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Tutorial on the OSOAA radiative transfer model

Ocean Successive Orders with Atmosphere - Advanced

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Outlines

- Software installation
- Graphical User Interface (GUI)
- Running the model using GUI
- Output files presentation
- Running the model using command files
- Examples of simulations

Software installation

- Download site (CNES website):
<https://github.com/CNES/RadiativeTransferCode-OSOAA>
- Deposite on personnal OSOAA root repertory
- Define the OSOAA_ROOT path



```
bruno@PO13561LX:~  
Fichier Édition Affichage Rechercher Terminal Aide  
[bruno@PO13561LX ~]$ ls -a  
.  
..  
.bash_history  
.bash_logout  
.bash_profile  
.bashrc  
Bureau  
.cache  
.config  
connectVPN.sh  
.dbus  
disconnectVPN.sh  
Documents  
.esd_auth  
.GlobalProtect  
.ICEauthority  
Images  
.local  
Modèles  
.mozilla  
Musique  
# .bashrc  
#OSOAA ROOT path  
export OSOAA_ROOT=/home/bruno/OSOAA_V2.0  
[bruno@PO13561LX ~]$ gedit .bashrc
```

Software installation

- List of directories

doc /
→ Documentation

ihm / (GUI)
→ Graphical User Interface tools

src /
→ Source programs

inc /
→ Constant parameters
(e.g., number of Gauss angles, threshold values,...)



gen /
→ Makefiles for the compilation

obj /
→ Compiled files

exe /
→ Executable code

fic /
→ Ancillary database

(e.g. aerosol models, seabed reflectance, ...)

- Compilation :

- cd \$OSOAA_ROOT/gen
- **make -f makefile_OSOAA.gfortran**
(or *.g77 or *.f77)

Launch of OSOAA model

- GUI launch
 - Prerequisite

Test : « java -version »
Must be version 16 or higher
 - `cd $OSOAA_ROOT/ihm/bin`
`./runOSOAAUI.bash`

Graphical User Interface (GUI)

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.443 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : | Show command | RUN

- Home
- ✓ Atmospheric & sea profiles
- ✓ Aerosols model
- ✓ Hydrosols model
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- Process tracker

Welcome to OSOAA

version 2.0



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Scientific Principal Investigator : Malik CHAMI (Sorbonne Université)
Technical Principal Investigator : Bruno LAFRANCE (CS GROUP company)
Chief Project Officer : Aimé MEYGRET (CNES)

Description of the GUI

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.443 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory :

Show command

RUN

Home
✓ Atmospheric & sea profiles
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✓ Hydrosols model
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✓ Geometric parameters
✓ Output specificities
⚙ Process tracker



- Top menu bar defines specific parameters
 - Wavelength of simulation (in μm)
 - SZA = Solar Zenith Angle (in degrees)
 - User's working folder (i.e. output files)
 - Requires the name of the full path directory

Description of the GUI

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.443 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory :

Show command

RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
Process tracker

- Top menu bar defines specific parameters
 - Wavelength of simulation (in μm)
 - ▶ Let's set 0.442 μm
 - SZA = Solar Zenith Angle (in degrees)
 - ▶ Let's set 30°
 - User's working folder (i.e. output files)
 - ▶ Let's define a working folder, as an example :
/home/bruno/OSOAA_TUTORIAL/SIMU_1

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working path : /home/bruno/OSOAA_TUTORIAL/SIMU_1

Description of the GUI

The screenshot shows the OSOAA GUI window titled "OSOAA :: Ocean Successive Orders with Atmosphere Advanced". The top bar contains input fields for "Radiance wavelength : 0.442 μm", "Solar zenith angle : 30 deg", a checkbox for "Expert mode", and a text field for "Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1". There are also buttons for "Show command" and "RUN". On the left, a sidebar lists six GUI windows: "Home", "Atmospheric & sea profiles", "Aerosols model", "Hydrosols model", "Sea/atmosphere interface", "Geometric parameters", "Output specificities", and "Process tracker". A blue arrow points from a callout box labeled "6 GUI windows" to the "Home" window. The main area displays a list of parameters to define for a simulation, grouped into "Physical parameters" and "Outputs specifications".

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home

- ✓ Atmospheric & sea profiles
- ✓ Aerosols model
- ✓ Hydrosols model
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- ⚙ Process tracker

6 GUI windows

- To perform a simulation, the user must define :
 - Atmospheric profile
 - Sea surface conditions
 - Sea water profile (composition and abundance)
 - Outputs specifications

Physical parameters

Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Atmospheric & sea prof...

- ✓ Aerosols model
- ✓ Hydrosols model
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- ⊗ Process tracker

Atmospheric and maritime profiles

Note : * means required field

Reset form

--> Reflectance limit conditions parameters

SEA.SurfAlb * : 0 Lambertian reflectance of the foam at the simulation wavelength (albedo of the foam at the sea surface)

SEA.BotType * : USER_LAMBERTIAN Type of seabed composition

SEA.BotAlb * : 0.2 Seabed albedo at the simulation wavelength (Lambertian component)

ATMOSPHERIC PROFILE

--> Atmospheric profile definition parameters

PROFILE_ATM.ResFile : PROFILE_ATM.txt Filename of the output of the atmospheric profile (result file)

PROFILE.Log : Name of log file for OSOAA_PROFILE calculations

--> Molecules

AP.MOT * : 0.23 Molecular optical thickness for the atmospheric profile (for the radiance simulation wavelength).

AP.Pressure * : 1,013 Atmospheric pressure at sea level (mbar)

AP.HR * : 8 Molecular height scale (km)

--> Aerosols

AER.Waref * : 0.55 Reference wavelength (μm) for the aerosol optical thickness (AER.AOTref)

AER.AOTref * : 0.2 Aerosol optical thickness for the reference wavelength

AP.HA * : 2 Aerosol height scale (in km)

SEA PROFILE

PROFILE_SEA.ResFile : PROFILE_SEA.txt Filename of the output of the sea profile

SEA.Depth : 50 Sea depth value (meters)

Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea prof...
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✓ Output specificities
⚙ Process tracker

Atmospheric and maritime profiles

Note : * means required field

Reset form

--> Reflectance limit conditions parameters

SEA.SurfAlb * : 0 Lambertian
SEA.BotType * : USER_LAMBERTIAN Type of sea
SEA.BotAlb * : 0.2 Seabed alb

ATMOSPHERIC PROFILE

--> Atmospheric profile definition parameters

PROFILE_ATM.ResFile : PROFILE_ATM.txt Filename of
PROFILE.Log : Name of log

--> Molecules

AP.MOT * : 0.23 Molecular o
AP.Pressure * : 1,013 Atmospheri
AP.HR * : 8 Molecular h

--> Aerosols

AER.Waref * : 0.55 Reference v
AER.AOTref * : 0.2 Aerosol opt
AP.HA * : 2 Aerosol he

SEA PROFILE

PROFILE_SEA.ResFile : PROFILE_SEA.txt Filename of
SEA.Depth : 50 Sea depth

Sea surface albedo (e.g. foam)

Seabed depth

Seabed composition to get albedo

Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea prof...
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Atmospheric and maritime profiles

Note : * means required field

Reset form

4 predefined seabed reflectance models

FILENAME : fic/info_OSOAA_SEA_BOTTOM_REFLECTANCES.txt

Seabed reflectance

Wavelength (nm)

Light sand
Green algae
Brown algae
Red algae

Atmospheric PROFILE

Profile ATM ResFile : PROFILE_ATM.txt

Profile Log :

Molecules

AP.MOT * : 0.23

AP.Pressure * : 1.013

AP.HR * : 8

Aerosols

AER.Waref * : 0.55

AER.AOTref * : 0.2

AP.HA * : 2

SEA PROFILE

Profile SEA ResFile : PROFILE_SEA.txt

SEA.Depth : 50

Filename of the output of the sea profile

Sea depth value (meters)

Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
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Atmospheric and maritime profiles

Note : * means required field

Reset form

--> Reflectance limit conditions parameters

SEA.SurfAlb * : 0 Lambertian reflectance of the foam at the simulation wavelength (albedo of the foam at the sea surface)

SEA.BotType * : USER_LAMBERTIAN Type of seabed composition

SEA.BotAlb * : 0.2 Backscattered albedo at the simulation wavelength (backscattering component)

ATMOSPHERIC PROFILE

--> Atmospheric profile definition parameters

PROFILE_ATM.ResFile : PROFILE_ATM.txt

PROFILE.Log :

--> Molecules

AP.MOT * : 0.23 Molecular optical thickness for the atmospheric profile (for the radiance simulation wavelength).

AP.Pressure * : 1,013 Atmospheric pressure at sea level (mbar)

AP.HR * : 8 Molecules height scale HR (km)

--> Aerosols

AER.Waref * : 0.55 Reference wavelength (μm) for the aerosol optical thickness (AER.AOTref)

AER.AOTref * : 0.2 Aerosol optical thickness for the reference wavelength

AP.HA * : 2 Aerosols height scale HA (km)

SEA PROFILE

FILE_SEA.ResFile : PROFILE_SEA.txt Filename of the output of the sea profile

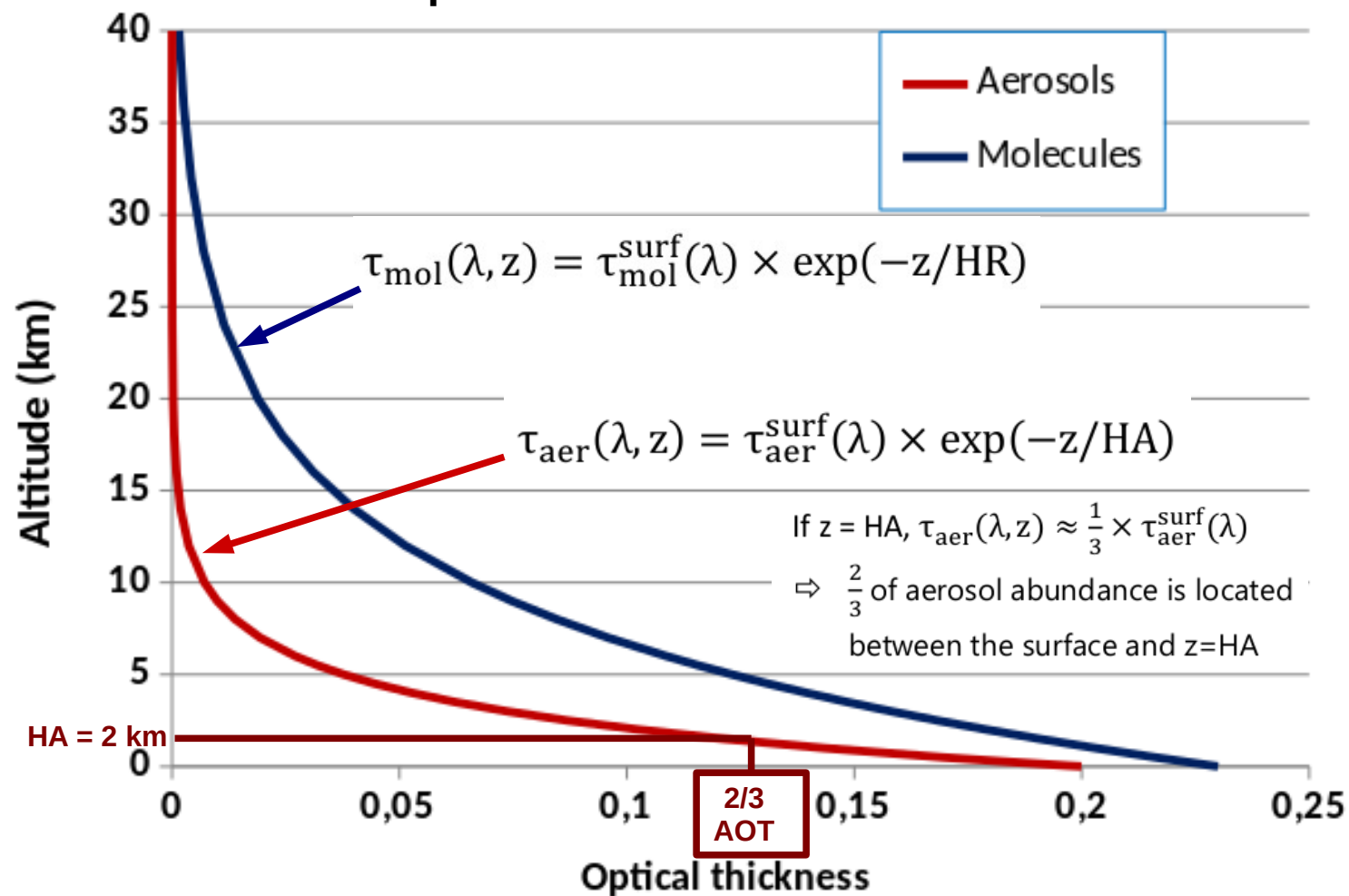
SEA.Depth : 50 Sea depth value (meters)

Annotations:

- λ_{ref} points to AER.Waref *
- Aerosol optical thickness points to AER.AOTref *
- Aerosols height scale HA (km) points to AP.HA *
- Molecular optical thickness → Pressure not required points to AP.MOT *
- Molecules height scale HR (km) points to AP.HR *

Atmospheric & maritime profiles

Vertical profile of molecules and aerosols



Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
 ✓ Atmospheric & sea prof...
 ✓ Aerosols model
 ✓ Hydrosols model
 ✓ Sea/atmosphere interface
 ✓ Geometric parameters
 ✓ Output specificities
 Process tracker

Atmospheric and maritime profiles

Note : * means required field

Reset form

--> Reflectance limit conditions parameters

SEA.SurfAlb * : 0.2 Lambertian reflectance of the foam at the simulation wavelength (albedo of the foam at the sea surface)

SEA.BotType * : USER_LAMBERTIAN Type of seabed composition

SEA.BotAlb * : 0.2 Seabed albedo at the simulation wavelength (Lambertian component)

ATMOSPHERIC PROFILE

--> Atmospheric profile definition parameters

PROFILE_ATM.ResFile : PROFILE_ATM.txt Filename of the output of the atmospheric profile (result file)

PROFILE.Log : Name of log file for OSOAA_PROFILE calculations

--> Molecules

AP.MOT * : 0.23 Molecular optical thickness for the atmospheric profile (for the radiance simulation wavelength)

AP.Pressure * : 1,013 **Pressure (mbar)**
 → Molecular optical thickness not required

AP.HR * : 8

--> Aerosols

AER.Wref * : 0.55 Reference wavelength (μm) for the aerosol optical thickness (AER.AOTref)

AER.AOTref * : 0.2 Aerosol optical thickness for the reference wavelength

AER.HA * : 2 Aerosol height scale (in km)

SEA PROFILE

PROFILE_SEA.ResFile : PROFILE_SEA.txt Filename of the output of the sea profile

SEA.Depth : 50 Sea depth value (meters)

Hansen & Travis (1974) formulation to derive the molecular optical thickness from Pressure

$$\tau_{\text{mol}}^{\text{surf}} = \frac{P}{P_0} \times \left(\frac{84,35}{\lambda^4} + \frac{-1,225}{\lambda^5} + \frac{1,4}{\lambda^6} \right) \times 10^{-4}$$

Atmospheric & maritime profiles

- Setting for the example #1 : SIMU_1
 - Open ocean with deep sea bottom and weak surface wind
 - ▶ *Let's set a depth at 500 m*
 - ▶ *Let's set the seabed albedo to 0*
 - ▶ *Let's set the sea surface albedo to 0*
 - Standard atmosphere : sea level pressure and aerosol load (AOT)
 - ▶ *Let's set the Pressure to 1013 mbar*
 - ▶ *Let's set the AOT to 0.2 at $\lambda_{\text{ref}} = 550 \text{ nm}$*
 - ▶ *Set the molecular and aerosols height scales respectively to 8 and 3 km*

Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea prof...
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
⊗ Process tracker

AP.Pressure *: 1,013 Atmospheric pressure at sea level (mbar)
AP.HR*: 8 Molecular height scale (km)

--> Aerosols

AER.Waref*: 0.55
AER.AOTref*: 0.2
AP.HA*: 3

SEA PROFILE

PROFILE_SEA.ResFile : PROFILE_SEA.txt
SEA.Depth : 500

--> Phytoplankton

PHYTO.ProfilType*: HOMOGENEOUS_PROFILE
PHYTO.Chl : 0.03
PHYTO.GP.Chlbg : 0
PHYTO.GP.Chlmax : 0
PHYTO.GP.Deep : 0
PHYTO.GP.Width : 0
PHYTO.Userfile :

--> Mineral-like particles

SED.Csed*: 0.1

--> Yellow substance and detritus

YS.Abs440*: 0
YS.Swa*: 0.014
DET.Abs440*: 0
DET.Swa*: 0.011

Definition of the marine profile :

- Phytoplankton
- Mineral-like Particles
- Yellow substance and detritus

Type of chlorophyll profile
Chlorophyll concentration at sea surface (mg.m-3)
Chlorophyll concentration background (mg.m-3)
Maximum chlorophyll-a concentration (mg.m-3) in the water column (reached at depth PHYTO.GP.Deep)
Depth of the maximum chlorophyll-a value (m)
Half-width of the chlorophyll gaussian peak (m)
Userfile describing the chlorophyll profile

Concentration of mineral-like particles at sea surface (mg.l-1)

Absorption coefficient of yellow substance at 440 nm (m-1)
Exponential slope of the spectral variation of the yellow substance absorption coefficient (m-1)
Absorption coefficient of detritus at 440 nm (m-1)
Exponential slope of the spectral variation of the detritus absorption coefficient (m-1)

Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA

Home

- Atmospheric & sea prof...
- Aerosols model
- Hydrosols model
- Sea/atmosphere interface
- Geometric parameters
- Output specificities
- Process tracker

AP.Pressure *: 1.013 Atmospheric pressure at sea level (mbar)

AP.HR*: 8 Molecular height scale (km)

---> Aerosols

AER.Waref *: 0.55 Reference wavelength (μm) for the aerosol

AER.AOTref *: 0.2 Aerosol optical thickness for the reference

AP.HA*: 3 Aerosol height scale (in km)

SEA PROFILE

PROFILE_SEA.ResFile : PROFILE_SEA.txt Filename of the output of the sea profile

SEA.Depth : 500 Sea depth value (meters)

---> Phytoplankton

PHYTO.ProfilType*: HOMOGENEOUS_PROFILE Type of chlorophyll profile

PHYTO.Chl : 0.03 Chlorophyll concentration at sea surface ($\text{mg} \cdot \text{m}^{-3}$)

PHYTO.GP.Chlbg : 0 Chlorophyll concentration background ($\text{mg} \cdot \text{m}^{-3}$)

PHYTO.GP.Chlmax : 0 Maximum chlorophyll-a concentration ($\text{mg} \cdot \text{m}^{-3}$)

PHYTO.GP.Deep : 0 Depth of the maximum chlorophyll-a value (m)

PHYTO.GP.Width : 0 Half-width of the chlorophyll gaussian peak (m)

