

# ESABASE2: Overview, Maintenance and Distribution Summary and Recent Developments

Final Presentation



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## **Introduction: ESABASE2**

### **ESABASE2 Maintenance and Distribution**

- Maintenance Activities
- ESABASE2 Website
- Distribution Status
- Release Planning

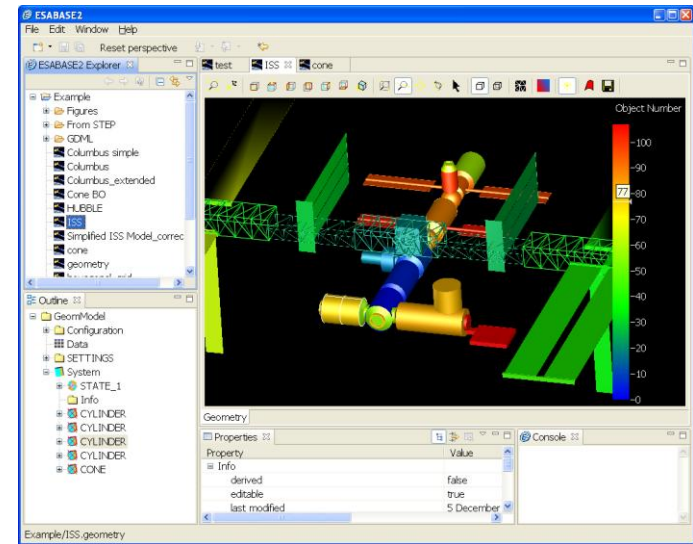
### **ESABASE2/Debris Extension**

- MEMr2 Implementation
- Scripting Module
- Linux Version

## **Summary and Outlook**

# Introduction: ESABASE2 (1)

- ESA's tool for space environment analyses
- Widely used in industry and academia
- ESABASE2 packages and analysis capabilities:
  - ESABASE2 framework
  - ESABASE2/Debris
  - ESABASE2/COMOVA Interface
  - ESABASE2/Atmosphere, Ionosphere, Sunlight
  - ESABASE2 complete (includes all applications)
- Users:
  - Major space companies: Debris and COMOVA
  - Academia: all packages
  - Small companies: various packages (mostly Debris)
  - Framework (for geometry conversion): in the space radiation analysis domain, e.g. as part of the REST-SIM and CIRSOS activities
  - User requests for further applications such as Perturbation/Mass, etc.



# Introduction: ESABASE2 (2)

- More than 20 years of ESABASE and ESABASE2 development experience at etamax space
- Responsibilities of etamax space
  - ESABASE2 developments
    - implementation of new space debris and meteoroid environment models
    - implementation of additional analysis capabilities
  - ESABASE2 maintenance, e.g.
    - update of open source components
    - bug fixing
    - establishment of software releases
    - website development and maintenance
  - ESABASE2 distribution
    - provision of different packages (e.g. ESABASE2/Debris)
    - provision of a trial version
    - establishment of License Agreements and Support Contracts
    - today about 120 ESABASE2 users
  - ESABASE2 training and support to licensees
- ESA Technical Officer: Mark Millinger

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- ESABASE2 maintenance
  - standard maintenance tasks
    - update of 3rd party components (e.g. Eclipse RCP, Open CASCADE, ...)
    - reaction on user feedback
    - bug fixing
  - implementation of (minor) improvements
- ESABASE2 website hosting, maintenance and update
- Tool advertising
- User training
- Distribution of ESABASE2 packages

# Maintenance Activities (1)

- Upgraded Java from 1.6 to 7
- Upgraded Eclipse from 3.3 to 4.2
  - new framework architecture
  - compatibility layer used
  - high effort pending to adapt the SW architecture
- Compatibility to Win7/Win10 and hopefully later...
  - switched Fortran compiler from Compaq to Intel
  - use of the compatibility option to avoid complete re-factoring of the Fortran sources
- Improvements of GDML import and export
  - GDML material handling fixed
  - User can select to split the exported file
  - Several improvements (world material, size of world box, meshing after import, Boolean operations rework, ...)

