EOMODEL: A MODEL LIBRARY FOR EARTH OBSERVATION END-TO-END SIMULATORS

INNOVATING SOLUTIONS

AGENDA

1. Why a library of Earth Observation models
2. The EOMODEL/BIBLOS project
3. BIBLOS website
4. Conclusions: added value of the BIBLOS project

BIBLOS

LIBRARY OF EO MODELS

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WHY A LIBRARY OF EO MODELS

- Current EO missions develop E2ES
- An E2ES is an **expensive** development
- All EO E2ES share commonalities.
- There are **re-engineering costs that can be avoided**.

- Interesting for early design phases (A)
  - There is not a lot of budget
  - But many EO missions have to prove performances for mission selection (for example in the Earth Explorers)
  - Useful tool for Requirements definition
  - Useful tool for Processing and Calibration testing and validation
  - Useful tool for Retrieval and Science validation
- Later evolution into operational simulators

ARCHEO PROJECT

Survey of past/current/planned EO missions

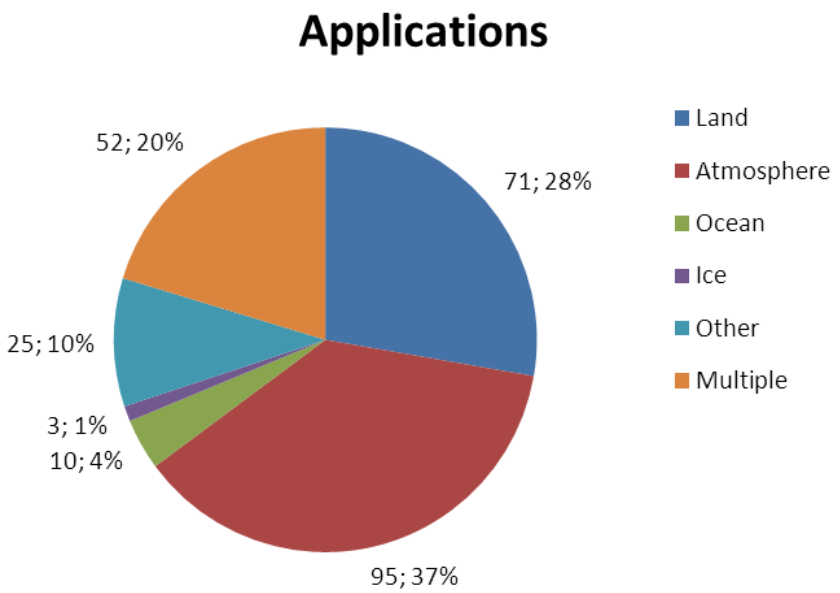
- **38 ESA**
- **218 non-ESA**

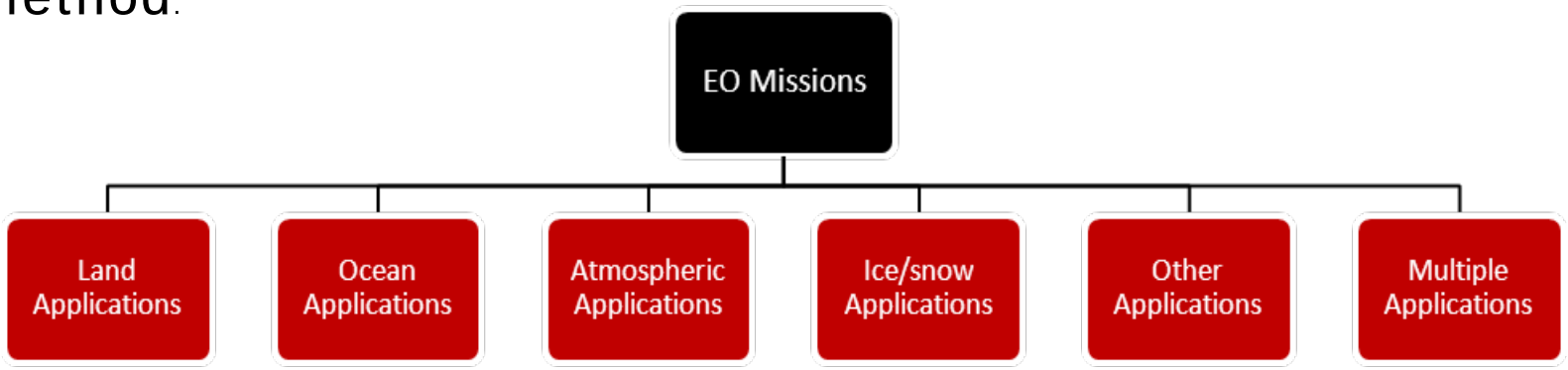
- Categorisation of Earth Observation **Missions**
- Categorisation of Earth Observation **Instruments**

- Definition of a **Reference Architecture**
- Definition of the composing Building **Blocks**

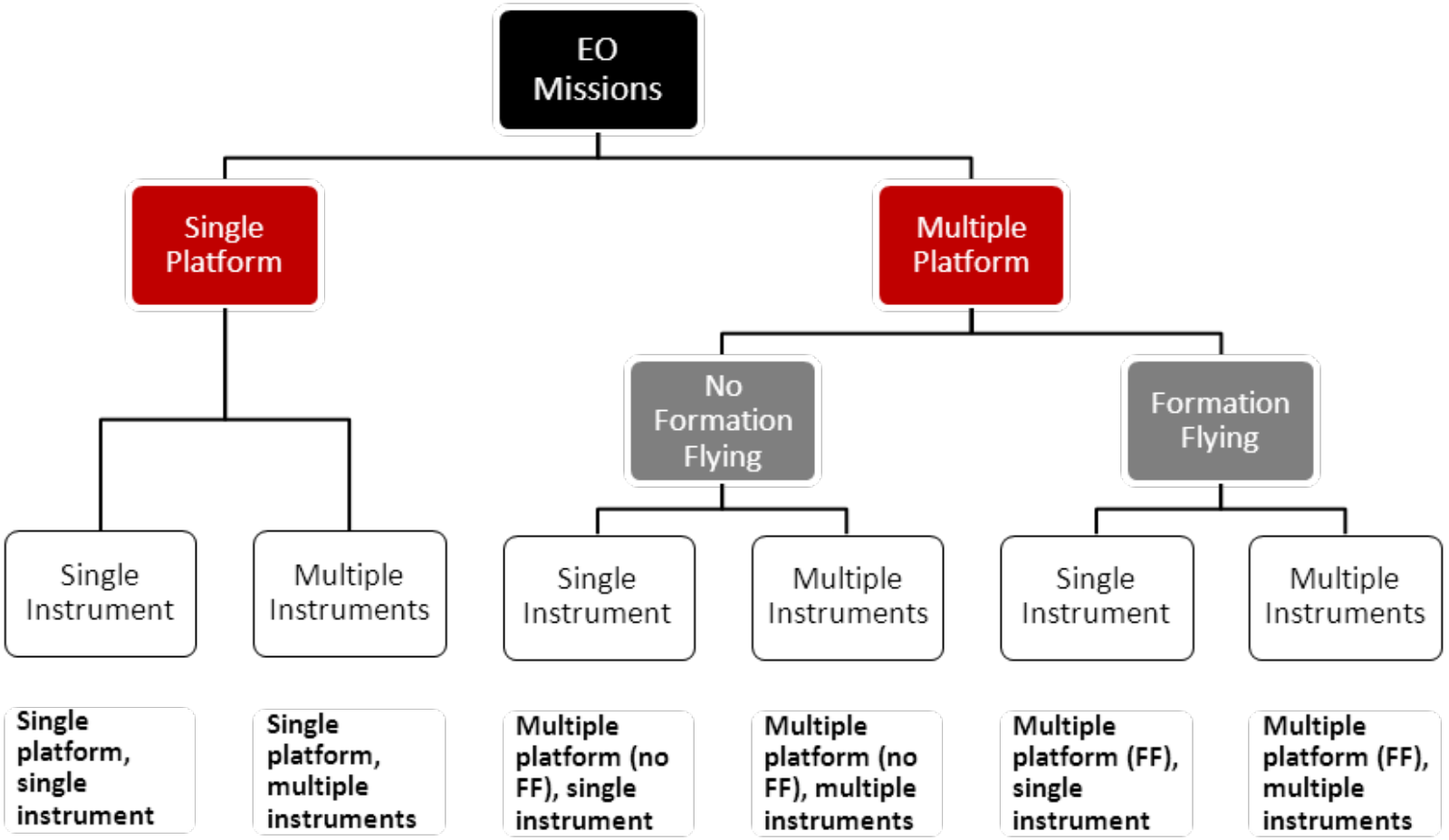
MISSION CATEGORISATION

- **Number of satellites** composing the mission.
- **Number of instruments** on-board the spacecraft.
- **Scientific objective** of the mission.
- Links with other missions: formation flying, processing, retrieval
- Orbit characteristics
- Observation geometry/scanning method.



