



OMERE

Introduction

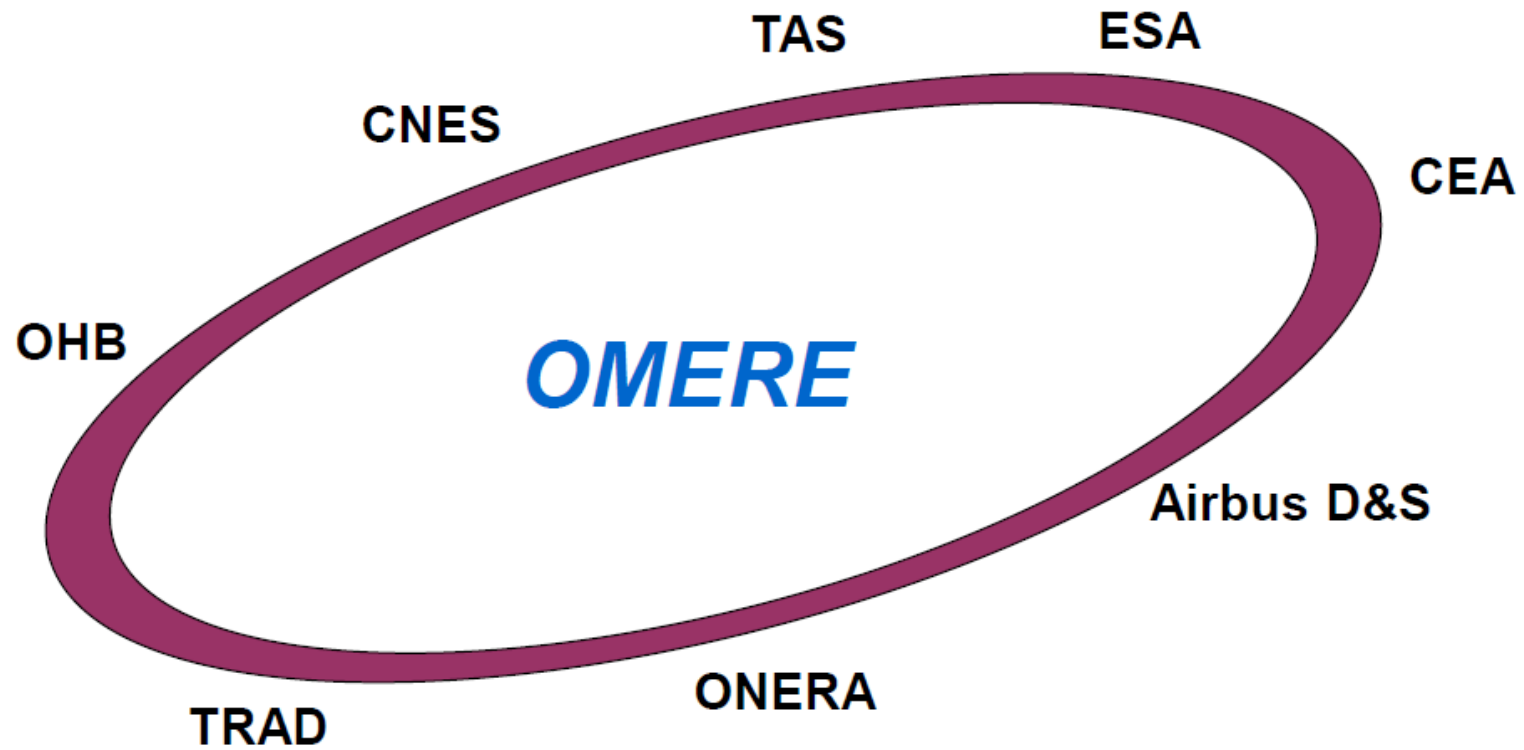
The OMERE software

- The project

- Since 1999
- TRAD development with CNES support
- Freeware for space radiation environment and effects on electronic components
- Stand alone software (no internet connection needed)
- Conceived to meet industrial requirements
- Integrates ONERA models
- Integrates outcomes of Research and Technology projects financed by CNES
- Coupling with FASTRAD.

The OMERE software

- The partnership

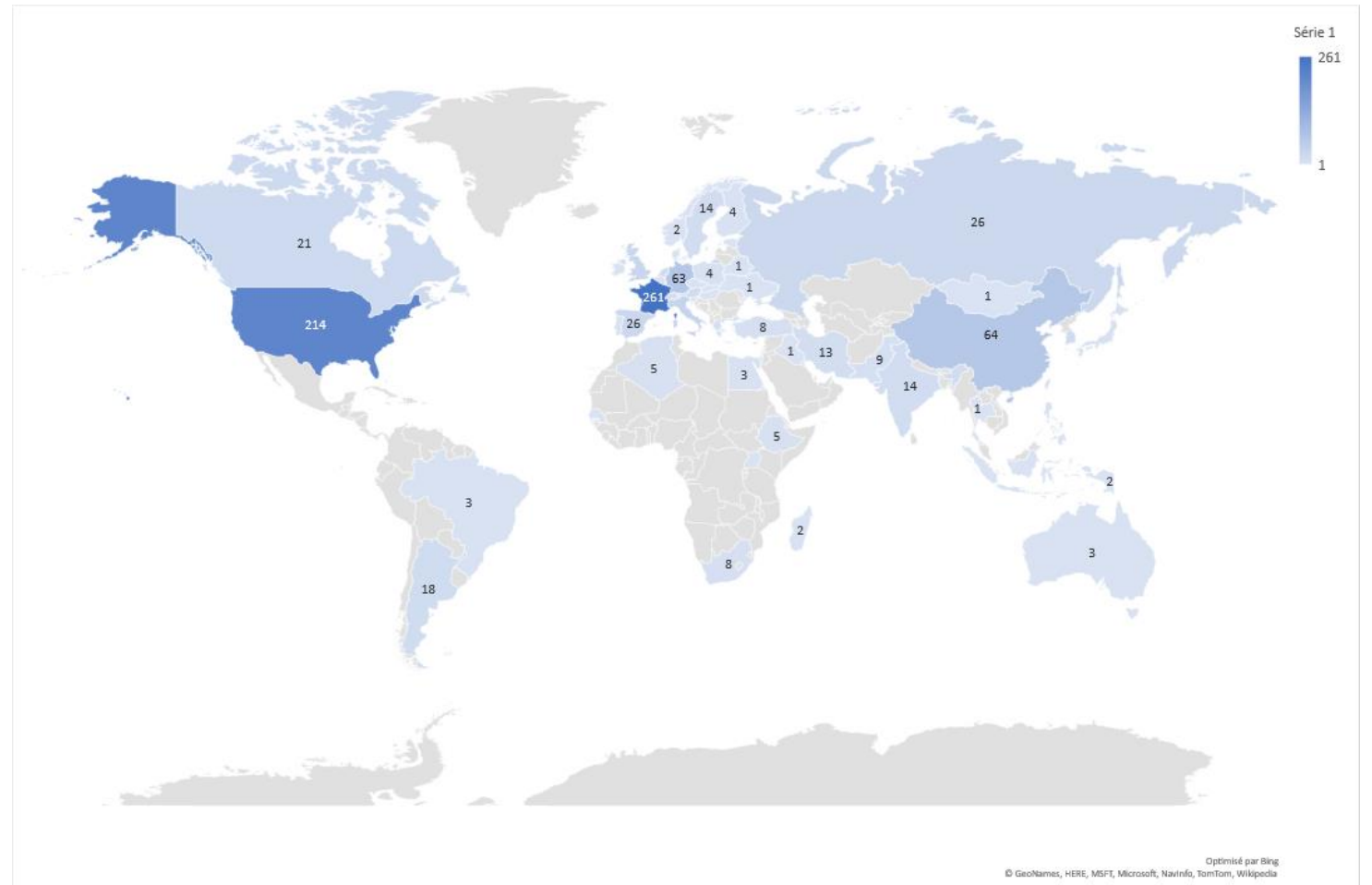


OMERE in summary

- **OMERE software**
 - One major release per year
 - Support for users
 - Training
 - Radiation analysis

