

ISO/IEC JTC 1/SC 24/WG 8 "Environmental representation"

Convenorship: BSI

Convenor: Mamaghani Farid Mr

**OKTAL-SE presentation on Capabilities to Standardize**

Document type	Related content	Document date	Expected action
Meeting / Working documents for discussion	Meeting: VIRTUAL 19 Jul 2021	2022-01-25	INFO by 2021-07-19

Description

OKTAL-SE presentation on Important Capabilities to Standardize

ISO/IEC JTC 1/SC 24

WG 8: environmental representation

Examples of new SE features – important to standardize in the future

- Wang tiling for texture data
- Patches of procedurally generated geo-typical data

www.oktal-se.fr

Souvenir of SC 24 in 2018 in Vigoulet - France

New features and standardization



OKTAL-SE company history: 30 years of SE experience

1986 → 1989

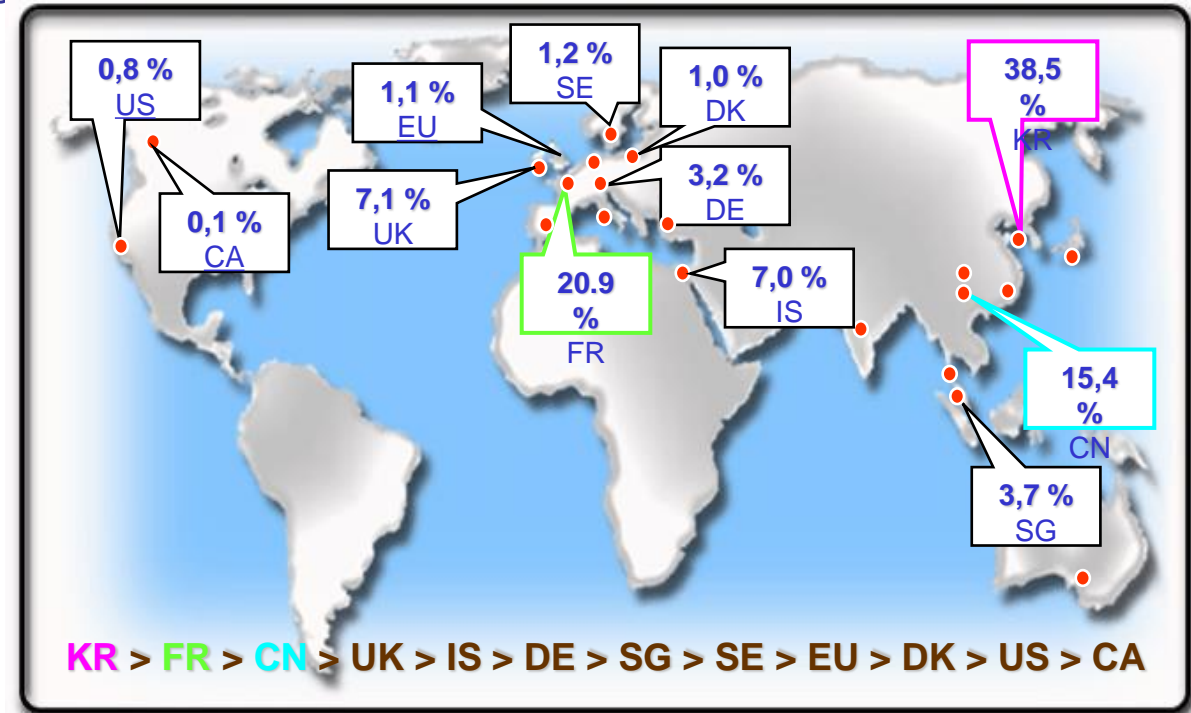
- ◆ *Thalès Training Simulation (Thomson) => Sogitec & => OKTAL*
- ◆ *Defense simulators*

