Past, present and future work of OKTAL-SE with SEDRIS

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OKTAL-SE

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Synthetic Environment

Topics:

- An Overview of OKTAL-SE
- OKTAL-SE first implementations and modelling of infrared and other sensor data
- Current uses of SEDRIS in the SE-WORKBENCH
- The SE-DB-MAT concept
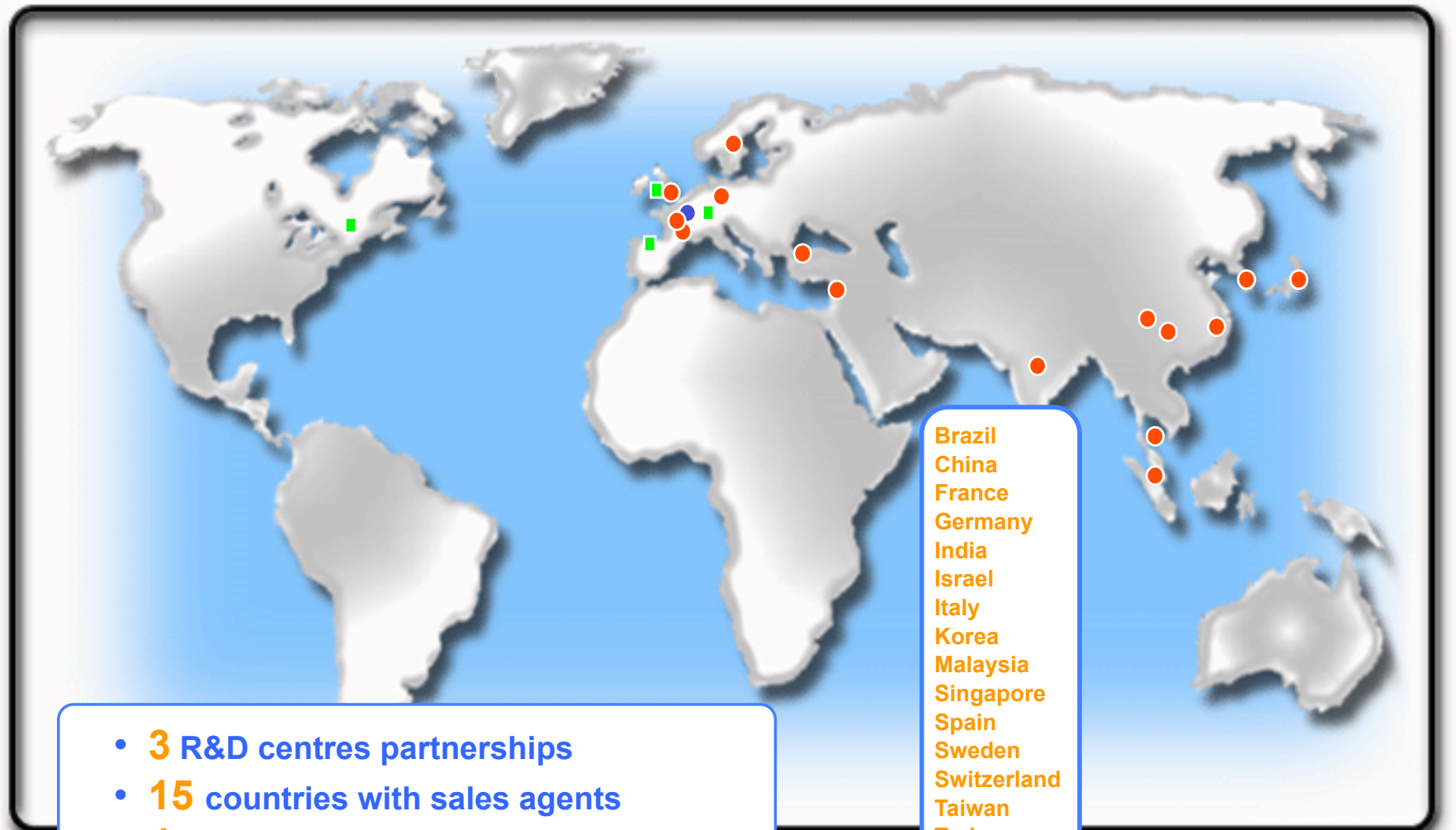
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An Overview of OKTAL-SE

✪ Before 1989: Thalès Training Simulation in Paris

✪ 1989: OKTAL => Railway simulators / Automotive simulators

✪ 2001: OKTAL-SE Defence and Research simulation

✪ 2005-2007: French MoD projects involving SEDRIS

✪ 2011: GNSS (Ergospace – GUIDE innovation platform)

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An Overview of OKTAL-SE

OKTAL-SE World class software editor

Brazil
China
France
Germany
India
Israel
Italy
Korea
Malaysia
Singapore
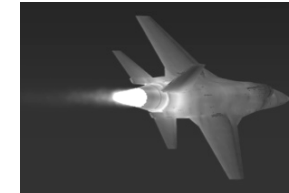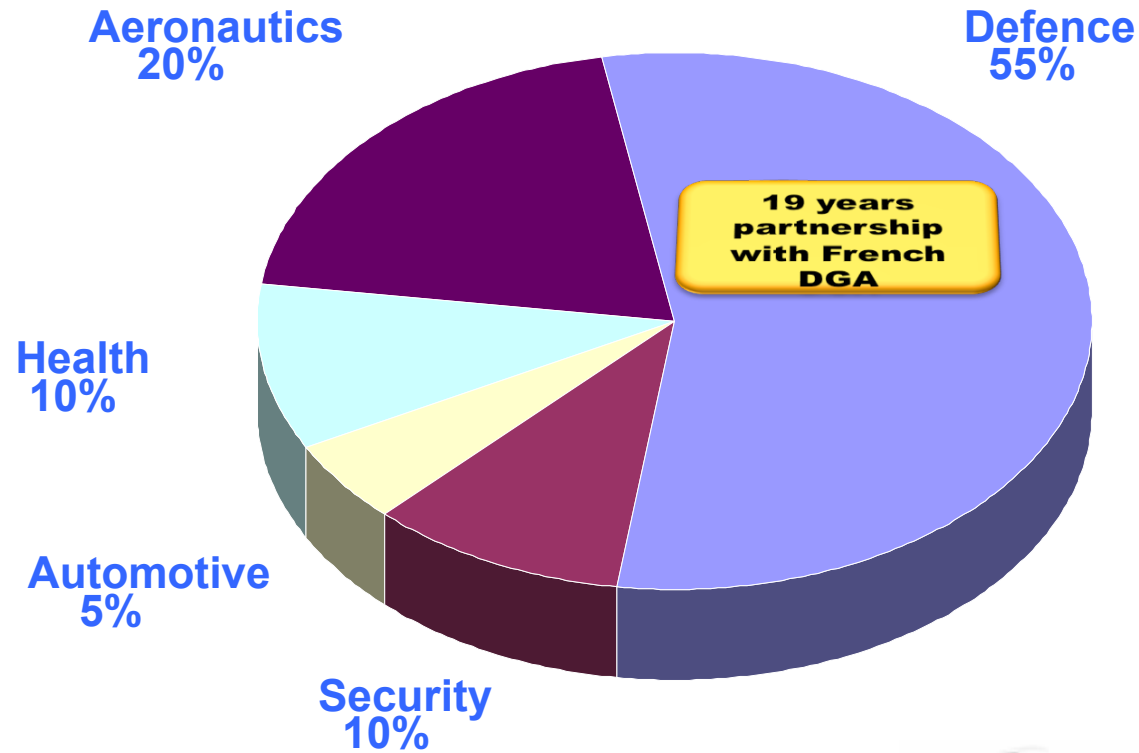Spain
Sweden
Switzerland
Taiwan
Turkey
UK

- **3** R&D centres partnerships
- **15** countries with sales agents
- **4** direct sales office (SOGECLAIR)
- **28** employees
- **300** licenses and more over the world

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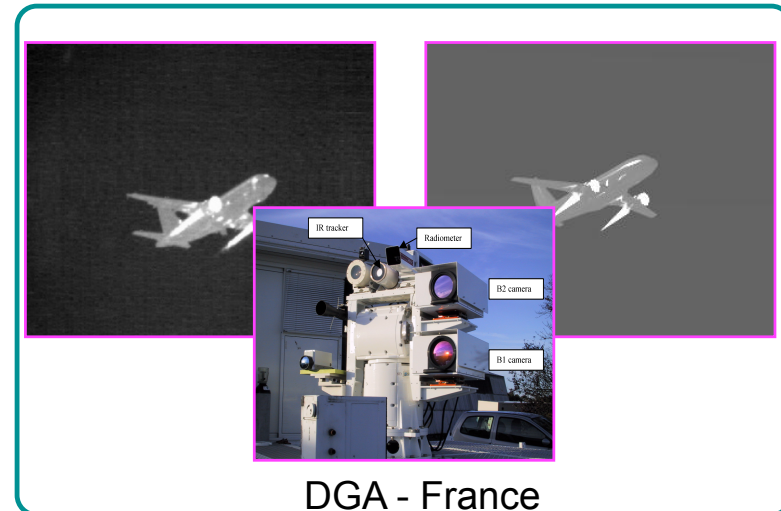
An Overview of OKTAL-SE

Targeted applications for the major markets segments

Aeronautics
20%

Defence
55%

19 years
partnership
with French
DGA

Health
10%

Automotive
5%

Security
10%

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Strategic alliances for software results validation

FOI - Sweden

Fraunhofer - Germany

ONERA - France

DGA - France

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The SE-WORKBENCH interface to third-parties

SketchUp

BB3D

Blueberry3D ™

SCANER

OSG

Blue Marble GEOGRAPHICS
MIND THE GAP BETWEEN WORLD AND MAP

Global Mapper

AUTODESK.

