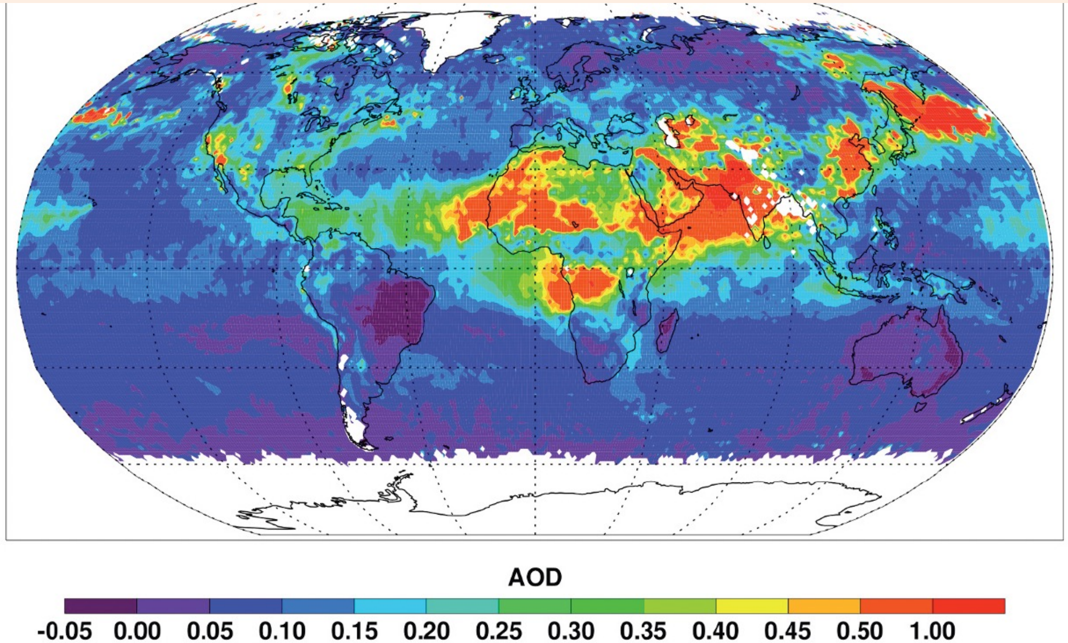
AEROSOLS from OCI

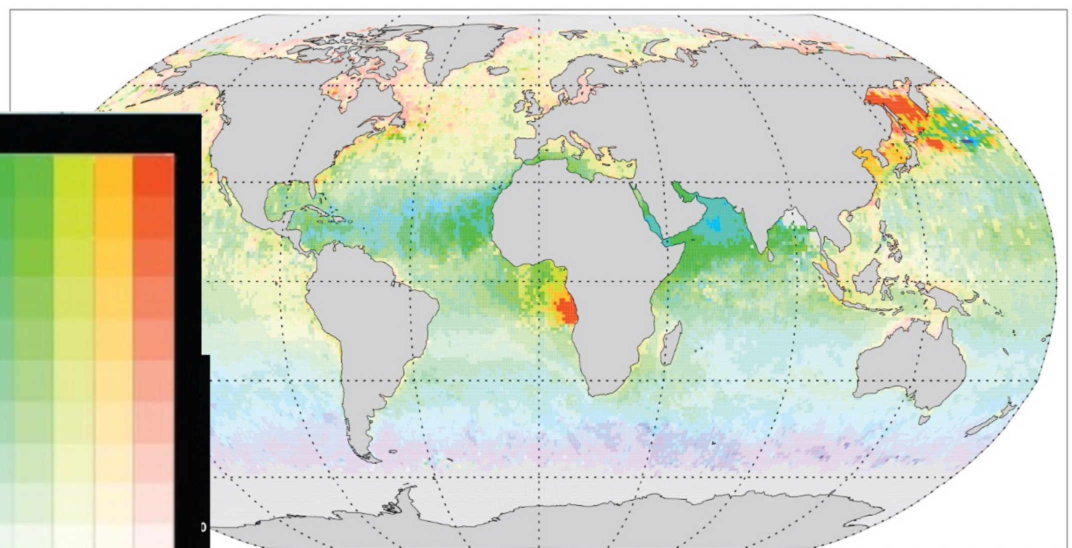
Lorraine Remer

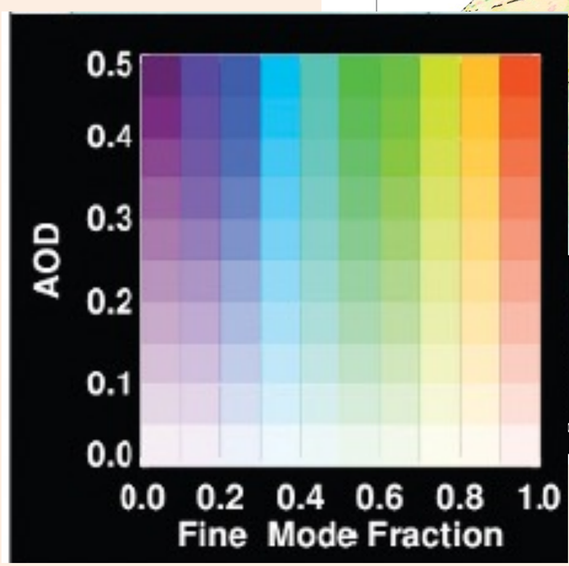
At launch aerosol products

Product	Description and Use
Spectral aerosol optical depth	Spectral measurement of the extinction of the solar beam caused by atmospheric aerosol particles, such as dust and haze, at 380, 440, 500, 550, 675, 870, 1240, 1610, 2250 nm (depending on whether land or ocean
Aerosol fine mode fraction (over ocean)	Fraction of visible aerosol optical depth from fine mode aerosols over oceans at 550 nm.