- Several corrections and improvements:
  - Material handling
  - Mission editor
  - Damage modelling (ESA Triple Wall equation; damage equation settings)
  - ORDEM 3.0 implementation update
  - STEP-SPE import/export (hierarchy issue, assembly handling, ...)
  - Several small bugs
- Maintained ESABASE2 website
  - Establishment and upload of advertising material
  - Provision of updates of the ESABASE2 documentation
  - Update and maintenance of the security plug-in
    - more than 30000 unauthorised attempts to login to the User's Area or even to the WordPress administration pages since March 2014 (additionally a non-trackable amount shielded by first barrier, e.g. server login check for administration page, direct exclusion of agents/usernames)
- Produced ESABASE2 image video
- Releases 8.0, 9.0 and 10.0 in progress



# ESABASE2 Website (1)

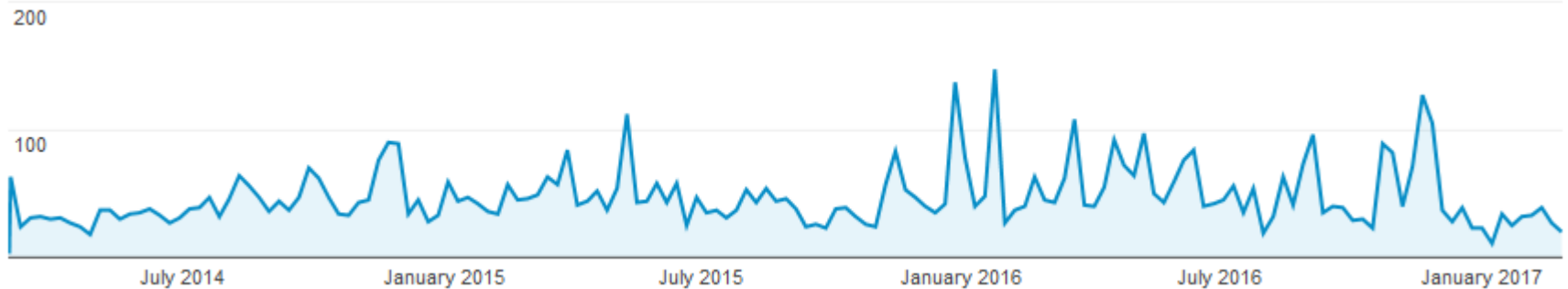
- Purpose
  - Advertising
  - Acquisition of licence requests
  - Announcements
  - Download of ESABASE2 documentation
  - User's Area
    - Download of ESABASE2 packages
    - Download of updates, patches, release candidates
    - User feedback and bug reporting forms

• <http://esabase2.net/>

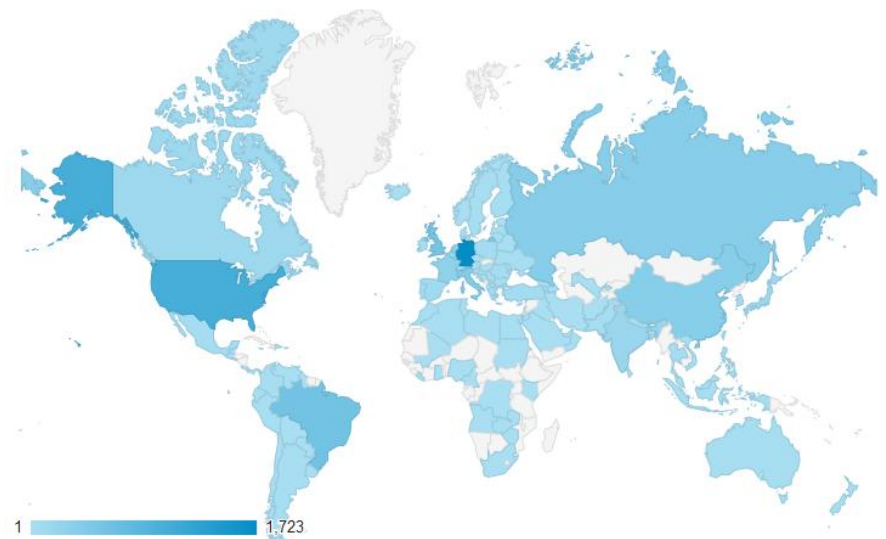
The screenshot shows the ESABASE2 website homepage. At the top right is the etamax logo and 'MEMBER OF FEV GROUP'. The main header features the ESABASE2 logo and a navigation menu with links: Home, Product, Service, Licensing, User's Area, and Contact. Below the navigation is a 'WELCOME TO THE ESABASE2 HOMEPAGE' section. It includes a video player titled 'ESABASE2 @ etamax space' showing a 3D model of a satellite. To the right of the video is a 'News' section with links for 'New Release' (December 10, 2015) and 'Evaluation Version' (September 17, 2015). Below the video are three columns: 'THE TOPIC', 'THE TOOL', and 'THE SERVICE', each with a small image and a brief description. The footer contains the ESA logo, the etamax logo, and the text 'MEMBER OF FEV GROUP'.

