

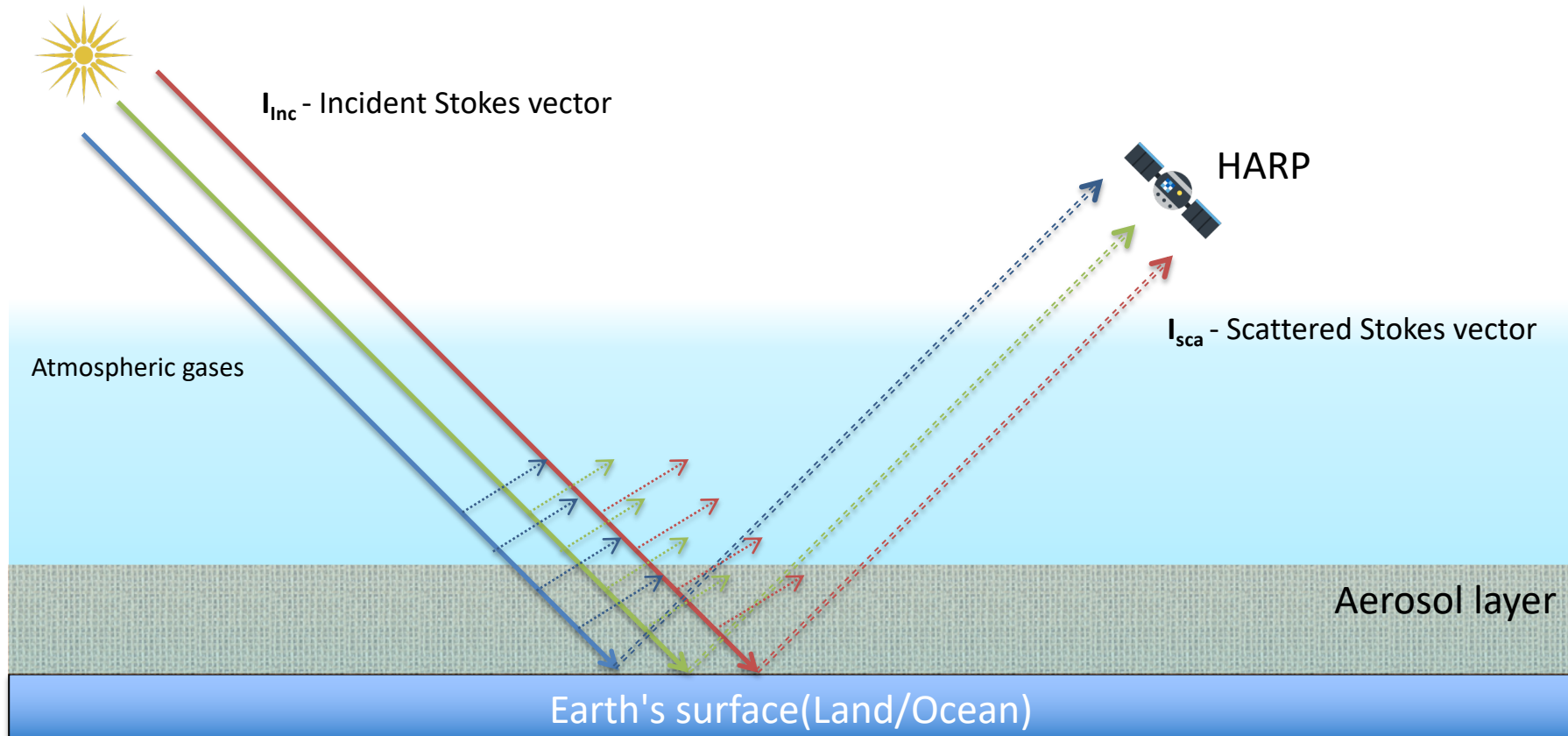
# Retrieval of Aerosol Properties from Airborne Hyper-Angular Rainbow Polarimeter (AirHARP) Observations During the 2017 ACEPOL campaign

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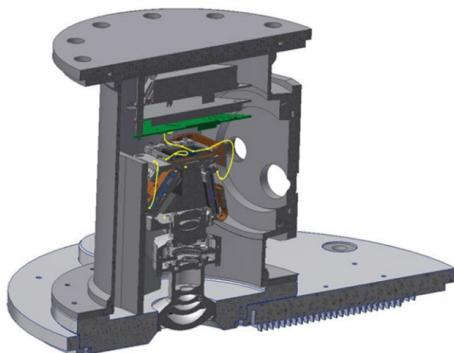
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- <sup>6</sup> Instituto de Física, Universidade de São Paulo., São Paulo, Brazil



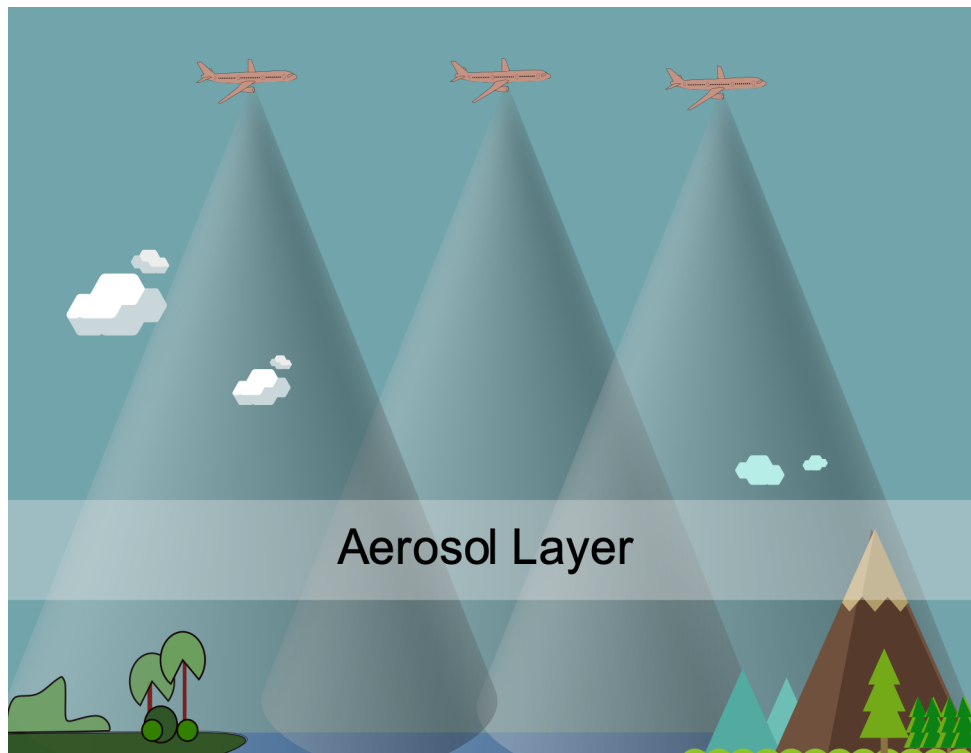
- Introduction
  - HARP(Hyper Angular Rainbow Polarimeter) observation
  - AirHARP
- Automated retrieval scheme using GRASP
- ACEPOL campaign
  - Examples of data and retrievals over different surfaces
  - Validation of AOD with AERONET and HSRL2 observations