Dark Target
+
Deep Blue

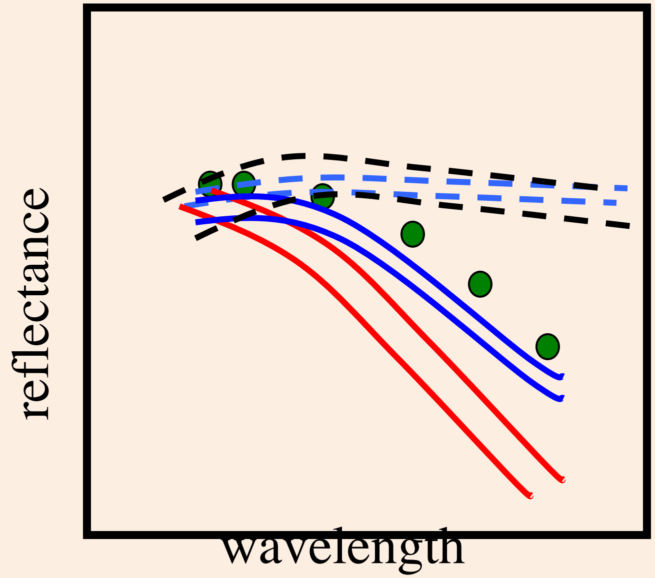


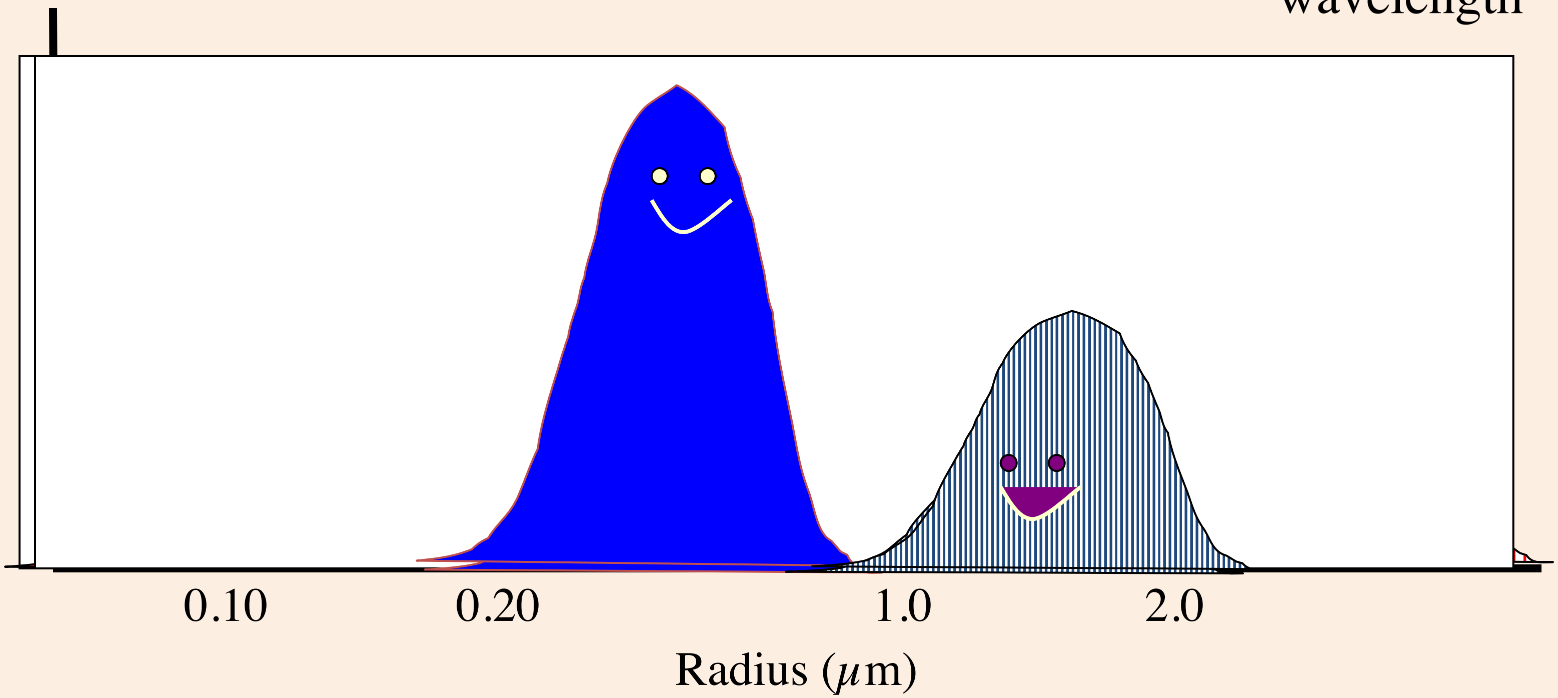




MODIS aerosol retrieval over ocean

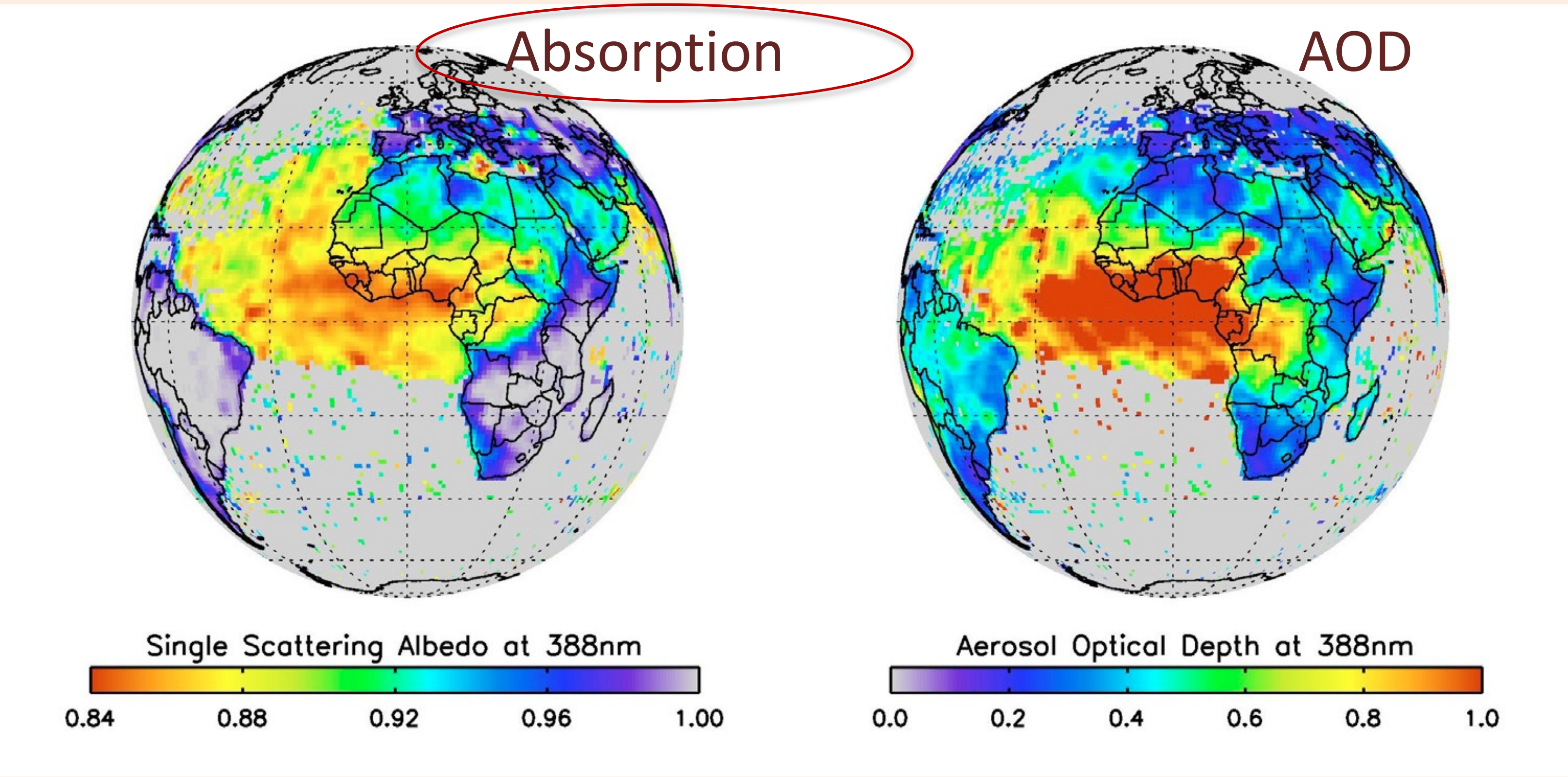
Find one coarse mode and
one fine mode
that combine to match the
observed spectral reflectances





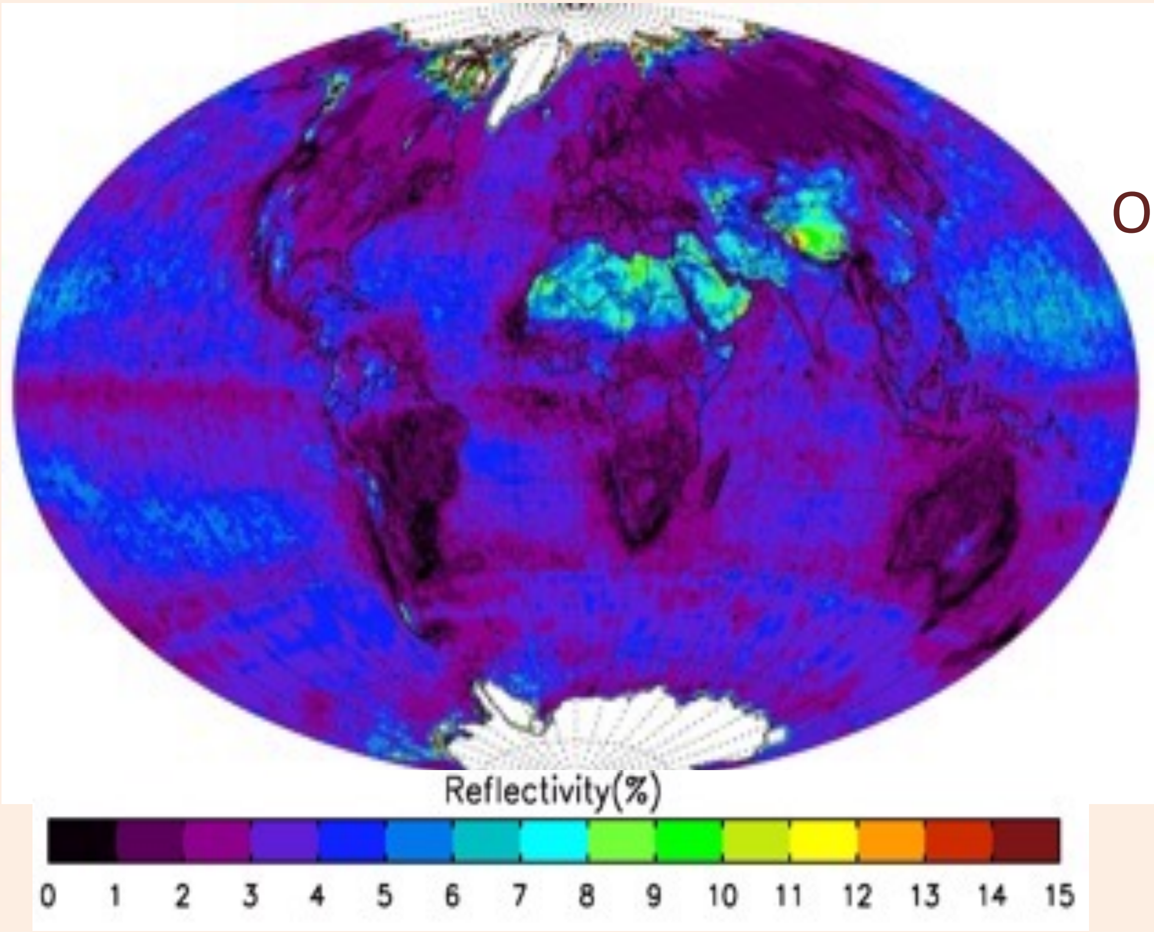
But OCI has the UV bands that MODIS and VIIRS do not.

- OCI can mimic the OMI (nearUV) algorithm, as well as Dark Target and Deep Blue
- Even better, we can combine the two traditions to make a more powerful algorithm.



