Overview of current and future SPENVIS and Organisation of the tutorials

M. Kruglanski (BIRA-IASB)

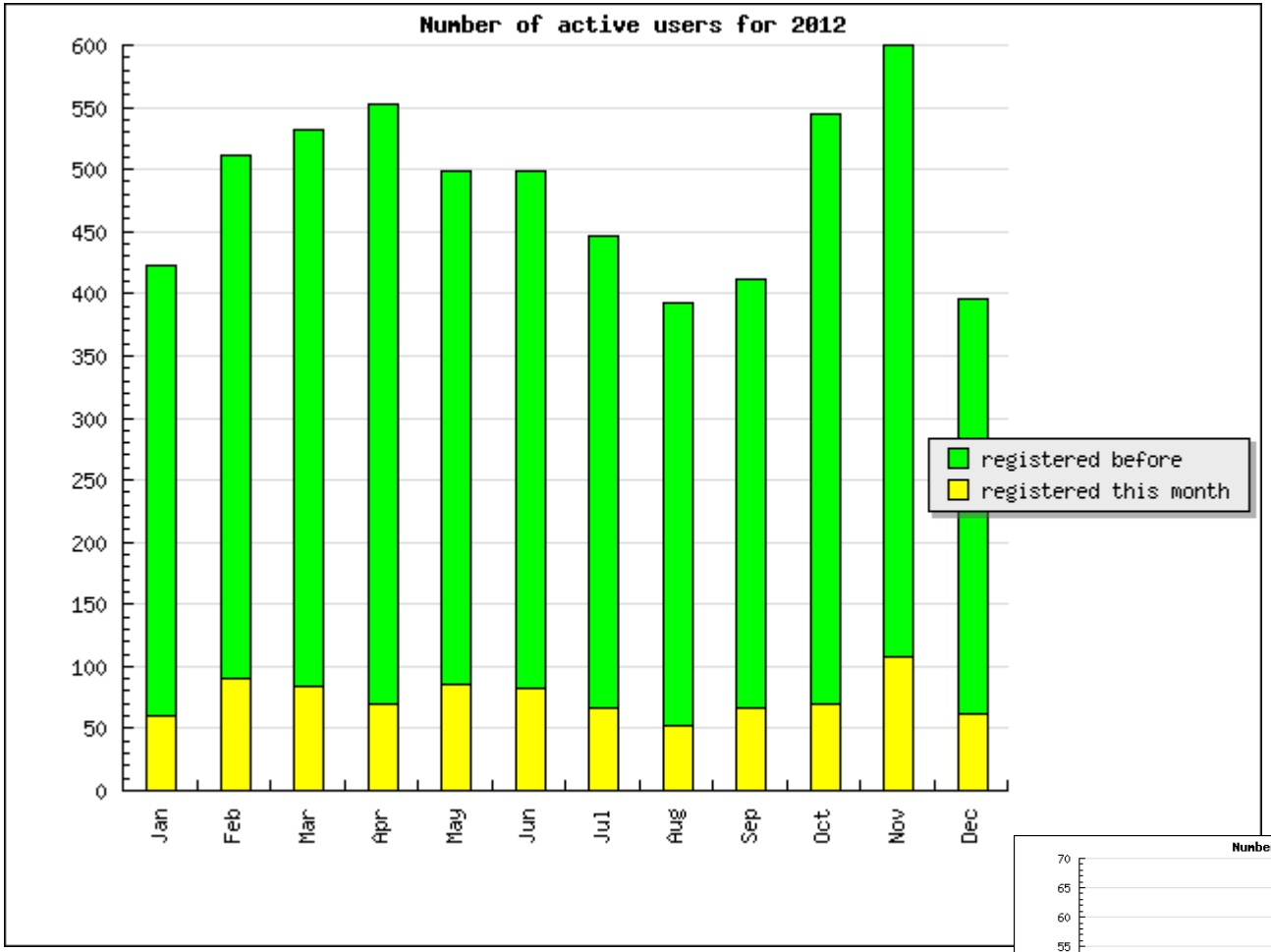
Overview of current and future SPENVIS and organisation of the tutorials

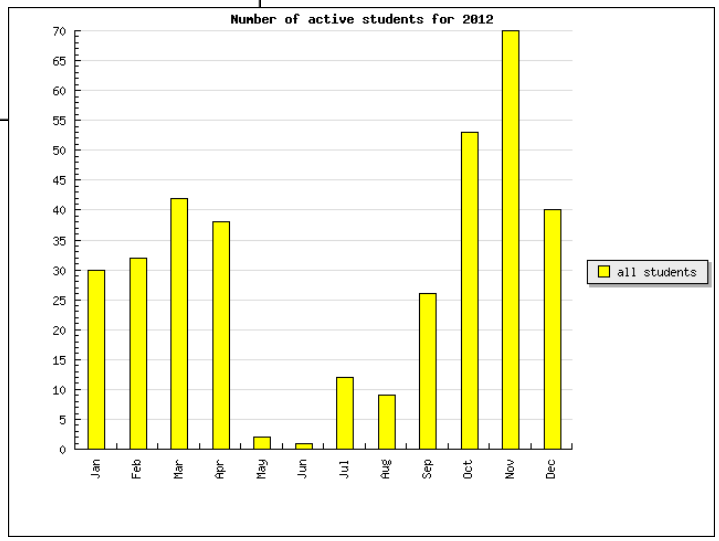
Outline of the presentation

- Overview of the current SPENVIS
- Introduction to the SUW 2013 tutorials
- Tutorial #0: Mission concept
- Outlook to next generation

Current SPENVIS

- Running at two locations:
  - swe.ssa.esa.int version (4.6.4) deployed in the framework of ESA Space Situational Awareness Preparatory Programme
  - www.spenvis.oma.be version (4.6.6) developed under ESA General Support Technologies Programme
- At www.spenvis.oma.be
  - running since 1998 with regular improvements
  - more than 10000 registrations
  - about 2900 active users in 2012
  - about 475 active users per month