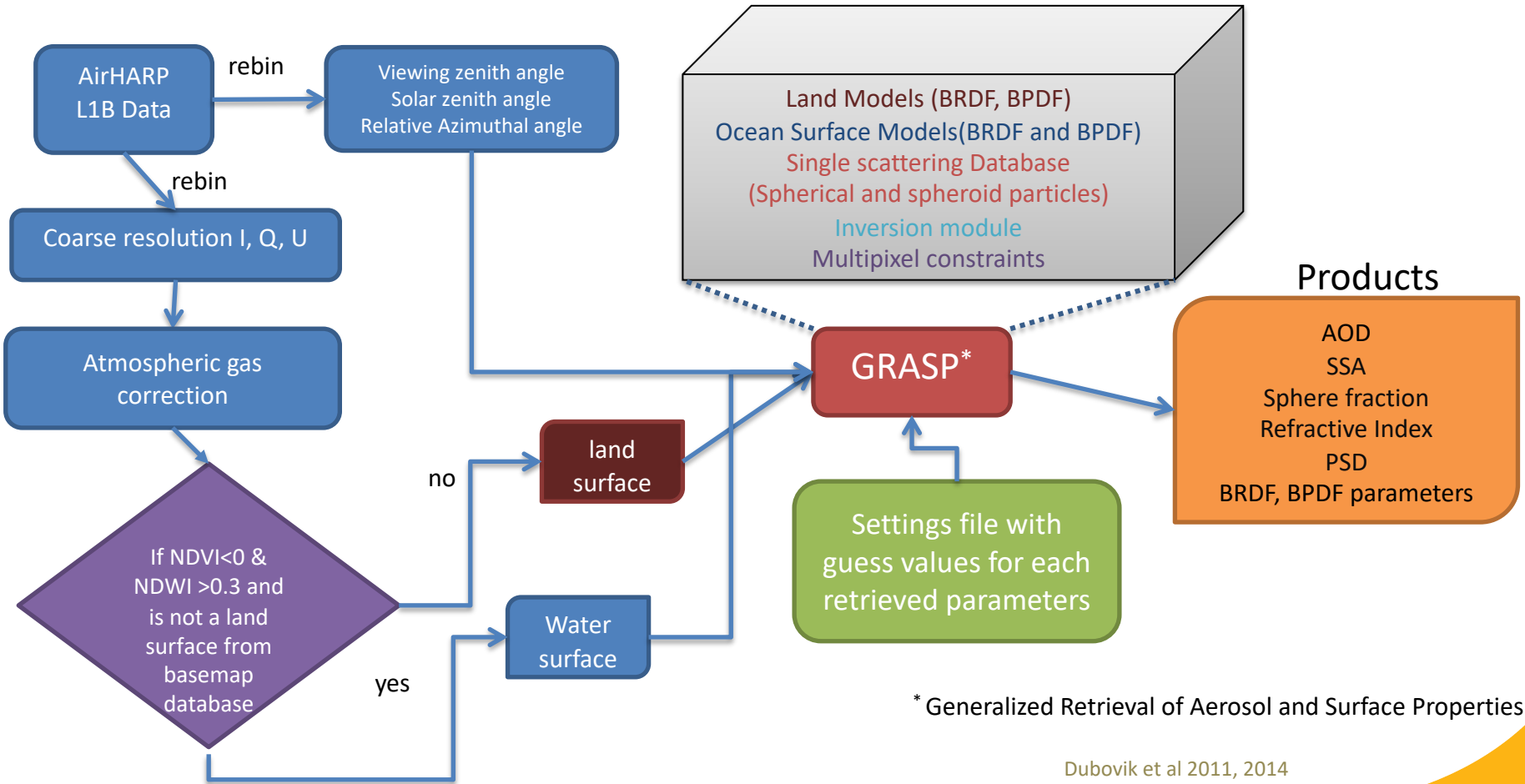


- Measures I, Q and U of stokes vector
  - Degree of Linear Polarization
  - $DoLP = \sqrt{Q^2 + U^2} / I$
- Wavelengths
  - 0.44, 0.55, 0.67, 0.87  $\mu\text{m}$
- Viewing Angles
  - 20 for Blue, Green and NIR
  - 60 for Red