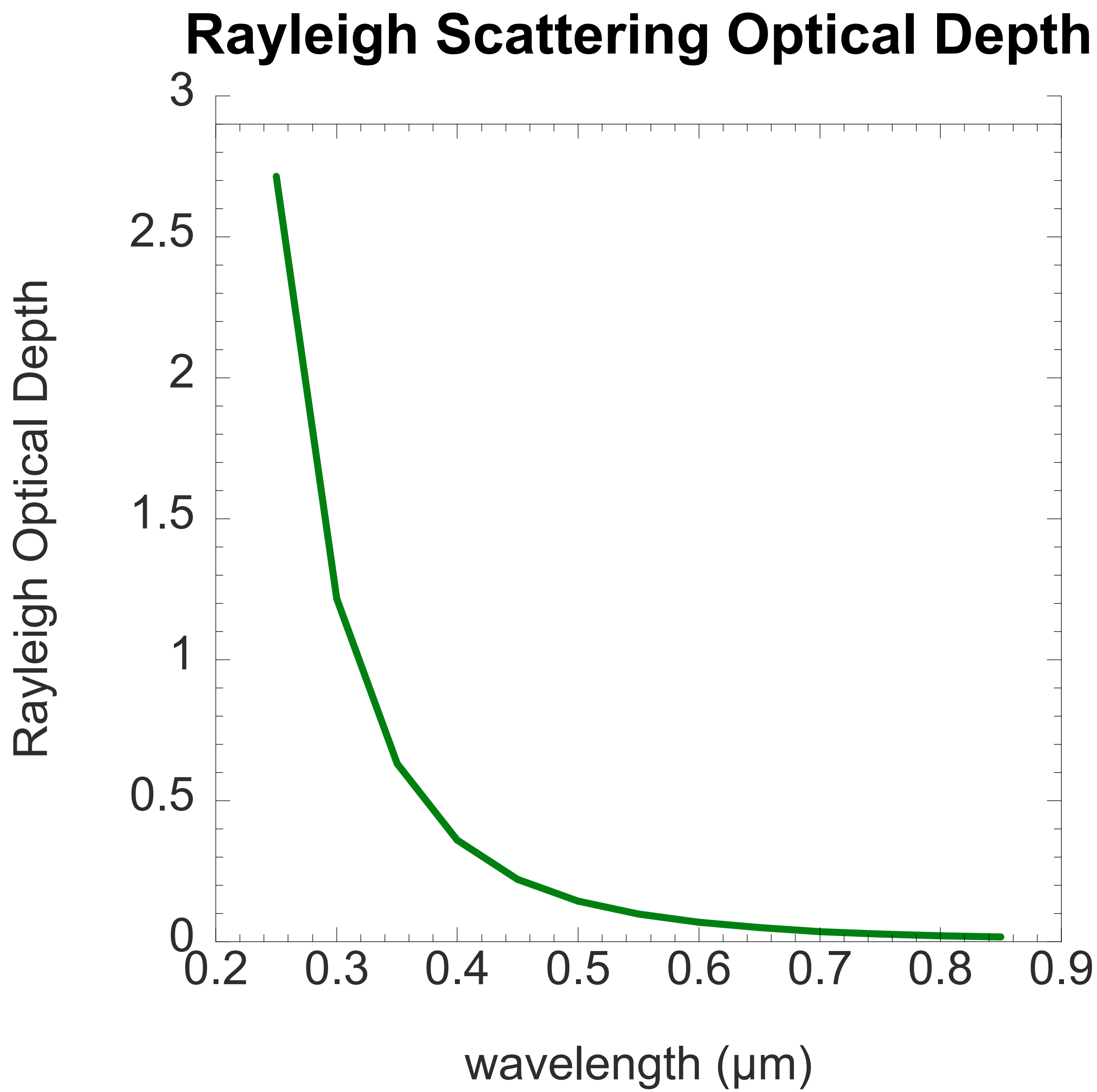
Beyond purple... where things get really weird

