Hyperspectral Imager Calibration in the Blue: Issues and Experiments

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Outline

• What is the blue problem?

• Possible culprits
  • Stray light
  • Polarization
  • Atmospheric correction

• Testing culprits
  • HICO calibrations with two spheres
  • Outdoor testing
  • Sphere testing with asd
What’s wrong in the blue?

- Many hyperspectral imagers for in-water applications often have lower than expected radiances at blue wavelengths (below 450-500nm)
  - These can be quite large and even lead to a negative remote sensing reflectance after atmospheric correction

- Examples of Sensors with a blue problem
  - PHILLS
  - CASI
  - HICO
  - microSHINE
  - Aviris (Gao, Atmospheric correction over water, Hyspiri 2014)
  - Others not published
Possible culprits

• Atmospheric correction
  • Especially over water, small aerosol signal used to remove large atmospheric signal to get at low water leaving radiance

• Polarization
  • Most sensors exhibit some polarization sensitivity due to reflective optics, especially blazed gratings
  • Most environmental signals exhibit at least some degree of polarization
  • Calibration assumes no polarization sensitivity in instrument

• Stray light
  • Out of band stray light could contaminate the in band signal
  • During calibration this could affect the gains, but this won’t be a problem unless a differently shaped spectrum is measured
  • Unfortunately typical calibration spheres are weak in the blue and strong in the red, which is opposite from most environmental signals
Atmospheric Correction

Spectral Radiance (W/m²/sr/micron) vs. Wavelength (microns)

- Large contribution from atmosphere
  - Low signal from target of interest

Important spectral region for atmospheric correction
Important spectral region for water property retrievals

Radiance from Water, Atmosphere, and Total at Sensor
Stray Light - Typical field vs. sphere signals

Calibration source enhanced with Xe lamp

Field signal range

Calibration source
HICO gains blue enhanced vs. halogen spheres—completely different sphere spectra derive same gains

If there is a stray light issue, gains (slopes) should be different, but they are the same.
Outdoor test- measure all sensors at the ground simultaneously

• Low to ground- removes atmosphere
• Simultaneous comparison to independently calibrated instrument- Field Spec ASD
• No polarization- spectralon plaque and sun far off specular direction
Rooftop Test Setup

Data date: 2014 Nov 10
Washington, DC

~2 m

~8 cm
Rooftop Test Setup continued…

- CASI
- FieldSpec (ASD)
- microSHINE
- Spectralon plaque target
ASD (black) VS CASI (red) and MicroShine (green)

Plaque Spectral Profile
Fraction CASI/ASD November 10, 2014
(wavelength re-gridded to CASI and not binned- exaggerates sharp peaks)

Ignore- known red processing issue

Blue problem

Ignore- known red processing issue
ASD gives correct radiance of integrating sphere

ASD vs Sphere
Sphere (red) 2014 July-independent calibration
ASD (blk) 2015 Jan

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Conclusions

• Still don’t understand blue issue
• Not polarization effect
• Doesn’t *appear* to be stray light from HICO calibrations
• Not atmospheric effect

• What is it???????????????????