AirHARP instrument cross section



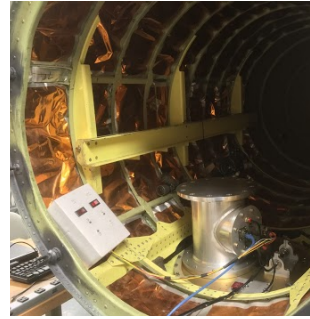


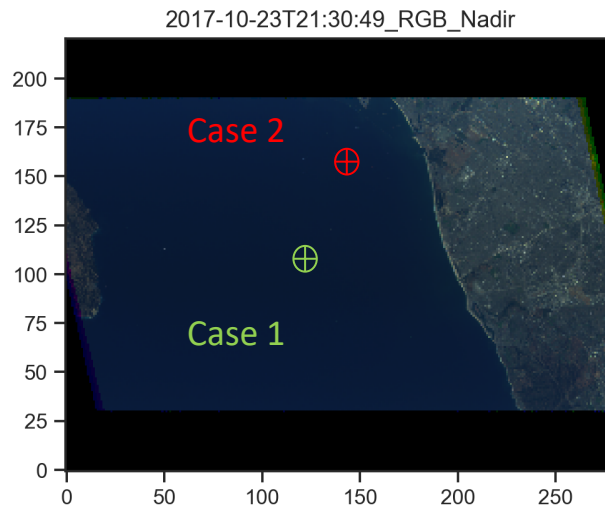
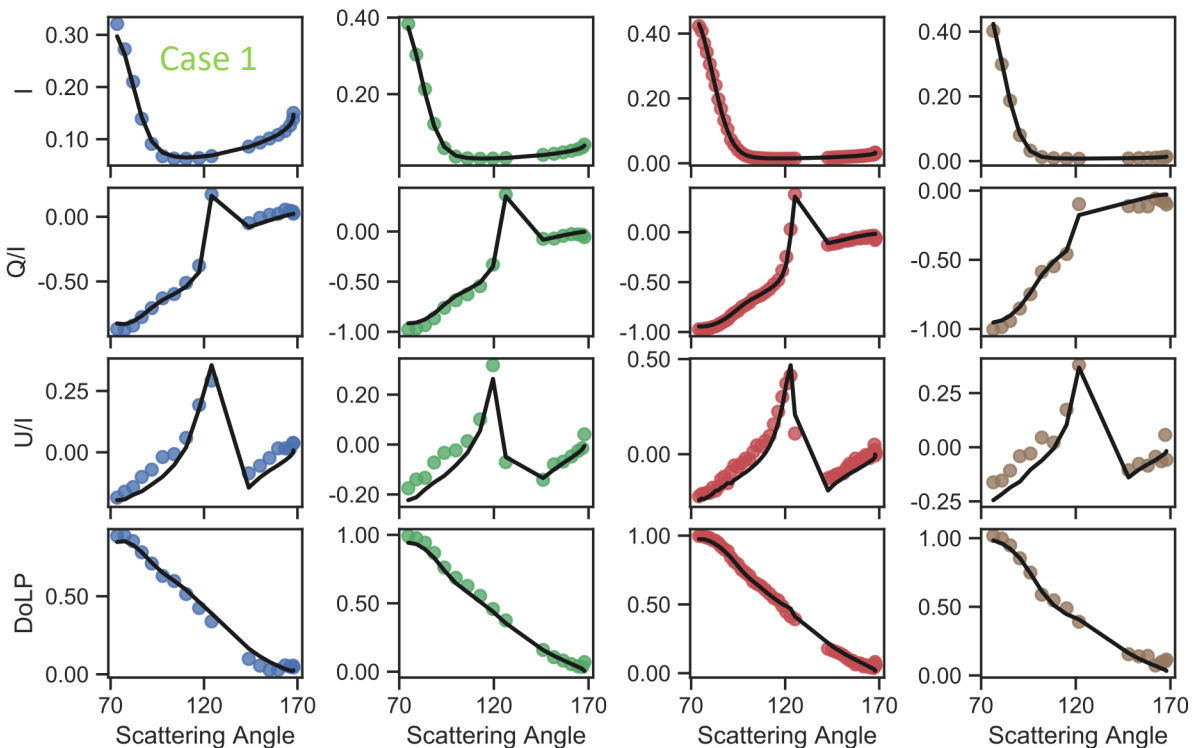
\* Generalized Retrieval of Aerosol and Surface Properties

# ACEPOL 2017

(Aerosol Characterization from  
Polarimeter and LiDAR)

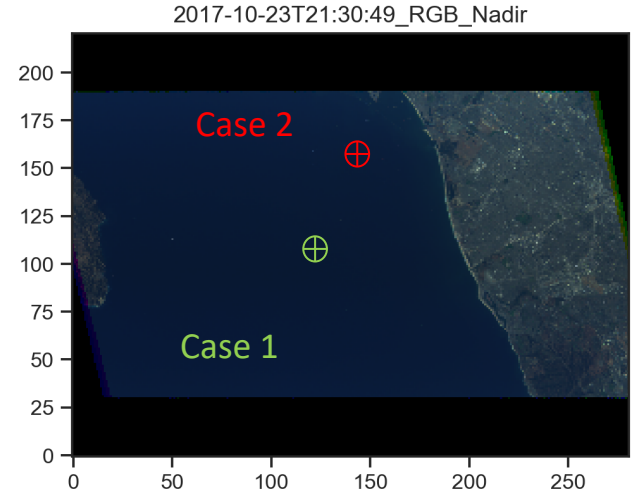
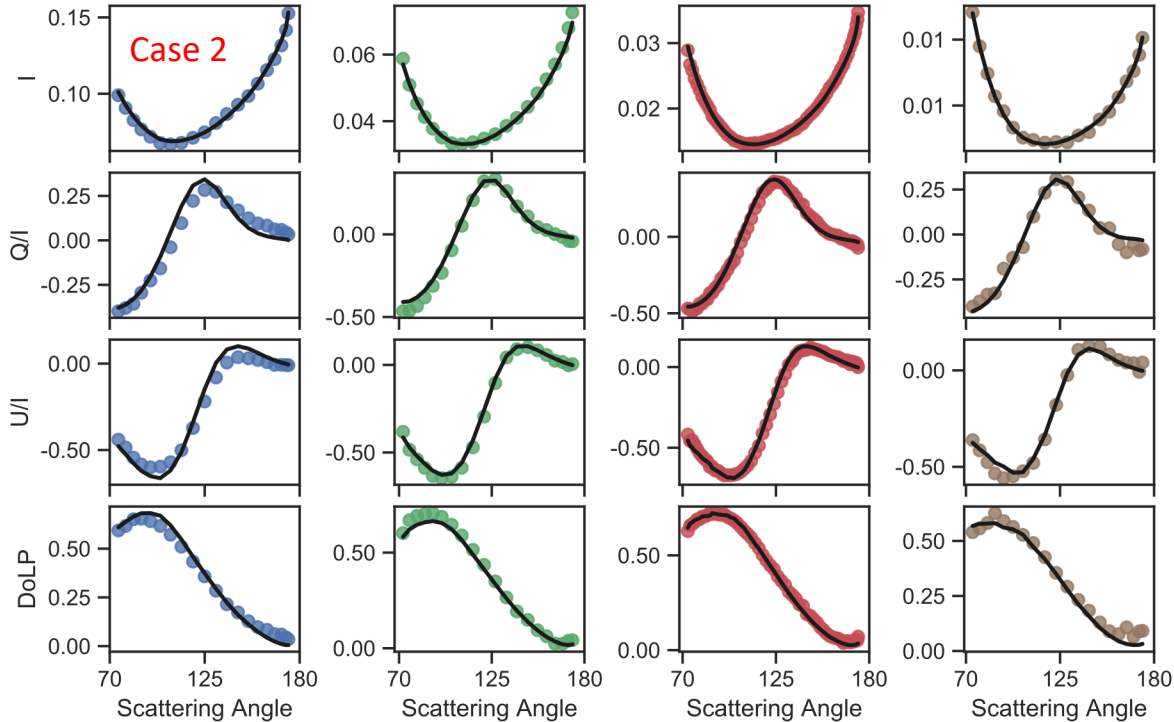
- ER-2 aircraft at 20km
- October 19, 2017 – November 09, 2017
- Overpass over multiple AERONET stations, smoke plume, over ocean, clouds
- CALIPSO track
- Ground measurement of BRDF/BPDF
- The measurements and algorithms are applicable to future satellite missions such as ACE, PACE and A&CCP





