laboratory calibration standards
- Minor radiometric correction in UV based on clouds (which are assumed smooth)



Courtesy Bo Cai Gao



Typical vegetation spectrum



Courtesy Bo Cai Gao



Solar spectrum F
(modified Kurucz)

Top of atmosphere
apparent reflectance ρ

$$\rho = \frac{\pi L}{F \cos(\theta)}$$

Retrieve pressure
altitude, H₂O vapor,
liquid by fitting
absorption features

Gaseous
transmission T_g

Aerosol particle type
distribution,
AOD at 550nm

Calculate molecular &
aerosol scattering w/6s
radiative transfer code

Aerosol transmission $T_d T_u$,
Spherical sky albedo s ,
Path reflectance r_a

Reflectance spectrum

$$r_s = \frac{\rho/T_g - r_a}{T_d T_u + s(\rho/T_g - r_a)}$$

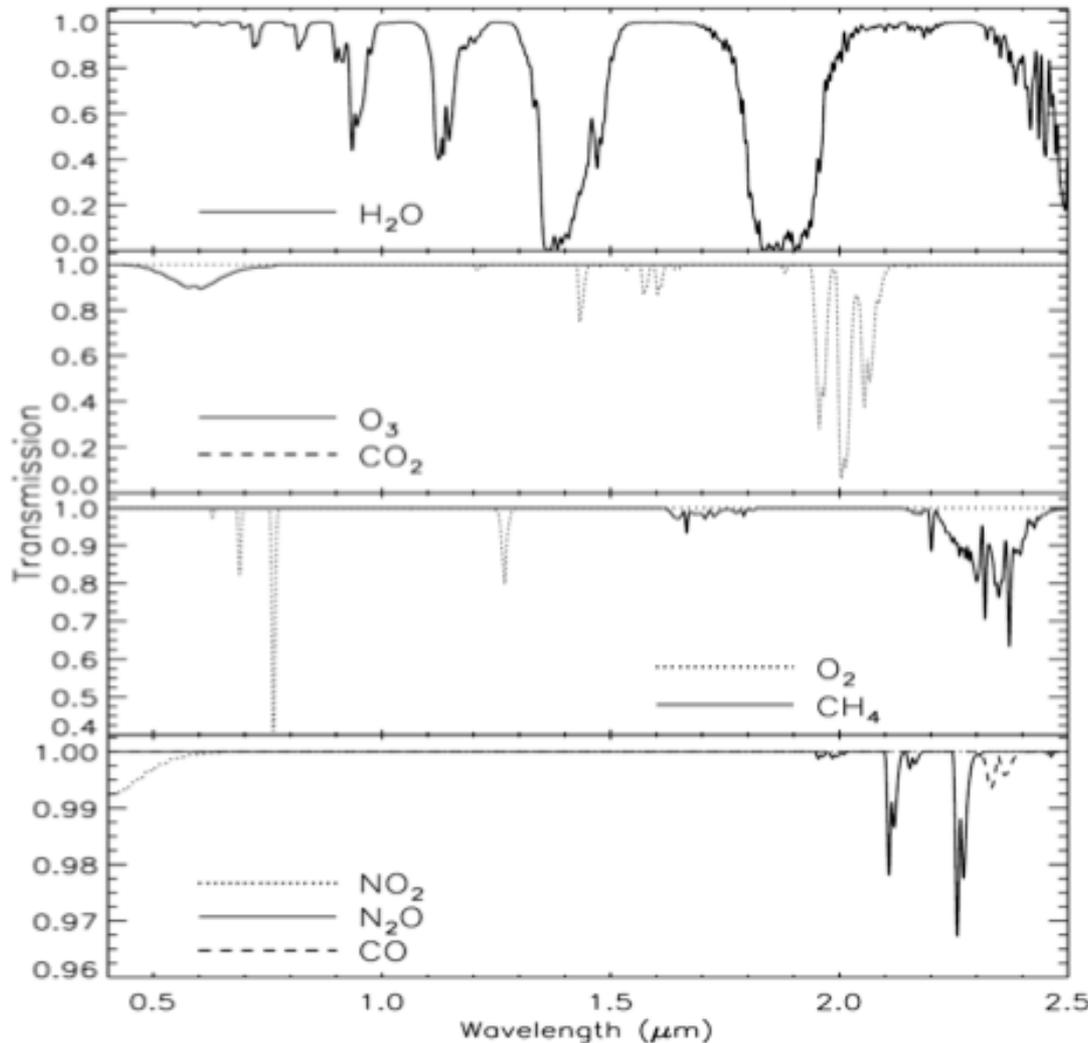
Residual suppression based on a reference target

