Aerosol properties from Airborne Hyper Angular Rainbow Polarimeter (AirHARP) observations during ACEPOL 2017

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UMBC ESI EARTH AND SPACE INSTITUTE

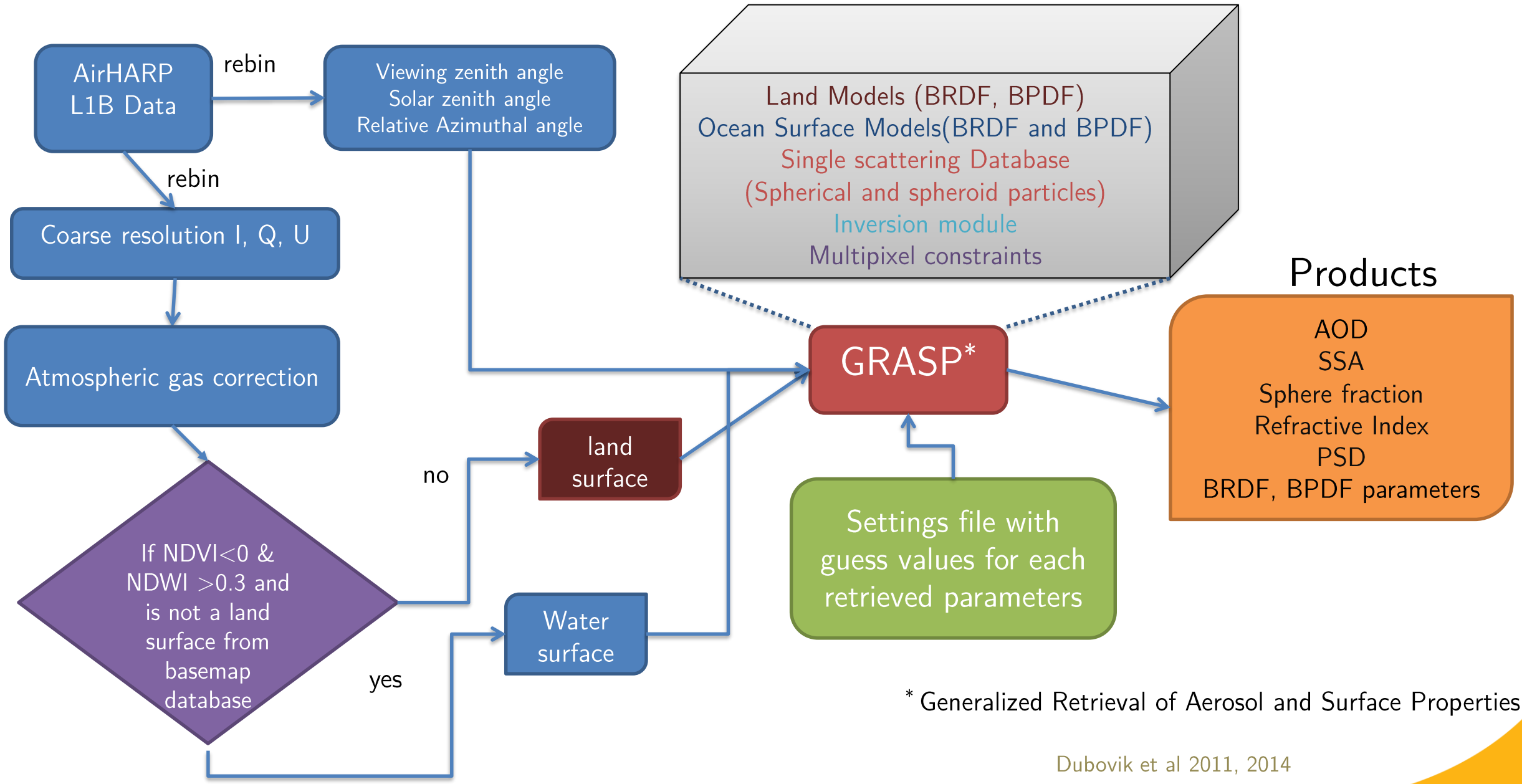
UMBC NASA-GSFC JCET The Joint Center for Earth Systems Technology

LACO Laboratory for Aerosol and Cloud Optics

GRASP In principle, yes!