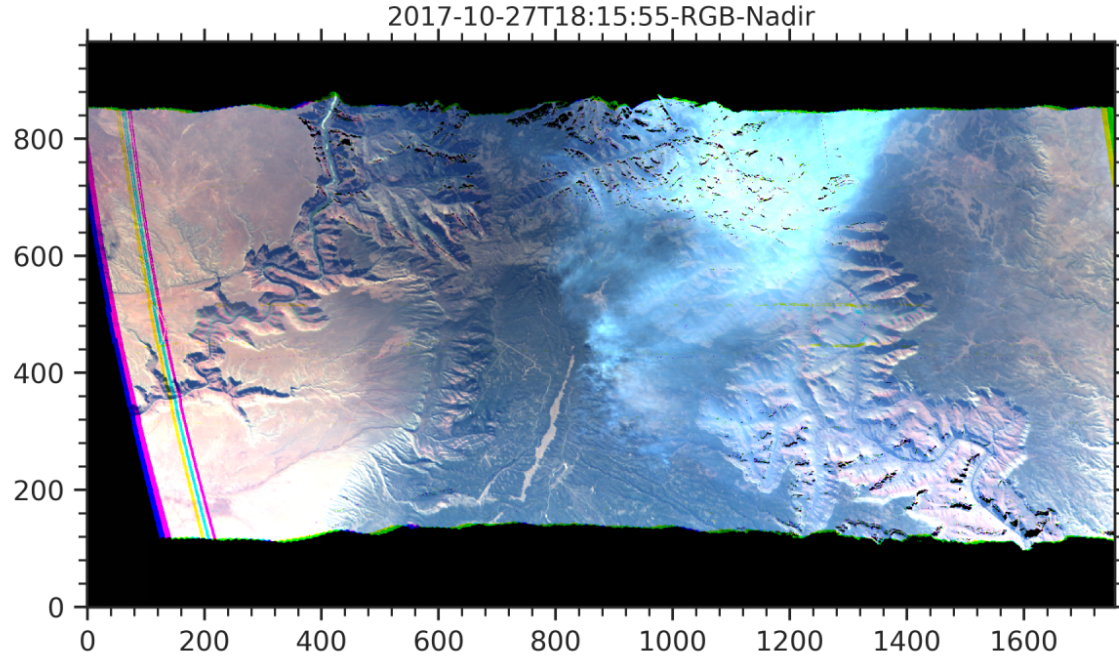
Ocean between Catalina island and LA  
(23-Oct-2017)

Solid circles are the airHARP data points and black line is the GRASP fit  
Blue: 440nm band, Green: 550nm band, Red: 670nm band and Brown: 873nm band

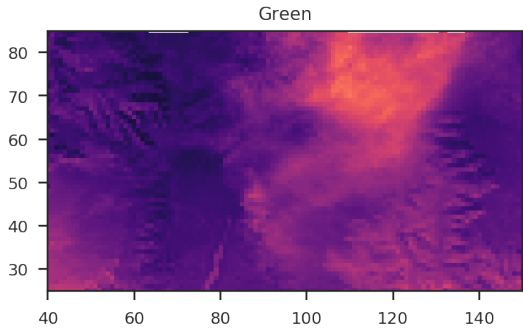


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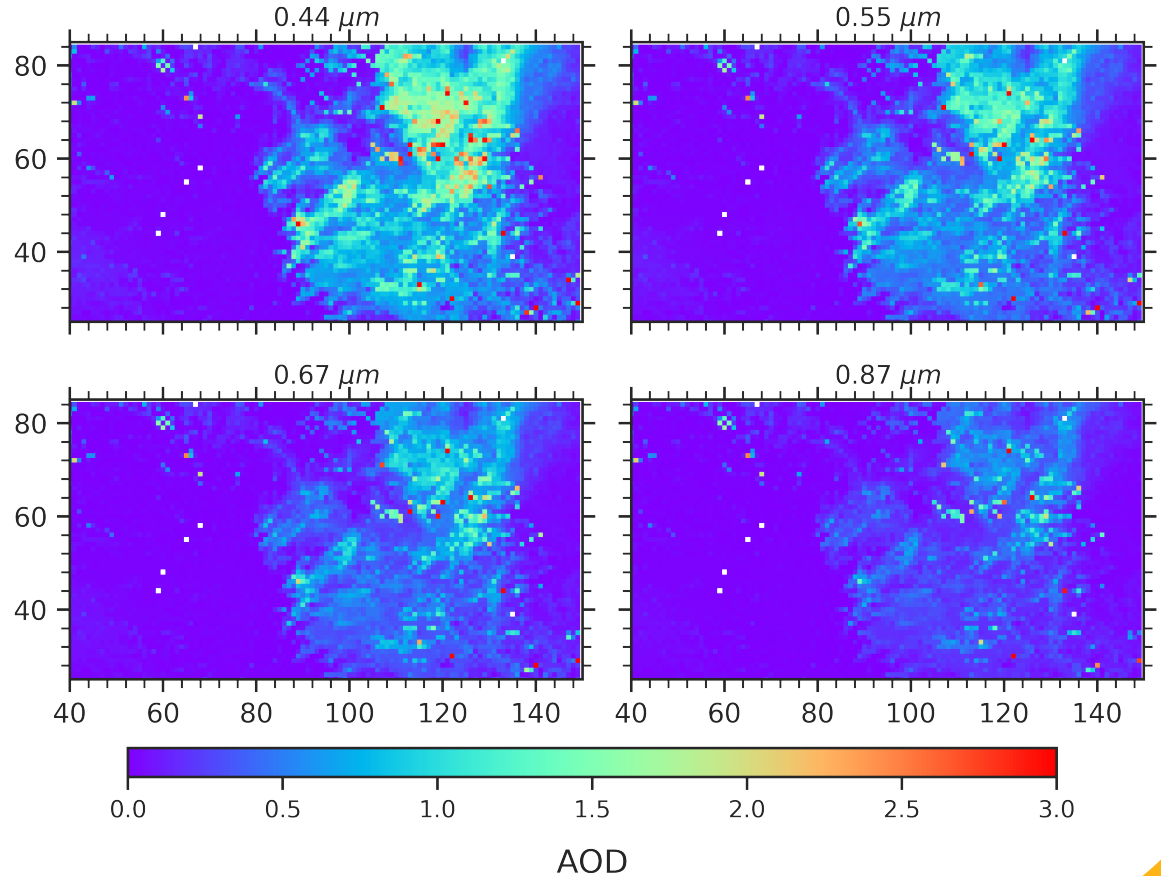