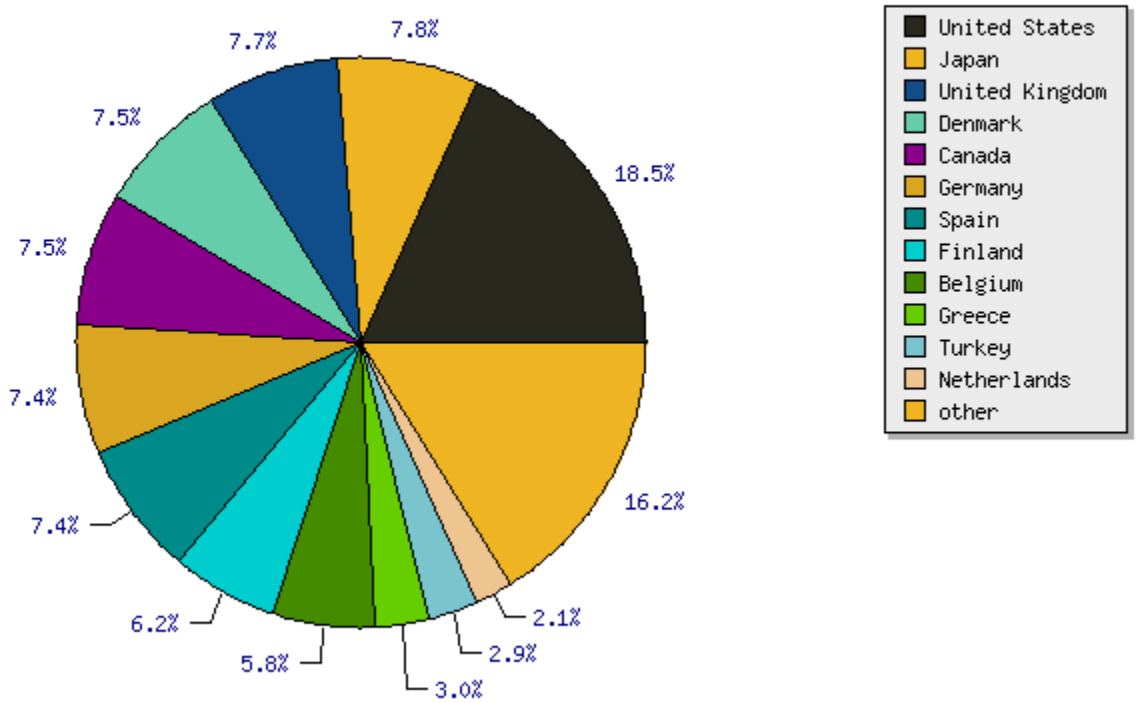
SPENVIS
The Space Environment Information System

aeronomie.be

belspo

.be

Distribution of user access per country for February 2013



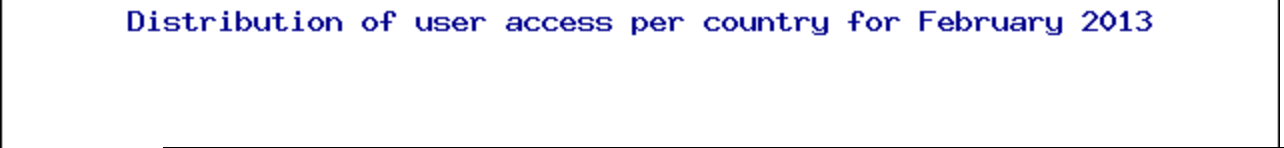
100% = 77743

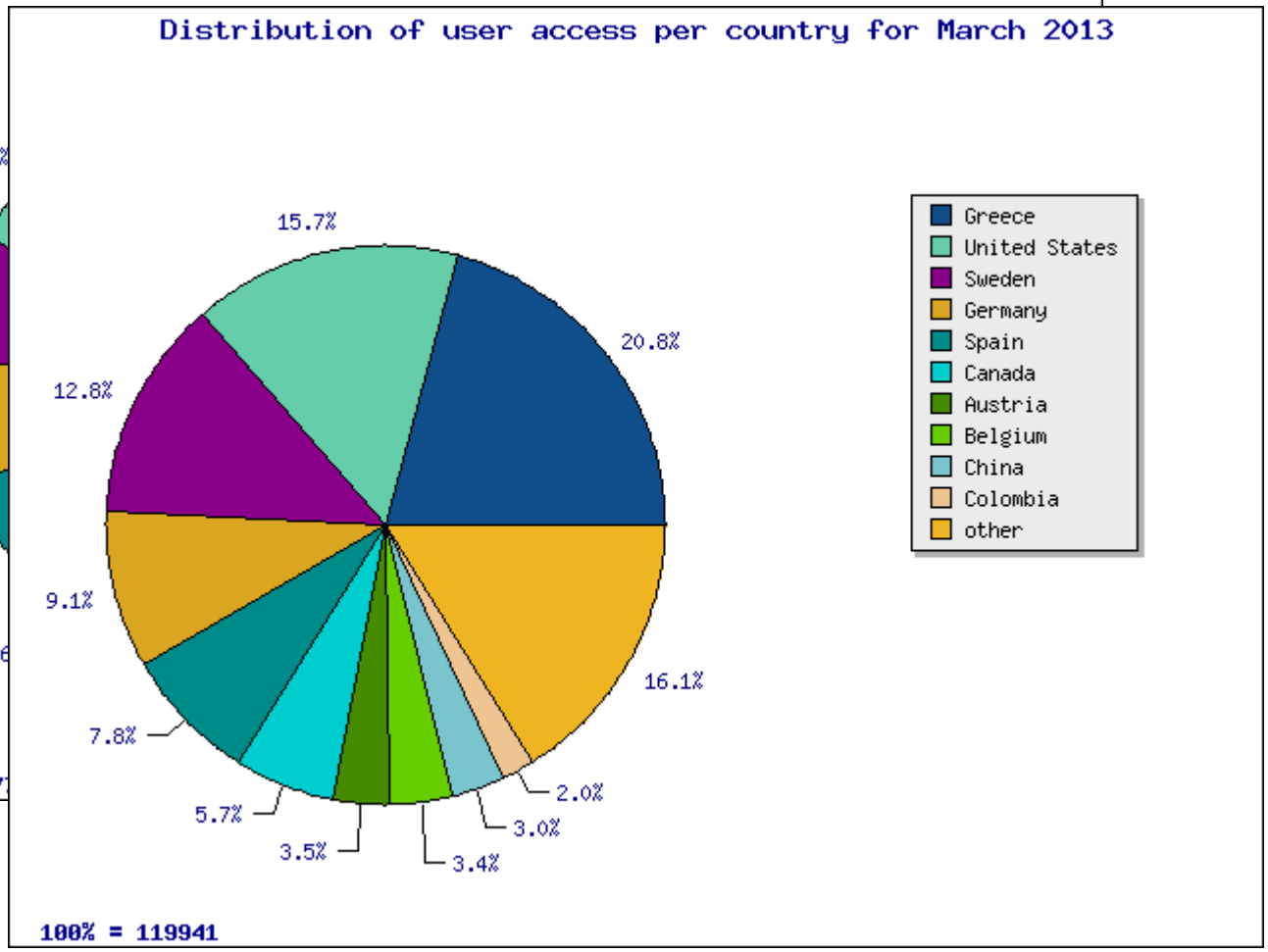
SPENVIS
The Space Environment Information System