1989 → 2001

- ◆ *OKTAL creation*
- ◆ *Defense, Aero, Railway, automotive simulators*

2001 → today

- ◆ *OKTAL Synthetic Environment creation*
- ◆ *Physical sensors M&S*

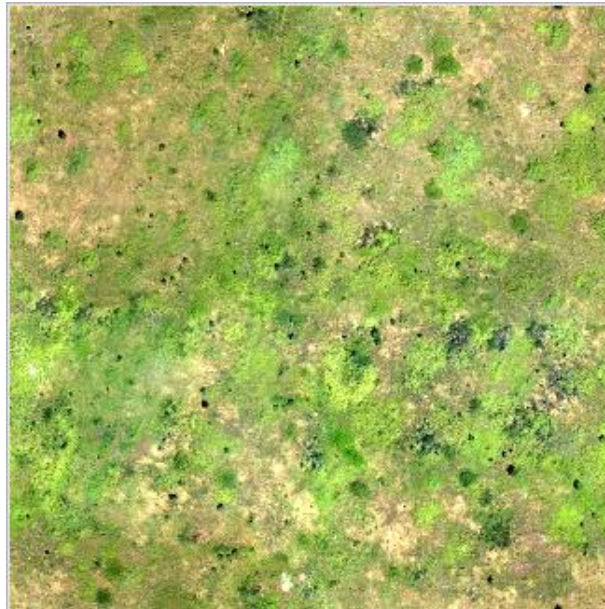


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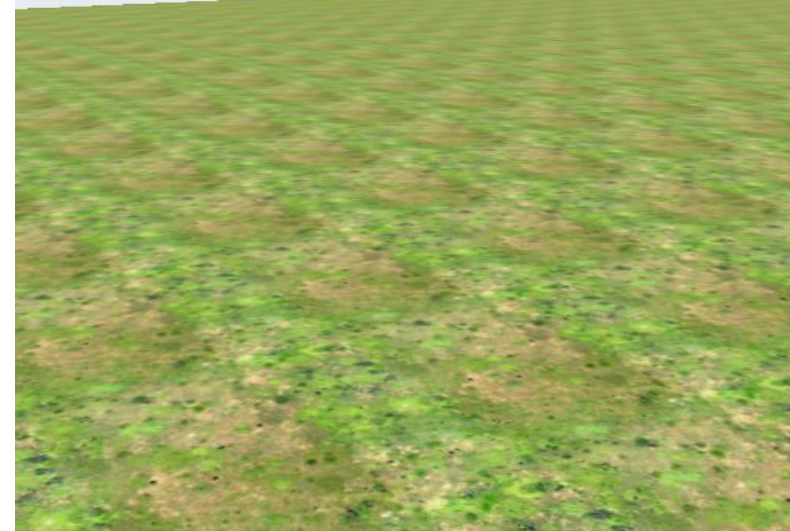
Wang tiling for texture data

Texture repetition

- Purpose: correct the “ravioli” effect
- Textures: classically used to add detail on a 3D scene
- 1st method: use of large textures
 - advantage: good quality in the image rendering
 - drawback: a big quantity of texture memory is needed
- 2nd method: use of small texture
 - advantage: small size of memory
 - drawback: the repetition of the texture appears => “ravioli” effect