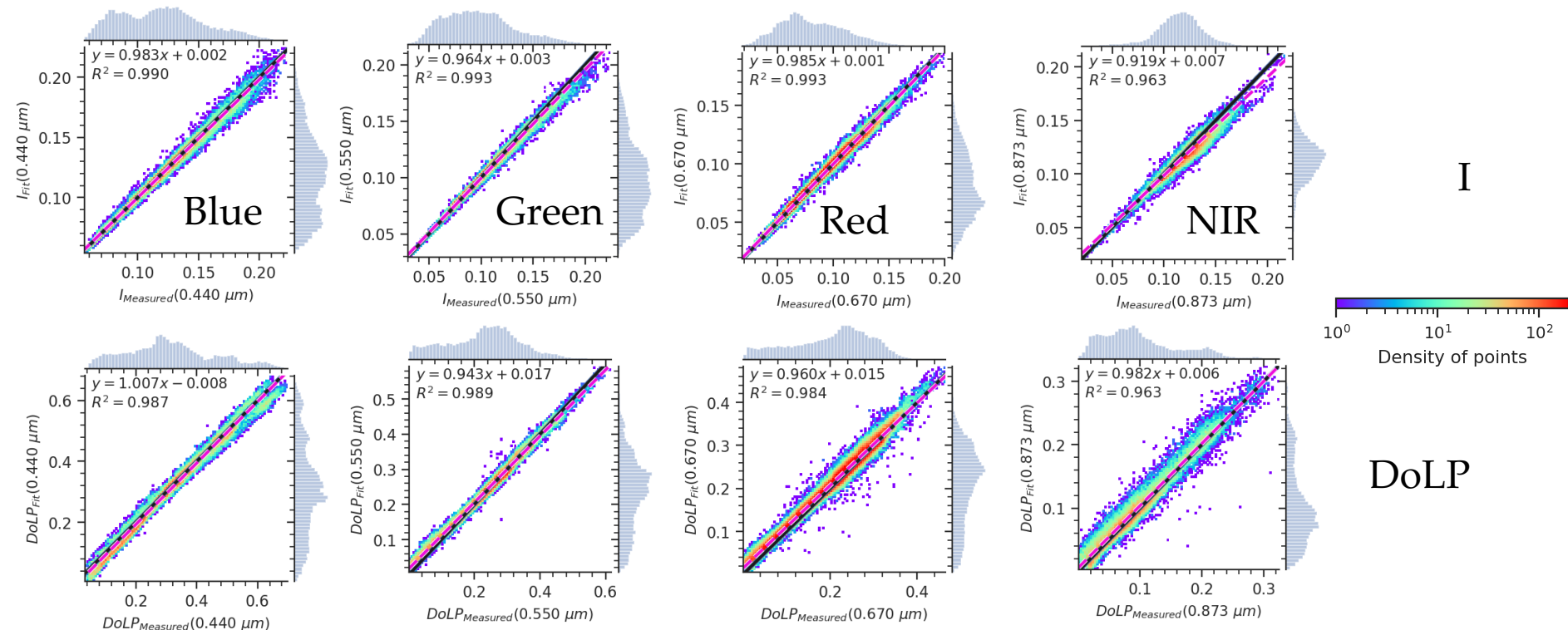


RGB image of the forest fire smoke scene near Grand canyon, AZ on 27th Oct 2017

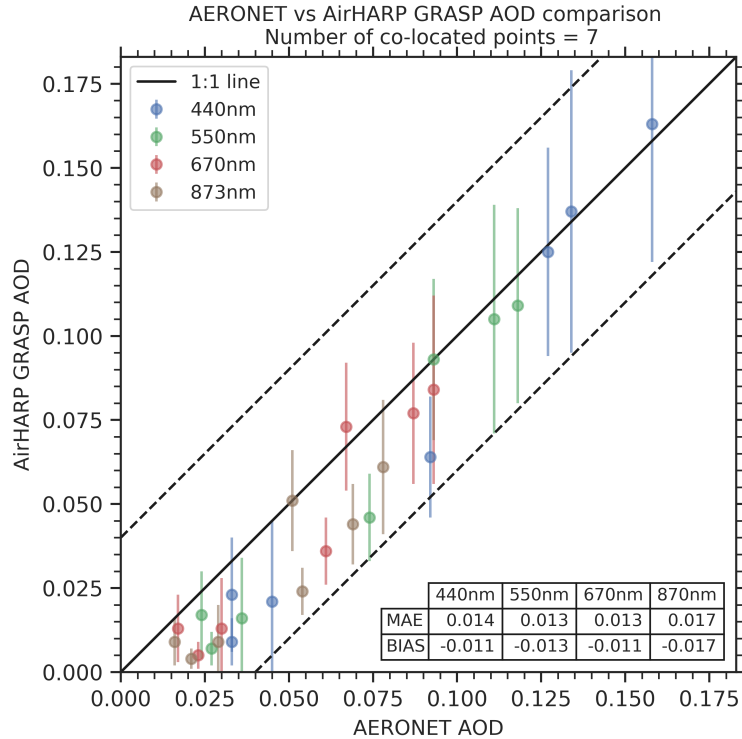


Radiance image of the scene where retrievals are performed  
 X and Y axes are pixel number  
 Pixel resolution ~ 400m x 400m





2D density plot of AirHARP measurement variables and GRASP fit for the pixels in the smoke scene. 1:1 line (cyan solid line), Ordinary Least Square (OLS) regression line (magenta dashed line), the OLS fit parameters, and R<sup>2</sup> are also reported in the same graph. For each plot, the histogram of measurement and GRASP fit for I and DoLP are plotted on the top and right axis respectively



## Details of the AERONET data used for the AirHARP AOD validation

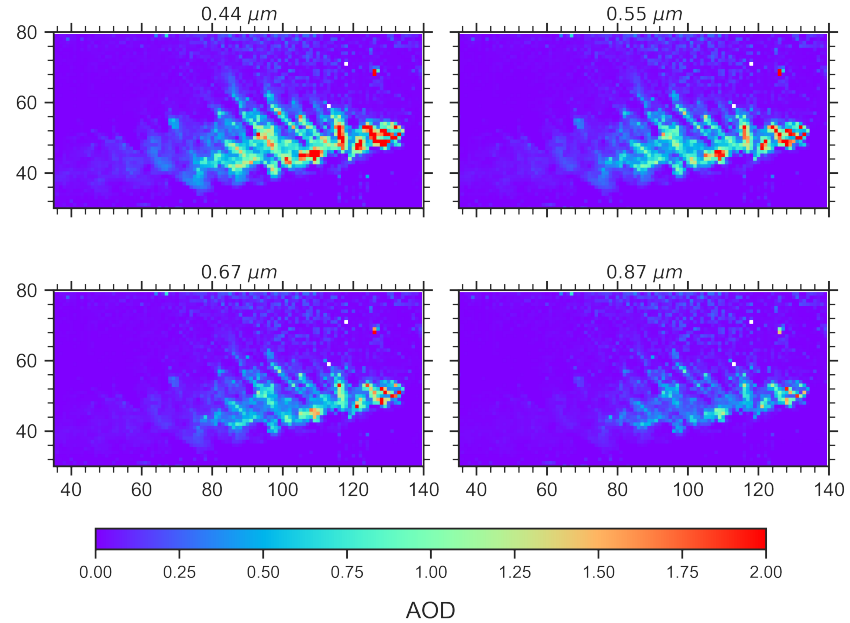
Date and Time (UTC)	AERONET Station	Data Quality Level
2017-10-23 21:53:00	CalTech	1
2017-10-25 19:55:00	Bakersfield	2
2017-10-26 18:55:00	Fresno2	2
2017-10-26 19:15:00	Bakersfield	2
2017-10-26 21:24:00	Railroad Valley	1.5
2017-11-07 19:36:00	Fresno2	2
2017-11-09 18:31:00	USGS_Flagstaff	2