aeronomie.be

belspo

.be



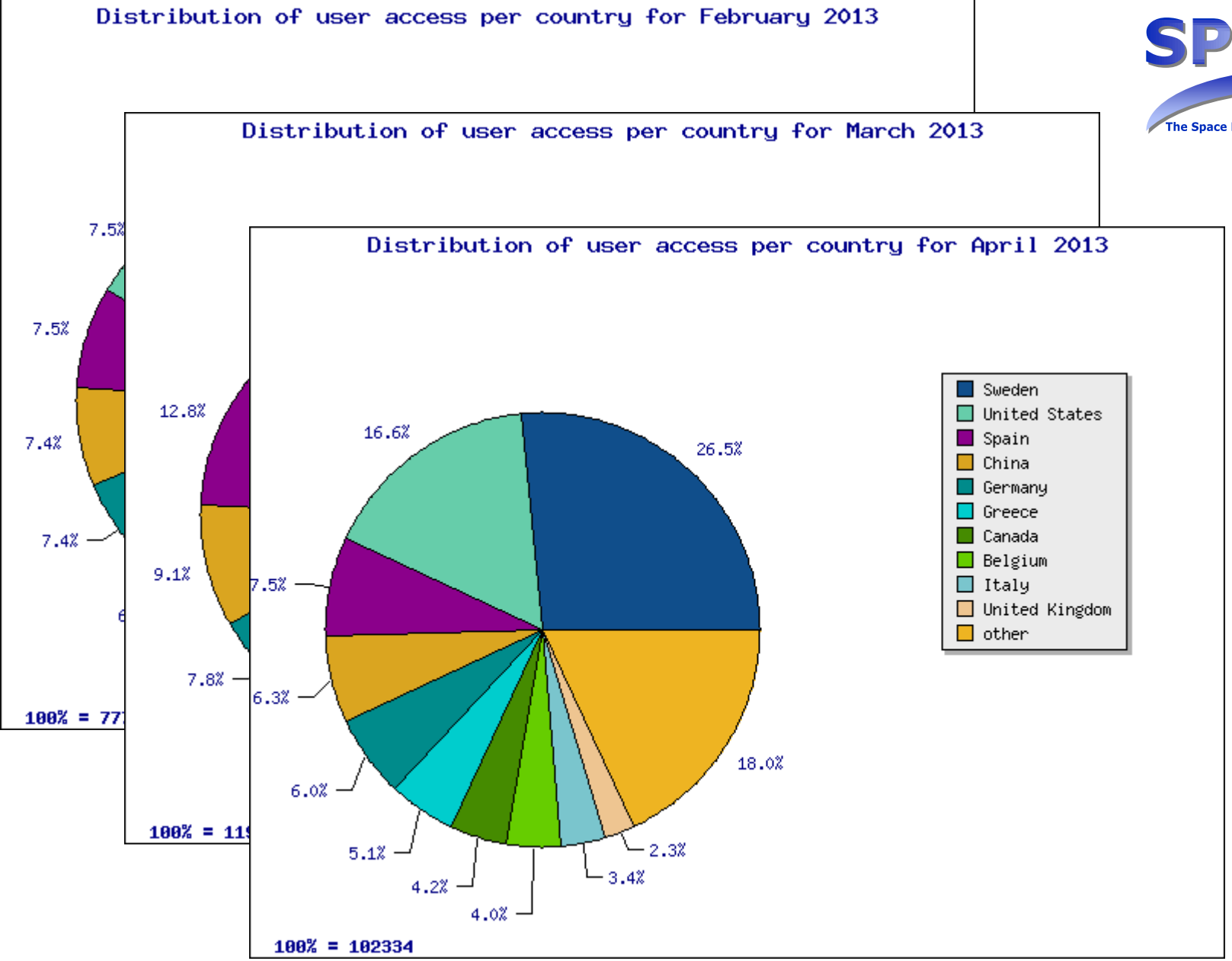


SPENVIS
The Space Environment Information System

aeronomie.be

belspo

.be



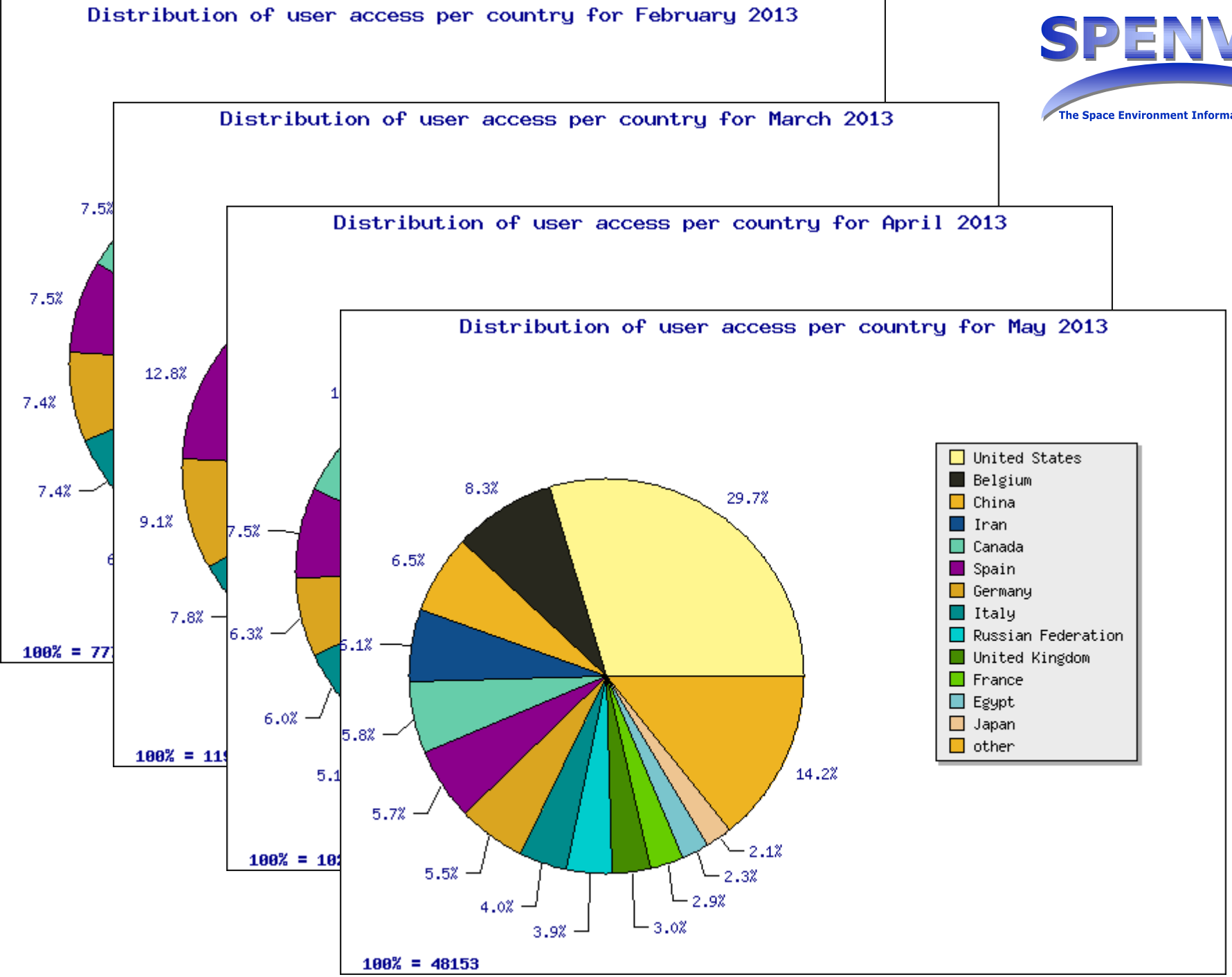
SPENVIS
The Space Environment Information System

aeronomie.be

belspo

.be

SPENVIS
The Space Environment Information System



aeronomie.be

belspo

.be

Last SPENVIS updates

- Single Event Upsets for long-term radiations
- Reviewed "combined run" feature
  as well as the layout of the output page
- Improvement and/or update of JOREM, PSYCHIC,…
- Upgrade of Geant4 tools
- Bug fixes

