OMERE space radiation environment and effects tool: new developments and new interface

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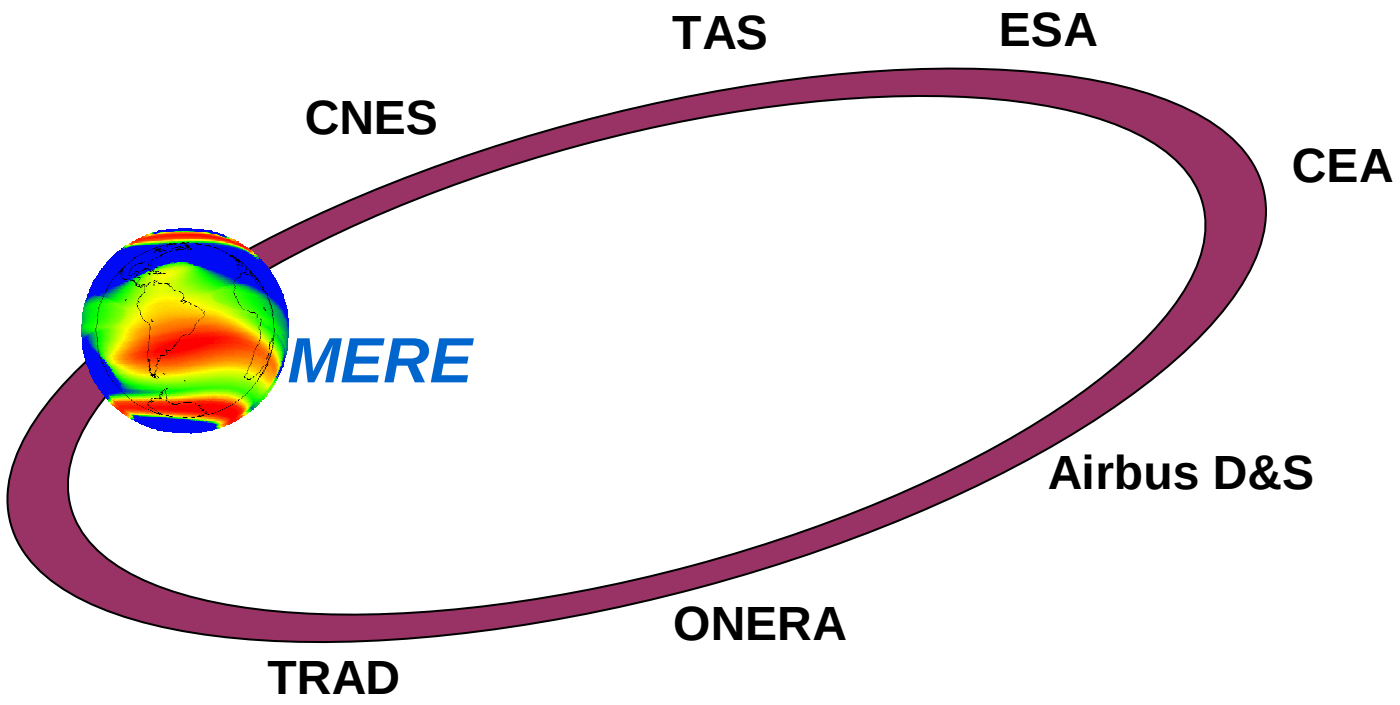
The OMERE software

OMERE = Outil de Modélisation de l'Environnement Radiatif Externe

- 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 the CNES.
  - Coupling with FASTRAD®.

The OMERE software

- The partnership



The OMERE Software

- Existing modules
  - Orbit and mission definition
    - Orbit parameters or trajectory file
  - Radiation environment definition
    - Radiation belt models
    - Solar proton and solar ion models
    - Cosmic Ray models
  - Ionising dose
    - Dose depth curve behind Al equivalent shielding
    - Dose rate calculation along the orbit
  - Non-Ionising dose
    - Using NIEL curves from the ONERA NEMO (NIEL Evaluation Model of ONERA) code.
    - Electron, proton and neutron equivalent fluence.

The OMERE Software

- Existing modules
  - LET spectrum
    - Behind fixed aluminium equivalent shielding or using a sector file.
  - Particle Transport
    - Electron, proton, ion behind fixed aluminium equivalent shielding or using a sector file.
  - Single Event Effects
    - Component database
    - Weibull fit of ion and proton cross-section curves
    - PROFIT and SIMPA methods for predicting proton cross-section curve from the ion one
    - Mission average and along the orbit single event rate behind fixed aluminium equivalent shielding or using a sector file.

The OMERE Software

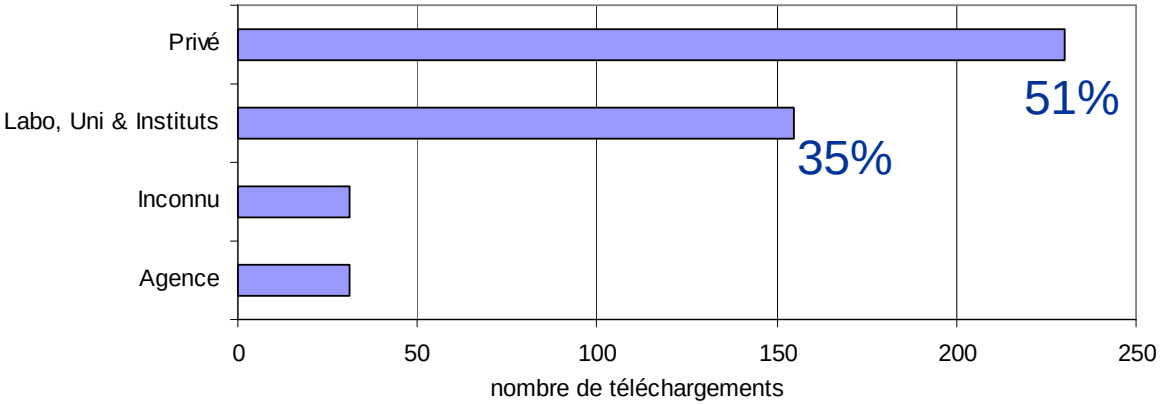
- Existing modules
  - Equivalent LET
    - LET variation inside the sensitive volume for an ion of energy E.
  - Solar Cells
  - Multi-mission calculations
    - Batch calculations of environment and effects for multiple missions.
    - Post processing tools.