# ESABASE2 Website (2)

- Traffic (Google Analytics, 2014-03-01 to 2017-02-28)
  - about 2500 visits per year



- > 5500 visitors from 118 countries worldwide



- 72 license requests within the 3 years maintenance period
- Most license requests via the ESABASE2 website
- Overall: about 300 license requests since 2006
  
- About 100 licenses in ESA member states
- Licenses for entities in non-member states
  - processed via ESA's Technology Transfer Board
  - 2 license requests approved and licenses provided
  
- Packages distribution:
  - ESABASE2 framework 10 licenses
  - ESABASE2/Debris 42 licenses
  - ESABASE2/COMOVA Interface 4 licenses
  - ESABASE2/Atmosphere, Ionosphere, Sunlight
  - ESABASE2 complete (includes all applications) 45 licenses

- Current release: 7.0, since December 2015
- (Intermediate releases containing MEMr2 and ORDEM 3.0 update provided to selected customers only)
- 8.0
  - MEMr2 implementation
  - ORDEM 3.0 update
  - Minor improvements and corrections
- 9.0
  - Trial version/new licensing process
  - Headless mode of ESABASE2/Debris
  - Scripting module for ESABASE2/Debris
  - Batch processor for ESABASE2/Debris
  - Minor improvements and corrections
- 10.0
  - Linux version of ESABASE2/Debris
  - Minor improvements and corrections



The screenshot shows a website interface with three tabs: 'News', 'Release', and 'Documents'. Below the tabs is a list of release notes for ESABASE2, each with a title, date, and author.

News	Release	Documents
<b>ESABASE2 7.0 Release Notes</b> December 10, 2015 • by: Anatoli Miller		
<b>ESABASE2 6.1 Release Notes</b> December 4, 2013 • by: Anatoli Miller		
<b>ESABASE2 6.0 Patch 1 Notes</b> October 21, 2013 • by: Anatoli Miller		
<b>ESABASE2 6.0 Release Notes</b> July 23, 2013 • by: Anatoli Miller		