OMI Surface Minimum Reflectivity
June 354 nm



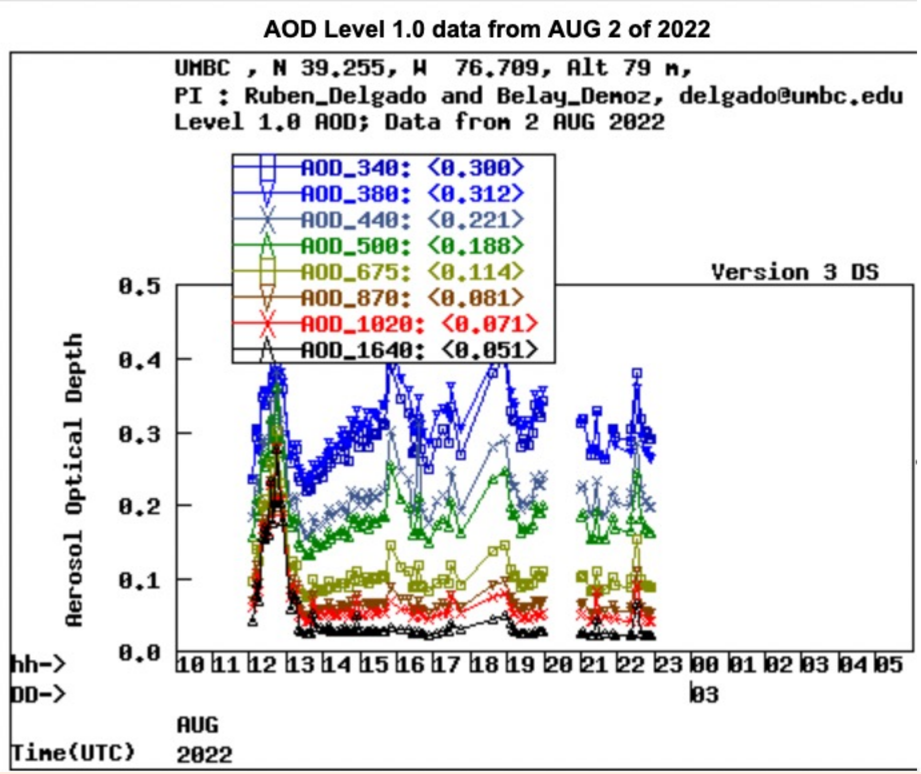
Land can be dark
Oceans can be bright

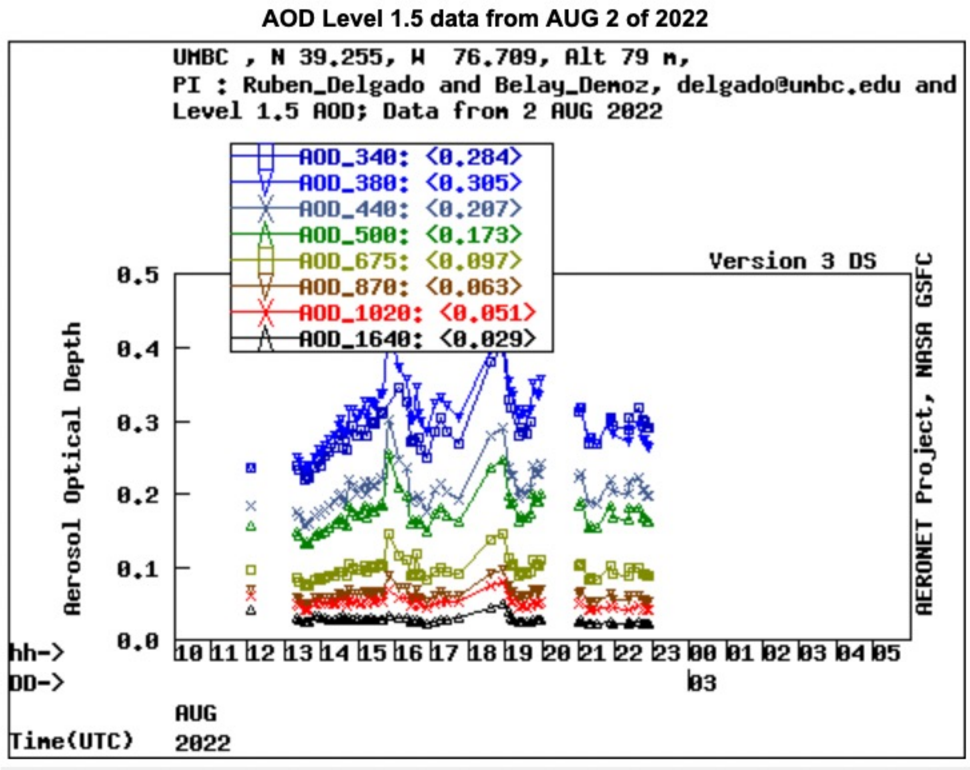
Omar Torres



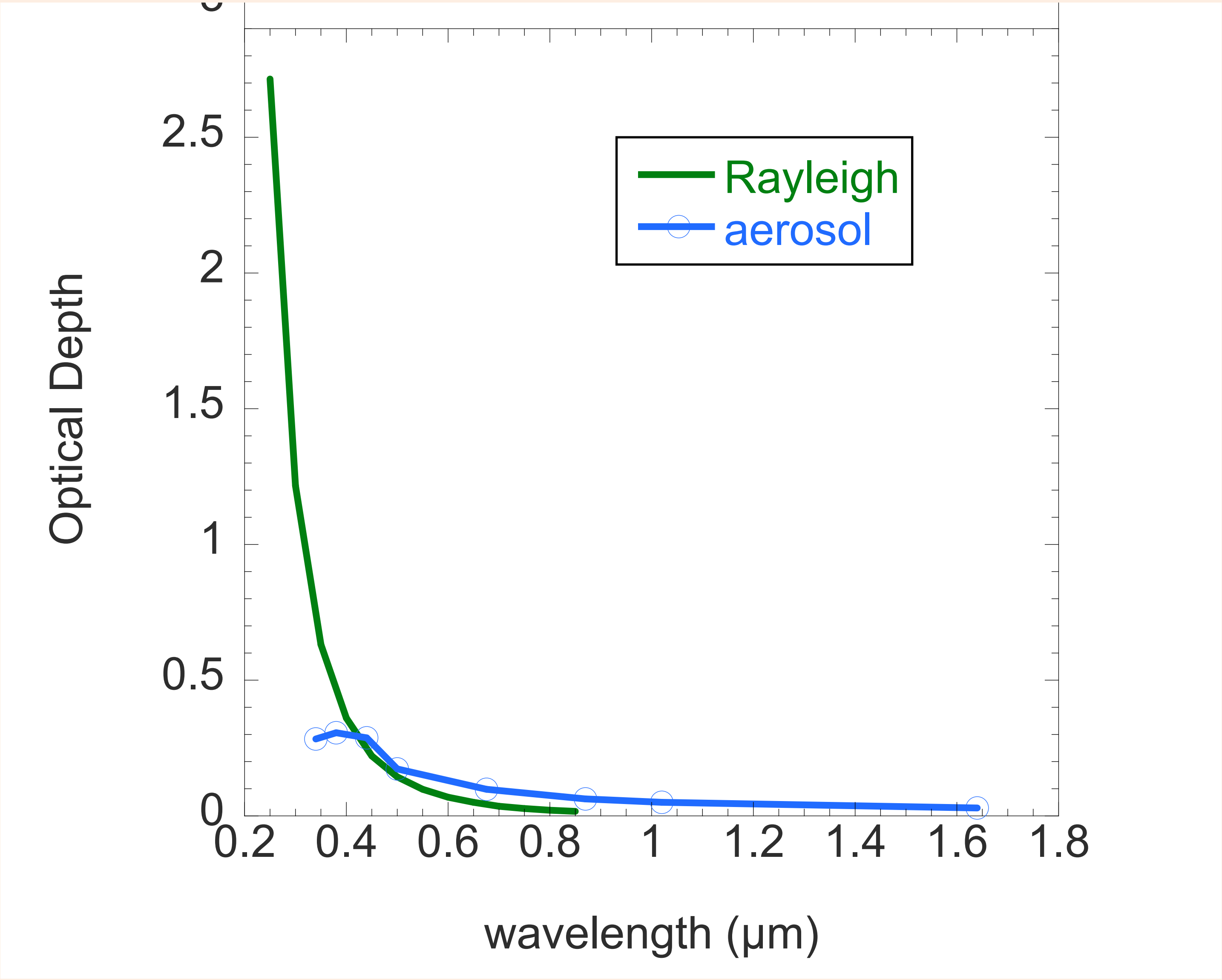
Rayleigh Scattering Optical Depth
Rayleigh Optical Depth
wavelength (μm)
0
0.5
1
1.5
2
2.5
3
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

Level 1 | Level 1.5



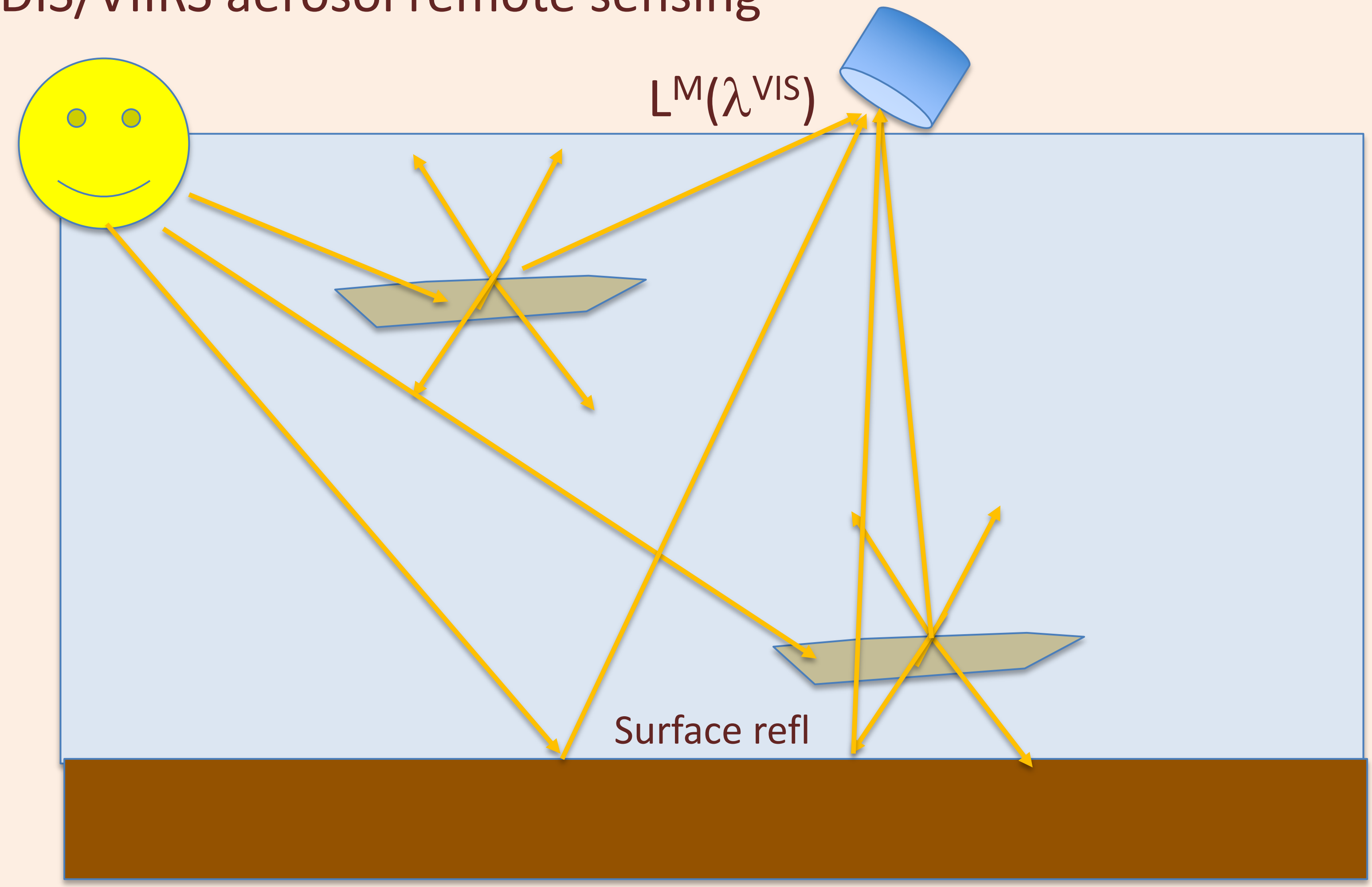


AERONET from UMBC yesterday



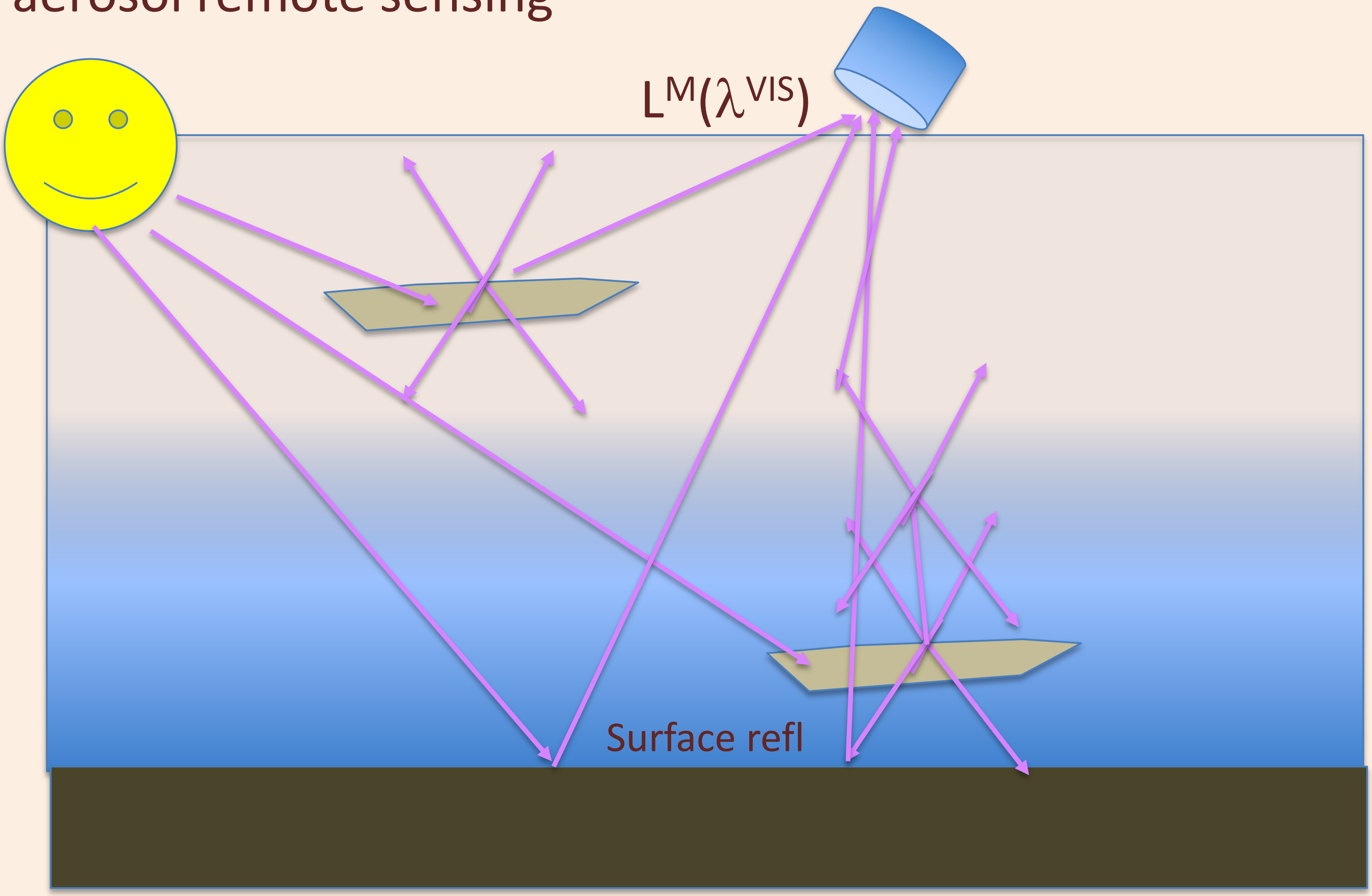
Rayleigh
aerosol
Optical Depth
wavelength (µm)
0
0.5
1
1.5
2
2.5
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