Corrected reflectance
spectrum

L2 Surface reflectance



Typical transmittance



Absorption is modeled for 7 gases

ATREM retrieves water vapor for each pixel using 0.94 and 1.14 μm H₂O band depths

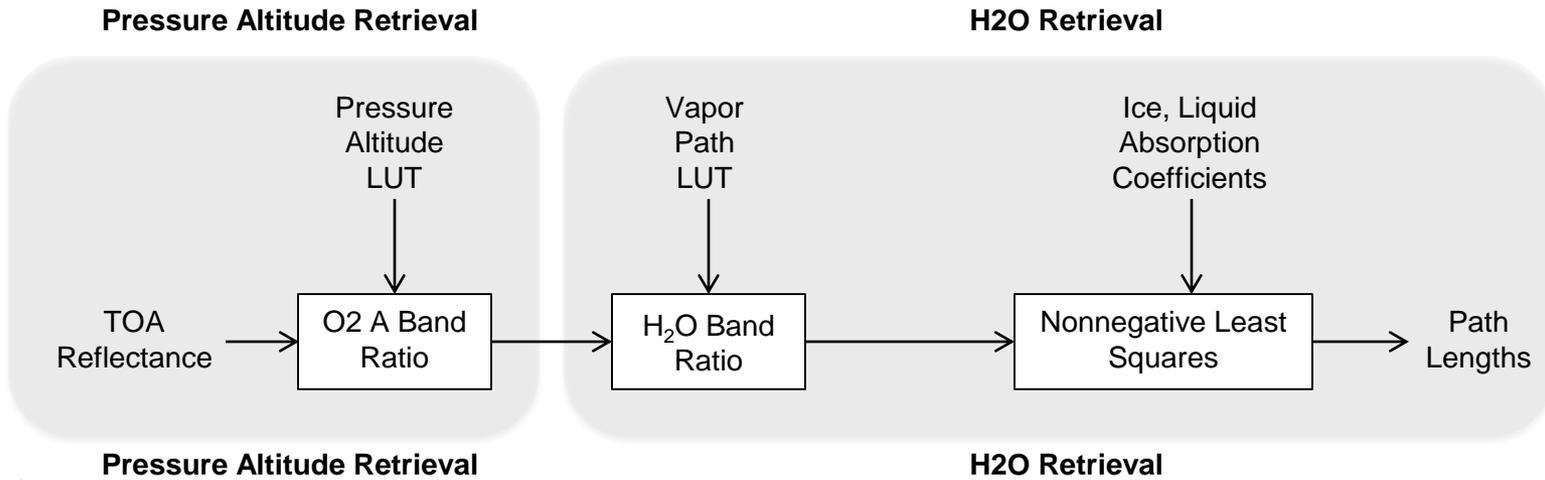
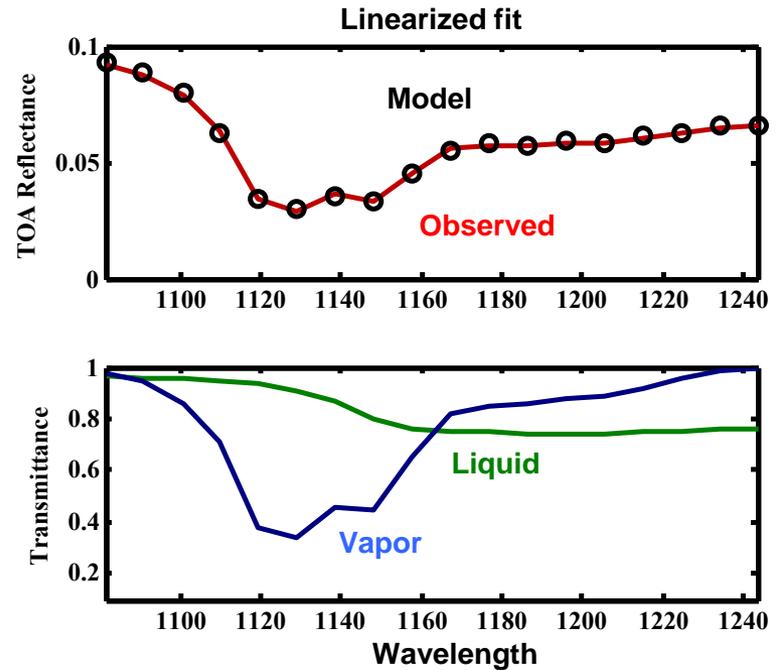
Vertical profiles use 20-layer atmospheres