- **Total number of downloads**

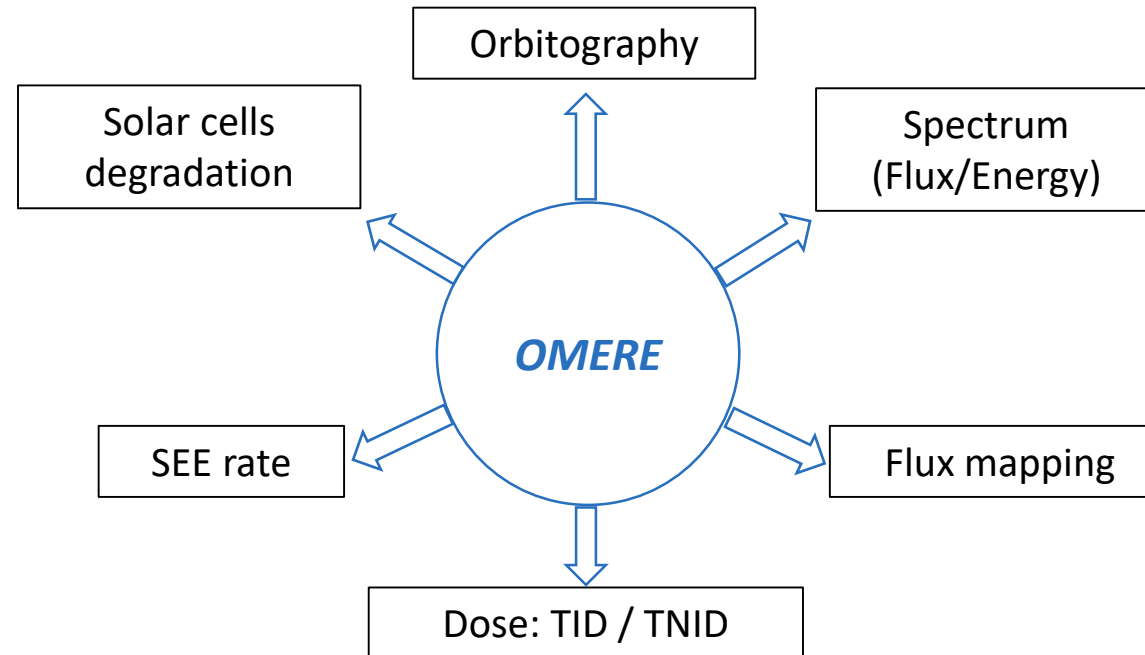
	2017	2018	2019	2020	2021
Total	410	583	682	722	998



Downloads of OMERE in 2021

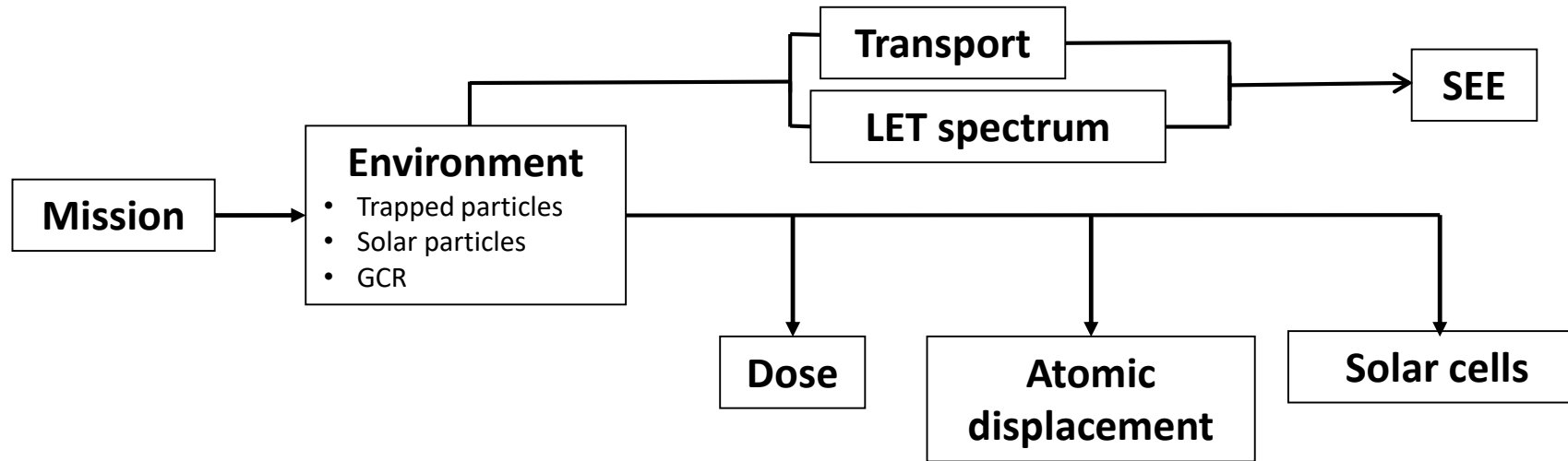
OMERE in summary

- OMERE software
 - What can we do with OMERE ?

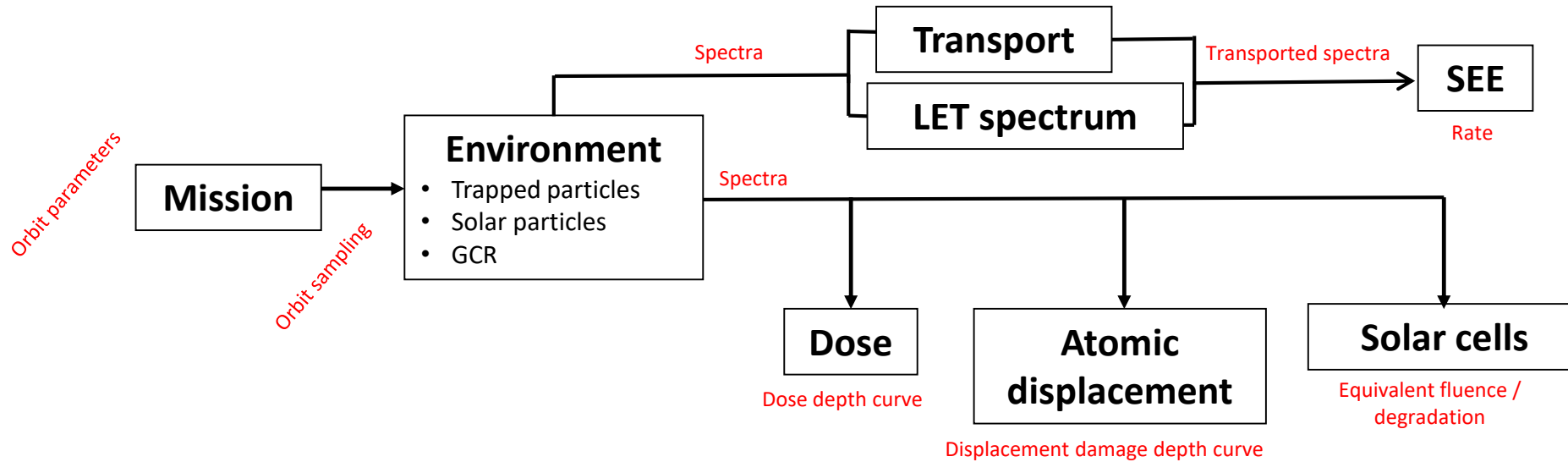


OMERE's architecture and overview

Software's architecture



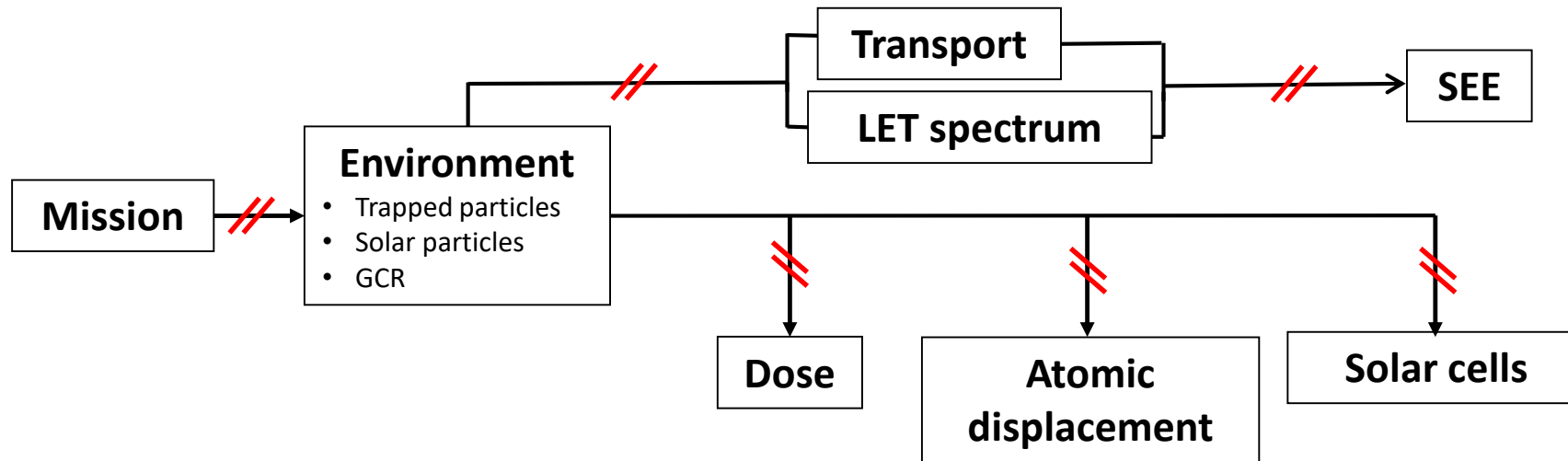
Software's architecture



• Output files

- Each module generates a specific output file
- Each output file has its own extension:
 - .flx / .fle for **Environment** module
 - .dos for **Dose** module
 - .see for **SEE** module
 - ...