PHYTO.Userfile : Userfile describing the chlorophyll profile

---> Mineral-like particles

SED.Csed*: 0.1 Concentration of mineral-like particles at sea bottom ($\text{g} \cdot \text{m}^{-3}$)

---> Yellow substance and detritus

YS.Abs440*: 0 Absorption coefficient of yellow substance at 440 nm (m^{-1})

YS.Swa*: 0.014 Exponential slope of the spectral variation of yellow substance

DET.Abs440*: 0 Absorption coefficient of detritus at 440 nm (m^{-1})

DET.Swa*: 0.011 Exponential slope of the spectral variation of detritus

Chlorophyll profile (phytoplankton)

Homogeneous profile

$$\text{Chl}(z) = \text{Chl}_{\text{surf}}$$

Gaussian profile

$$\text{Chl}(z) = \text{Chl}_{\text{bg}} + \text{Chl}_{\text{zmax}} \cdot \exp\left(-\frac{(z - z_{\text{max}})^2}{2\sigma^2}\right)$$

Lewis et al., 1983 - Morel & Berthon, 1989

User defined profile : Userfile

Z_user (m) ; Chl_user ($\text{mg} \cdot \text{m}^{-3}$)

Profile of scattering coefficients

$$\sigma_{\text{sca}}^{\text{phyto}}(\lambda, z) = 0.30 \times \left(\frac{550}{\lambda}\right) \times \text{Chl}(z)^{0.62}$$

Morel, 1988

Profile of absorption coefficients

$$\sigma_{\text{abs}}^{\text{phyto}}(\lambda, z) = \text{AP}(\lambda) \times \text{Chl}(z)^{\text{EP}(\lambda)}$$

Bricaud et al. 1998

Atmospheric & maritime profiles

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Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

- Home
- ✓ Atmospheric & sea prof...
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- ✓ Hydrosols model
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- Process tracker

AP.Pressure *: 1,013 Atmospheric pressure at sea level (mbar)

AP.HR*: 8 Molecular height scale (km)

--> Aerosols

AER.Waref*: 0.55 Reference wavelength (μm)

AER.AOTref*: 0.2 Aerosol optical thickness for reference wavelength

AP.HA*: 3 Aerosol height scale (in km)

SEA PROFILE

PROFILE_SEA.ResFile : PROFILE_SEA.txt Filename of the output of the sea profile

SEA.Depth : 500 Sea depth value (meters)

--> Phytoplankton

PHYTO.ProfilType*: HOMOGENEOUS_PROFILE Type of chlorophyll profile

PHYTO.Chl : 0.03 Chlorophyll concentration at sea surface

PHYTO.GP.Chlbg : 0 Chlorophyll concentration below depth

PHYTO.GP.Chlmax : 0 Maximum chlorophyll-a concentration

PHYTO.GP.Deep : 0 Depth of the maximum chlorophyll-a concentration

PHYTO.GP.Width : 0 Half-width of the chlorophyll-a concentration

PHYTO.Userfile : Userfile describing the chlorophyll profile

--> Mineral-like particles

SED.Csed* : 0.1 Concentration of mineral-like particles (g/L)

--> Yellow substance and detritus

YS.Abs440*: 0 Absorption coefficient of yellow substance at 440 nm (m⁻¹)

YS.Swa*: 0.014 Exponential slope of the spectral variation of the absorption coefficient of yellow substance (nm⁻¹)

DET.Abs440*: 0 Absorption coefficient of detritus at 440 nm (m⁻¹)

DET.Swa*: 0.011 Exponential slope of the spectral variation of the detritus absorption coefficient (nm⁻¹)

Mineral-Like Particles (MLP) profile (sediment « Sed »)

Homogeneous profile

⇒ User defines the Csed concentration of sediment at sea surface



$$\sigma_{sca}^{sed}(z) = 10^{-6} \times \frac{C_{sed}}{d_{sed}} \times \frac{\tilde{\sigma}_{sca}^{sed}}{\tilde{V}^{sed}}$$

$$\sigma_{ext}^{sed}(z) = \frac{\sigma_{sca}^{sed}(z)}{\omega_0^{sed}}$$

Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

- Home
- ✓ Atmospheric & sea prof...
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- ✓ Hydrosols model
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- ✓ Geometric parameters
- ✓ Output specificities
- Process tracker

AP.Pressure *: 1,013 Atmospheric pressure at sea level (mbar)

AP.HR*: 8 Molecular height scale (km)

--> Aerosols

AER.Waref*: 0.55 Reference wavelength (μm)

AER.AOTref*: 0.2 Aerosol optical thickness for reference wavelength

AP.HA*: 3 Aerosol height scale (in km)

SEA PROFILE

PROFILE_SEA.ResFile : PROFILE_SEA.txt Filename of the output of the sea profile

SEA.Depth : 500 Sea depth value (meters)

--> Phytoplankton

PHYTO.ProfilType*: HOMOGENEOUS_PROFILE Type of chlorophyll profile

PHYTO.Chl : 0.03 Chlorophyll concentration at sea surface

PHYTO.GP.Chlbg : 0 Chlorophyll concentration below depth

PHYTO.GP.Chlmax : 0 Maximum chlorophyll-a concentration

PHYTO.GP.Deep : 0 Depth of the maximum chlorophyll-a concentration

PHYTO.GP.Width : 0 Half-width of the chlorophyll-a concentration

PHYTO.Userfile : Userfile describing the chlorophyll profile

--> Mineral-like particles

SED.Csed* : 0.1 Concentration of mineral-like particles

--> Yellow substance and detritus

YS.Abs440*: 0 Absorption coefficient of yellow substance at 440 nm

YS.Swa*: 0.014 Exponential slope of the spectral variation of the absorption coefficient of yellow substance

DET.Abs440*: 0 Absorption coefficient of detritus at 440 nm (m⁻¹)

DET.Swa*: 0.011 Exponential slope of the spectral variation of the detritus absorption coefficient (m⁻¹)

Mineral-Like Particles (MLP) profile

Homogeneous profile

⇒ User defines the Csed concentration of sediment at sea surface

↓

$$\sigma_{sca}^{sed}(z) = 10^{-6} \times \frac{C_{sed}}{d_{sed}} \times \frac{\tilde{\sigma}_{sca}^{sed}}{\tilde{V}^{sed}}$$

$$\sigma_{ext}^{sed}(z) = \frac{\sigma_{sca}^{sed}(z)}{\omega_0^{sed}}$$

Radiative properties calculated using Mie theory

⇒ dependent on the size distribution

Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
☒ Atmospheric & sea prof...
☒ Aerosols model
☒ Hydrosols model
☒ Sea/atmosphere interface
☒ Geometric parameters
☒ Output specificities
☐ Process tracker

AP.Pressure *: 1,013 Atmospheric pressure at sea level (mbar)
 AP.HR*: 8 Molecular height scale (km)

--> Aerosols
 AER.Waref*: 0.55 Reference wavelength (μm) for the aerosol optical thickness (AER.AOTref)
 AER.AOTref*: 0.2 Aerosol optical thickness for the reference wavelength
 AP.HA*: 3 Aerosol height scale (in km)

SEA PROFILE
 PROFILE_SEA.ResFile : PROFILE_SEA.txt Filename of the output of the sea profile
 SEA.Depth : 500 Sea depth value (meters)

--> Phytoplankton
 PHYTO.ProfilType*: HOMOGENEOUS_PROFILE Type of chlorophyll profile
 PHYTO.Chl : 0.03 Chlorophyll concentration at the surface
 PHYTO.GP.Chlbg : 0 Chlorophyll concentration background
 PHYTO.GP.Chlmax : 0 Maximum chlorophyll-a concentration
 PHYTO.GP.Deep : 0 Depth of the maximum chlorophyll-a concentration
 PHYTO.GP.Width : 0 Half-width of the chlorophyll-a concentration profile
 PHYTO.Userfile : Userfile describing the chlorophyll profile

--> Mineral-like particles
 SED.Csed*: 0.1 Concentration of mineral-like particles

--> Yellow substance and detritus
 YS.Abs440*: 0 Absorption coefficient of yellow substance at 440 nm (m^{-1})
 YS.Swa*: 0.014 Exponential slope of the spectral variation of the yellow substance absorption coefficient (m^{-1})
 DET.Abs440*: 0 Absorption coefficient of detritus at 440 nm (m^{-1})
 DET.Swa*: 0.011 Exponential slope of the spectral variation of the detritus absorption coefficient (m^{-1})

CDOM (YS) and detritus (DET)

- Absorption coefficients at 440 nm (m^{-1})
- Coefficients of the spectral variation S^{ys} and S^{det} (green background = default standard value)

$$a_{ys}(\lambda) = a_{ys}(440) \times \exp[-S^{ys} \times (\lambda - 440)]$$

$$a_{det}(\lambda) = a_{det}(440) \times \exp[-S^{det} \times (\lambda - 440)]$$

Atmospheric & maritime profiles

- Setting for the example #1 : SIMU_1

- Gaussian Chlorophyll profile

- ▶ Let's set a background concentration : $Chl_{bg} = 0.1 \text{ mg.m}^{-3}$

- ▶ Let's set a maximum concentration of the gaussian : $Chl_{z_{max}} = 6 \text{ mg.m}^{-3}$

- ▶ Let's set the depth of $Chl_{z_{max}}$: $z_{max} = 40 \text{ m}$

- ▶ Let's set a standard deviation (σ) of the peak :
 $\sigma = 5 \text{ m}$

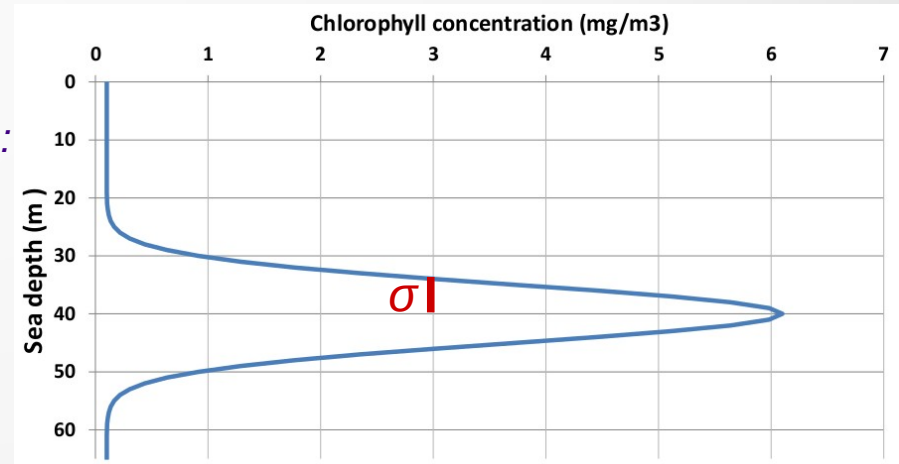
- No Mineral Like Particles

- ▶ Let's set $C_{sed} = 0$

- CDOM

- ▶ Let's set the absorption coefficient $YS.Abs440$ (a_{cdom}) = 0.1 m^{-1}

- No detritus



Atmospheric & maritime profiles

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

- Home
- ✓ Atmospheric & sea prof...
- ✓ Aerosols model
- ✓ Hydrosols model
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- Process tracker

AP.Pressure *: 1,013 Atmospheric pressure at sea level (mbar)

AP.HR*: 8 Molecular height scale (km)

--> Aerosols

AER.Waref*: 0.55 Reference wavelength (μm) for the aerosol optical thickness (AER.AOTref)

AER.AOTref*: 0.2 Aerosol optical thickness for the reference wavelength

AP.HA*: 3 Aerosol height scale (in km)

SEA PROFILE

PROFILE_SEA.ResFile : PROFILE_SEA.txt Filename of the output of the sea profile

SEA.Depth : 500 Sea depth value (meters)

--> Phytoplankton

PHYTO.ProfilType*: GAUSSIAN_PROFILE Type of chlorophyll profile

PHYTO.Chl : 0.03 Chlorophyll concentration at sea surface (mg.m-3)

PHYTO.GP.Chlbg : 0.1 Chlorophyll concentration background (mg.m-3)

PHYTO.GP.Chlmax : 6 Maximum chlorophyll-a concentration (mg.m-3) in the water column (reached at depth PHYTO.GP.Deep)

PHYTO.GP.Deep : 40 Depth of the maximum chlorophyll-a value (m)

PHYTO.GP.Width : 5 Half-width of the chlorophyll gaussian peak (m)

PHYTO.Userfile : Userfile describing the chlorophyll profile

--> Mineral-like particles

SED.Csed*: 0 Concentration of mineral-like particles at sea surface (mg.l-1)

--> Yellow substance and detritus

YS.Abs440*: 0.1 Absorption coefficient of yellow substance at 440 nm (m-1)

YS.Swa*: 0.014 Exponential slope of the spectral variation of the yellow substance absorption coefficient (m-1)

DET.Abs440*: 0 Absorption coefficient of detritus at 440 nm (m-1)

DET.Swa*: 0.011 Exponential slope of the spectral variation of the detritus absorption coefficient (m-1)

The first GUI window is ready !

Aerosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ **Aerosols model**
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
⚙ Process tracker

Aerosols models

Note : * means required field

Reset form

AER.ResFile : PM_AER.txt | Filename for the radiative properties calculated for aerosols (result file)

AER.DirMie * : /home/bruno/OSOAA/DATABASE/MIE | Mie files repository directory (full path)

AER.MieLog : | Name of log file for aerosol Mie calculations

AER.Log : Aerosols.log | Log filename of the OSOAA_PHASE_MATRIX routine

AER.ResFile.IOP : | Filename for the IOPs aerosols (result file)

AER.Trunca : ☒ YES | Phase function truncation

|--> Aerosols : size distribution model

AER.Model * : SHETTLE_AND_FENN_BI_MODAL | Type of aerosol models

AER.SF.Model * : TROPOSPHERIC | Type of Shettle & Fenn model

AER.SF.RH * : 70 | Percentage of relative humidity (from 0 to 99%)

Aerosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ **Aerosols model**
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
⚙ Process tracker

Aerosols models

Note : * means required field

AER.ResFile : PM_AER.txt

AER.DirMie * : /home/bruno/OSOAA/DATABASE/MIE

AER.MieLog :

AER.Log : Aerosols.log

AER.ResFile.IOP :

AER.Trunca : ☒ YES

Phase function truncation

[--> Aerosols : size distribution model]

AER.Model * : SHETTLE_AND_FENN_BI_MODAL

Type of aerosol models

AER.SF.Model * : TROPOSPHERIC

Type of Shettle & Fenn model

AER.SF.RH * : 70

Percentage of relative humidity (from 0 to 99%)

Directory for the storage of Mie calculation results

⇒ Mie calculations can take time (1 or 2 minutes)

Aerosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Home

- ✓ Atmospheric & sea profiles
- ✓ **Aerosols model**
- ✓ Hydrosols model
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- ⚙ Process tracker

Aerosols models

*Note : * means required field*

AER.ResFile :

AER.DirMie * :

AER.MieLog :

AER.Log :

AER.ResFile.IOP :

AER.Trunca : ☒ YES

|--> Aerosols : size distribution model

AER.Model * :

SHETTLE_AND_FENN_BI_MODAL

MONO_MODAL

WMO_MULTI_MODAL

SHETTLE_AND_FENN_BI_MODAL

LOG_NORMAL_BI_MODAL

PHASE_FUNCTIONS_FROM_AN_EXTERNAL_SOURCE

AER.SF.Model :

AER.SF.RH :

Aerosol models

- Mono modal models
(i.e. Log-Normal distribution or Junge power law)
- Predefined standard models :
 - WMO models
 - Shettle & Fenn models
- Bi modal models (i.e. user defined)

Mie calculations

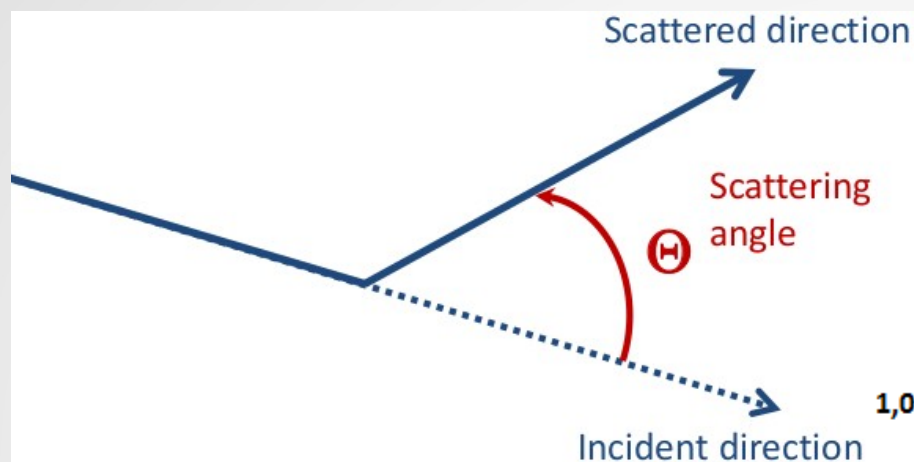
Single scattering albedo

$$\omega_{\lambda}(\tau) = \frac{\tilde{\sigma}_{sca}^{\lambda}(\tau)}{\tilde{\sigma}_{ext}^{\lambda}(\tau)}$$

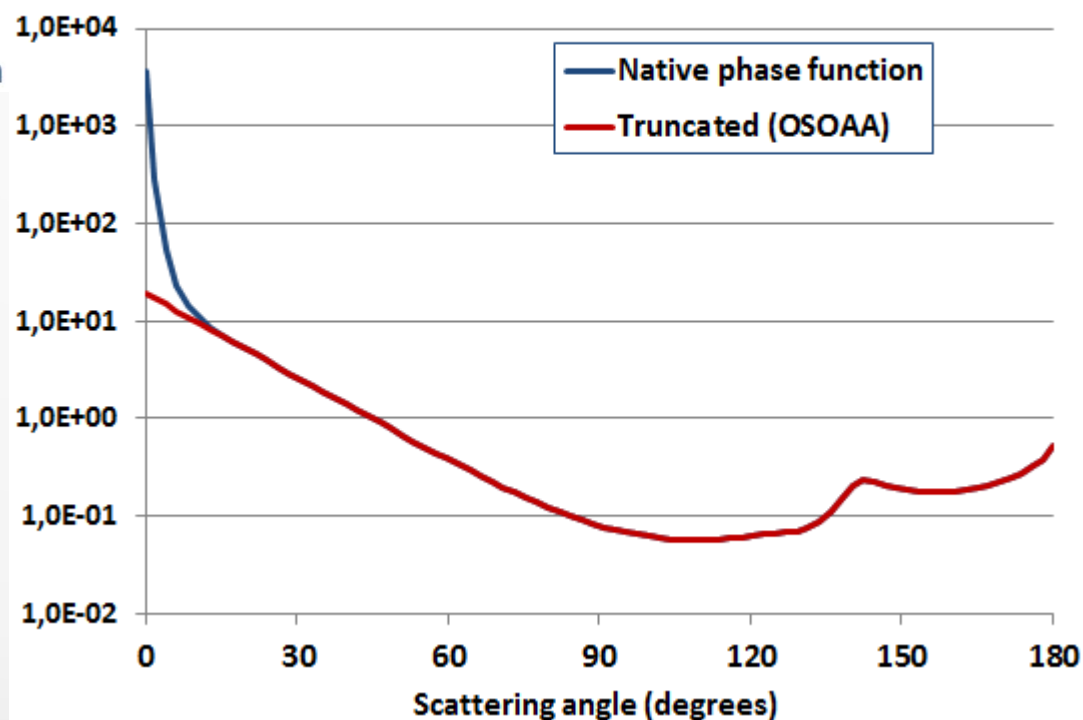
Phase matrix : probability of scattering in a given direction

$$\tilde{P}_{\lambda}(\Theta) = \begin{pmatrix} P_{11}(\Theta) & P_{12}(\Theta) & 0 \\ P_{12}(\Theta) & P_{22}(\Theta) & 0 \\ 0 & 0 & P_{33}(\Theta) \end{pmatrix}$$

