Study of Atmospheric Polarization with Ground-based Robotic Hyperspectral Measurements and HARP2 Data Analysis

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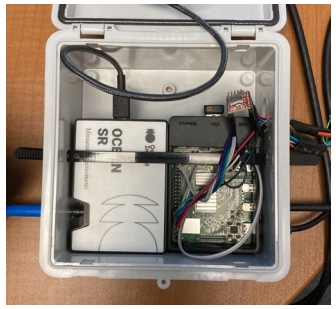
Objectives

- Instrument development, integration, and field measurements
- Generate and analyze graphs of hyperspectral data to study atmospheric polarization from ground-based hyperspectral measurements
- Analysis of satellite based HARP2 data
- In preparation for validation of satellite data with ground measurements

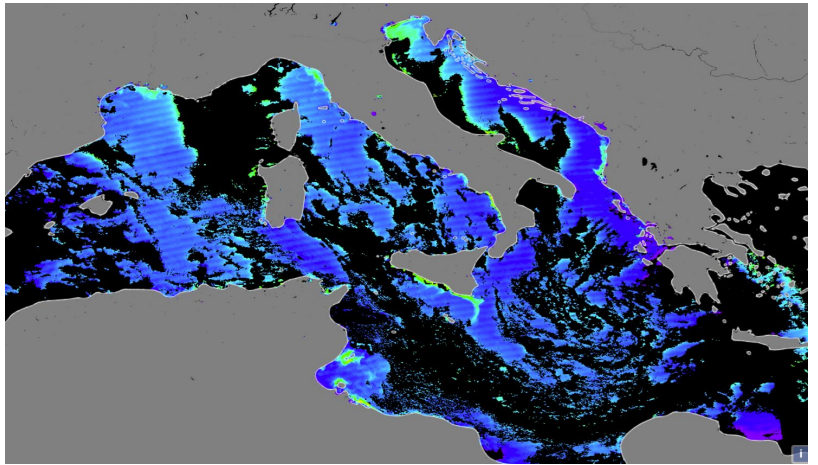


Motivation

- Atmospheric polarization can be used to monitor air quality
  - characterizing aerosols
- Polarization can affect satellite image quality (striping) which needs correction

NASA PACE HARP2

NOAA-20 VIIRS nlw(411)



Instrument Parts

Major components of instrument system:

(a) Telescope with Concave Mirror
(b) Polarization Lens
(c) Optical Fiber
(d) Ocean Insight Spectrometer
(e) Raspberry Pi Model 4B
(f) Display for Raspberry Pi

Assembly

- Assisted in development of 3D printed piece to hold optical fiber
- Prepare instruments for ground-based hyperspectral measurements

(a)

(b)

(c)

(d)

(e)

(f)

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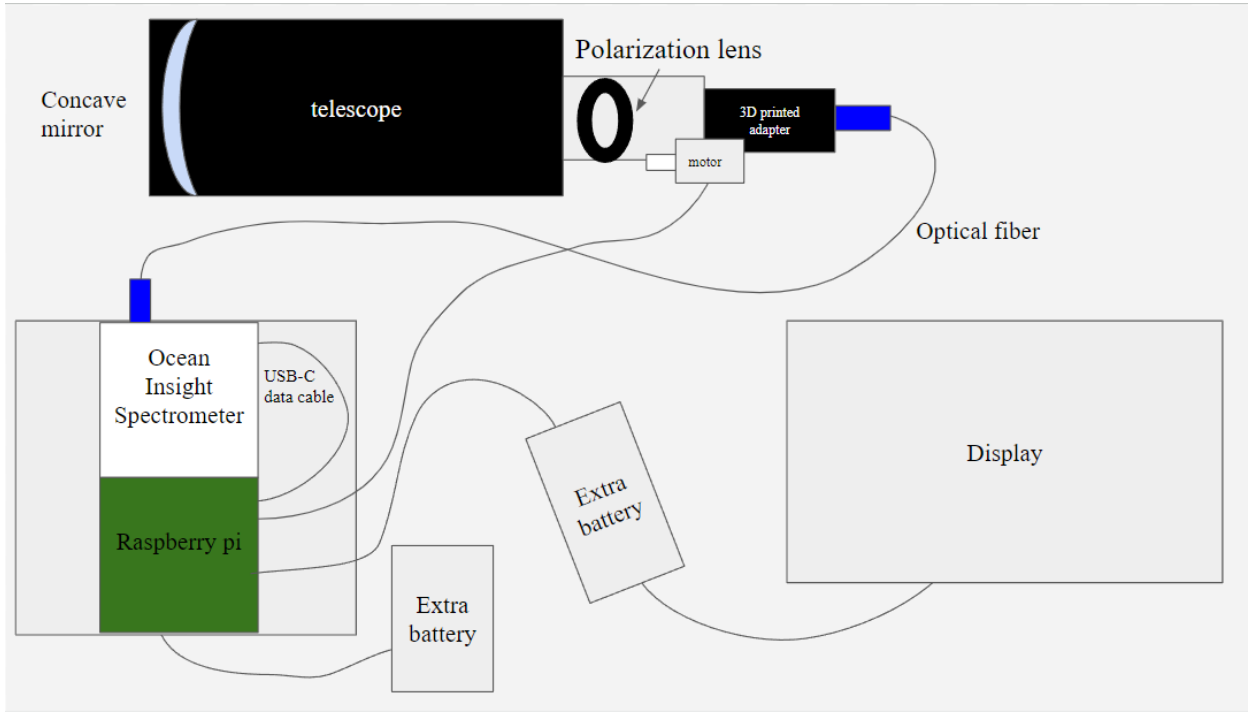
Schematic Design & Integrated System