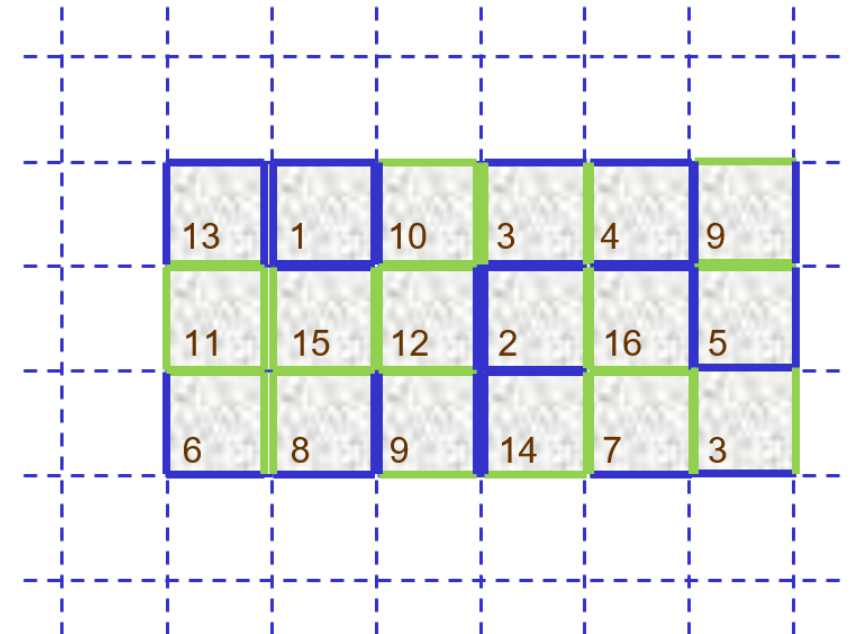
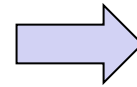


same texture mapped on a large polygon



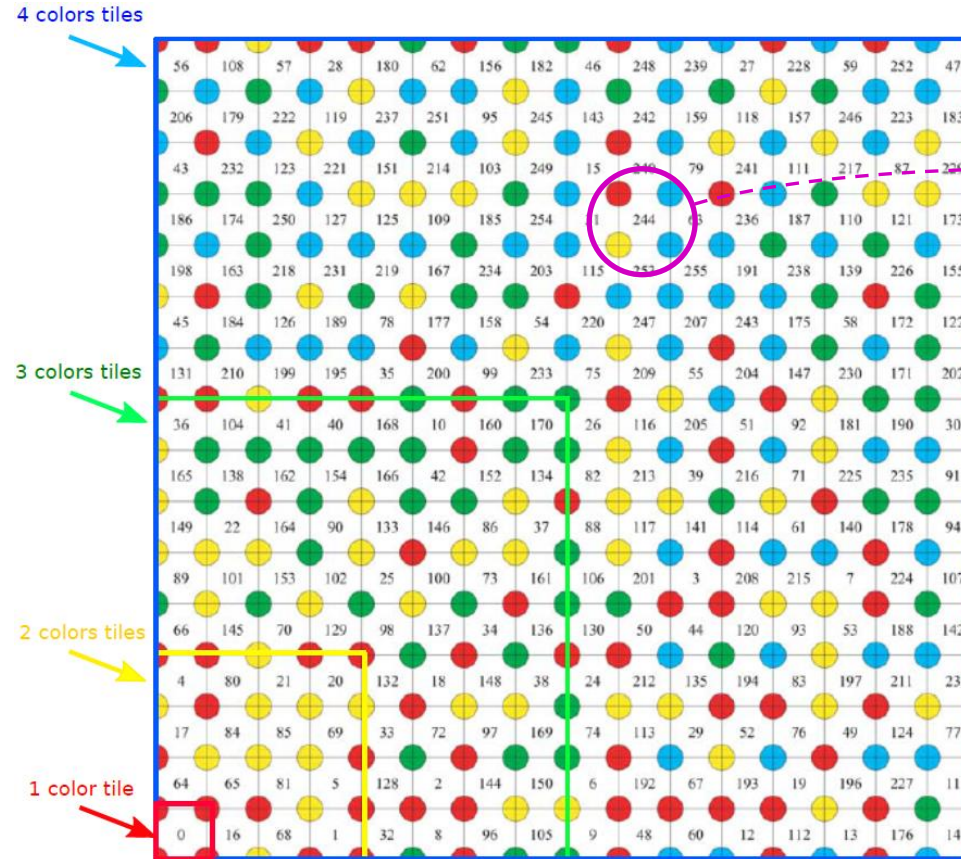
Wang Tiling example with 2 “colours”

- Wang tiling: mapping technique that enables a texture to be mapped on a large area without any repetition of a pattern
- Basic principle of the Wang tiling method: same as "dominos" game.
 - 1) Set of elementary square tiles matching to some others by a common side.
 - 2) Each time you have to place a tile, you have the choice to place on any free side one of the matching tiles you have