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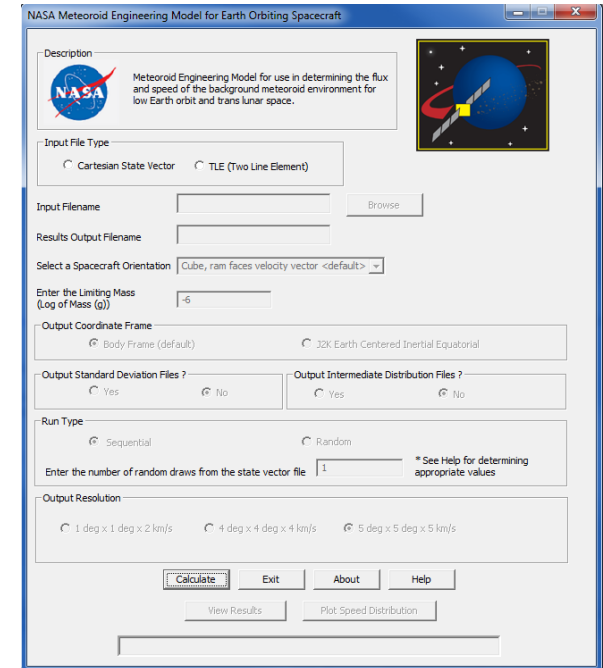
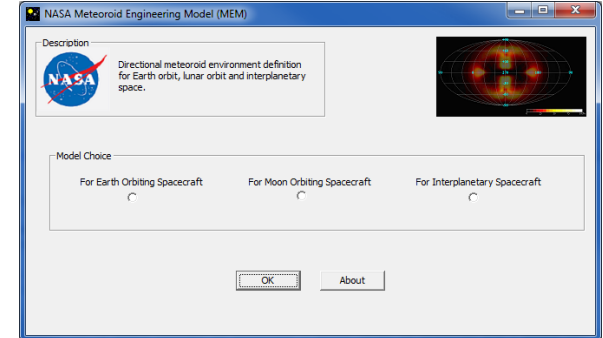
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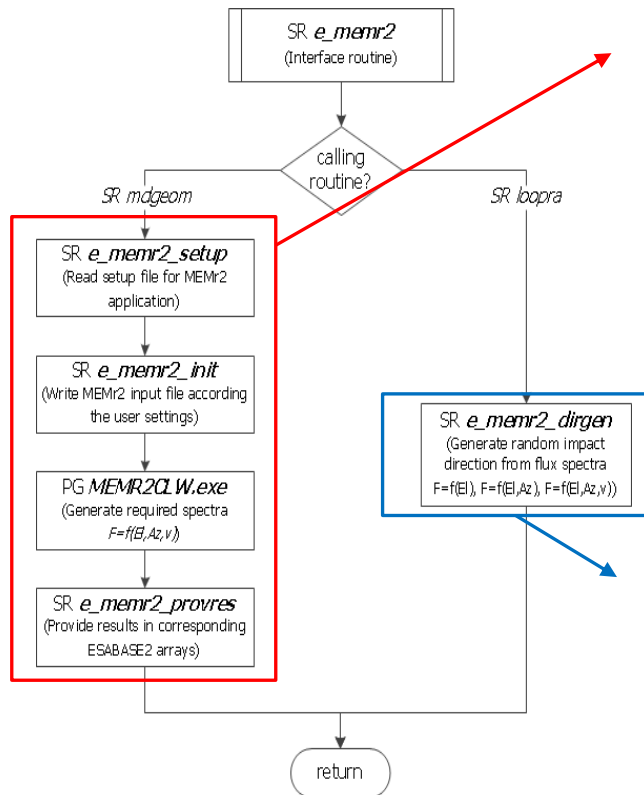
## Summary and Outlook

# MEMr2 Implementation - Overview

- MEM: Meteoroid Engineering Model
  - Developed by NASA/MSFC
  - Latest version: MEMr2
    - combines previous versions of EarthMEM, LunarMEM, IPMEM
  - Usually GUI-driven
  - NASA provided command line version for the ESABASE2/Debris implementation
- Required by space projects under NASA lead



- Based on the previous implementation of MEM releases
- Single interface approach
- Command line version called from the code



## 1. Branch

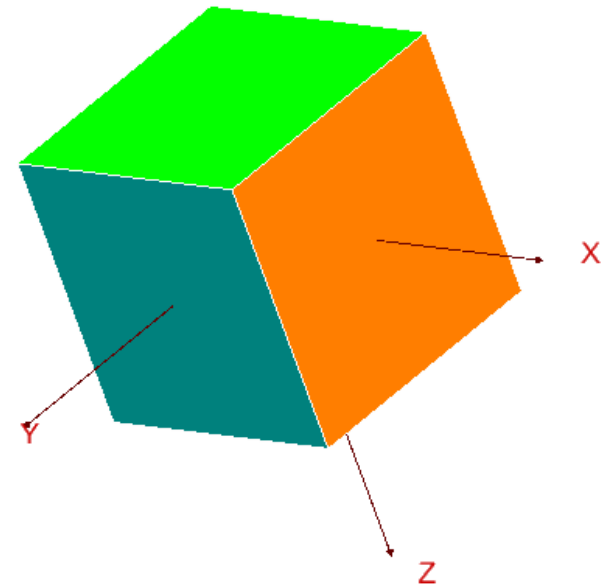
- Read path and file names for MEMr2
- Specify sub-model based on central body
- Write MEMr2 input parameter into input file
- Run MEMr2 command line tool
- Read the output files and write required flux spectra to the appropriate arrays