NASA

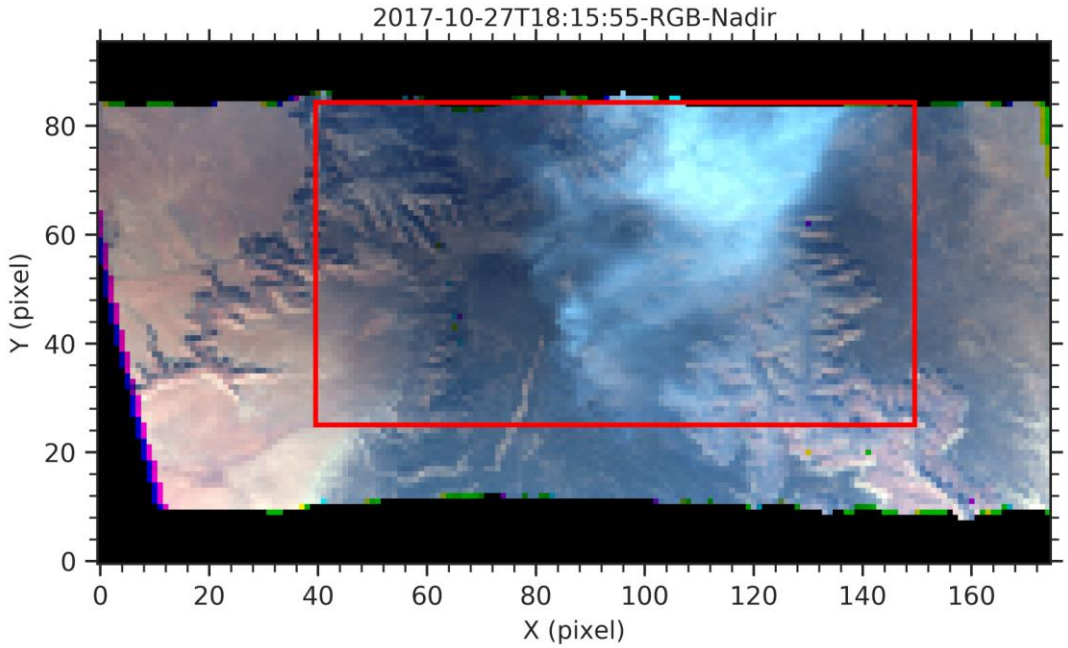
Automated retrieval scheme



* Generalized Retrieval of Aerosol and Surface Properties

Dubovik et al 2011, 2014

Smoke case – 27 Oct 2017T18:16



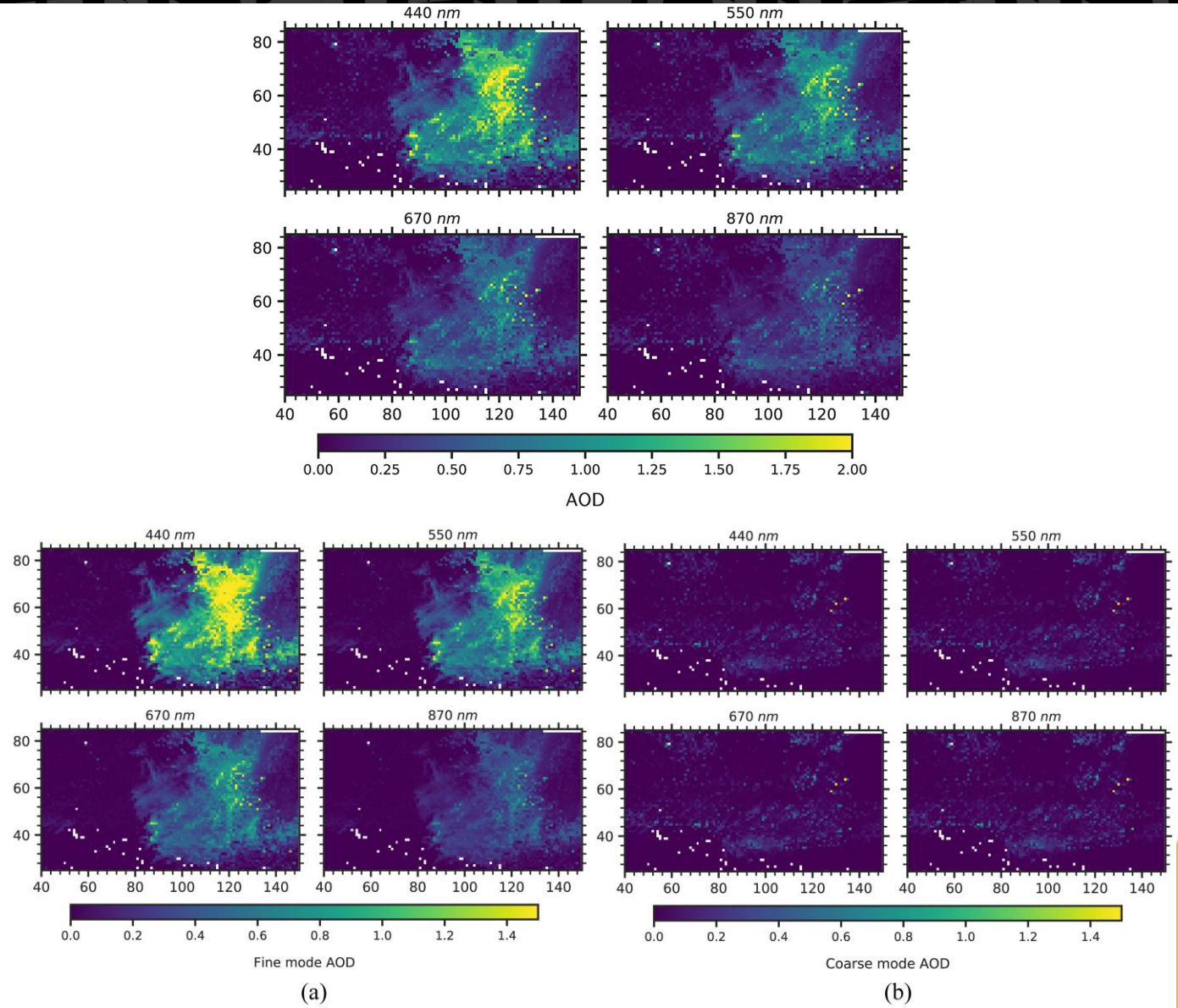
RGB image of the forest fire smoke scene near Grand canyon, AZ on 27th Oct 2017

Aerosol optical and microphysical properties retrieved for the smoke scene

Spectral band	Single scattering albedo	Spherical fraction (%)	Angstrom exponent[a]	Real refractive index (RRI)	Imaginary refractive index (RRI)
440 nm	0.87 ± 0.06	$49.9 \pm 36\,\%$[b]	1.53 ± 0.336	1.55 ± 0.04	0.024 ± 0.017
550 nm	0.86 ± 0.07				
670 nm	0.84 ± 0.08				
870 nm	0.81 ± 0.09				

[a] Angstrom exponent calculated using the AOD at wavelength bands 440 and 870 nm of the AirHARP.
[b] Retrieved spherical fraction includes a significant number of pixels with SF ~ 99 %.