[Gao and Green 2010]



Reducing bias in H₂O vapor maps

Thompson et al., HypsIRI Special Issue
Rem. Sens. Environ 2015 (in press).



Better H₂O Vapor Maps

RGB



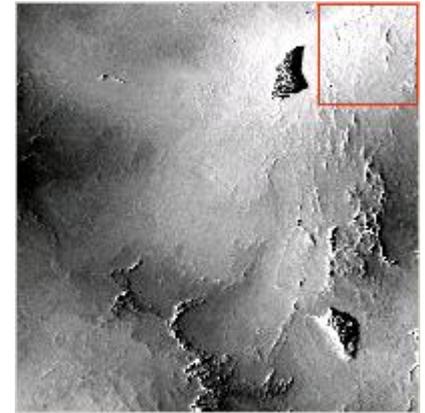
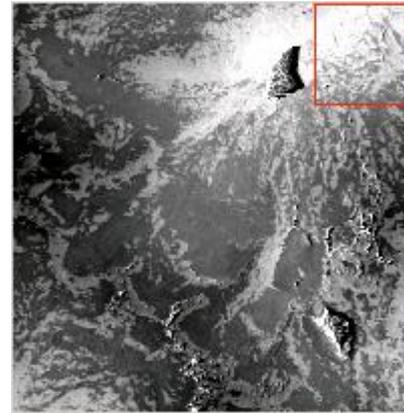
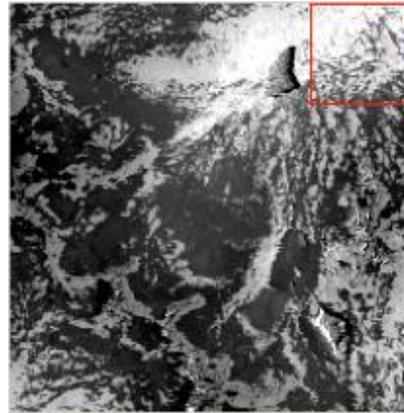
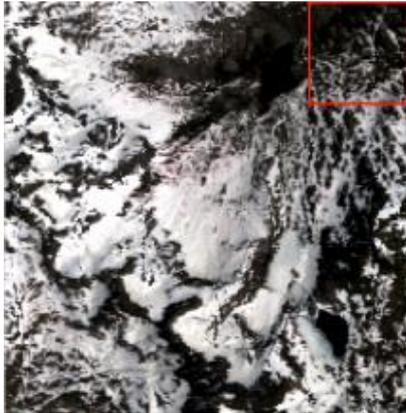
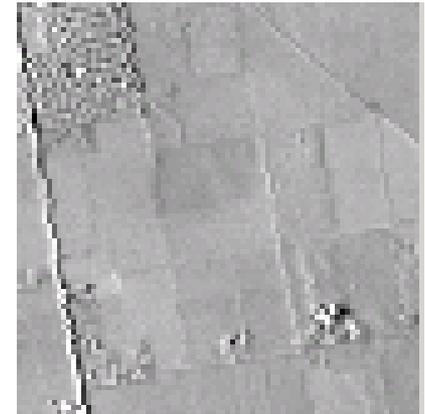
Initial guess