Aerosol models



Phase function of Shettle & Fenn Maritime model
98% relative humidity at 442 nm



Note:

The native phase function is truncated in the forward peak within OSOAA to reduce the computation time (Lenoble, 1974 ; Chami et al., 2001)

Aerosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
Process tracker

Aerosols models

Note : * means required field

AER.ResFile : PM_AER.txt
AER.DirMie * : /home/bruno/OSOAA/DATABASE/MIE
AER.MieLog :
AER.Log : Aerosols.log
AER.ResFile.IOP :
AER.Tronca : ☒ YES

|--> Aerosols : size distribution model

AER.Model * : PHASE_FUNCTIONS_FROM_AN_EXTERNAL_SOURCE Type of aerosol models

AER.ExtData * : Filename of external phase function data (full path)

Radiative parameters can be provided by the user too :

- Extinction cross-section
- Scattering cross-section
- Phase matrix functions

Example of a user's phase function data defined by -AER.ExtData

```
EXTINCTION_COEF : 5.43712E-02
SCATTERING_COEF : 5.39636E-02
NB_LINES : 99
Angle      F11      -F12/F11    F22/F11    F33/F11
180.00     4.190E-01    0.000E+00  1.000E+00 -1.000E+00
178.57     3.522E-01    6.297E-02  1.000E+00 -6.856E-01
176.72     3.175E-01   -5.297E-02  1.000E+00 -2.274E-01
174.86     2.848E-01   -1.160E-01  1.000E+00 -2.901E-02
.
```

Aerosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA/TUTORIAL/SIMUL1

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
⚙ Process tracker

Aerosols models

Note : * means required field

AER.ResFile : PM_AER.txt
AER.DirMie * : /home/bruno/OSOAA/DATABASE/MIE
AER.MieLog :
AER.Log : Aerosols.log
AER.ResFile.IOP : ☐

AER.Tronca : ☒ YES

|--> Aerosols : size distribution model

AER.Model * : SHETTLE_AND_FENN_BI_MODAL

AER.SF.Model * : TROPOSPHERIC Type of S
AER.SF.RH * : 70 Percenta

Optional parameter to request Inherent Optical Properties of aerosols

New output for OSOAA V2.0

RADIATIVE PROPERTIES OF AEROSOLS

Cross-sections:

Extinction cross-section (mic^2): 0.18008E+00
Scattering cross-section (mic^2): 0.17968E+00
Single scattering albedo : 0.99774

Phase matrix:

1st column : Scattering angle
2nd column : Phase function P11
3rd column : Polarized phase function P12
4th column : Polarized phase function P22
5th column : Polarized phase function P33

180.00	0.5272E+00	0.0000E+00	0.5272E+00	-0.5272E+00
178.29	0.3849E+00	-0.1455E-01	0.3849E+00	-0.1171E+00
176.07	0.3244E+00	0.4367E-01	0.3244E+00	0.5076E-01
173.84	0.2705E+00	0.5072E-01	0.2705E+00	0.7072E-01
171.61	0.2437E+00	0.4979E-01	0.2437E+00	0.6414E-01
169.37	0.2258E+00	0.3997E-01	0.2258E+00	0.5761E-01
167.14	0.2076E+00	0.2873E-01	0.2076E+00	0.4998E-01
164.90	0.1922E+00	0.1662E-01	0.1922E+00	0.4363E-01
162.67	0.1830E+00	0.8224E-02	0.1830E+00	0.3953E-01
*				
*				
*				

Aerosol models

- Setting for the example #1 : SIMU_1
 - ▶ *Let's define your own repertory for Mie files storage*
 - ▶ *Let's set aerosol optical properties are modelled using the Shettle & Fenn Maritime model for a 98 % relative humidity*

Aerosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ **Aerosols model**
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
⚙ Process tracker

Aerosols models

Note : * means required field

Reset form

AER.ResFile : PM_AER.txt | Filename for the radiative properties calculated for aerosols (result file)

AER.DirMie * : /home/bruno/OSOAA/DATABASE/MIE | Mie files repository directory (full path)

AER.MieLog : | Name of log file for aerosol Mie calculations

AER.Log : Aerosols.log | Log filename of the OSOAA_PHASE_MATRIX routine

AER.ResFile.IOP : | Filename for the IOPs aerosols (result file)

AER.Trunca : ☒ YES | Phase function truncation

|--> Aerosols : size distribution model

AER.Model * : SHETTLE_AND_FENN_BI_MODAL | Type of aerosol models

AER.SF.Model * : MARITIME | Type of Shettle & Fenn model

AER.SF.RH * : 98 | Percentage of relative humidity (from 0 to 99%)

The second GUI window is ready !

Hydrosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

- Home
- ✓ Atmospheric & sea profiles
- ✓ Aerosols model
- ✓ **Hydrosols model**
- ✓ Sea-atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- Process tracker

Hydrosol models : Mineral-like particles and phytoplankton

*Note : * means required field*

HYD.DirMie * : /home/bruno/OSOAA/DATABASE/MIE	Mie files repository directory (full path)
HYD.MieLog :	Log filename of Mie calculations for
HYD.Log :	Name of log file for calculations of h
PHYTO.ResFile : PM_PHYTO.txt	Filename of radiative properties calc
MLP.ResFile : PM_MLP.txt	Filename of radiative properties calc
HYD.ResFile.IOP :	Filename for the IOPs of hydrosols (

☒ By using size distribution models

HYD.Model * : ☐ By using a user-defined external Mueller matrix (phase function,...) and Mie theory for absorption/scattering coefficients

☐ By using a user-defined external Mueller matrix and a user-profile of a and b coefficients

}

Type of hydrosol characterization

|--> Hydrosols characterization by models

|--> Main mode of phytoplankton : Junge distribution

PHYTO.JD.MRwa * :	1.05	Real part of the refractive index at the simulation wavelength
PHYTO.JD.MIwa * :	0	Imaginary part of the refractive index (negative value) at the simulation wavelength
PHYTO.JD.slope * :	4	Slope of Junge's law (positive value, Warning: 3 is a singular value)
PHYTO.JD.rmin * :	0.01	Minimum radius of phytoplankton particles (μm)
PHYTO.JD.rmax * :	200	Maximum radius of phytoplankton particles (μm)
PHYTO.JD.rate * :	1	Rate of the main mode relatively to the overall distribution (i.e. the proportion of phytoplankton particle

|--> Secondary mode of phytoplankton : LND parameters

PHYTO.LND.SM.MRwa :	0	Real part of the refractive index for the secondary LND mode particles at the simulation wavelength
PHYTO.LND.SM.MIwa :	0	Imaginary part of the refractive index for the secondary LND mode particles at the simulation wavelength
PHYTO.LND.SM.SDradius :	0	Modal radius of particles for the secondary LND mode (μm)

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Hydrosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1

Home

- ✓ Atmospheric & sea profiles
- ✓ Aerosols model
- ✓ **Hydrosols model**
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- Process tracker

Directory for the storage of Mie calculation results

HYD.DirMie *: /home/bruno/OSOAA/DATABASE/MIE

HYD.MieLog :

HYD.Log :

PHYTO.ResFile : PM_PHYTO.txt

MLP.ResFile : PM_MLP.txt

HYD.ResFile.IOP :

☒ By using size distribution models
☐ By using a user-defined external Mueller matrix
☐ By using a user-defined external Mueller matrix and a

Hydrosols characterization by models

PHYTO.JD.MRwa *:

PHYTO.JD.Mlwa *:

PHYTO.JD.slope *:

PHYTO.JD.rmin *:

PHYTO.JD.rmax *:

PHYTO.JD.rate *:

PHYTO.LND.SM.MRwa *:

PHYTO.LND.SM.Mlwa *:

PHYTO.LND.SM.SDradius *:

Hydrosol models

- Multi modal model

Junge's law model: Main mode

$$\begin{cases} r \leq r_{\min} : N_{\text{hyd}}^{\text{Junge}}(r) = r_{\min}^{-v} \\ r_{\min} < r \leq r_{\max} : N_{\text{hyd}}^{\text{Junge}}(r) = r^{-v} \\ r > r_{\max} : N_{\text{hyd}}^{\text{Junge}}(r) = 0 \end{cases}$$

Log-Normal size Distribution (LND): secondary and tertiary modes

$$N_i^{\text{LND}}(r) = \frac{1}{r \cdot \sigma_i \cdot \sqrt{2\pi}} \times \exp \left[\frac{-\ln^2(r/r_i)}{2\sigma_i^2} \right] \quad \text{optional}$$

- Radiative parameters can be provided by user

Mie calculations

Single scattering albedo

$$\omega_{\lambda}(\tau) = \frac{\tilde{\sigma}_{\text{sca}}^{\lambda}(\tau)}{\tilde{\sigma}_{\text{ext}}^{\lambda}(\tau)}$$

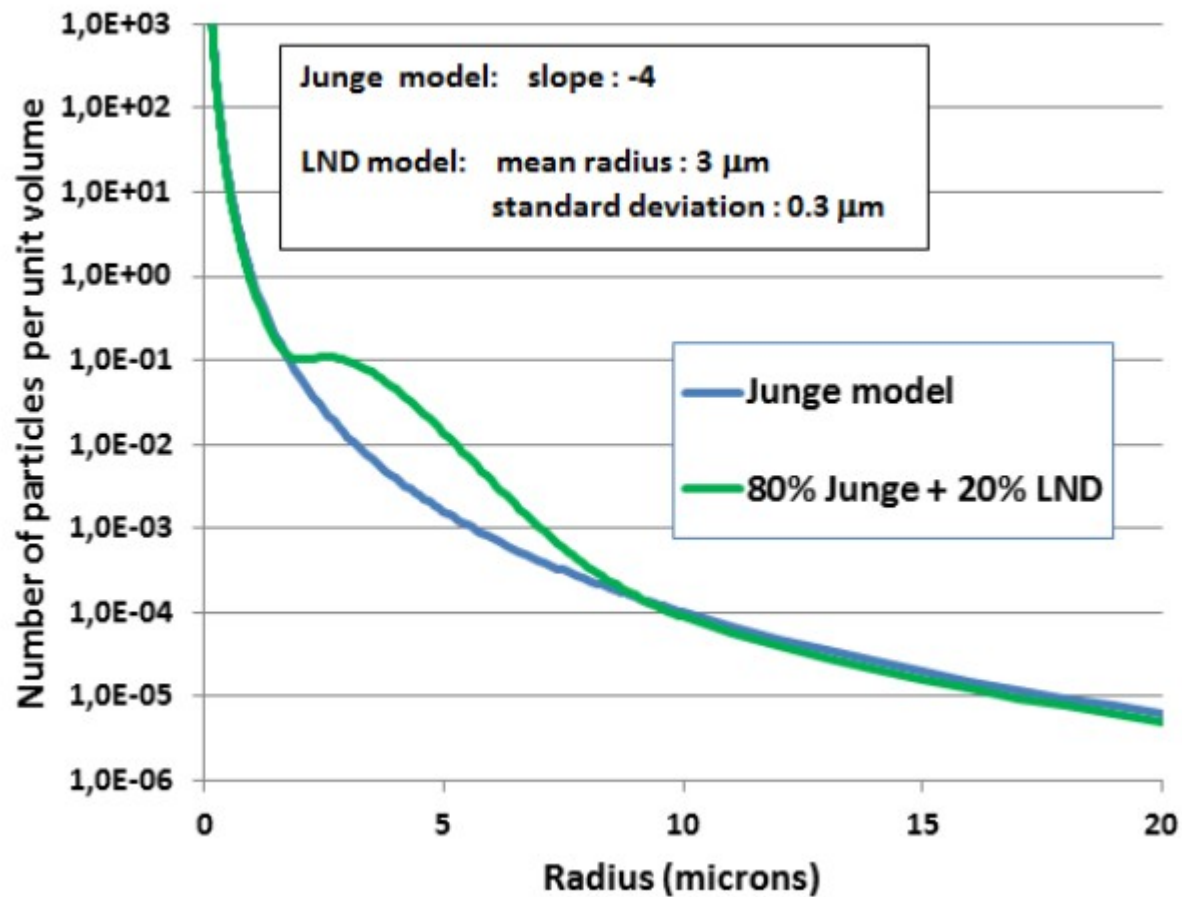
Phase matrix

$$\tilde{P}_{\lambda}(\Theta) = \begin{pmatrix} P_{11}(\Theta) & P_{12}(\Theta) & 0 \\ P_{12}(\Theta) & P_{22}(\Theta) & 0 \\ 0 & 0 & P_{33}(\Theta) \end{pmatrix}$$

P_{11} = Phase function of hydrosols
 P_{12} = Polarized phase function

For these use cases, absorption and scattering profiles (a & b coefficients) are defined on the basis of models

Hydrosol models



Hydrosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1

Home
 ✓ Atmospheric & sea profiles
 ✓ Aerosols model
Hydrosols model
 ✓ Sea/atmosphere interface
 ✓ Geometric parameters
 ✓ Output specificities
 ⚙ Process tracker

Hydrosol models : Mineral-like particles and phytoplankton

Note : * means required field

Reset form

HYD.DirMie * : /home/bruno/OSOAA/DATABASE/MIE

HYD.MieLog :

HYD.Log :

PHYTO.ResFile : PM_PHYTO.txt

MLP.ResFile : PM_MLP.txt

HYD.ResFile.IOP :

☐ By using size distribution models
☐ By using a user-defined external Mueller matrix (phase function,...) and Mie theory for absorption/scattering coefficients
☒ By using a user-defined external Mueller matrix and a user-profile of a and b coefficients

[\[>> Hydrosols model & a and b coef. : external data\]](#)

HYD.ExtData * :

HYD.UserProfile * :

Userfile for sea
 Filename (full path)

New use case :
 Radiative properties and profiles of absorption
 and scattering are provided by the user

Type of hydrosol characterization

The user provides

- Radiative parameters
- Measured profiles of absorption and scattering coefficients of non-water constituents

Total absorption coefficient	Pure seawater absorption coeff	Total scattering coefficient	Pure seawater scattering coeff
z_{user}	$a(z_{\text{user}}) - a_w$	$b(z_{\text{user}}) - b_w$	
Depth (in m)	Hydrosols absorption coefficient (in m^{-1})	Hydrosols scattering coefficient (in m^{-1})	

z_{user}

Depth (in m)

$a(z_{\text{user}}) - a_w$

Hydrosols absorption coefficient (in m^{-1})

$b(z_{\text{user}}) - b_w$

Hydrosols scattering coefficient (in m^{-1})

New feature for OSOAA V2.0

Hydrosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : | Working directory : /home/bruno/OSOAA-TUTORIAL/SIMUL1 | Show command | RUN

- Home
- Atmospheric & sea profiles
- Aerosols model
- Hydrosols model**
- Sea/atmosphere interface
- Geometric parameters
- Output specificities
- Process tracker

Note : * means required field

HYD.DirMie * : /home/bruno/OSOAA/DATABASE/M
 HYD.MieLog :
 HYD.Log :
 PHYTO.ResFile : PM_PHYTO.txt
 MLP.ResFile : PM_MLP.txt
 HYD.ResFile.IOP : ←

☒ By using size distribution mod
 HYD.Model * : ☐ By using a user-defined exte
☐ By using a user-defined exte

--> Hydrosols characterization by models

--> Main mode of phytoplankt

PHYTO.JD.MRwa * :
 PHYTO.JD.Mlwa * :
 PHYTO.JD.slope * :
 PHYTO.JD.rmin * :
 PHYTO.JD.rmax * :
 PHYTO.JD.rate * :

--> Secondary mode of phyto

PHYTO.LND.SM.MRwa :
 PHYTO.LND.SM.Mlwa :
 PHYTO.LND.SM.SDradius :

Optional parameter to request Inherent Optical Properties of hydrosols

New output for OSOAA V2.0

RADIATIVE PROPERTIES OF HYDROSOLS

PHYTOPLANKTON:

Phase matrix:
 1st column : Scattering angle
 2nd column : Phase function P11
 3rd column : Polarized phase function P12
 4th column : Polarized phase function P22
 5th column : Polarized phase function P33

180.00	0.2927E-01	0.0000E+00	0.2927E-01	-0.2927E-01
178.29	0.1973E-01	-0.3624E-03	0.1973E-01	-0.7189E-02
176.07	0.1580E-01	-0.2264E-03	0.1580E-01	-0.1060E-01
*				
*				
3.93	0.1571E+03	0.1298E+00	0.1571E+03	0.1571E+03
1.71	0.4230E+03	0.2201E+00	0.4230E+03	0.4230E+03
0.00	0.1895E+05	0.0000E+00	0.1895E+05	0.1895E+05

Phase function integration (no truncation)
 Phase function integration from 0 to 180 deg: 2.0031944636763619
 Phase function integration from 90 to 180 deg: 1.4899820768392236E-002

MINERAL-LIKE PARTICLES:

*

*

*

**b, bb, bb/b profiles for Phytoplankton,
Mineral-like particles, and for the global mixture**

SCATTERING and BACK-SCATTERING PROFILES

Depth (m)	PHYTOPLANKTON			MINERAL-LIKE PARTICLES			GLOBAL MIXTURE OF PARTICLES		
	b (/m)	bb (/m)	bb/b	b (/m)	bb (/m)	bb/b	b (/m)	bb (/m)	bb/b
0.00	0.89549E-01	0.66713E-03	0.74499E-02	-0.00000E+00	-0.00000E+00	0.00000E+00	0.38093E-01	0.28379E-03	0.74499E-02
0.05	0.89549E-01	0.66713E-03	0.74499E-02	-0.00000E+00	-0.00000E+00	0.00000E+00	0.38093E-01	0.28379E-03	0.74499E-02
0.10	0.89549E-01	0.66713E-03	0.74499E-02	-0.00000E+00	-0.00000E+00	0.00000E+00	0.38093E-01	0.28379E-03	0.74499E-02
*									
*									
39.95	0.11454E+01	0.85330E-02	0.74499E-02	-0.00000E+00	-0.00000E+00	0.00000E+00	0.92739E+00	0.69090E-02	0.74499E-02
40.00	0.11454E+01	0.85333E-02	0.74499E-02	-0.00000E+00	-0.00000E+00	0.00000E+00	0.92742E+00	0.69092E-02	0.74499E-02
40.05	0.11454E+01	0.85330E-02	0.74499E-02	-0.00000E+00	-0.00000E+00	0.00000E+00	0.92739E+00	0.69090E-02	0.74499E-02
*									
*									
*									