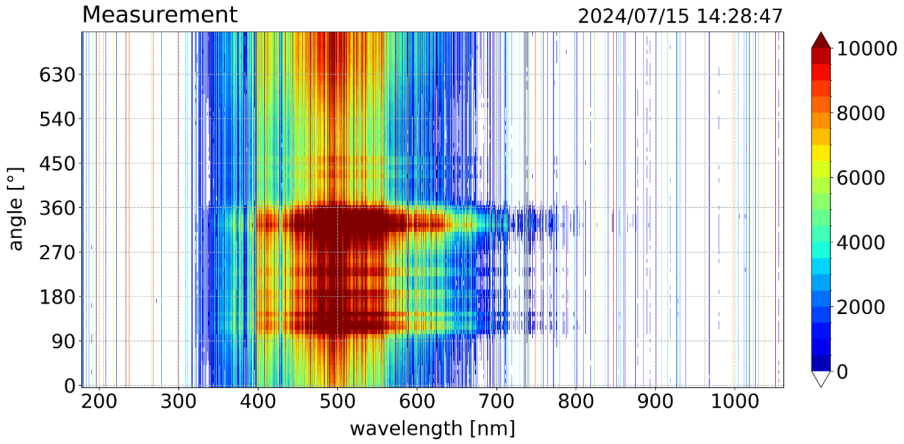
Schematic Diagram

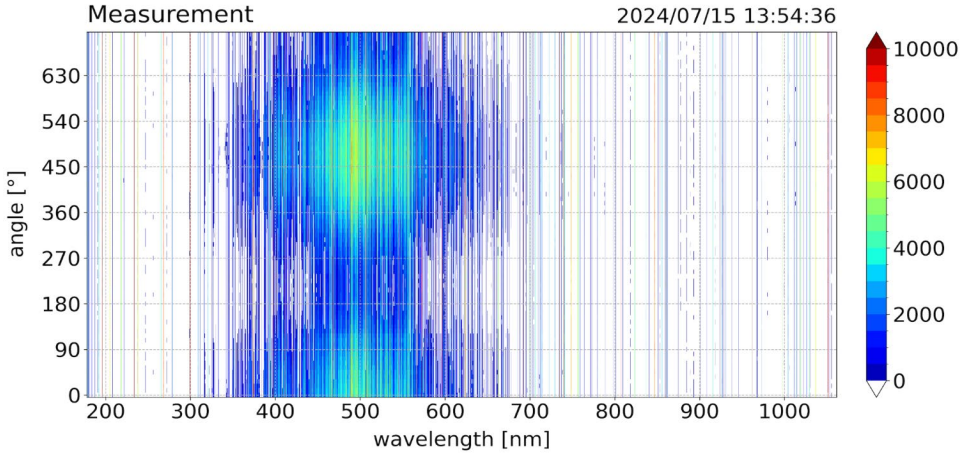


Field measurements, July 15th

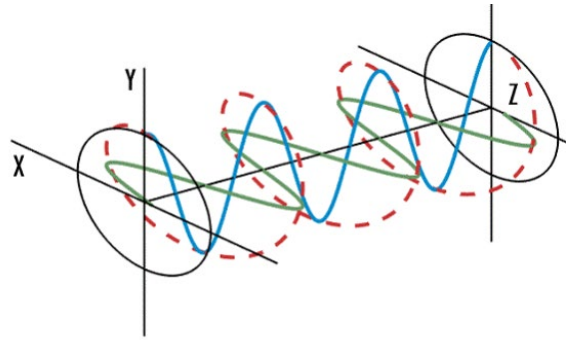
Field Experiment Data Analysis & Visualization

