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APOLO (Lille, France, Nov 4-7, 2018)

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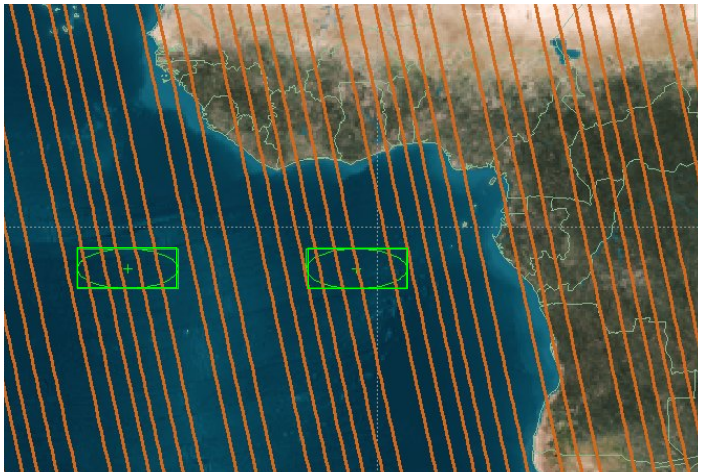
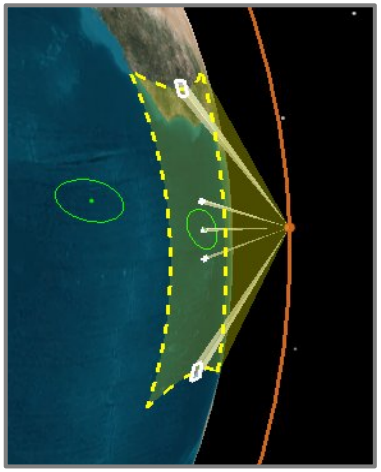
Spaceborne ocean color remote sensing in the UV-A part of the spectrum

Jacek Chowdhary
Susanne Bauer, Matteo Ottaviani, Andrzej Wasilewski, Li Liu





Motivation

- PACE
- CDOM
- Brown Carbon

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Motivation

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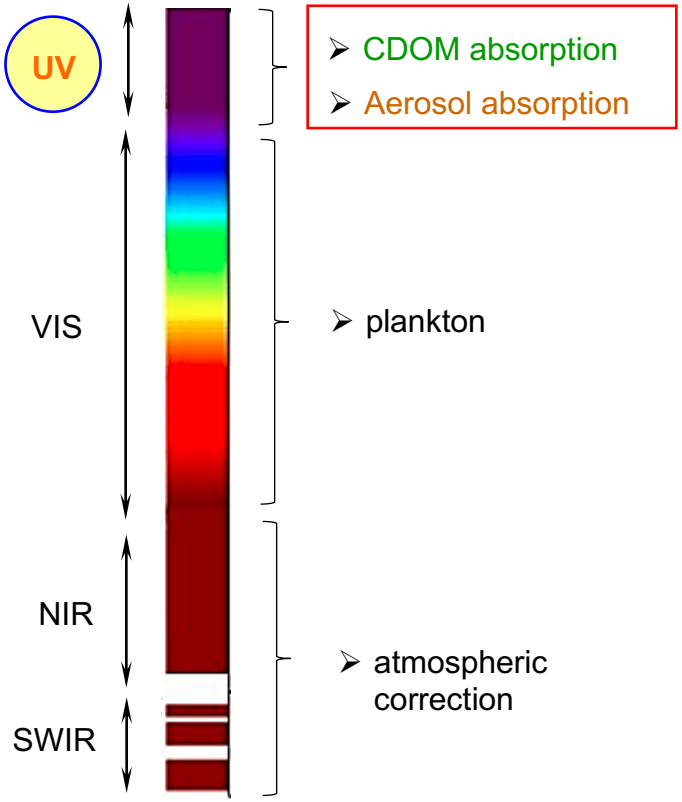
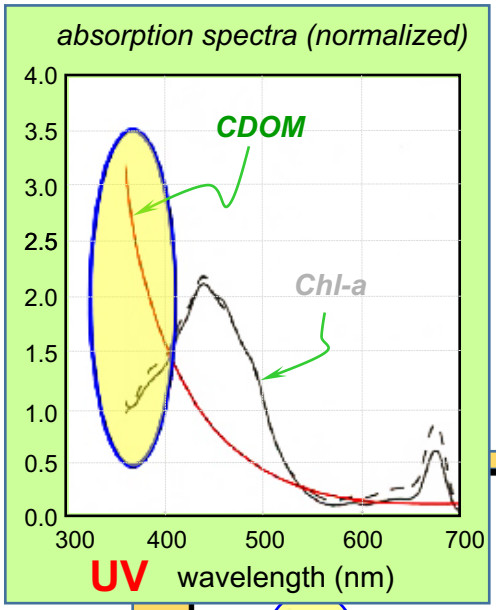
PACE Plankton, Aerosol, Cloud, ocean Ecosystem

OCI

data | Launch: 2022 | products

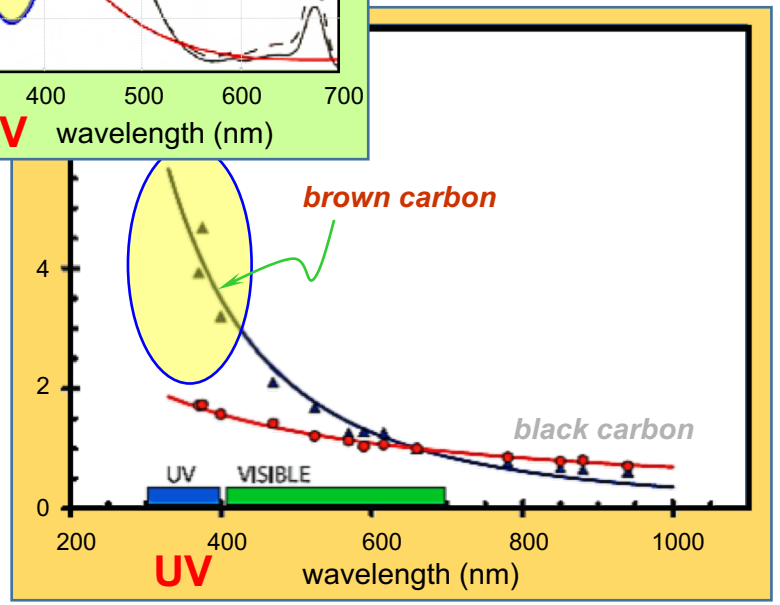


- CDOM absorption
- Aerosol absorption
- plankton
- atmospheric correction

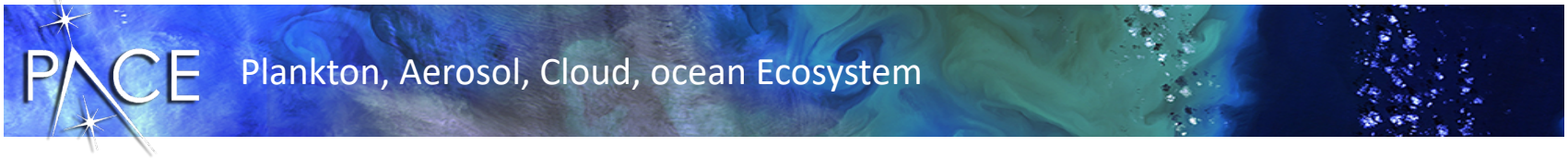


CDOM ("gelbstoff"):

Brown Carbon



Motivation



OCI

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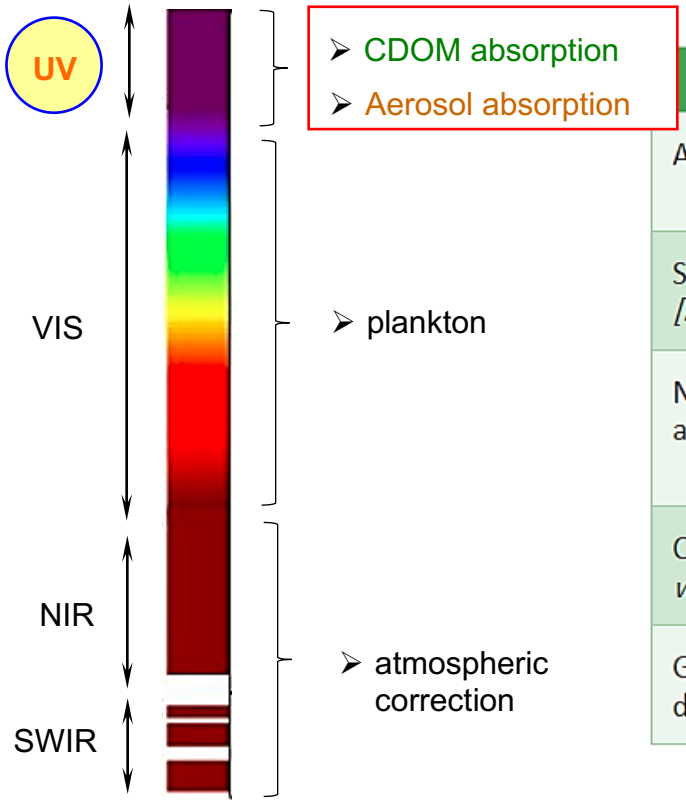

Polarimeters

multi-angle, linear polarization

	SPEXone	HARP-2
Attributes	Hyperspectral (UV) & narrow swath	Hyperangular & wide swath
Spectral range *[resolution]*	385-770 nm *[hyperspectral 2 nm]*	440, 550, 670 nm *[10 nm]* & 870 nm *[40 nm]*
Number of viewing angles *[degrees]*	5 *[-57°, -20°, 0°, 20°, 57°]*	20 for 440, 550, 870 nm & 60 for 670 nm *[spaced over 114°]*
Coverage *[swath width]*	9° *[100 km]*	94° *[1550 km]*
Ground sample distance	2.5 km	3 km