Hydrosol models

- Setting for the example #1 : SIMU_1
 - ▶ *Let's define a directory for the storage of Mie calculations*
 - Phytoplankton
 - ▶ *Let's set a refractive index = 1.05 (no imaginary part)*
 - ▶ *Let's set hydrosol size distribution by a Junge model with :*
 - *Minimal radius : $r_{min} = 0.01$*
 - *Maximal radius : $r_{max} = 200 \mu m$*
 - *Slope of the Junge power law : $-v = -4$*
 - No mineral-like particles

Hydrosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

- Home
- ✓ Atmospheric & sea profiles
- ✓ Aerosols model
- ✓ **Hydrosols model**
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ Output specificities
- ⊗ Process tracker

Hydrosol models : Mineral-like particles and phytoplankton

*Note : * means required field*

HYD.DirMie * : /home/bruno/OSOAA/DATABASE/MIE

HYD.MieLog :

HYD.Log :

PHYTO.ResFile : PM_PHYTO.txt

MLP.ResFile : PM_MLP.txt

HYD.ResFile.IOP :

HYD.Model * :
☒ By using size distribution models
☐ By using a user-defined external Mueller matrix (phase function,...) and Mie theory for absorption/scattering coefficients
☐ By using a user-defined external Mueller matrix and a user-profile of a and b coefficients

Mie files repository directory (full path)

Log filename of Mie calculations for

Name of log file for calculations of H

Filename of radiative properties calc

Filename of radiative properties calc

Filename for the IOPs of hydrosols (

} Type of hydrosol characterization

---> Hydrosols characterization by models

---> Main mode of phytoplankton : Junge distribution

PHYTO.JD.MRwa * : 1.05

PHYTO.JD.MIwa * : 0

PHYTO.JD.slope * : 4

PHYTO.JD.rmin * : 0.01

PHYTO.JD.rmax * : 200

PHYTO.JD.rate * : 1

---> Secondary mode of phytoplankton : LND parameters

PHYTO.LND.SM.MRwa : 0

PHYTO.LND.SM.MIwa : 0

PHYTO.LND.SM.SDradius : 0

Real part of the refractive index at the simulation wavelength

Imaginary part of the refractive index (negative value) at the simulation wavelength

Slope of Junge's law (positive value, Warning: 3 is a singular value)

Minimum radius of spherical particles (nm)

Maximum radius of spherical particles (nm)

Real part of the refractive index at the simulation wavelength

Imaginary part of the refractive index at the simulation wavelength

Minimum radius of spherical particles (nm)

Junge Distribution rate = 1

⇒ Ensure to only define a 100 % Junge distribution (no other distribution modes)

Whatever the value set for LND secondary and tertiary modes, it will not be accounted for as long as PHYTO.JD.rate = 1

38

Hydrosol models

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1

Show command RUN

- Home
- Atmospheric & sea profiles
- Aerosols model
- Hydrosols model**
- Sea/atmosphere interface
- Geometric parameters
- Output specificities
- Process tracker

PHYTO.LND.TM.MRwa : 0 Real part of the refractive index for the tertiary LND mode particles at the simulation wavelength

PHYTO.LND.TM.MIwa : 0 Imaginary part of the refractive index for the tertiary LND mode particles at the simulation wavelength

PHYTO.LND.TM.SDradius : 0 Modal radius of particles for the tertiary LND mode (μm)

PHYTO.LND.TM.SDvar : 0 Standard deviation of particles for the tertiary LND mode

PHYTO.LND.TM.rate : 0 Rate of the tertiary mode relatively to the overall distribution (i.e. the proportion of Mineral-Like particles for the tertiary mode)

Whatever the values set for parameterizing the Mineral-like particles optical properties, they will not be accounted for as long as a null concentration is set (SED.Csed = 0)

SED.JD.MRwa * : 1.15 Real part of the refractive index at the simulation wavelength

SED.JD.MIwa * : 0 Imaginary part of the refractive index (negative value) for the simulation wavelength

SED.JD.slope * : 4 Slope of Junge's law (positive value. Warning: 3 is a singular value)

SED.JD.rmin * : 0.01 Minimum radius of mineral-like particles (μm)

SED.JD.rmax * : 200 Maximum radius of mineral-like particles (μm)

SED.JD.rate * : 1 Rate of the main mode relatively to the overall distribution (i.e. the proportion of Mineral-Like particles for the main mode)

--> Secondary mode of mineral-like particles : LND parameters

SED.LND.SM.MRwa : 0 Real part of the refractive index for the secondary LND mode particles at the simulation wavelength

SED.LND.SM.MIwa : 0 Imaginary part of the refractive index for the secondary LND mode particles at the simulation wavelength

SED.LND.SM.SDradius : 0 Modal radius of particles for the secondary LND mode (μm)

SED.LND.SM.SDvar : 0 Standard deviation of LND size distribution

SED.LND.SM.rate : 0 Rate of the secondary mode relatively to the overall distribution (i.e. the proportion of Mineral-Like particles for the secondary mode)

--> Tertiary mode of mineral-like particles : LND parameters

SED.LND.TM.MRwa : 0 Real part of the refractive index for the tertiary LND mode particles at the simulation wavelength

SED.LND.TM.MIwa : 0 Imaginary part of the refractive index for the tertiary LND mode particles at the simulation wavelength

SED.LND.TM.SDradius : 0 Modal radius of particles for the tertiary LND mode (μm)

SED.LND.TM.SDvar : 0 Standard deviation of particles for the tertiary LND mode

SED.LND.TM.rate : 0 Rate of the tertiary mode relatively to the overall distribution (i.e. the proportion of Mineral-Like particles for the tertiary mode)

The third GUI window is ready !

Sea / atmosphere interface

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ **Sea/atmosphere interf...**
✓ Geometric parameters
✓ Output specificities
Process tracker

Sea surface interface

Note : * means required field

Reset form

SEA.Dir *:	/home/bruno/OSOAA/DATABASE/SURF	Surface files repository directory (full path)
SEA.Log :		Name of log file for calculations of surface properties
SEA.Ind *:	1.34	Sea water refractive index for the simulation wavelength
SEA.Wind *:	5	Wind velocity at sea surface (m/s)

Sea / atmosphere interface

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interf...
✓ Geometric parameters
✓ Output specificities
Process tracker

Sea surface interface

Note : * means required field

Reset form

SEA.Dir *	/home/bruno/OSOAA/DATABASE/SURF	Surface files repository directory (full path)
SEA.Log :		Name of log file for calculations of surface properties
SEA.Ind *	1.34	Sea water refractive index for the simulation wavelength
SEA.Wind *	5	Wind velocity at sea surface (m/s)

Directory for the storage of interface matrices (reflexion, transmission)

⇒ Calculations can take time (1 or 2 minutes)

⇒ Storage in a database (no recalculation if the computation has been already made)

Sea / atmosphere interface

- Setting for the example #1 : SIMU_1
 - ▶ *Let's define a directory for the storage of surface reflexion and transmission matrices*
 - ▶ *No logfile for surface matrices computations*
 - ▶ *Let's set a surface wind speed null*
 - ▶ *Let's set a refractive index sea/atmosphere = 1.34*

Sea / atmosphere interface

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interf...
✓ Geometric parameters
✓ Output specificities
Process tracker

Sea surface interface

Note : * means required field

Reset form

SEA.Dir *	/home/bruno/OSOAA/DATABASE/SURF	Surface files repository directory (full path)
SEA.Log :		Name of log file for calculations of surface properties
SEA.Ind *	1.34	Sea water refractive index for the simulation wavelength
SEA.Wind *	0	Wind velocity at sea surface (m/s)

The fourth GUI window is ready !

Defining the number of angles used for calculations

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
Process tracker

Geometric conditions

Note : * means required field

ANG.Rad.NbGauss *	48	Number of Gauss angles used for radiance calculation
ANG.Rad.UserAngFile :		File
ANG.Rad.ResFile :	RAD_UsedAngles.txt	Output file name of angles and maximum orders of series expansion to be used for radiance calculations
ANG.Mie.NbGauss *	40	Number of Gauss angles used for phase functions calculation
ANG.Mie.UserAngFile :		File
ANG.Mie.ResFile :	MIE_UsedAngles.txt	Output file name of angles and maximum orders of series expansion to be used for phase function calculations
ANG.Log :	ANGLES.Log	Name of log file for angle calculation

Defines the number of Gauss angles used for :

- radiance calculation (by default 48)
- phase functions calculation (by default 40)

Note :

The higher the number of Gauss angles, the longer the time computations.
The lower the number of Gauss angles, the lower the accuracy of simulations.

It is not recommended to modify the default values.

Defining the number of angles used for calculations

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ **Geometric parameters**
✓ Output specificities
Process tracker

Geometric conditions

Note : * means required field

ANG.Rad.NbGauss *	48	Number of Gauss angles used for radiance calculation (by default 48)
ANG.Rad.UserAngFile :		File
ANG.Rad.ResFile :	RAD_UsedAngles.txt	Output file name of angles and maximum orders of series expansion to be used for phase function calculations
ANG.Mie.NbGauss *	40	Number of Gauss angles used for phase functions calculation (by default 40)
ANG.Mie.UserAngFile :		File
ANG.Mie.ResFile :	MIE_UsedAngles.txt	Output file name of angles and maximum orders of series expansion to be used for phase function calculations
ANG.Log :	ANGLES.Log	Name of log file for angle calculation

Note :

Only the **expert mode** enables to change the default values !

Defining the number of angles used for calculations

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ **Geometric parameters**
✓ Output specificities
Process tracker

The user can add a list of angles for which an output of the radiance calculation is desired

Reset form

ANG.Rad.NbGauss *:	48	Number of Gauss angles for radiance simulation and BRDF/BPDF calculations at sea interface
ANG.Rad.UserAngFile :		File name of user-defined supplementary angles for radiance computations
ANG.Rad.ResFile :	RAD_UsedAngles.txt	Output file name of angles and maximum orders of series expansion to be used for radiance calculations
ANG.Mie.NbGauss *:	40	Number of Gauss angles for phase functions
ANG.Mie.UserAngFile :		File name of user-defined supplementary angles for phase functions
ANG.Mie.ResFile :	MIE_UsedAngles.txt	Output file name of angles and maximum orders of series expansion to be used for phase function calculations
ANG.log :	ANGLES.Log	Name of log file for angle calculation

Example of a user's angles file defined by -ANG.Rad.UserAngFile
In this example, only the radiance calculated for the user's angles will be provided in radiance output files (presented in section 3.4.1).

```
OUTPUT_GAUSS_ANGLES=0
20
25
30
35
40
```

Defining the number of angles used for calculations

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ **Geometric parameters**
✓ Output specificities
Process tracker

Geometric conditions

Note : * means required field

Reset form

ANG.Rad.NbGauss *:	48	Number of Gauss angles for radiance simulation and BRDF/BPDF calculations at sea interface
ANG.Rad.UserAngFile :		File name of user-defined supplementary angles for radiance computations
ANG.Rad.ResFile :	RAD_UsedAngles.txt	Output file name of angles and maximum orders of series expansion to be used for radiance calculations
ANG.Mie.NbGauss *:	40	Number of Gauss angles for phase functions
ANG.Mie.UserAngFile :		File name of user-defined supplementary angles for phase functions
ANG.Mie.ResFile :	MIE_UsedAngles.txt	Output file name of angles and maximum orders of series expansion to be used for phase function calculations
ANG.Log :	ANGLES.Log	Name of log file for angle calculation

► *Let's keep the default setting*

The fifth GUI window is ready !

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ **Output specificities**
Process tracker

Output specificities

Note : * means required field

Reset form

SOS.IGmax : 100

Scattering maximum order

Choice of output type

OSOAA.View.Phi * : 0

Relative azimuth angle (degrees)

OSOAA.View.Level * : Top of Atmosphere

Output level definition

OSOAA.View.Z * : 0

Altitude or depth (meters) for which the radiance will be provided as a function of the viewing zenith angle

OSOAA.View.VZA * : 0

Viewing zenith angle (from 0 to 180 degrees) for which the radiance will be provided as a function of the relative azimuth angle

Output files

SOS.Log :

Name of log file for model core radiative transfer calculations

SOS.ResFile.Bin * : LUM_SF.bin

Filename of the SOS binary output including Fourier series expansions

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt

Output ascii file providing the radiance versus the viewing zenith angle (for the given level and relative azimuth angle)

OSOAA.ResFile.vsZ : LUM_vsZ.txt

Output ascii file providing the radiance versus the depth (for the given viewing zenith angle and relative azimuth angle)

OSOAA.Log : Main.log

Name of the main log file

Advanced outputs

OSOAA.ResFile.Adv.Up : LUM_Advanced_Up.txt

Filename of the output as an ascii file that provides the UPWARD radiance field

OSOAA.ResFile.Adv.Down : LUM_Advanced_Down.txt

Filename of the output as an ascii file that provides the DOWNWARD radiance field

files providing the radiance as a function of the altitude or depth, and viewing zenith angle

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

- Home
- ✓ Atmospheric & sea profiles
- ✓ Aerosols model
- ✓ Hydrosols model
- ✓ Sea/atmosphere interface
- ✓ Geometric parameters
- ✓ **Output specificities**
- Process tracker

Output specificities

Note : * means required field

SOS.IGmax : 100

--> Choice of output type

OSOAA.View.Phi * : 0

OSOAA.View.Level * : Top of Atmosphere

OSOAA.View.Z * : 0

OSOAA.View.VZA : 0

--> Output files

SOS.Log :

SOS.ResFile.Bin * : LUM_SF.bin

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt

OSOAA.ResFile.vsZ : LUM_vsZ.txt

OSOAA.Log : Main.log

--> Advanced outputs

OSOAA.ResFile.Adv.Up : LUM_Advanced_Up.txt

OSOAA.ResFile.Adv.Down : LUM_Advanced_Down.txt

Do not change the IGmax default value to simulate all the interactions (multiple scatterings and reflexions)

Only expert user can possibly modify the default value.

Viewing zenith angle (from 0 to 180 degrees) for which the radiance will be provided as function of the depth

Name of log file for model core radiative transfer calculations

Filename of the SOS binary output including Fourier series expansions

Output ascii file providing the radiance versus the viewing zenith angle (for the given level and wavelength)

Output ascii file providing the radiance versus the depth (for the given viewing zenith angle and wavelength)

Name of the main log file

files providing the radiance as a function of the altitude or depth, and viewing zenith angle

Filename of the output as an ascii file that provides the UPWARD radiance field

Filename of the output as an ascii file that provides the DOWNWARD radiance field

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐

Home
☒ Atmospheric & sea profiles
☒ Aerosols model
☒ Hydrosols model
☒ Sea/atmosphere interface
☒ Geometric parameters
☒ **Output specificities**
☒ Process tracker

Note : * means required field

SOS.IGmax : 1

|--> Choice of output type

OSOAA.View.Phi * :

OSOAA.View.Level * : Top of Atmosphere

OSOAA.View.Z * :

OSOAA.View.VZA :

|--> Output files

SOS.Log :

SOS.ResFile.Bin * : LUM_SF.bin

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt

OSOAA.ResFile.vsZ : LUM_vsZ.txt

OSOAA.Log : Main.log

Important note :

In the OSOAA model, $\Phi_{\text{OSOAA}} = 0$ means that the satellite is located in the specular half-plane and $\Phi_{\text{OSOAA}} = 180^\circ$ means that the satellite is located in the backscattering half-plane

Outputs of the radiometric quantities (radiance, degree of polarization, ...) are provided for a relative azimuth plane « Φ_{OSOAA} » (OSOAA.View.Phi)
 $\Rightarrow L(\theta, \phi)$

Outputs are given for Viewing Zenith Angle (VZA= θ) in the range $[-88^\circ, +88^\circ]$

Backscattering half-plane

Specular half-plane

$\Phi_{\text{OSOAA}} = 180^\circ - \phi$

Scattering angle

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐

Home
 ✓ Atmospheric & sea profiles
 ✓ Aerosols model
 ✓ Hydrosols model
 ✓ Sea/atmosphere interface
 ✓ Geometric parameters
 ✓ **Output specificities**
 Process tracker

Note : * means required field

SOS.IGmax : 1

|--> Choice of output type

OSOAA.View.Phi * :

OSOAA.View.Level * : Top of Atmosphere

OSOAA.View.Z * :

OSOAA.View.VZA :

|--> Output files

SOS.Log :

SOS.ResFile.Bin * : LUM_SF.bin

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt

OSOAA.ResFile.vsZ : LUM_vsZ.txt

OSOAA.Log : Main.log

Convention used for the sign of the viewing zenith angle VZA (for a given azimuth plane)

Outputs of the radiometric quantities (radiance, degree of polarization, ...) are provided for a relative azimuth plane « Φ_{OSOAA} » (OSOAA.View.Phi)
 $\Rightarrow L(\theta, \phi)$

Outputs are given for Viewing Zenith Angle (VZA= θ) in the range $[-88^\circ, +88^\circ]$

Azimuth plane

$\theta < 0$: half plane $\phi + \pi$ zenith $\theta > 0$: half plane ϕ

Upward radiance

Downward radiance

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ **Output specificities**
Process tracker

Note : * means required field

SOS.IGmax : 100

|--> Choice of output type

OSOAA.View.Phi * : 0

OSOAA.View.Level * : **Top of Atmosphere**

OSOAA.View.Z * : Sea bottom

OSOAA.View.VZA : Above Sea surface 0+
Under Sea surface 0-
User's definition of altitude or depth

|--> Output files

SOS.Log :

SOS.ResFile.Bin * : LUM_SF.bin

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt

OSOAA.ResFile.vsZ : LUM_vsZ.txt

OSOAA.Log : Main.log

|--> Advanced outputs

OSOAA.ResFile.Adv.Up : LUM_Advanced_Up.txt

OSOAA.ResFile.Adv.Down : LUM_Advanced_Down.txt

Altitude/depth of the desired outputs

Top of the atmosphere

Any altitude level

Just above sea surface : level 0+

Just below sea surface : level 0-

Any depth level

Seabed

Four pre-defined levels :
Top of Atmosphere,
0+, 0- and seabed

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ **Output specificities**
⚙ Process tracker

Output specificities

Note : * means required field

Reset form

SOS.IGmax : 100

Choice of output type

OSOAA.View.Phi * : 0

OSOAA.View.Level * : User's definition of altitude or depth

OSOAA.View.Z * : 0

OSOAA.View.VZA : 0

Output files

SOS.Log :

SOS.ResFile.Bin * : LUM_SF.bin

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt

OSOAA.ResFile.vsZ : LUM_vsZ.txt

OSOAA.Log : Main.log

Advanced outputs

OSOAA.ResFile.Adv.Up : LUM_Advanced_Up.txt

OSOAA.ResFile.Adv.Down : LUM_Advanced_Down.txt

Altitude or depth Z must be defined by the user if the option « user's definition » is selected