## 2. Branch

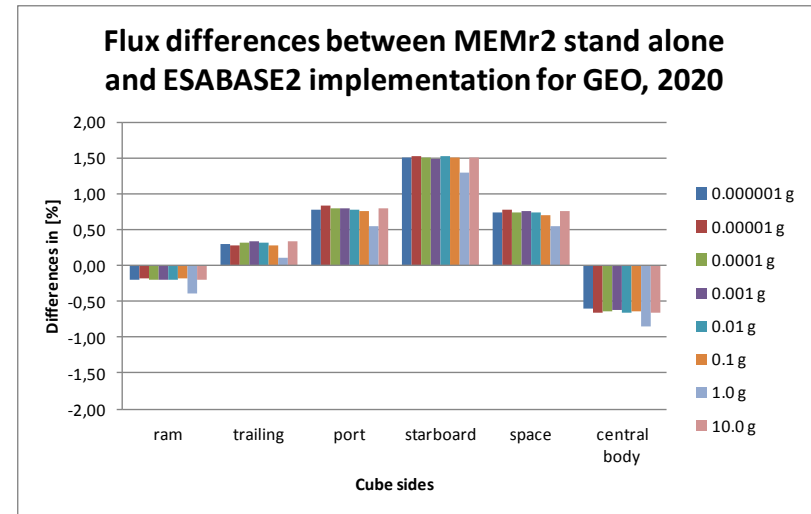
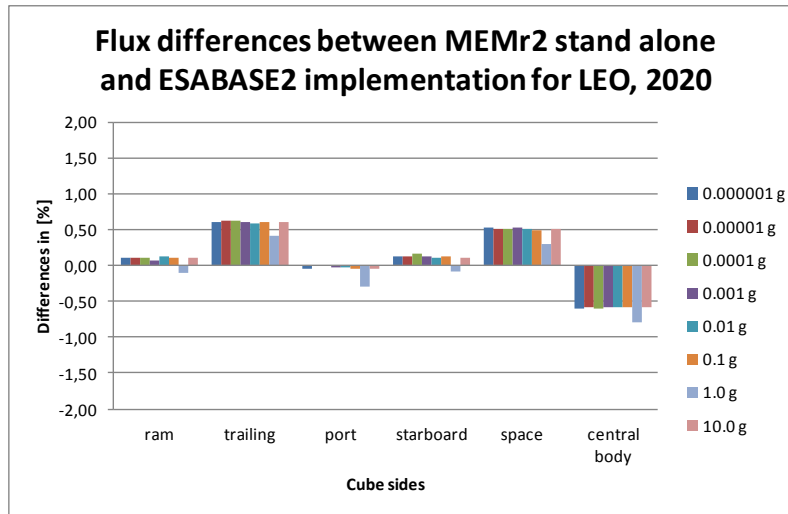
- Generate random impact velocity vector from flux spectra

## Test cases:

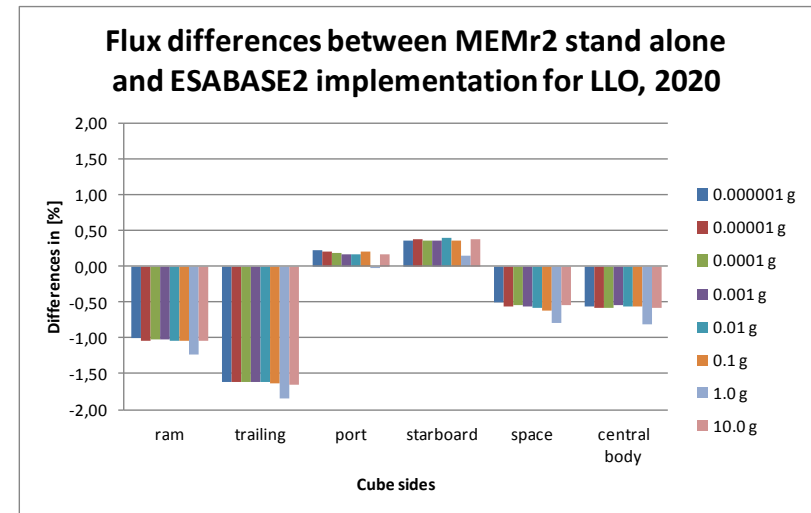
- Comparison of the MEMr2 stand-alone version and its ESABASE2 implementation
  - Meteoroid flux on the six faces of an orbiting cube
  - Use of the so called “TestGrid” which is applied for each newly implemented environment model
  - Model specific TestGrid configuration:
    - 6 orbit types (4 Earth, 2 Lunar)
    - 6 mission dates are applied:  
2010; 2013; 2015; 2018; 2020; 2025
    - 8 particle sizes are applied [g]:  
0.000001; 0.00001; 0.0001;  
0.001; 0.01; 0.1; 1.0; 10.0
- 288 tests