Two usages strategies



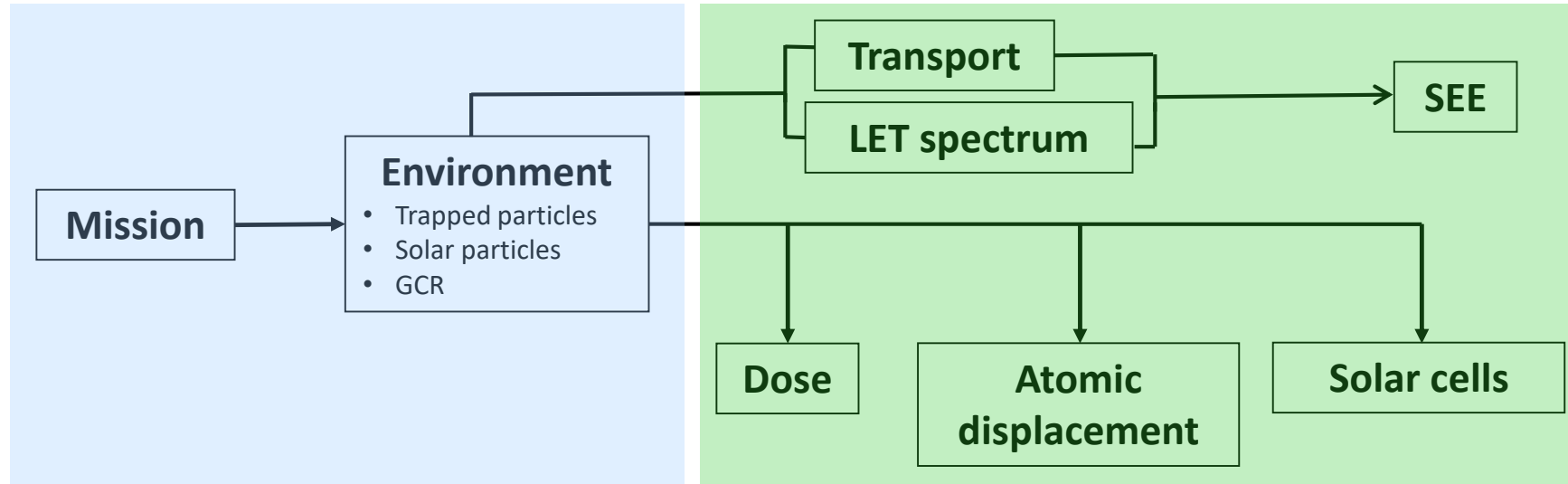
- From mission

- Calculation is done considering the inputs/parameters set in the other modules
- No need to calculate the output for each module

- From files //

- User can input an orbit file instead of generating the mission with the orbit parameters
- E.g., user can input the spectra instead of calculating them with OMERE

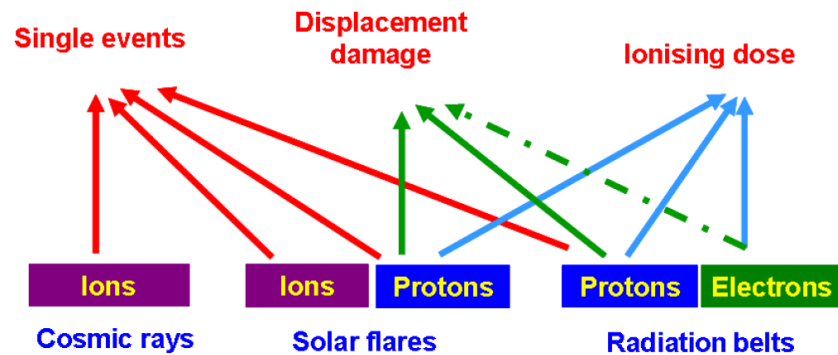
Software's architecture



- **1- Determines the spectra around the spacecraft**
 - Isotropic environment
 - No shielding considered
- **2- Estimates the effects on components**
 - SEE rate, ionizing dose, non-ionizing dose
 - Shielding: simple geometry only

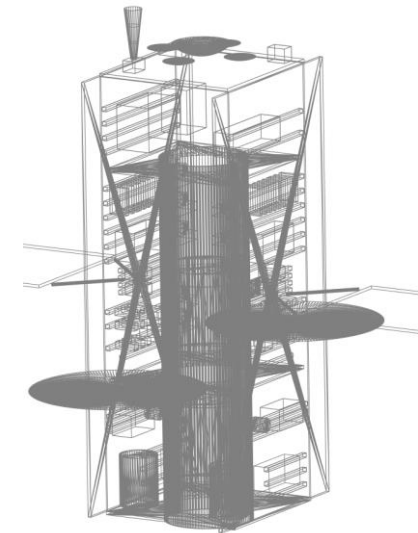
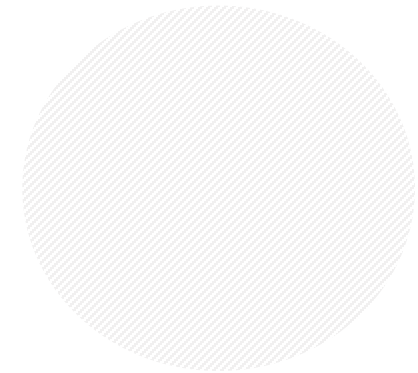
Why a simple shielding ?

- Impact of the shielding depends on the source
 - Heavy ions: weakly impacted
 - Protons, electrons: strongly impacted
- Particles type per effect :



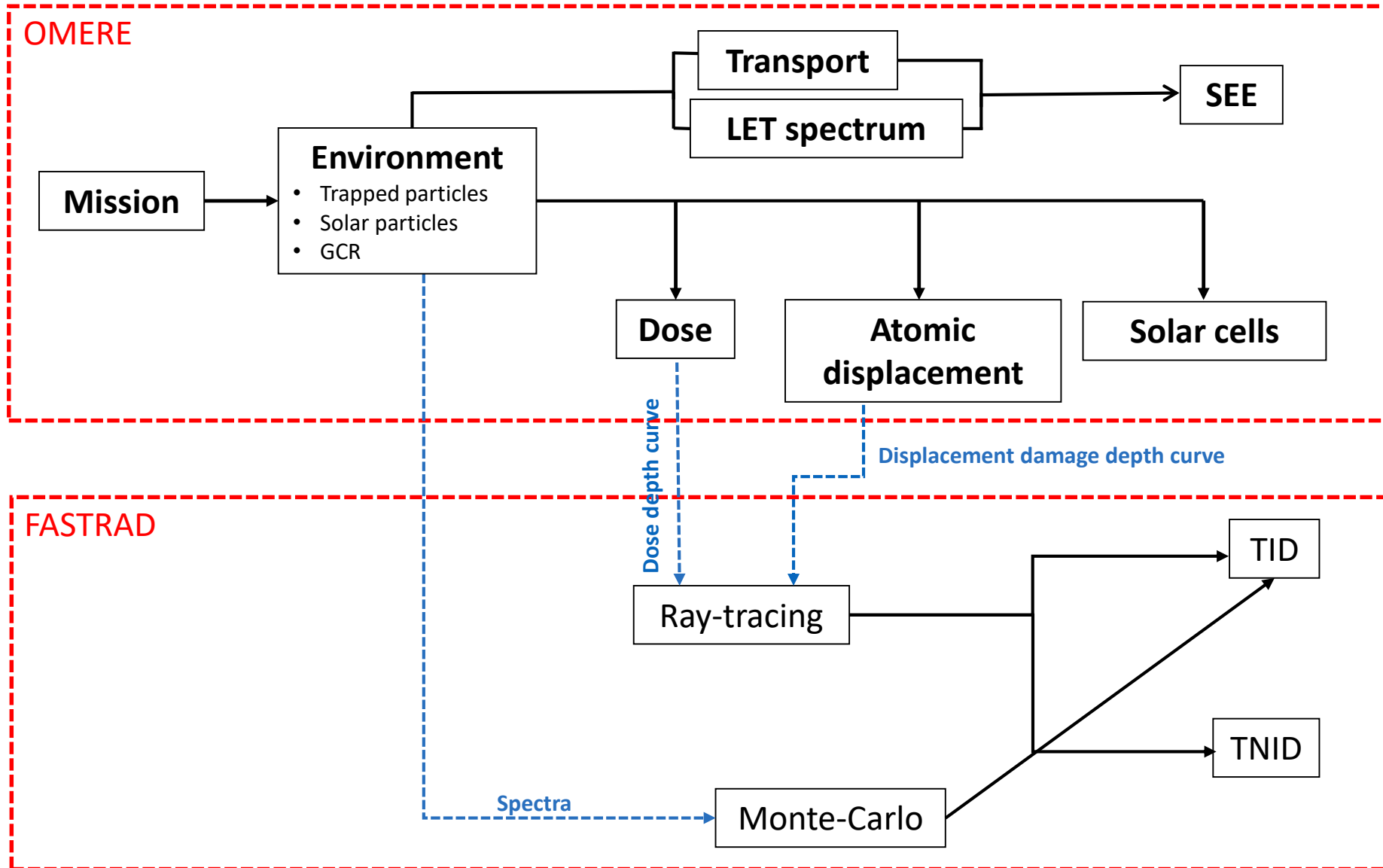
- Considering the shielding:
 - The simple geometry approach is appropriate for SEE rate
 - A complex geometry must be considered for the dose calculation