Modeling

- CDOM
- Brown Carbon
- Other aerosols
- Other hydrosols

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CDOM

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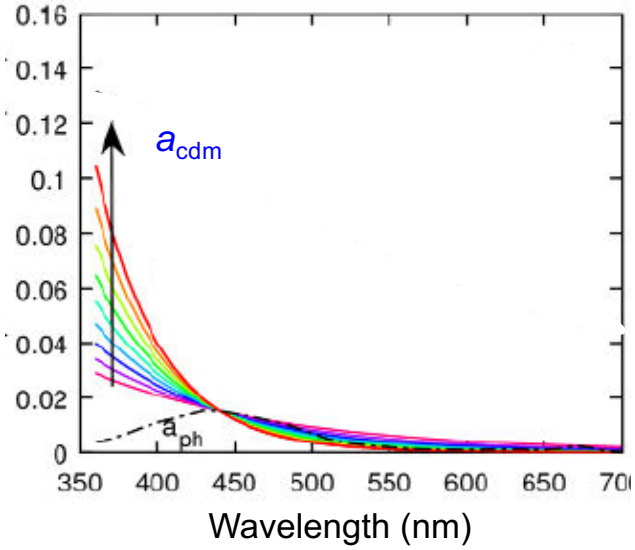
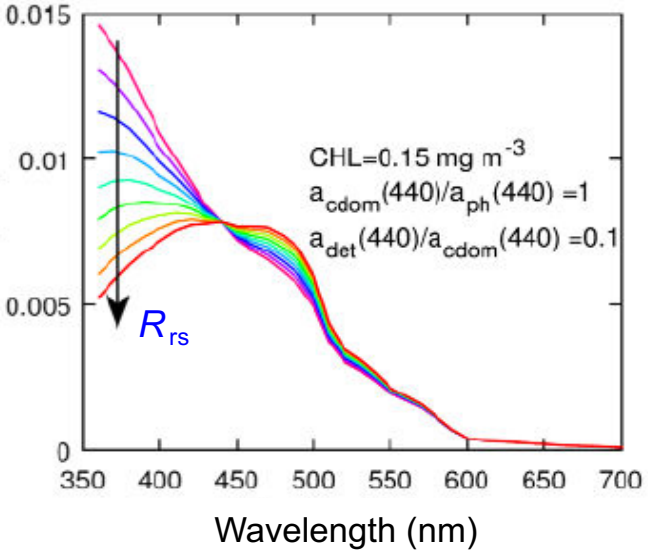
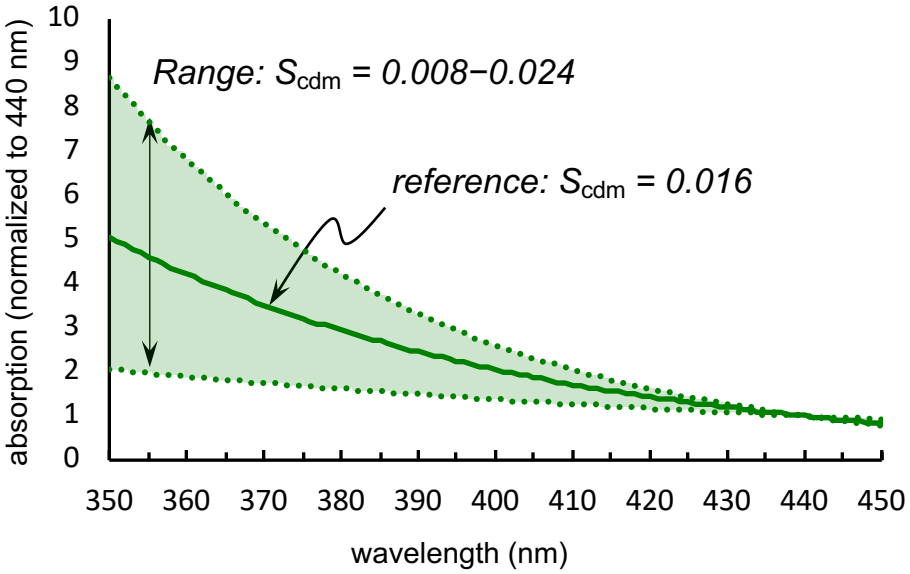
Wei et al. (2016)





CD(O)M absorption spectral slope (S_{cdm})



Δ(CDOM) → *Impact on TOA reflectance*

- perturbation 1 : (S_{cdm} = .016) - (S_{cdm} = .008)
- perturbation 2 : (S_{cdm} = .016) - (S_{cdm} = .024)

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Brown Carbon (biomass burning)

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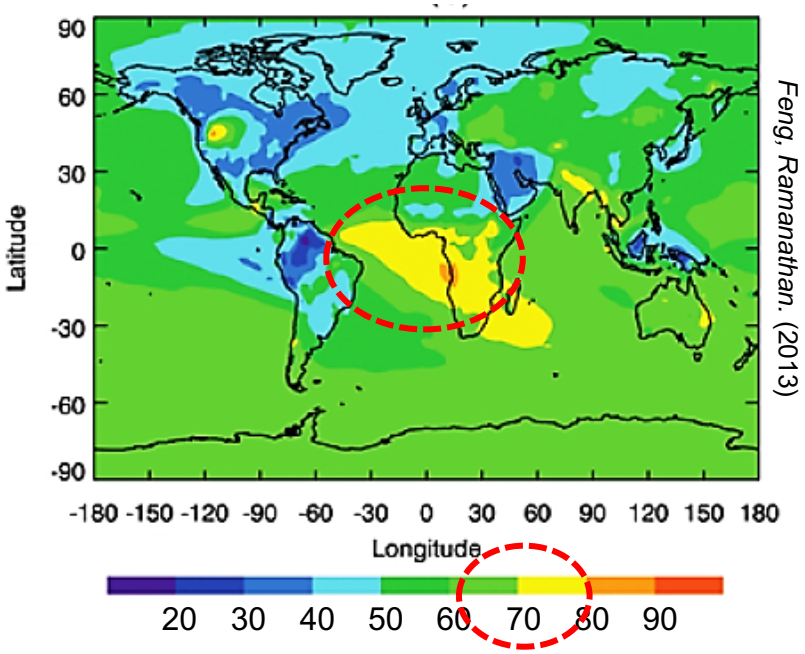
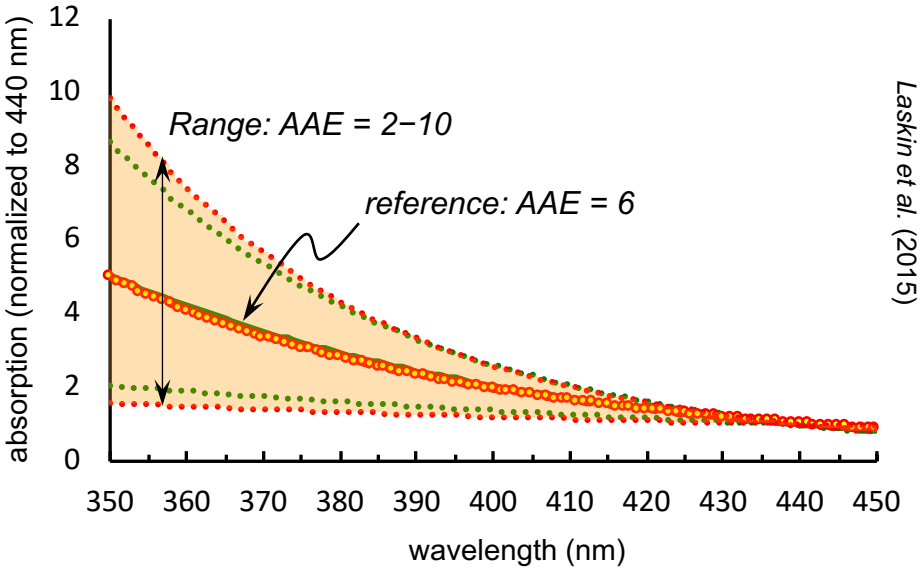
BrC % of OC mass



- scenario 1 : BrC mass = 10% OC mass
- scenario 2 : BrC mass = 70% OC mass

BrC Absorption Angstrom Exponent (AAE)



Δ(BrC) → *Impact on TOA reflectance*

- perturbation i : (AAE = 6) - (AAE = 10)
- perturbation ii: (AAE = 6) - (AAE = 2)

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Atmosphere model

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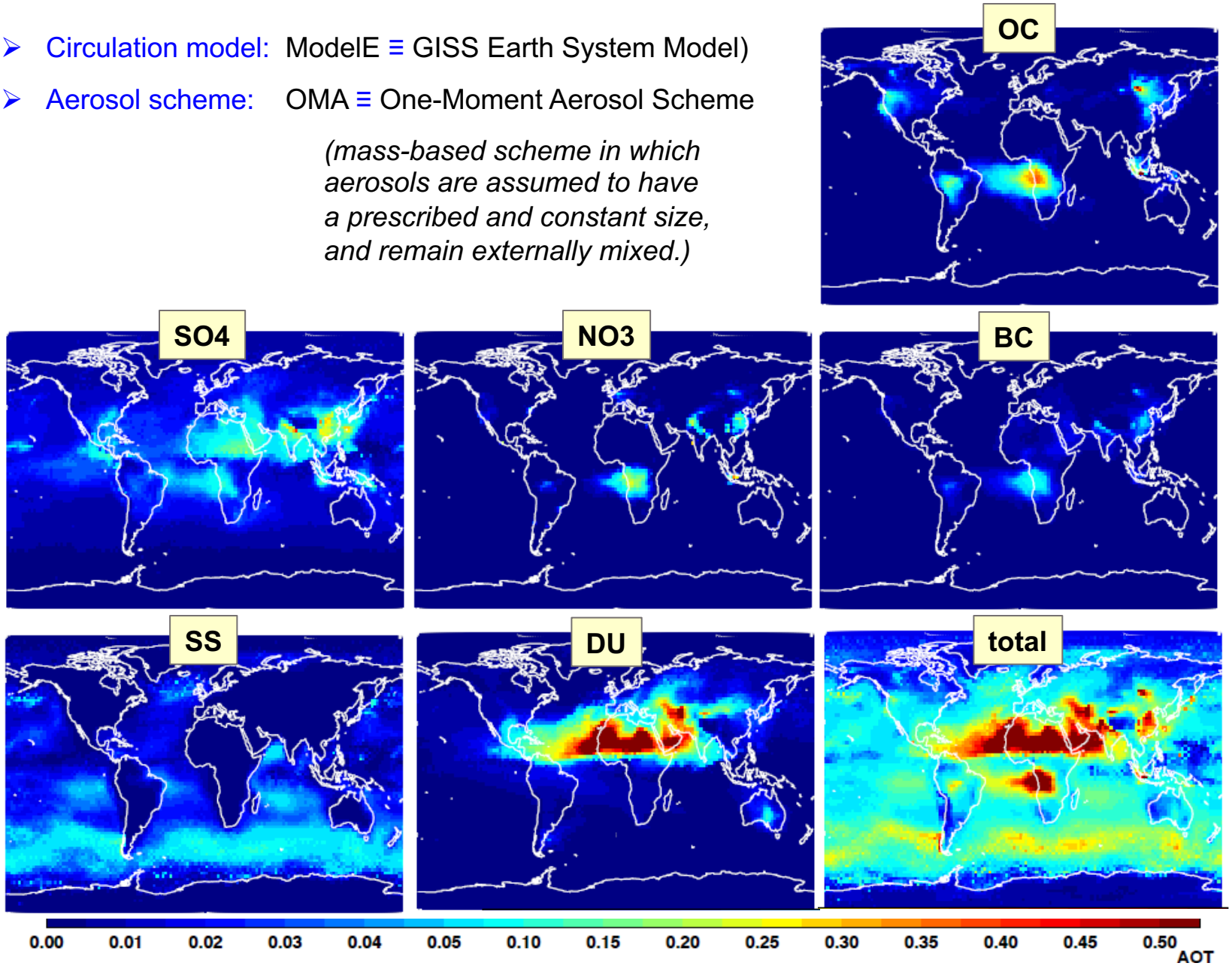
- Circulation model: ModelE ≡ GISS Earth System Model)
- Aerosol scheme: OMA ≡ One-Moment Aerosol Scheme

(mass-based scheme in which aerosols are assumed to have a prescribed and constant size, and remain externally mixed.)