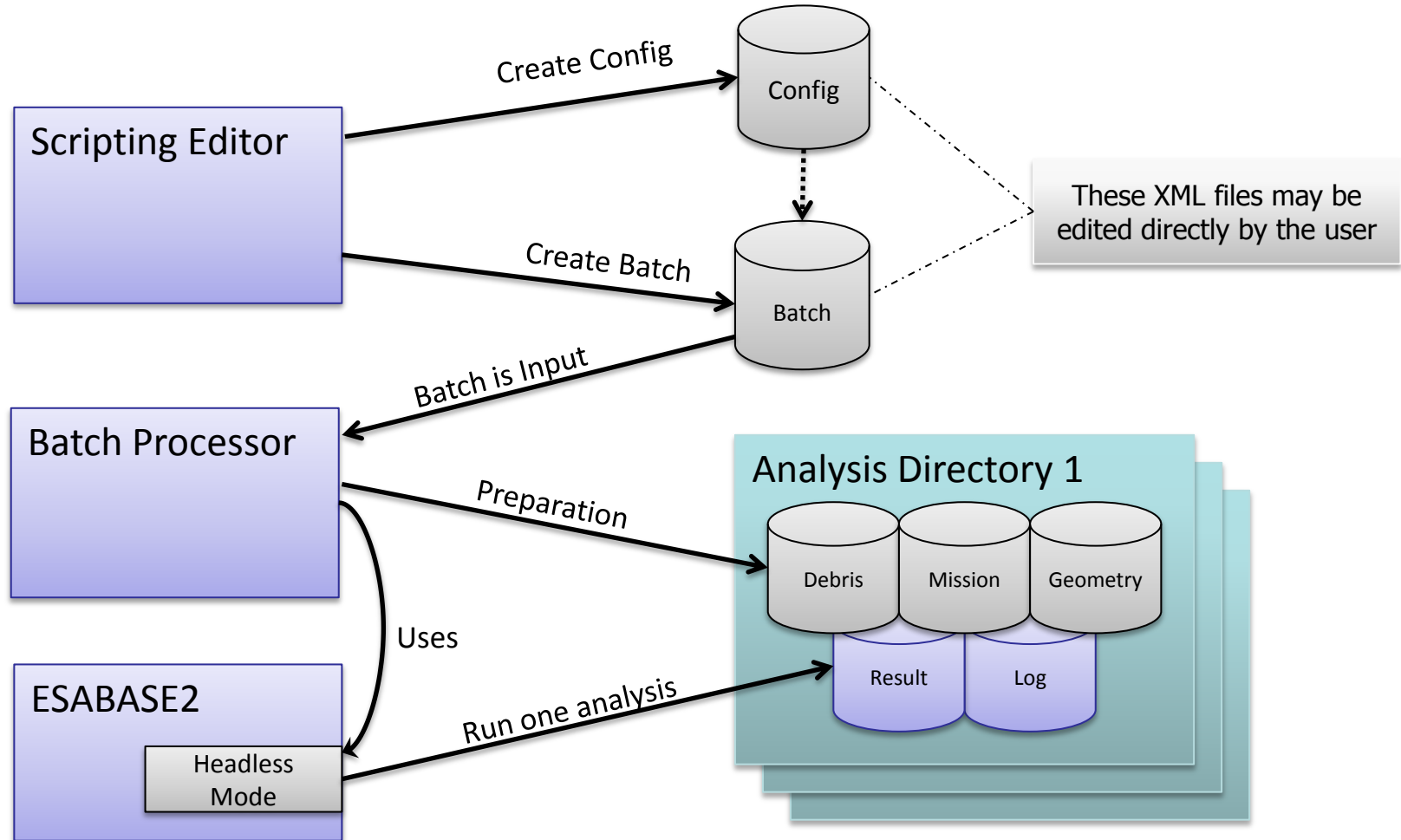


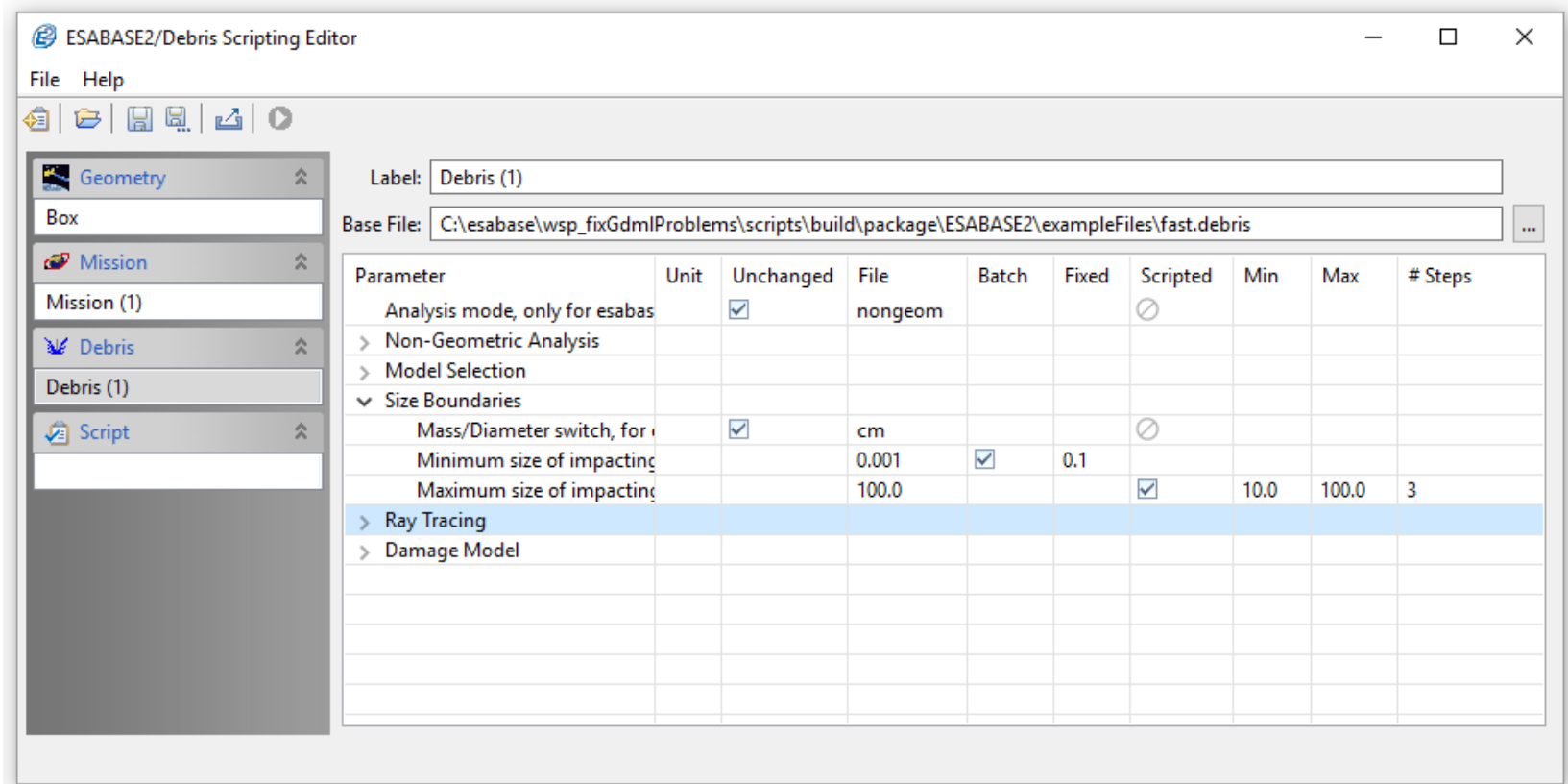
- Summary of TestGrid results:
  - LEO: deviations  $< \pm 1.4\%$
  - SSO: deviations  $< \pm 2.5\%$
  - GTO: deviations  $< \pm 1.6\%$
  - GEO: deviations  $< \pm 1.6\%$
  - PLO: deviations  $< \pm 2.2\%$
  - LLO: deviations  $< \pm 2.1\%$
- The correspondence of the flux results is excellent.