Wang tiling up to 4 "colours"

- Wang tiling technique used in SE-WORKBENCH is based on corresponding "corners" rather than corresponding "sides" with 2, 3 or 4 "colors" for the corners



The corner tile problem:

Permutation of 256
 =>
 256!
 =>
 10⁵⁰⁷ combinations
 =>
 cloud pre computation

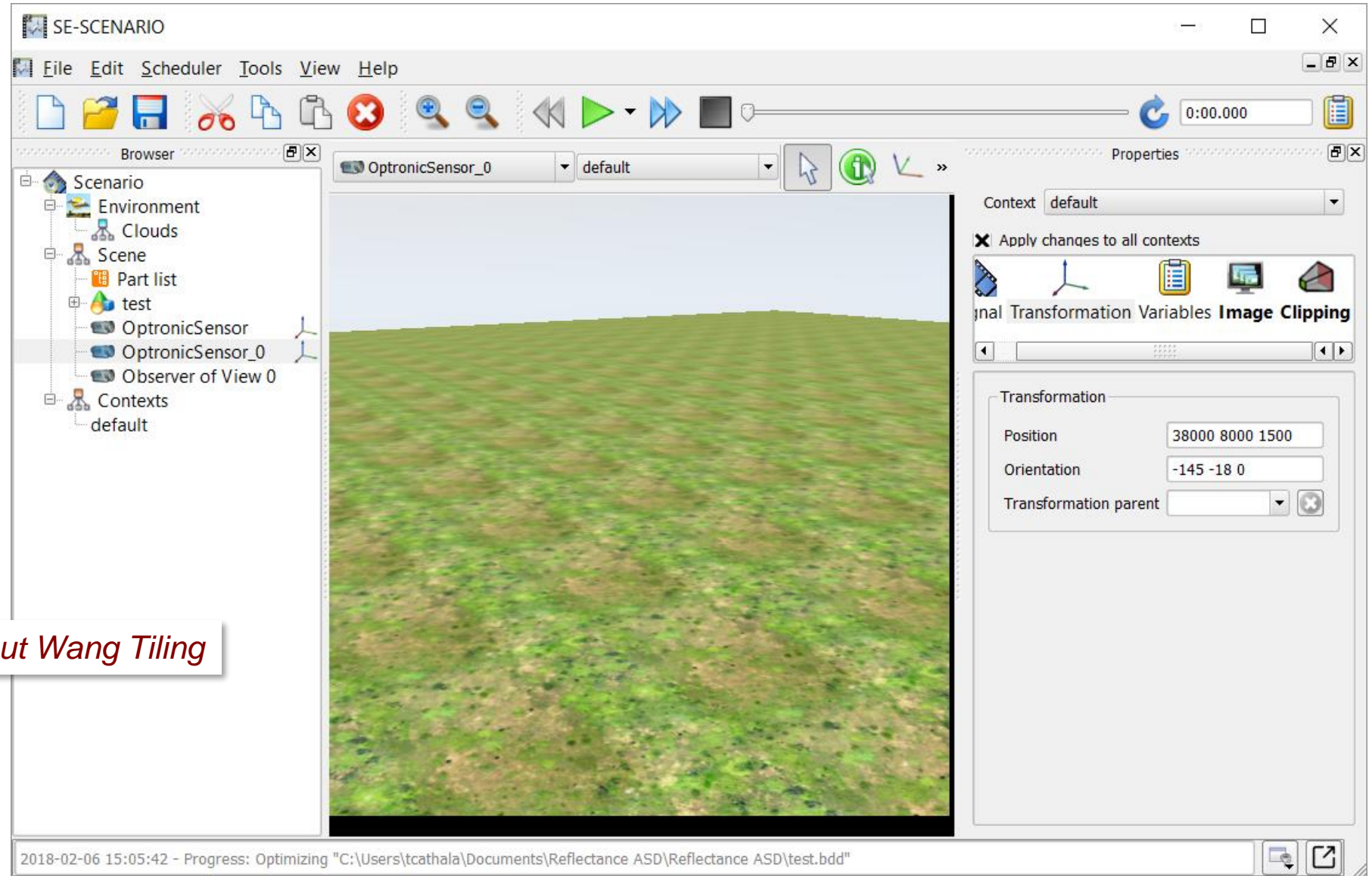
2 "colors" Wang tiling:
 => 16 different tiles

