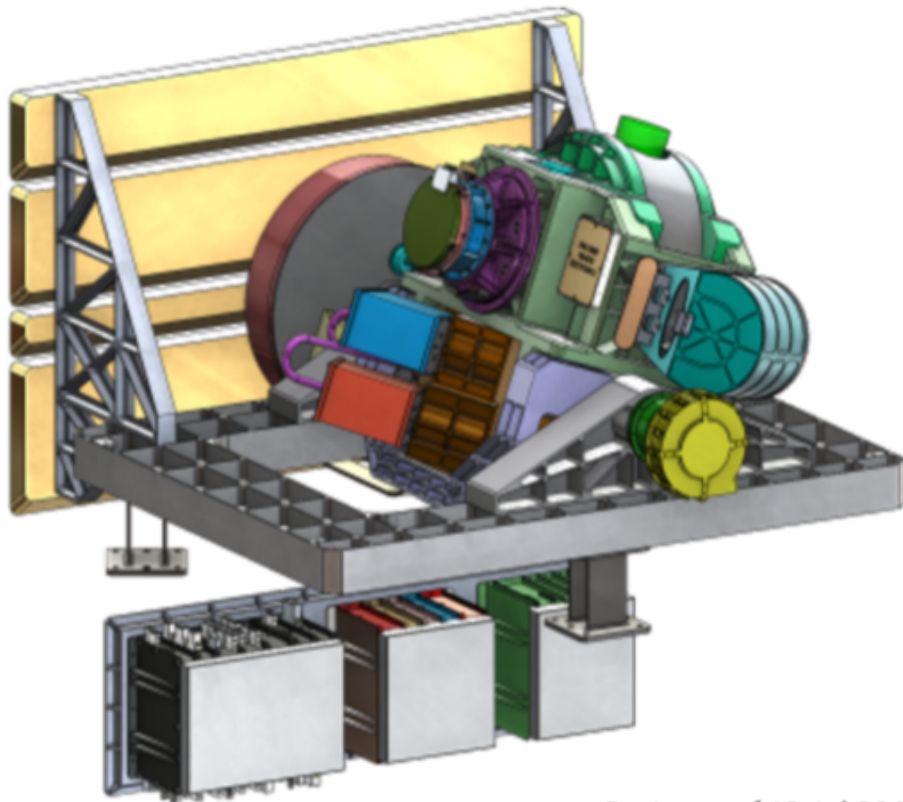


# Aerosol absorption retrievals from base-line OCI observations

## Ocean Color Instrument



*Design as of 13-Jul-2017*

Lorraine Remer, UMBC  
Shana Mattoo, NASA GSFC  
Robert Levy, NASA GSFC  
Omar Torres, NASA GSFC  
Zia Ahmad, NASA GSFC  
Vanderlei Martins, UMBC  
Pawan Gupta, NASA GSFC