Output level definition
Altitude or depth (meters) for which the radiance will be provided as a function of the viewing zenith angle (from 0 to 180 degrees) for which the radiance will be provided as function of the viewing zenith angle

Name of log file for model core radiative transfer calculations
Filename of the SOS binary output including Fourier series expansions
Output ascii file providing the radiance versus the viewing zenith angle (for the given level)

Associated output filename
⇒ $L(\theta, \phi)$ for Z or predefined level (TOA, 0+, 0-, Seabed)

The radiance $L(\theta, \phi)$ is normalized to an extra-terrestrial solar radiance value E_{sun} of π :

$$L_{\text{OSOAA}}(z) = \pi * L(z) / E_{\text{sun}}$$

Normalized radiance (sr^{-1}) Radiance ($\text{W.m}^{-2}.\mu\text{m}^{-1}.\text{sr}^{-1}$) Solar irradiance ($\text{W.m}^{-2}.\mu\text{m}^{-1}$)

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ **Output specificities**
⚙ Process tracker

Output specificities

Note : * means required field

Reset form

SOS.IGmax : 100 Scattering maximum order

Choice of output type

OSOAA.View.Phi * : 0

OSOAA.View.Level * : Top of Atmosphere

OSOAA.View.Z * : 0

OSOAA.View.VZA * : 0 Viewing zenith angle (from 0 to 180 degrees) for which the radiance will be provided as function of depth

Output files

SOS.Log : Name of log file for model core radiative transfer calculations

SOS.ResFile.Bin * : LUM_SF.bin Filename of the SOS binary output including Fourier series expansions

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt Output ascii file providing the radiance versus the viewing zenith angle (for the given level and wavelength)

OSOAA.ResFile.vsZ : LUM_vsZ.txt Output ascii file providing the radiance versus the depth (for the given viewing zenith angle and wavelength)

OSOAA.Log : Main.log

Advanced outputs

OSOAA.ResFile.Adv.Up : LUM_Advanced_Up.txt Filename of the output as an ascii file that provides the UPWARD radiance field

OSOAA.ResFile.Adv.Down : LUM_Advanced_Down.txt Filename of the output as an ascii file that provides the DOWNWARD radiance field

Viewing zenith angle desired when the optional « output of radiance versus the sea depth » is selected

Associated output filename
⇒ L(Z) for a fixed geometry of observation (θ, ϕ)

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ **Output specificities**
⊞ Process tracker

Output specificities

Note : * means required field

Reset form

SOS.IGmax : 100 | Scattering maximum order

Choice of output type

OSOAA.View.Phi * : 0 | Relative azimuth angle (degrees)

OSOAA.View.Level * : Top of Atmosphere | Output level definition

OSOAA.View.Z * : 0 | Altitude or depth (meters) for which the radiance will be provided as a function of the viewi

OSOAA.View.VZA * : 0 | Viewing zenith angle (from 0 to 180 degrees) for which the radiance will be provided as fun

Output files

SOS.Log : | Name of log file for model core radiative transfer calculations

SOS.ResFile.Bin * : LUM_SF.bin | Filename of the SOS binary output including Fourier series expansions

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt

OSOAA.ResFile.vsZ : LUM_vsZ.txt

OSOAA.Log : Main.log

Advanced outputs

OSOAA.ResFile.Adv.Up : LUM_Advanced_Up.txt

OSOAA.ResFile.Adv.Down : LUM_Advanced_Down.txt

Filename for the advanced file when the optional « output of radiance versus the sea depth or altitude AND the viewing angle » is selected
⇒ $L(Z, \theta)$ for a fixed relative azimuth angle ϕ

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ **Output specificities**
⊞ Process tracker

Output specificities

Note : * means required field

Reset form

SOS.IGmax : 100 | Scattering maximum order

|--> Choice of output type

OSOAA.View.Phi * : 0 | Relative azimuth angle (degrees)

OSOAA.View.Level * : Top of Atmosphere | Output level definition

OSOAA.View.Z * : 0 | Altitude or depth (meters) for which the radiance will be provided as a function of the view

OSOAA.View.VZA * : 0 | Viewing zenith angle (from 0 to 180 degrees) for which the radiance will be provided as fun

|--> Output files

SOS.Log : |

SOS.ResFile.Bin * : LUM_SF.bin | Binary file including the full expansion in Fourier series of the radiance field

OSOAA.ResFile.vsVZA * : LUM_vsVZA.txt | ⇒ Devoted to avoid a full reprocessing when similar inputs are used

OSOAA.ResFile.vsZ : LUM_vsZ.txt | It is recommended to keep the same name of the file for a given set of parameters

OSOAA.Log : Main.log

|--> Advanced outputs

OSOAA.ResFile.Adv.Up : LUM_Advanced_Up.txt

OSOAA.ResFile.Adv.Down : LUM_Advanced_Down.txt

Definition of outputs

- Setting for the example #1 : SIMU_1
 - ▶ *Let's define an observation in the solar principal plane :
Relative azimuth angle $\Phi = 0^\circ$*
 - ▶ *Output (i.e., radiance, reflectance, degree of polarization) for
Top Of Atmosphere*
 - ▶ *Output versus the viewing angle
Let's call the output file : LUMvzVZA_Simu1_TOA.txt*
 - ▶ *No Advanced output files*
 - ▶ *Let's call the binary file : LUM_SF_Simu1.bin*

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ **Output specificities**
○ Process tracker

Output specificities

Note : * means required field

Reset form

SOS.IGmax : 100

Scattering maximum order

Choice of output type

OSOAA.View.Phi * : 0

Relative azimuth angle (degrees)

OSOAA.View.Level * : Top of Atmosphere

Output level definition

OSOAA.View.Z * : 0

Altitude or depth (meters) for which the radiance will be provided as a function of the viewing :

OSOAA.View.VZA * :

Viewing zenith angle (from 0 to 180 degrees) for which the radiance will be provided as function

Output files

SOS.Log :

SOS.ResFile.Bin * : LUM_SF_Simu1.bin

OSOAA.ResFile.vsVZA * : LUM_vsVZA_Simu1_TOA.txt

OSOAA.ResFile.vsZ :

Output ascii file providing the radiance versus the depth (for the given viewing zenith angle de

OSOAA.Log : Main.log

Name of the main log file

Advanced outputs

OSOAA.ResFile.Adv.Up :

Filename of the output as an ascii file that provides the UPWARD radiance field

OSOAA.ResFile.Adv.Down :

Filename of the output as an ascii file that provides the DOWNWARD radiance field

files providing the radiance as a function of the altitude or depth, and viewing zenith angle

The last GUI window is ready !
We are now ready to perform a run !

Definition of outputs

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | **RUN**

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ **Output specificities**
○ Process tracker

Output specificities

Note : * means required field

SOS.IGmax : 100

Scattering maximum order

|--> Choice of output type

OSOAA.View.Phi * : 0

Relative azimuth angle (degrees)

OSOAA.View.Level * : Top of Atmosphere

Output level definition

OSOAA.View.Z * : 0

Altitude or depth (meters) for which the radiance will be provided as a function of the viewing zenith angle

OSOAA.View.VZA : 0

Viewing zenith angle (from 0 to 180 degrees) for which the radiance will be provided as a function of the viewing zenith angle

|--> Output files

SOS.Log :

Name of log file for model core radiative transfer calculations

SOS.ResFile.Bin * : LUM_SF_Simu1.bin

Filename of the SOS binary output including Fourier series expansions

OSOAA.ResFile.vsVZA * : LUM_vsVZA_Simu1_TOA.txt

Output ascii file providing the radiance versus the viewing zenith angle (for the given level definition)

OSOAA.ResFile.vsZ :

Output ascii file providing the radiance versus the depth (for the given viewing zenith angle definition)

OSOAA.Log : Main.log

Name of the main log file

|--> Advanced outputs

OSOAA.ResFile.Adv.Up :

files providing the radiance as a function of the altitude or depth, and viewing zenith angle

Filename of the output as an ascii file that provides the UPWARD radiance field

OSOAA.ResFile.Adv.Down :

Filename of the output as an ascii file that provides the DOWNWARD radiance field

Let's click on the RUN icon

Running OSOAA

The screenshot displays the OSOAA software interface. On the left, a sidebar contains navigation options: Home, Atmospheric & sea profiles, Aerosols model, Hydrosols model, Sea/atmosphere interface, Geometric parameters, Output specificities, and Process tracker (which is highlighted). The main window is titled 'OSOAA :: Ocean Successive Orders with Atmosphere Advanced'. It features input fields for 'Radiance wavelength' (0.442 μm), 'Solar zenith angle' (30 deg), and 'Expert mode' (unchecked). The 'Working directory' is set to '/home/bruno/OSOAA_TUTORIAL/SIMU_1'. A 'Show command' button and a 'RUN' button are also present. The 'Process tracker' section shows the start and end dates (Mar 25, 2025, 11:20:45 AM and 11:20:54 AM) and the time elapsed (9 seconds). Below this, the 'Executed command' is displayed as a long line of shell commands. The 'Process output' section shows the execution progress, including warnings and the successful completion of various calculations (Angles, Aerosols, Hydrosols, Atmospheric and sea profiles, Sea/atmosphere interface, and Radiative transfer). The final status is 'Program terminated successfully.'

Output files

OSOAA :: Ocean Successive Orders with Atmosphere Advanced

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1 | Show command | RUN

OSO... RIAL / SIMU_1

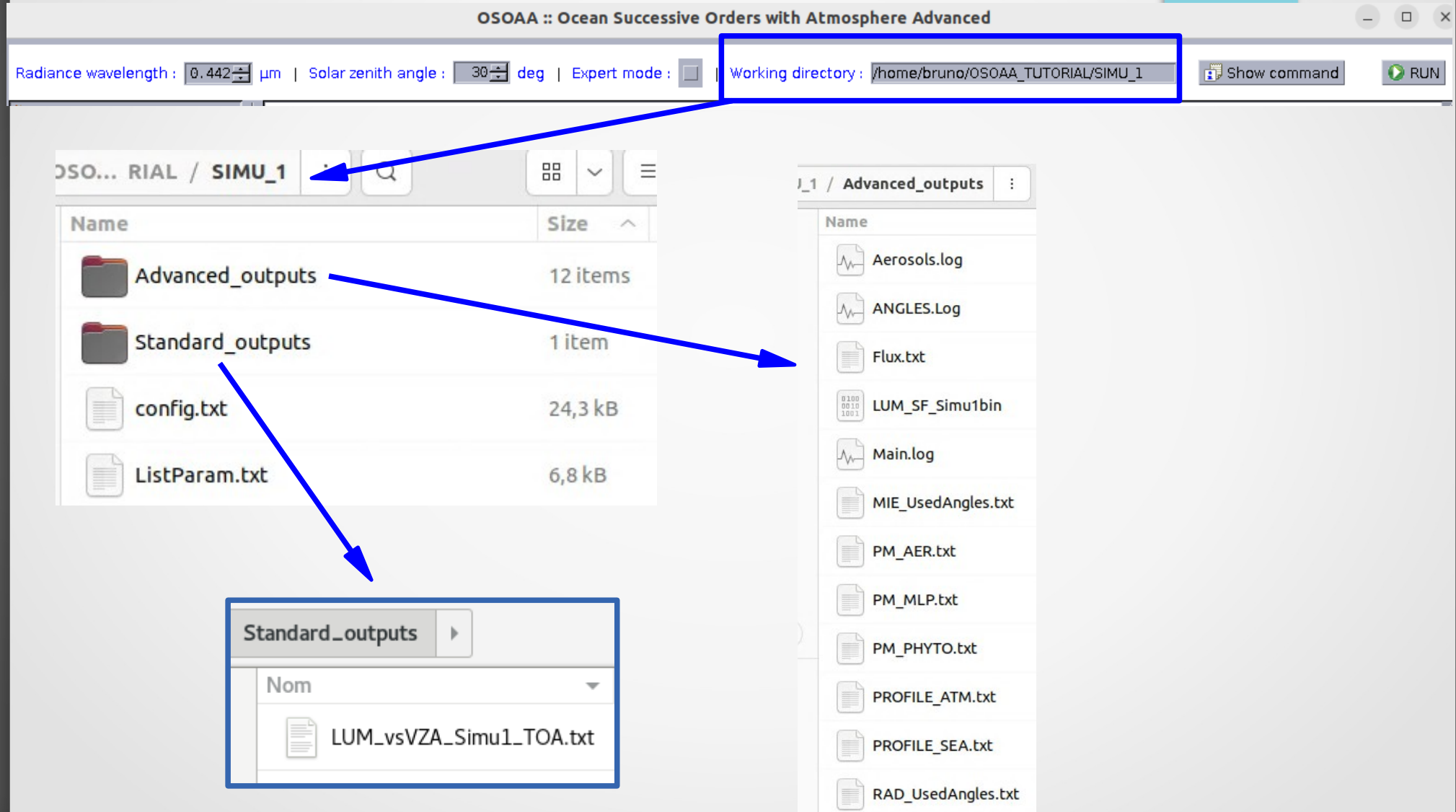
Name	Size
Advanced_outputs	12 items
Standard_outputs	1 item
config.txt	24,3 kB
ListParam.txt	6,8 kB

Advanced_outputs

Name
Aerosols.log
ANGLES.Log
Flux.txt
LUM_SF_Simu1bin
Main.log
MIE_UsedAngles.txt
PM_AER.txt
PM_MLP.txt
PM_PHYTO.txt
PROFILE_ATM.txt
PROFILE_SEA.txt
RAD_UsedAngles.txt

Standard_outputs

Nom
LUM_vsVZA_Simu1_TOA.txt



Output files

Standard_outputs ▶

Nom



LUM_vsVZA_Simu1_TOA.txt

Header of the output file

Viewing Zenith Angle (VZA)

Normalized radiance is defined as:

$$L_{\text{OSOAA}} = \pi * L(z) / E_{\text{sun}}$$

The radiance in geophysical units ($\text{W.m}^{-2}.\text{sr}^{-1}$) is :

$$L_{\text{geophys}} = E_{\text{sun}} * L_{\text{OSOAA}} / \pi$$

STANDARD RESULTS :

UPWARD RADIANCE FIELD VERSUS THE VIEWING ZENITH ANGLE
(RELATIVE AZIMUTH AND ALTITUDE/DEPTH ARE FIXED)

Relative azimuth (degrees) :

Relative azimuth convention :

180 degrees <-> Satellite and Sun in the same half-plane

0 degree <-> Satellite and Sun in opposite half-planes with respect to the zenith direction

Simulated relative azimuth (degrees) :

for VZA < 0 (sign convention): 180.00000000000000

for VZA > 0 (sign convention): 0.0000000000000000

TOA level - Altitude (km) : 300.00000000000000

Columns parameters :

VZA : Viewing Zenith Angle (deg)

SCA_ANG : Scattering angle (deg)

I : Stokes parameter at output level Z (in sr-1)

normalized to the extraterrestrial solar irradiance ($\pi * L(z) / E_{\text{sun}}$)

REFL : Reflectance at output level Z ($\pi * L(z) / E_{\text{d}}(z)$)

POL_RATE: Degree of polarization (%)

LPOL : Polarized intensity at output level Z (in sr-1)

normalized to the extraterrestrial solar irradiance ($\pi * L_{\text{pol}}(z) / E_{\text{sun}}$)

REFL_POL: Polarized reflectance at output level Z ($\pi * L_{\text{pol}}(z) / E_{\text{d}}(z)$)

VZA	SCA_ANG	I	REFL	POL_RATE	LPOL	REFL_POL
-89.07	120.93	0.319458E+00	0.368878E+00	46.34	0.148049E+00	0.170952E+00
-87.20	122.80	0.313348E+00	0.361823E+00	42.39	0.132835E+00	0.153385E+00
-85.34	124.66	0.304782E+00	0.351932E+00	39.30	0.119786E+00	0.138317E+00
-83.47	126.53	0.294714E+00	0.340307E+00	36.87	0.108659E+00	0.125468E+00
-81.61	128.39	0.283251E+00	0.327070E+00	34.84	0.986768E-01	0.113942E+00
-79.74	130.26	0.271018E+00	0.312944E+00	33.01	0.894733E-01	0.103315E+00
-77.88	132.12	0.258639E+00	0.298651E+00	31.26	0.808569E-01	0.933655E-01

Scattering angle

Normalized radiance

Reflectance

Degree of polarization

Polarized normalized radiance

Polarized reflectance

Output files

J_1 / Advanced_outputs

Name

Aerosols.log

ANGLES.Log

Flux.txt

- Advanced_Outputs/Flux.txt

Profile of downward and upward fluxes from TOA to the sea bottom
for a solar extra-terrestrial irradiance at TOA equals to P_0 .