A simple shielding geometry



A complex shielding geometry

OMERE/FASTRAD coupling



Output types

- **Outputs:**
 - **Mean calculation:** mean values for the entire mission
 - **Instantaneous flux:** value at any time
 - **Along the orbit:** values for every points of the orbit
 - **Proton peak flux:** duration and flux of each SAA crossing

	Trapped		Solar		GCR	Transp.	LET spec.	Dose	Atomic disp.	SEE	Solar cells
	Ele	Pro	Aver.	Flares							
Mean on the mission	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Instant flux	✓	✓	✓			✓					✓
Along the orbit	✓	✓	✓				✓	✓	✓	✓	✓
Proton peak flux		✓									

See help menu for examples

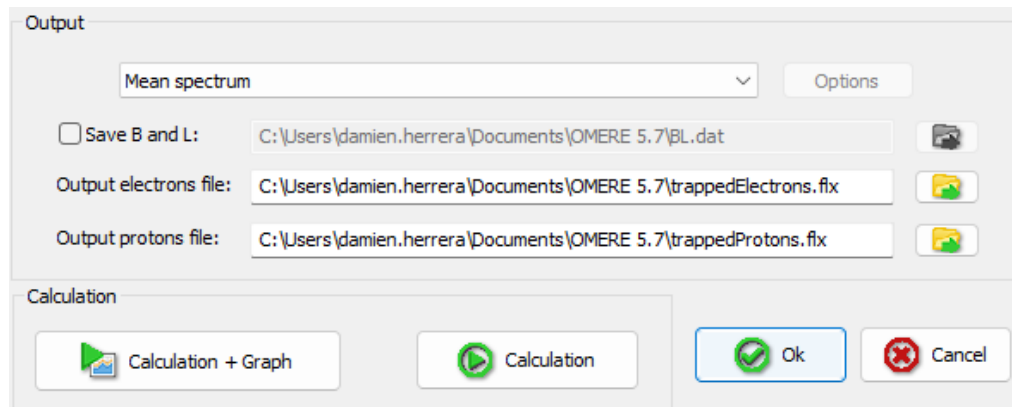


Output types

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Mean on the mission	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Instant flux	✓	✓	✓			✓					✓
Along the orbit	✓	✓	✓				✓	✓	✓	✓	✓
Proton peak flux		✓									

See help menu for examples



- **Stored in your personal workspace**
 - File → Default directory

Output files

- Typical output file structure:
 - A file is generated for each calculation

```

1 #=====
2 #.OMERE.5.7.0.34019.--Trapped.electrons.flux.file
3 #
4 #.File.:C:\Users\damien.herrera\Documents\OMERE.5.7\trappedElectrons.flx
5 #.Creation.:26/09/2023.11:47:51
6 #=====
7
8 #.Model.:.MEO.average.case
9 #.Start.year.:2023
10
11 #.Use.the.default.model.energy.grid
12
13 #.==.Orbit.1/1.==
14 #.Orbit.data.:
15 #.Name.:.....Orbit.Galileo.GSAT0101
16 #.Duration.:.....12.year(s)
17 #.Perigee.:.....23222.000000km
18 #.Apogee.:.....23222.000000km
19 #.Inclination.:.....56.000°
20 #.Argument.of.Perigee.:.....0.000°
21 #.Longitude.of.Ascending.node.:.....253.703°
22 #.(with.respect.to.Greenwich)
23 #.True.Anomaly.:.....15.153°
24 #.Period.:.....50681.772s
25 #.Number.of.orbits.:.....17
26 #.Number.of.points.per.orbit.:.....50
27
28 #.Energy.spectrum.:
29 #.....Energy..Differential.flux..Integral.flux
30 #.....MeV.....cm-2.s-1.MeV-1.....cm-2.s-1
31 .....0.2800.....3.94034e+07.....1.00570e+07
32 .....0.4000.....2.65366e+07.....6.32133e+06
33 .....0.5600.....1.27928e+07.....3.00766e+06
34 .....0.8000.....4.20282e+06.....1.24496e+06
35 .....1.1200.....1.35325e+06.....4.79440e+05
36 .....1.6000.....3.29694e+05.....1.38461e+05
37 .....2.2400.....6.33599e+04.....3.58784e+04

```

Header : OMERE version, file path...

Space environment model information

Orbit / Mission information

Output data : energy spectrum, dose rate along the orbit...



Summary

- **OMERE allows us to:**
 - Compute the radiative environment around the spacecraft
 - Estimate the effect behind a simple geometry shielding

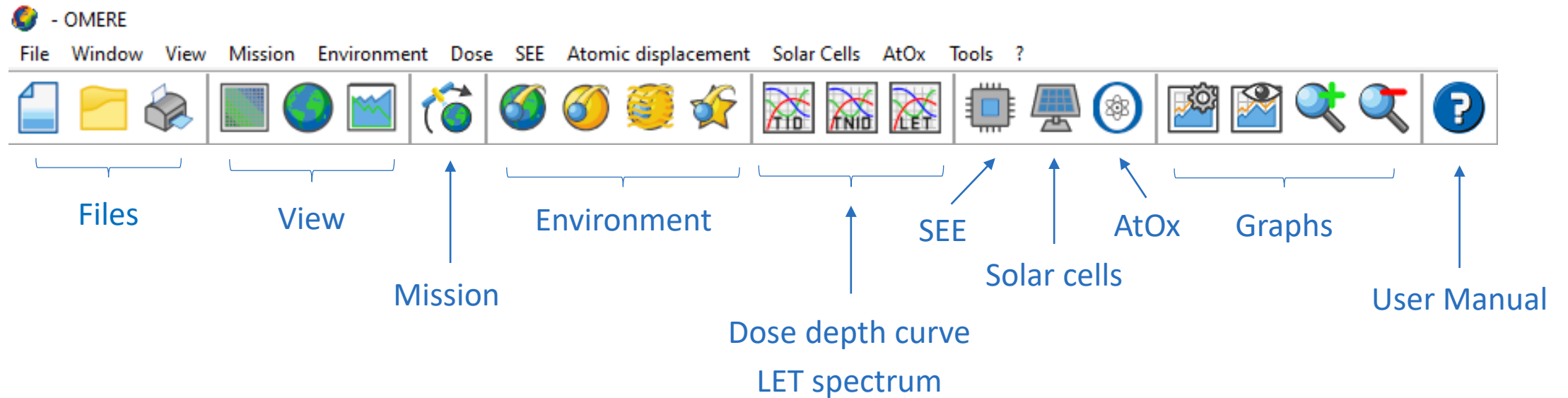
- **Considering a simple geometry for the shielding:**
 - Fair approach for SEE calculation
 - Not for the dose at component level (only dose curves)

OMERE's main features

- Shortcuts
- Mission
- Environment
- Dose
- Atomic Displacement
- Single Event Effects
- Solar Cells
- Tips and advices

Shortcuts

- Each button corresponds to a shortcut of an important module
- OMERE's toolbar:



Mission



OMERE

File Window View **Mission** Environment Dose SEE Atomic displacement Solar Cells AtOx Tools ?

Mission definition

Mission launch date

Date of launch : 09/26/2023

Time of launch : 14:16:09

Solar Cycle

Orbit(s)

Orbit name	Inclination	Apogee	Perigee
Orbit GEO	--	35784.0km	35784.0km

Output File: C:\Users\damién.herrera\Documents\OMERE 5.7\orbit

Ok Cancel

- Define the mission:

- Orbit
- Launch date

- Orbit type:

- Simple position
- Orbit parameters
- Orbit file
- Two Lines Elements (TLE)

Orbit type

Simple Position

Orbit Parameters

Orbit File

TLE



Mission – Simple position

- Mission defined for one specific position
 - Realistic only for GEO orbit
 - Useful for worst-case orbits (SAA)
- Two types of parameters
 - Coordinates: altitude, longitude, latitude
 - Mission duration:
 - Solar cycle dependencies
 - Used for cumulated quantities:
 - Fluence, dose, ...

Orbit parameters

Name : Standards ▾

Orbit type

Simple Position
 Orbit Parameters
 Orbit File
 TLE

Altitude : km

Longitude : degrees

Latitude : degrees

Mission duration : year(s) ▾

Ok Cancel



Mission – Orbit parameters

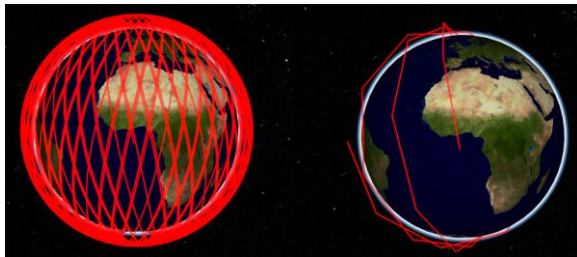
- Use of orbit parameters:
 - Apogee and perigee (or semi-major axis and eccentricity)
 - Inclination
 - ...

- Mission duration:

- Used for cumulated quantities:
 - Fluence, dose, ...