# OCI

300

400

500

600

700

900

1300

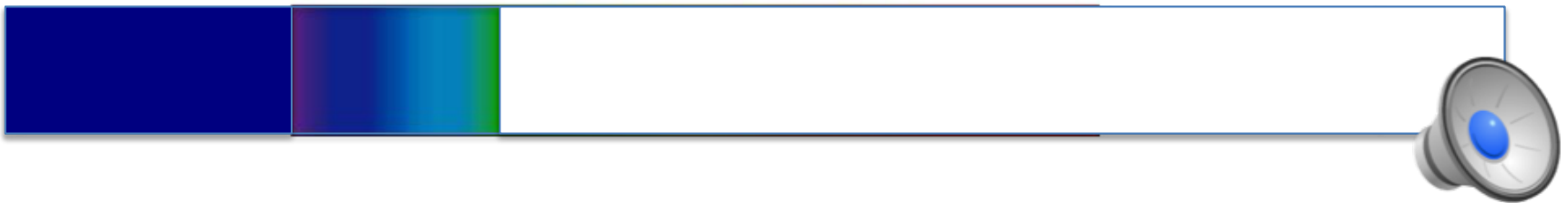
2200



# MODIS



# OMI

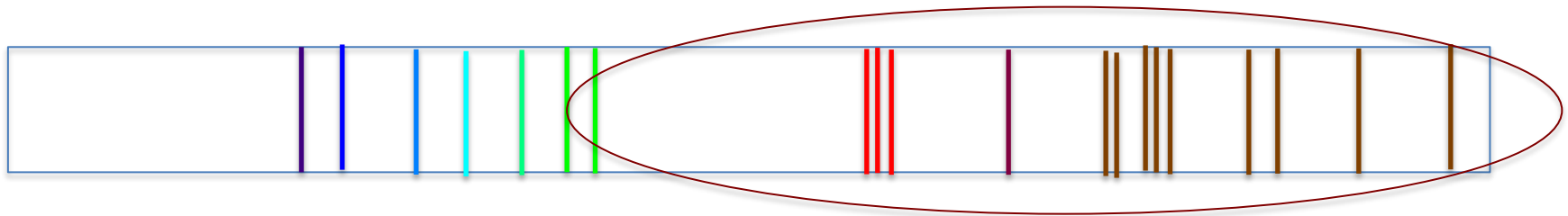


# OCI

300 400 500 600 700 900 1300 2200

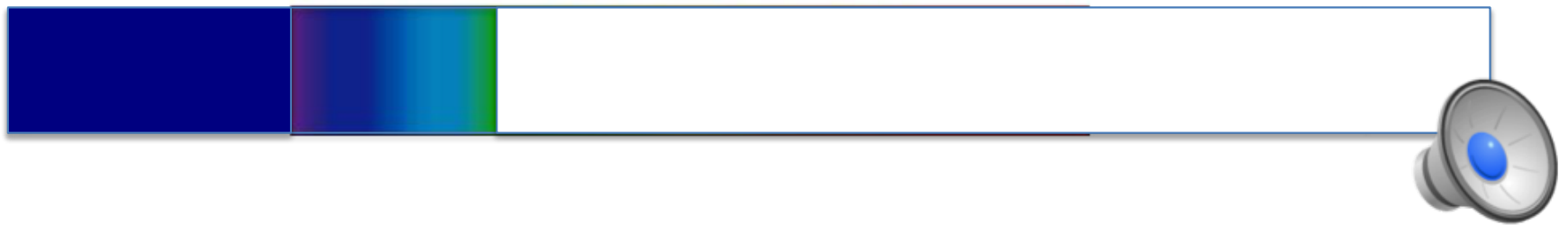


# MODIS

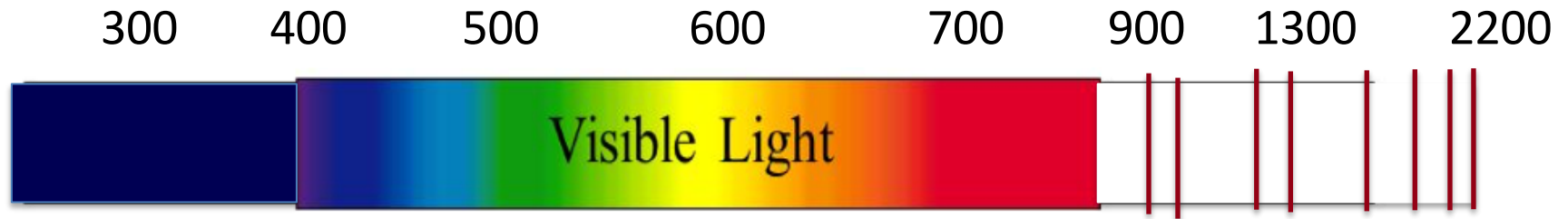


Over ocean MODIS uses some of these channels that are most sensitive to loading and particle size