One fitting iteration



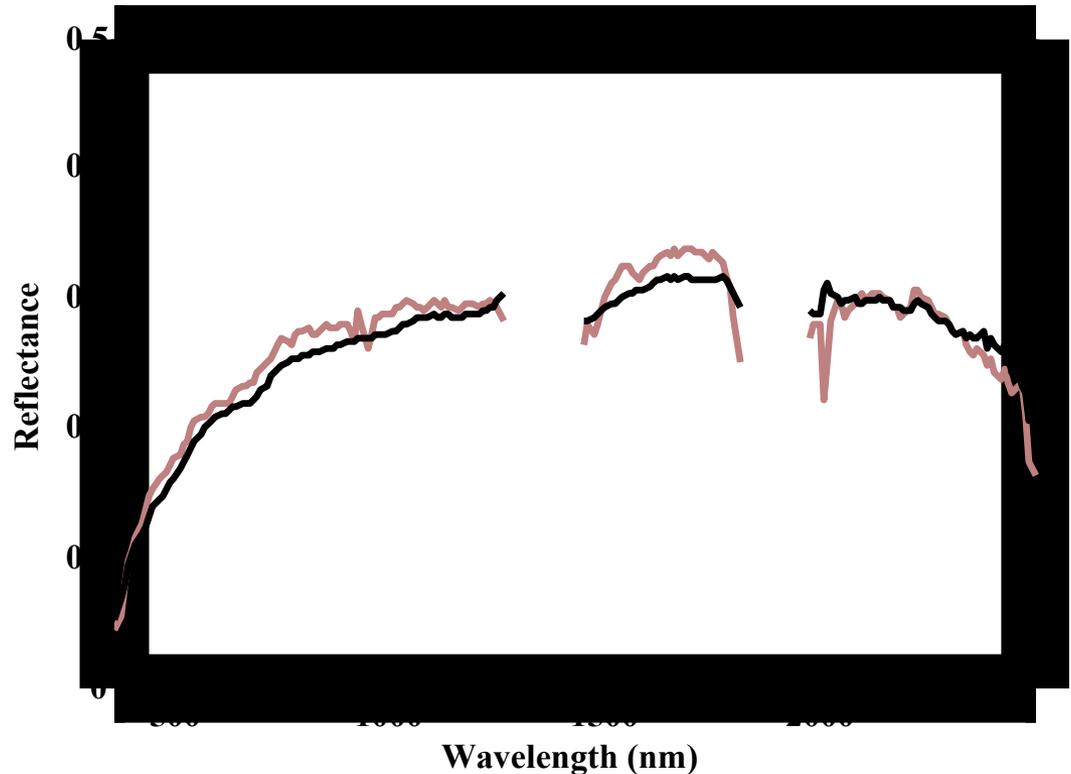
Converged



From Pennington et al., AGU 2015

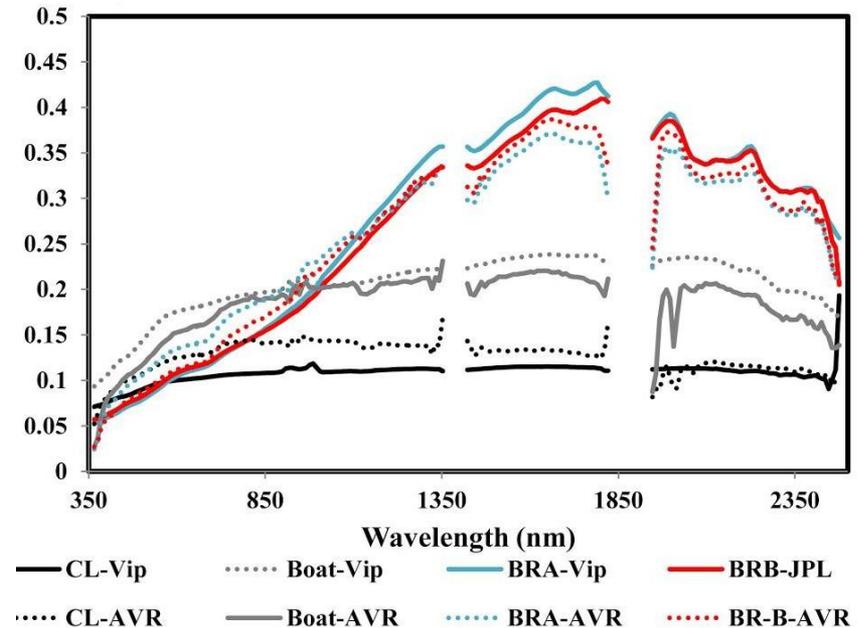
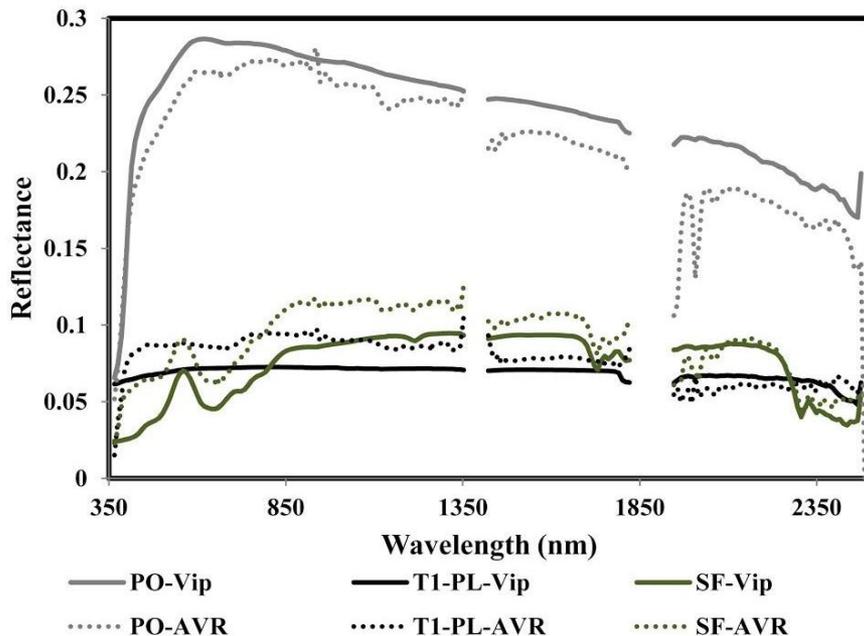
Residual suppression

- Multiplicative correction
- Derived from a smooth surface once per flight season
- Reversible using coefficients stored in metadata



Ground truth validation targets

- Dark targets too bright, bright targets too dark
- This suggests uncorrected scattering is a major offender
- Accuracy degrades somewhat at short wavelengths
- Water vapor maps (not shown) still show some “vegetation bias”