3DMax

SE-Workbench

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GeoConcept

SEDRIS

ONTAR CORPORATION

MODTRAN

SPIRENT
SimGEN ™

ThermoAnalytics

Agenium
Informatique & Systèmes

TACTICAL TECHNOLOGIES INC

RadTherm

STK

TESS

SPIRENT

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An Overview of OKTAL-SE

Long term partnerships with customers

- *French DGA:*   **19 years of collaboration**

- *MBDA Fr and UK:*   **15 years of collaboration**

- *ONERA:*   **13 years of collaboration**

- *SAGEM:*   **10 years**

- *Korean ADD:*   **9 years**

- *Swedish FOI:*   **8 years**

- *German FGAN :*   **7 years**

- *Singapore DSTA:*   **6 years**

- *…*

All under multi-years maintenance contracts

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An Overview of OKTAL-SE

An overview of data preparation and fusion stages in providing sensor simulations

ISO/IEC JTC 1/SC 24 meetings London on 24-28 August 2015

1

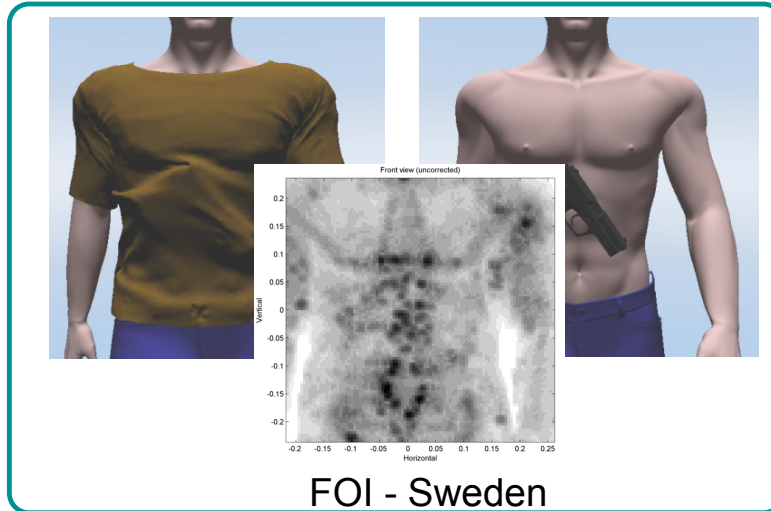Planimetry

Photography

+

Altimetry

2D data

2

3D terrain

+ Sensor

+ Scenario

+ Objects

+ Thermal History

+ Atmospheric Properties

+ Materials Physical properties

4

IR

RF

Sensor signal simulation

3

3D Synthetic Environment

Synthetic Environment
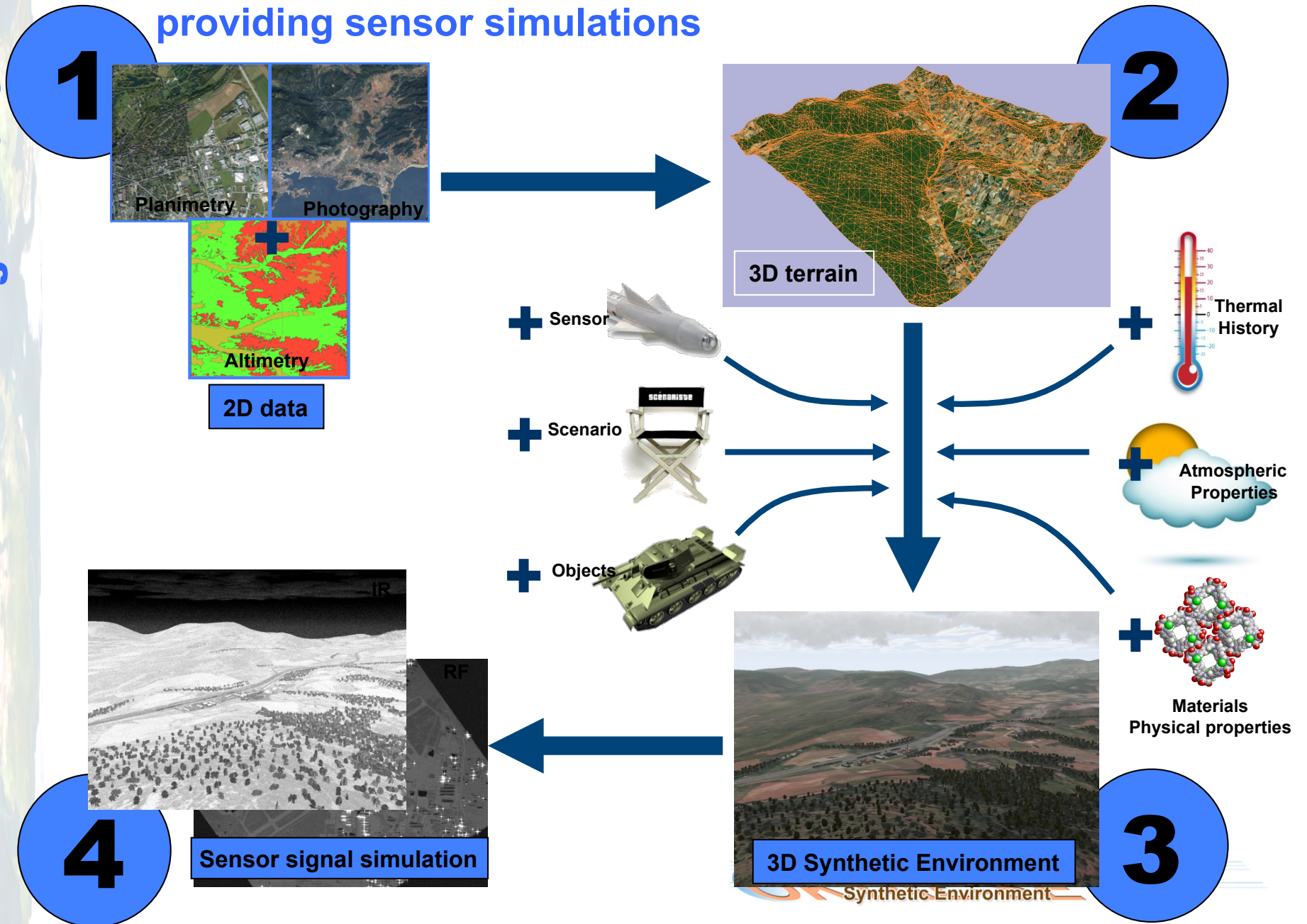
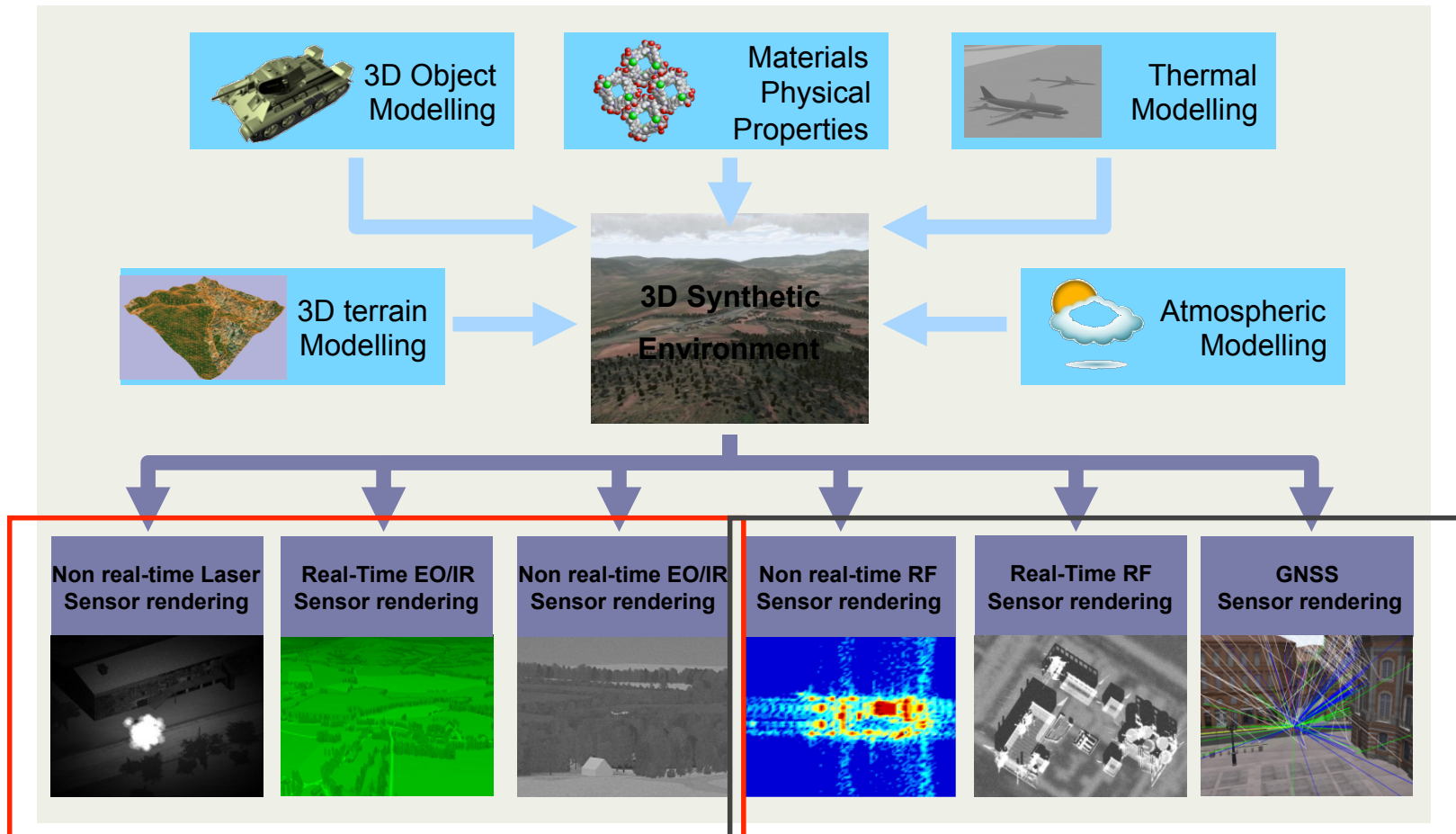**The SE-WORKBENCH™: A single kernel for multi-sensor environment modelling**