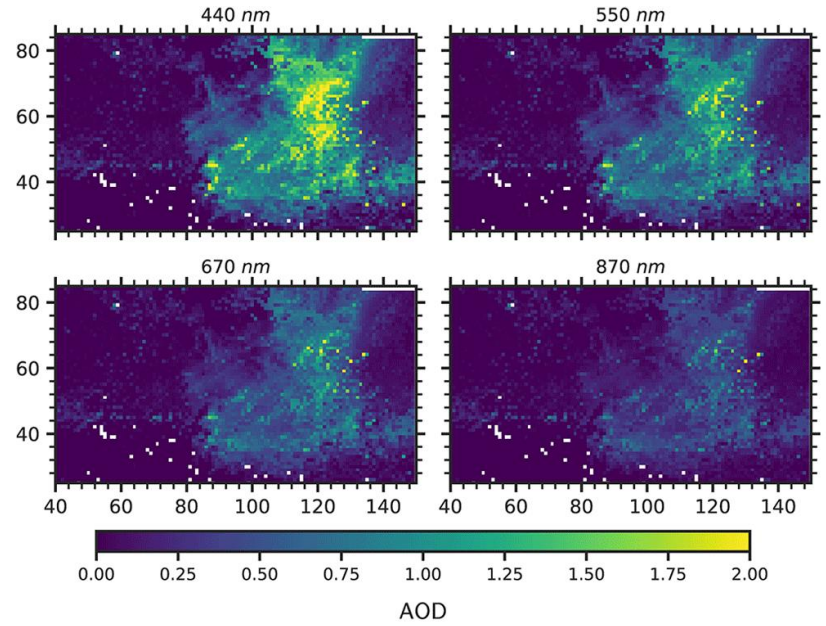
Puthukkudy et al., 2020 AMT

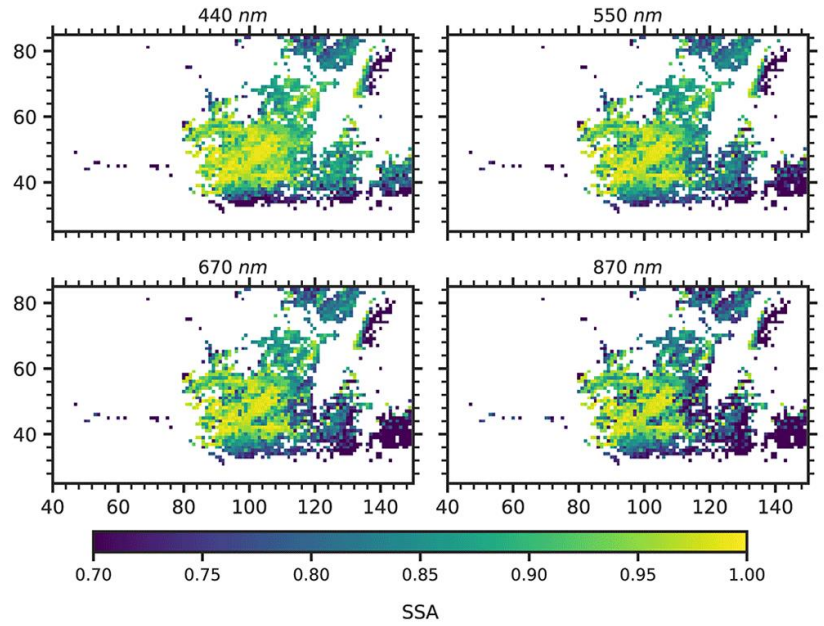


(a)Fine and (b)Coarse mode AOD retrieved using I and DoLP measurements of AirHARP at different wavelengths