	Level	Z(m)	Direct_Down	Diffuse_Down	Total_Down	Direct_Up	Diffuse_Up	Total_Up	Total_Up/Total_Down
TOA	0	300000.00000	0.272070E+001	0.000000E+000	0.272070E+001	0.230128E-001	0.404820E+000	0.430433E+000	0.158207E+000
	1	21067.00000	0.266862E+001	0.339498E-001	0.270257E+001	0.261126E-001	0.386517E+000	0.412630E+000	0.152680E+000
	2	15700.00000	0.261845E+001	0.660302E-001	0.268448E+001	0.266129E-001	0.368208E+000	0.394821E+000	0.147075E+000
	3	12681.00000	0.257018E+001	0.966905E-001	0.266687E+001	0.271128E-001	0.350364E+000	0.377477E+000	0.141543E+000
	4	10630.00000	0.252376E+001	0.126170E+000	0.264993E+001	0.276115E-001	0.333180E+000	0.360791E+000	0.136151E+000
	5	9105.00000	0.247907E+001	0.154625E+000	0.263369E+001	0.281092E-001	0.316705E+000	0.344814E+000	0.130924E+000
	6	7908.00000	0.243592E+001	0.182210E+000	0.261813E+001	0.286072E-001	0.300893E+000	0.329500E+000	0.125853E+000
	7	6934.00000	0.239421E+001	0.208975E+000	0.260319E+001	0.291055E-001	0.285707E+000	0.314813E+000	0.120934E+000
	*								
	*								
	*								
	24	362.00000	0.182631E+001	0.573796E+000	0.240011E+001	0.381560E-001	0.777433E-001	0.115899E+000	0.482892E-001
	25	177.00000	0.179878E+001	0.590868E+000	0.238965E+001	0.387400E-001	0.669443E-001	0.105684E+000	0.442259E-001
Level 0+	26	0.00000	0.177177E+001	0.607498E+000	0.237927E+001	0.393306E-001	0.564370E-001	0.957676E-001	0.402509E-001
	27	-0.00000	0.173244E+001	0.575489E+000	0.230793E+001	0.000000E+000	0.210157E-001	0.210157E-001	0.910588E-002
Level 0-	28	-0.00000	0.173231E+001	0.575472E+000	0.230778E+001	0.000000E+000	0.210144E-001	0.210144E-001	0.910591E-002
	29	-1.80400	0.130621E+001	0.508931E+000	0.181514E+001	0.000000E+000	0.166171E-001	0.166171E-001	0.915473E-002
	30	-3.60800	0.984920E+000	0.440888E+000	0.142581E+001	0.000000E+000	0.130973E-001	0.130973E-001	0.918590E-002
	31	-5.41200	0.742658E+000	0.376310E+000	0.111897E+001	0.000000E+000	0.103050E-001	0.103050E-001	0.920936E-002
	32	-7.21600	0.559986E+000	0.317575E+000	0.877561E+000	0.000000E+000	0.809873E-002	0.809873E-002	0.922868E-002
	33	-9.02000	0.422245E+000	0.265619E+000	0.687864E+000	0.000000E+000	0.636010E-002	0.636010E-002	0.924615E-002
	*								
	*								
	*								
	103	-51.52900	0.597642E-006	0.928106E-004	0.934082E-004	0.000000E+000	0.918747E-006	0.918747E-006	0.983582E-002
	104	-52.58800	0.473425E-006	0.770871E-004	0.775605E-004	0.000000E+000	0.677501E-006	0.677501E-006	0.873513E-002
	105	-53.84400	0.369093E-006	0.626283E-004	0.629974E-004	0.000000E+000	0.454464E-006	0.454464E-006	0.721402E-002
	106	-55.31400	0.283311E-006	0.497645E-004	0.500478E-004	0.000000E+000	0.238391E-006	0.238391E-006	0.476327E-002
Seabed	107	-56.96200	0.215144E-006	0.389111E-004	0.391262E-004	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000

or depth for which the maximum allowed value of the optical depth is reached ($\tau_{\max} = 30$ for OSOAA)

Additional simulations

- Additional simulations for the example #1 : SIMU_1

Modifications
of the output
conditions

► *Let's perform the same simulation for :*

- *Just above the sea surface : Level 0+
→ Output file : LUMvzVZA_Simu1_Level0p.txt*
- *Just below the sea surface : Level 0-
→ Output file : LUMvzVZA_Simu1_Level0m.txt*

- New setting : example #2 (SIMU_2)

Modifications
of the surface
conditions

- *Same conditions as SIMU_1 but for a surface wind speed of 5 m/s*
- *Outputs for the levels : TOA, 0+ and 0-*

- New setting : example #3 (SIMU_3)

- *Same conditions as SIMU_1 but for a surface wind speed of 10 m/s*
- *Outputs for the levels : TOA, 0+ and 0-*

Additional simulations

- A few comments :
 - Running the same simulation to get radiances for another level is very fast
 - ⇒ Re-use of the previous result file (SOS.ResFile.Bin) including all the radiance fields, over all the maritime and atmospheric profiles
 - Running simulations by introducing a new value of surface wind speed induces an additional calculation of sea/atmosphere interface matrices

```
==> Sea / atmosphere interface matrices computation
Surface matrices repertory : /home/bruno/OSOAA/DATABASE/SURF
Matrix RAA : RAA-1.340-05.0-RadMU48-NB80-SZA30.000-TSZA21.909
-- RAA Matrix file is being calculated
Matrix TAW : TAW-1.340-05.0-RadMU48-NB80-SZA30.000-TSZA21.909
-- TAW Matrix file is being calculated
Matrix RWW : RWW-1.340-05.0-RadMU48-NB80-SZA30.000-TSZA21.909
-- RWW Matrix file is being calculated
Matrix TWA : TWA-1.340-05.0-RadMU48-NB80-SZA30.000-TSZA21.909
-- TWA Matrix file is being calculated
==> Radiative transfer computation
```

Performing a simulation using the command line mode

- The GUI generates and executes a command line

Radiance wavelength : 0.442 μm | Solar zenith angle : 30 deg | Expert mode : ☐ | Working directory : /home/bruno/OSOAA_TUTORIAL/SIMU_1

Home
✓ Atmospheric & sea profiles
✓ Aerosols model
✓ Hydrosols model
✓ Sea/atmosphere interface
✓ Geometric parameters
✓ Output specificities
Process tracker

Process tracker

Start date : Mar 25, 2025, 3:08:15 PM
End date : Mar 25, 2025, 3:08:30 PM
Time elapsed : 14 seconds

Executed command : /home/bruno/Documents/OSOAA/OSOAA_V2.0_testB/exe/OSOAA_MAIN.exe

Format

Executable program file

List of couples : [Keyword , Value]

e.g : -OSOAA.Wa 0.442

```
-AER.AOTRef 0.2 \  
-AER.DirMie /home/bruno/OSOAA/DATABASE/MIE \  
-AER.Log Aerosols.log \  
-AER.Model 2 \  
-AER.ResFile PM_AER.txt \  
-AER.SF.Model 3 \  
-AER.SF.RH 98.00 \  
-AER.Tronca 1 \  
-AER.Waref 0.55 \  
-ANG.Log ANGLES.Log \  
-ANG.Mie.NbGauss 40 \  
-ANG.Mie.ResFile MIE_UsedAngles.txt \  
-ANG.Rad.NbGauss 48 \  
-ANG.Rad.ResFile RAD_UsedAngles.txt \  
-ANG.Thetas 30.00 \  
-AP.HA 3.00 \  
-AP.HR 8.00 \  
-AP.Pressure 1013.00 \  
-DET.Abs440 0.00 \  
-DET.Swa 0.011 \  
-HYD.DirMie /home/bruno/OSOAA/DATABASE/MIE \  
-HYD.Model 1 \  
-MLP.ResFile PM_MLP.txt \  
-OSOAA.Log Main.log \  
-OSOAA.ResFile.vsvZA LUM_vsvZA_Simul_TOA.txt \  
-OSOAA.ResRoot /home/bruno/OSOAA_TUTORIAL/SIMU_1 \  
-OSOAA.View.Level 1 \  
-OSOAA.ViewPhi 0.00 \  
-OSOAA.Wa 0.442 \  
-PHYTO.Chl 0.03 \  
-PHYTO.GP.Chlbg 0.1 \  
-PHYTO.GP.Chlmax 6.00 \  
-PHYTO.GP.Deep 40.00 \  
-PHYTO.GP.Width 5.00 \  
-PHYTO.JD.MIwa 0.00 \  
-PHYTO.JD.MRwa 1.05 \  
-PHYTO.JD.rate 1.00 \  
-PHYTO.JD.rmax 200.00 \  
-PHYTO.JD.rmin 0.01 \  
-PHYTO.JD.slope 4.00 \  

```

Performing a simulation using the command line mode

- Use of shell scripts can help for :

- single simulation
- many simulations using a single script file
- Look-Up Tables calculations

- A demonstration script is available in
\$OSOAA_ROOT/exe

`./run_OSOAA_demo.ksh`

```
dirRESULTS=${OSOAA_ROOT}/OSOAA_RESULTS_DEMO

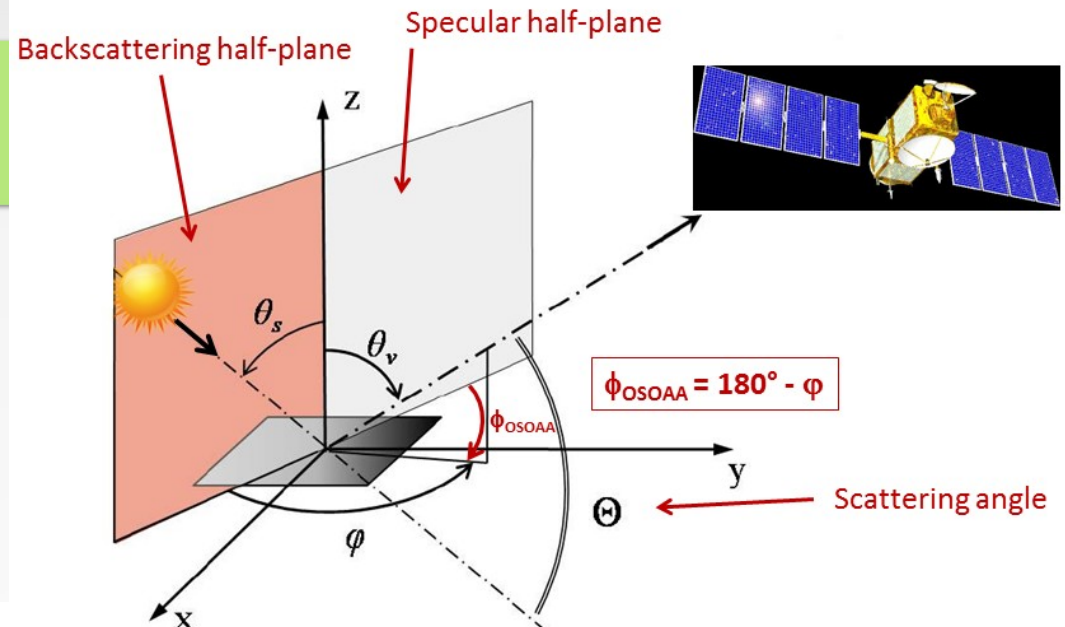
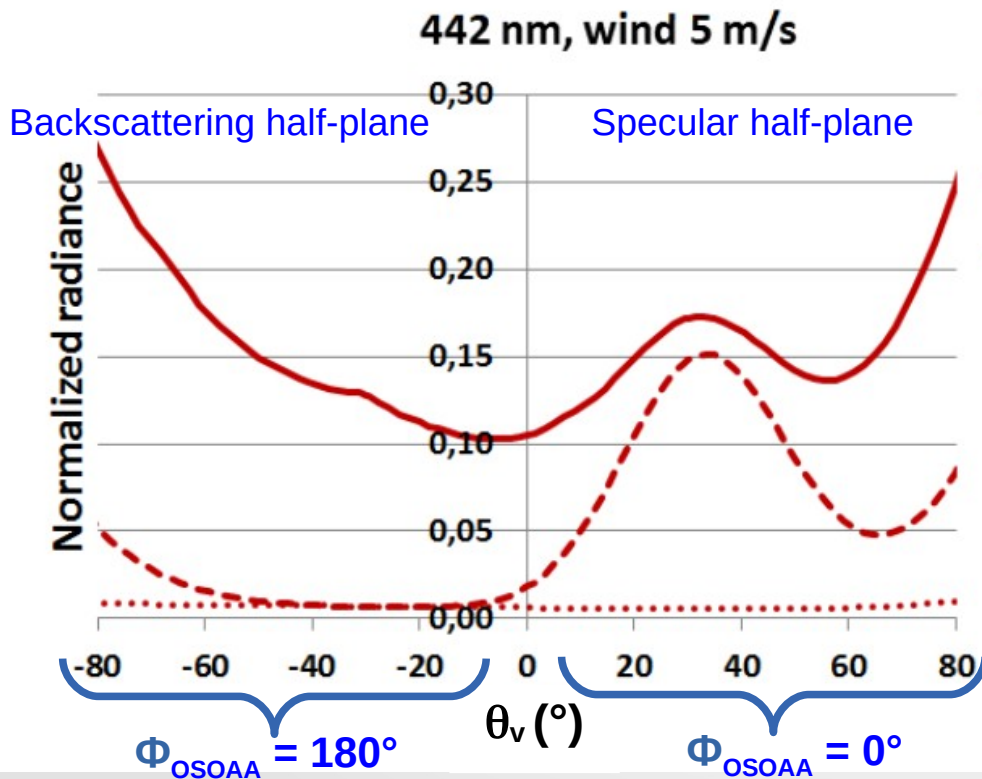
dirMIE_AER=${OSOAA_ROOT}/DATABASE/MIE_AER && mkdir -p ${dirMIE_AER}
dirMIE_HYD=${OSOAA_ROOT}/DATABASE/MIE_HYD && mkdir -p ${dirMIE_HYD}
dirSURF=${OSOAA_ROOT}/DATABASE/SURF_MATR && mkdir -p ${dirSURF}

${OSOAA_ROOT}/exe/OSOAA_MAIN.exe \
  -OSOAA.ResRoot ${dirRESULTS} \
  -OSOAA.Log Main.Log \
  -OSOAA.Wa 0.440 \
  -ANG.Thetas 30. \
  -AP.Pressure 1013.0 -AP.HR 8.0 -AP.HA 2.0 \
  -AER.Waref 0.550 -AER.AOTref 0.1 \
  -AER.DirMie ${dirMIE_AER} \
  -AER.Model 2 \
  -AER.SF.Model 3 -AER.SF.RH 98. \
  -PHYTO.Chl 0.2 \
  -SED.Csed 0.0 -PHYTO.ProfilType 1 \
  -YS.Abs440 0.00 -DET.Abs440 0.00 \
  -SEA.Depth 15.000 \
  -HYD.DirMie ${dirMIE_HYD} \
  -HYD.Model 1 \
  -PHYTO.JD.slope 4.0 -PHYTO.JD.rmin 0.01 -PHYTO.JD.rmax 200. \
  -PHYTO.JD.MRwa 1.05 -PHYTO.JD.MIwa -0.000 -PHYTO.JD.rate 1.0 \
  -SEA.Dir ${dirSURF} -SEA.Ind 1.34 -SEA.Wind 7 \
  -SEA.SurfAlb 0.0 -SEA.BotType 1 -SEA.BotAlb 0.30 \
  -OSOAA.View.Phi 0.0 \
  -OSOAA.View.Level 5 \
  -OSOAA.View.Z -10.0 -OSOAA.ResFile.vsVZA RESLUM_vsVZA.txt \
  -OSOAA.View.VZA 0.0 -OSOAA.ResFile.vsZ RESLUM_vsZ.txt \
  -OSOAA.ResFile.Adv.Up RESLUM_Advanced_UP.txt \
  -OSOAA.ResFile.Adv.Down RESLUM_Advanced_DOWN.txt
```

Example of results

Data from directory **Standard_Outputs/**

- LUM_vsVZA_Simu2_TOA.txt
- LUM_vsVZA_Simu2_Level0p.txt
- LUM_vsVZA_Simu2_Level0m.txt



Important note :

In the OSOAA model, $\Phi_{OSOAA} = 0$ means that the satellite is located in the specular half-plane and $\Phi_{OSOAA} = 180^\circ$ means that the satellite is located in the backscattering half-plane

Illustration of the normalized radiance in the Solar Principal Plan ($\Phi_{OSOAA} = 0^\circ$ & 180°)

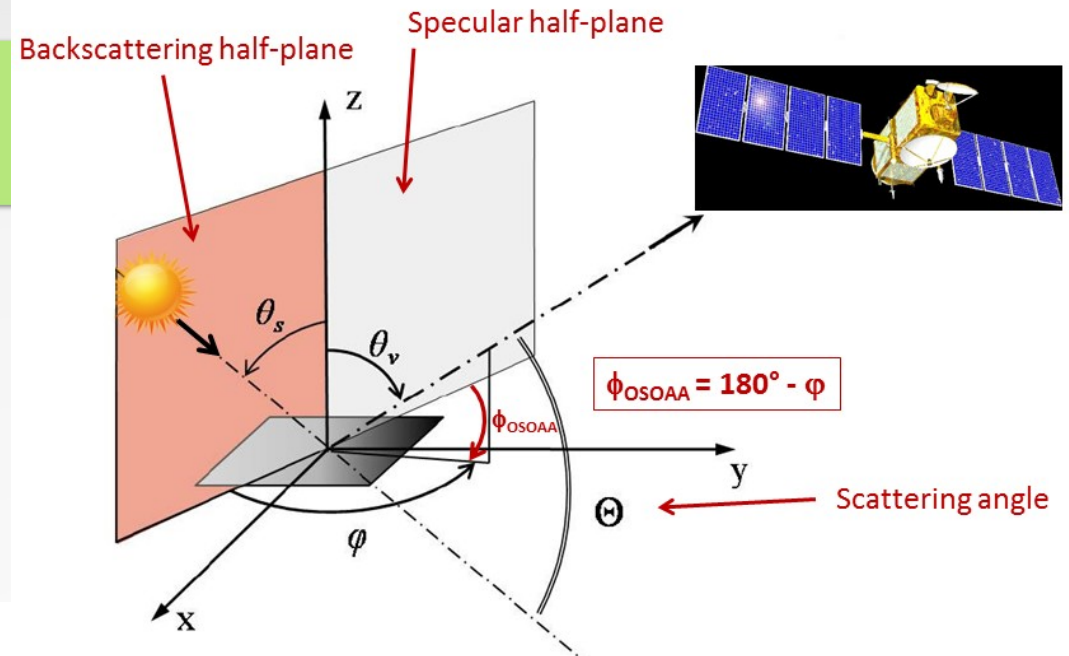
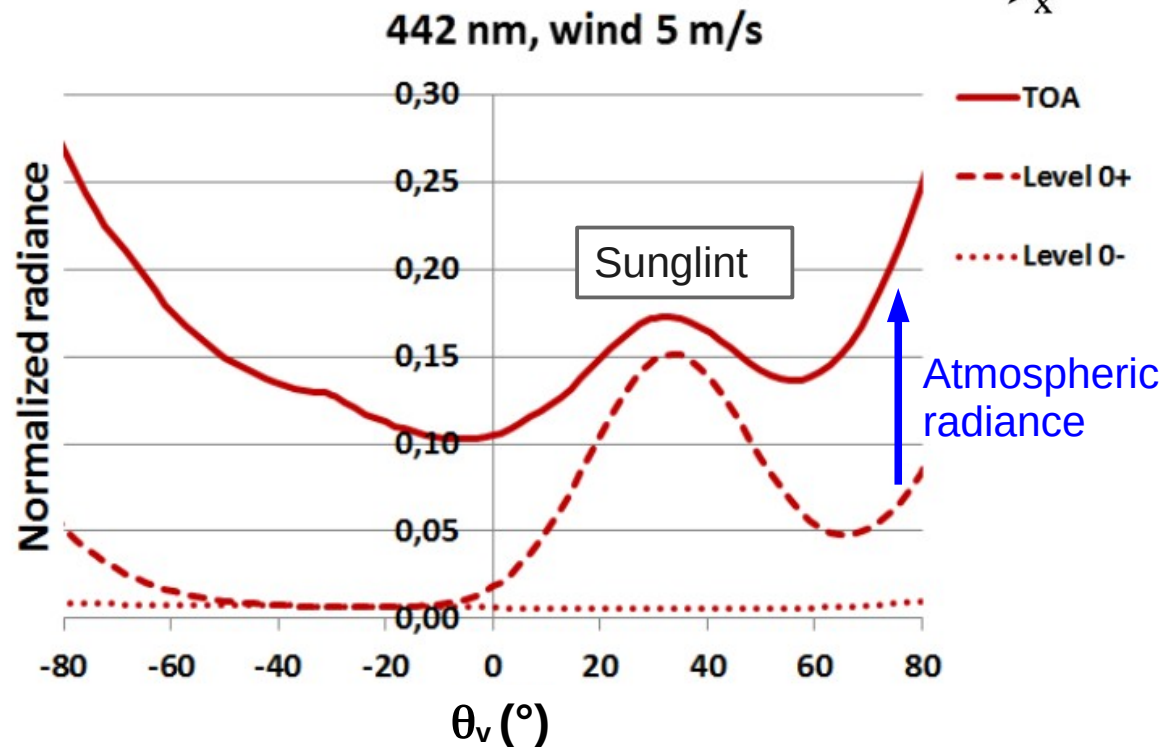
Normalized radiance is defined as:

$$\pi * L(z) / E_{\text{sun}}$$

Example of results

Data from directory **Standard_Outputs/**

- LUM_vsVZA_Simu2_TOA.txt
- LUM_vsVZA_Simu2_Level0p.txt
- LUM_vsVZA_Simu2_Level0m.txt