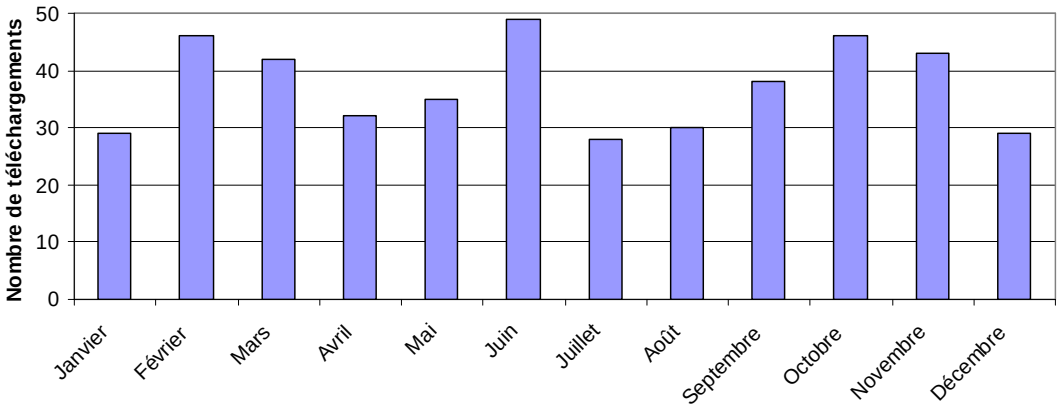
The OMERE software

- The users
  - System engineering (can be a client requirement)
  - Electronic component engineering
  - Equipment and scientific instrument conception
  - Research and development
  - Education