3D Object Modelling

Materials Physical Properties

Thermal Modelling

3D terrain Modelling

3D Synthetic Environment

Atmospheric Modelling

Non real-time Laser Sensor rendering

Real-Time EO/IR Sensor rendering

Non real-time EO/IR Sensor rendering

Non real-time RF Sensor rendering

Real-Time RF Sensor rendering

GNSS Sensor rendering

SE-WORKBENCH-EO

SE-WORKBENCH-RF

Dual real-time and non real-time solutions

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OKTAL-SE first implementations and modelling of infrared and other sensor data

- **CQCEGC**

Software for:

Quality control → checking the conformity of data with the format and content specifications

Exchange → importing and exporting (with some restriction)

Correction → modifying the data and metadata

Configuration management → EDS versions catalogue (PostGreSQL database)

for **Environment Database for Simulation** (EDS)

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OKTAL-SE first implementations and modelling of infrared and other sensor data

- **CQCEGC**

Mains goals :

- checking conformity of SIF-France EDS with the format specification

- visual control on elements and parts of EDS

- gathering tools for automatic, supervised and interactive correction of EDS

- exchanging EDS in standard formats such as VMAP, DLMS, SIF-France, SEDRIS, Digitised Terrain and Open Flight

- manage configuration of the various versions of EDS

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OKTAL-SE first implementations and modelling of infrared and other sensor data

- **CQCEGC**

Quality control, exchange and correction

➲ **SEDRIS data model**

Able to host data coming from the various formats handled :

- SIF-France v2

- SEDRIS 4.0 (and now 4.1)

- DLMS DFAD

- DLMS DTED

- Open Flight 15.6

- VMAP1

- Digitised Terrain MNT CELAR

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OKTAL-SE first implementations and modelling of infrared and other sensor data

- **CQCEGC**

 SEDRIS was used here as a pivot data container and representation.

  Every data of a work session is converted to SEDRIS and organised in the data model.

  Corrections are done in the SEDRIS structure and then exported in the input format or another compatible format.

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OKTAL-SE first implementations and modelling of infrared and other sensor data

- CQCEGC

Excerpt of the SEDRIS data model : planimetry

Synthetic Environment
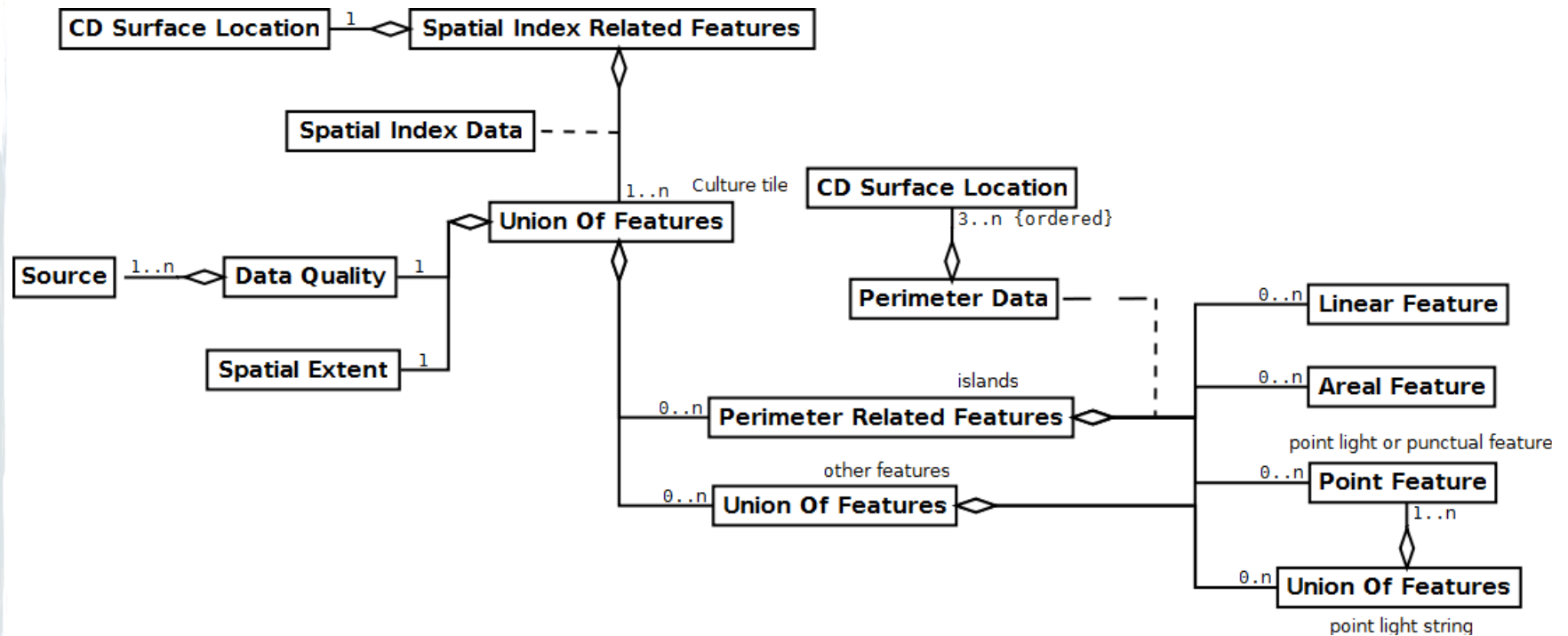
OKTAL-SE first implementations and modelling of infrared and other sensor data

- **CQCEGC**

CQCEGC GUI
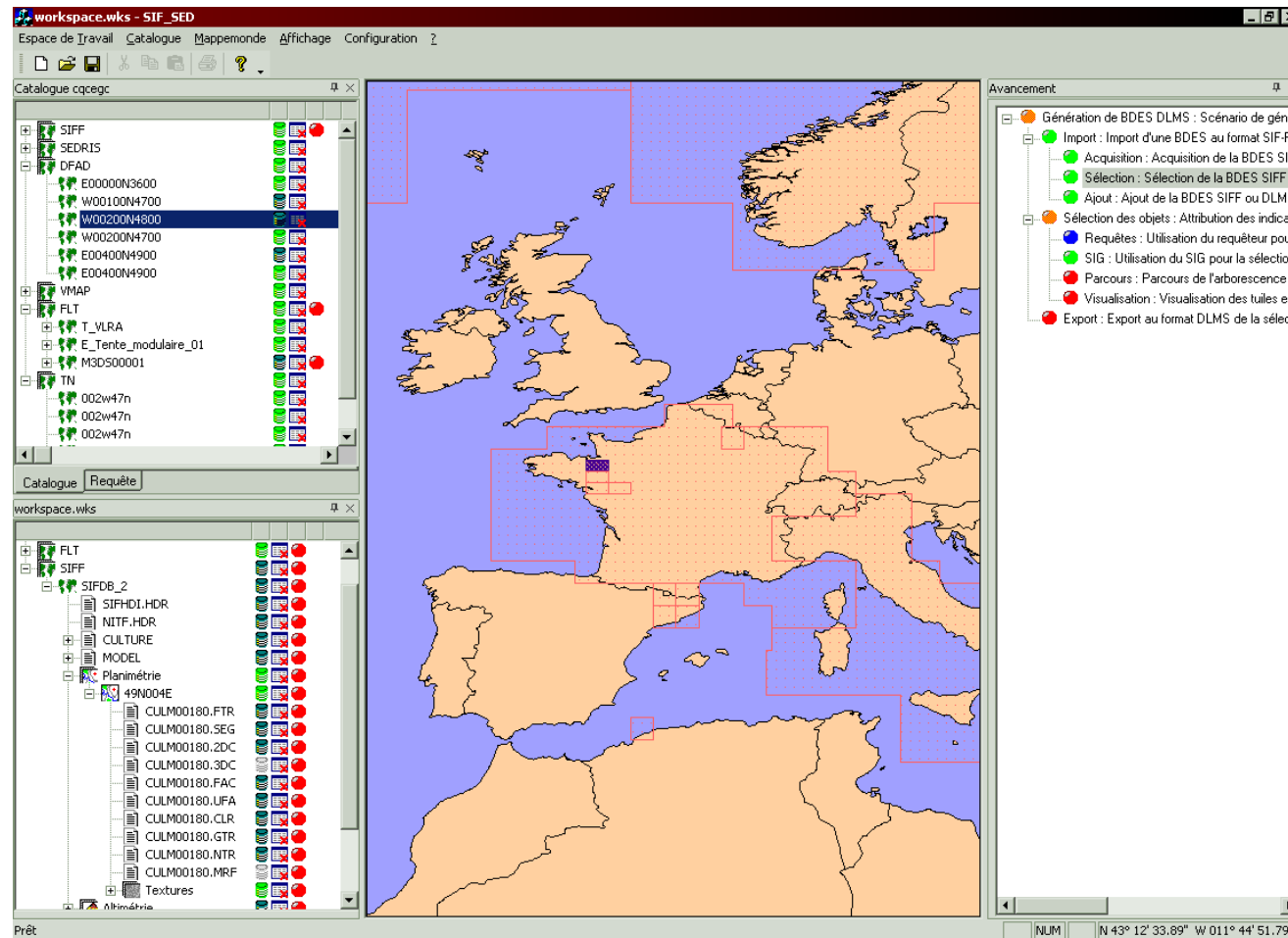
OKTAL-SE first implementations and modelling of infrared and other sensor data