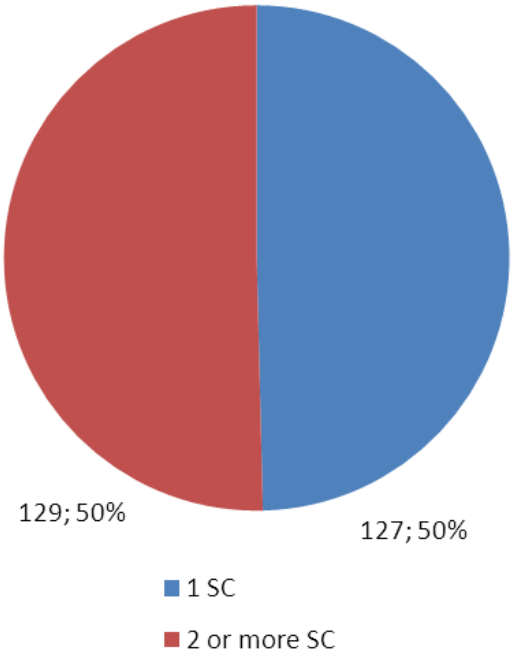


MISSION CATEGORISATION

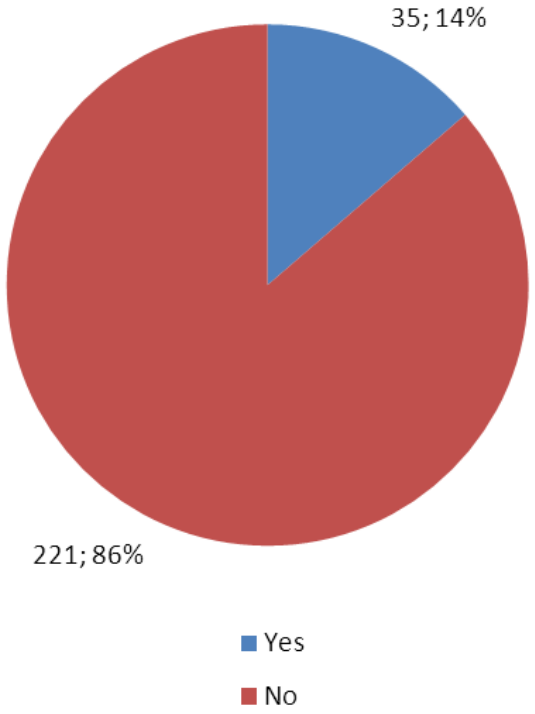


MISSION CATEGORISATION

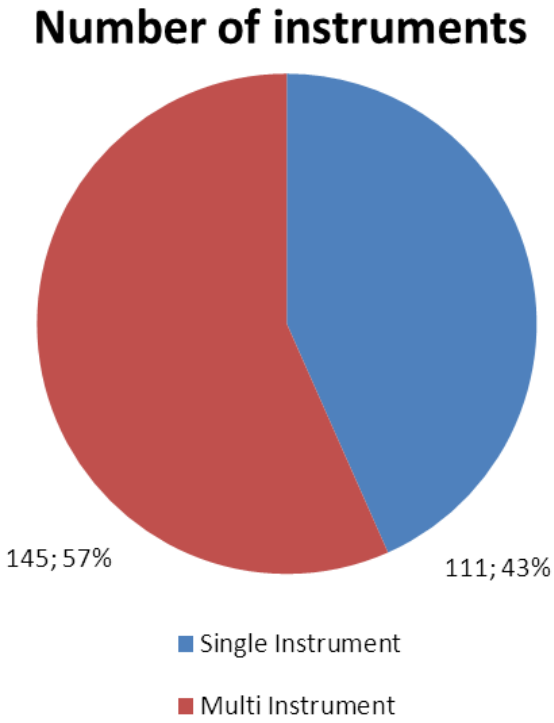
Number of Spacecraft



Formation Flying

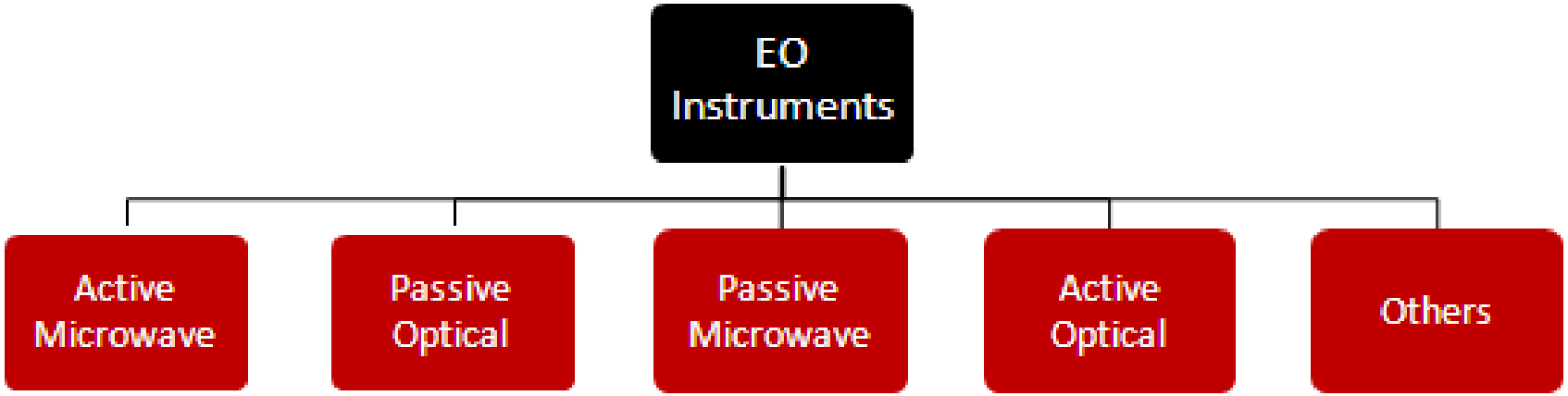


Number of instruments