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Atmosphere model

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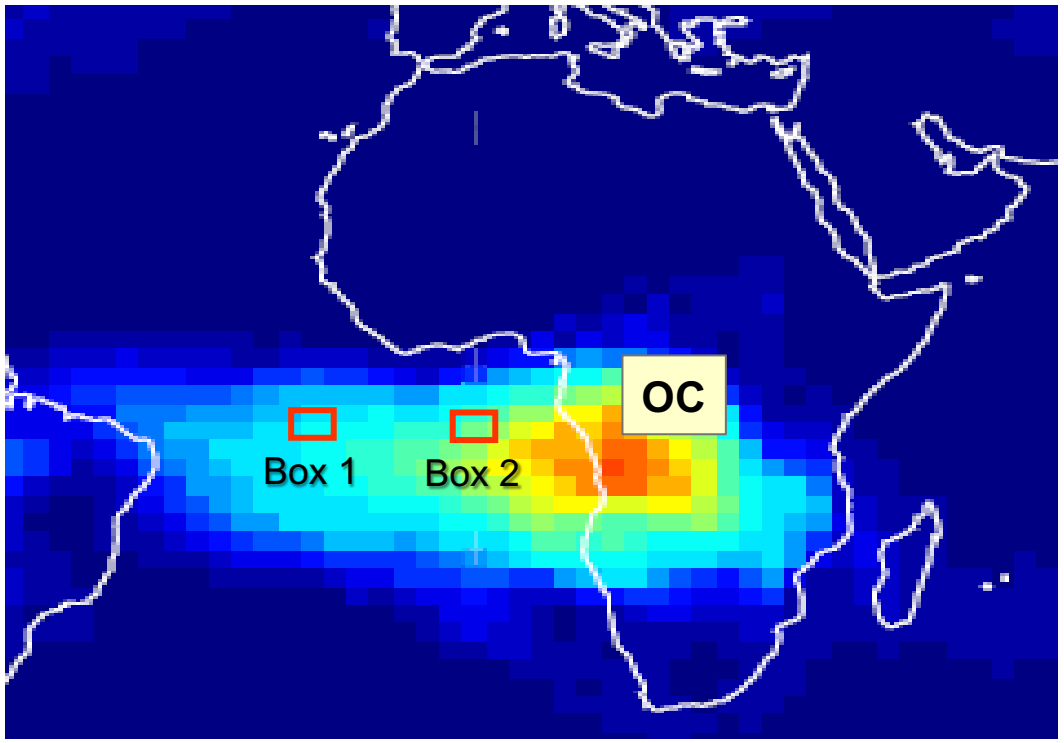
- Circulation model: ModelE
- Aerosol scheme: OMA

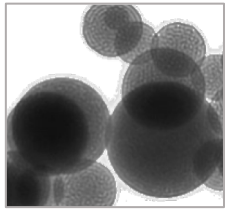
τ (555 nm)

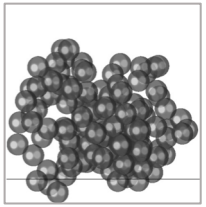
aerosol	Box 1	Box 2
OC	36%	47%
BC	9%	12%
SO4	21%	19%
NO3	4%	11%
SS	30%	11%
DU	0%	0%



Aug, 2016

- Aerosol model: CO, BrC, SO4, NO3, SS: BC:





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SeaWiFS constraints

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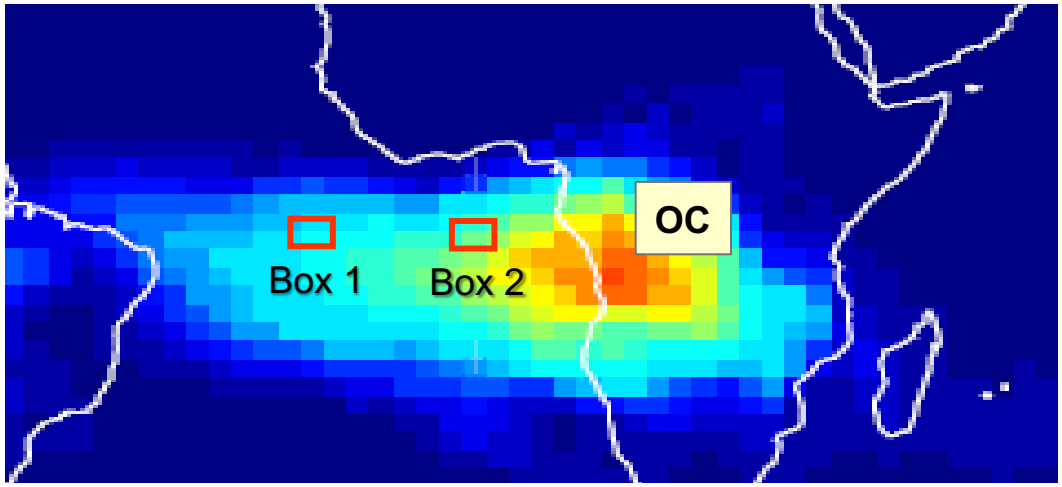
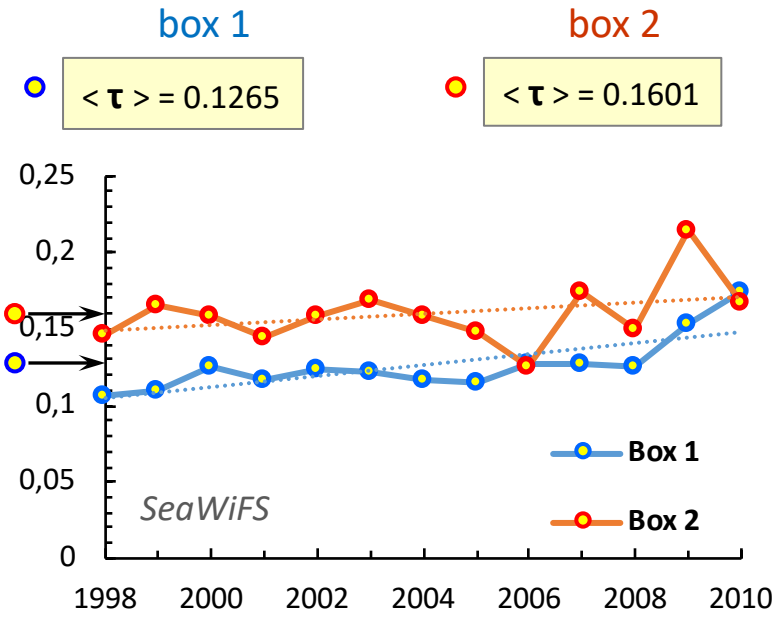


Box 1 & Box 2

Aerosol τ(864 nm) for August



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SeaWiFS constraints

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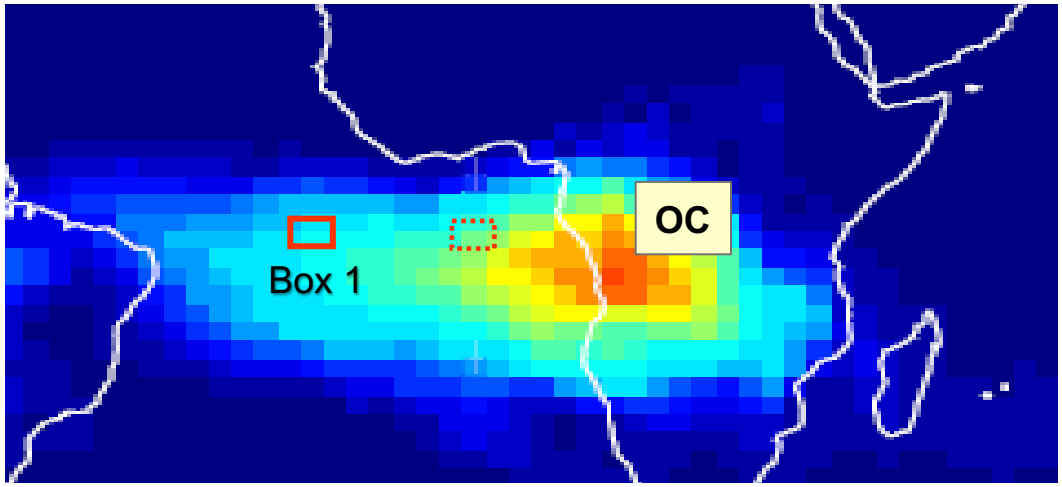
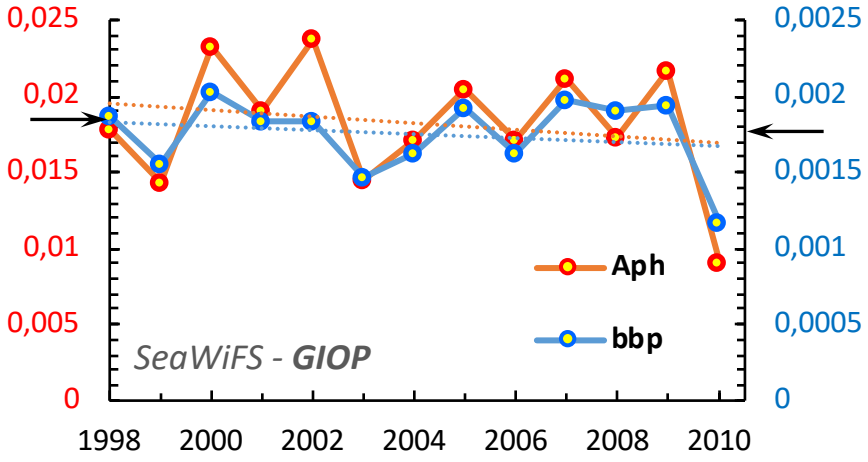