- ## PROVIDENS

PROVIDENS = assistance system for the Interactive PROduction and Validation of Synthetic ENvironment Data

Plug-in for the ITCS (Joint Technical Simulation Architecture)

Based on **SEDRIS as pivot data container and representation**

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OKTAL-SE first implementations and modelling of infrared and other sensor data

- ## PROVIDENS

Environmental data = various and disparate

Usually need to be processed through various steps before being exploitable by simulation applications
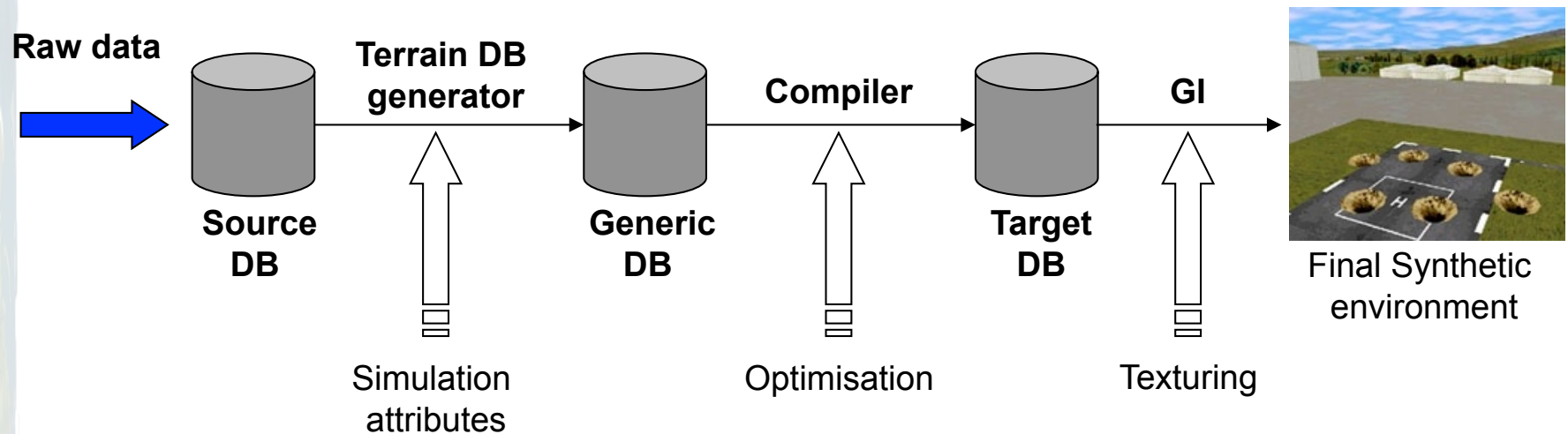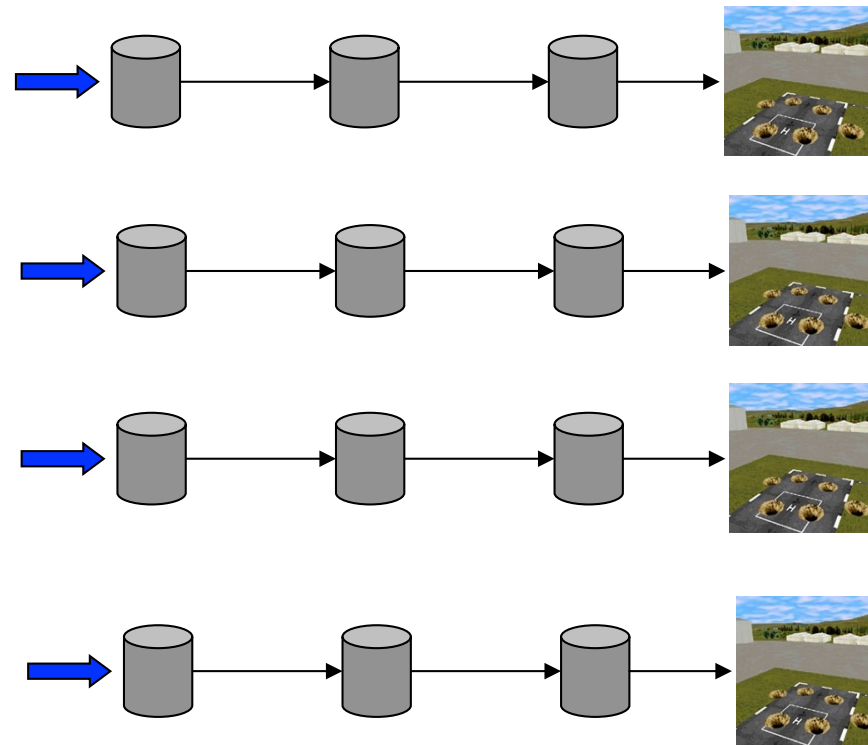

Final Synthetic environment

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- **PROVIDENS**

Most expensive step : transform source databases into generic databases… that are not generic.
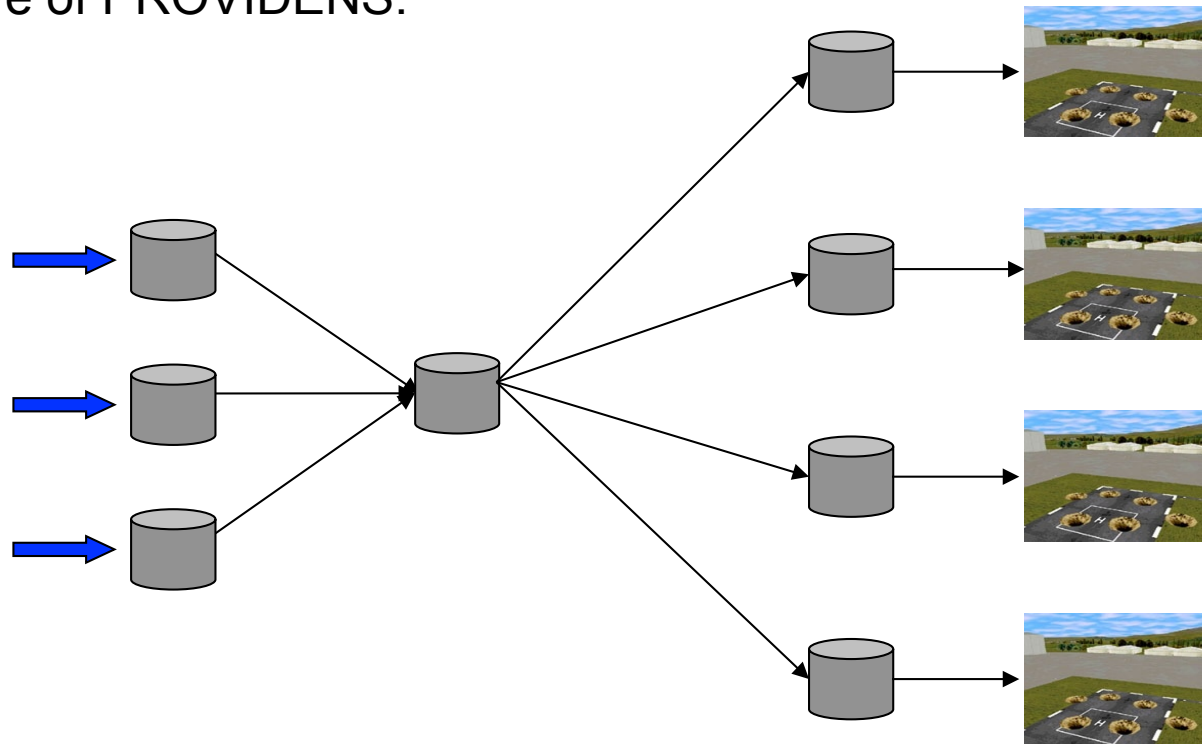
So…

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- **PROVIDENS**

Objective of PROVIDENS:

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- **PROVIDENS**

Interoperability ⇒ Facilitate the exchange and reuse of data

➲**SEDRIS as a pivot data container and representation for source, generic and target database.**

•corrected source data or validated target database → **SEDRIS → capitalisation** → retrieval → import → exploited by applications using different native formats

•**SEDRIS** = very comprehensive data representation : only available format/representation able to describe data as various as planimetry or altimetry data, geo-localised photographs, 3D models, atmospheric data, physical properties, etc.