3 "colors" Wang tiling:
 => 81 different tiles

4 "colors" Wang tiling:
 => 256 different tiles

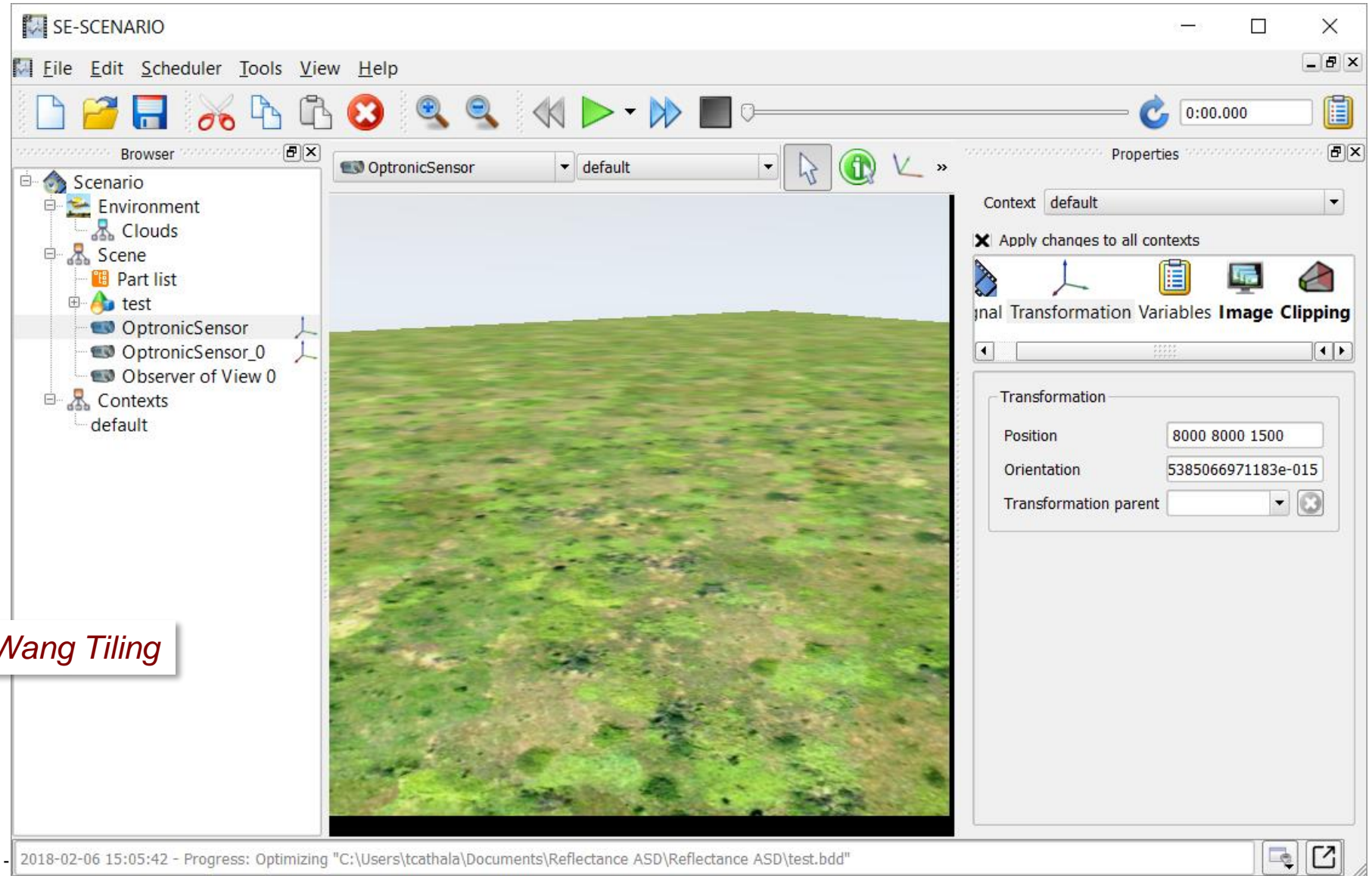
Without Wang Tiling

- Wang Tiling 4 colours method implemented in SE-Workbench-EO



With Wang Tiling

- Wang Tiling 4 colours method implemented in SE-Workbench-EO