Data Plots

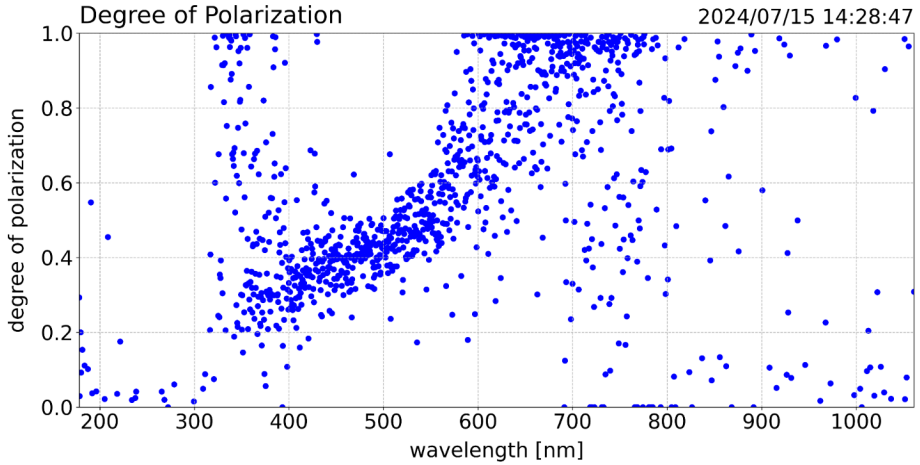


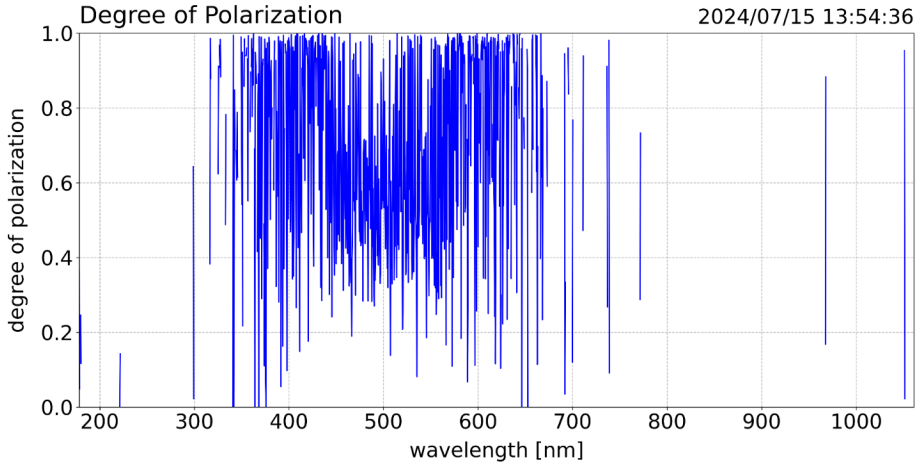


Electromagnetic wave propagation



Degree of Polarization Plots





Degree of Polarization Formula

$$V = \frac{I_{max} - I_{min}}{I_{max} + I_{min}},$$

$I_{\max}$: maximum intensity of light