MODIS/VIIRS aerosol remote sensing



$$L^M(\lambda^{VIS}) = f(\text{geometry, AOD, aerosol scattering optical properties, surface refl, RayOD})$$

OMI aerosol remote sensing



$L^M(\lambda^{UV})$ = f(geometry, RayOD, AOD,
aerosol scattering optical properties,
aerosol absorbing properties, layer height
surface refl)

Visible

$L^M(\lambda^{VIS})$ = f(geometry,
AOD,
aerosol scattering optical properties,
surface refl,
RayOD)

UV

$L^M(\lambda^{UV})$ = f(geometry,
RayOD,
AOD,
aerosol absorbing properties,
aerosol scattering optical properties,
layer height
surface refl)

Retrieving aerosol

In both visible and UV retrievals,
we have to assume something about surface reflectance
and aerosol scattering properties

Then in the visible, the retrieval is more or less constrained

But in the UV three free parameters still exist (AOD, absorption, height),
but there are only two pieces of information

The goal for an advanced OCI aerosol algorithm is to use the broad spectral range.

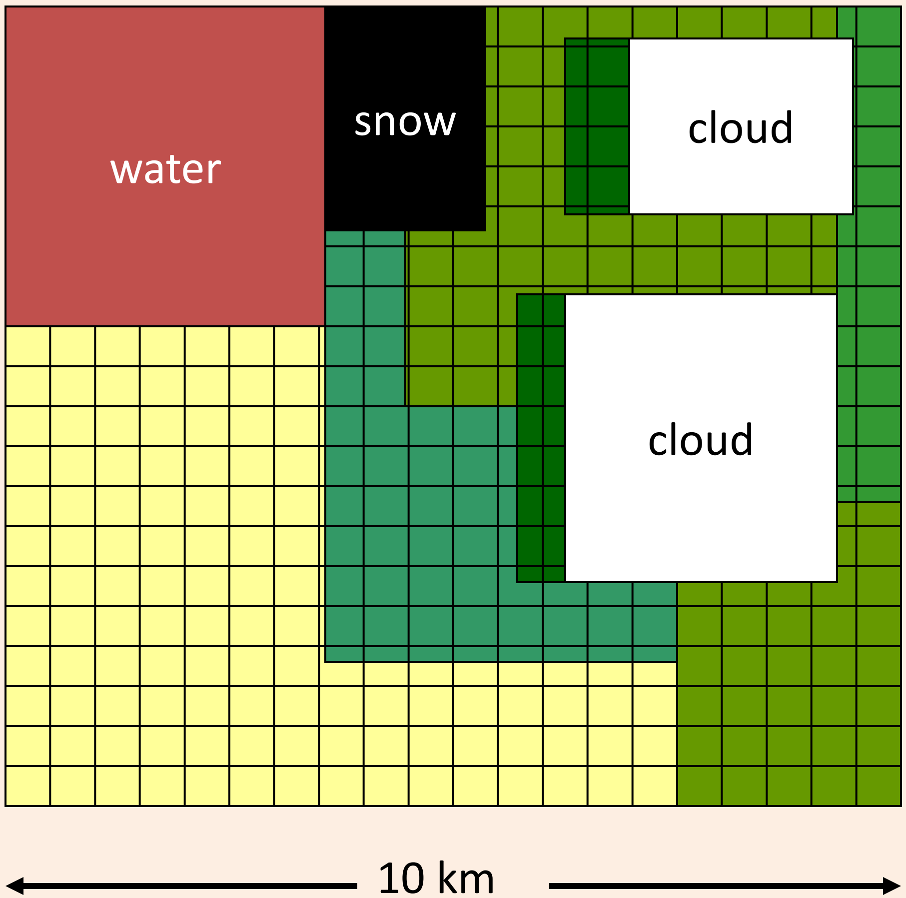
This adds information to the retrieval.

The visible retrieval can constrain AOD,
allowing the UV retrieval to return absorption and layer height.

Unified Algorithm Goals (at 7 km)

Product	Description and Use
Spectral aerosol optical depth	Spectral measurement of the extinction of the solar beam caused by atmospheric aerosol particles, such as dust and haze, at 354, 388, 412, 470, 500, 550, 675, 870, 1240, 1610, 2250 nm (depending on whether land or ocean)
Aerosol fine mode fraction (over ocean)	Fraction of visible aerosol optical depth from fine mode aerosols over oceans at 550 nm.
Single Scattering Albedo	A measure of absorption at 354, 388, 440, 550, 675 nm
Aerosol layer height	In km
AOD above cloud	At 354, 388 and 550 nm

MODIS Over Land Algorithm
20 x 20 pixels at 500 m resolution
(10 km at nadir)



400 total
- 56 water

344
- 24 snow

320
- 55 cloud

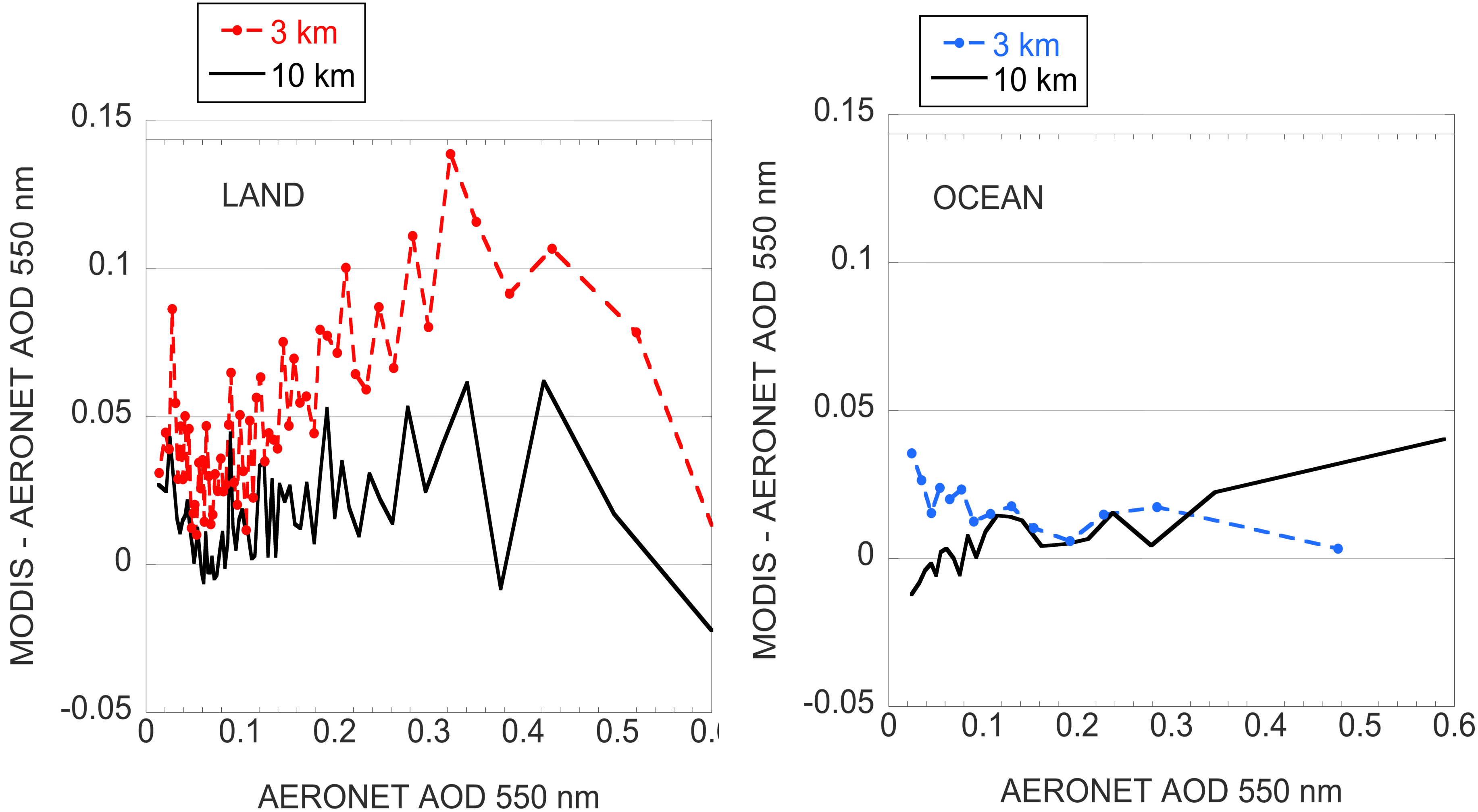
265
-116 "bright"