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- ## PROVIDENS

  - Integration of existing tools in the PROVIDENS platform

  - Development and integration of new converters

  - Enhancement and integration of existing tools (Focus)

  - SEDRIS expertise

  - **Basis for exchanging terrain modelling tools "work data"**

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OKTAL-SE first implementations and modelling of infrared and other sensor data
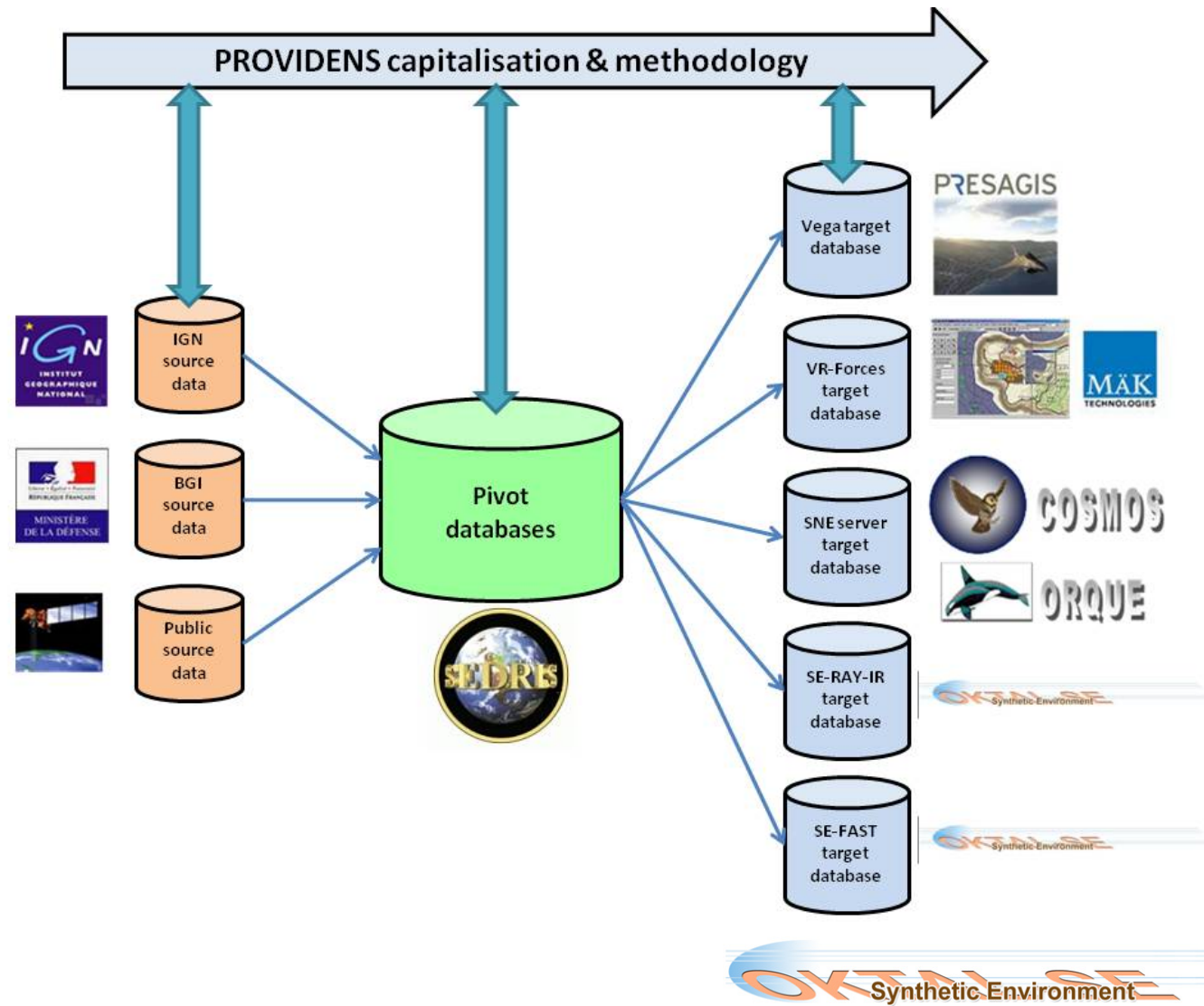
- ## PROVIDENS

PROVIDENS user can :

- retrieve (source or generic) databases in the capitalisation database

- convert them to the native format they need

- request a production plan: best way to perform the data processing needed to produce new (generic or target) databases

- extract and edit their metadata

- capitalise those new databases

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- PROVIDENS

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- **ITCS**

After CQCEGC, before PROVIDENS, the most complete attempt to model OKTAL-SE synthetic environment databases in SEDRIS

ITCS = Joint Technical Simulation Architecture: providing support environment for conceiving and realising simulations

OKTAL-SE for ITCS:

- software for exporting EDS in the SDM format (OKTAL-SE format) to SEDRIS and importing SEDRIS EDS in the SDM format
- providing SEDRIS tools
- providing SEDRIS expertise

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- **ITCS**

- modelling of the meshed geometry (easy)

- modelling of the physical properties

- modelling of complex SDM mechanisms:

  - material classification (physical properties of any pixel of a texture) through material images
  - multi-domains materials (materials defined by the association of elementary materials defined on one domain) through data tables

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OKTAL-SE first implementations and modelling of infrared and other sensor data
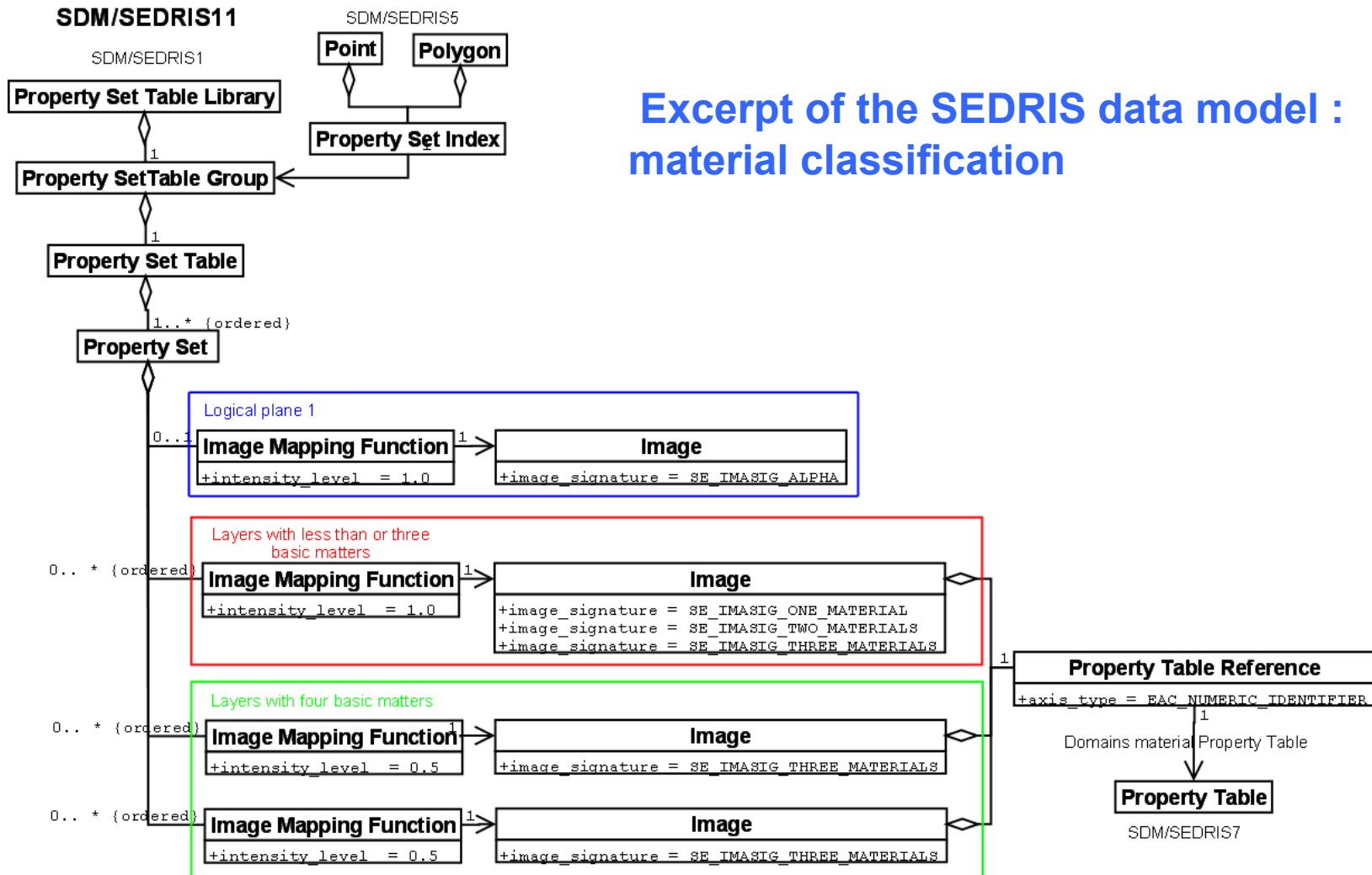
- ITCS