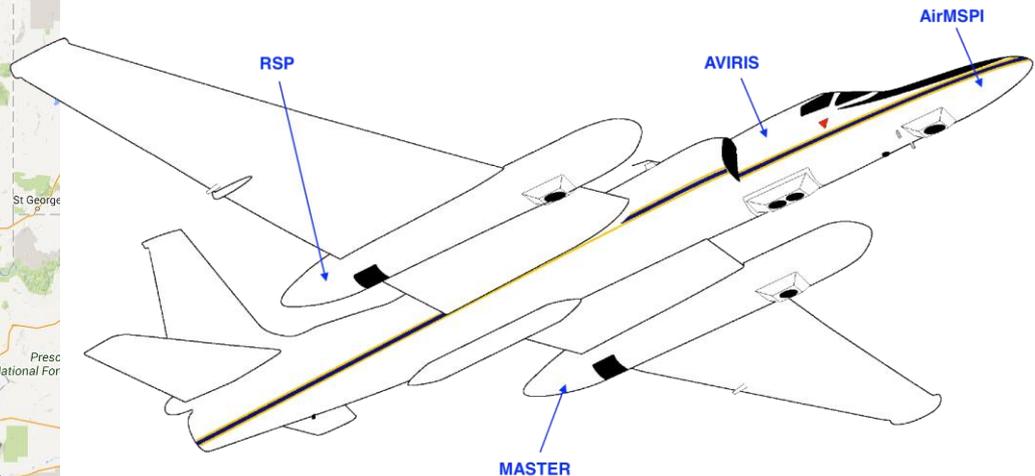
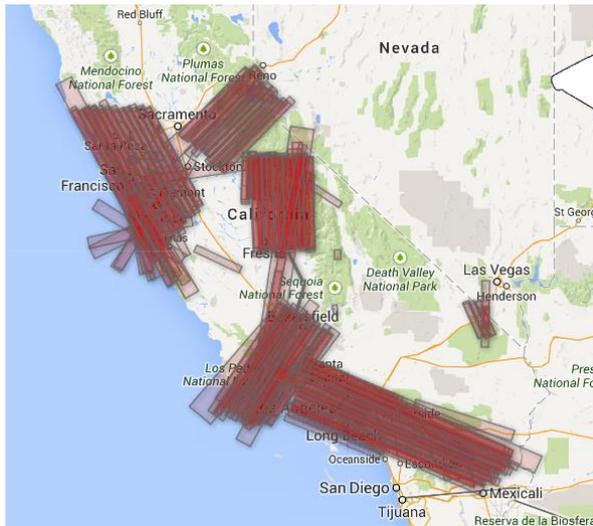


Courtesy Dar Roberts from Thompson et