OMERE in 2016

- User statistics
  - 450 downloads in 2016
  - From 40 different countries



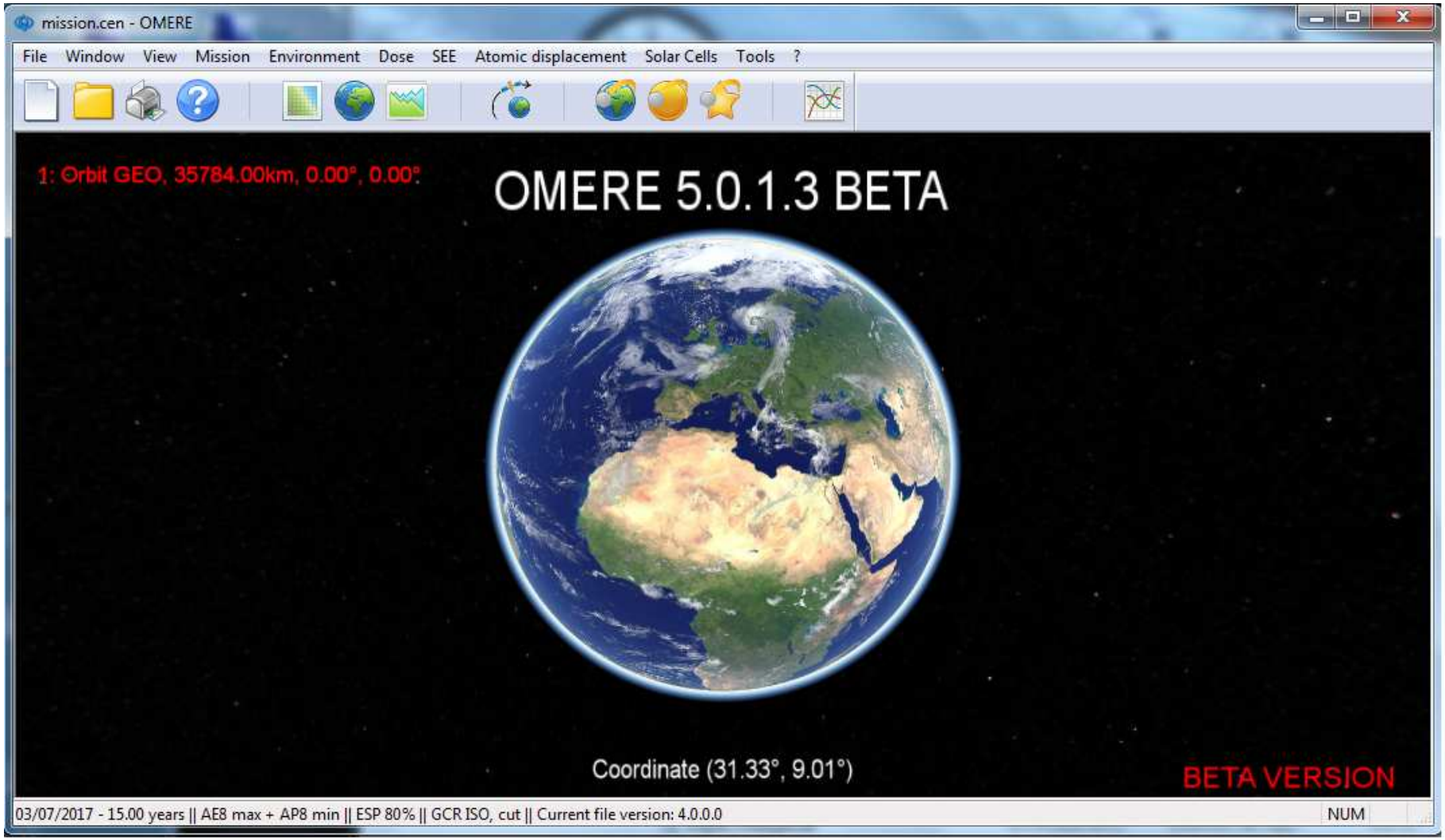


On average 1 new download/day

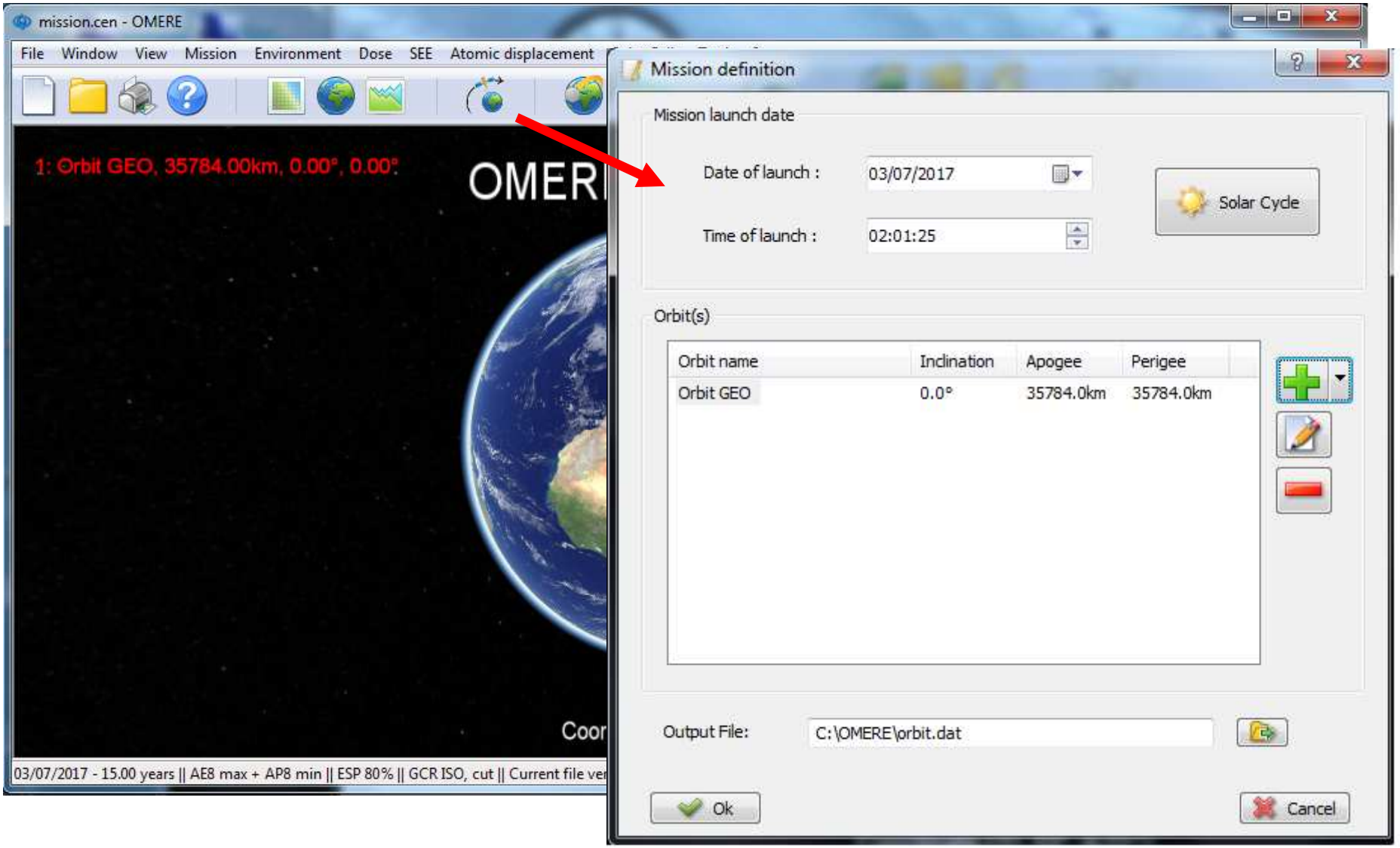
OMERE 5.0

- Since 2015, important efforts to improve interface and optimize code
- Calculations are faster – approximate factor of x2 less
- The first version reflecting this work is v5.0, soon to be released on the TRAD web page (http://www.trad.fr/OMERE-Software.html)