Excerpt of the SEDRIS data model : material classification

Synthetic Environment

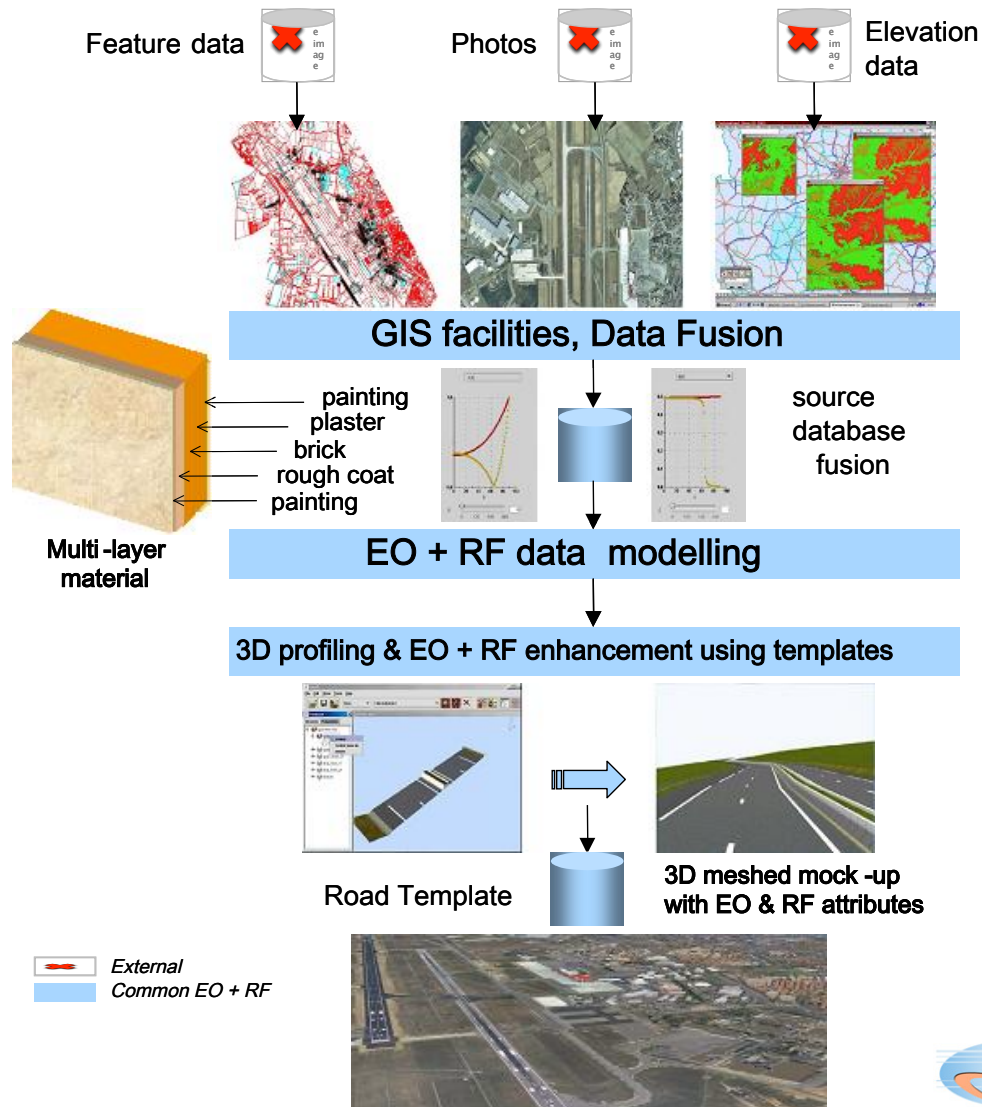# Current uses of SEDRIS in the SE-WORKBENCH

- ITCS
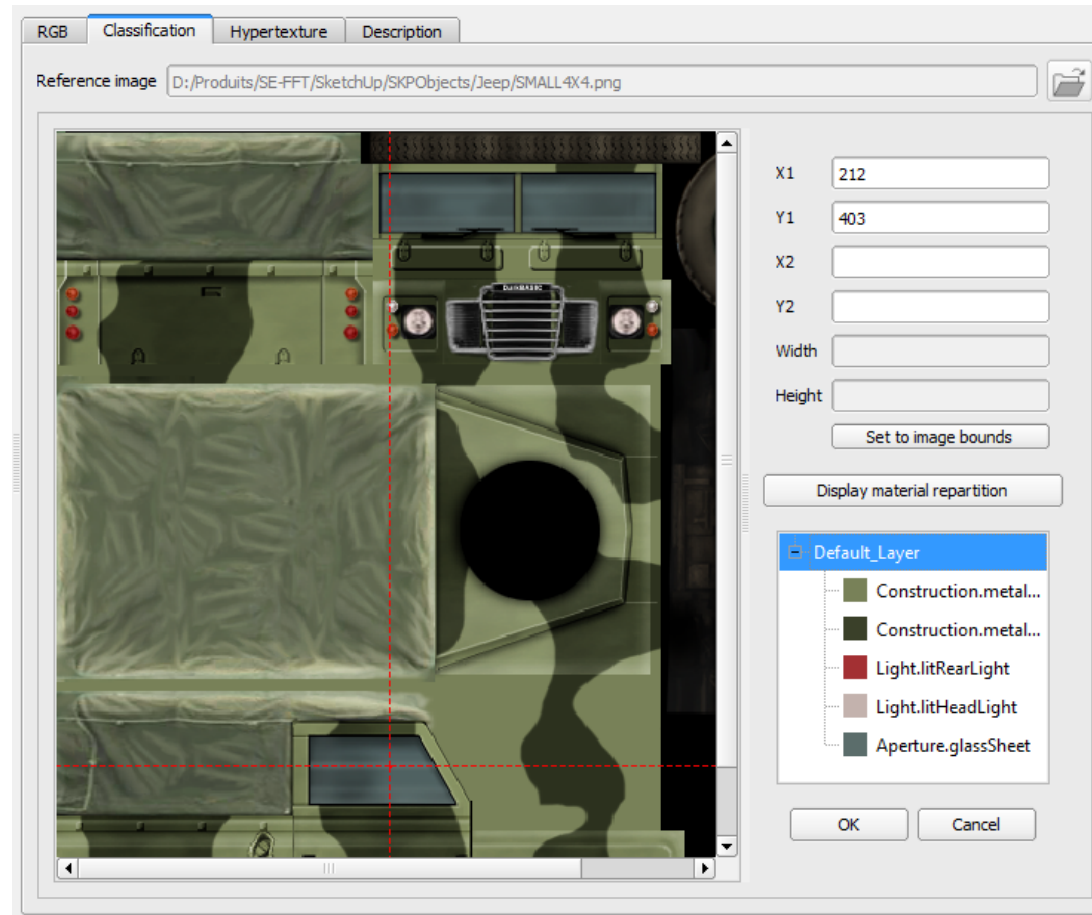
Example of classification with logical materials

Current uses of SEDRIS in the SE-WORKBENCH

SE-AGETIM

SE-AGETIM = Integrated software tools enabling rapid and realistic 3D synthetic environment generation for multi sensors simulation application (OTW, EO, RF)

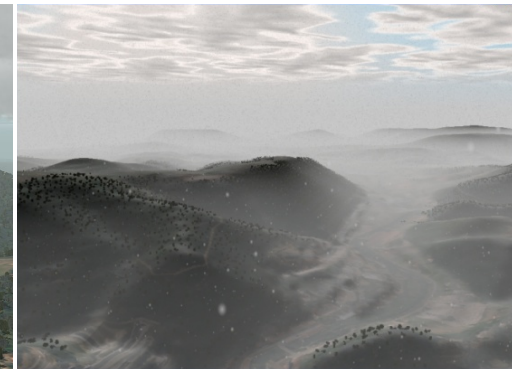# Current uses of SEDRIS in the SE-WORKBENCH

- **Current uses of SEDRIS in SE-WORKBENCH: SE-AGETIM**

SE-AGETIM uses **SEDRIS** for:

- Importing source data from DFAD and GeoTiff databases

- Importing planimetry and altimetry from SEDRIS databases

- Creating SEDRIS databases from altimetry grids

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Current uses of SEDRIS in the SE-WORKBENCH

- ## SE-FAST-IG

Current uses of SEDRIS in the SE-WORKBENCH

- **SE-FAST-IG**

SE-FAST-IG = OKTAL-SE real time image generator for rendering synthetic environments in the visible and EO domain

Used one specific SEDRIS component: **the SRM**.

Provides a robust and complete description of the spatial coordinates system as defined by SEDRIS: abstract coordinates system and spatial referential.

Also provides functionalities for spatial transformations (coordinates, directions and orientations conversions)

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Current uses of SEDRIS in the SE-WORKBENCH

- **SE-FAST-IG**

SE-FAST-IG use the communication standard CIGI (Common Image Generator Interface).