- Resolution of the orbit sampling

- Number of orbits
- Number of points per orbit



100x100

3x10

Orbit parameters
?
✕

Name : Standards ▼

Orbit type

Simple Position

Orbit Parameters

Orbit File

TLE

Semi-major axis and eccentricity

Apogee (Altitude) : km

Perigee (Altitude) : km

Inclination : degrees

Perigee argument : degrees

Longitude of ascending node ▼ degrees

True anomaly : degrees

Period : 100.9 mn Semi-major axis : 7178.1 km

Mission duration : year(s) ▼

Number of orbits : Duration : 168.1 h

Number of points per orbit : Time Step : 60.5 s

Ok
 Cancel





Mission – Orbit file

- Orbit file:

- Input a file giving the position of the satellite at any moment
- Four columns: altitude, latitude, longitude, time
- Order of the columns can be modified

Orbit type

Simple Position
 Orbit Parameters
 Orbit File
 TLE

Column order:

Altitude Latitude Longitude Time

File path:

Orbit Files Database

- EOR
 - EOR_200km_36000km_97days.dat
 - EOR_11000km_36000km_123days.dat

#	altitude (km)	latitude (°)	longitude (°)	temps (s)
9				
10				
11				
12	199.960	0.000	180.000	0.0
13	205.920	-0.457	-176.278	42.1
14	223.719	-0.910	-172.565	84.3
15	253.586	-1.361	-168.842	126.8
16	295.689	-1.805	-165.117	169.8
17	350.572	-2.242	-161.390	213.4
18	417.624	-2.668	-157.671	257.8
19	498.416	-3.083	-153.940	303.2
20	593.092	-3.485	-150.205	349.8
21	702.303	-3.871	-146.468	397.7
22	826.489	-4.240	-142.737	447.2
23	967.143	-4.591	-138.992	498.6
24	1124.997	-4.923	-135.244	552.2
25	1300.445	-5.232	-131.503	608.1

- Orbit Files Database:

- Manage your database as you want
- Edit the column with the small arrows





Mission – Two Lines Elements (TLE)

- Two Line Elements (TLE)
 - Input a file giving a serie of two line elements.
 - The position of the satellite is interpolated between two TLE. The time resolution can be edited.

```

1 # TLEs NOAA-15. File from celestrak.com
2 1 25338U 98030A 98133.67211713 -.00000044 00000-0 00000+0 0 26
3 2 25338 98.6959 163.5428 0000009 160.4552 25.6356 14.19938778 04
4 1 25338U 98030A 98133.70628213 -.00000044 00000-0 00000+0 0 16
5 2 25338 98.7279 163.6236 0008455 317.7671 42.2856 14.23584175 03
6 1 25338U 98030A 98133.77664591 -.00000044 00000-0 00000+0 0 34
7 2 25338 98.7169 163.6809 0010553 336.0999 24.1467 14.22915048 09
8 1 25338U 98030A 98133.77664591 -.00000044 00000-0 00000-0 0 35
9 2 25338 98.7169 163.6809 0010553 336.0999 24.1467 14.22915048 09
    
```

Line 1

Field	Columns	Content	Example
1	1	Line number	1
2	03-07	Satellite catalog number	25338
3	8	Classification (U: unclassified, C: classified, S: secret)	U
4	10-11	International Designator (last two digits of launch year)	98
5	12-14	International Designator (launch number of the year)	030
6	15-17	International Designator (piece of the launch)	A
7	19-20	Epoch year (last two digits of year)	98
8	21-32	Epoch (day of the year and fractional portion of the day)	133.67211713
9	34-43	First derivative of mean motion; the ballistic coefficient	-0.00000044
10	45-52	Second derivative of mean motion (decimal point assumed)	00000+0
11	54-61	B*, the drag term, or radiation pressure coefficient (decimal point assumed)	-11610
12	63-63	Ephemeris type (always zero; only used in undistributed TLE data)	0
13	65-68	Element set number. Incremented when a new TLE is generated for this object	2
14	69-69	Checksum (modulo 10)	6

Line 2

Field	Columns	Content	Example
1	1	Line number	2
2	03-07	Satellite Catalog number	25338
3	09-16	Inclination (degrees)	98.6959
4	18-25	Right ascension of the ascending node (degrees)	163.5428
5	27-33	Eccentricity (decimal point assumed)	0000009
6	35-42	Argument of perigee (degrees)	160.4552
7	44-51	Mean anomaly (degrees)	25.6356
8	53-63	Mean motion (revolutions per day)	14.19938778
9	64-68	Revolution number at epoch (revolutions)	0
10	69	Checksum (modulo 10)	4



From Mission to Environment

- Mission's outputs processing to Environment:

Mission

- List of positions
- Launch date
- Mission duration



Environment

- Sources of particles
- Models and parameters
- Specific format



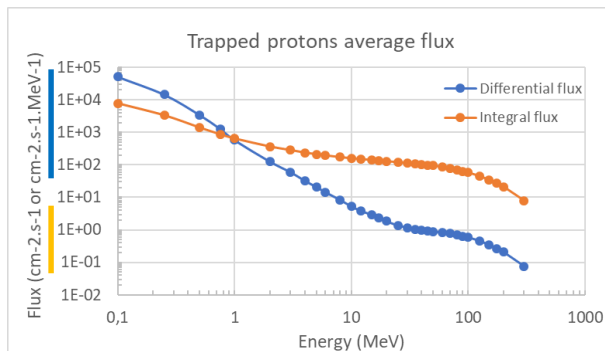
- Mission tool indicates to the Environment tool the positions of the spacecraft with time

- The Environment tool allows the user to select the models and set their parameters for each source of particles

- Environment models take outputs of the Mission tool and compute energy spectra

- ✓ Each model takes a different format of inputs: transparent for the user

- ✓ Unique output file format



Environment – Trapped particles



- OMERE

File Window View Mission **Environment** Dose SEE Atomic displacement Solar Cells AtOx Tools ?

Model selection

Parameters

Energy grid option

Output type selection:

- Mean spectrum
- Instant flux
- Along the orbit
- (Proton) Peak Flux

Electrons
Model : AE8
(ECSS 10-04 for non-specific orbit)
 Max Min Weighting
Magnetic field STANDARD (JENSEN_CAIN) Use Daly interpolation

Protons
Model : AP8
(ECSS 10-04 for non-specific orbit)
 Max Min Weighting
Magnetic field STANDARD (JENSEN_CAIN) Use Daly interpolation

Energy grid
 Custom grid: C:\Users\damien.herrera\Documents\OMERE 5.7\EnergyGridTrapped.txt
Edit New

Output
Mean spectrum Options



Environment – Solar particles



- OMERE

File Window View Mission **Environment** Dose SEE Atomic displacement Solar Cells AtOx Tools ?

Two types of models:

Average Statistical models

Flare models



Environment – Solar particles



- OMERE

File Window View Mission **Environment** Dose SEE Atomic displacement Solar Cells AtOx Tools ?

Two types of models:

Average Statistical models

Output type:

- Mean spectrum
- Instantaneous flux (at an energy)
- Instantaneous energy spectrum along the orbit

Flare models

Output:
Flux of protons/ions at a given energy

Magnetospheric cutoff model selection



Environment – Solar particles



OMERE

File Window View Mission **Environment** Dose SEE Atomic displacement Solar Cells AtOx Tools ?

Two types of models:

Average Statistical models

Model selection

Ions range selection

Average models

Protons model: ESP

ECSS 10-04 standard

Ions model (LET et SEE): SAPPHIRE - Ions

Confidence level: 80 %

Solar active period: 11.00 year(s)

Parameters

Energy grid

Custom grid:

C: \Users\damien.herrera\Documents\OMERE 5.7\Eni

Environment

Magnetospheric cutoff

Störmer (ECSS 10-04)

Output

Mean Flux and Fluence

Output type:

- Mean spectrum
- Instantaneous flux (at an energy)
- Instantaneous energy spectrum along the orbit

Flare models

Model selection

Parameters

Flare Models

Protons

Worst Day October 1989

Peak flux during a solar flare

Ions

CREME96 Worst Case 1 Day (ECSS 10-04)

Peak flux during a solar flare.