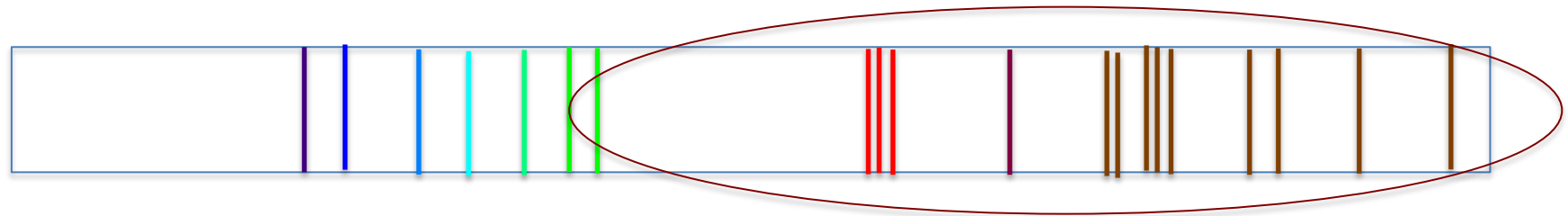
# OMI



# OCI

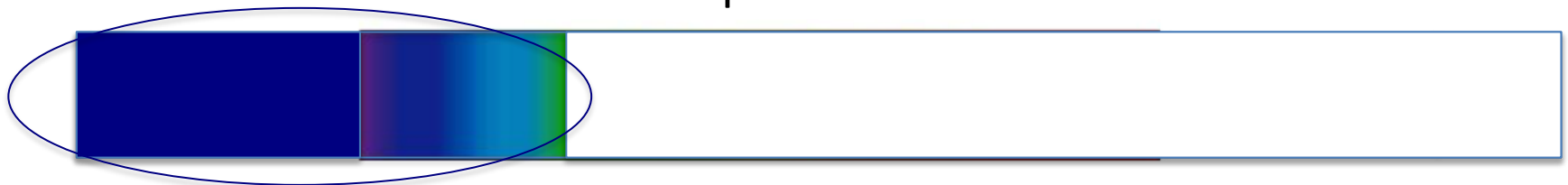


# MODIS



Over ocean MODIS uses some of these channels that are most sensitive to loading and particle size

# OMI



Meanwhile, OMI uses specific wavelengths here that are most sensitive to loading, absorption and layer height



# Aerosol Characteristics (total column)

## Aerosol loading

- AOD (VIS to SWIR)
- mass concentration

## Particle size

- Angstrom Exponent (VIS to SWIR)
- total effective radius (0.05 to 8  $\mu\text{m}$ )
- fine mode fraction (2 modes assumed)
- Effective radius of individual modes
- Size distribution

## Scattering properties (wavelength, total, per mode)

- Real part of the refractive index
- Phase function
- Polarization

## Absorption properties (wavelength, total, per mode)

- Imaginary part of the refractive index
- Single scattering albedo

## Particle shape

- Degree of nonsphericity
- Shape distribution

MODIS over ocean gives



# Aerosol Characteristics

## Aerosol loading

- **AOD (UV to VIS)**
- mass concentration

## Particle size

- Angstrom Exponent (spectral dependence of AOD)
- total effective radius
- fine mode fraction
- Effective radius of individual modes
- Size distribution

## Scattering properties (wavelength, total, per mode)

- Real part of the refractive index
- Phase function
- Polarization

## Absorption properties

- Imaginary part of the refractive index
- **Single scattering albedo (1 wavelength in UV)**

## Particle shape

- Degree of nonsphericity
- Shape distribution



OM gives  
Constrain layer height

# Aerosol Characteristics

## Aerosol loading

- AOD (UV to VIS)
- mass concentration

## Particle size

- Angstrom Exponent (spectral dependence of AOD)
- total effective radius
- fine mode fraction
- Effective radius of individual modes
- Size distribution

## Scattering properties (wavelength, total, per mode)

- Real part of the refractive index
- Phase function
- Polarization

## Absorption properties

- Imaginary part of the refractive index
- **Single scattering albedo (1 wavelength in UV)**

## Particle shape

- Degree of nonsphericity
- Shape distribution



**Aerosol layer height  
OMI gives  
Constrain AOD**

# Aerosol Characteristics

## Aerosol loading

- **AOD (UV to SWIR)**
- mass concentration

## Particle size

- **Angstrom Exponent (spectral dependence of AOD)**
- **total effective radius**
- **fine mode fraction**
- Effective radius of individual modes
- Size distribution