al., RSE 2015 (in press)



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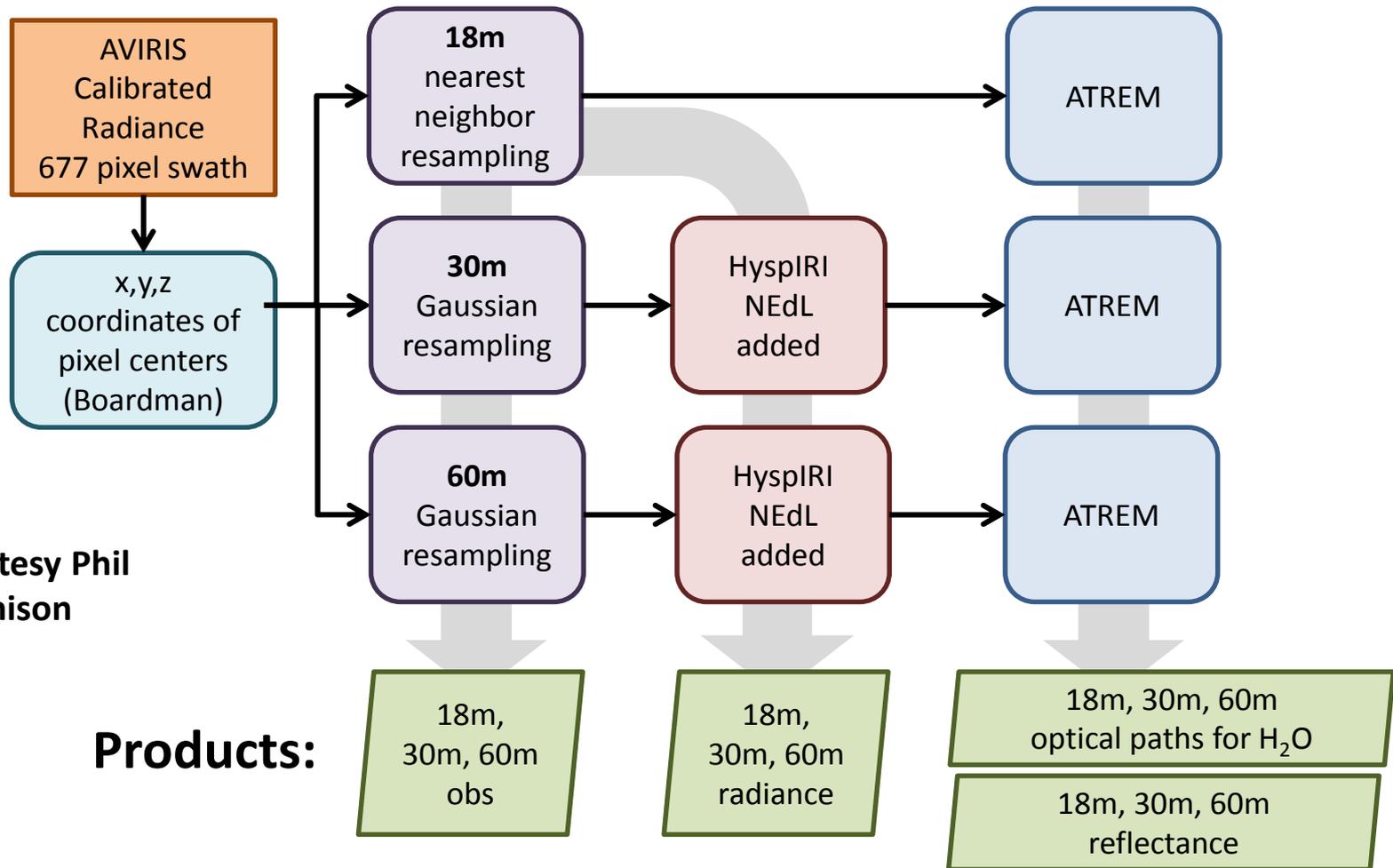