From atomic number H to U

Environment

Magnetospheric cutoff

Störmer (ECSS 10-04)

Ions range selection

Output

Output protons file: C: \Users\damien.herrera\Documents\OMERE 5.7\solarFlareProtons.fx

Output ions file: C: \Users\damien.herrera\Documents\OMERE 5.7\solarFlareIons.fx

Output:
Flux of protons/ions at a given energy

Magnetospheric cutoff model selection



Environment – Galactic Cosmic Rays (GCR)

Model selection

Model
Cosmic rays model: GCR ISO 15390 ECSS 10-04 standard

Parameters

Solar minimum Solar maximum Mission

Options

Elements(ordered by ascending mass): from H to U

Environment

Magnetospheric cutoff Störmer (ECSS 10-04) Parameters

Output

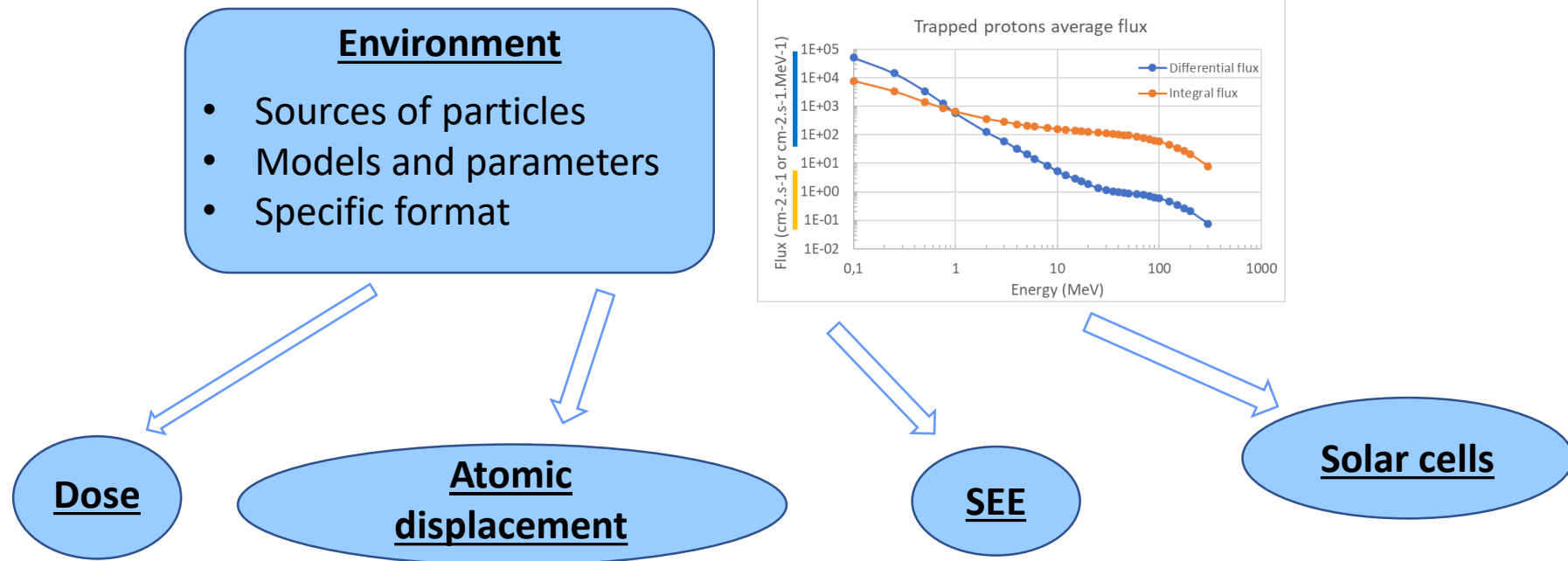
Output file: C:\Users\damien.herrera\Documents\OMERE 5.7\cosmicIons.flx

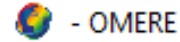
Annotations:

- Model selection* (points to 'Cosmic rays model')
- Parameters* (points to 'Solar minimum')
- Ions range selection* (points to 'Elements' dropdowns)
- Magnetospheric cutoff model selection* (points to 'Magnetospheric cutoff' checkbox)
- Output:*
Flux at a given energy for each ion species (points to 'Output file' field)

From Environment to Effects

- Environment's outputs processing to Effects modules:





Estimate a dose depth curve

- The dose depth curve is calculated with SHIELDOSE-2 considering:
 - Energy spectra
 - Calculation parameters: geometry, target material
- Inputs: energy spectra
 - *From mission*: the spectra are calculated considering the mission and models selected in the environment module
 - *From files*: user directly inputs the spectra
- Parameters:
 - Geometry: simple geometry considered for the dose calculation
 - Target material: the dose estimated in a given material



Dose

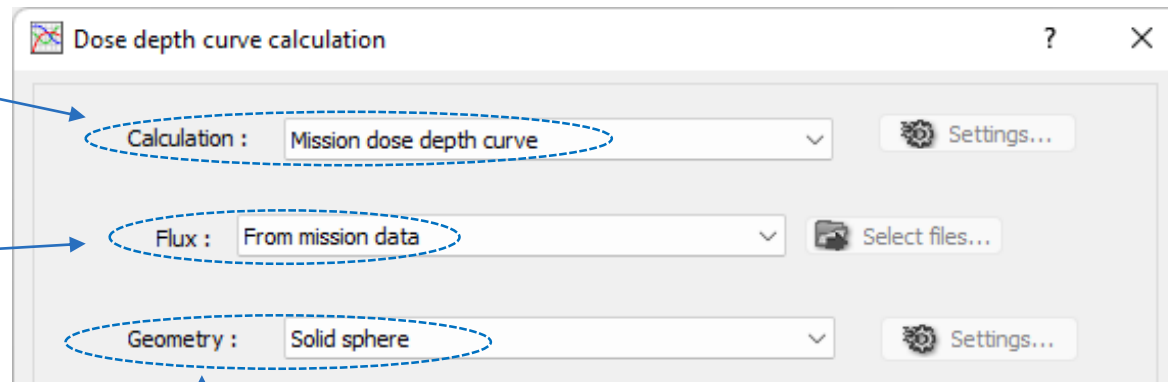


- OMERE

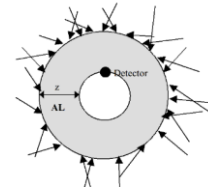
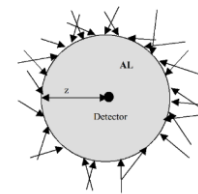
File Window View Mission Environment **Dose** | SEE Atomic displacement Solar Cells AtOx Tools ?

- Calculation type:*
- Mission dose depth curve
 - Dose rate along the orbit

- Input data:*
- From mission data
 - From data files



- Geometry:*
- Solid sphere
 - Shell sphere
 - Finite slab
 - Semi-infinite slab



Atomic displacement



- OMERE

File Window View Mission Environment Dose SEE **Atomic displacement** Solar Cells AtOx Tools ?

Estimate a displacement damage depth curve

- The dose depth curve is calculated considering:
 - Energy spectra
 - Calculation parameters: NIEL data
- Inputs: energy spectra
 - *From mission*: the spectra are calculated considering the mission and models selected in the environment tools.
 - *From files*: user directly inputs the spectra
- Output:
 - The result can be expressed in terms of displacement dose or equivalent fluence

Atomic displacement



- OMERE

File Window View Mission Environment Dose SEE **Atomic displacement** Solar Cells AtOx Tools ?

Estimate a displacement damage depth curve

- **Output:**
 - The result can be expressed in terms of displacement dose or equivalent fluence
- **Equivalent fluence:**
 - Corresponds to the fluence that a monoenergetic beam of a given particle must have to deposit the same Displacement Damage Dose (DDD) of the mission
- **Parameters**
 - Target materials
 - Non-Ionizing Energy Loss (NIEL) model
 - Type of particle and energy for the computation of the Displacement Damage Equivalent Fluence (DDEF)

Atomic displacement



- OMERE

File Window View Mission Environment Dose SEE **Atomic displacement** Solar Cells AtOx Tools ?

Input data:

- From mission data
- From data files

Parameters

Output:

- Displacement dose
- Equivalent fluence

Calculation type:

- On the mission
- Along the orbit

Atomic displacement



- OMERE

File Window View Mission Environment Dose SEE **Atomic displacement** Solar Cells AtOx Tools ?

Estimate a displacement damage depth curve

- Non-Ionizing Energy Loss models available in OMERE:
 - Summers93 (by default for Silicon)
 - Barry95 (for GaAs)
 - NEMO-ONERA (Si, GaAs or any other materials)
- Possible to import your own NIEL data

Atomic Displacement

Input data

Flux : From mission data

Incidence : Normal Omni-directional

Calculation parameters

Output data

Output type : Equivalent fluence file

Calculation type : On the mission



NIEL data

Defined materials SILICON (summers 93)

Your NIEL data

NIEL Protons :

NIEL electrons :

Single Event Effects



- OMERE

File Window View Mission Environment Dose SEE Atomic displacement Solar Cells AtOx Tools ?

Estimate a SEE rate

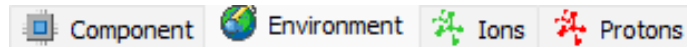
- The SEE rate is calculated considering:
 - LET spectrum for ions / Transported flux for protons
 - Cross sections data (Weibull fit, experimental data...)
 - Calculation parameters: Number of sensitive cells and cell depth
- Inputs: energy spectra
 - *From mission*: the LET spectrum and transported proton flux are calculated considering the mission and models selected in the environment tools, user has to choose the shielding thickness
 - *From files*: user directly inputs the LET spectrum and the transported proton flux
- Output:
 - The SEE rate is computed for each source of particles



Single Event Effects

Estimate a SEE rate

- Definition of the Environment
 - From Mission



Use environment from: Mission Files

Protons:		Ions:		
Source	Model	Source	Model	Zmin
<input checked="" type="checkbox"/> Trapped Particles ...	AP8 min	<input type="checkbox"/> Trapped Particles ...	AP8 min	
<input checked="" type="checkbox"/> Solar Mean Protons	ESP	<input type="checkbox"/> Solar Mean Protons	ESP	
<input type="checkbox"/> Solar Flare Protons	Worst day octob...	<input type="checkbox"/> Solar Flare Protons	Worst day ...	
<input checked="" type="checkbox"/> Solar Flare Ions (Z=1)	CREME96 worst ...	<input checked="" type="checkbox"/> Solar Flare Ions	CREME96 ...	1
<input checked="" type="checkbox"/> Cosmics rays (Z=1)	GCR-ISO	<input checked="" type="checkbox"/> Cosmics rays	GCR-ISO	1