$I_{\min}$: minimum intensity of light

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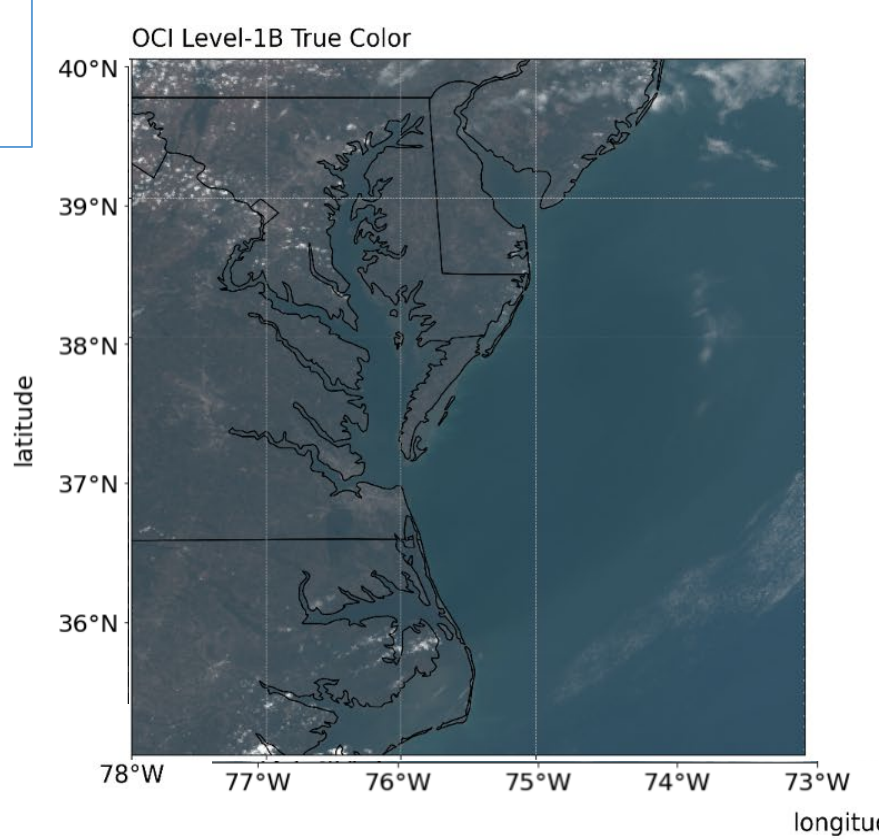
HARP2 Data Analysis

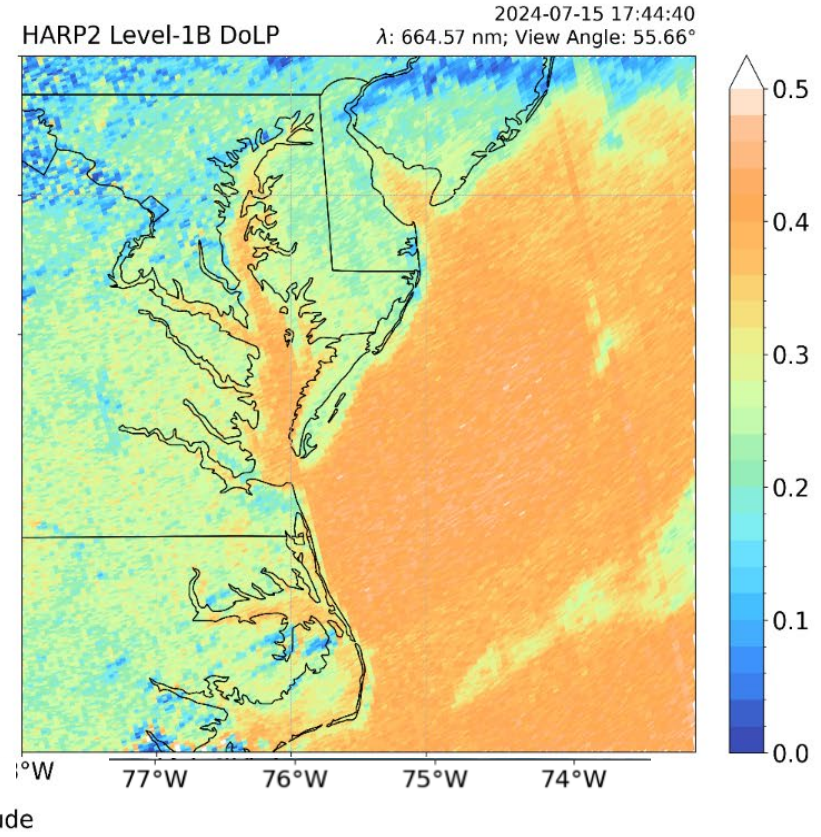
NASA PACE mission
- Ocean Color Instrument (OCI)
- 2 Polarimeters
  - HARP2
  - SPEXone