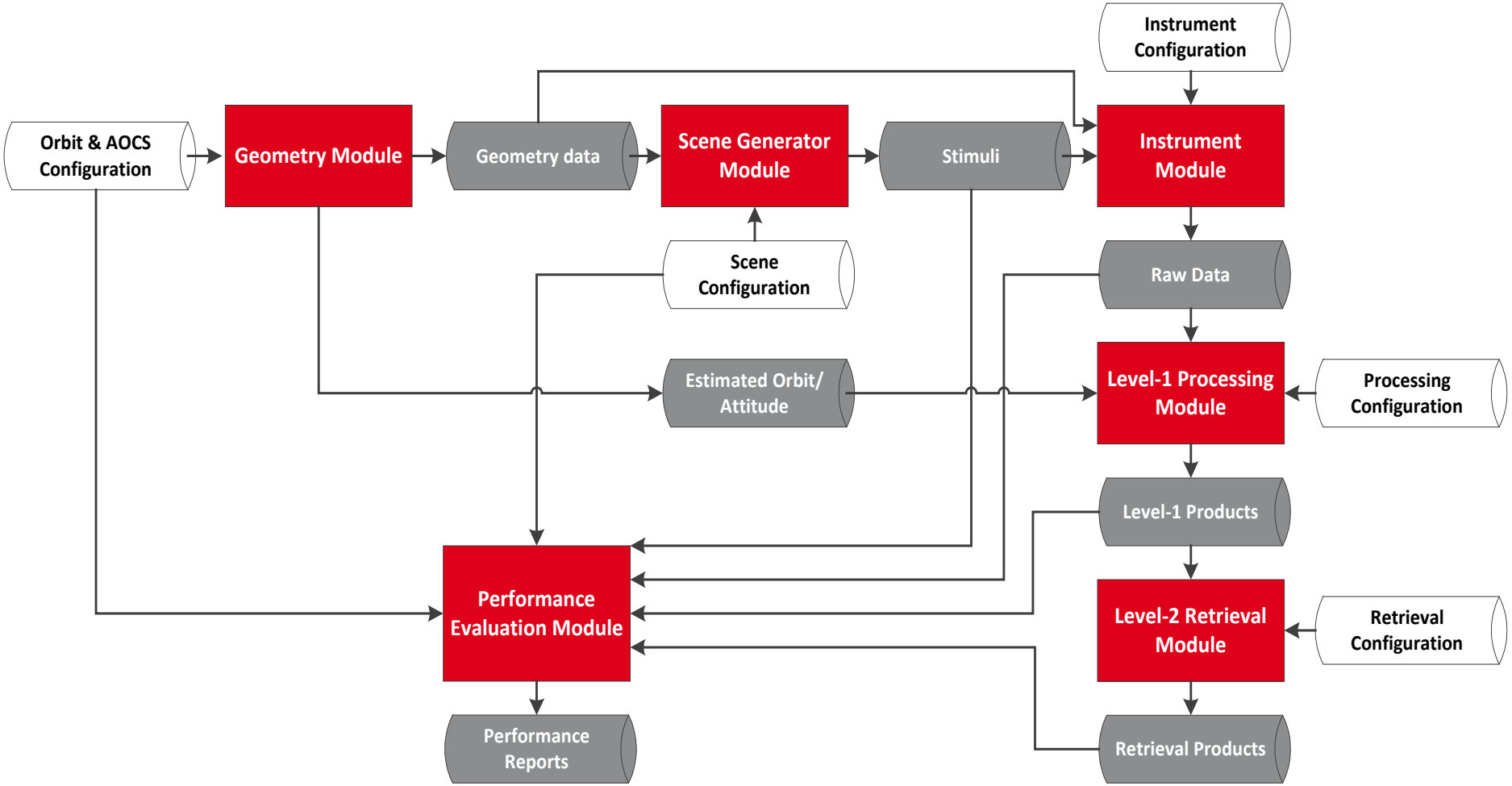


INSTRUMENT CATEGORISATION

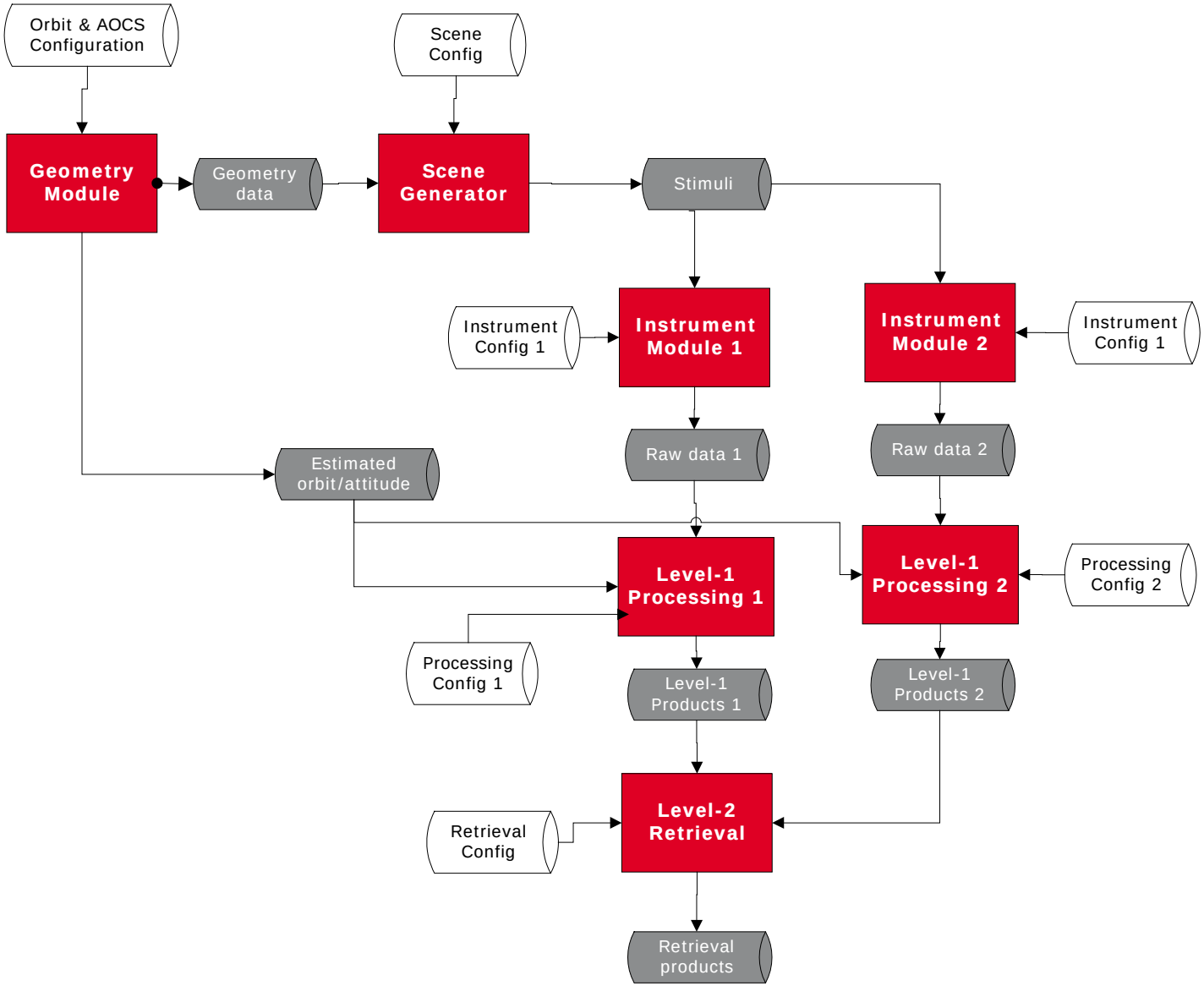
- Region of the **spectrum** they operate
- **Passive vs. active** instruments
- Target of the measurement
- Type of retrieval products
- Calibration method
- Scanning geometry