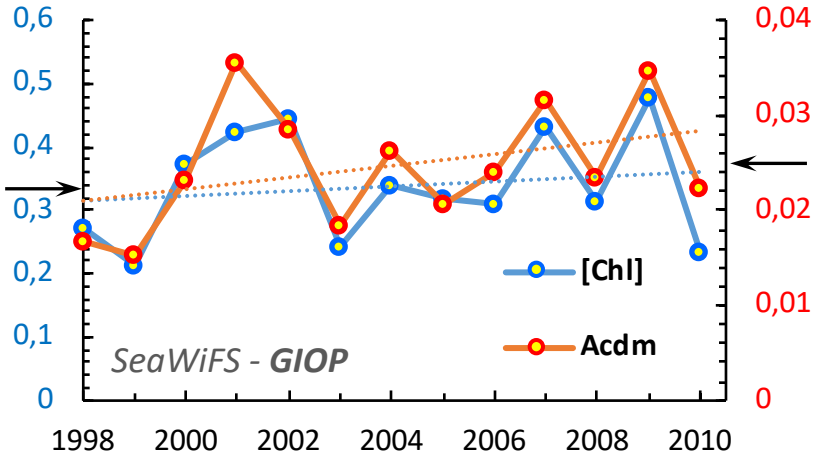
Box 1

IOPs (443 nm) for August

< **Aph** > = 0.0182 < **bbp** > = 0.00175



< **Chl** > = 0.0338 < **Acdm** > = 0.0247



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SeaWiFS constraints

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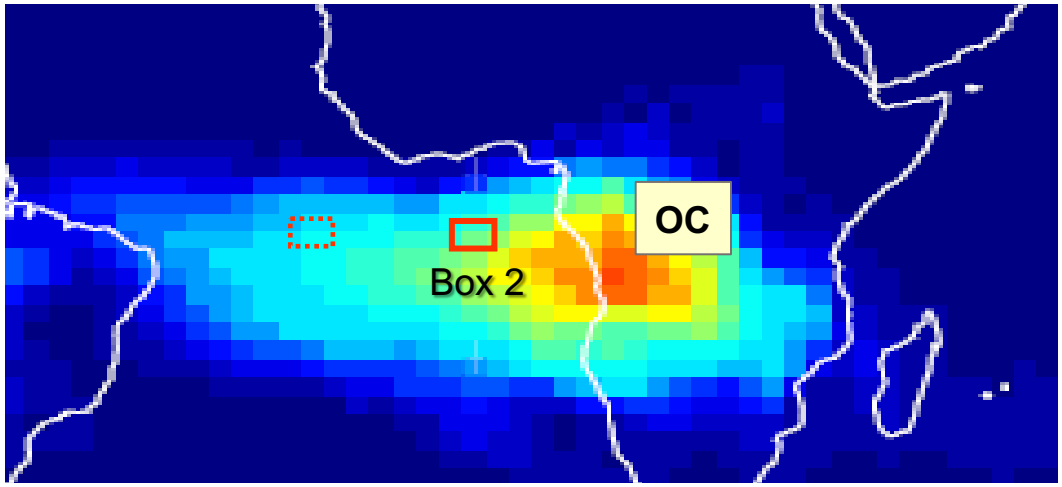
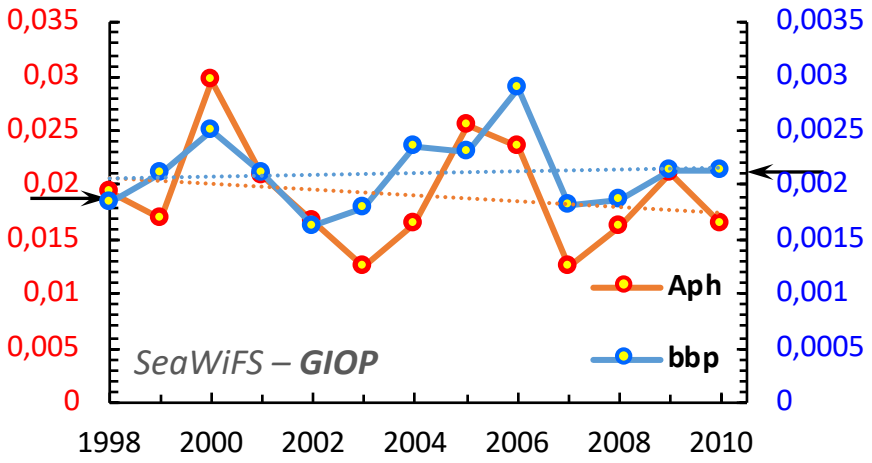
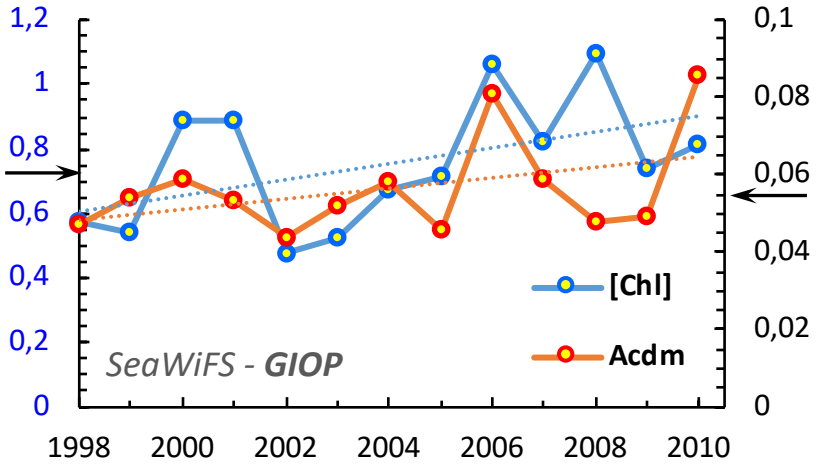


Box 2

IOPs (443 nm) for August

< **Aph** > = 0.0190 < **bbp** > = 0.00211 < **Chl** > = 0.0754 < **Acdm** > = 0.0565





Results

- PACE orbits
- PACE simulations

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PACE orbits

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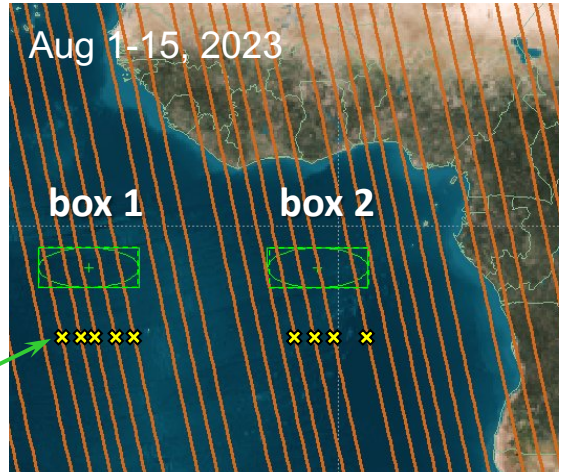
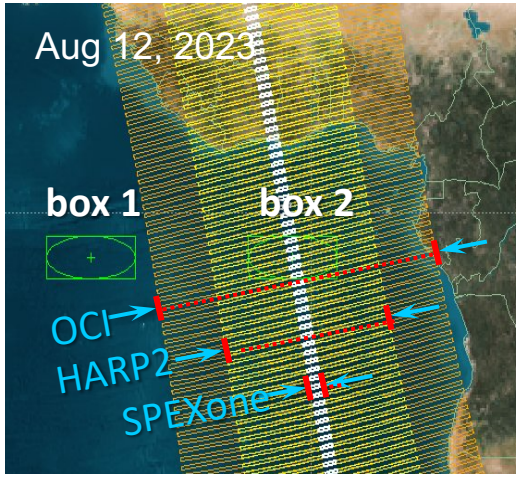
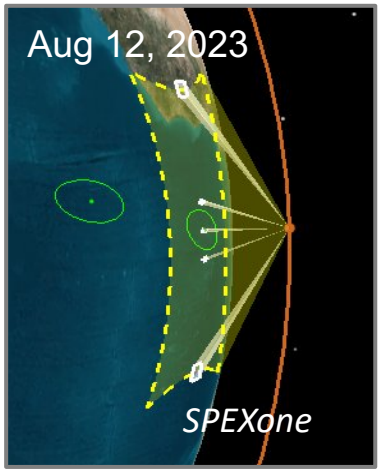
PACE orbits







PACE orbits

August 12, 2023

	Box 1	Box 2	swath	views	UV-NIR wavelengths	data
platform		1 orbit				
OCI		1 orbit	>2000 km	1 angle	350-885 @ 5 nm	*I*
HARP		1 orbit	1550 km	20 (60) angle	440, 550, 670, 870 nm	*I, P, I**
SPEXone		1 orbit	100 km	5 angle	385-770 @ 2 nm	*I, P, I**
Sun θ_0		18.7°				
Sun φ_0		0°				

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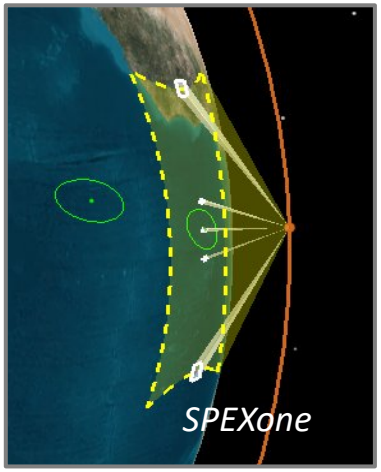
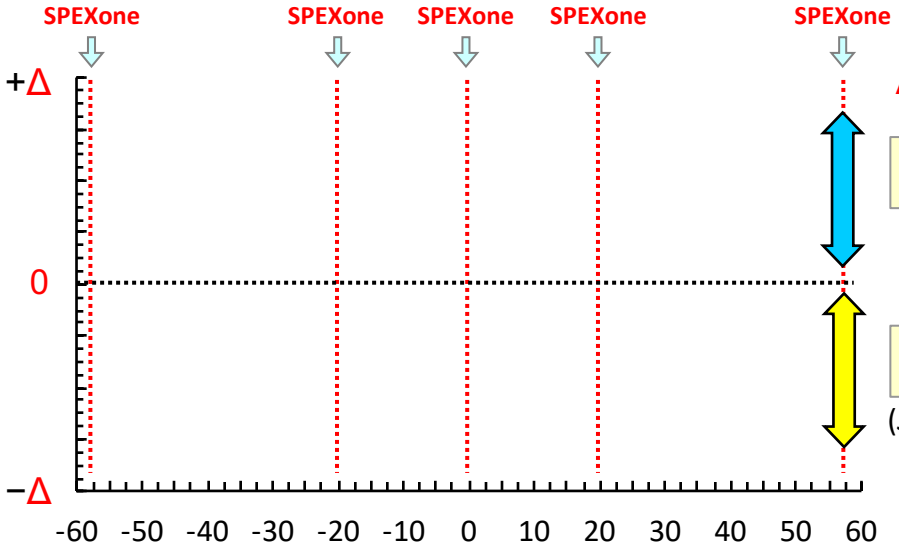