Smoke case – 27 Oct 2017T18:16

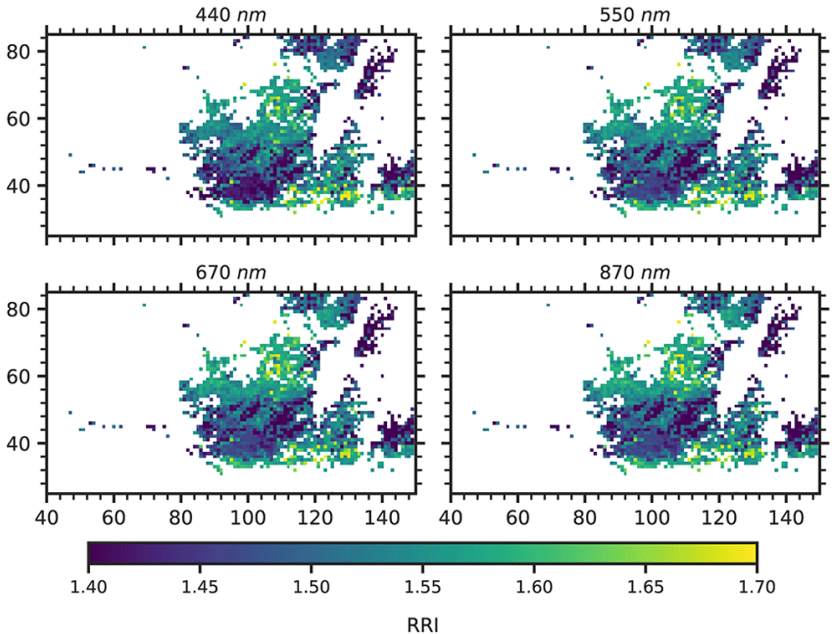
Aerosol Optical Depth

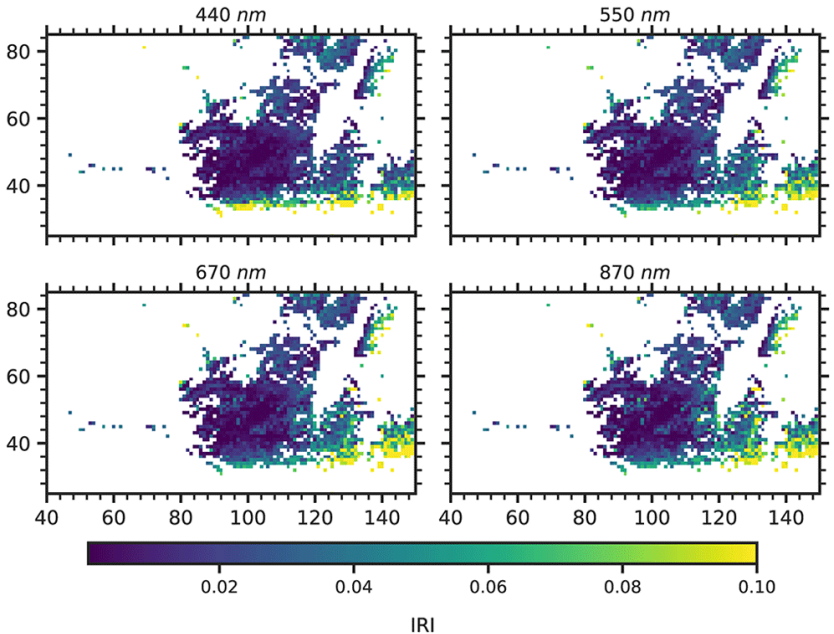




Single Scattering Albedo

Real Refractive Index



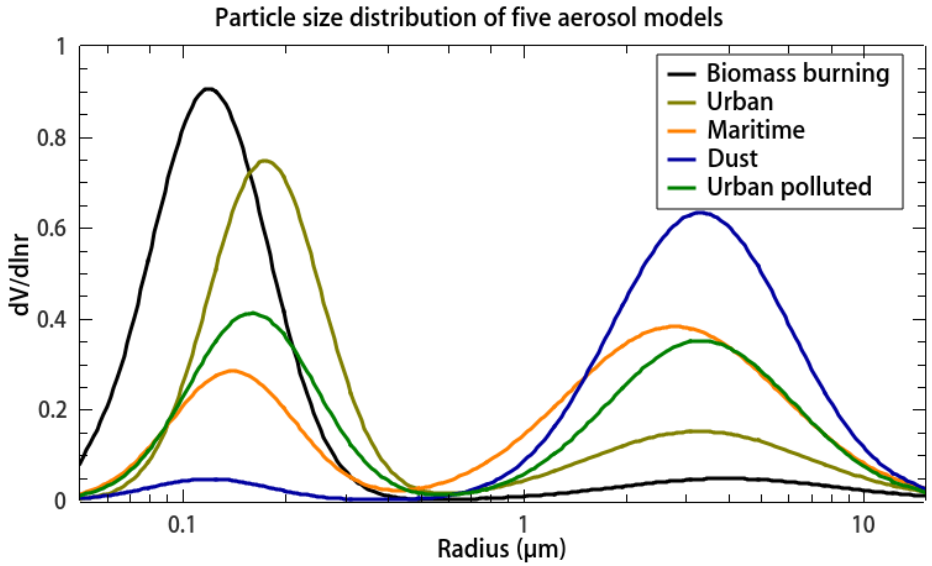


Imaginary Refractive Index

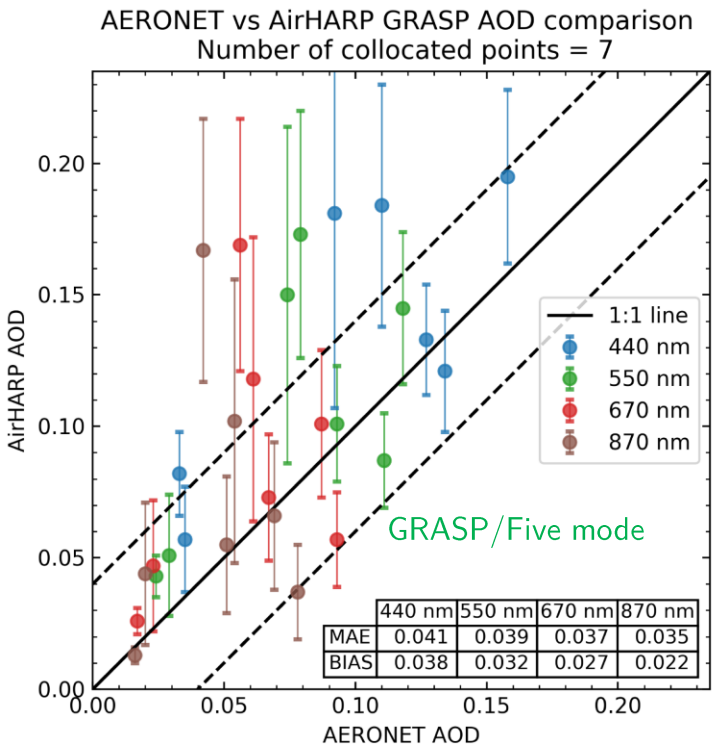
AERONET AOD Comparison