Choose the source of protons

Choose the source of heavy ions

Shielding type:

- Single
- Sector file

Unit:

- g/cm^2
- μm
- mm
- $mils$

Mission Shielding

Type: Single

Single Shielding Parameters

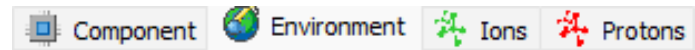
Thickness: 1

Unit: q/cm^2 Density: $2.6989 q/cm^3$

Single Event Effects

Estimate a SEE rate

- Definition of the Environment
 - From Files



Choose the file path

Use environment from: Mission Files

Input files

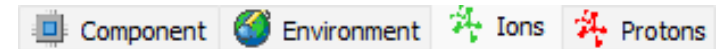
<input checked="" type="checkbox"/> Transported protons flux file	Energie	Flux
C:\Users\damien.herrera\Documents\OMERE 5.7\trar	MeV	/cm ² /s /MeV
<input checked="" type="checkbox"/> LET spectrum file	LET	Flux
C:\Users\damien.herrera\Documents\OMERE 5.7\LET.	MeV cm ² /g	/cm ² /s

Units

Single Event Effects

Estimate a SEE rate

- Definition of the cross section data and model (ions and protons)



Selection of the fit model

Cross section type:

- Data input
- Fit parameters only
- Step function
- File

Note :

For protons, if you do not have test data or Weibull fit, you can estimate the proton data from ions data with PROFIT, SIMPA or METIS methods

The screenshot shows the software interface for defining cross section data and fit parameters. The 'Model' is set to 'WEIBULL'. The 'Cross section type' is set to 'Data input'. A table shows LET values and corresponding cross sections. The 'Fit parameters' section includes W (1.984e+1), S (1.531e+0), Limit cross section (9.910e-2 cm²/device), and LET threshold (3.958e+0 MeV cm²/mg). Other parameters include Critical charge (0.0816178 pC), a = b = 4.69276 μm, c = 2 μm, and Material = SILICON (2.33g/cm³). A 'Fit Estimation' button and 'View data'/'Export data' buttons are also visible.

LET MeV.cm ² .mg ⁻¹	Cross section cm ² /device
4	3e-05
4.5	0.0001
5.5	0.002
8	0.008
19	0.04
25	0.06
55	0.099

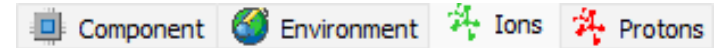
Fit parameters



Single Event Effects

Estimate a SEE rate

- Definition of the cross section data and model (ions and protons)



Selection of the fit model

Cross section type:

- Data input
- Fit parameters only
- Step function
- File

Note :

For protons, if you do not have test data or Weibull fit, you can estimate the proton data from ions data with PROFIT, SIMPA or METIS methods

The screenshot shows the 'Cross section data' configuration window. The 'Model' is set to 'WEIBULL'. The 'Cross section type' is 'Data input'. A table shows LET values (4, 4.5, 5.5, 8, 19, 25, 55) and corresponding cross section values (3e-05, 0.0001, 0.002, 0.008, 0.04, 0.06, 0.099). On the right, 'Fit parameters' are defined: W = 1.984e+1, S = 1.531e+0, Limit cross section = 9.910e-2 cm²/device, and LET threshold = 3.958e+0 MeV cm²/mg. Other parameters include Critical charge (0.0816178 pC), a = b = 4.69276 μm, c = 2 μm, and Material = SILICON (2.33g/cm³).

Fit parameters

The 'Calculations' dialog box shows the 'Output file' path as 'C:\Users\damien.herrera\Documents\OMERE 5.7\seeRates.see'. It includes a 'Run selected component(s)' button and 'Ok' and 'Cancel' buttons.

	Cosmic rays (Heavy Ions Rate)	Solar protons (Protons Rate)
HF459046	2.33e-1 /device /day	5.06e-2 /device /day
HF459047	7.81e-2 /device /day	5.14e-2 /device /day

Compute the SEE rate





Estimate the degradation on solar cells

- Three models:

- **JPL**: estimates the equivalent fluence for three electrical parameters:

- P_{max}, V_{oc}, I_{sc} .

- **NRL**: estimates the EOL (End Of Life) performances via displacement damage.

- **SADC**: estimates the GRF (Global Remaining Factors) for each electrical parameters via displacement damage.

- Three types of shielding:

- Simple: only one value of shielding is considered
- Multiple: the degradation is estimated for several values of shielding
- Complex: different layers of shielding, considering realistic material (only available for SADC)

- Output:

- Output file with EOL performance for each source of particle (JPL/NRL)
- Output file with GRF for each electrical parameter (SADC)



Solar cells – JPL and NRL



- OMERE

File Window View Mission Environment Dose SEE Atomic displacement **Solar Cells** AtOx Tools ?

Input data:

- From mission data
- From data files

Degradation model:

- NRL
- JPL

Shielding parameters

Calculation type:

- Mean of the mission
- Along the orbit
- Time profile

```
# Back Shielding: Infinite
# Coverglass || Displacement || EOL ||
# Thickness || Damage Dose || Performance ||
# (um) || (MeV/g) || (%) ||
# || Electrons | Protons | Total ||
#-----|-----|-----|-----|-----|
# 5.000e+01 | 1.712e+09 | 3.218e+09 | 4.931e+09 | 7.854e+01
```



Solar cells – SADC



- OMERÉ

File Window View Mission Environment Dose SEE Atomic displacement **Solar Cells** AtOx Tools ?

Input data:

- From mission data
- From data files

Solar cell model:

- Optical layer
- Active layer
- Shielding layer
- Can be modified

- SADC allows to:
 - define a realistic solar cell model
 - consider the darkening due to TID on coverglass
 - propagate measurement uncertainties
 - study new technology of solar cells

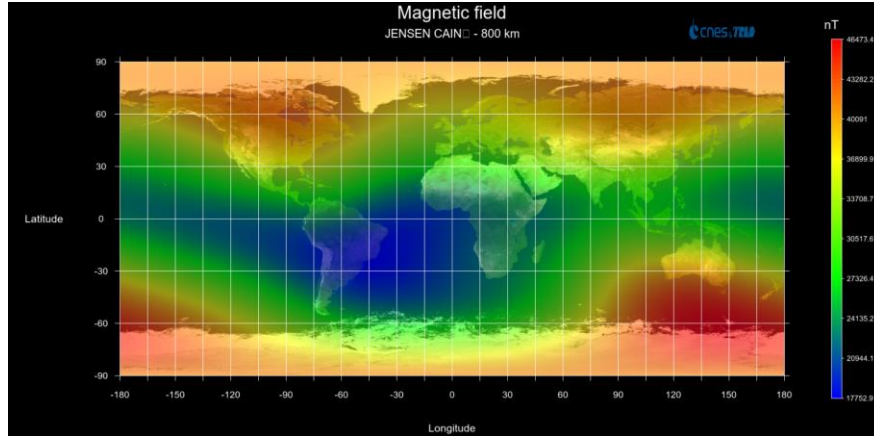
```
# ->Electrical parameters
# Name | DDDe | DDDe->p | DDDp | RF | GRF
# | (MeV/g) | (MeV/g) | (MeV/g) | (%) | (%)
# | min | mid | max | min | mid | max
#-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
# Isc | 3.15279e+09 | 3.15279e+09 | 9.91119e+09 | 96.197 | 96.197 | 96.197 | 96.1176 | 96.1176 | 96.1176
# Voc | 3.15279e+09 | 1.45568e+09 | 9.91119e+09 | 89.8404 | 89.8404 | 89.8404
# Pmax | 3.15279e+09 | 1.70307e+09 | 9.91119e+09 | 80.9301 | 80.9301 | 80.9301 | 80.8632 | 80.8632 | 80.8632
# Ipm | 3.15279e+09 | 3.15279e+09 | 9.91119e+09 | 94.6636 | 94.6636 | 94.6636 | 94.5854 | 94.5854 | 94.5854
# Vpm | 3.15279e+09 | 6.2246e+08 | 9.91119e+09 | 87.9862 | 87.9862 | 87.9862
```