Box 1, 2

TOA observations

Sensitive to Δ(CDOM) | Sensitive to Δ(BrC) | Sensitive to Δ(CDOM) *and* Δ(BrC) | Accuracy



Δ = Δ *I* (refl):

Δ(CDOM)

(AAE = 6 for BrC)

Δ(BrC)

(S_{cdm} = 0.016 for CDOM)

Δ = Δ*I* / *I*, Δ*P* / *P*, Δ*I** / *I**

= 0.5%

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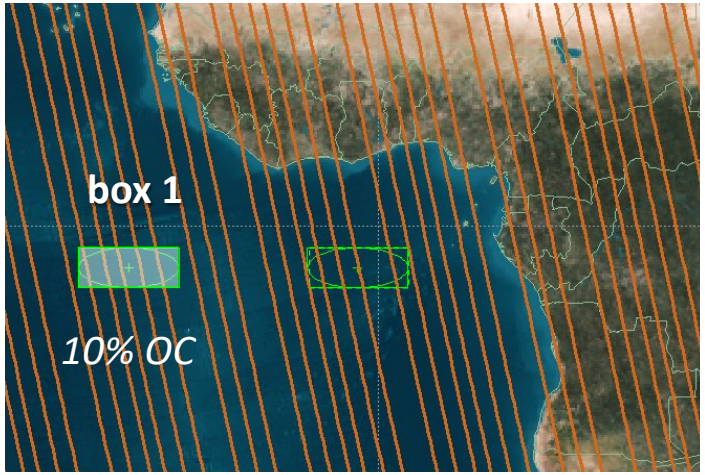

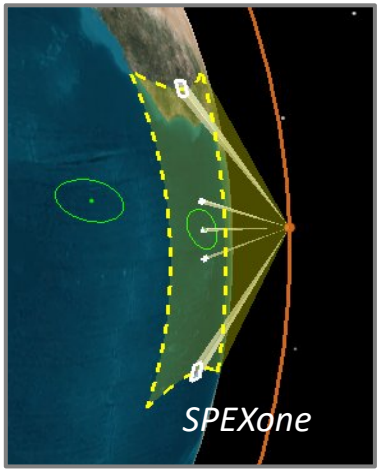

Box 1

TOA observations

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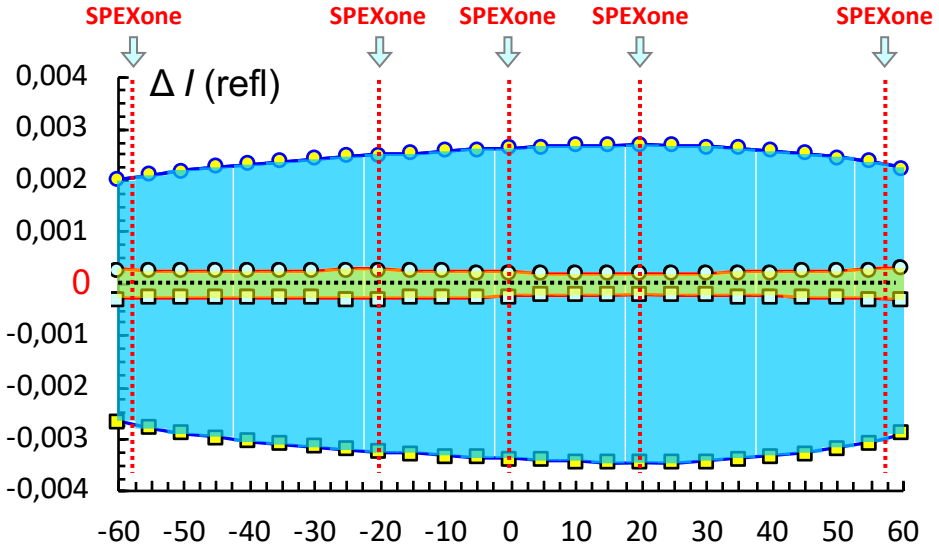

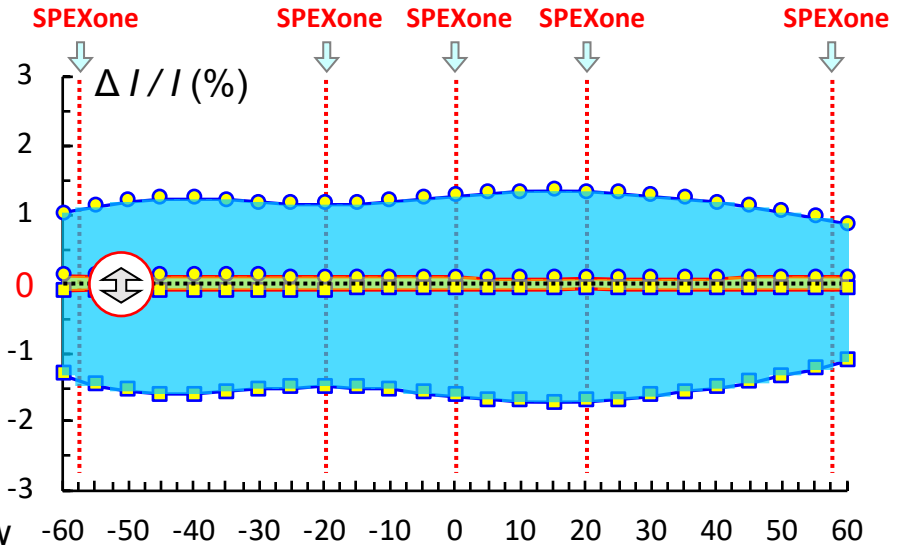

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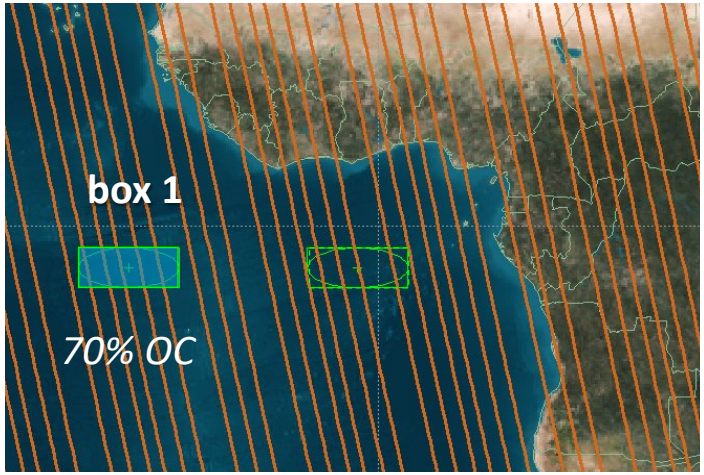

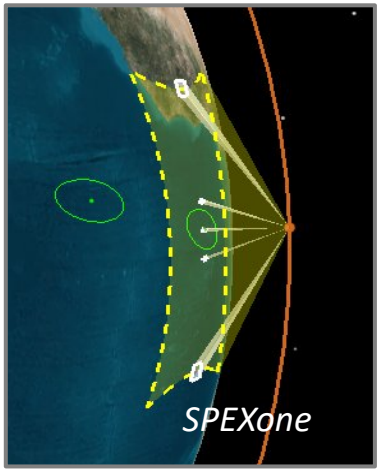

Box 1

TOA observations

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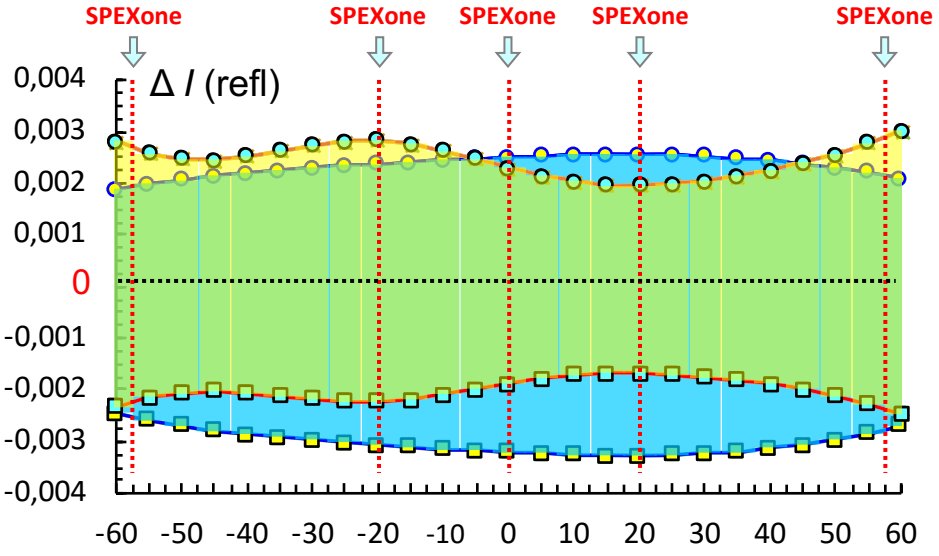