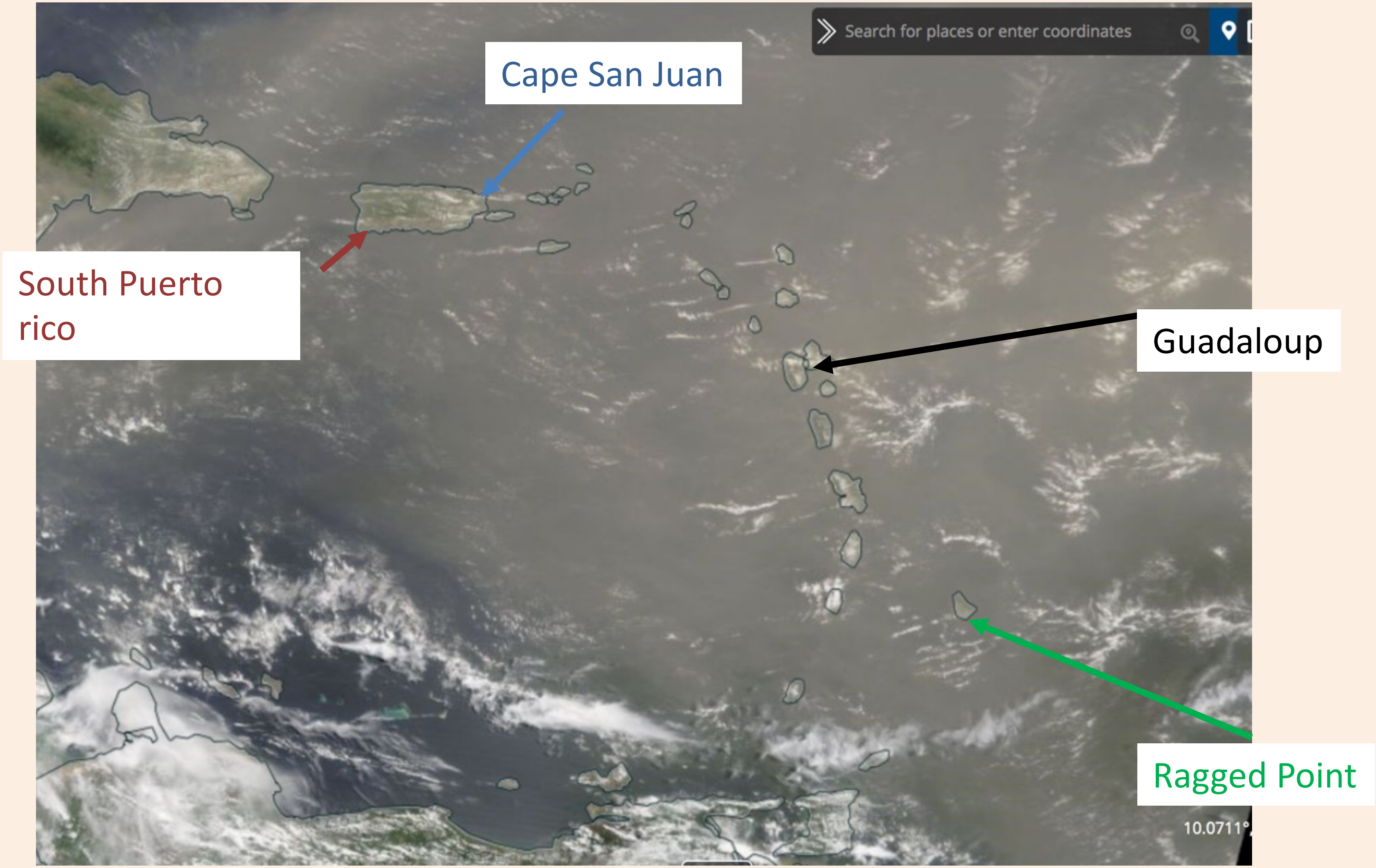
149 "good"

Discard brightest 50% and darkest 20% of the 149 good pixels.