Scatter plot of AERONET AOD vs AirHARP GRASP AOD retrieved. Pixels with a resolution of 400m x400m are used for the retrievals. Each circle in the figure is the mean of 10x10 pixels(4km x 4km) around the respective AERONET station.

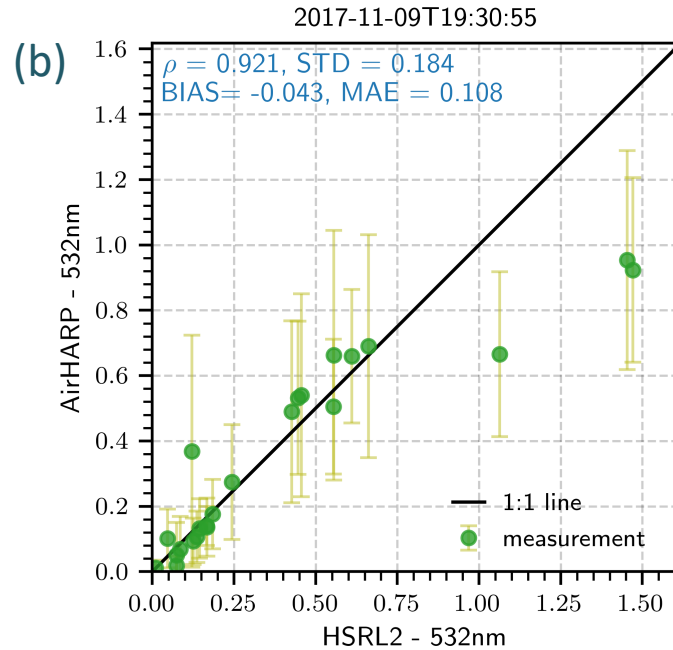
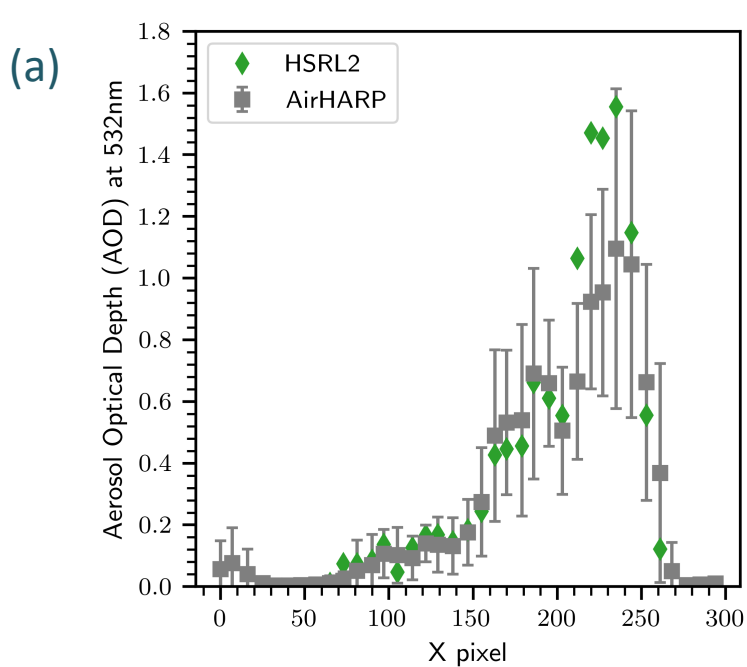


AirHARP RGB image in 40m native resolution

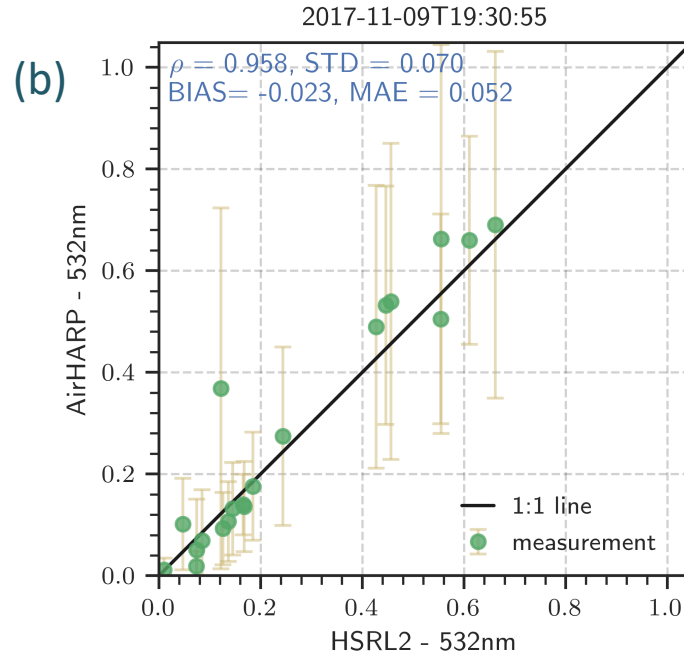
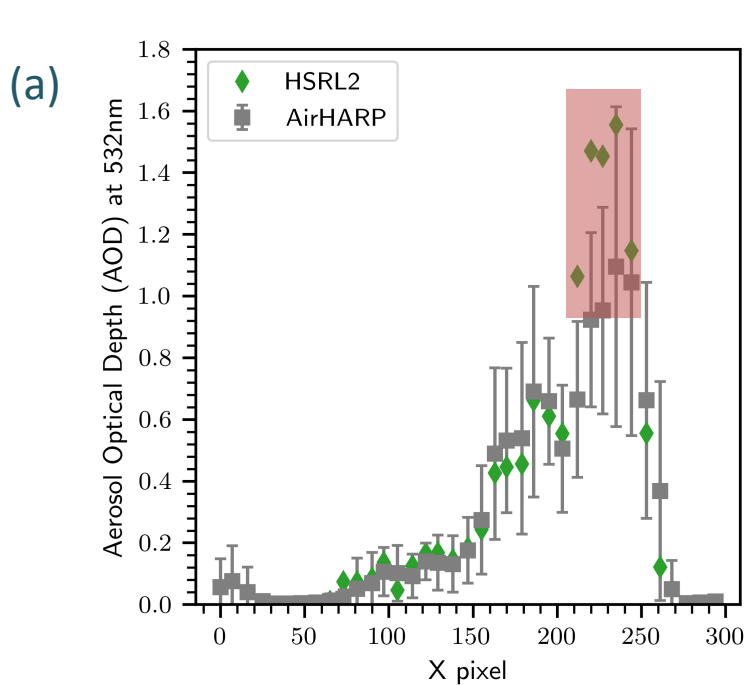
## AOD Retrievals