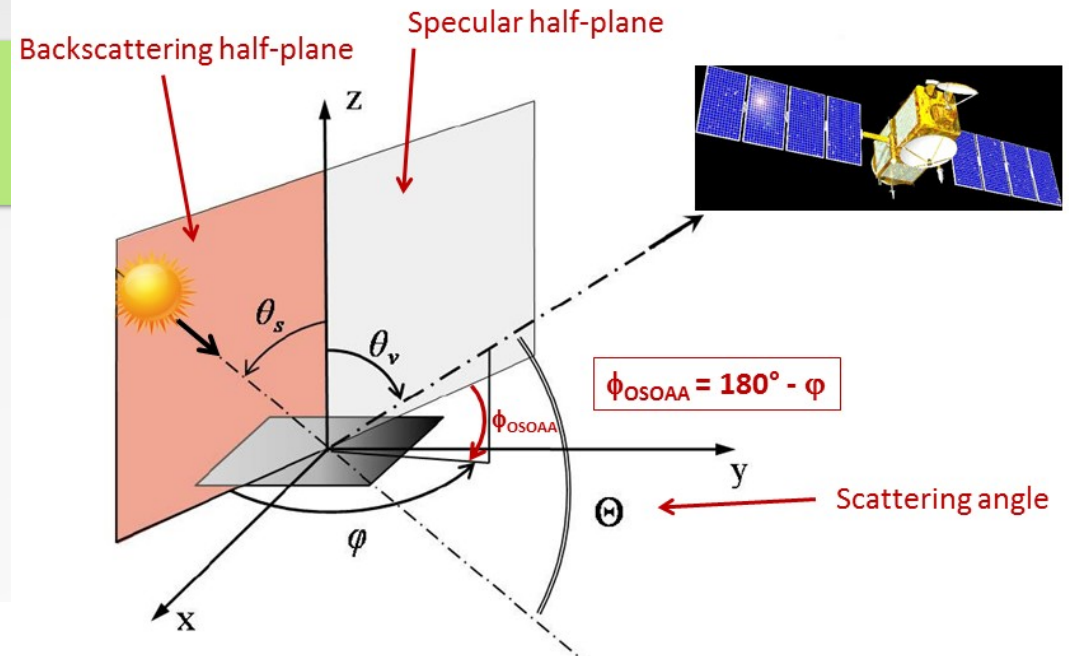
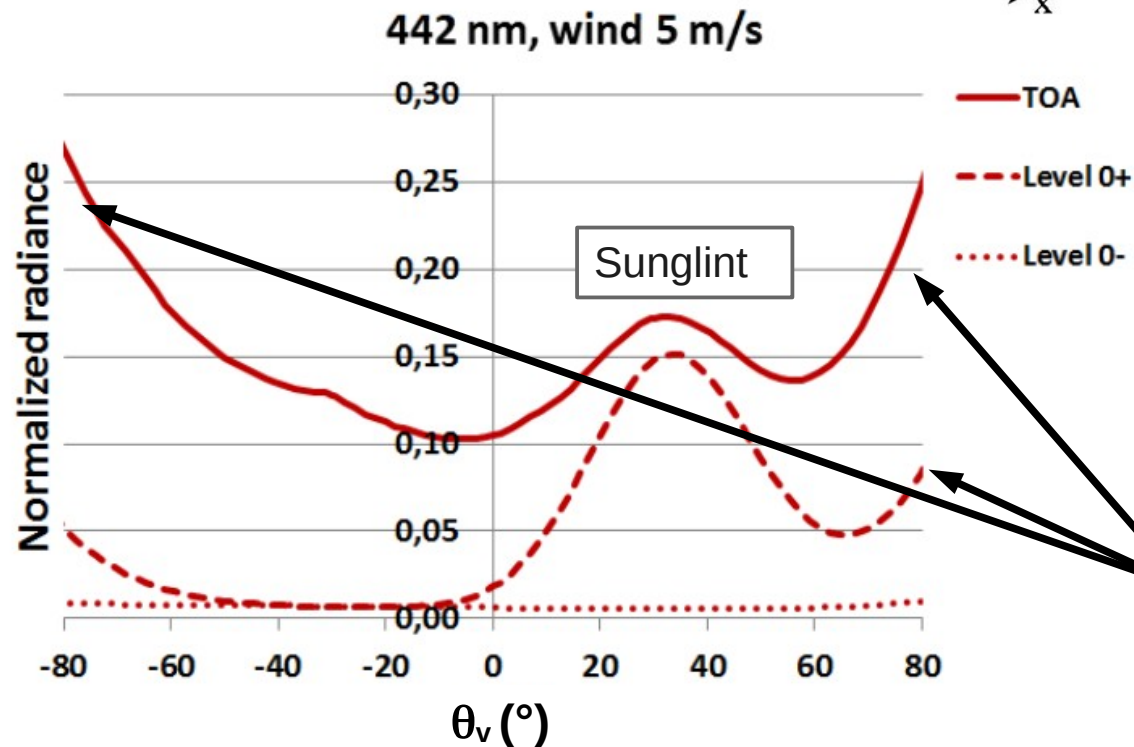


Sunglint in the specular direction

Example of results

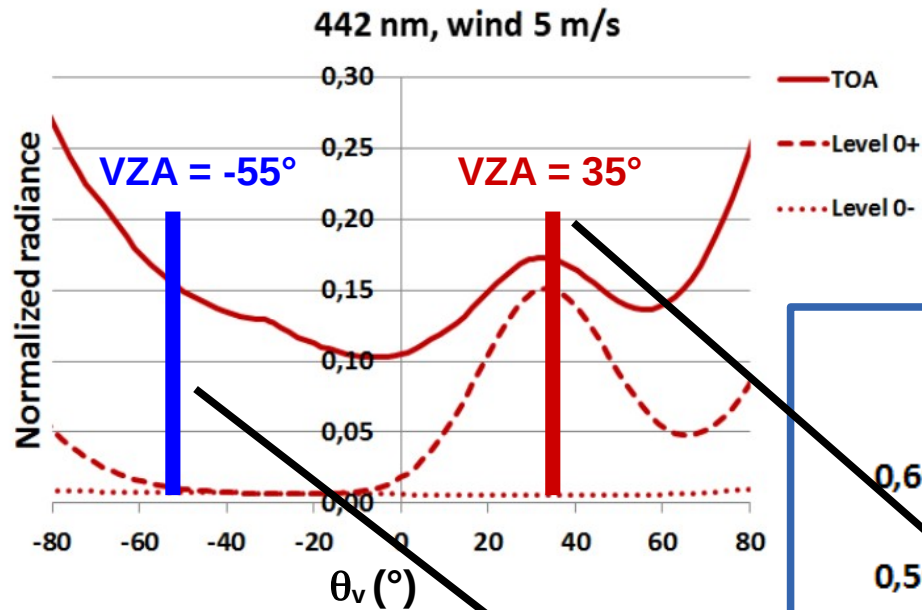
Data from directory **Standard_Outputs/**

- LUM_vsVZA_Simu2_TOA.txt
- LUM_vsVZA_Simu2_Level0p.txt
- LUM_vsVZA_Simu2_Level0m.txt

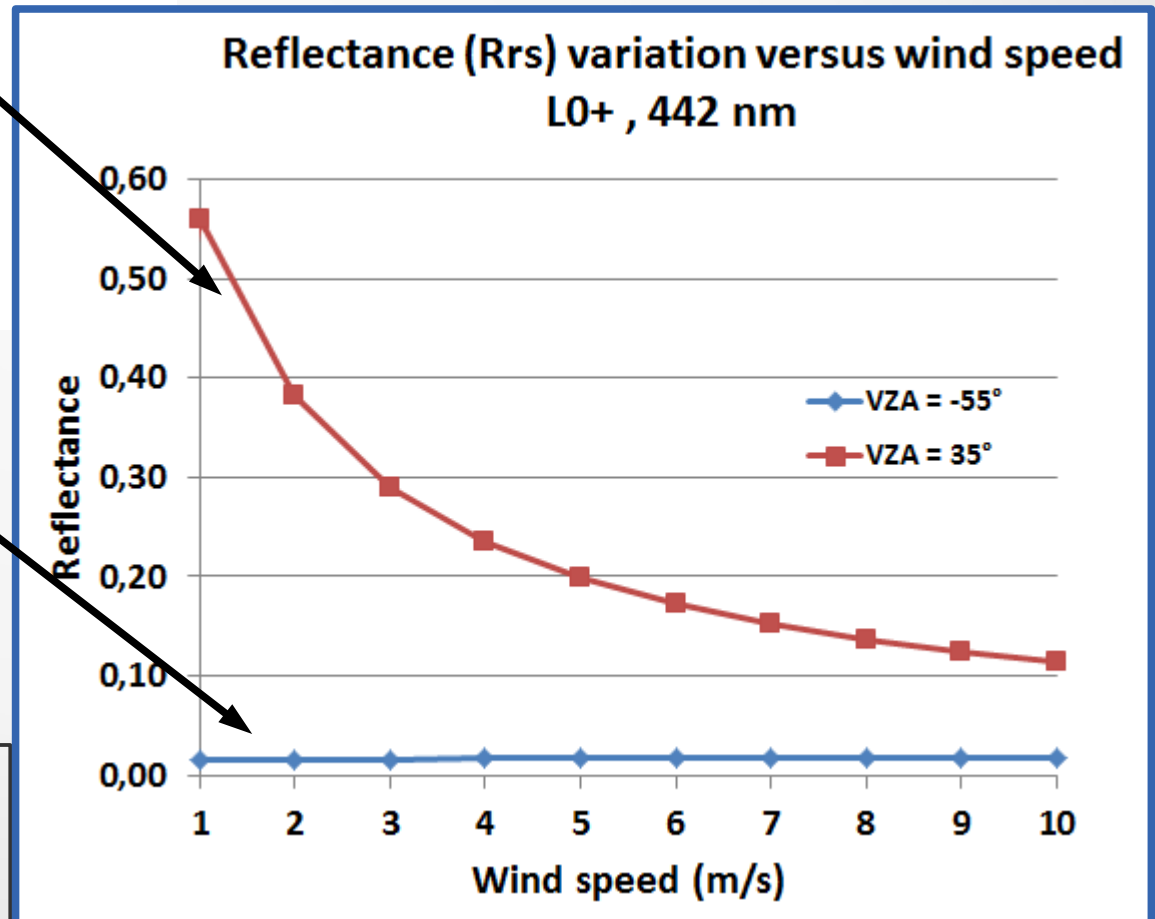


Increase of the radiance towards limb (high viewing zenith angles VZA)

Example of results



Sensitivity of the surface reflectance $R_{sr}(0+)$ to the wind speed

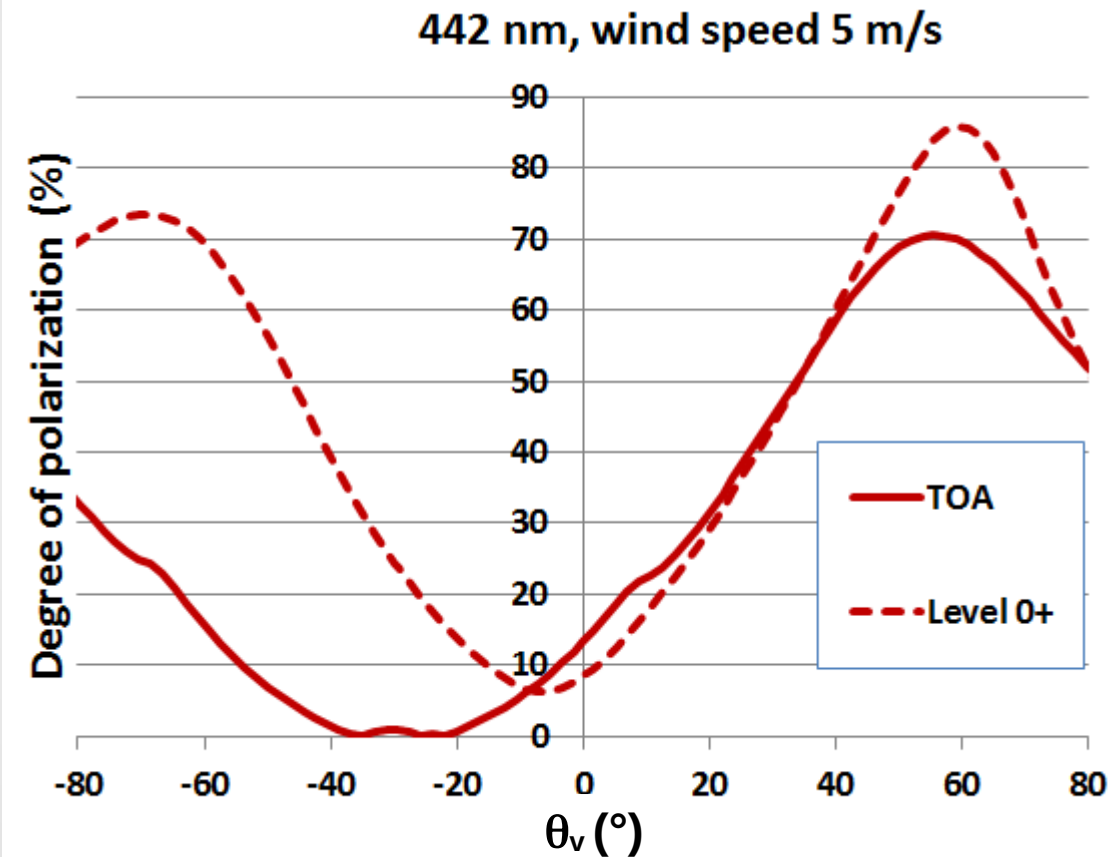


Data from **Standard_Outputs**.

Calculations for a wind speed from 1 to 10 m/s by step of 1m/s (loop on command lines + data extraction)

Example of results

Angular variation of the degree of polarization



The atmospheric scattering induces a depolarization of the radiation from 0+ to TOA

Example of results

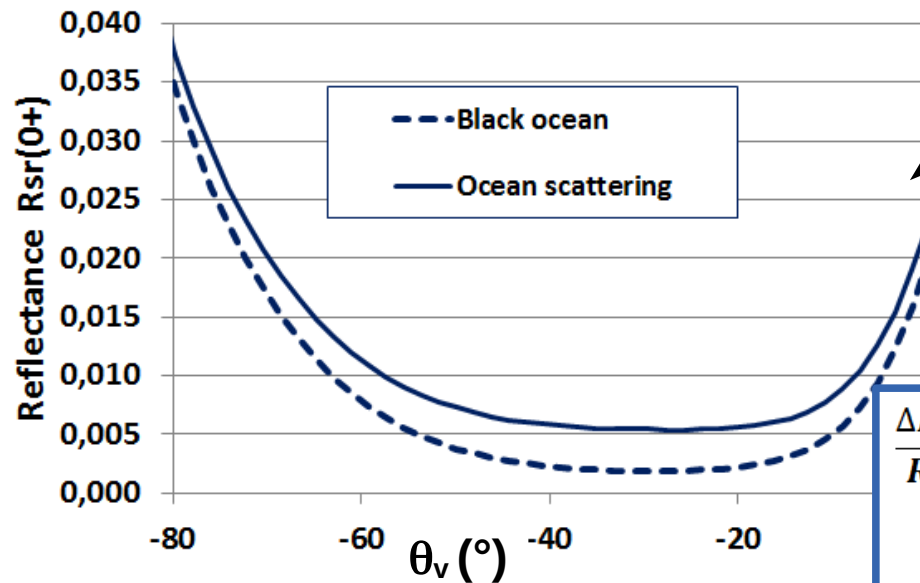
- Procedure to simulate a « Black Ocean »
 - Open the source code src / **OSOAA_SOS_CORE.F**
 - To cancel the ocean scattering, set the expert parameter EXPERT_MODE_FORCED_FSEA_NULL as « .TRUE. »

```
C      EXPERT_MODE_FORCED_FATM_NULL : Constant devoted to expert analyses
C      ==> Force the atmospheric source function to be null if TRUE
C      EXPERT_MODE_FORCED_FSEA_NULL : Constant devoted to expert analyses
C      ==> Force the sea source function to be null if TRUE
C-----
#include "OSOAA.h"
#define INCTE_IDLOG_SOS 99
#define INCTE_PI DACOS(-1.D+00)

#define EXPERT_MODE_FORCED_FATM_NULL .FALSE.
#define EXPERT_MODE_FORCED_FSEA_NULL .FALSE.
```
 - Make a new compilation : gen/Makefile_OSOAA.gfortran
 - If the seabed depth is weak (i.e., shallow waters), ensure to set the seabed albedo to the value of zero

Example of results

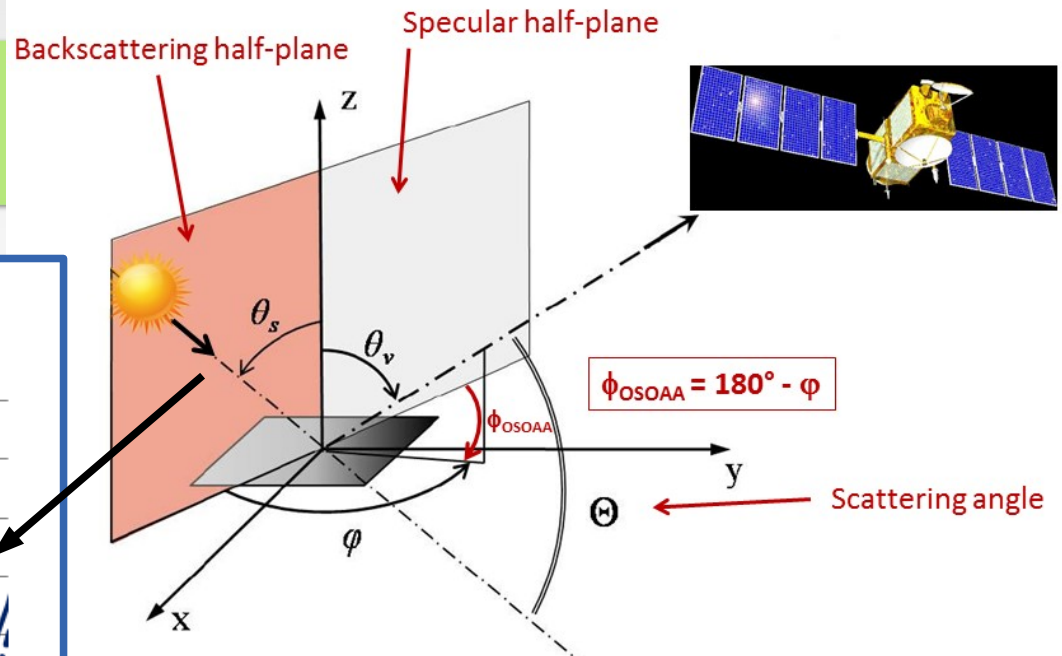
Impact of the ocean scattering
Level 0+, wind 5 m/s, 550 nm



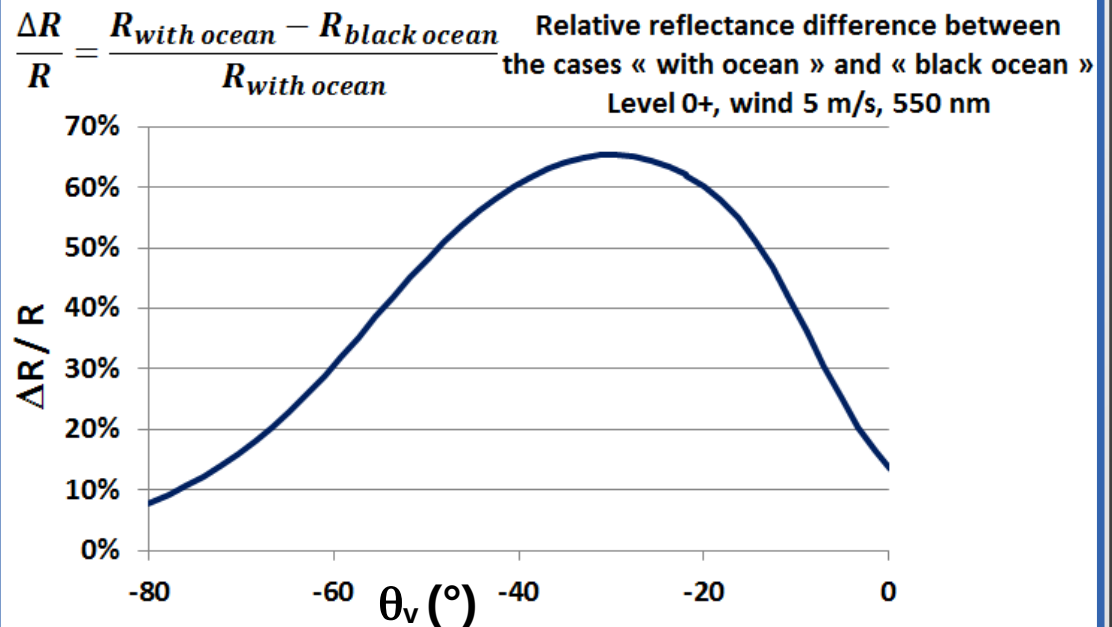
Sensitivity of the surface reflectance $R_{sr}(0+)$ to the ocean scattering.