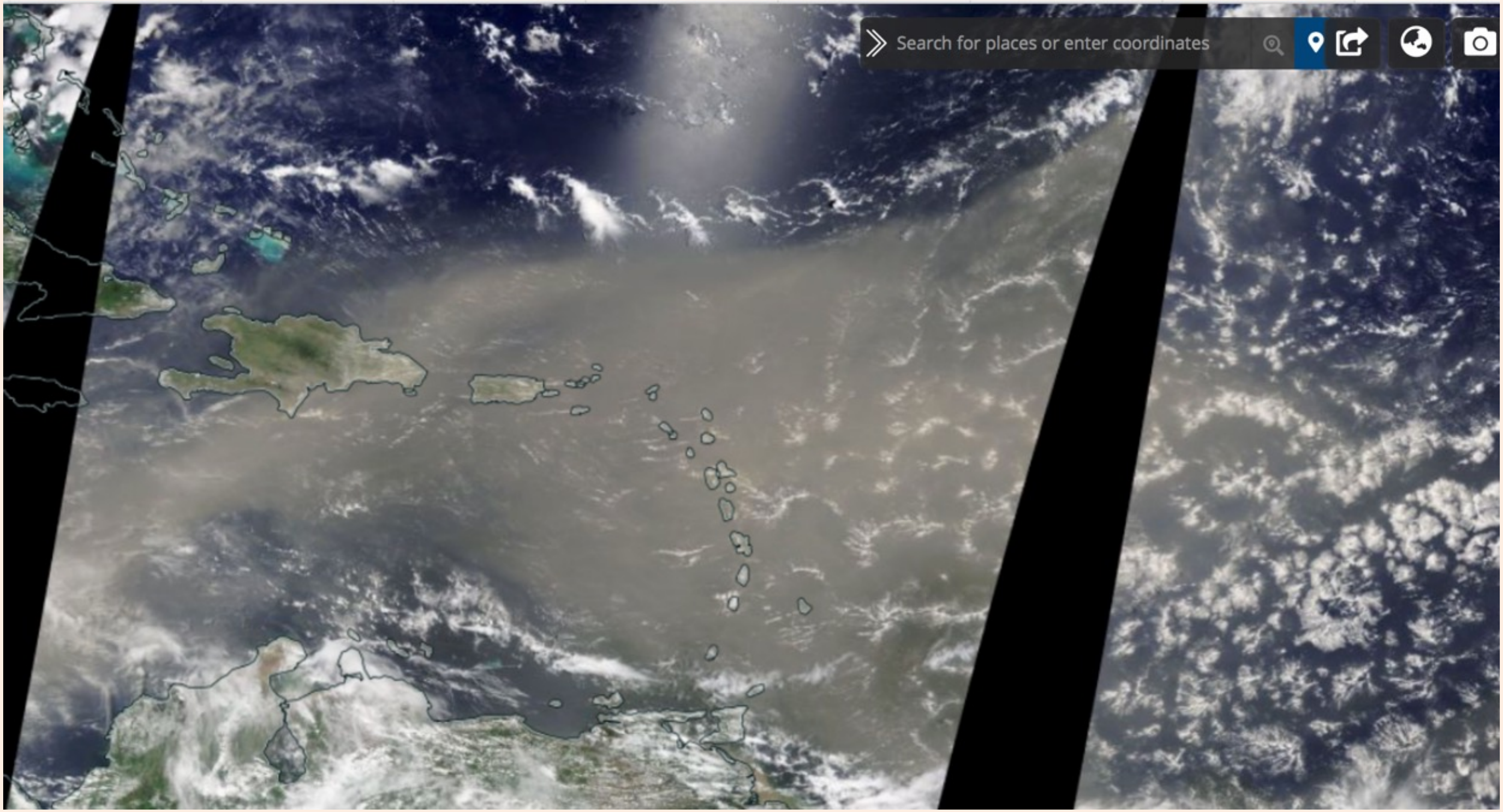
44 pixels

Finer resolution introduces more error

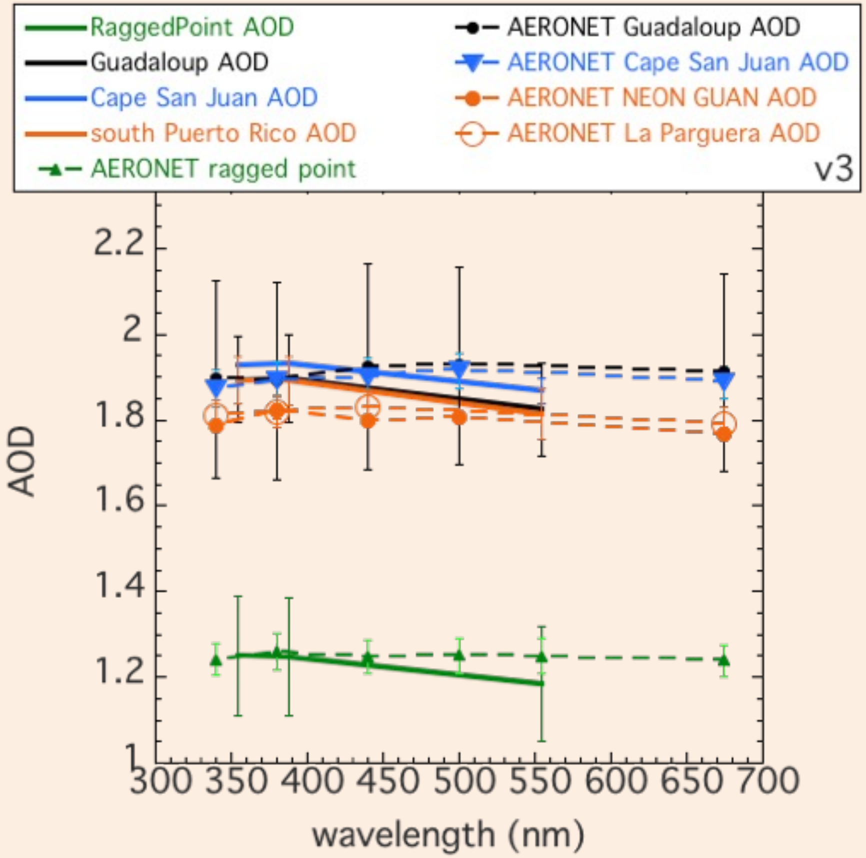


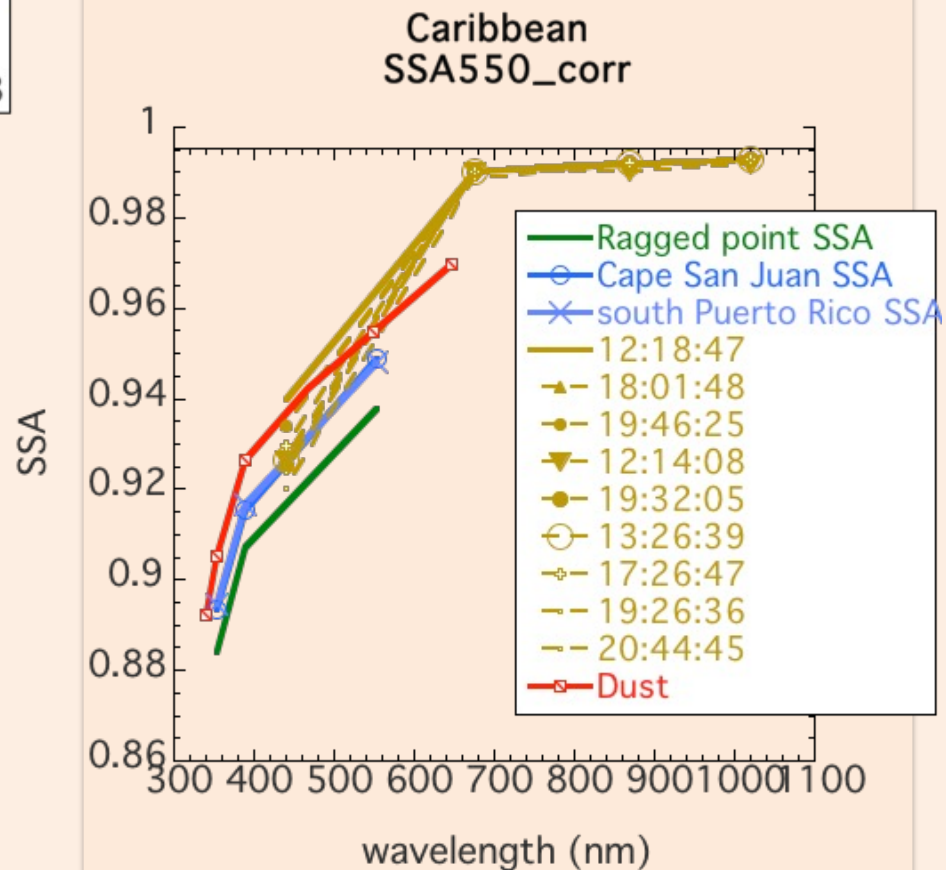


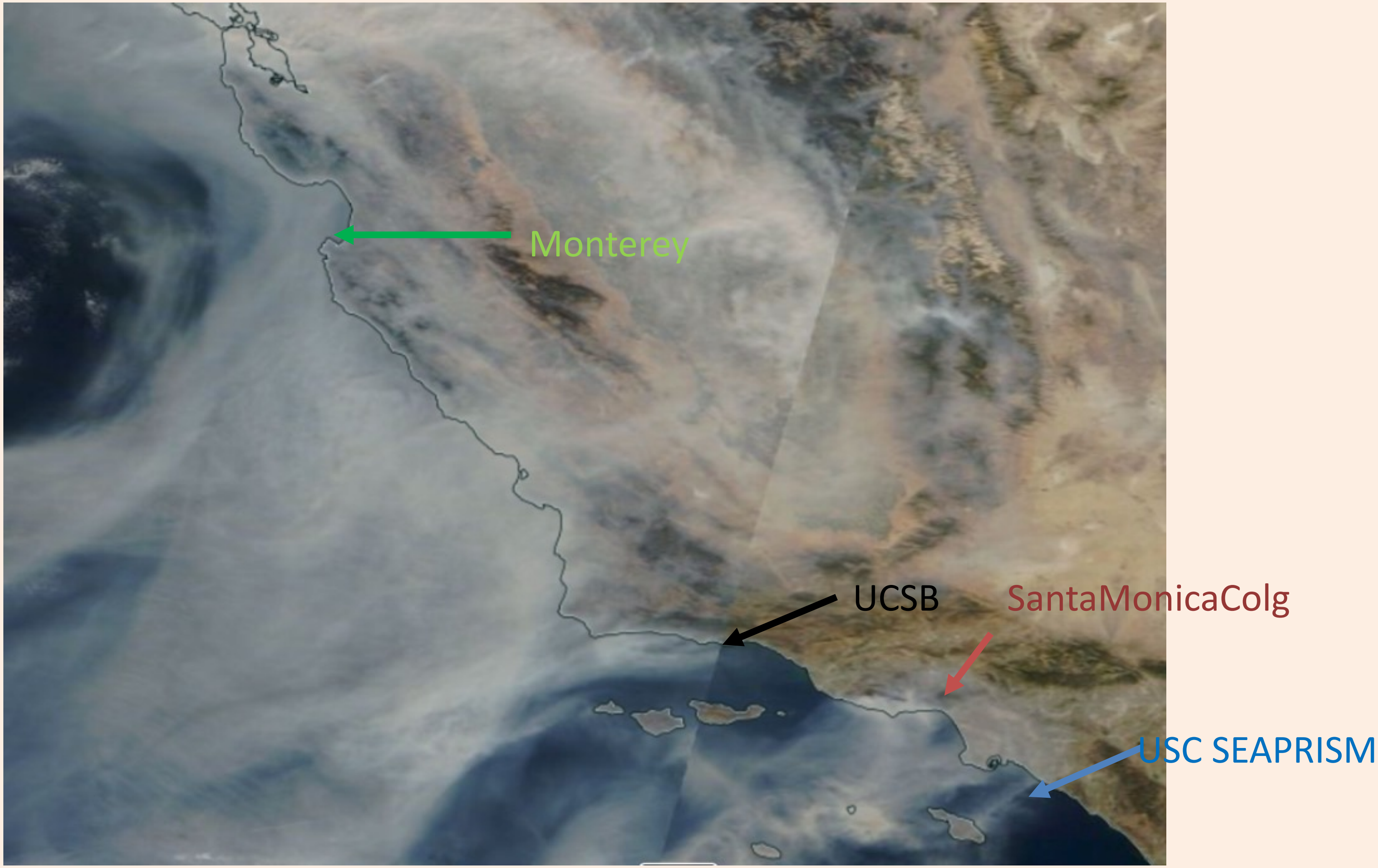
Search for places or enter coordinates
Cape San Juan
South Puerto rico
Guadaloup
Ragged Point
10.0711°