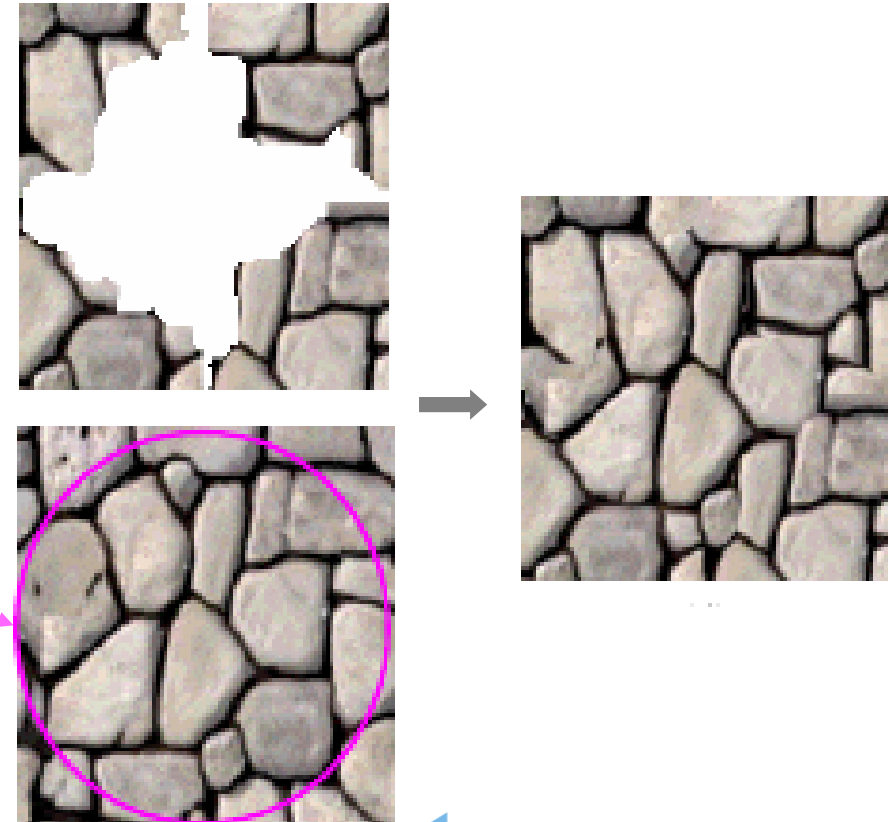
Wang Tiling texture and interoperability

Short term approach:

- ➔ Storing all the Wang Tiles (256 tiles)
- ➔ Storing the arrangement of these 256 tiles

Long term approach:

- ➔ Store the alpha tile
- ➔ Store sets of intermediate tiles
- ➔ Store the “filter”