GRASP/Five mode kernel:Five log-normal modes used for particle size distribution in GRASP retrieval for AirHARP; r_v is the volume median radius and $\log(\sigma_v)$ the geometric standard deviation (SD). In this kernel, other particle properties are free to be retrieved

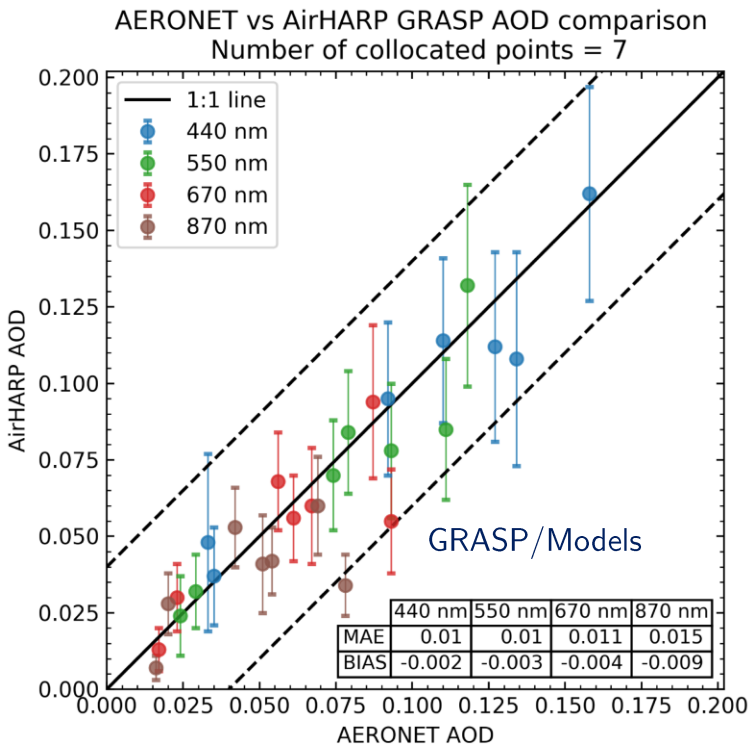
r_v (μm)	$\log(\sigma_v)$
0.1	0.35
0.1732	0.35
0.3	0.35
1.0	0.5
2.9	0.5