## Scattering properties (wavelength, total, per mode)

- Real part of the refractive index
- Phase function
- Polarization

## Absorption properties

- Imaginary part of the refractive index
- **Single scattering albedo (UV)**

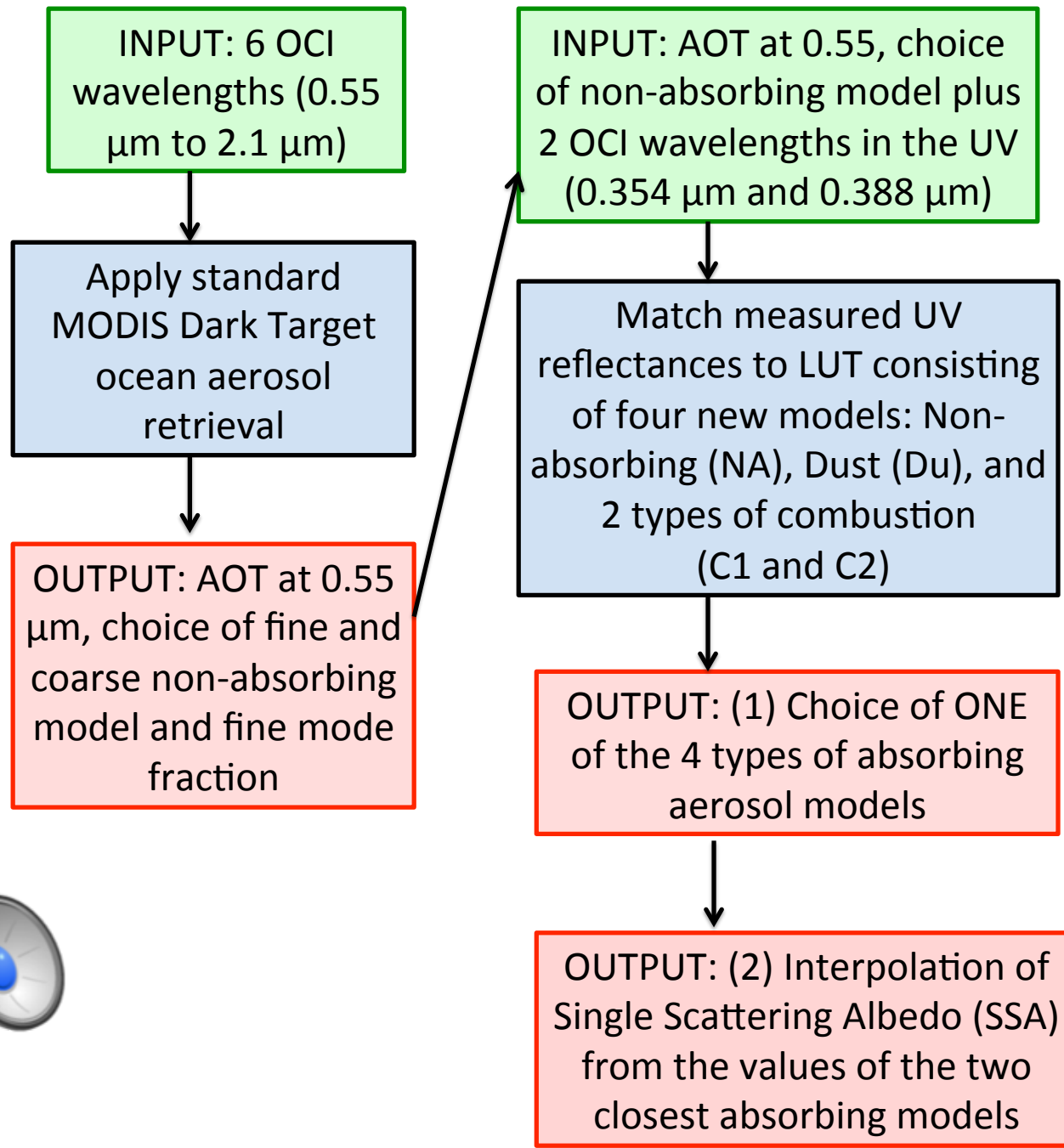
## Particle shape

- Degree of nonsphericity