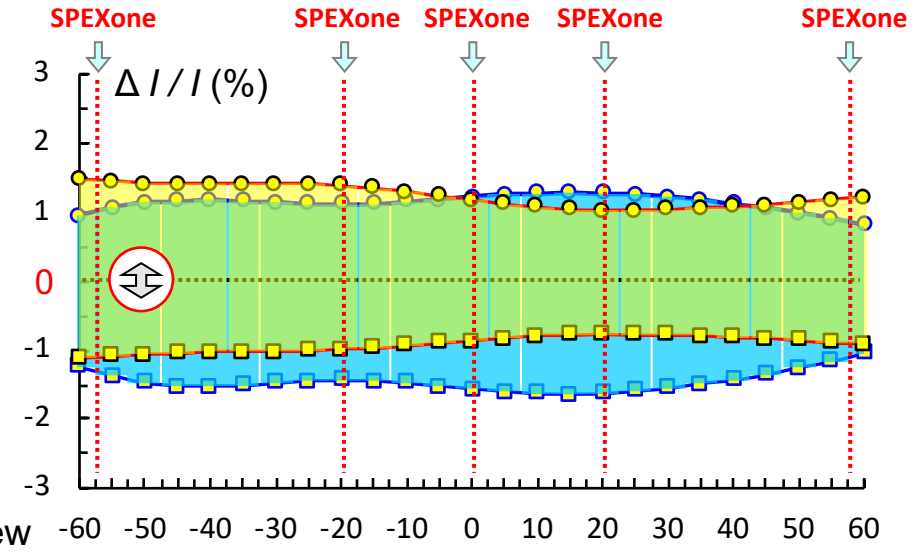

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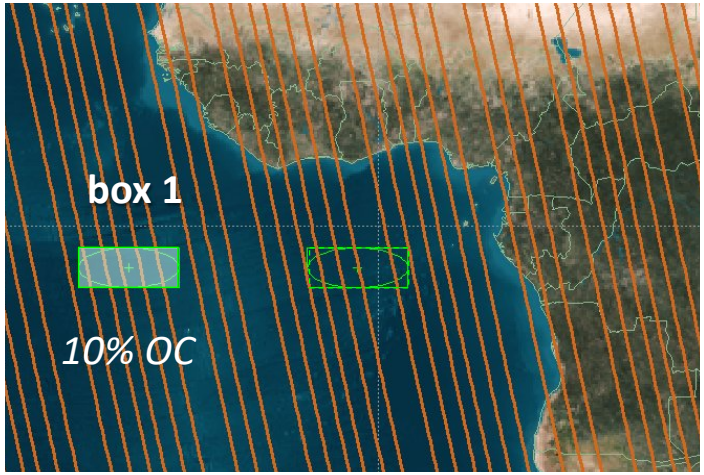
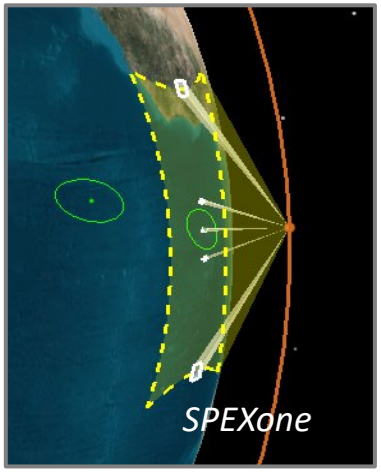
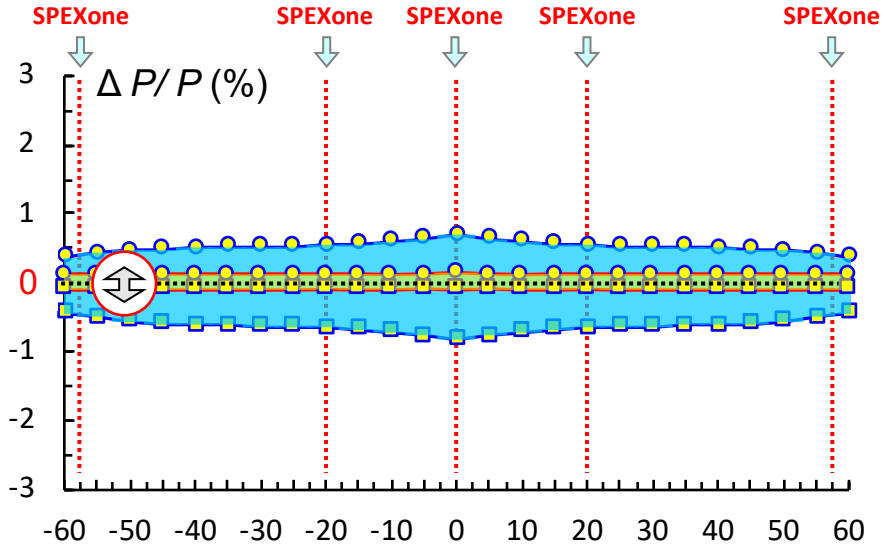


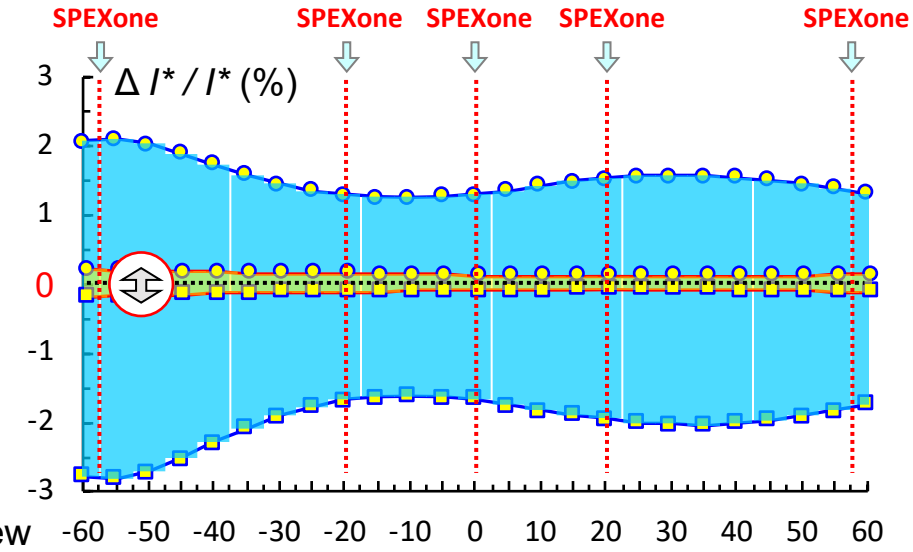


Box 1

TOA observations

Sensitive to Δ(CDOM) | Sensitive to Δ(BrC) | Sensitive to Δ(CDOM) *and* Δ(BrC) | Accuracy





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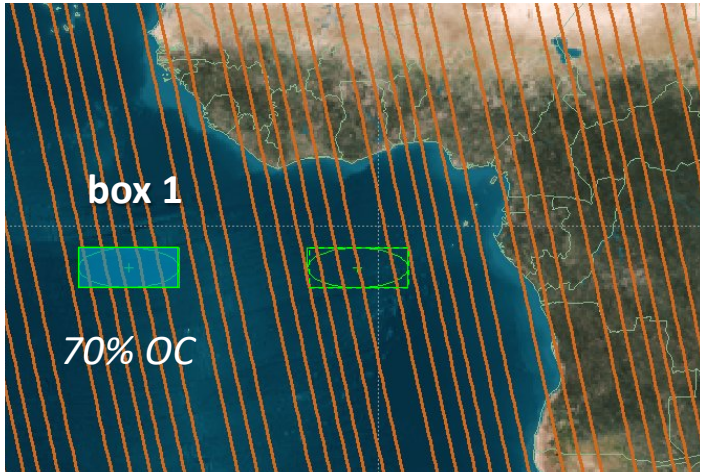

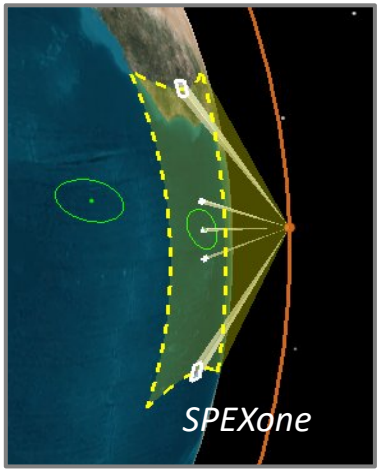

Box 1

TOA observations

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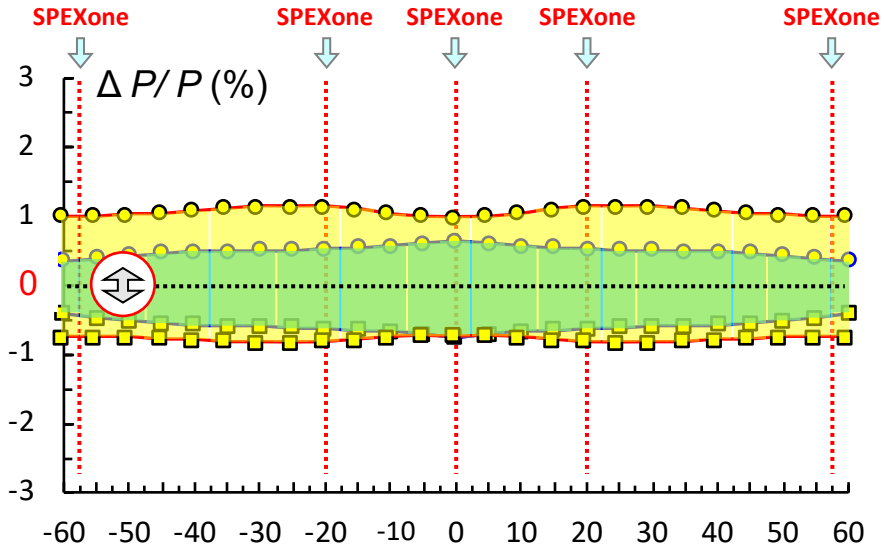