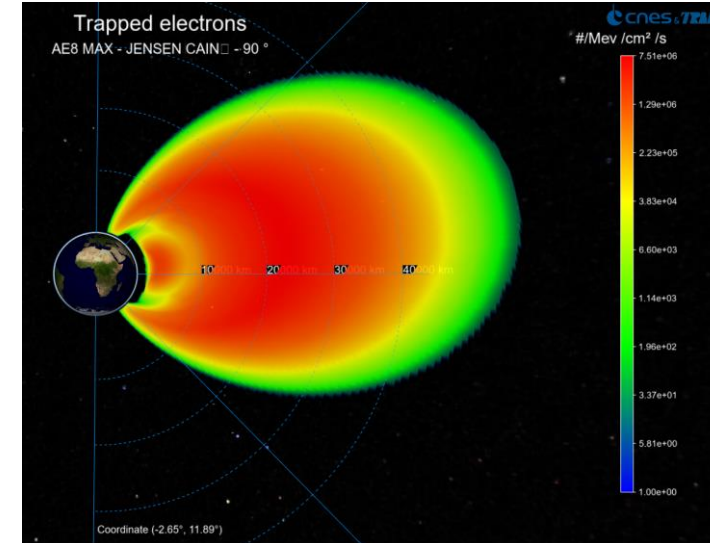
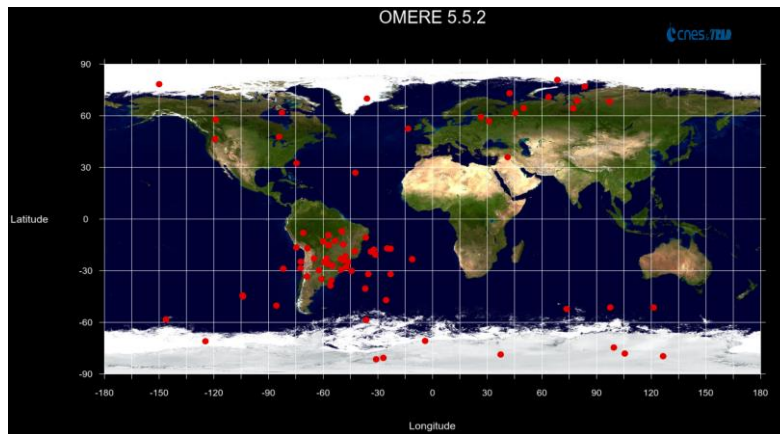
Other functionalities, tips and advices

Other fonctionnalities

- Flux and magnetic field mapping for example



SEL data for a specific mission (REX data)



- Many others:
 - SEE mission's data plots
 - LET computation in material (ion test)
 - DDEF converter
 - ...

Tips and advices

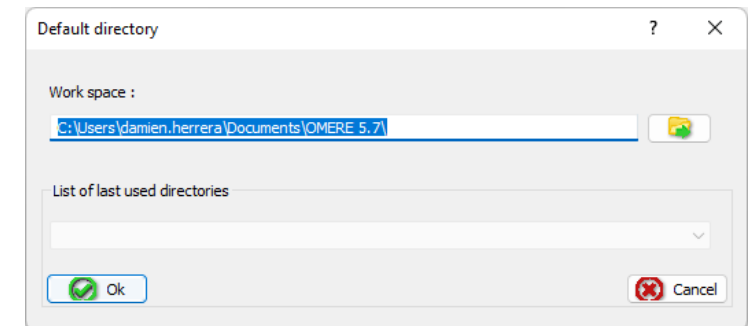
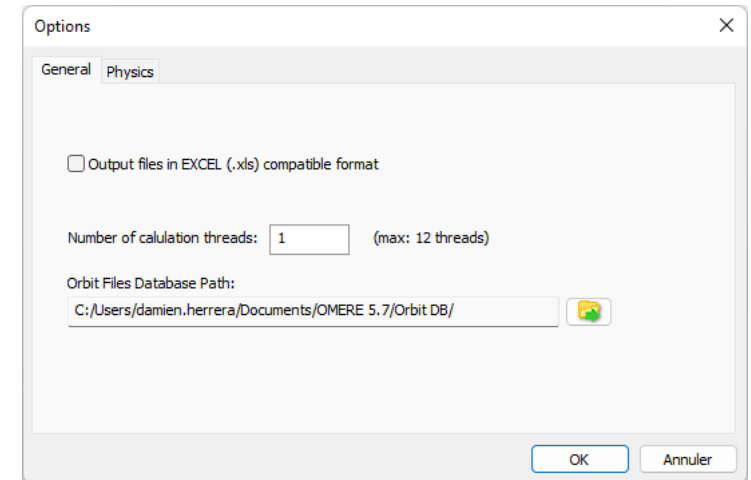
- Think to look at the setup button : 

- The environment models are always indicated at bottom left corner of OMERE window:

09/26/2023 - 15.00 years || AP8 min || ESP 80% || GCR ISO, cut || Current file version: 5.7.0

- Interesting options available in OMERE:

- Define your workspace in OMERE: File -> Default directory



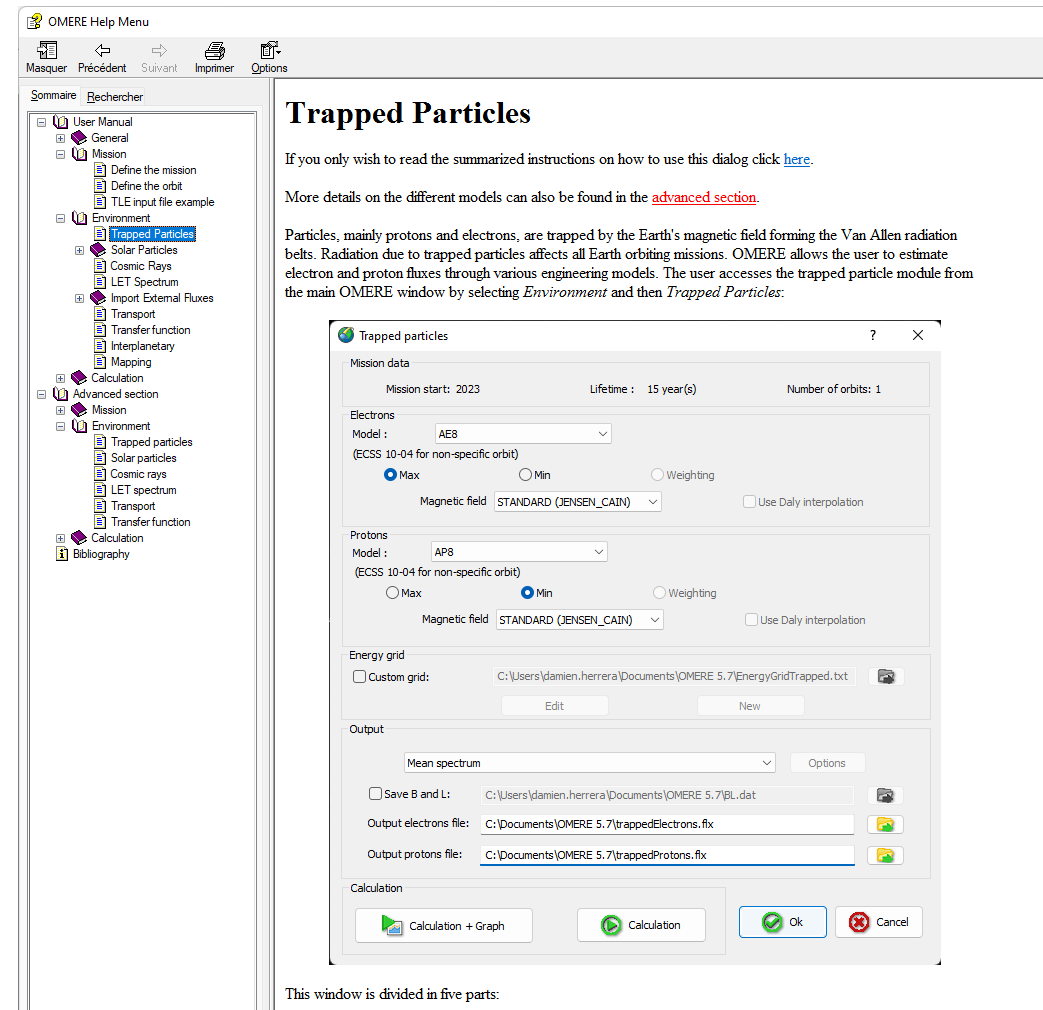
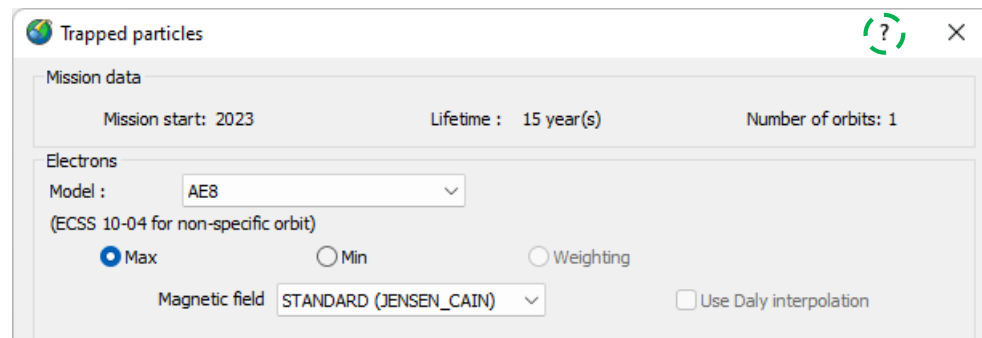


- OMERE

File Window View Mission Environment Dose SEE Atomic displacement Solar Cells AtOx Tools

- Help menu:

- Global and advanced information
- Available for each module
- Check the top right corner !



Need some help ?

Do not hesitate to contact us at our TRAD email adress
if you need more information or support !

omere@trad.fr

Thank you for your attention

For further information on:

www.trad.fr – www.fastrad.net
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