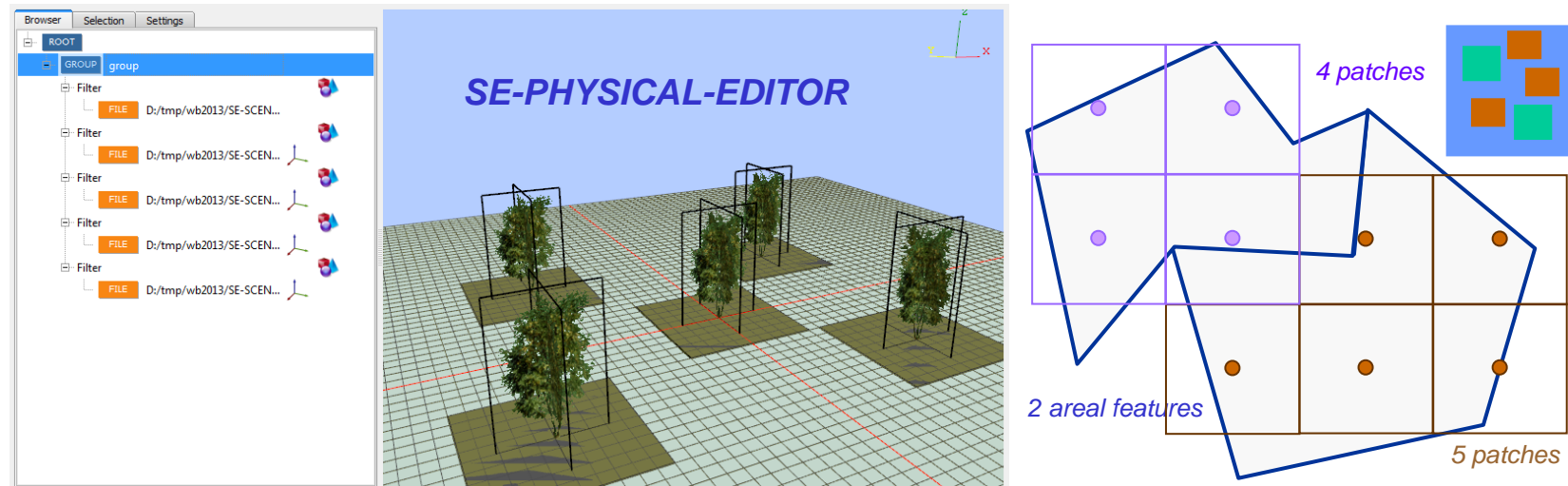


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Patches of procedurally generated geo-typical data