HyspIRI simulation objective

- Create orthorectified reflectance data with similar spatial and noise characteristics to the HyspIRI VSWIR
- Demonstrate processing pipeline that is scalable to anticipated HyspIRI data rates
- Demonstrate L2 algorithms operating across large, diverse geographic areas



HyspIRI simulated data products



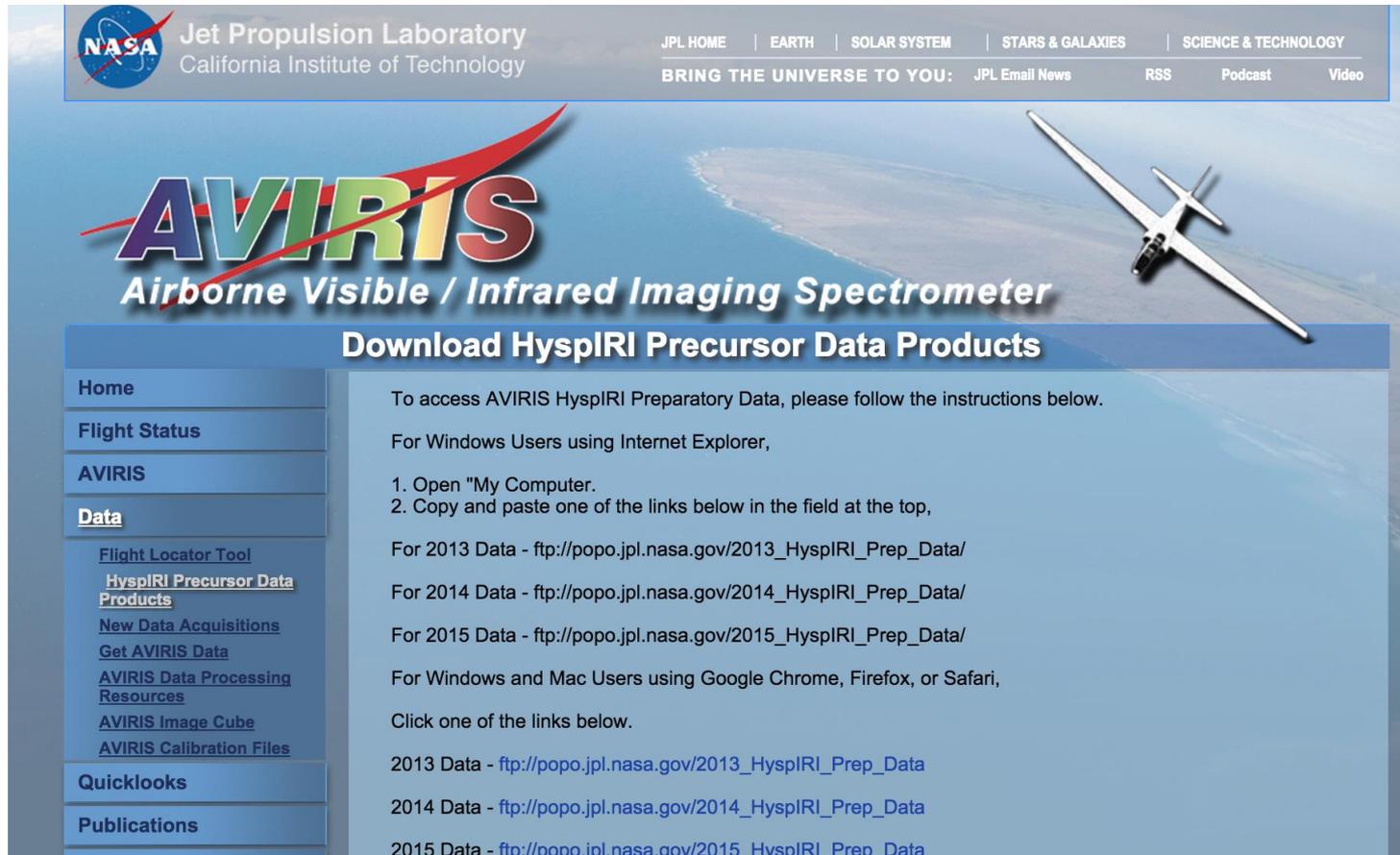
Courtesy Phil
Dennison

http://aviris.jpl.nasa.gov/data/AV_HyspIRI_Prep_Data.html



Data access instructions:

http://aviris.jpl.nasa.gov/data/AV_HyspIRI_Prep_Data.html



The screenshot shows the AVIRIS website interface. At the top left is the NASA logo and the text "Jet Propulsion Laboratory California Institute of Technology". To the right is a navigation menu with links for "JPL HOME", "EARTH", "SOLAR SYSTEM", "STARS & GALAXIES", and "SCIENCE & TECHNOLOGY". Below this is a secondary menu with "BRING THE UNIVERSE TO YOU:" followed by "JPL Email News", "RSS", "Podcast", and "Video". The main header features the "AVIRIS" logo in large, colorful letters, with the subtitle "Airborne Visible / Infrared Imaging Spectrometer" below it. An image of the AVIRIS aircraft is shown in flight over a landscape. The main content area is titled "Download HyspIRI Precursor Data Products" and contains the following text:

To access AVIRIS HyspIRI Preparatory Data, please follow the instructions below.

For Windows Users using Internet Explorer,

1. Open "My Computer."
2. Copy and paste one of the links below in the field at the top,

For 2013 Data - ftp://popo.jpl.nasa.gov/2013_HyspIRI_Prep_Data/

For 2014 Data - ftp://popo.jpl.nasa.gov/2014_HyspIRI_Prep_Data/

For 2015 Data - ftp://popo.jpl.nasa.gov/2015_HyspIRI_Prep_Data/

For Windows and Mac Users using Google Chrome, Firefox, or Safari,

Click one of the links below.

2013 Data - ftp://popo.jpl.nasa.gov/2013_HyspIRI_Prep_Data

2014 Data - ftp://popo.jpl.nasa.gov/2014_HyspIRI_Prep_Data

2015 Data - ftp://popo.jpl.nasa.gov/2015_HyspIRI_Prep_Data

The left sidebar contains a navigation menu with the following items:

- Home
- Flight Status
- AVIRIS
- Data
 - [Flight Locator Tool](#)
 - [HyspIRI Precursor Data Products](#)
 - [New Data Acquisitions](#)
 - [Get AVIRIS Data](#)
 - [AVIRIS Data Processing Resources](#)
 - [AVIRIS Image Cube](#)
 - [AVIRIS Calibration Files](#)
- Quicklooks
- Publications