$R_{sr}(0+)$ is driven by the skylight reflection onto the sea surface in the case of a black ocean

Data from **Standard Outputs**.
Calculations for an expert mode



550 nm \Rightarrow Phytoplankton scattering



Example of results

Physical explanation of the reason for an increase of the radiance at high viewing zenith angles (VZA)

⇒ Possible with OSOAA by simulating a « **Black Sky** »

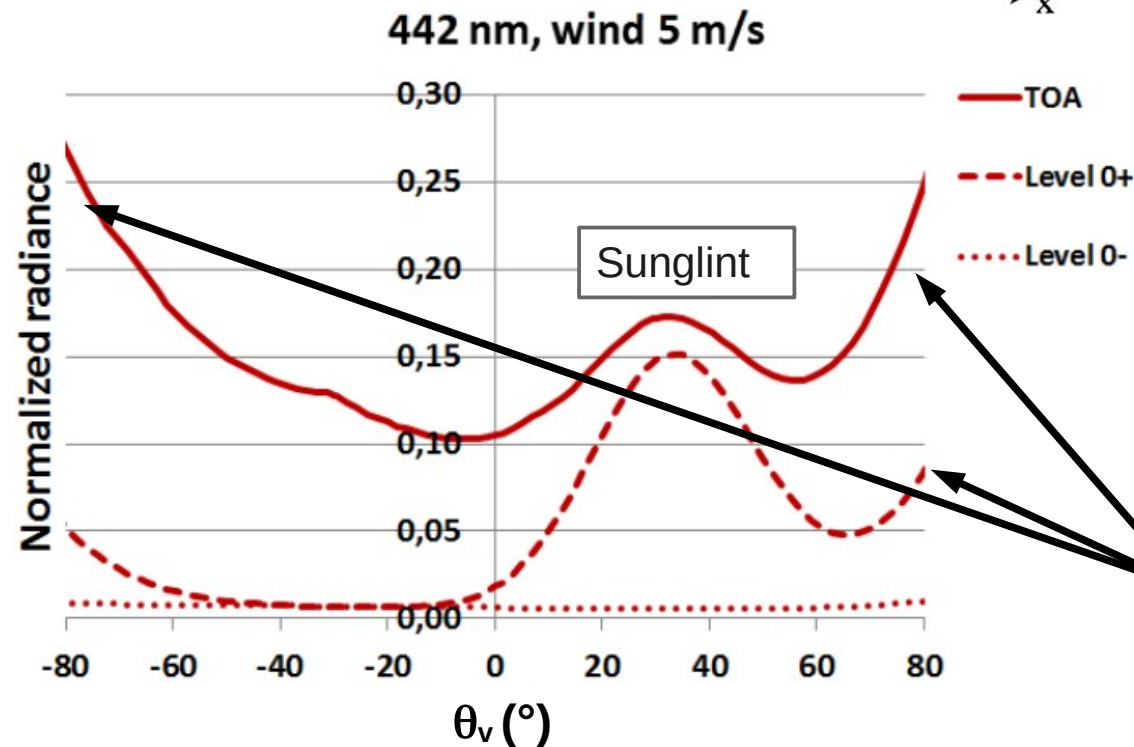
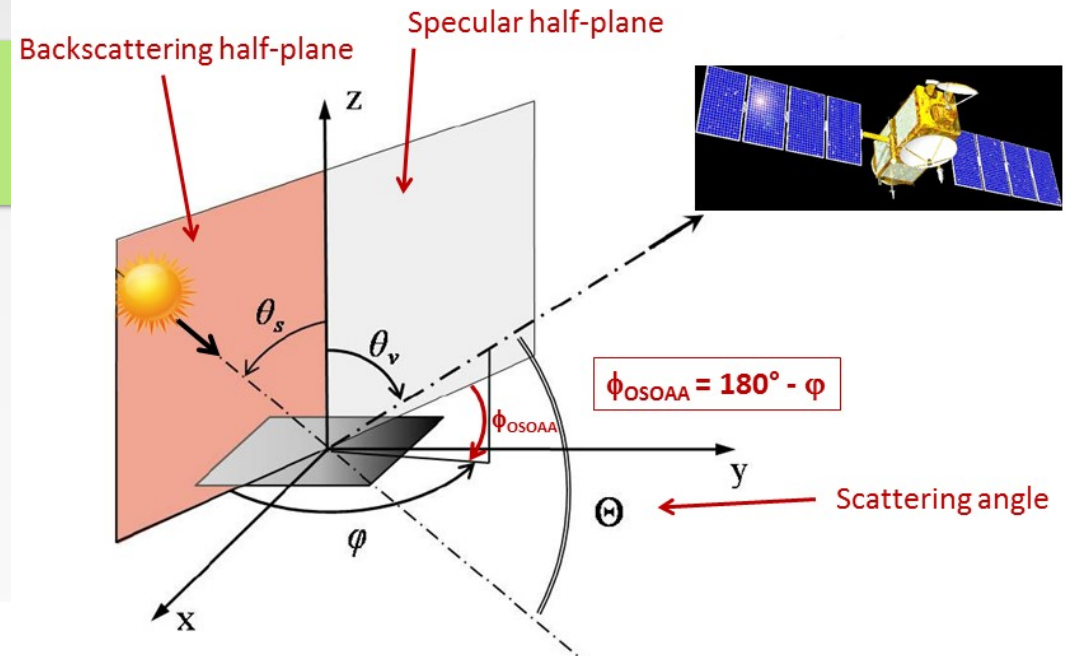


Illustration of the normalized radiance in the Solar Principal Plan ($\Phi_{OSOAA} = 0^\circ$ & 180°)

Increase of the radiance towards limb (high viewing zenith angles VZA)

Example of results

- Procedure to simulate a « Black Sky »
 - Code src / **OSOAA_SOS_CORE.F**
 - Cancel the atmospheric scattering : set the expert parameter EXPERT_MODE_FORCED_FATM_NULL as « .TRUE. »

```
C   EXPERT_MODE_FORCED_FATM_NULL : Constant devoted to expert analyses
C   ==> Force the atmospheric source function to be null if TRUE
C   EXPERT_MODE_FORCED_FSEA_NULL : Constant devoted to expert analyses
C   ==> Force the sea source function to be null if TRUE
C-----
#include "OSOAA.h"
#define INCTE_IDLOG_SOS 99
#define INCTE_PI DACOS(-1.D+00)

#define EXPERT_MODE_FORCED_FATM_NULL .FALSE.
#define EXPERT_MODE_FORCED_FSEA_NULL .FALSE.
```

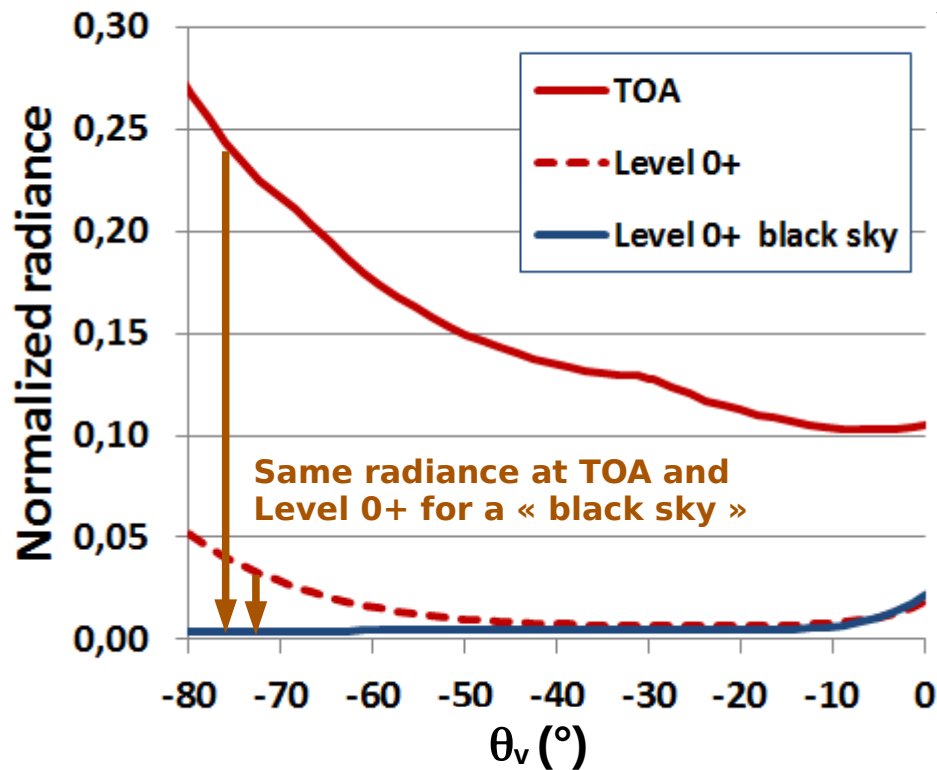
- Make a new compilation
- Set the AOT = 0 and a fairly zero molecular optical thickness (≈ 0.001)

Example of results

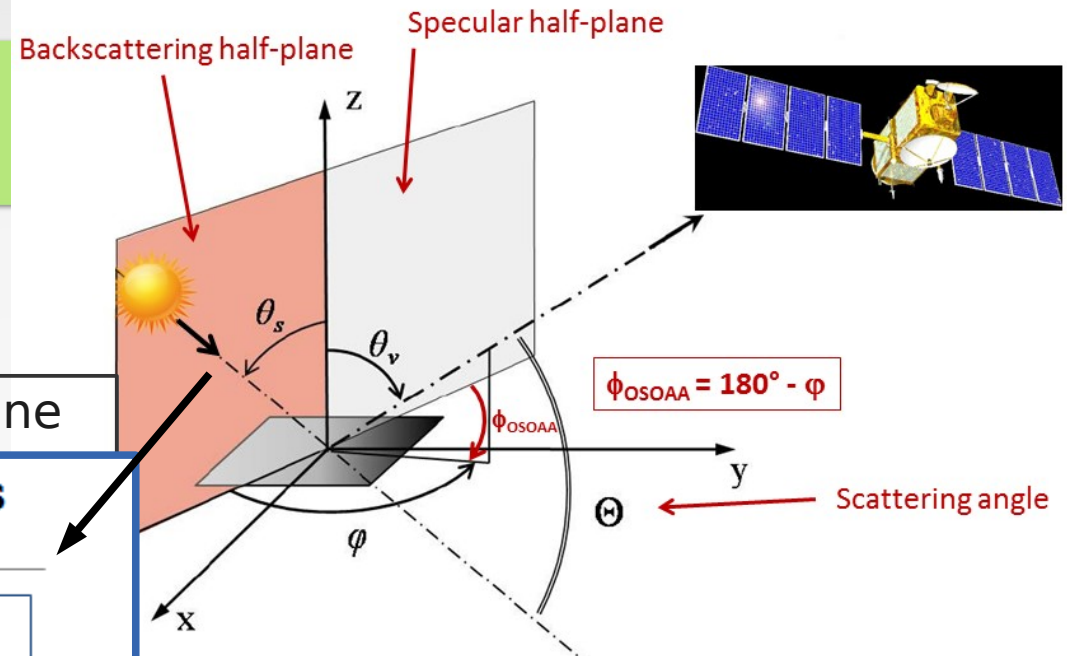
Impact of the atmospheric scattering on TOA radiance

Focus on the backscattering half-plane

442 nm, wind 5 m/s



Data from **Standard_Outputs**.
Calculations for an expert mode

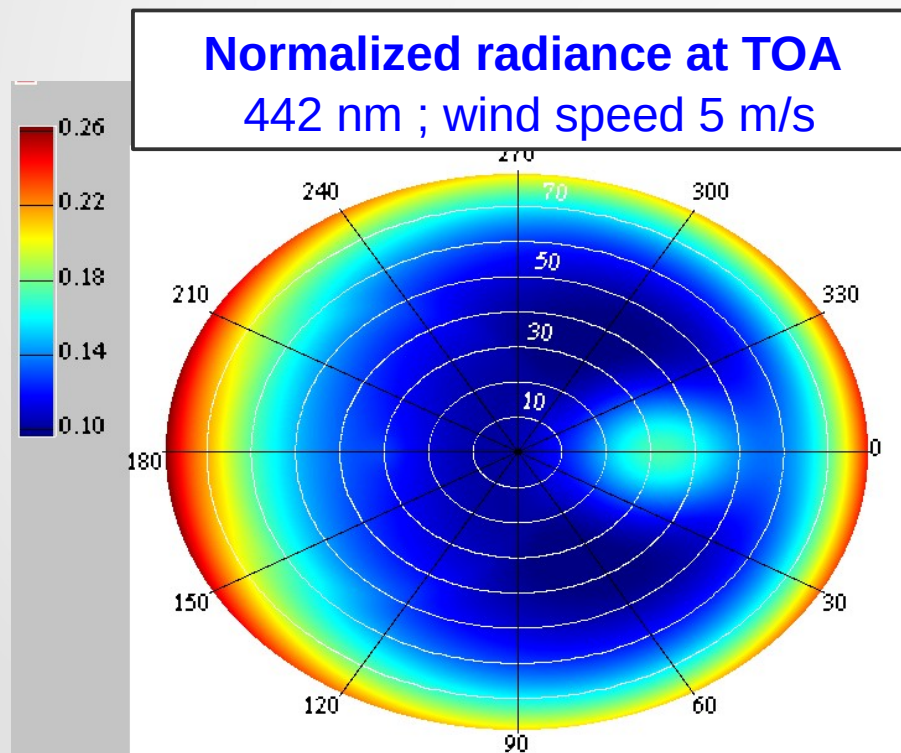


Increase of the radiance towards high viewing zenith angles (VZA)

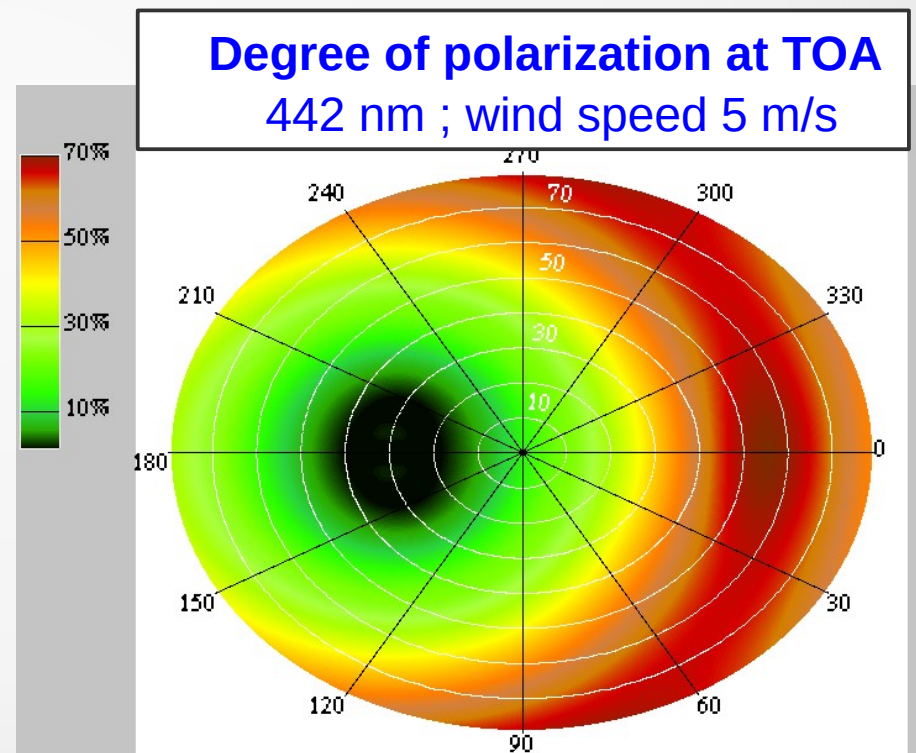
⇒ Caused by the reflexion of the downward atmospheric diffuse light onto the sea surface (i.e., skylight reflexion)

Example of results

- OSOAA simulations cover all geometry of observations (variations in azimuth and zenith angles)
- OSOAA can thus be used for the analysis of satellite ocean color observations



Data obtained using a loop of simulations over the values of Φ_{OSOAA} from 0 to 180° by step of 2°



Illustrations made using the Mgraph software from Laboratoire d'Optique Atmosphérique (LOA, France) 78

OSOAA is yours

Enjoy using OSOAA !



<https://github.com/CNES/RadiativeTransferCode-OSOAA>

Thank you for your attention !