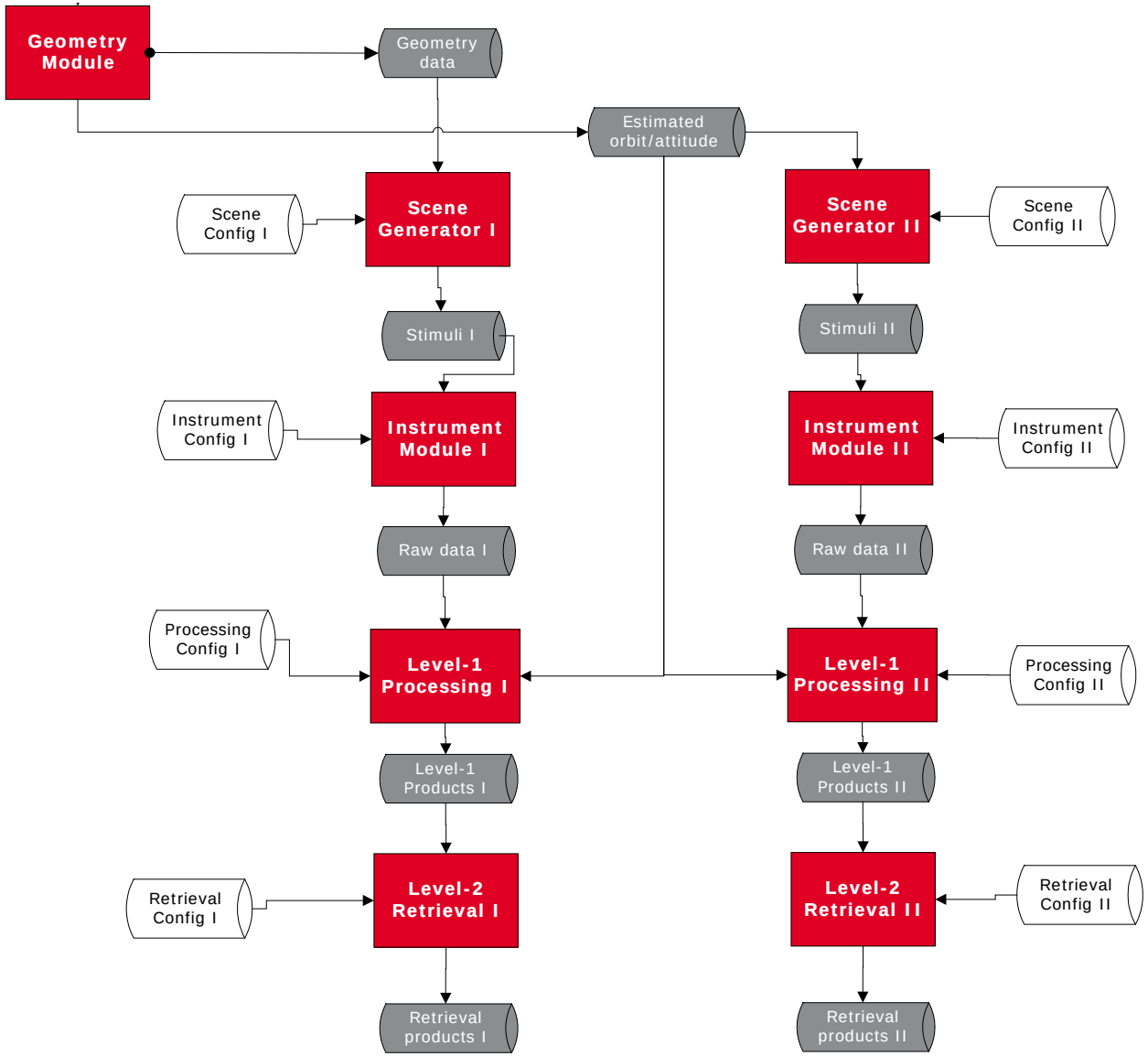
REFERENCE ARCHITECTURE OF AN E2ES



AN ARCHITECTURE FOR EACH MISSION

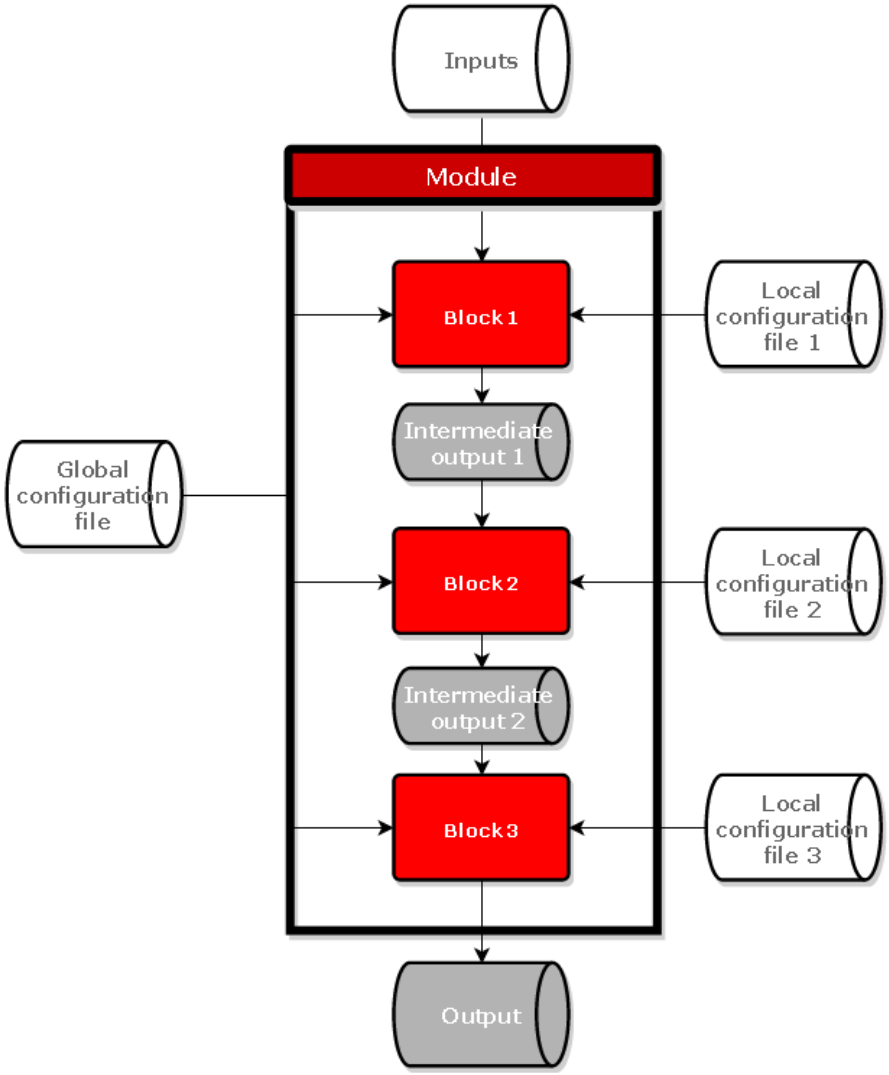


AN ARCHITECTURE FOR EACH MISSION



BUILDING BLOCKS

- Each Module (Geometry, Scene Generation, Instrument, L1, L2, PEM) is composed of building Blocks
- A Blocks is a unit of SW that performs a distinguishable activity. They are the **'bricks'** of the E2ES.
- A chain of blocks builds the Module.
- The communication between the blocks is data driven. So they are **flexible**.



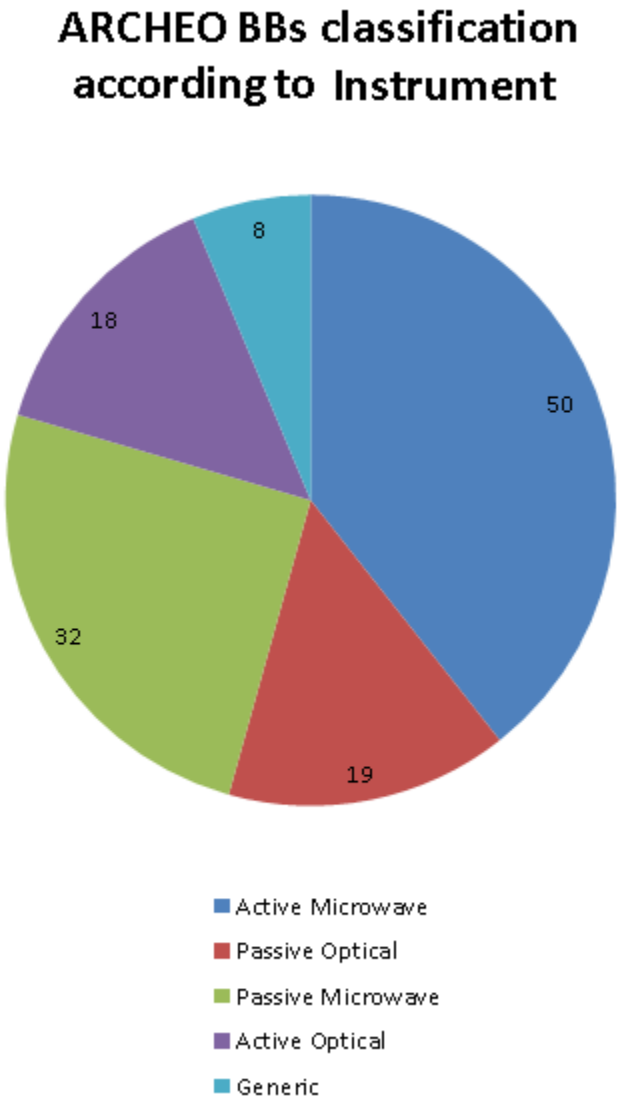
BUILDING BLOCKS

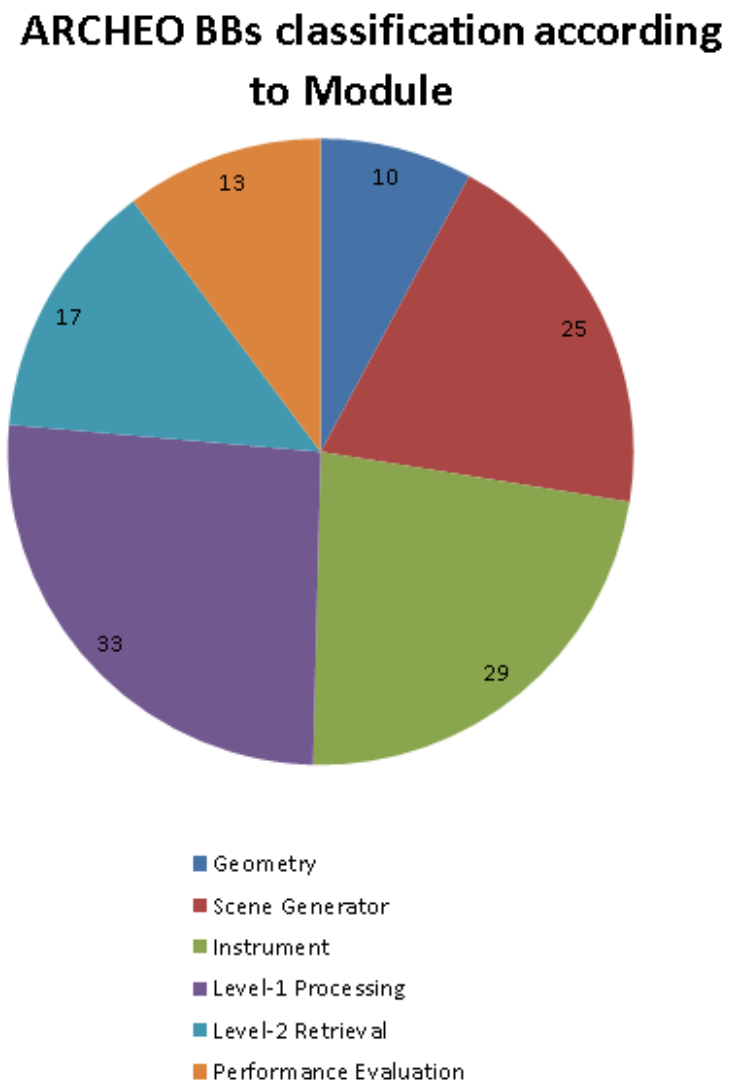
In ARCHEO Blocks were defined

- For each main **Instrument** type (Passive/Active Opticals & Microwaves)
- For each **Module** (Geometry, Scene Generation, Instrument, L1, L2, PEM)

A total of **127** Blocks were identified.