The CIGI piloting frames are geographic (latitude/longitude/altitude coordinates, local tangent orientations) while the database visualised use a local Cartesian frame

⇨ **The SRM API allows precise and efficient conversions**

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▪ PURPOSE of the SE-MAT-DB

Physical material is a key feature that heavily conditions the realism of a simulation

But the drawback of the current situation is that the classification quality depends on the user skill in term of material characterization

⇨ **SE-DB-MAT:** Provide a common set of data that are ready to use by the customers and give impressive results

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▪ PURPOSE of the SE-MAT-DB

Currently, using SE-PHYSICAL-EDITOR, the user has to know, for example for a road, that:
- it is made of asphalt
- the roughness is characterized by a given RMS height the layers are characterized by given thickness   …

⇨ In the future, the user should only have to recognise the feature, for example a highway feature, and SE-PHYSICAL-EDITOR should choose the appropriate material combination
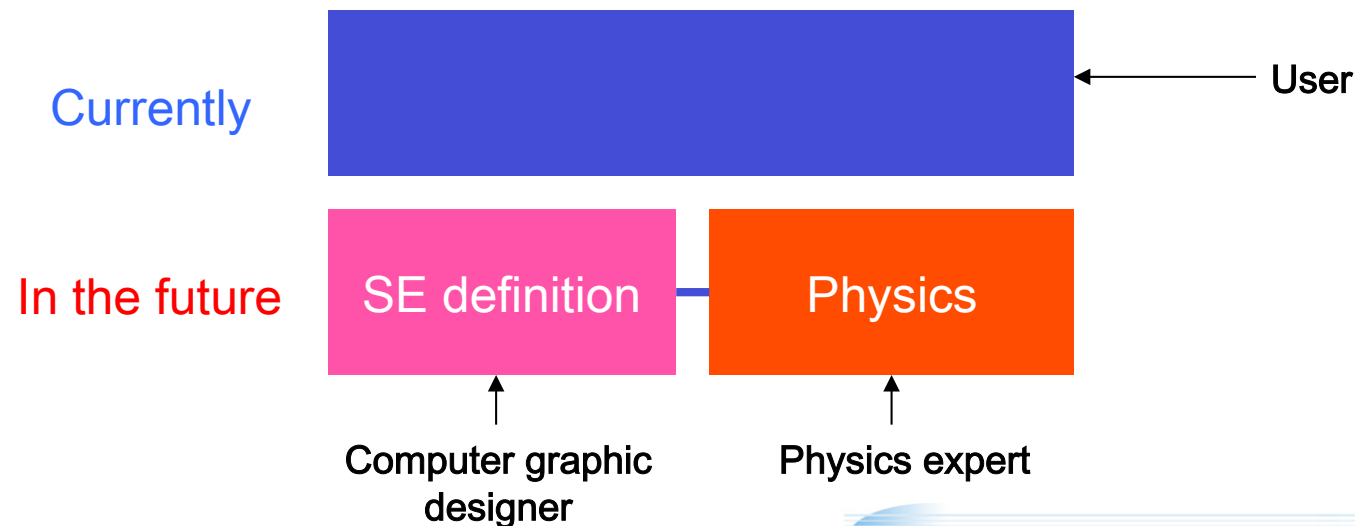
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▪ PURPOSE of the SE-MAT-DB

Another drawback of the current situation is that the validation of the material database is a complex task

It mixes Synthetic Environment problems (what is the internal structure of a material ?) and Physical problems (what is the BRDF of an intrinsic material ?)

⇨ A divide and conquer strategy:

Currently ⟵ User

In the future   SE definition — Physics

Computer graphic designer   Physics expert

OKTAL SE — Synthetic Environment

The SE-DB-MAT concept

- ## Method

Top-Down approach:

We begin with the needs and requirements in terms of Synthetic Environment creation

We deduce the material from Synthetic Environment to Physics, not the reverse way as currently i.e. from Physics to Synthetic Environment

⇨ Analyse of the source data and the modelling tools to define a chart of all the generic features we can find in a given Synthetic Environment and rely on standards like SEDRIS

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The SE-DB-MAT concept

- **Analyse**

  Several classifications to take into account: Nature:

  Road network
  - Highway
  - Main roads
  - Secondary roads
  - Residential road
  - Road
  - Path
  - Parking
  - Tolling
  - …

  Buildings
  - Industrial
  - Commercial
  - Sports
    - Stadium
    - Swimming pool
    - Tennis
    - Race course
  - Civilian
    - Post office
    - Bank
    - Embassy
    - City hall
    - Modern castle
    - Last centuries castle
    - Middle age castle
    - Farm
    - Ranch
    - Classical style building
    - …

  Vegetation
  - Natural
    - Wood
      Hardwood
      Persistent
    - Clutter
    - Not Cultivated Field
    - Grassy
    - Meadow
    - Swamp
    - Isolated tree
  - Man made
    - Wood
      Hardwood
      Persistent
    - Orchard
    - …

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- ## Analyse

   Geographical area: Asian vegetation ? European vegetation ? etc.

   Season: Summer ? Winter ?

   …

   ⇨ **The SEDRIS EDCS gives very good tools to create such classifications but we have several entry points**

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- ### Analyse

Ideal: In SE-AGETIM: It is in Europe, it is winter and:

Forest

Pasture

Wheat field

Industrial zone

Highway

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■ Analyse

But, in terms of modelling, those elements are different

Wheat field, pasture = **material**

Forest = **SE-AGETIM pattern** composed of trees (**3D models**)

Highway = **SE-AGETIM pattern** composed of a specific road **profile** applied to the road axis

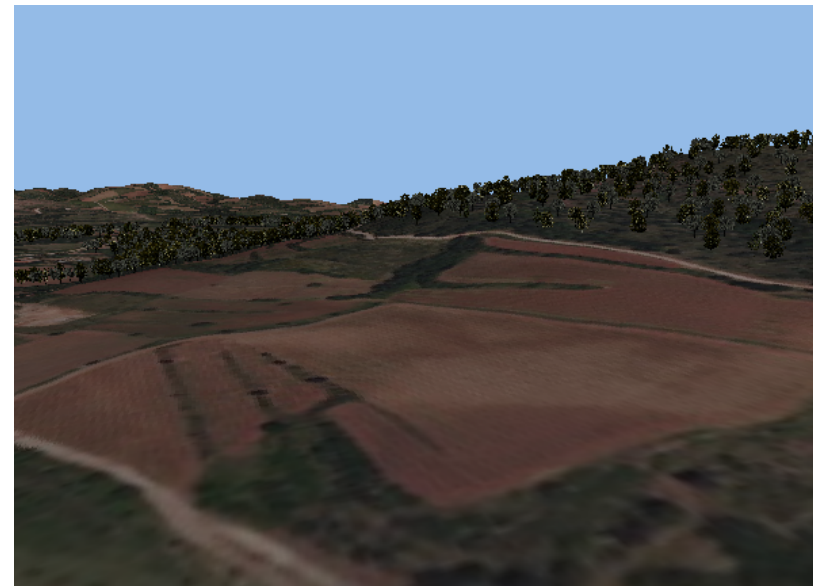Industrial zone = **SE-AGETIM pattern** composed of various **building templates**

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The SE-DB-MAT concept

■ Analyse

Field

Materials

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Synthetic Environment
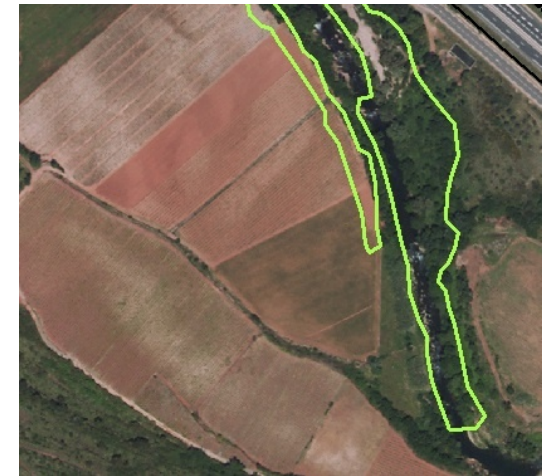
The SE-DB-MAT concept

- ## Analyse

Forest

Tree 3D model

SE-AGETIM forest patch

+

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Materials

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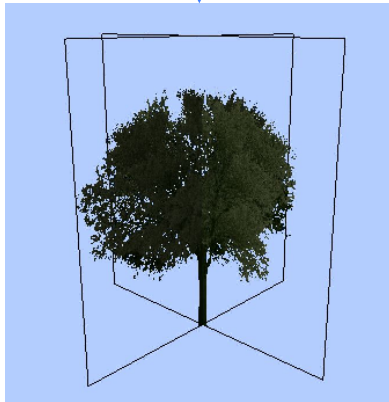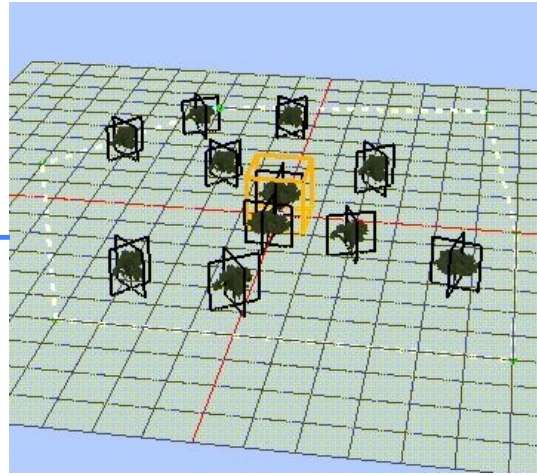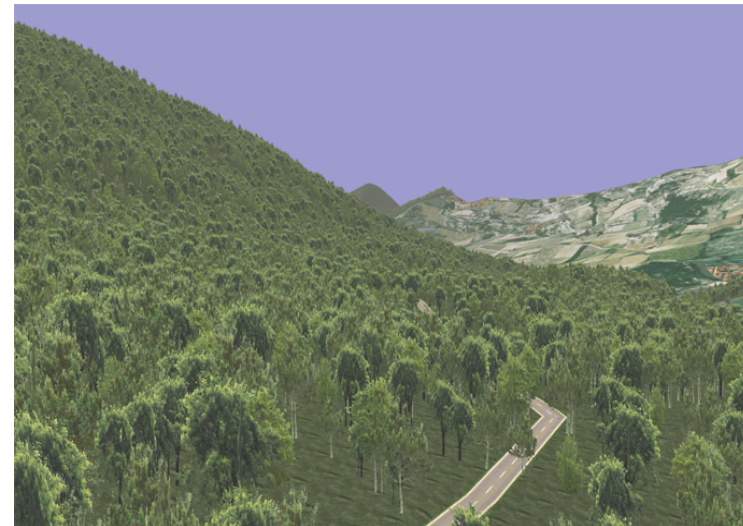
The SE-DB-MAT concept