- Shape distribution

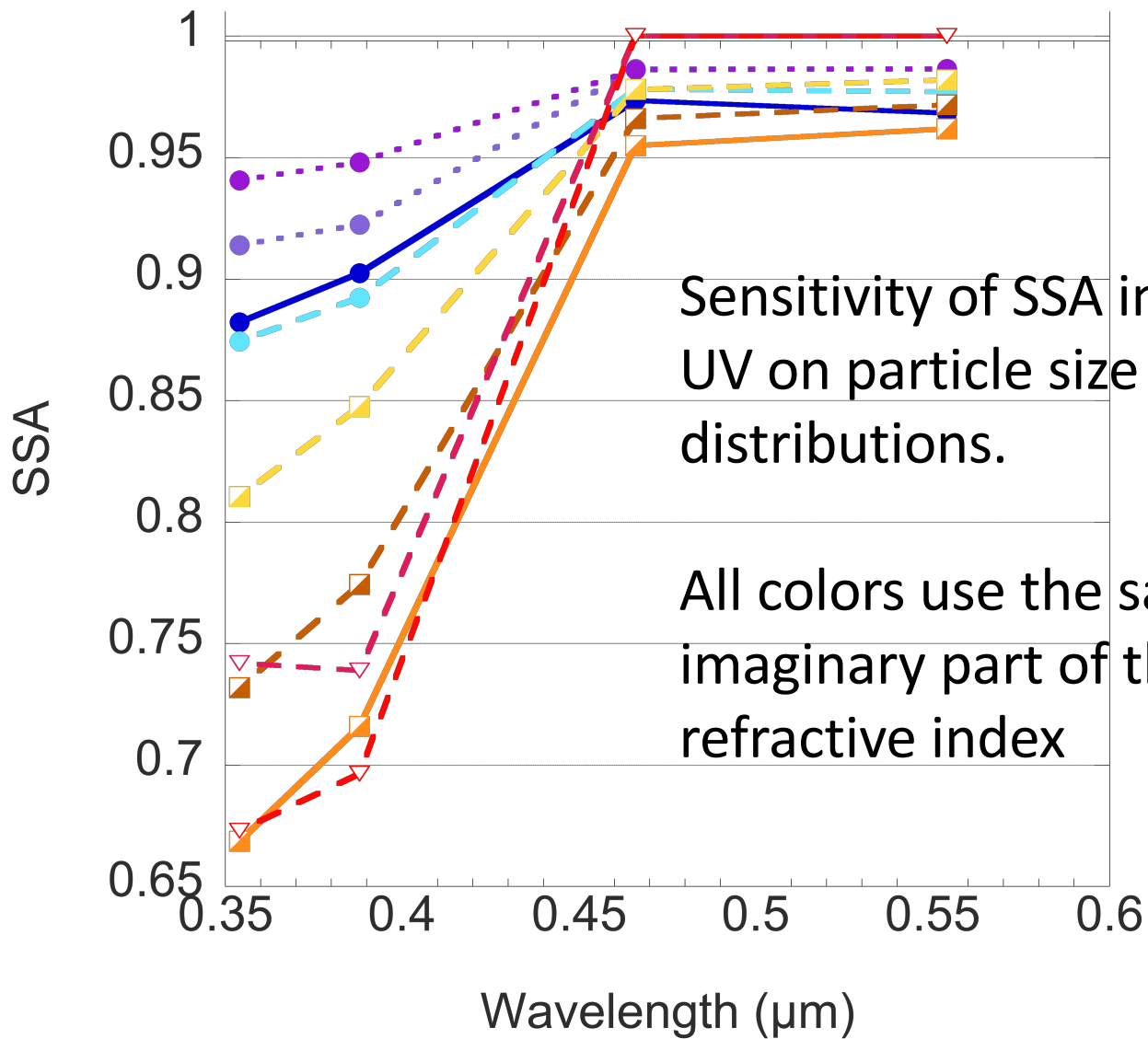


OCC should give  
Layer Height

# MODIS Dark Target (MDT) New OCI addition (DT+UV)

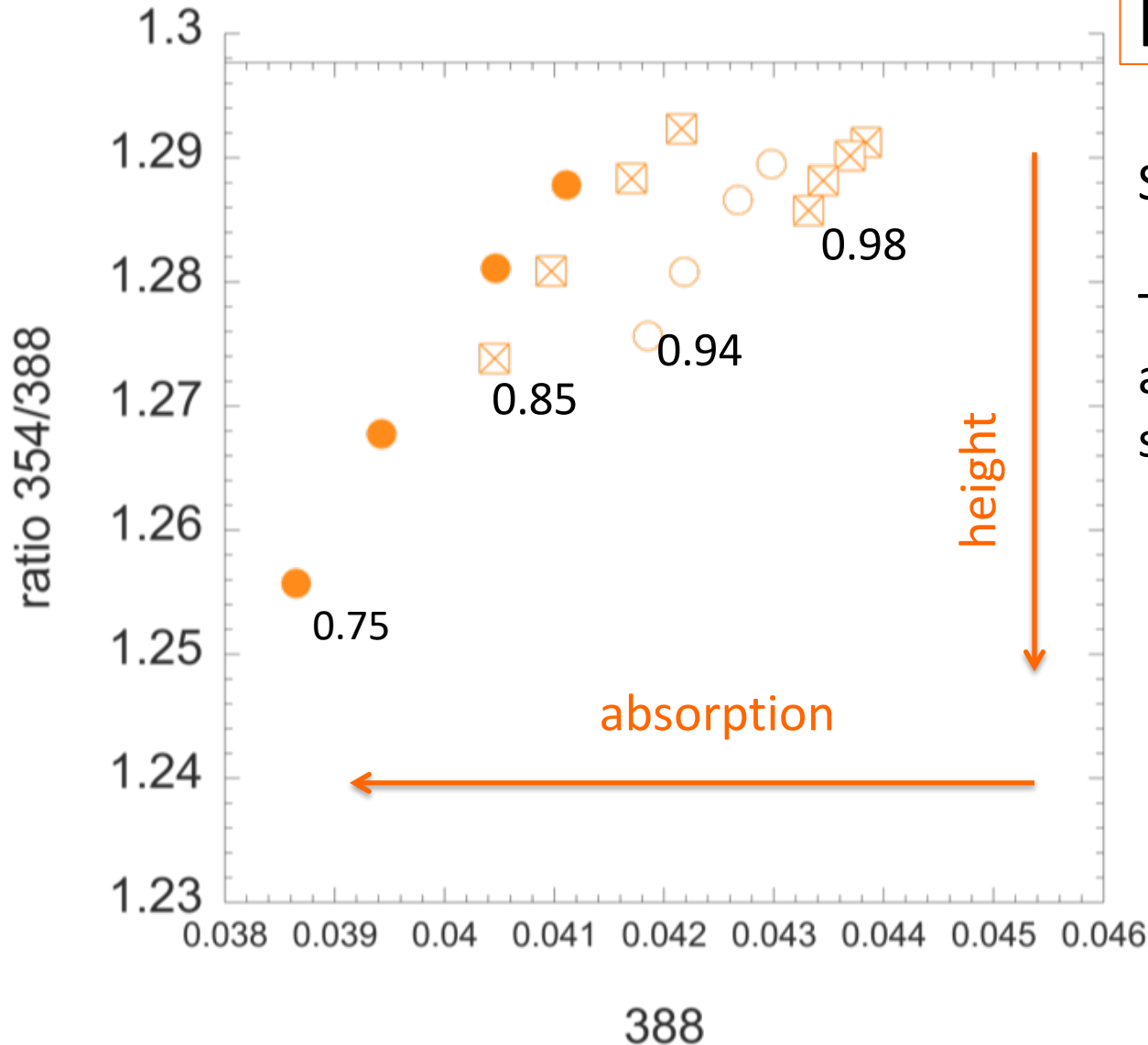


## Combustion-2 (C2)



nadir view (scat ang =131)  
4 layer heights  
1 fine mode fraction (FMF)  
4 single scattering albedo