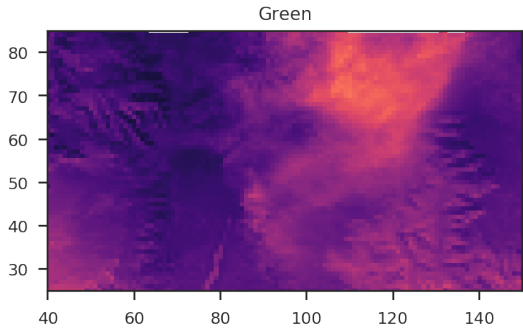
Rebin to a lower resolution of 400m x 400m for each pixels



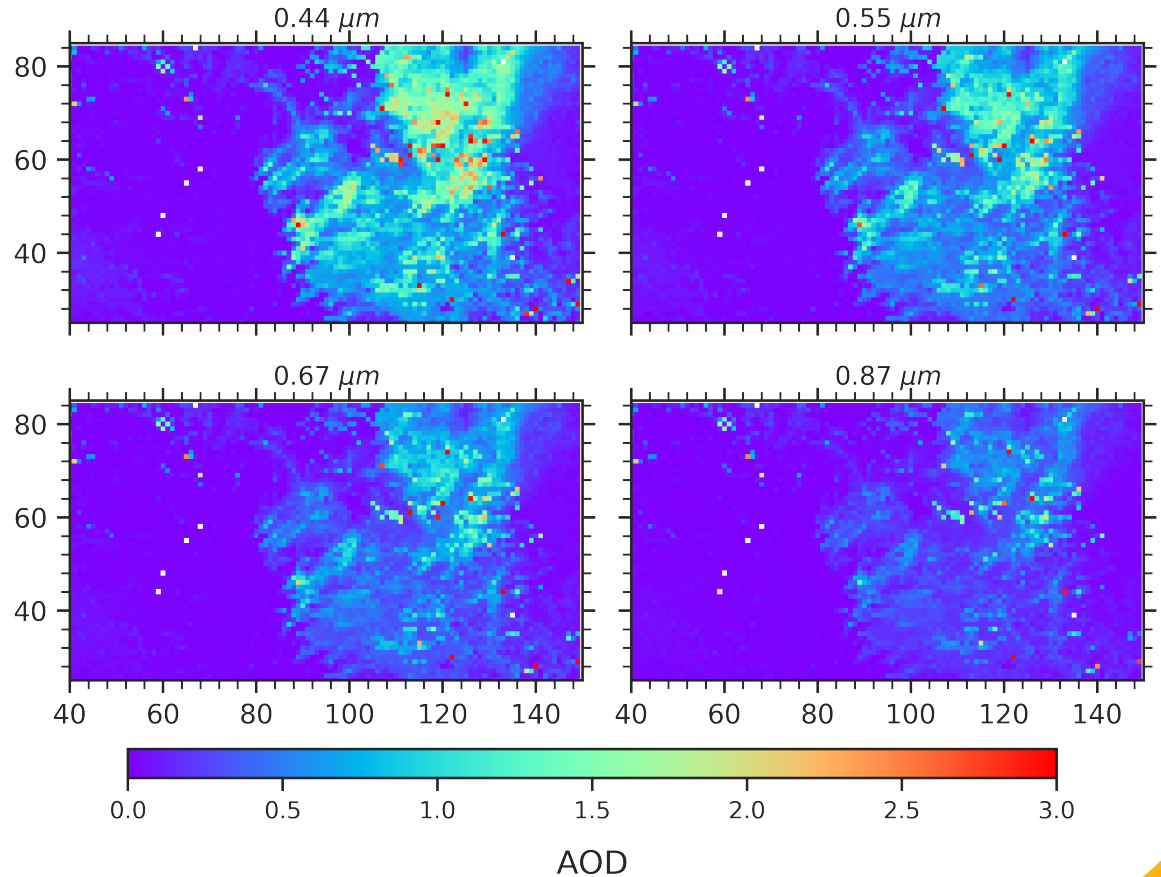
(a) AOD measured at 532nm by AirHARP versus HSRL2 AOD at 532nm for the forest fire scene on 09-11-17\_07,31,00PM ; (b) Correlation plot for the HSRL2 AOD at 532nm vs AirHARP AOD at 532nm for the flight on 9<sup>th</sup> November 2017 over a smoke plume