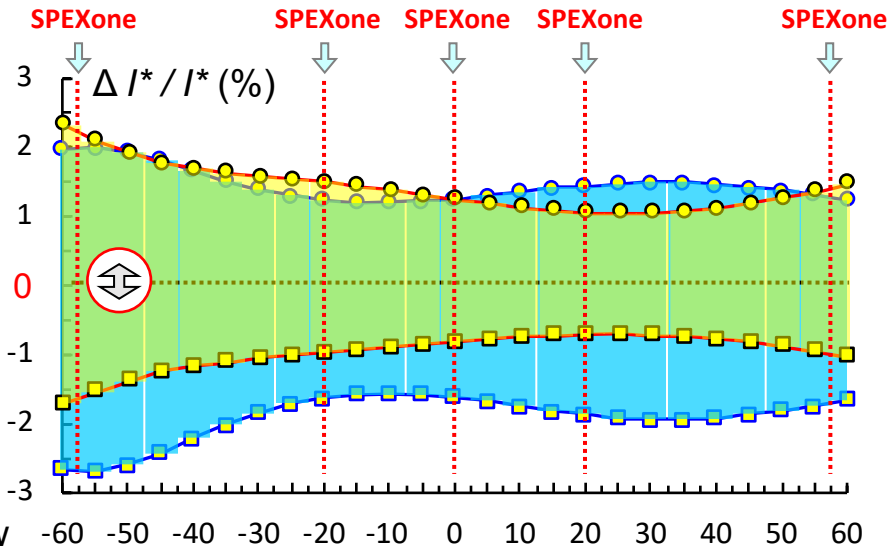

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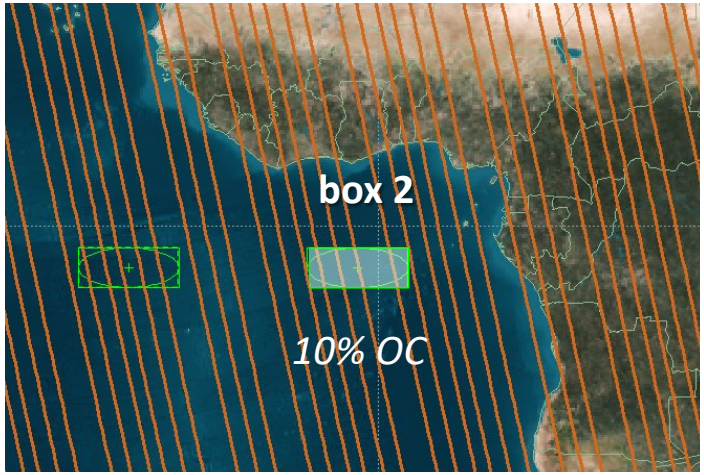
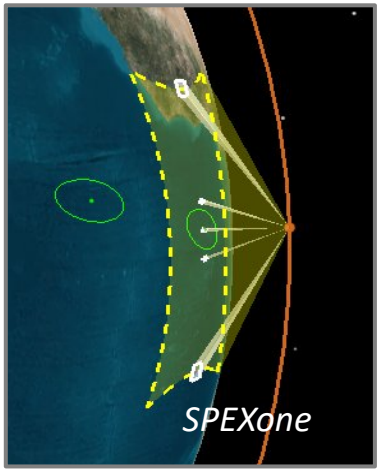
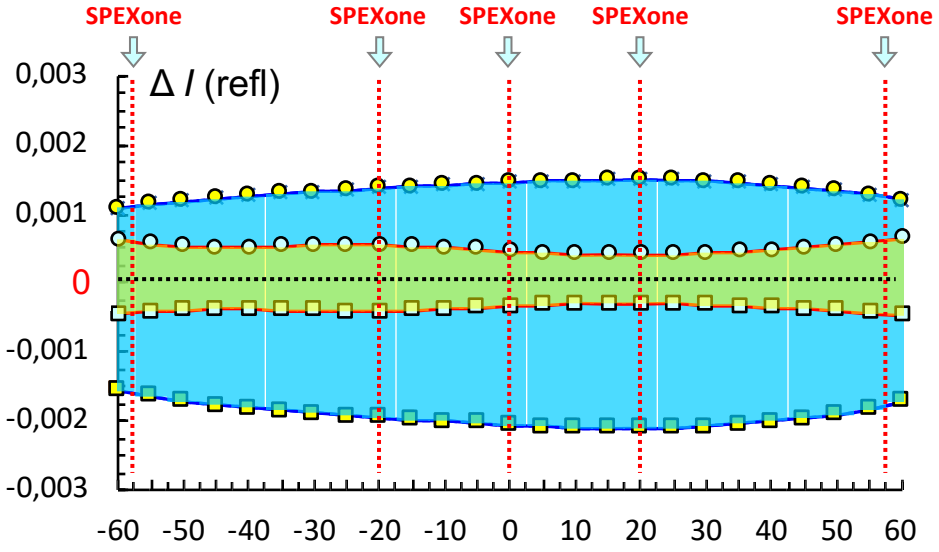


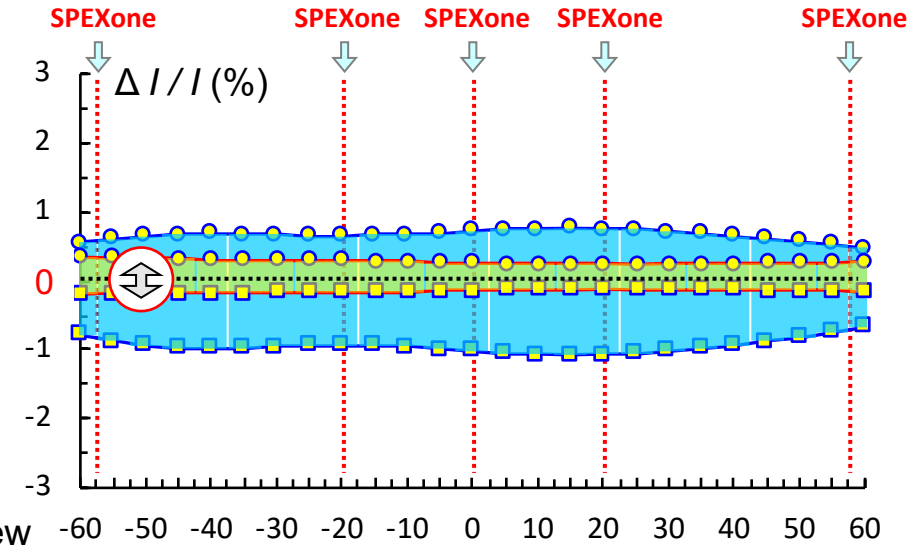


Box 2

TOA observations

Sensitive to Δ(CDOM) | Sensitive to Δ(BrC) | Sensitive to Δ(CDOM) *and* Δ(BrC) | Accuracy





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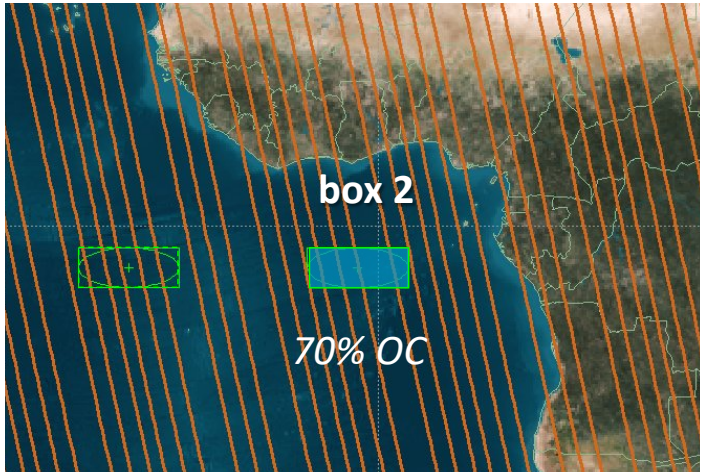

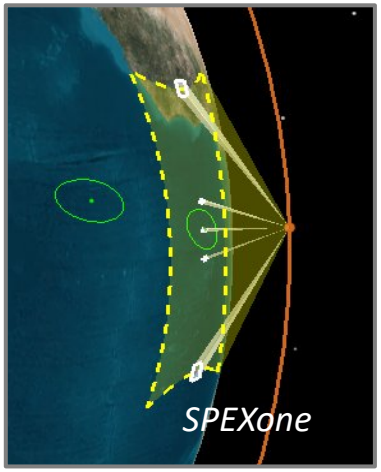

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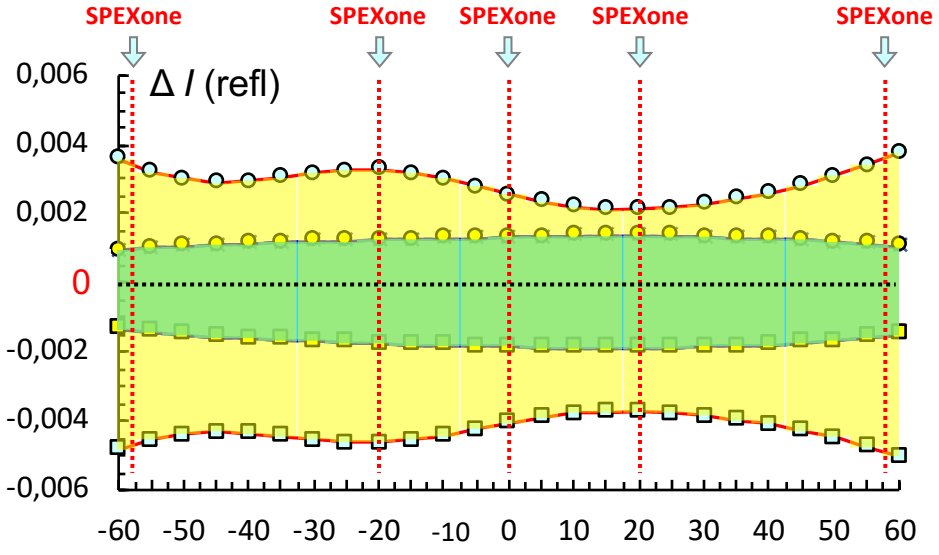

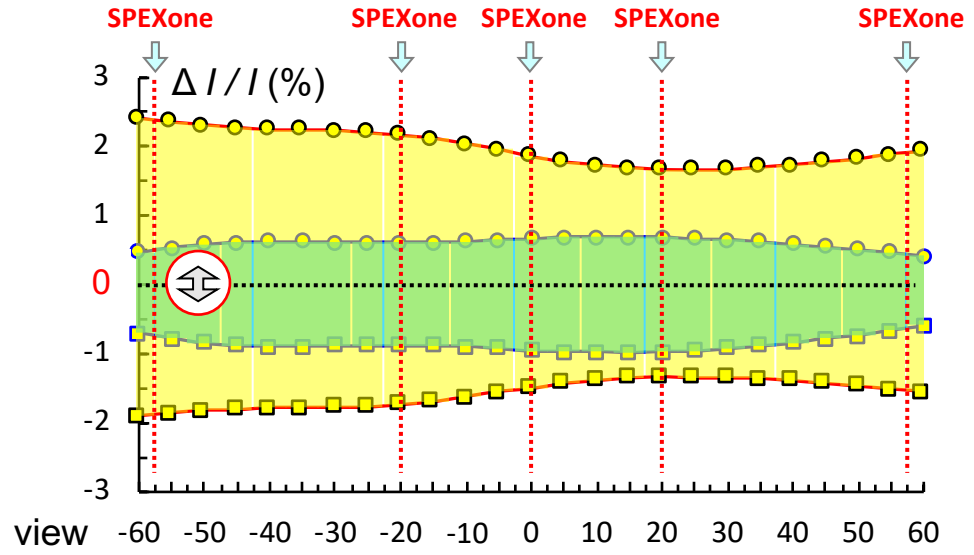

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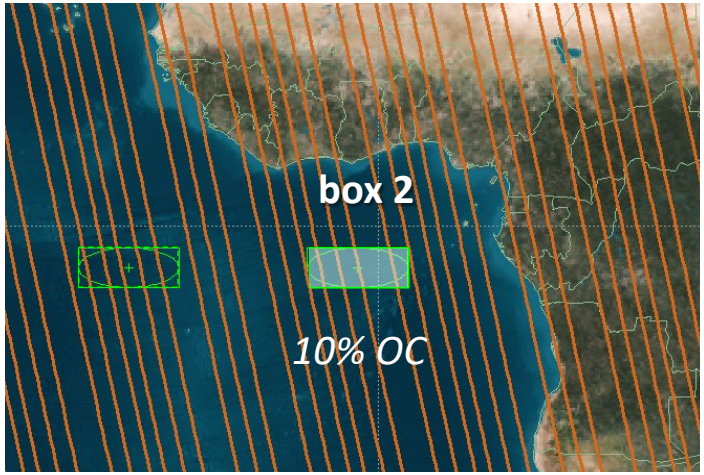