➔ More details during the tutorials…

SUW 2013 Tutorials

SPENVIS
The Space Environment Information System

aeronomie.be

belspo

.be

SUW 2013 Tutorials

1. Radiation models in SPENVIS and their accuracy,
   D. Heynderickx (DHConsultancy)
2. Geant4 Package in SPENVIS,
   N. Messios (BIRA-IASB)
3. Single Event Effects modeling with SPENVIS,
   E. De Donder (BIRA-IASB)
4. SPENVIS spacecraft charging models,
   E. De Donder (BIRA-IASB)

Tutorial structure

- Introduction and overview of main models
- How to do step by step (screenshots) for typical situation
- Outlook for Next Generation SPENVIS

Tutorial #0
"SPENVIS Mission Concept"

Outline:

- Introduction
  - Current SPENVIS workflow logic
  - SPENVIS Orbit generator
  - Mission concept
- How to
  - Define a mission
- Outlook for SPENVIS-NG

Current SPENVIS workflow logic

- Input-driven workflow
  - Model can be accessed only if all required inputs are present
    ➔ « Parent » models have to be executed first
  - Typically
    1. Orbit generator
    2. Radiation environment (RB, GCR, SEP)
    3. Radiation effects (e.g. doses)

Radiation sources and effects: Dose model parameters - Mozilla Firefox

www.spenvis.oma.be/htbin/spenvis.exe?%23resettoprevious(dose_sd.html)

SPENVIS Project: SAPRE

UP

Radiation sources and effects

Ionizing dose models: Parameters

Output

Help

In order to run the dose models, the trapped radiation and/or solar proton models have to be run first to generate particle spectra. No spectra were found for the current project.

To proceed, run the trapped radiation a this page.

© ESA

Radiation sources and effects: Trapped radiation model parameters - Mozilla Firefox

www.spenvis.oma.be/htbin/spenvis.exe/SAPRE?%23ResetToPrevious(trep_par.html)

SPENVIS Project: SAPRE

UP

Radiation sources and effects

Trapped radiation: Model parameters

Output

Help

In order to run the Earth's trapped radiation models, an orbit (around Earth) has to be generated.

No orbit file has been found in the current project.
To proceed, generate the orbit and return to this page.

© ESA

Current SPENVIS workflow logic

- Models are grouped by
  - Package
    - Coordinate generators; Radiation sources and effects; Spacecraft charging; Atmosphere and ionosphere; Magnetic field; Meteoroids and debris; Miscellaneous; Geant4 tools
  - Planet
    - Earth, Mars, Jupiter
  - Type of coordinate generators
    - Spacecraft trajectories
    - Coordinate grids
    - Other

Package “Radiation sources and effects” as function of the project state

Planet: Earth

Coordinate generators
Radiation sources and effects
Trapped particle flux maps and profiles
Geomagnetic cutoff maps and profiles
Spacecraft charging
Atmosphere and ionosphere
Magnetic field
Meteoroids and debris
Miscellaneous
Geant4 Tools
ECSS Space Environment Standard

Planet: Earth

Coordinate generators
Radiation sources and effects
Radiation sources
Trapped proton and electron fluxes
Trapped proton flux anisotropy
Solar proton fluences
Solar cell radiation damage
Damage equivalent fluences for solar cells (EQFLUX)
NIEL based damage equivalent fluences for solar cells (MC-SCREAM)
Radiation doses
Ionizing and non-ionizing dose models for simple geometries
Single event effects
Ion energy and LET spectra
Single event upset rates
Spacecraft charging
Atmosphere and ionosphere
Magnetic field
Meteoroids and debris
Miscellaneous
Geant4 Tools
ECSS Space Environment Standard