- ## Analyse

Buildings
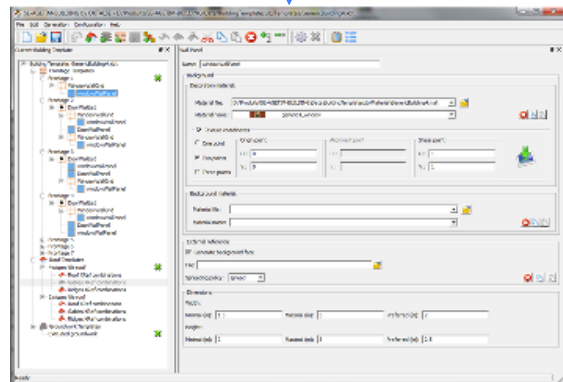
SE-AGETIM-BUILDING templates

SE-AGETIM pattern

+

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Materials

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The SE-DB-MAT concept

- **Analyse**

Road

SE-AGETIM pattern

+
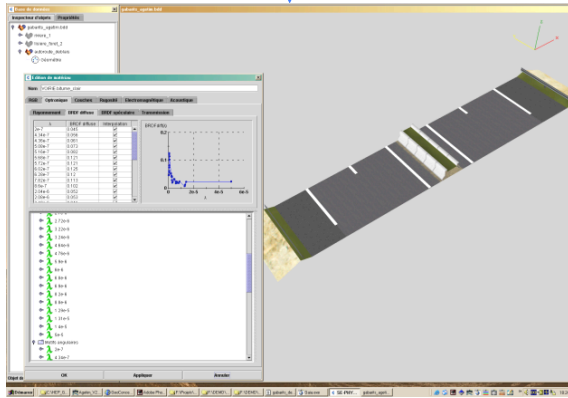
SE-AGETIM template

=

Materials
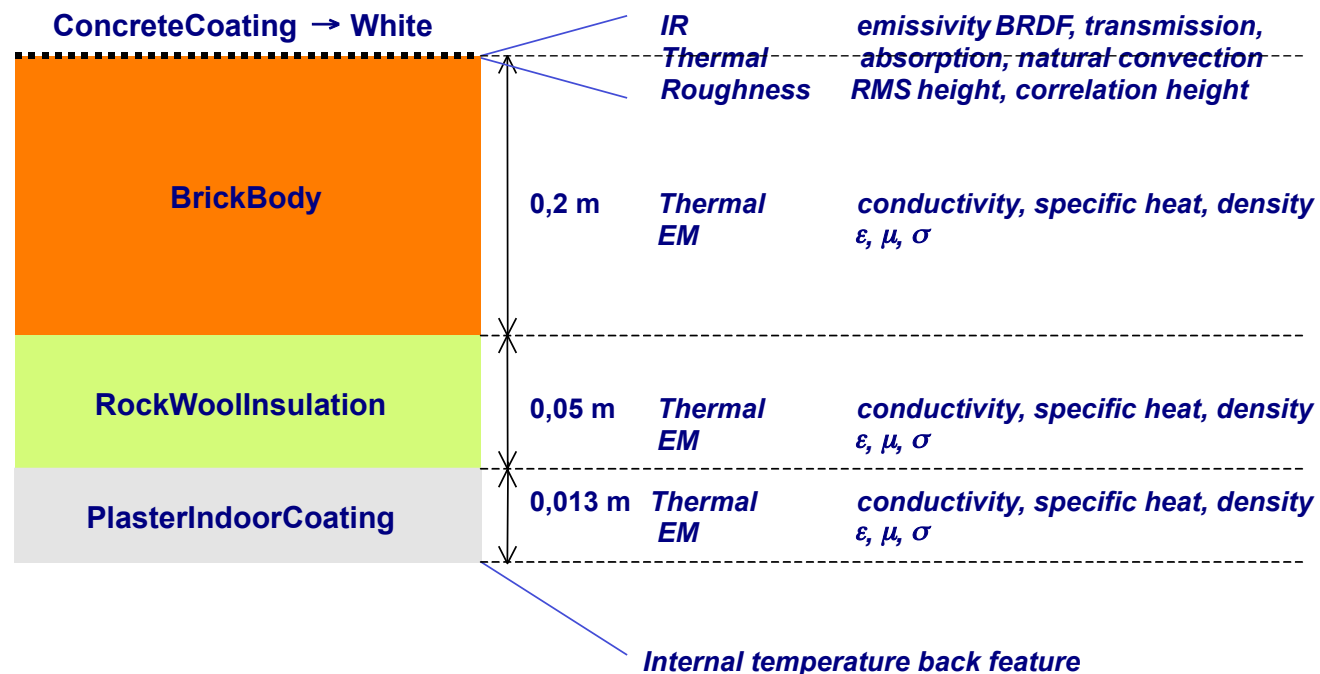

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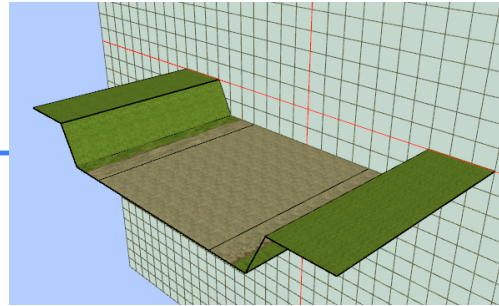
The SE-DB-MAT concept

- ## Analyse

Even if we try to keep it simple for our users, we need them to use materials.

But we have to simplify our materials: A user wants to choose a "classical white concrete wall" material… (s)he does not want to know that:

ConcreteCoating → White	**IR**	**emissivity BRDF, transmission, absorption, natural convection**
	Thermal	
	Roughness	**RMS height, correlation height**
BrickBody	0,2 m **Thermal**	**conductivity, specific heat, density**
	EM	**ε, μ, σ**
RockWoolInsulation	0,05 m **Thermal**	**conductivity, specific heat, density**
	EM	**ε, μ, σ**
PlasterIndoorCoating	0,013 m **Thermal**	**conductivity, specific heat, density**
	EM	**ε, μ, σ**

Internal temperature back feature

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▪ Analyse

So we see that wee need a EDCS classification, gathering elements of different kinds according to their use.

Roads: Classification code + Road profile pattern

Buildings: Classification code + Building template
or + 3D model

Vegetation: Classification code + Forest patch
or 3D model
or high level material

Physical materials

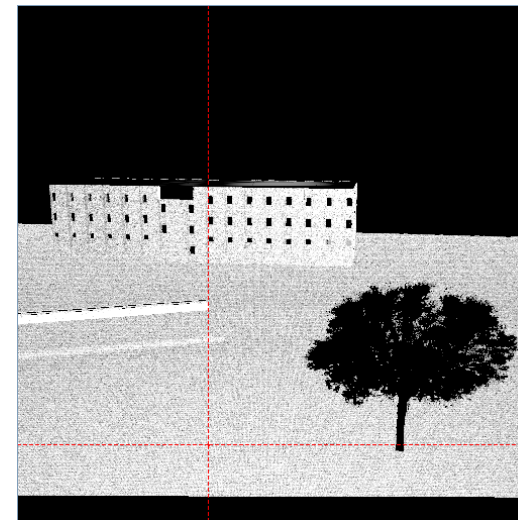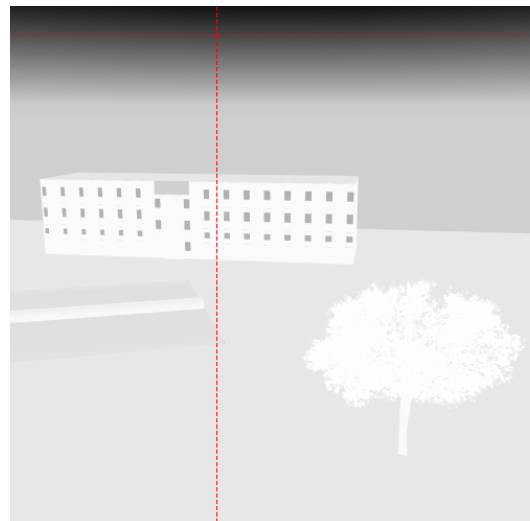OKTAL SE
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■ Analyse

All the elements share the same physical materials (after all, grass is grass, stone is stone, etc.)

The amount of material is very large (several thousands)

But actually the amount of intrinsic physical material is small

⇨ **Physical validation is easier** (only the physical materials to validate)

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- ## Conclusion

⇨ **Advantage of new approach**

Much more variety of materials and elements, correctly classified thanks to SEDRIS EDCS

Less intrinsic materials to be physically validated

Less risk for classifying: the computer artist chooses the elements that are consistent with the mock-up, the physicist validate the physics

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