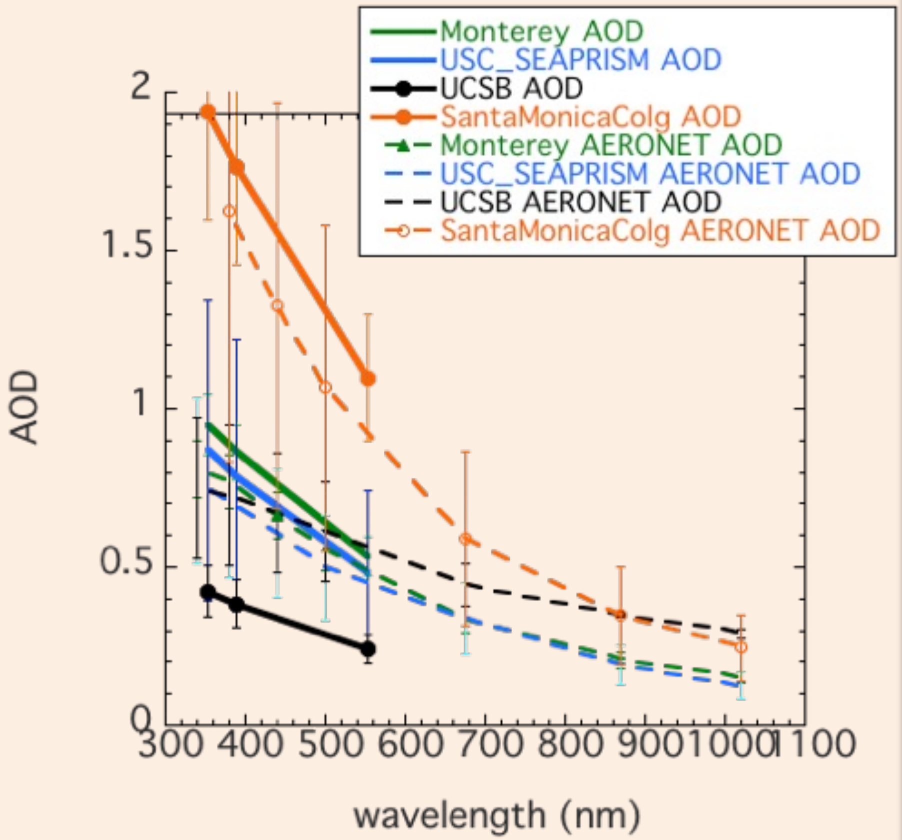

Search for places or enter coordinates

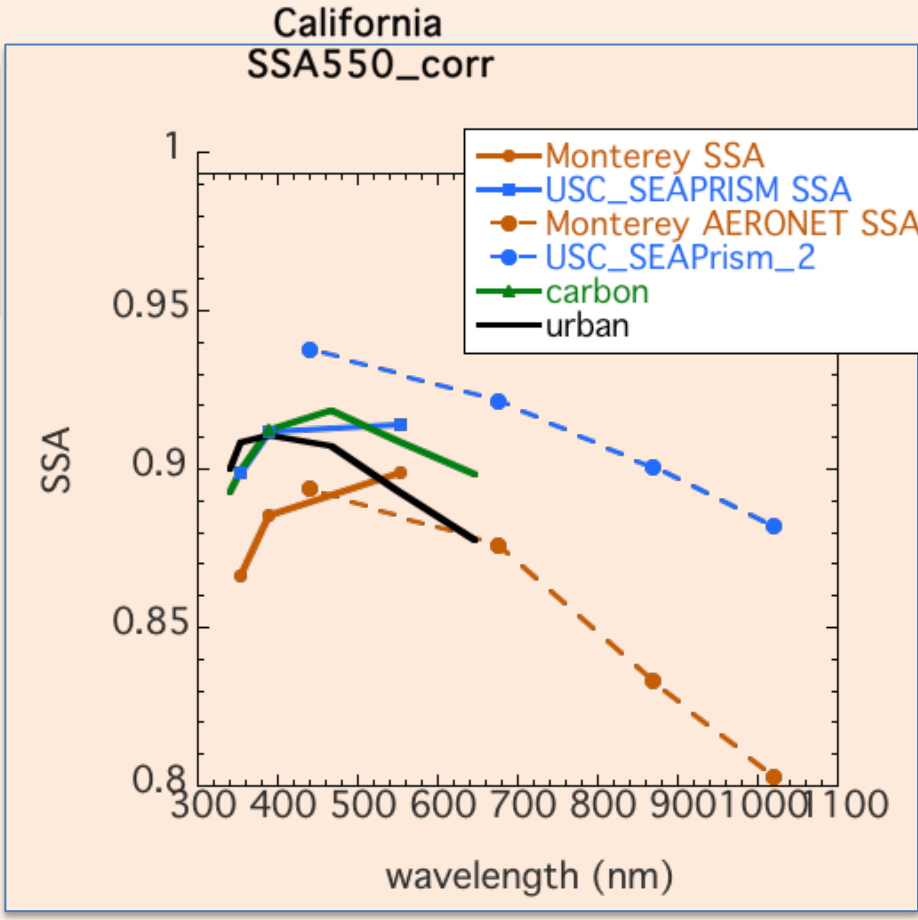
Ragged point: fmf = 0.25±0.02; height = 2.6 ± 0.7 km
Guadaloup: fmf = 0.22±0.02; height = 3.3 ± 0.3 km
CapeSanJuan: fmf = 0.21±0.01; height = 2.4 ± 0.07 km
South P.R. fmf = 0.23±0.01; height = 2.2 ± 0.04 km

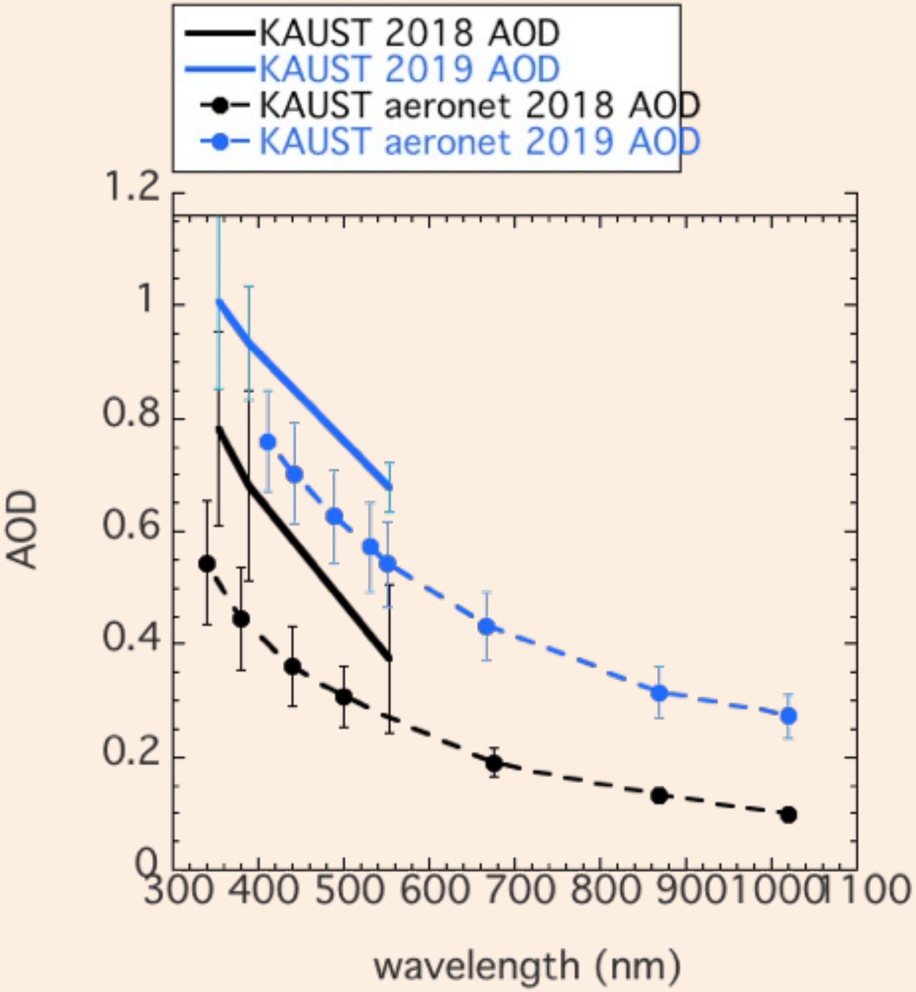





Monterey
UCSB
SantaMonicaColg
USC SEAPRISM

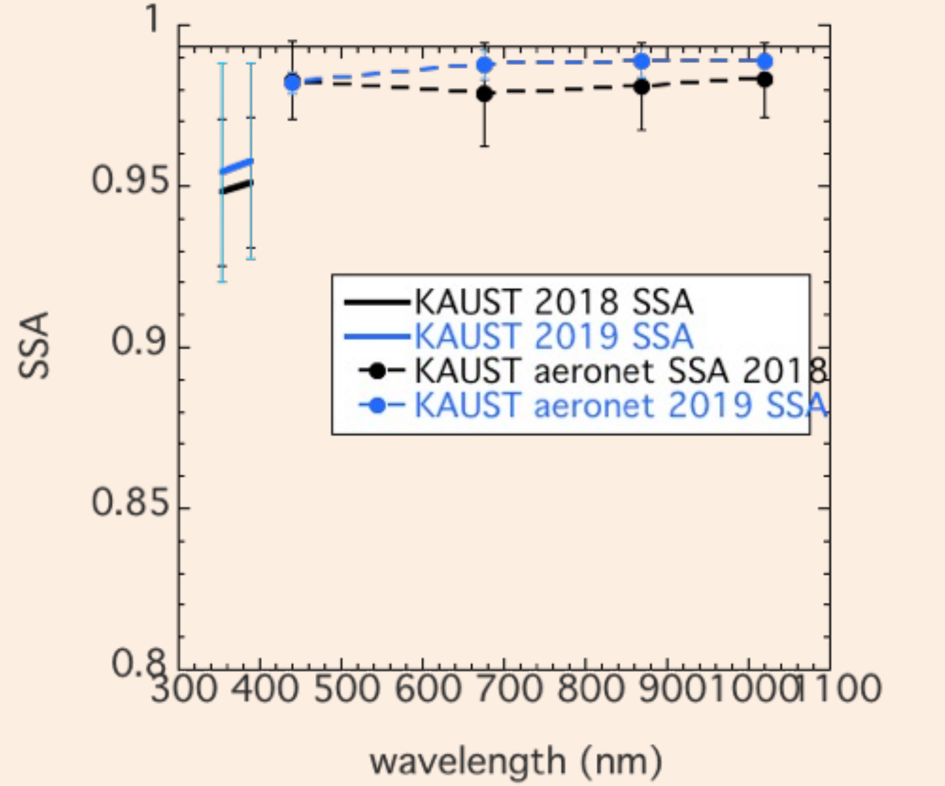

Monterey AOD
USC_SEAPRISM AOD
UCSB AOD
SantaMonicaColg AOD
Monterey AERONET AOD
USC_SEAPRISM AERONET AOD
UCSB AERONET AOD
SantaMonicaColg AERONET AOD
AOD
wavelength (nm)
0
0.5
1
1.5
2
300 400 500 600 700 800 900 1000 1100


California
SSA550_corr
Monterey SSA
USC_SEAPRISM SSA
Monterey AERONET SSA
USC_SEAPrism_2
carbon
urban
SSA
wavelength (nm)
0.8
0.85
0.9
0.95
1
300 400 500 600 700 800 900 1000 1100



KAUST 2018: fmf = 0.8 ± 0.1; height =

KAUST 2019; fmf = 0.62 ± 0.05; height = 2.0 ± 0.8



Summary

- All of these algorithms are multi-spectral algorithms.
- None use OCI's hyperspectral capability
- None rely on the polarimeter data
- The At-Launch algorithms will be as good as what we have for MODIS and VIIRS now
- The At-Launch algorithm does not take advantage of the UV on OCI
- An advanced algorithm is in process, showing the ability to retrieve aerosol absorption characteristics
- And should be able to retrieve aerosol layer height and AOD above clouds
- We could also use OCI hyperspectral capability through the Oxygen bands to retrieve layer height also.
- This part of the proposal was descoped.