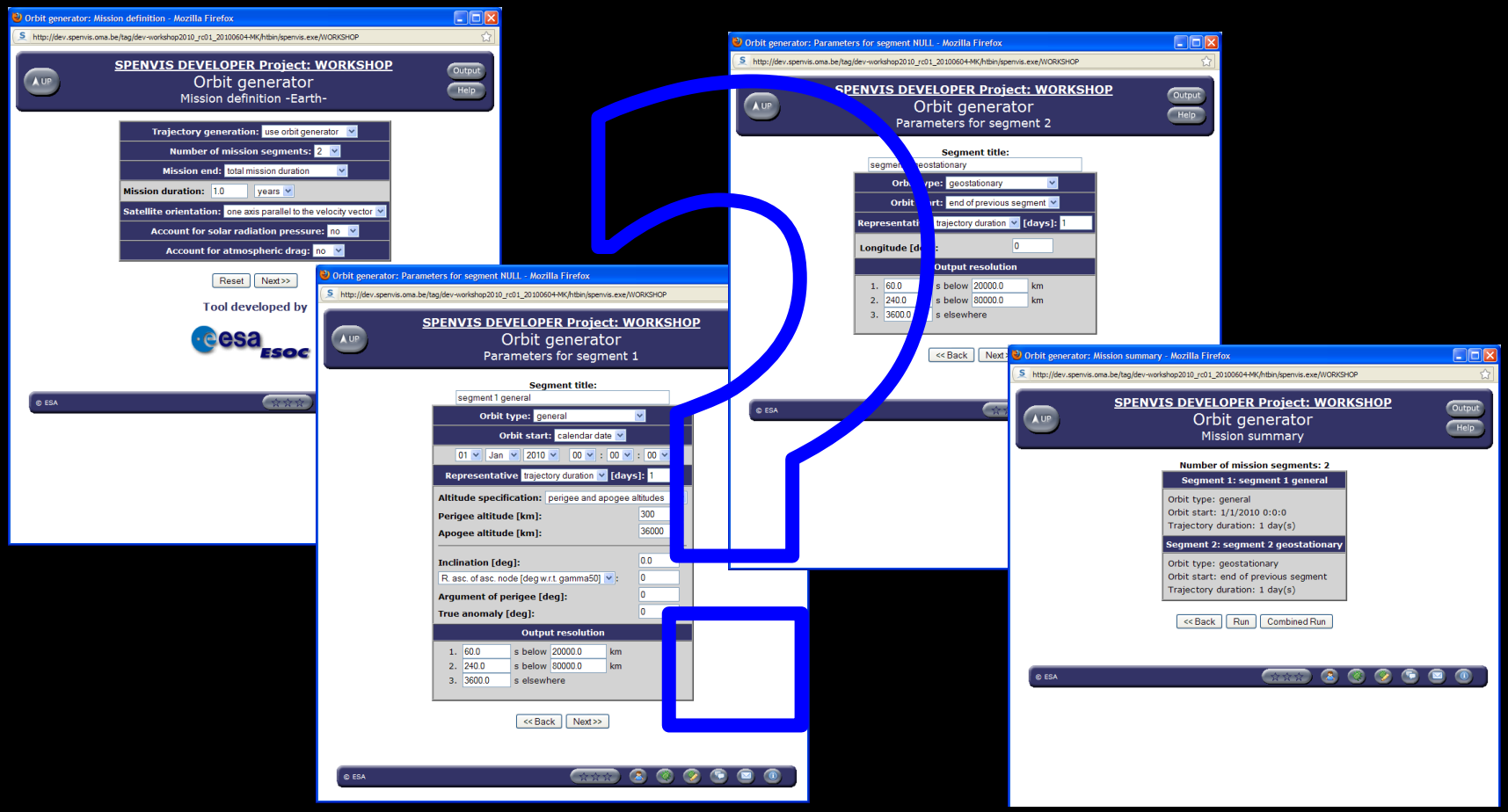
Planet: Earth

Coordinate generators
Radiation sources and effects
Radiation sources
Trapped proton and electron fluxes
Trapped proton flux anisotropy
Solar proton fluences
Solar cell radiation damage
Damage equivalent fluences for solar cells (EQFLUX)
NIEL based damage equivalent fluences for solar cells (MC-SCREAM)
Radiation doses
Ionizing and non-ionizing dose models for simple geometries
Single event effects
Ion energy and LET spectra
Single event upset rates
Spacecraft charging
Atmosphere and ionosphere
Magnetic field
Meteoroids and debris
Miscellaneous
Geant4 Tools
ECSS Space Environment Standard

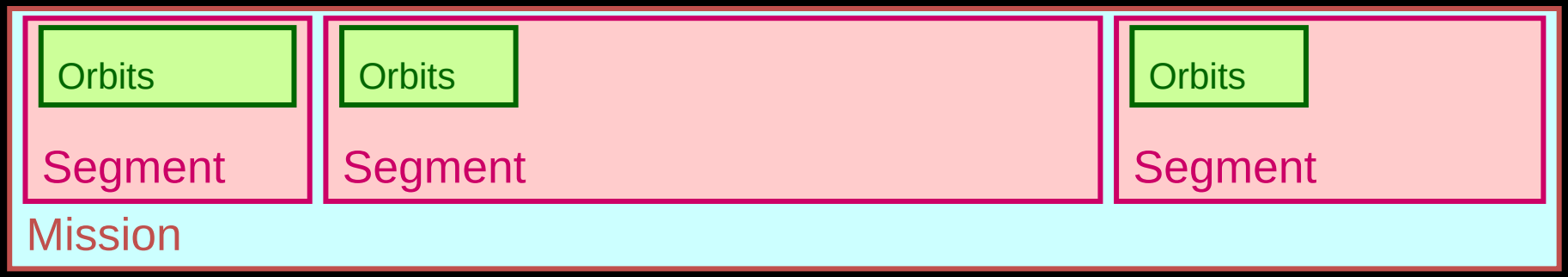
Planet: Jupiter

Coordinate generators
Radiation sources and effects
Radiation sources
Trapped proton and electron fluxes
Solar cell radiation damage
Damage equivalent fluences for solar cells (EQFLUX)
NIEL based damage equivalent fluences for solar cells (MC-SCREAM)
Radiation doses
Ionizing and non-ionizing dose models for simple geometries
Miscellaneous
Geant4 Tools
ECSS Space Environment Standard

First “parent” model: orbit generator, alias SAPRE



SPENVIS Mission Concept
(Earth only)



- Number of mission segments — e.g. 3
- Mission duration — e.g. 5 years

For each segment

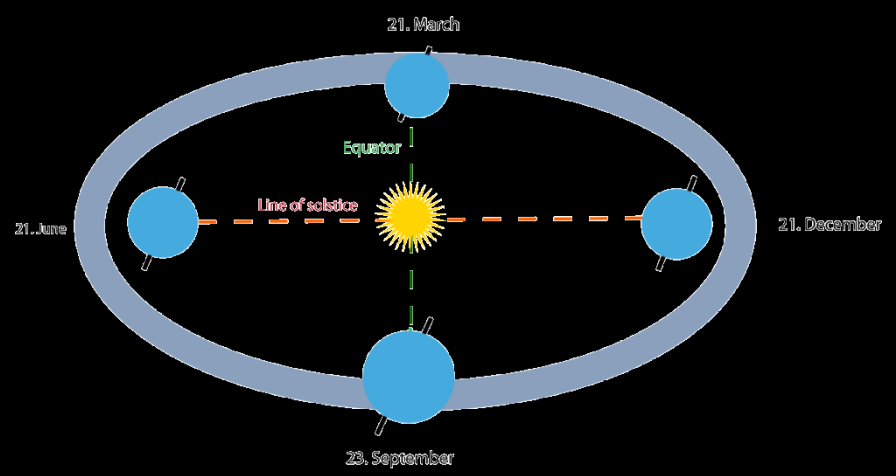
- Orbit start
- Orbit duration
- Segment duration (implicit)

SPENVIS Mission Concept: why?

- Generating a trajectory over the full mission results in slow execution and huge file without real added value
- One mission = succession of segments
- Each segment as a representative orbit
  - Segment start epoch = orbit start epoch
  - Segment end epoch = start of next segment or mission end
- Orbit → Mission: $\langle f^M \rangle = \sum_i \langle f^T \rangle_i \, S_i \, / \, M$

Which criteria to determine the number of segments?

- Spacecraft orbit change, e.g. GTO → GEO
- Precession of the orbital plane
  - e.g. SAMPEX (near-polar orbit) precession period = 6 months
- Space & time variability of the Space Environment
  - Solar cycle variation
  - Seasonal effect,
    e.g tilt of magnetic dipole
- Type of target models



Which duration for the representative orbit?