Hyper-Angular Rainbow Polarimeter #2 (HARP2)

OCI True Color



HARP2 Degree of Linear Polarization (DoLP)



HARP2 DoLP Data Analysis over Chesapeake Bay Region

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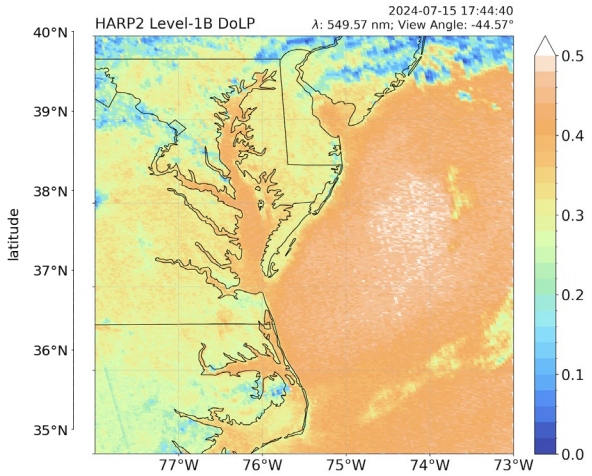
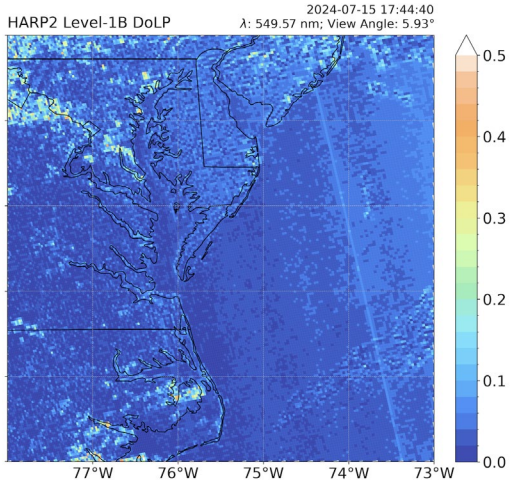
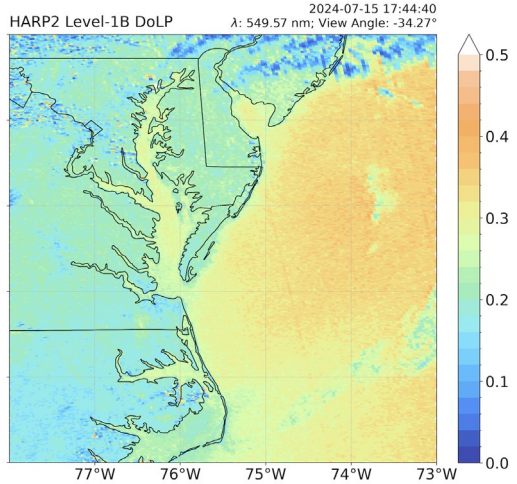
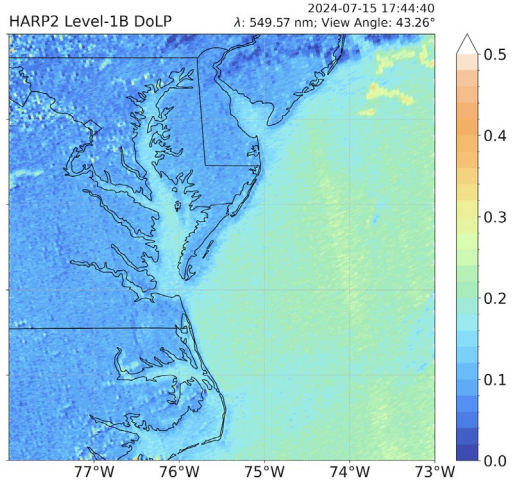
Same Wavelength (549.57 nm) Different View-Angles









Similar View-Angle (~ 20°) Different Wavelengths

HARP2

OCI