For a given AOD  
and given  
particle size



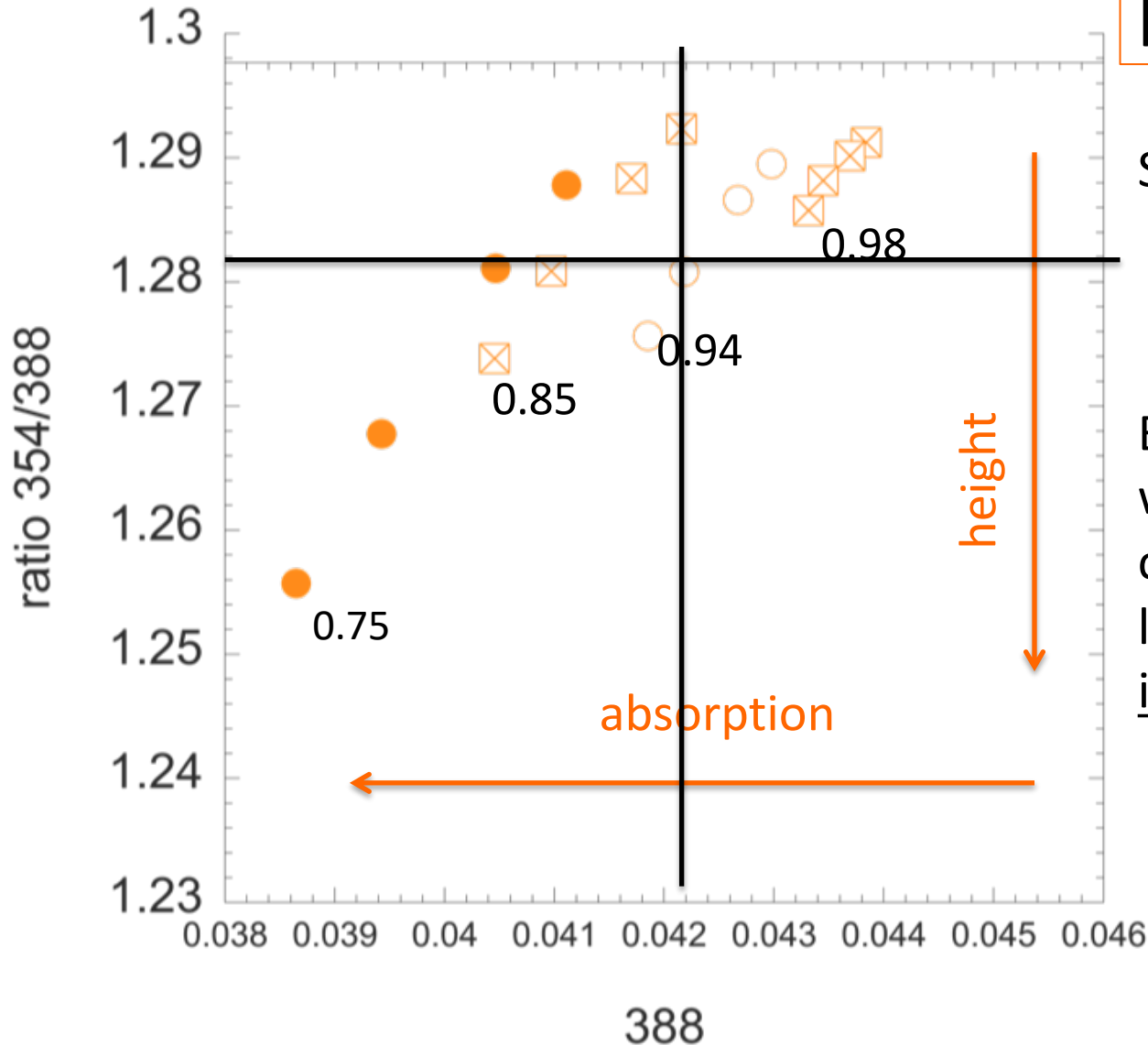
SSA in UV indicated

The greater the  
absorption, the more  
sensitivity to height



nadir view (scat ang = 131)  
4 layer heights  
1 fine mode fraction (FMF)  
4 single scattering albedo

For a given AOD  
and given  
particle size



SSA in UV indicated

By measuring 2  
wavelengths in the UV,  