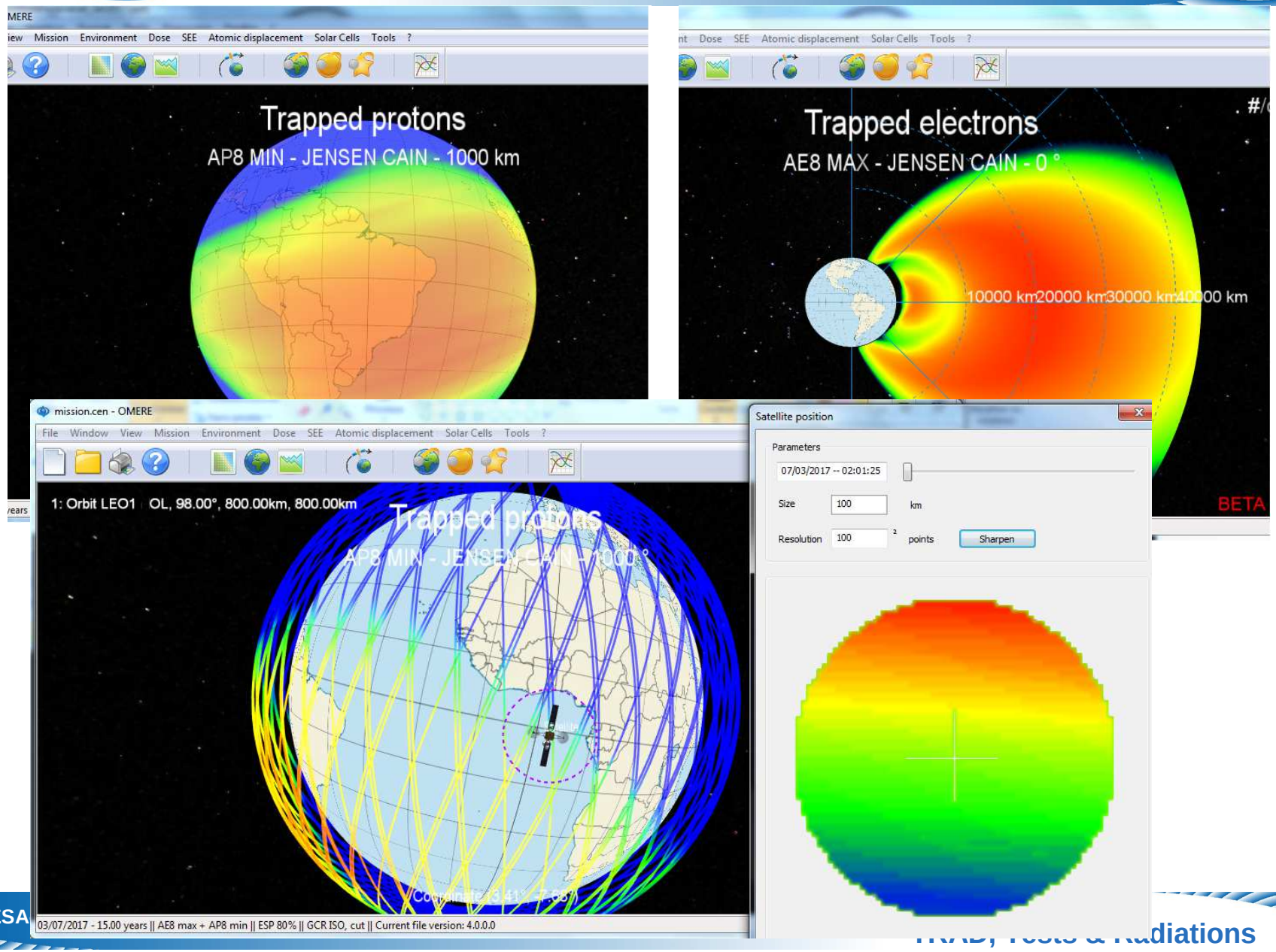
OMERE 5.0


mission.cen - OMERE
File Window View Mission Environment Dose SEE Atomic displacement Solar Cells Tools ?
1: Orbit GEO, 35784.00km, 0.00°, 0.00°
OMERE 5.0.1.3 BETA
Coordinate (31.33°, 9.01°)
BETA VERSION
03/07/2017 - 15.00 years || AE8 max + AP8 min || ESP 80% || GCR ISO, cut || Current file version: 4.0.0.0
NUM