PSD of the aerosol components used in the GRASP/Models kernel



(a)

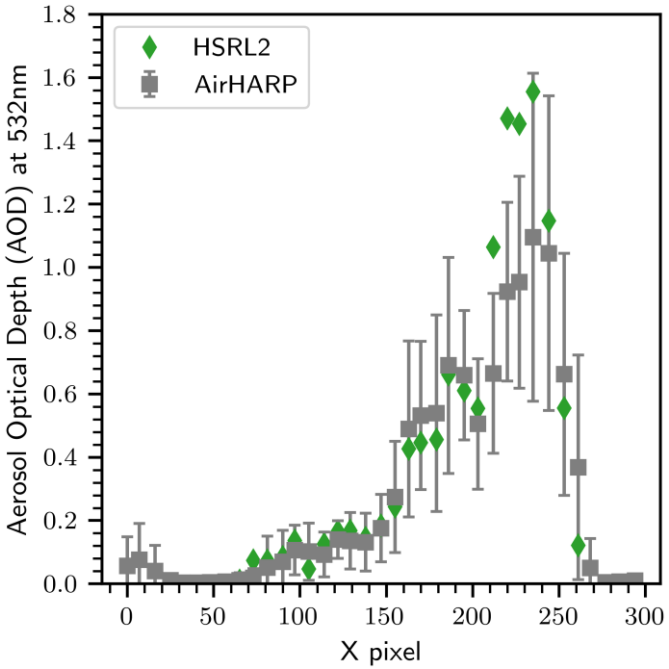


(b)

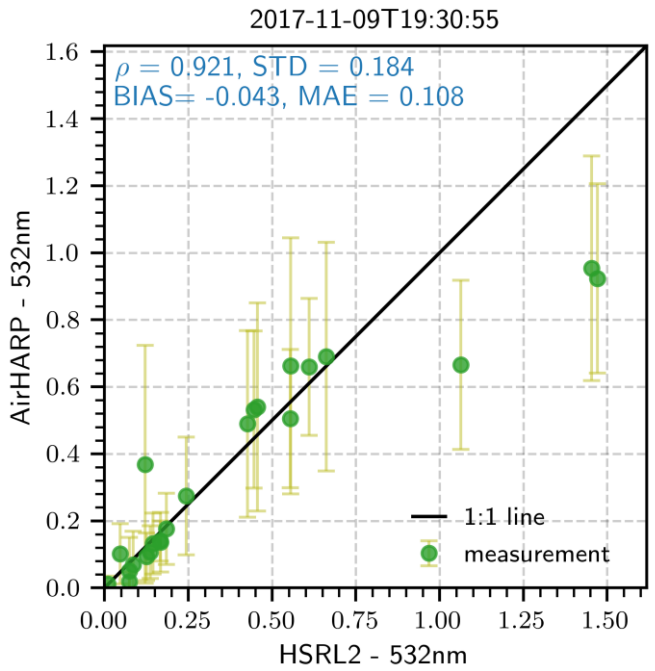
Scatter plot of AERONET AOD vs AirHARP GRASP AOD retrieved. Pixels with a resolution of 550m x550m are used for the retrievals. Each circle in the figure is the mean of 10x10 pixels(5.5km x 5.5km) around the respective AERONET station. (a) using GRASP/Five mode kernel and (b) using GRASP/Models kernel