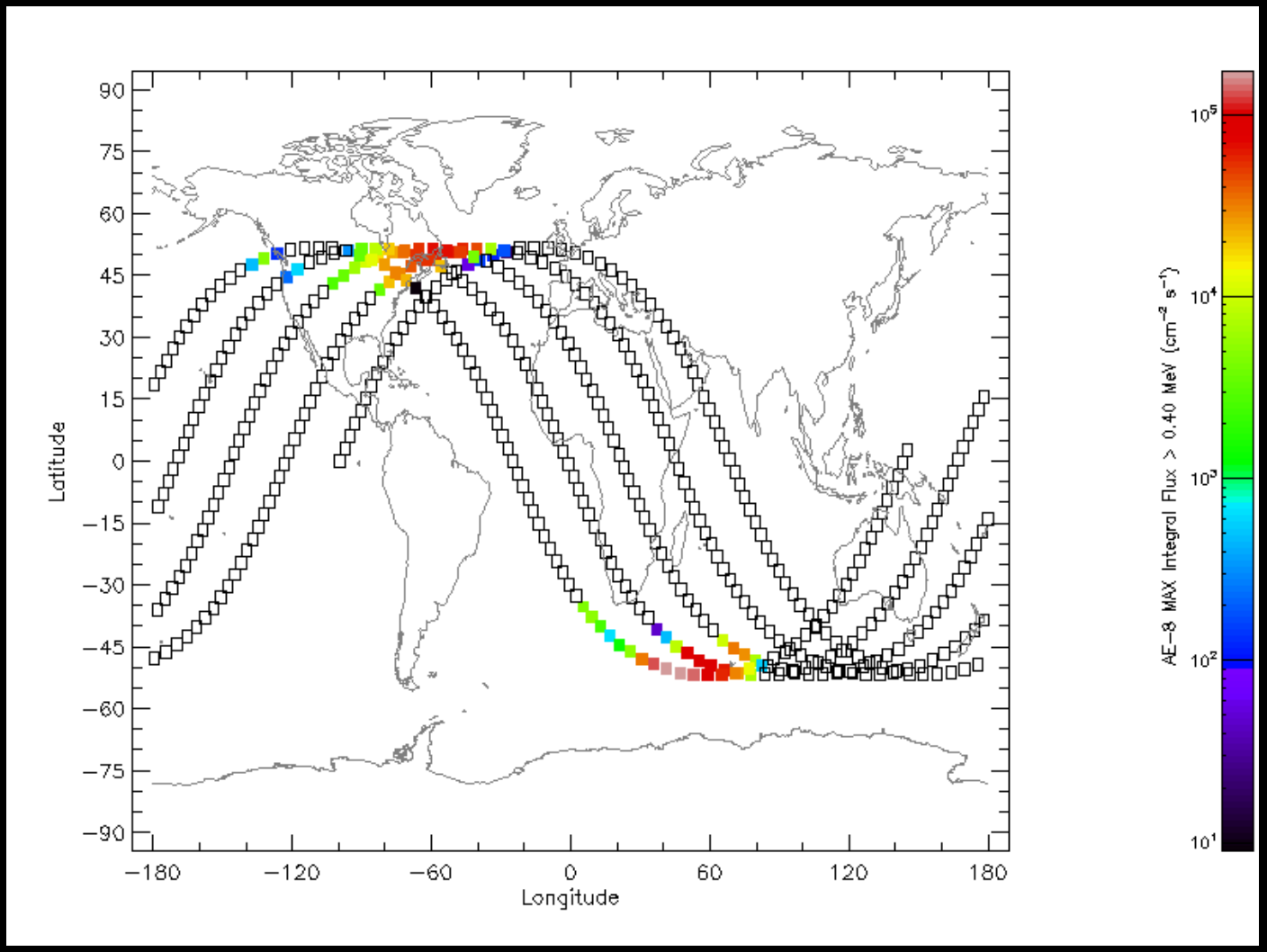
- Too long: huge files, not real added value
- Too short: missing feature

Possible criteria

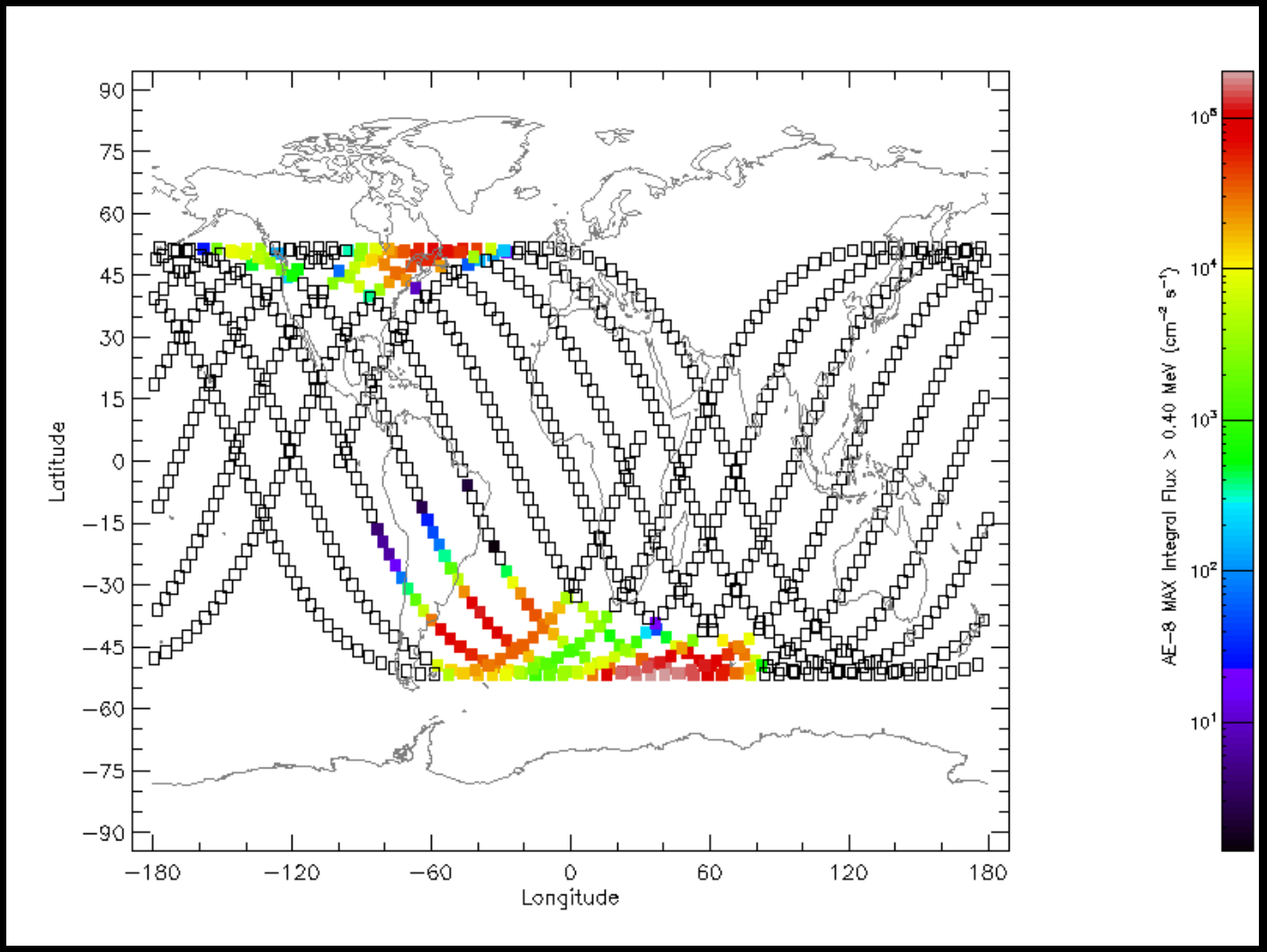
  – Space variability of the Space Environment