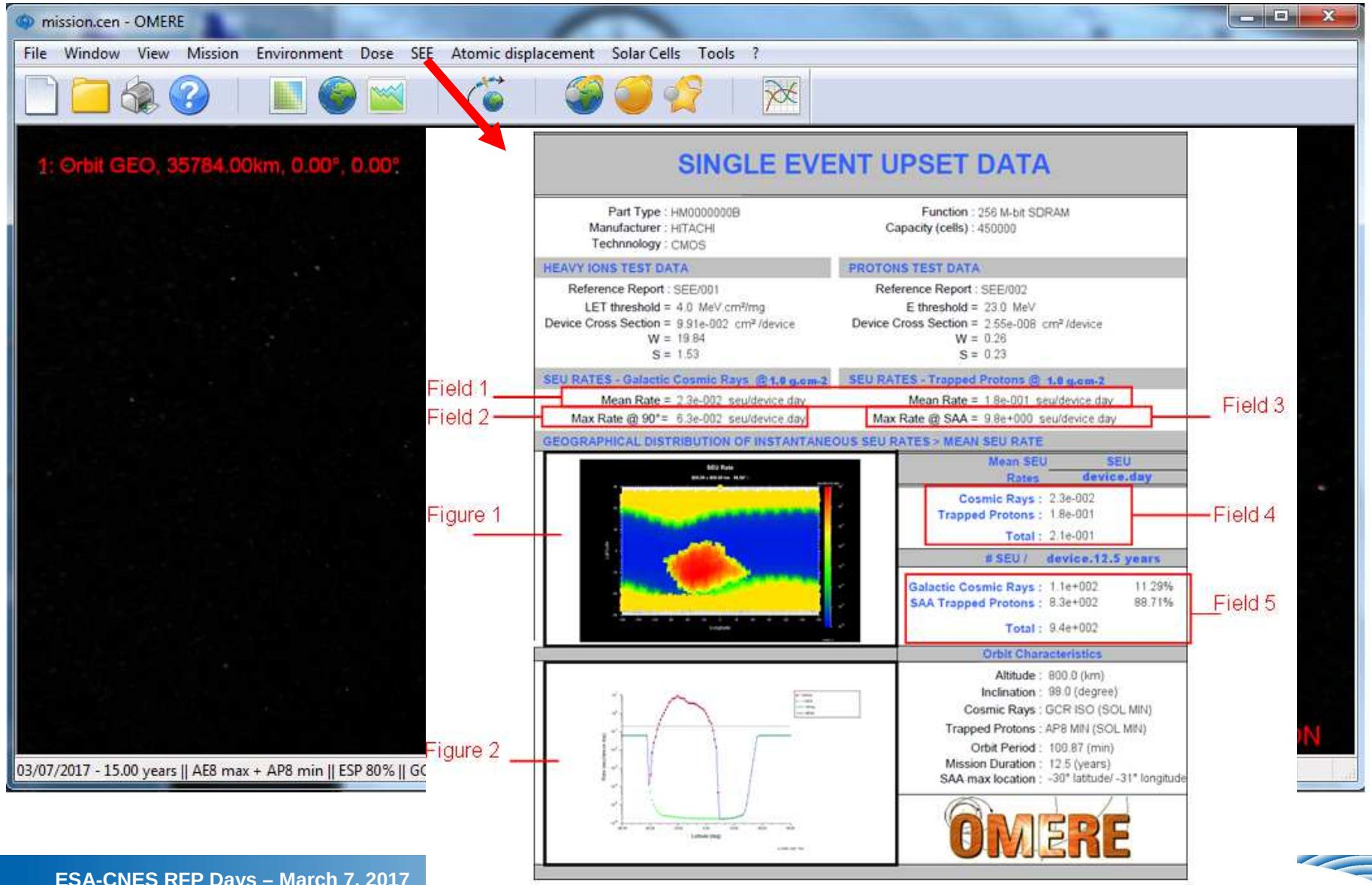
OMERE 5.0


mission.cen - OMERE
File Window View Mission Environment Dose SEE Atomic displacement
1: Orbit GEO, 35784.00km, 0.00°, 0.00°
OMER
Coor
03/07/2017 - 15.00 years || AE8 max + AP8 min || ESP 80% || GCR ISO, cut || Current file ver
Mission definition
Mission launch date
Date of launch :
03/07/2017
Time of launch :
02:01:25
Solar Cycle
Orbit(s)
Orbit name
Inclination
Apogee
Perigee
Orbit GEO
0.0°
35784.0km
35784.0km
Output File:
C:\OMERE\orbit.dat
Ok
Cancel