BUILDING BLOCKS





WHAT BLOCKS ARE COMMON FOR EO MISSIONS

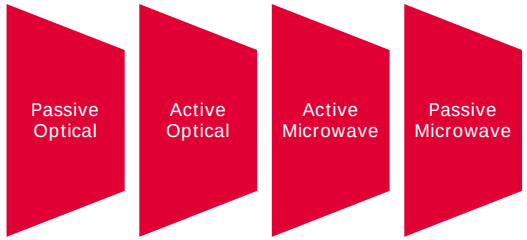
The most common Blocks are:

- All the blocks from the **Geometry Module** as it common for all EO missions (Orbit, Attitude, AOCS, Scene Interaction Blocks)
- **Passive Opticals** and **Active Microwaves** are the most typical EO missions, so it is useful to implement blocks belonging to the **Scene Generation and Instrument Modules**
- Part of the **L1-Processing** chain is common for all missions (Geolocation, Removal of Radiometric Errors, Coregistration)

On the other hand, the most mission-specific Blocks (least common) are:

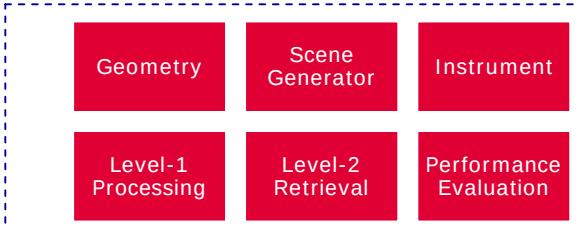
- Forward Model
- L2-Retrieval
- Some calibration processes

WORKFLOW



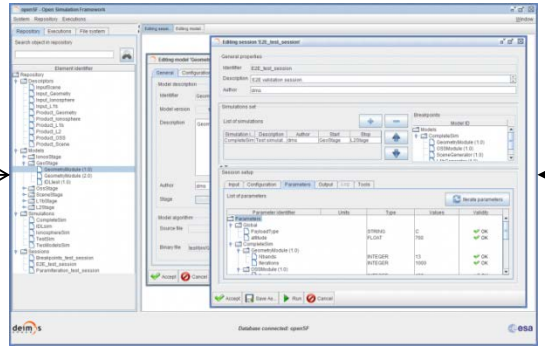
Predefined Reference Architecture Templates

- Reference architectures defined in scope of present activity (Task 2).
- Number of architectures minimised by trade-offs.



Module and/or Building Block Repository (internal or external to framework)

- Building blocks and/or modules are stored in a dedicated repository.
- They are used to fill-in the stages created in the framework by selecting the reference architecture template.



EO E2E Simulator Framework

- Pre-creates interconnected stages and templates for configuration files according to selected reference architecture.
- Input/output interfaces defined according to Building Blocks definition (Task 3).

User

BIBLOS

EOMODEL/BIBLOS

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THE BIBLOS PROJECT

There are 3 main activities in the BIBLOS project

1. Definition of the **Technical Specifications** for all of the Modules and for each of the Blocks. Each Block's technical specification contains

- Overview
- Requirements
- Algorithms
- Architecture

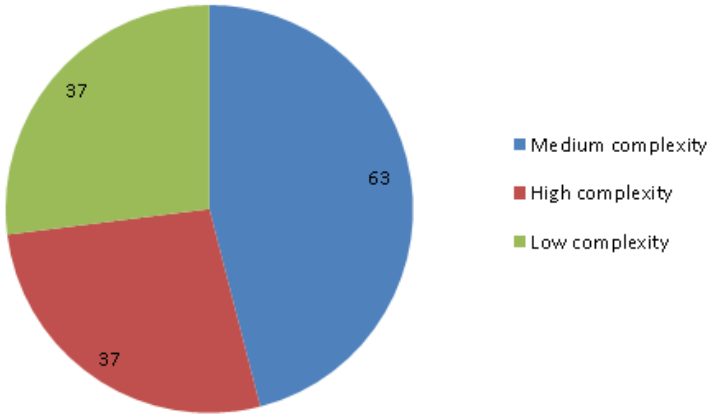
2. **Implementation** of some of the Blocks

3. Design and production of a **Website**

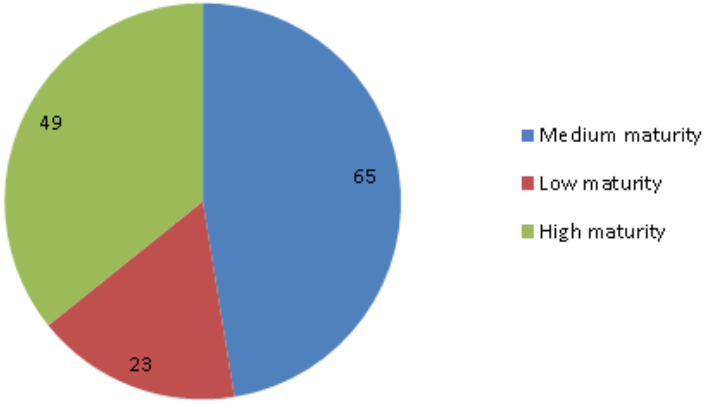
- The website includes a step-by-step guide on how to create an E2ES
- The website contains the available SW (Modules/Blocks)

BUILDING BLOCK CLASSIFICATION FOR BIBLOS

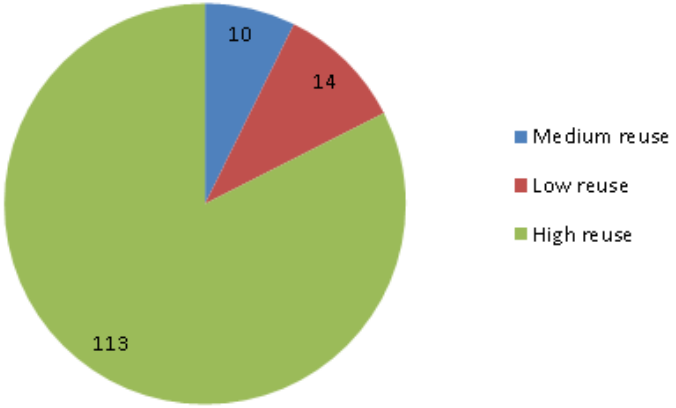
BBs classification according to Complexity



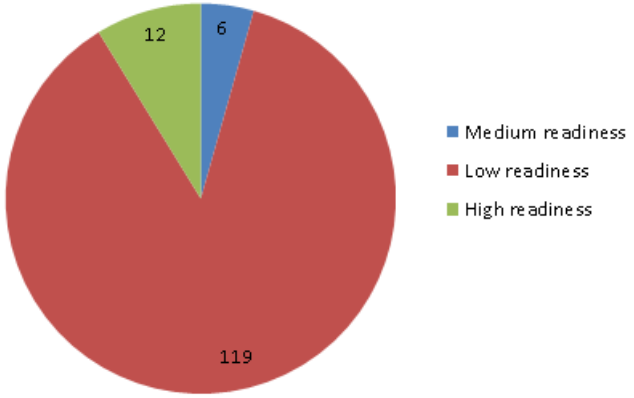
BBs classification according to Maturity