E.g. South Atlantic Anomaly

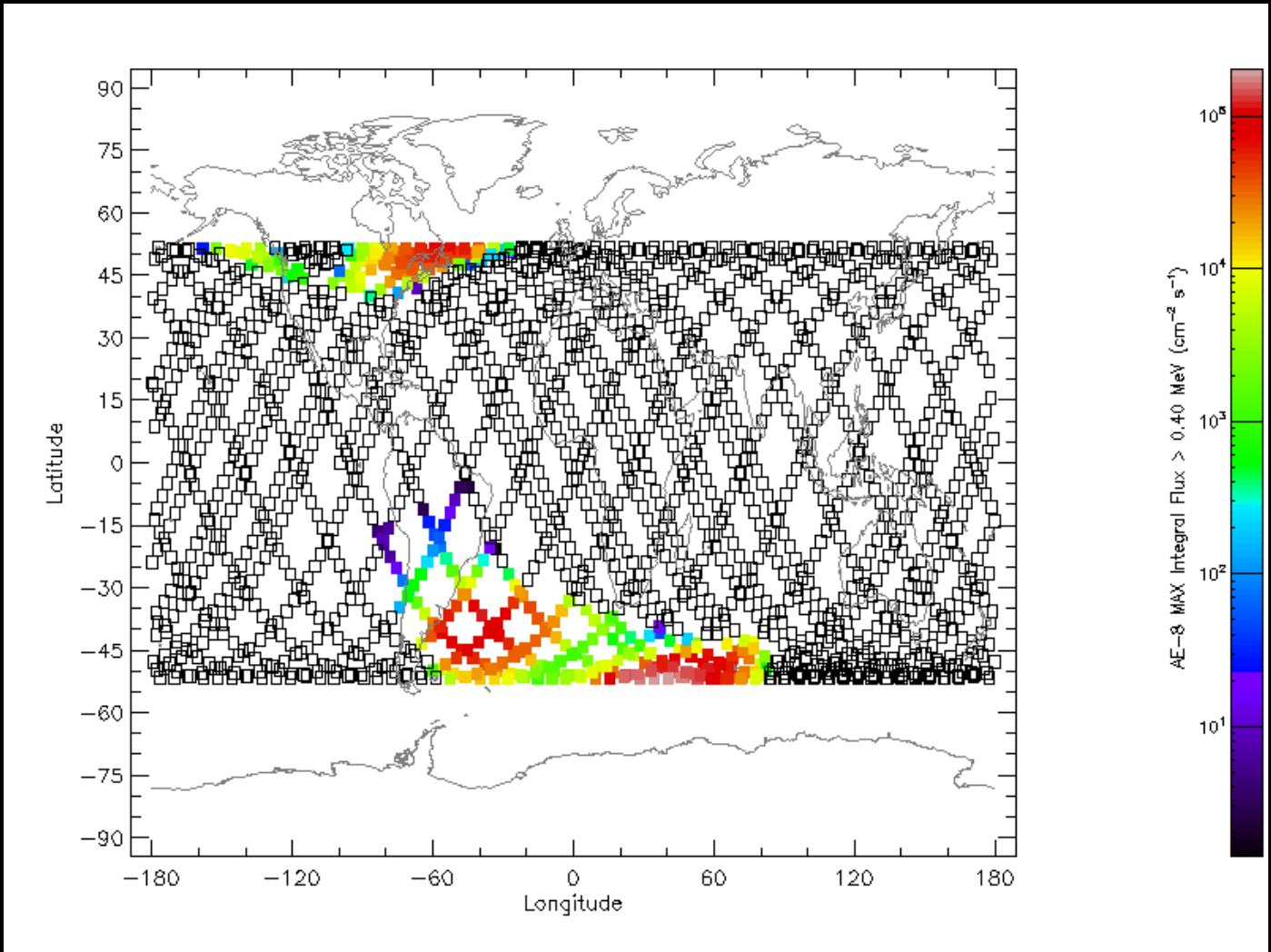
ISS-like orbit: comparing 5, 10, 20, 30 orbits



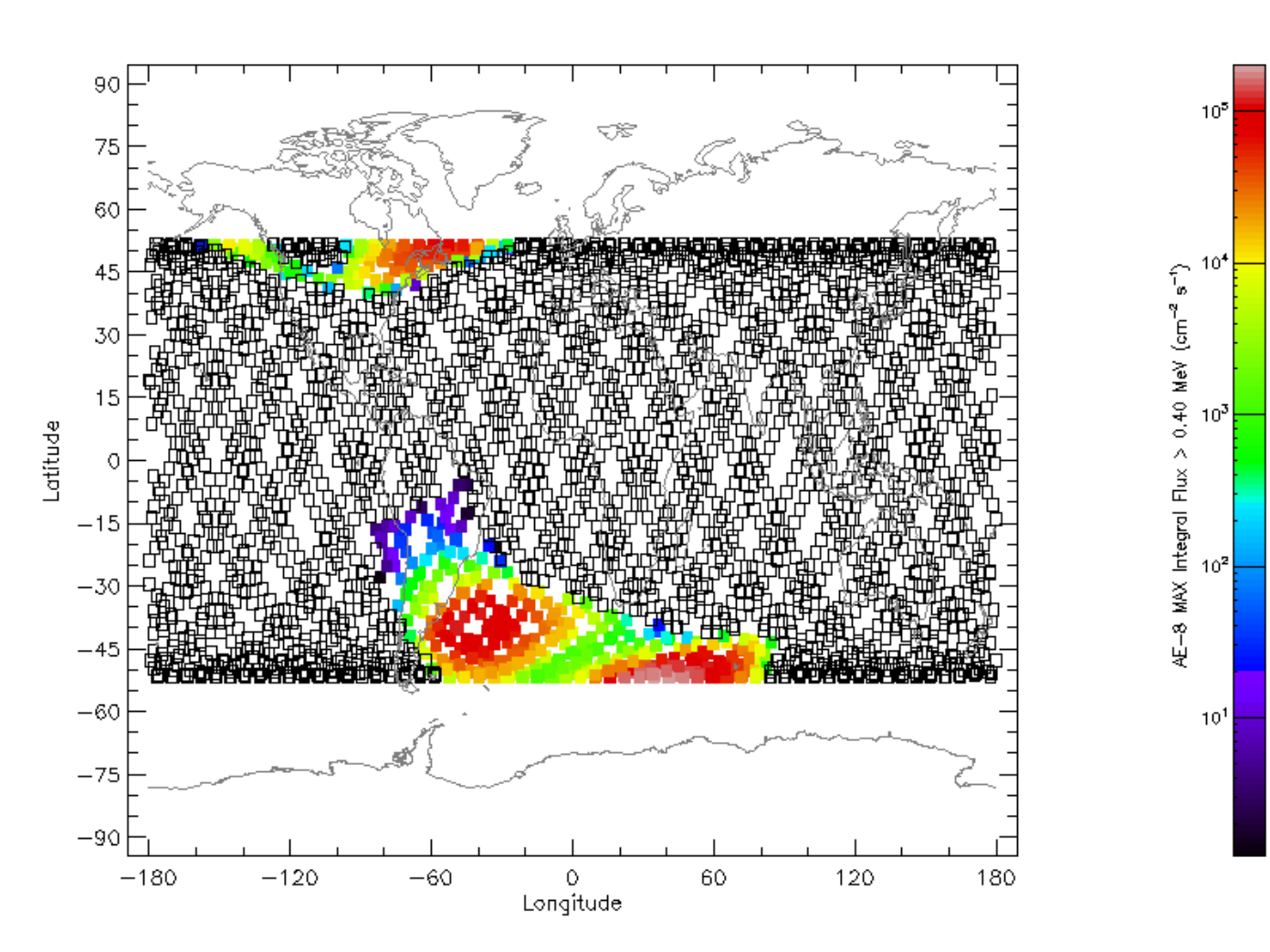
ISS-like orbit: comparing 5, 10, 20, 30 orbits