HSRL2 comparison

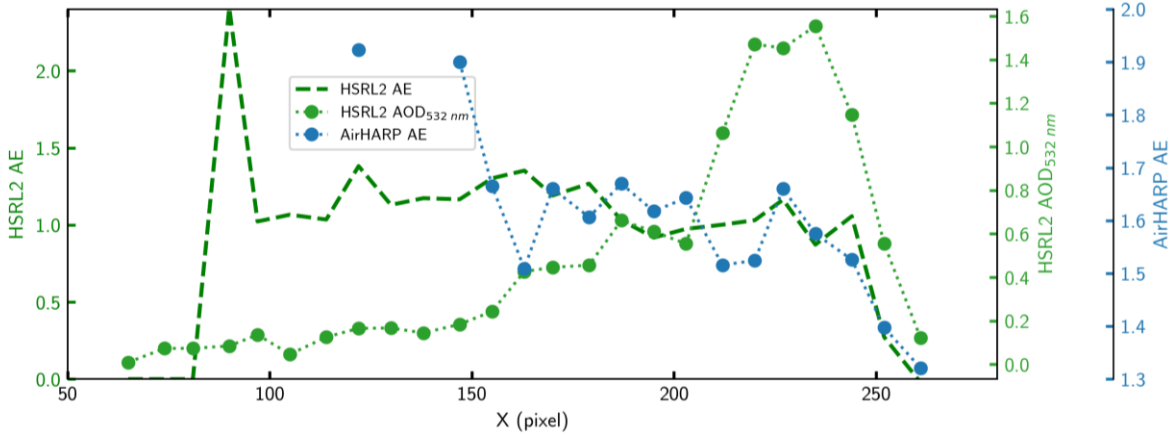
(a)



(b)

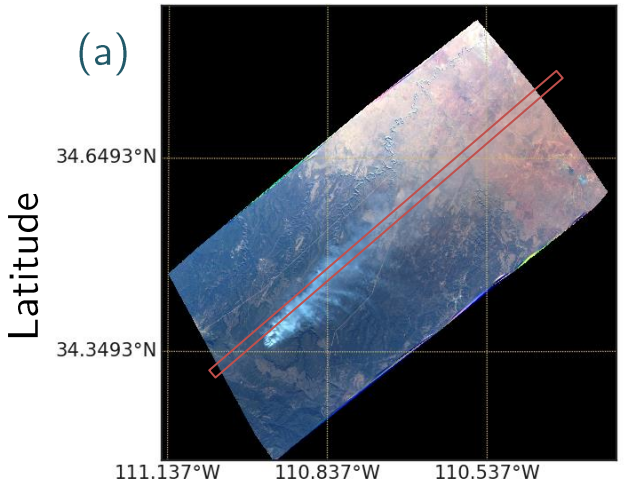


(a) AOD measured at 532nm by AirHARP versus HSRL2 AOD at 532nm for the forest fire scene on 09-11-17_07,31,00PM ; (b) Correlation plot for the HSRL2 AOD at 532nm vs AirHARP AOD at 532nm for the flight on 9th November 2017 over a smoke plume. (c) Comparison of Angstrom Exponent from HSRL2 measurement and AirHARP-GRASP retrievals

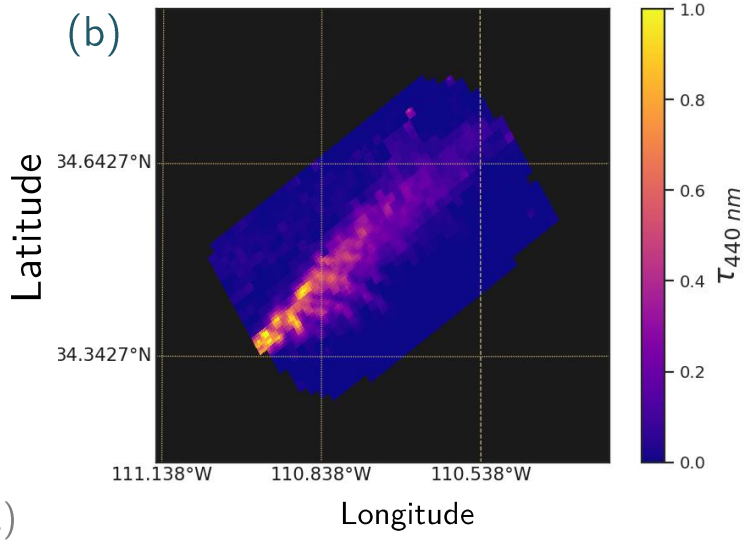


Comparison of HSRL2 Angstrom exponent (AE) (355 and 532 nm) with AirHARP retrieved AE (440 and 870 nm)

(a)



(b)



(a) Projected RGB image and (b) $AOD_{440\ nm}$ map from AirHARP GRASP retrievals for the scene on 09-November-2017 T19:30:55 UTC