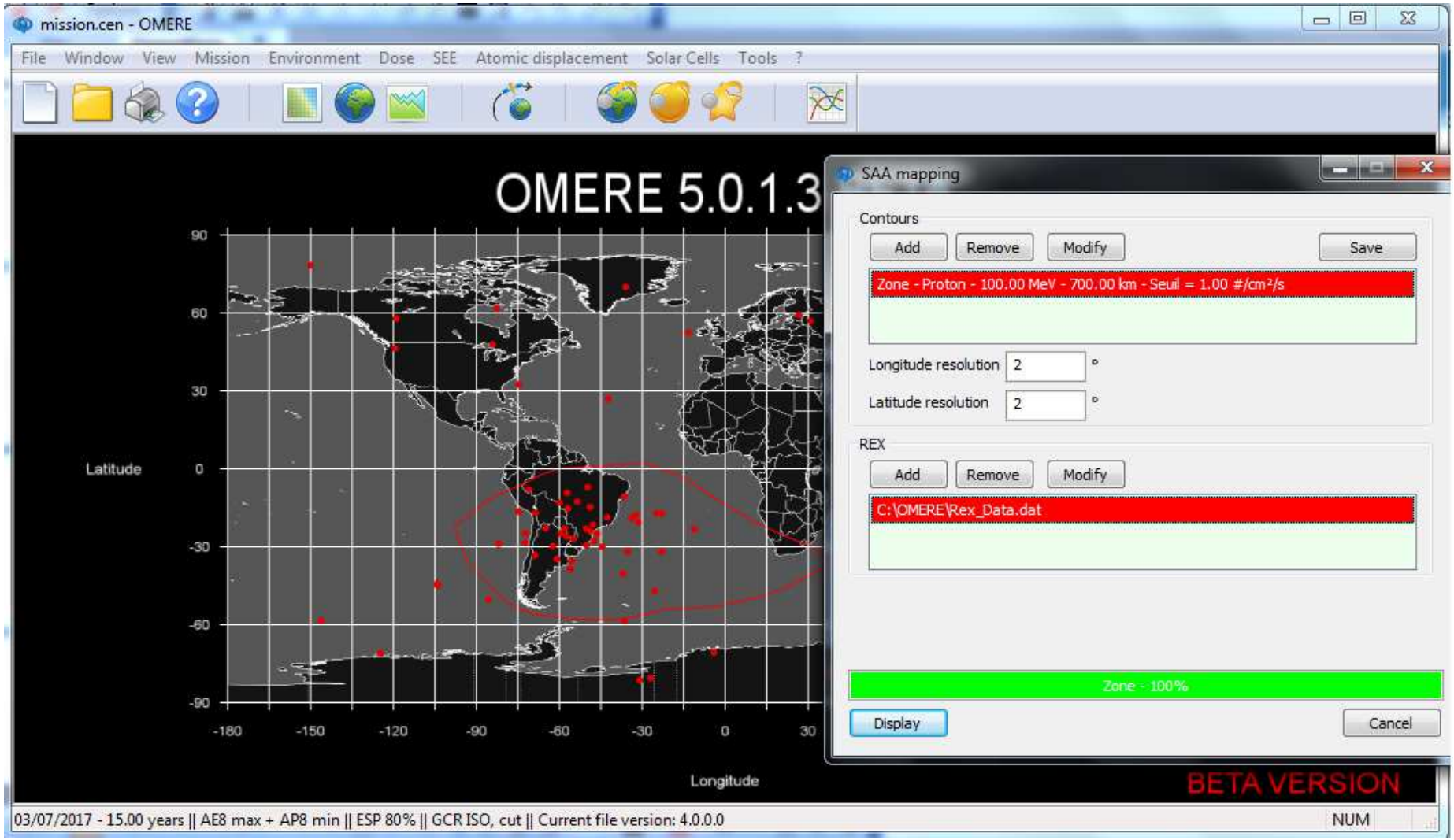
OMERE 5.0


Trapped protons
AP8 MIN - JENSEN CAIN - 1000 km
Trapped electrons
AE8 MAX - JENSEN CAIN - 0 °
10000 km20000 km30000 km40000 km
BETA
mission.cen - OMERE
File Window View Mission Environment Dose SEE Atomic displacement Solar Cells Tools ?
1: Orbit LEO1 OL, 98.00°, 800.00km, 800.00km
Trapped protons
AP8 MIN - JENSEN CAIN - 1000 °
03/07/2017 - 15.00 years || AE8 max + AP8 min || ESP 80% || GCR ISO, cut || Current file version: 4.0.0.0
Satellite position
Parameters
07/03/2017 -- 02:01:25
Size 100 km
Resolution 100 points
Sharpen