BBs classification according to Reuse



BBs classification according to Readiness

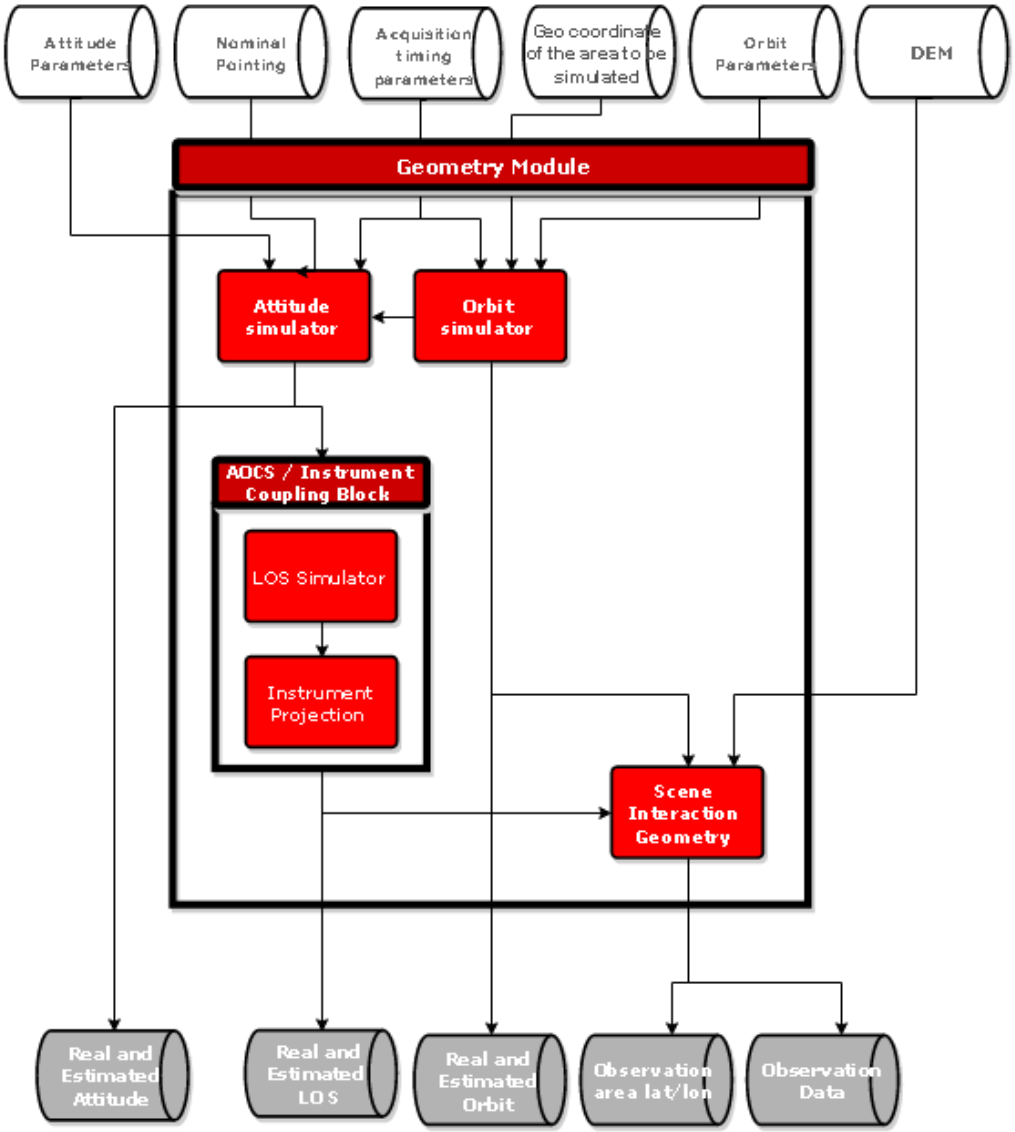


BIBLOS PRIORITIES FOR IMPLEMENTATION

- Starting point: Generation of **satellite images (raw data) for a Passive optical imaging mission**
- Purpose of generating test data for ground processing SW validation
- Focus on the Geometry, Scene Generator and Instruments Modules
- Aiming at a **phase A** E2ES. But is designed with later phases (B/C) into account.
  - Programming language
  - Image processing capability
  - Performances (limited).

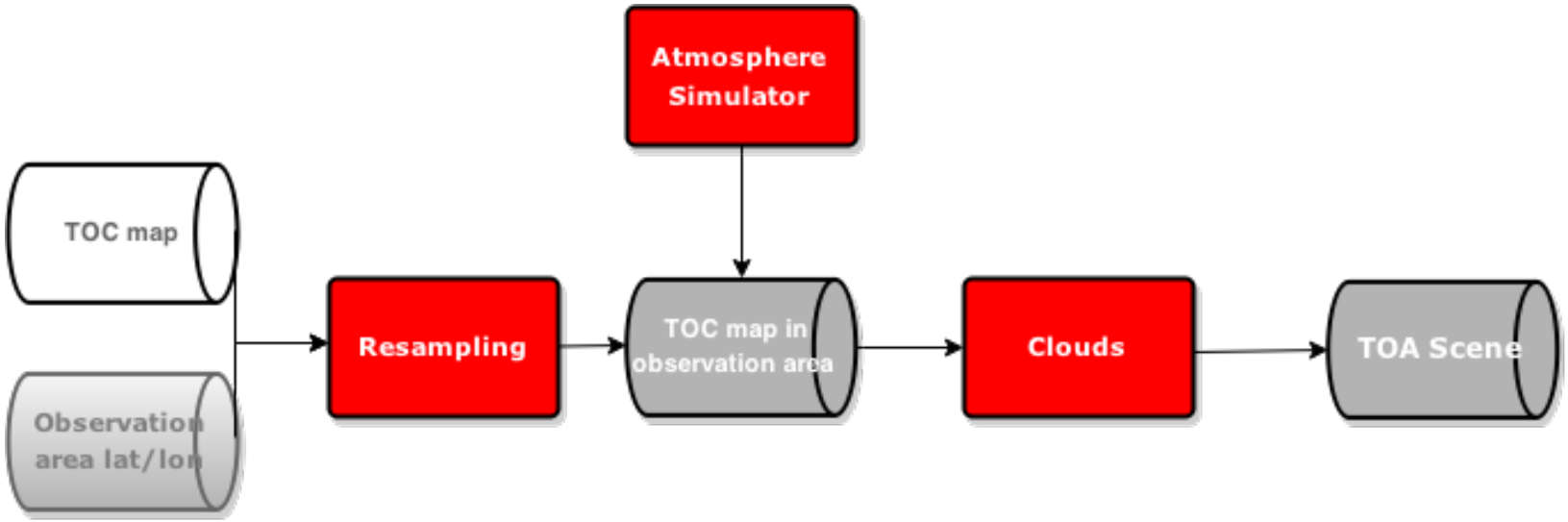
GEOMETRY MODULE

- Blocks to be implemented:
  - Orbit Simulator
  - Attitude Simulator
  - AOCS Simulator
  - Scene Interaction