can retrieve SSA and  
layer height, when AOD  
is known.



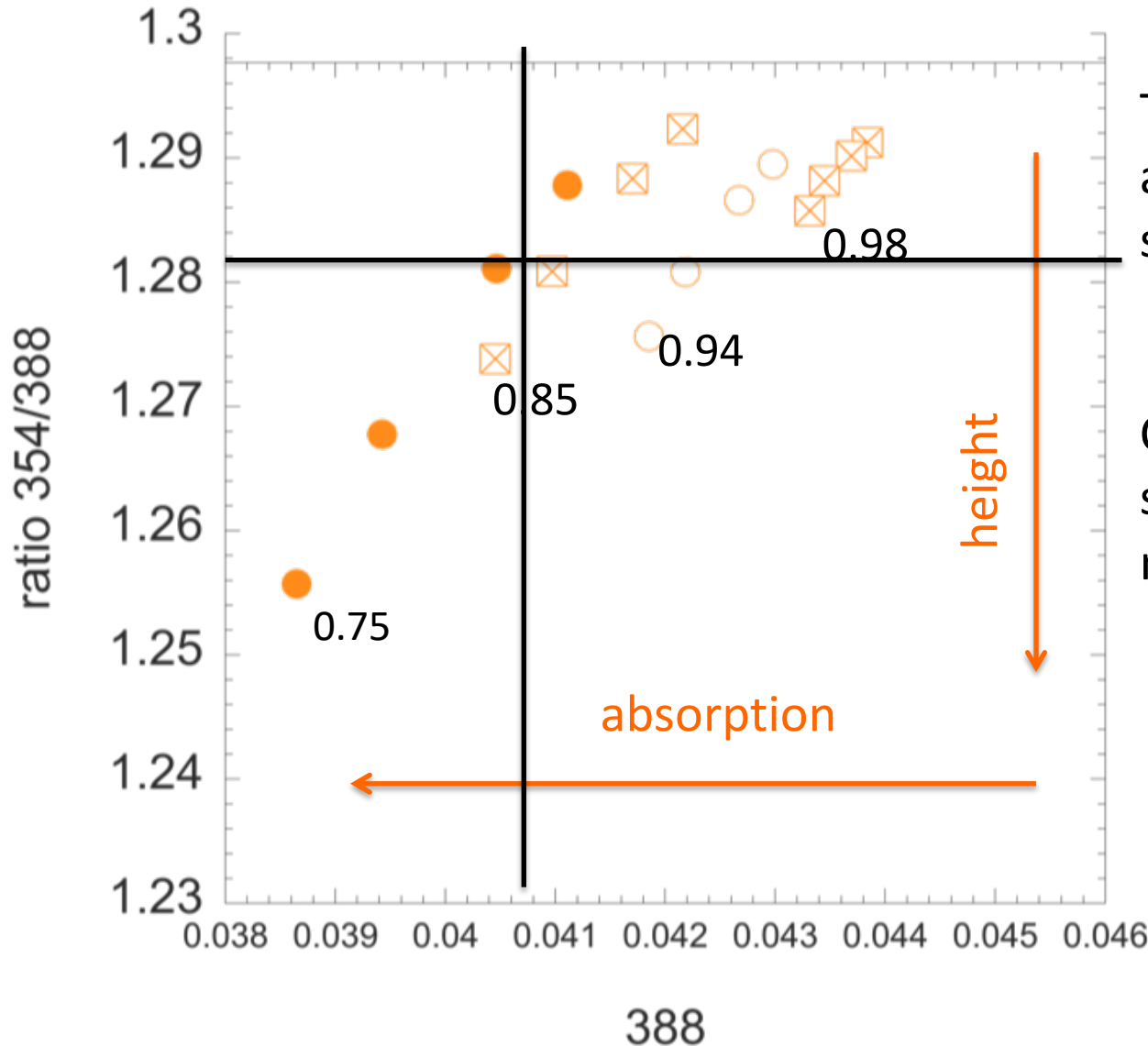
nadir view (scat ang =131)  
4 layer heights  
1 fine mode fraction (FMF)  
4 single scattering albedo

For a given AOD

SSA in UV indicated

The greater the absorption, the more sensitivity to height

Certain geometries and scattering models are more ambiguous.