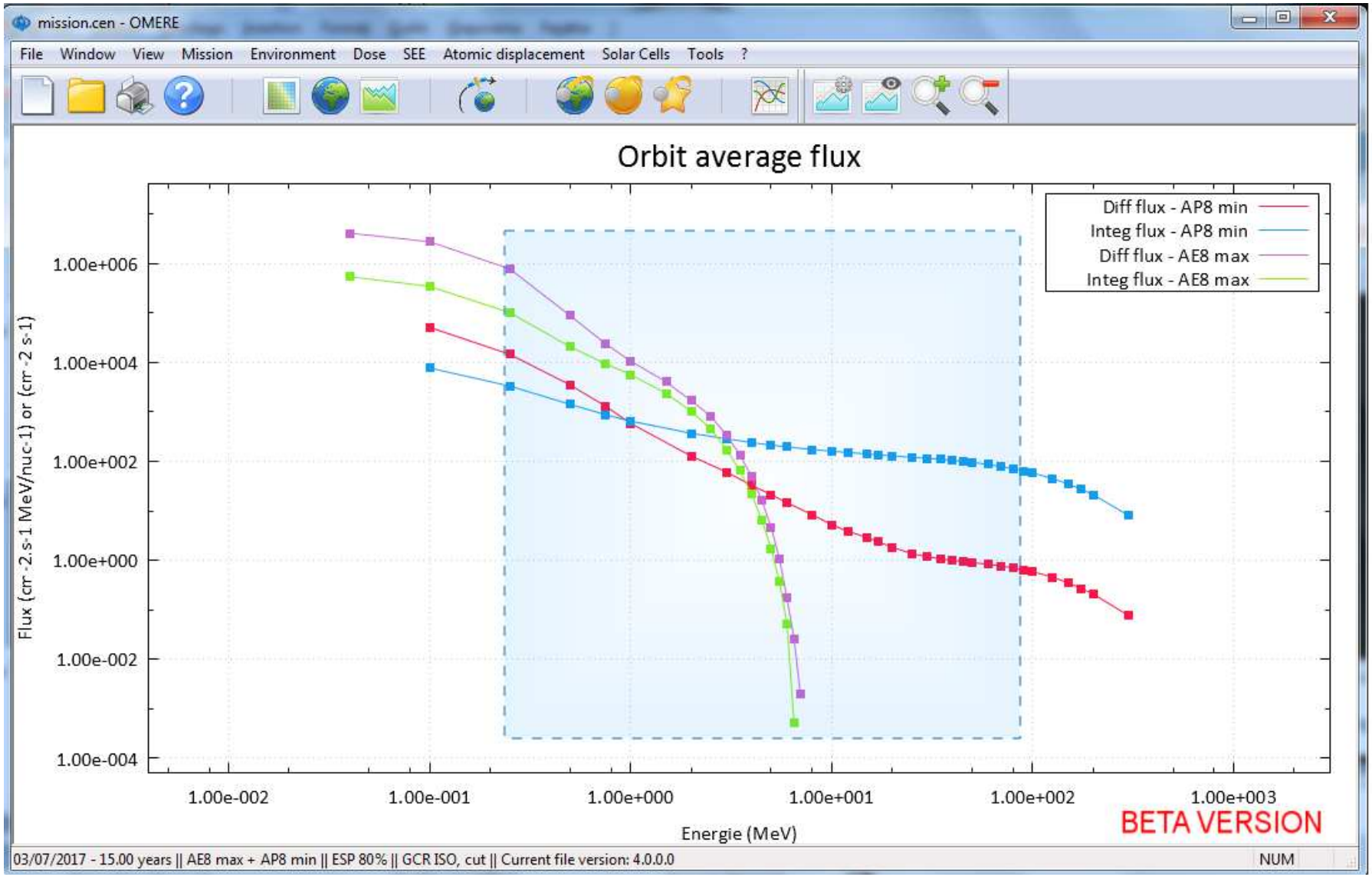
OMERE 5.0


mission.cen - OMERE
File Window View Mission Environment Dose SEE Atomic displacement Solar Cells Tools ?
1: Orbit GEO, 35784.00km, 0.00°, 0.00°
03/07/2017 - 15.00 years || AE8 max + AP8 min || ESP 80% || GC
SINGLE EVENT UPSET DATA
Part Type : HM0000000B
Manufacturer : HITACHI
Technnology : CMOS
Function : 256 M-bit SDRAM
Capacity (cells) : 450000
HEAVY IONS TEST DATA
Reference Report : SEE/001
LET threshold = 4.0 MeV.cm²/mg
Device Cross Section = 9.91e-002 cm² /device
W = 19.84
S = 1.53
PROTONS TEST DATA
Reference Report : SEE/002
E threshold = 23.0 MeV
Device Cross Section = 2.55e-008 cm² /device
W = 0.26
S = 0.23
SEU RATES - Galactic Cosmic Rays @ 1.0 g.cm-2
Mean Rate = 2.3e-002 seu/device.day
Max Rate @ 90°= 6.3e-002 seu/device.day
SEU RATES - Trapped Protons @ 1.0 g.cm-2
Mean Rate = 1.8e-001 seu/device.day
Max Rate @ SAA = 9.8e+000 seu/device.day
GEOGRAPHICAL DISTRIBUTION OF INSTANTANEOUS SEU RATES > MEAN SEU RATE
Mean SEU Rates
SEU device.day
Cosmic Rays : 2.3e-002
Trapped Protons : 1.8e-001
Total : 2.1e-001
SEU / device.12.5 years
Galactic Cosmic Rays : 1.1e+002 11.29%
SAA Trapped Protons : 8.3e+002 88.71%
Total : 9.4e+002
Orbit Characteristics
Altitude : 800.0 (km)
Inclination : 98.0 (degree)
Cosmic Rays : GCR ISO (SOL MIN)
Trapped Protons : AP8 MIN (SOL MIN)
Orbit Period : 100.87 (min)
Mission Duration : 12.5 (years)
SAA max location : -30° latitude/ -31° longitude
OMERE
Field 1
Field 2
Field 3
Figure 1
Field 4
Field 5
Figure 2

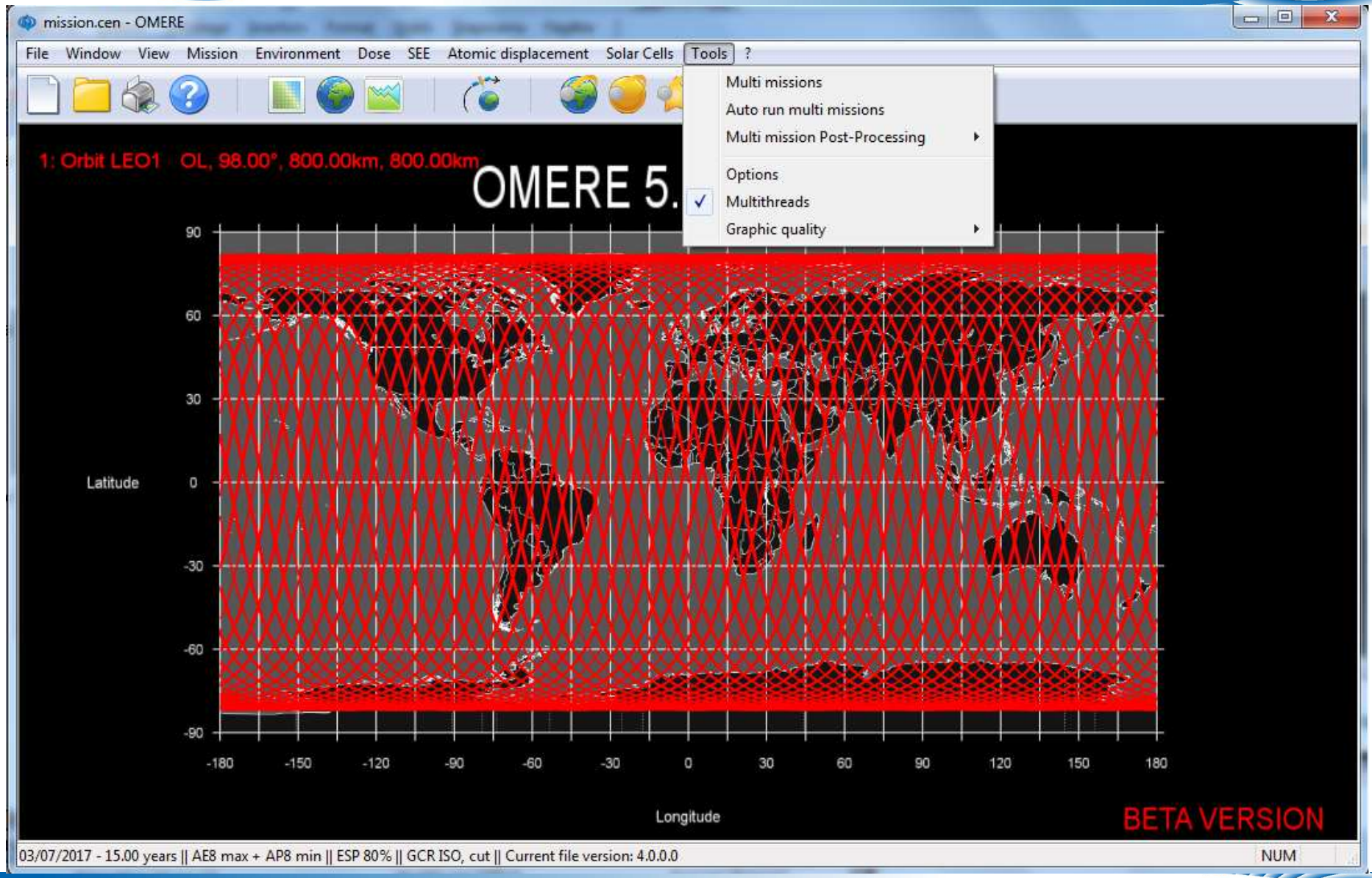
OMERE 5.0


mission.cen - OMERE
File Window View Mission Environment Dose SEE Atomic displacement Solar Cells Tools ?
OMERE 5.0.1.3
Latitude
Longitude
90
60
30
0
-30
-60
-90
-180
-150
-120
-90
-60
-30
0
30
SAA mapping
Contours
Add
Remove
Modify
Save
Zone - Proton - 100.00 MeV - 700.00 km - Seuil = 1.00 #/cm²/s
Longitude resolution 2 °
Latitude resolution 2 °
REX
Add
Remove
Modify
C:\OMERE\Rex_Data.dat
Zone - 100%
Display
Cancel
BETA VERSION
03/07/2017 - 15.00 years || AE8 max + AP8 min || ESP 80% || GCR ISO, cut || Current file version: 4.0.0.0
NUM