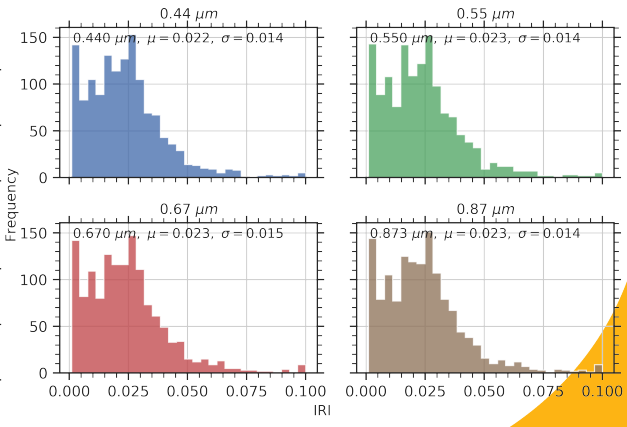
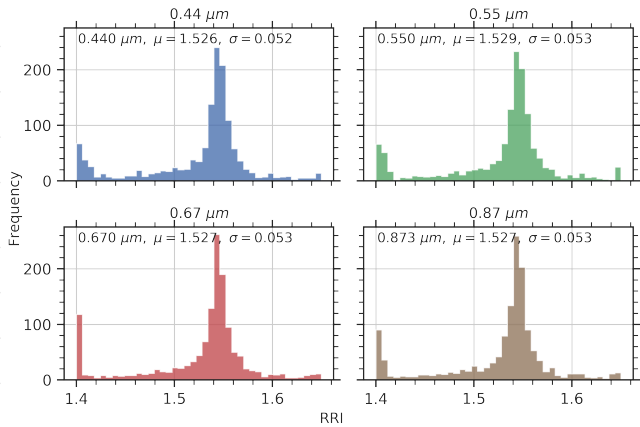
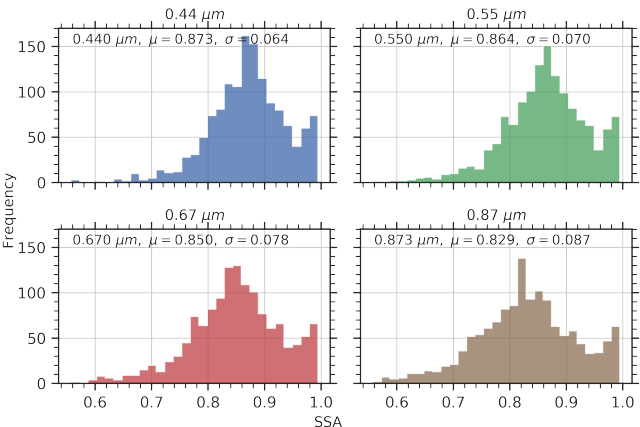
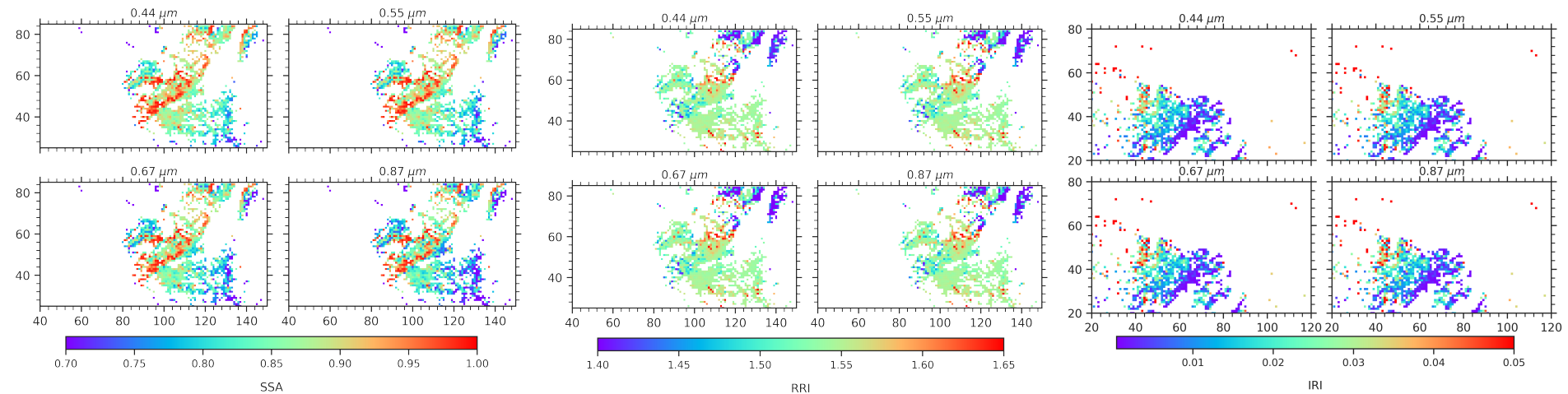
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Radiance image of the scene where retrievals are performed  
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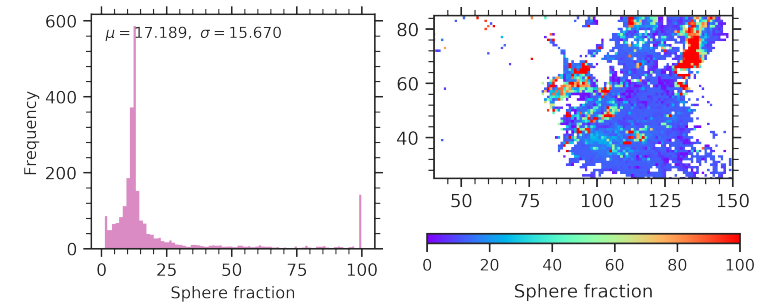
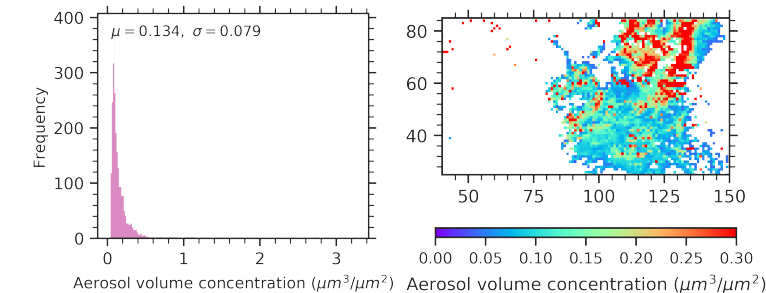
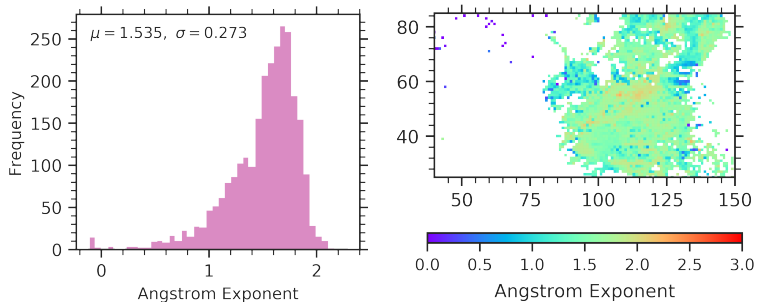




Single Scattering Albedo

Real Refractive Index

Imaginary Refractive Index



Aerosol optical and microphysical properties retrieved for the smoke scene

Spectral Band	Single Scattering Albedo	Sphere Fraction	Angstrom Exponent <sup>#</sup>	Real Refractive Index (RRI)	Imaginary refractive Index (RRI)
440nm	0.873			1.53	0.022
550nm	0.864	17.189	1.535	1.53	0.023
670nm	0.850			1.53	0.023
870nm	0.829			1.53	0.023

- AirHARP + GRASP shows promising capabilities in the AOD retrievals
- AirHARP AOD retrievals shows good correlation with the AERONET and HSRL2 observations
- With sufficient aerosol loading you can get information on the optical properties
- Future research includes the comparison of retrieved surface properties with other surface retrievals(X. Xu poster).
- Adaptation of the current retrieval algorithm for HARP/HARP2

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