# Retrieval testing on merged MODIS-OMI granules

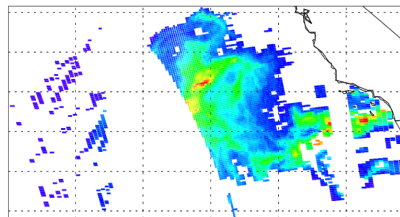
MODIS RGB

Smoke example

23 October  
2007  
21:40



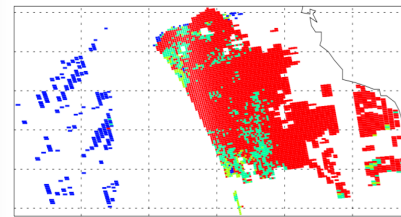
AOT 550 nm



0.00 0.30 0.60 0.90 1.20 1.50

Absorption model

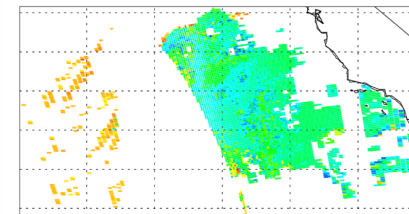
Chl = 0.3 mg/m<sup>3</sup>



NA Du C1 C2

Single scattering albedo

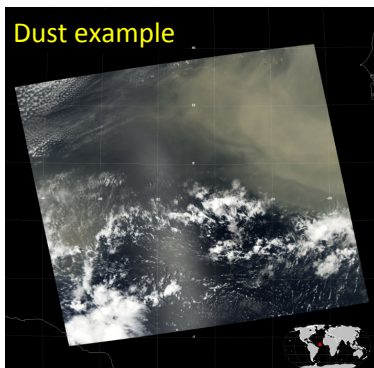
388 nm



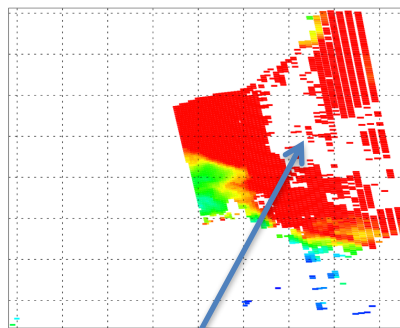
0.80 0.84 0.88 0.92 0.96 1.00

Dust example

13 March  
2006  
15:25

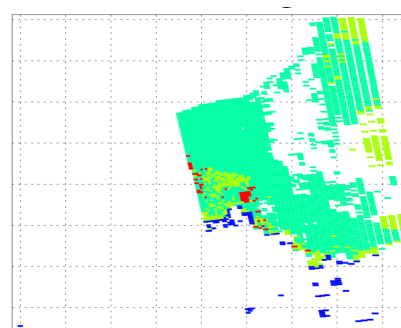


AOT 550 nm



0.00 0.30 0.60 0.90 1.20 1.50

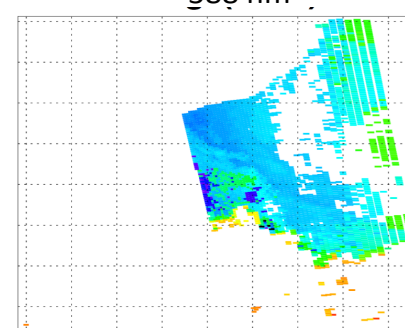
Absorption model



NA Du C1 C2

Single scattering albedo

388 nm



0.80 0.84 0.88 0.92 0.96 1.00

Falls outside window of assumptions



## Conclusions:

From OCI alone, retrievals of SSA and aerosol height in the UV are possible.

Robustness of SSA retrieval is strongly dependent on the accuracy of the heritage MODIS VIS-SWIR retrieved constraints.

AOD at 0.55  $\mu\text{m}$  must exceed 0.30 to avoid uncertainties introduced by ocean

.

Some geometries, aerosol situations are too ambiguous to allow a retrieval.  
Working on that.

Desperately seeking test bed data with validation for SSA and/or aerosol height.