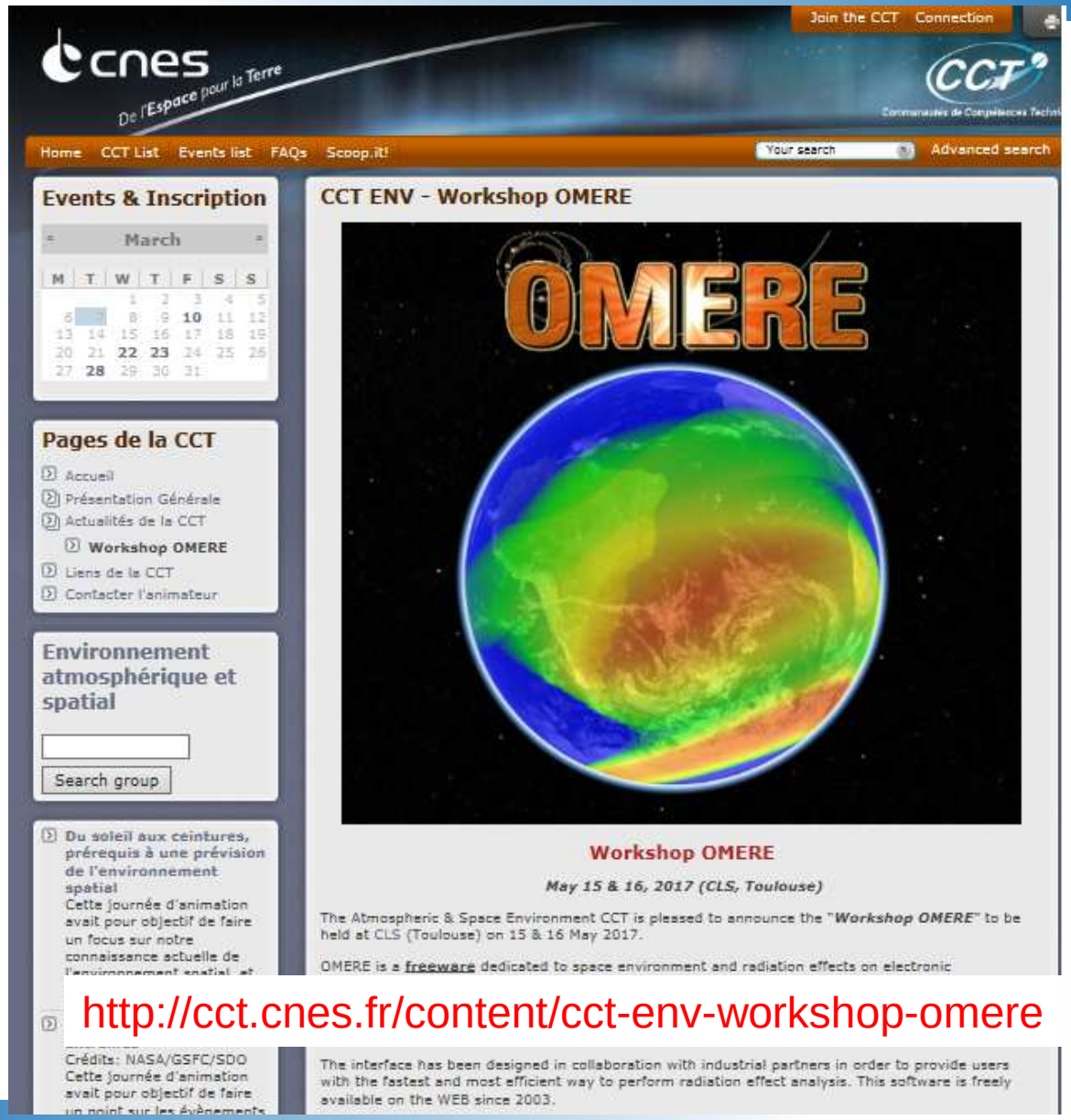
OMERE 5.0


mission.cen - OMERE
File Window View Mission Environment Dose SEE Atomic displacement Solar Cells Tools ?
Orbit average flux
Diff flux - AP8 min
Integ flux - AP8 min
Diff flux - AE8 max
Integ flux - AE8 max
Flux (cm-2.s-1.MeV/nuc-1) or (cm-2.s-1)
1.00e+006
1.00e+004
1.00e+002
1.00e+000
1.00e-002
1.00e-004
1.00e-002
1.00e-001
1.00e+000
1.00e+001
1.00e+002
1.00e+003
Energie (MeV)
BETA VERSION
03/07/2017 - 15.00 years || AE8 max + AP8 min || ESP 80% || GCR ISO, cut || Current file version: 4.0.0.0
NUM

OMERE 5.0


mission.cen - OMERE
File Window View Mission Environment Dose SEE Atomic displacement Solar Cells Tools ?
Multi missions
Auto run multi missions
Multi mission Post-Processing
Options
Multithreads
Graphic quality
1: Orbit LEO1 OL, 98.00°, 800.00km, 800.00km
OMERE 5.
Latitude
90
60
30
0
-30
-60
-90
-180 -150 -120 -90 -60 -30 0 30 60 90 120 150 180
Longitude
BETA VERSION
03/07/2017 - 15.00 years || AE8 max + AP8 min || ESP 80% || GCR ISO, cut || Current file version: 4.0.0.0
NUM

Workshop in May 2017



http://cct.cnes.fr/content/cct-env-workshop-omere