ISS-like orbit: comparing 5, 10, 20, 30 orbits



ISS-like orbit: comparing 5, 10, 20, 30 orbits



SPENVIS Mission concept

- Need an adequate selection of
  - Mission segments
  - Representative orbits

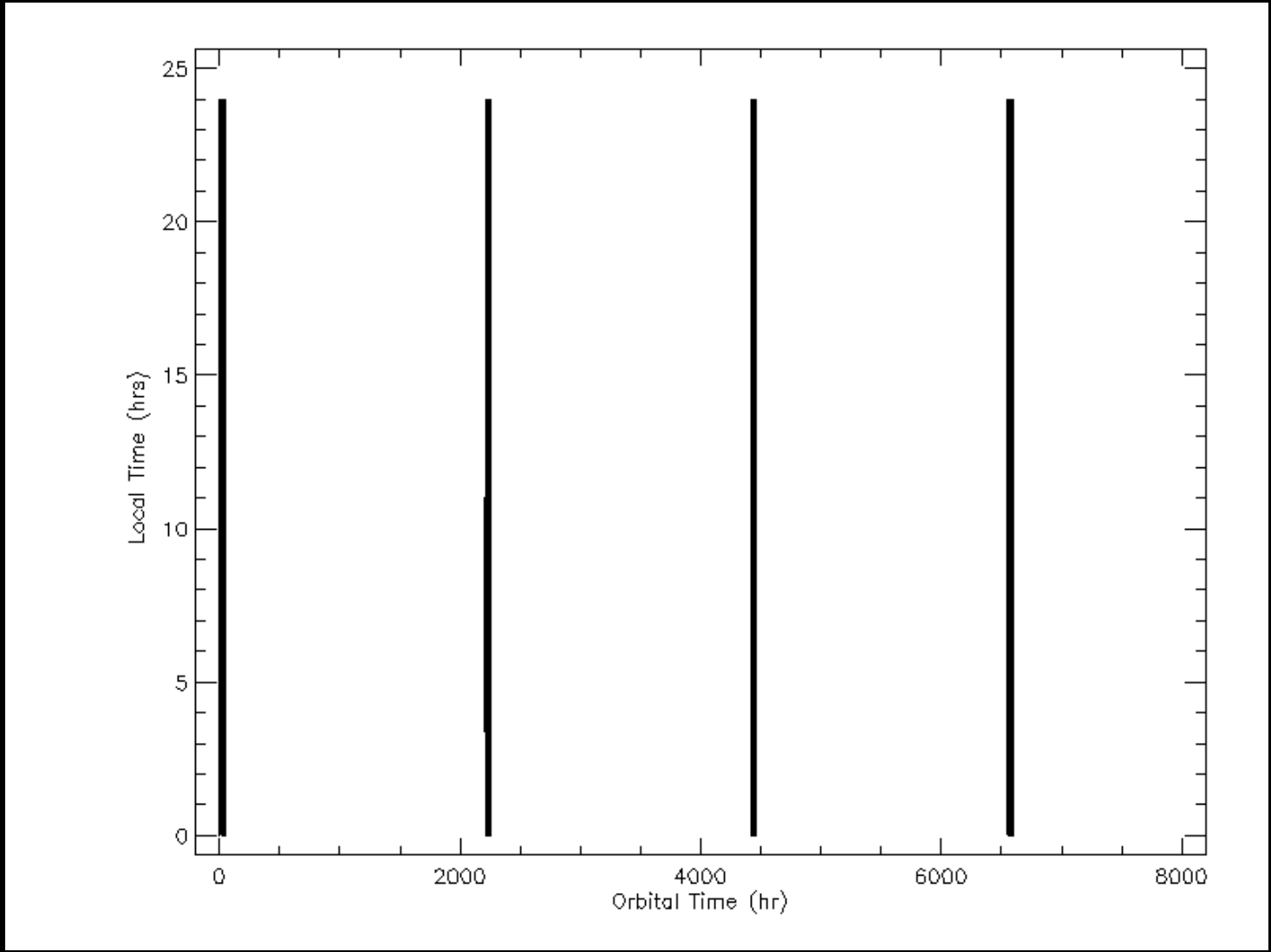
in order to catch

  - all variability of the space environment

- SPENVIS provides the tool but

its use is user's responsibility

Example


25
20
15
10
5
0
Local Time (hrs)
0
2000
4000
6000
8000
Orbital Time (hr)

Outlook for SPENVIS-NG

- Other workflow logic
  - e.g. result driven
- Mixing of segments for different planets
- Possibility to select models per segment
  - e.g. IGE/POLE @ GEO vs AP8 @ MEO
- Alternative trajectory generators
- Unifying s/c trajectories and coord. grids

Next Generation

- Technologies used by the current SPENVIS system are limiting the extension of the system.
- ESA has initiated the re-engineering of the system using current web design techniques in order to define a new, extensible, open and distributed framework for SPENVIS
- The new framework will provide more flexibility in combining different models, and also will facilitate plugin of new models

Next Generation SPENVIS
ESTEC Contract No. 4000104812

Next Generation SPENVIS

- Project has suffered some delays
- Preliminary Design Review on March 5, 2013
- Critical Design Review scheduled for July 2013

➔ More details during the tutorials and Friday

Overview of current and future SPENVIS and Organisation of the tutorials

M. Kruglanski (BIRA-IASB)