- Purpose:  
Perform multiple debris analysis runs in one go
- Motivation:
  - To facilitate parametric studies
  - In most “real-world” M/OD analysis cases, many runs have to be performed
  - Manual set-up of inputs is very time-consuming
    - Preparing the input files
    - Combining the input files to a run configuration
    - Perform sequential execution of each analysis
- Scripting module allows:
  - „**Batch Processing**“: Perform multiple analysis runs that will be processed in one go
  - „**Scripting**“: Preparing multiple analysis runs with varied analysis parameters and perform the corresponding analysis runs in one go via the batch processor

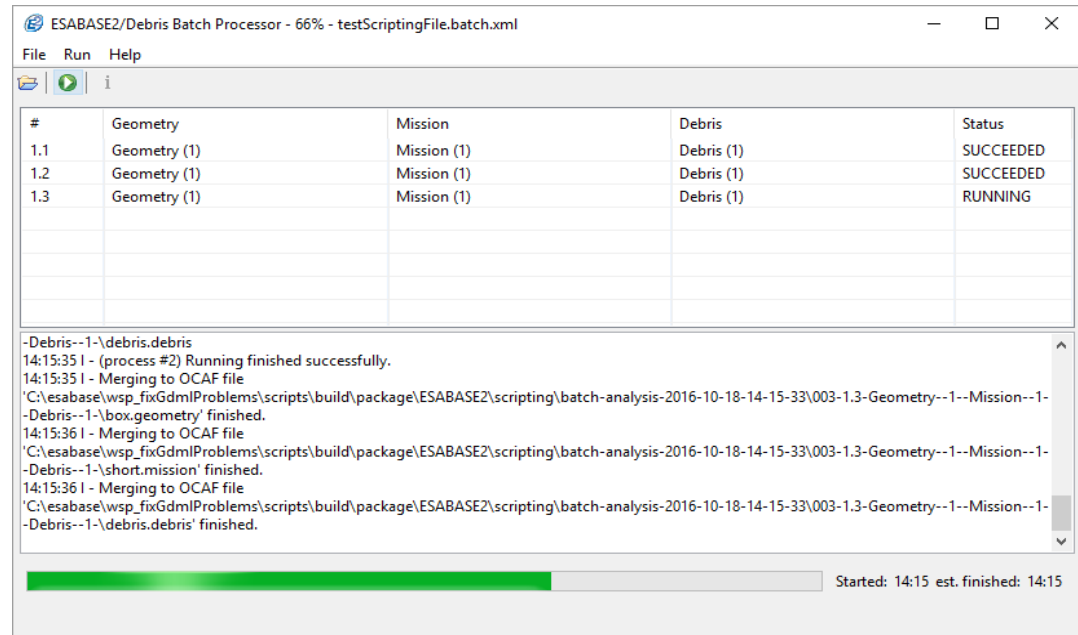
# Scripting Module - Work Flow





- For each parameter: Use pre-defined value or change to a fixed value
- Several debris and mission configuration parameters can be scripted
- A range and the number of steps must be defined for scripted parameters

- Scripting Editor creates a batch of run configurations
  - This batch is handled by the Batch Processor:
    - Calls ESABASE2/Debris in command line mode for each item in the batch
    - Creates a directory for each run, containing
      - All input files (which might contain modified values)
      - All output files
      - Log files
- traceable results
- all input files are available
  - each batch run can be re-produced with a single “standard” ESABASE2 run



- Linux distribution
  - For development: Ubuntu 14.04 LTS, 32bit
  - Supported (TBC): Ubuntu, Debian, CentOS, openSUSE
- Approach
  - Migration of the three ESABASE2 layers
  - Multilanguage environment
  - Several external libraries
  - Migration of the ESABASE2 test suite included
- Space debris and meteoroid environment models
  - Use of Linux versions of MASTER models
  - NASA models (ORDEM, MEM): only Windows versions available  
→ Use of "Wine" for their execution

Layer	Language	Additional Components
GUI	Java	SWT/JFace JFreeChart
	C	Eclipse
Business Layer	C++	OpenCASCADE Xerces netgen CppUnit log4cxx OpenSSL
	FORTRAN	Analysis Modules
	C++	OpenCASCADE
Persistence Layer		

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- ESABASE2 Maintenance CCN successfully completed
  - ESABASE2 8.0 will be released soon
- Next maintenance period: 2017-03-01 to 2020-02-28
  - CCN preparation in progress
  - Several high priority maintenance tasks
- ESABASE2/Debris Extension CCN close to completion
  - Major extensions of usability
  - Related ESABASE2 releases 9.0 and 10.0 in progress
- Further extensions of ESABASE2's functionality envisaged:
  - Implementation of the new MASTER model
  - Provision of comprehensive results post-processing capabilities
  - Risk and damage analysis for interplanetary missions
  - Damage assessment of internal spacecraft components



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