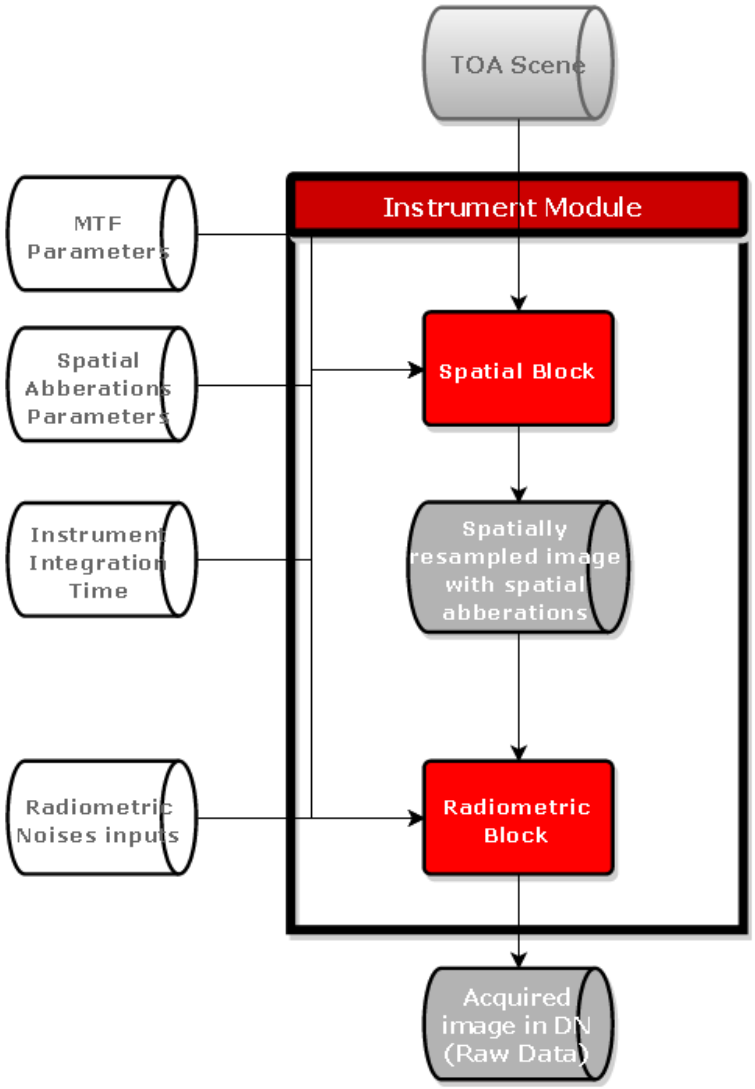
SCENE GENERATION MODULE

- Blocks to be implemented:
  - Resampling Block
  - Atmospheric RTM



INSTRUMENT MODULE

- Blocks to be implemented
  - Spatial Block
  - Radiometric Block

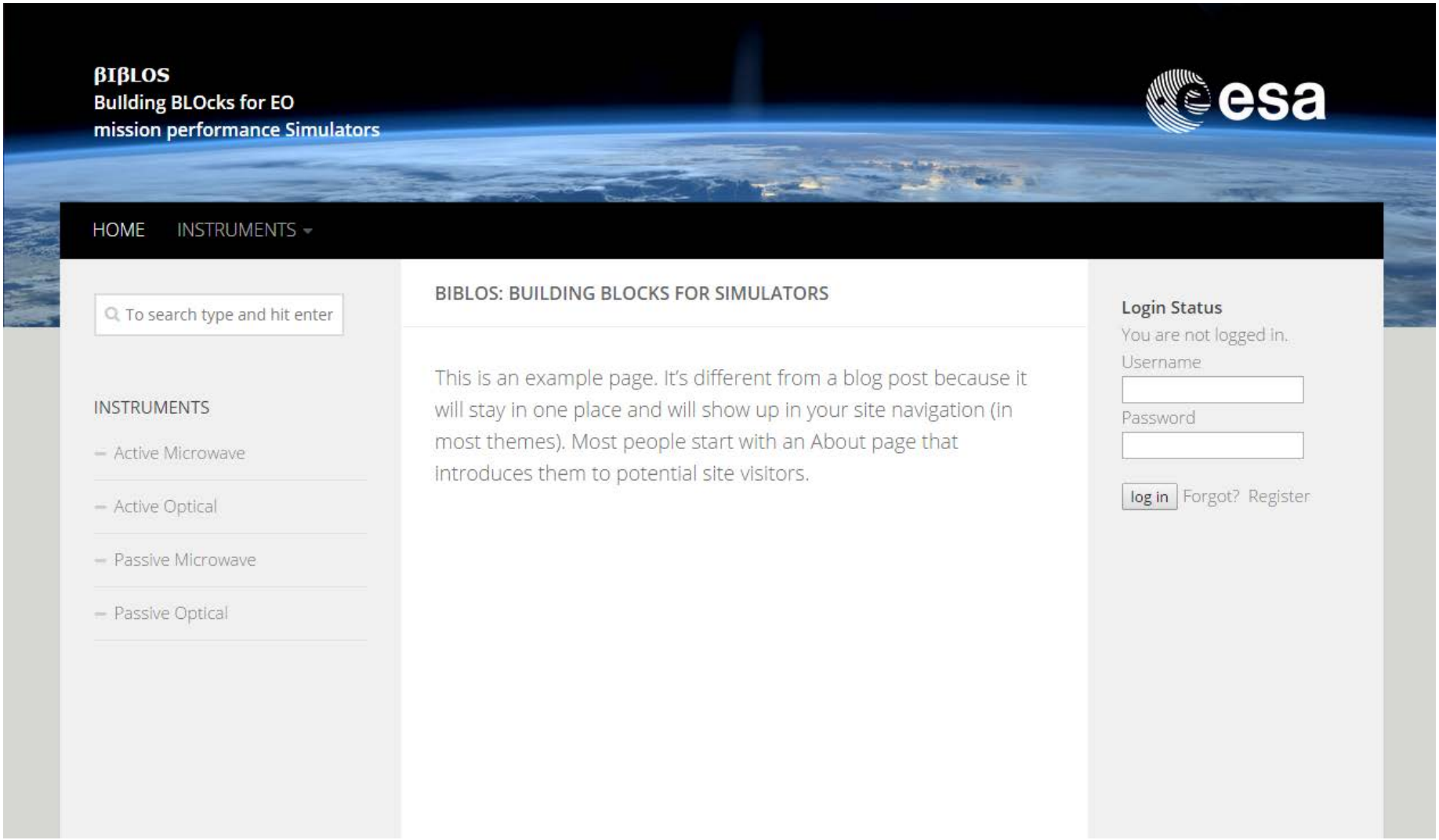


BIBLOS

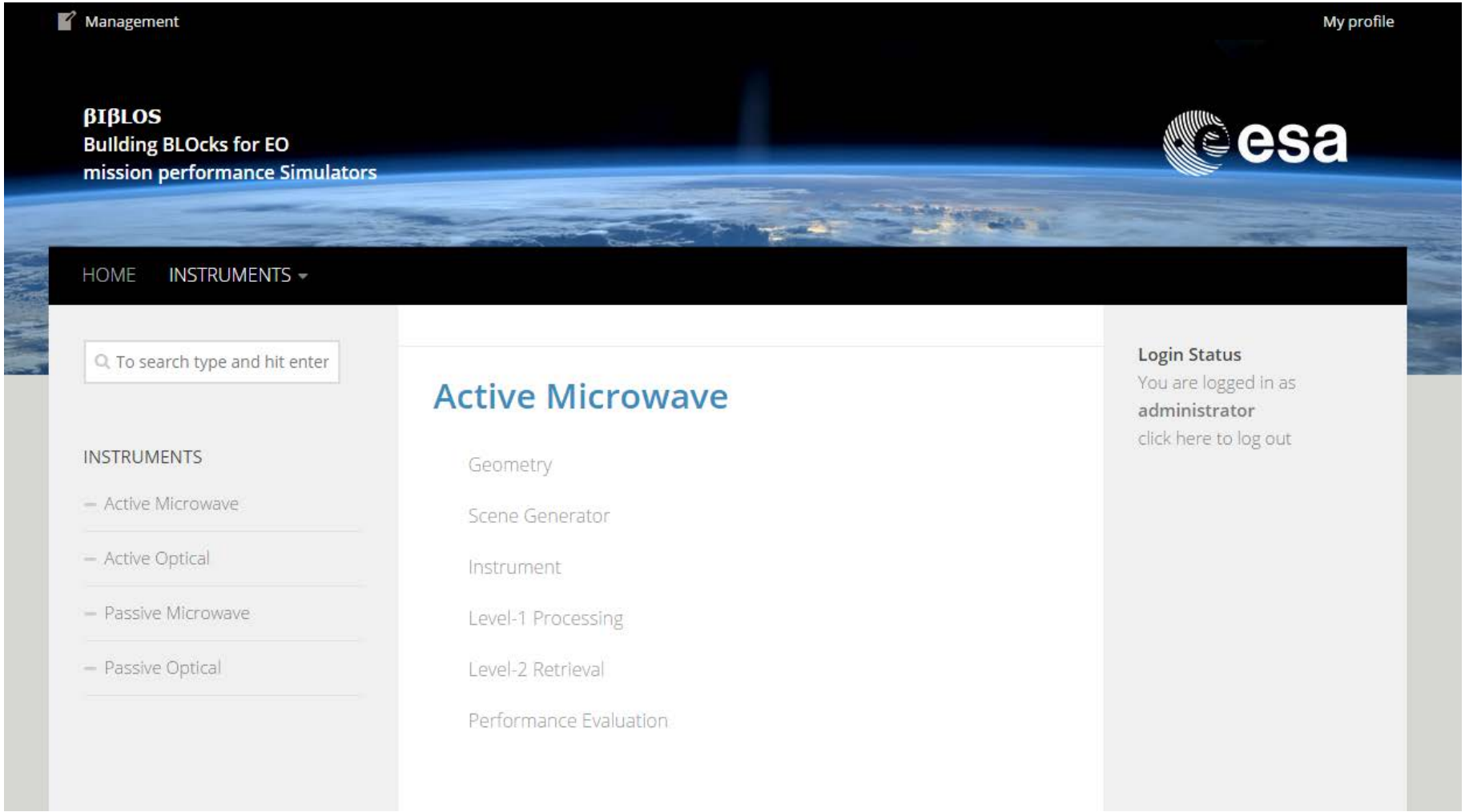
WEBSITE

INNOVATING SOLUTIONS

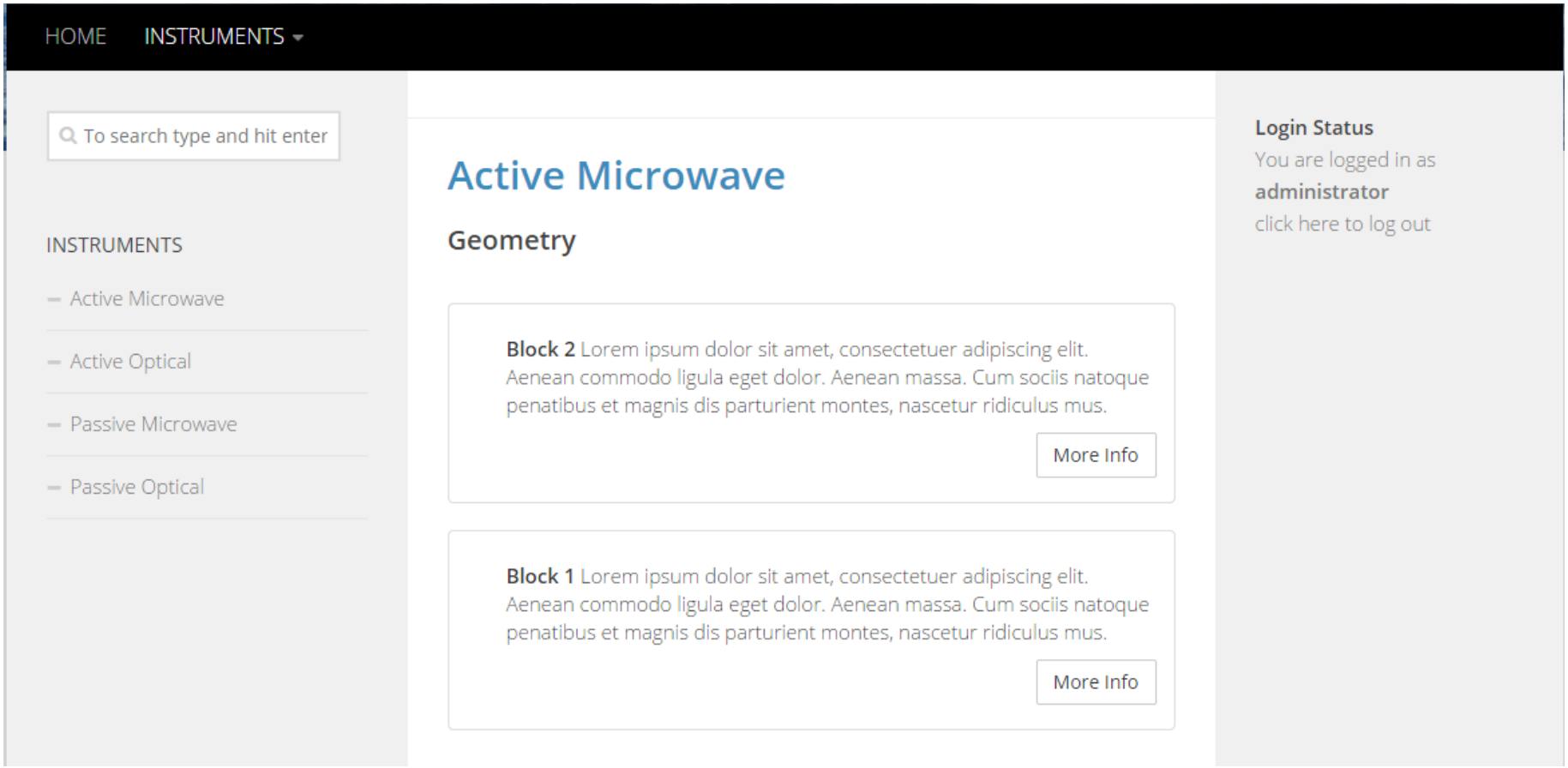
HOME



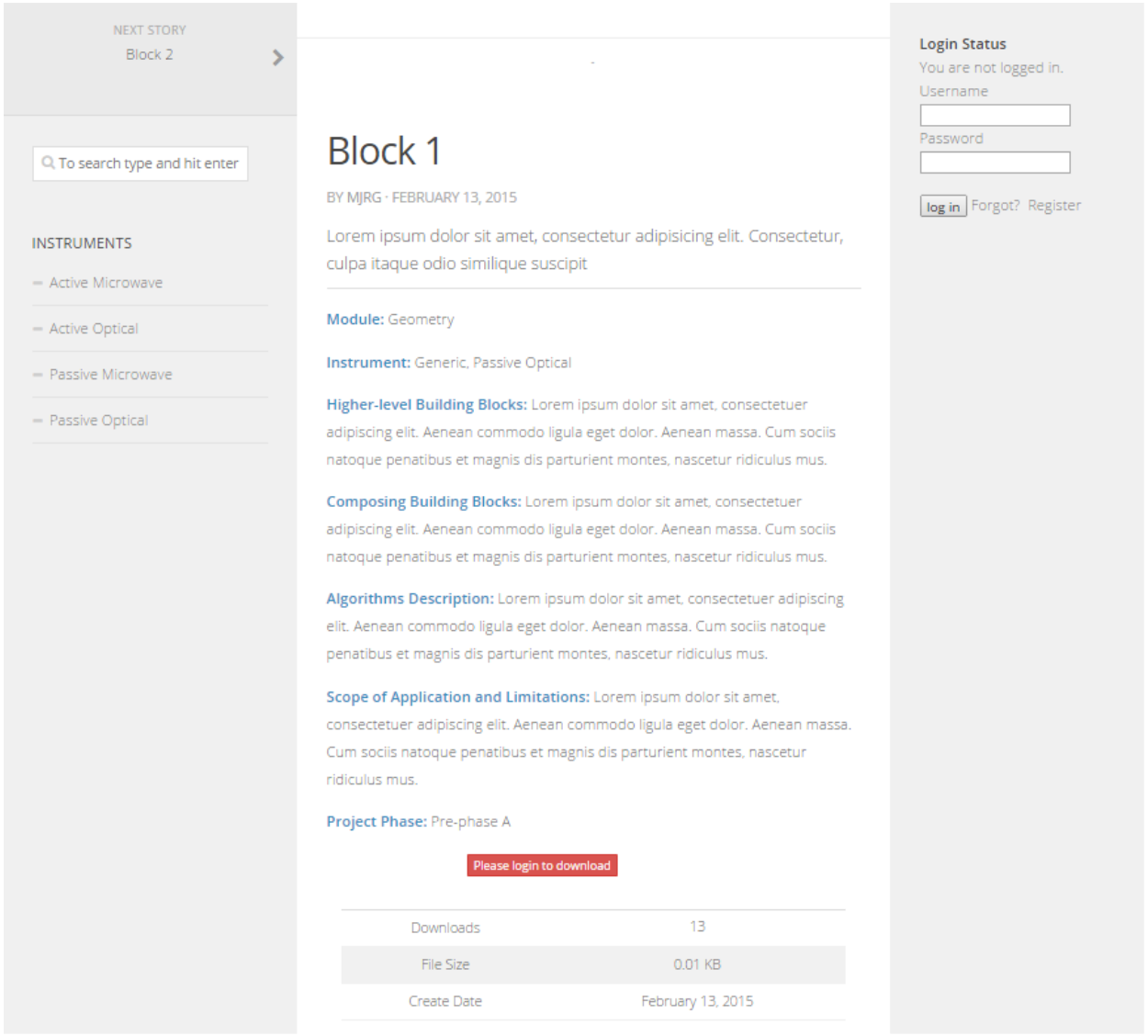
INSTRUMENT>MODULE



INSTRUMENT>MODULE>BLOCK



BLOCK



BIBLOS

CONCLUSIONS

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BIBLOS' ADDED VALUE

- Easy guide to creating an Earth Observation End-to-End Simulator for all types of EO missions
- Offers the common blocks to avoid re-engineering and lower E2ES cost
- Puts together information now scattered around the web
- Currently aiming at phase A design

- Important for design of the system, definition of requirements
- Important for validation of the processing and calibration
- Important for validation of the retrieval algorithms and science.
- Important for mission selection

Thank you

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