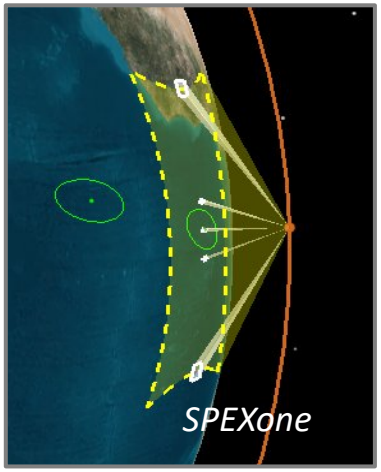

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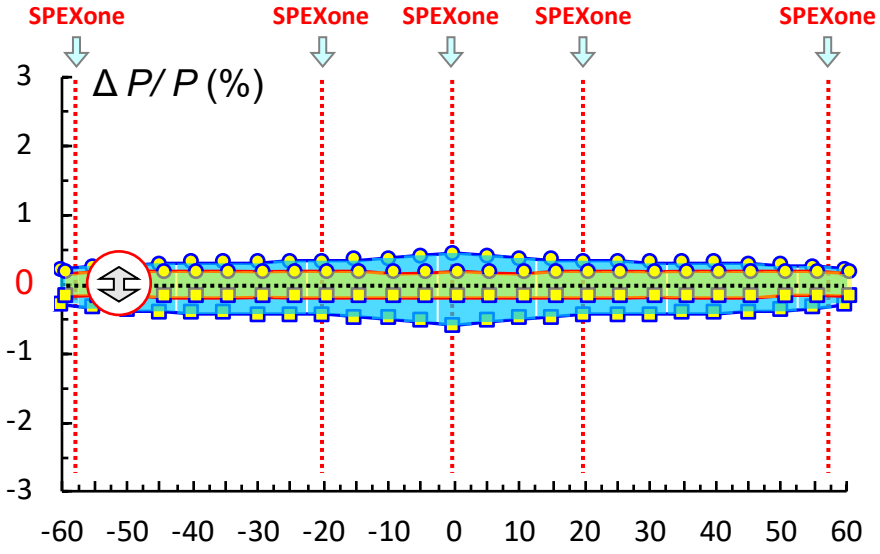

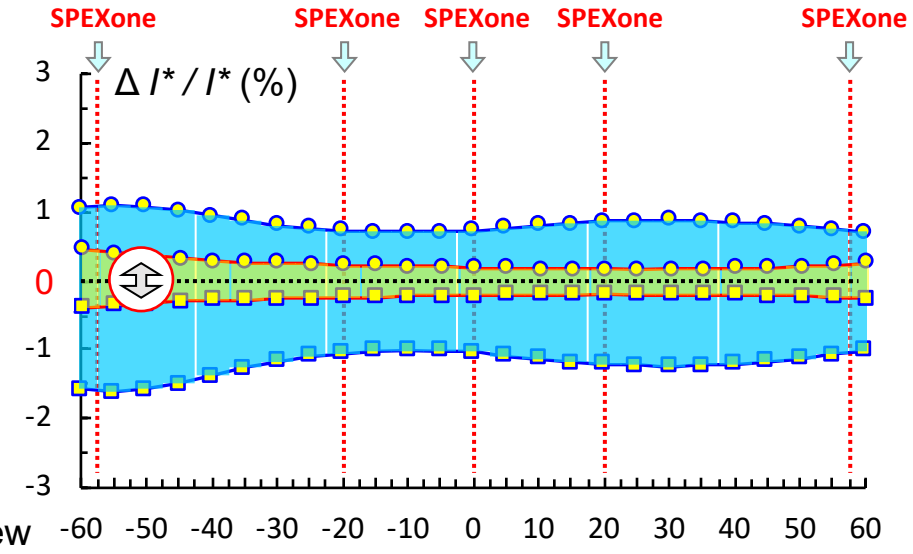

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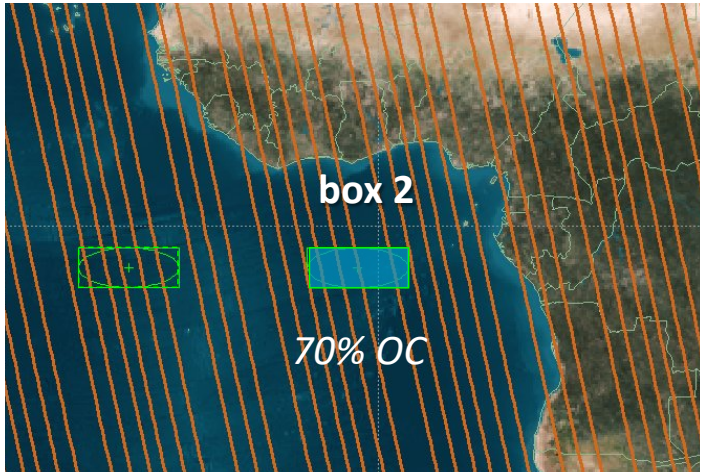

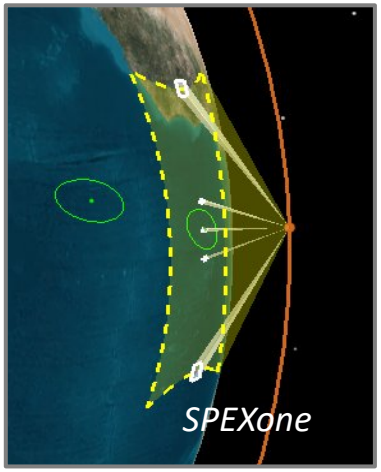

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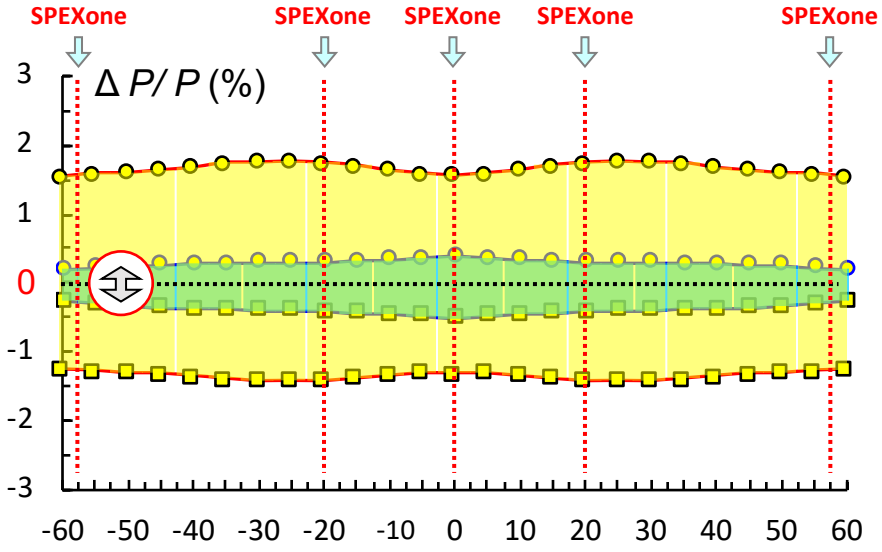

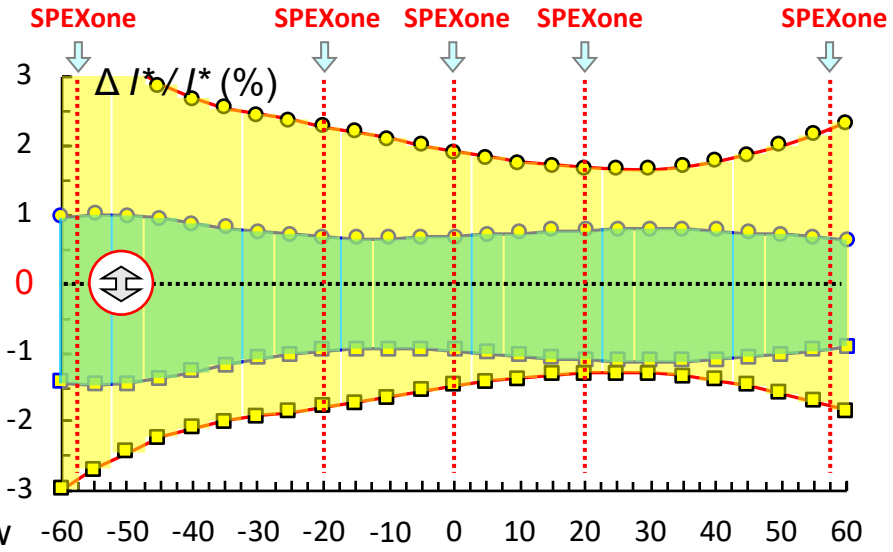

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Summary

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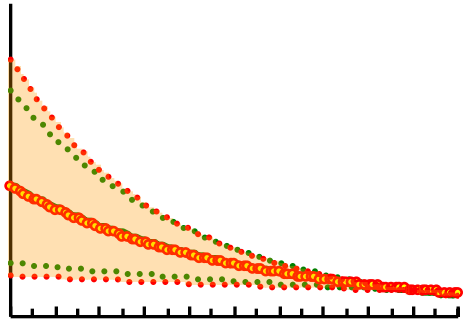
What do we want you to remember from this study?

1. CDOM and BrC have similar absorption spectra
   → Snorre Stamnes, Tuesday
2. BrC and CDOM impact on UV radiance can comparable
3. Multiangular UV measurements from SPEXone will be extremely helpful in separating BrC and CDOM impact
   → Robert Frouin, Thursday

1.



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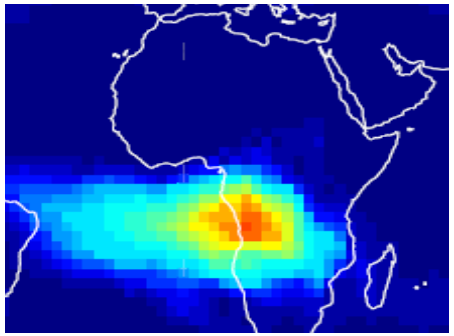

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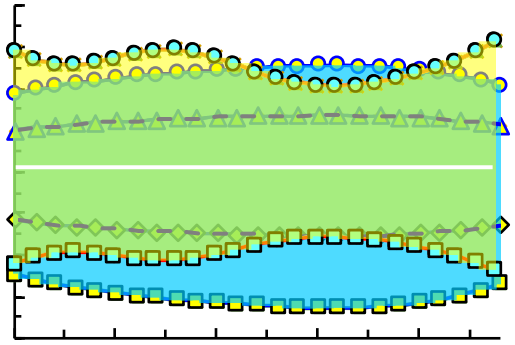

3.