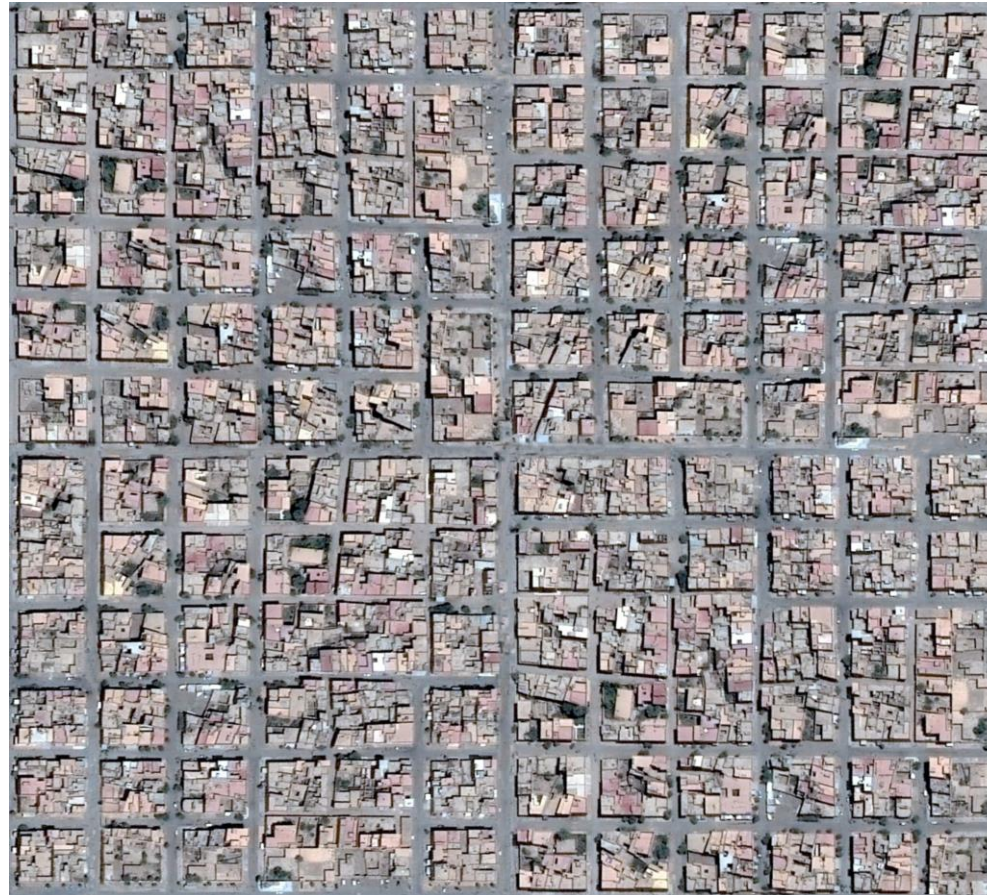
Using PATCHES: general method

- Patches are used by OKTAL-SE in SE-AGETIM for populating areal features
- Patches are entities that are applied on terrain surfaces, each element of the patch being used as a “3D stamp”
- Patches can be:
 - tree instances for creating a forest
 - buildings to create a generic town
 - cars to populate a parking lot etc...
- A filter is associated to each instance in order:
 - to avoid patches associated to 2 areal feature to interpenetrate
 - to avoid patches to interpenetrate within the same areal feature (for example we can create a tree patch and a bush patch)



Using PATCHES: operational example

- In addition to the specific individual buildings, several SE-AGETIM-BUILDING templates were specially created, representing houses of this desert geographic area
- Using these building templates, individual objects, vegetation samples and a satellite image, a generic town area has been created



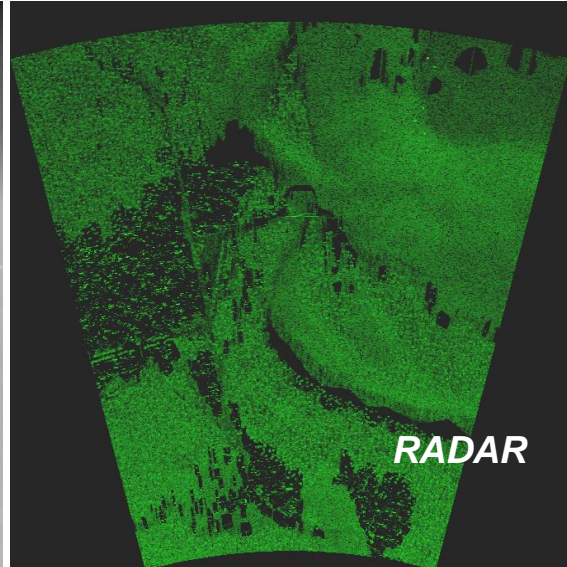
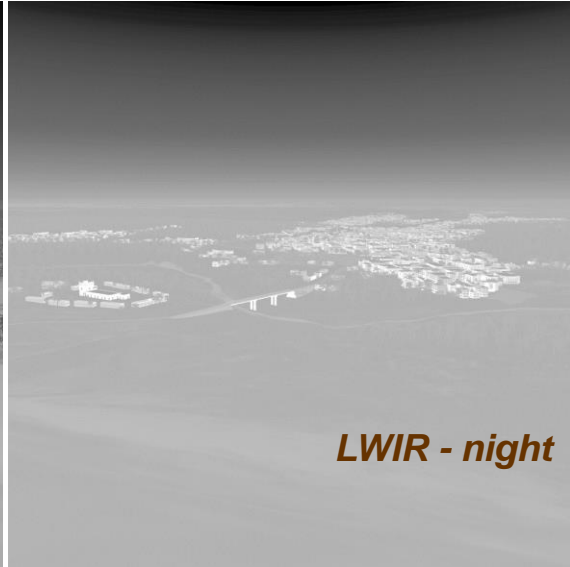
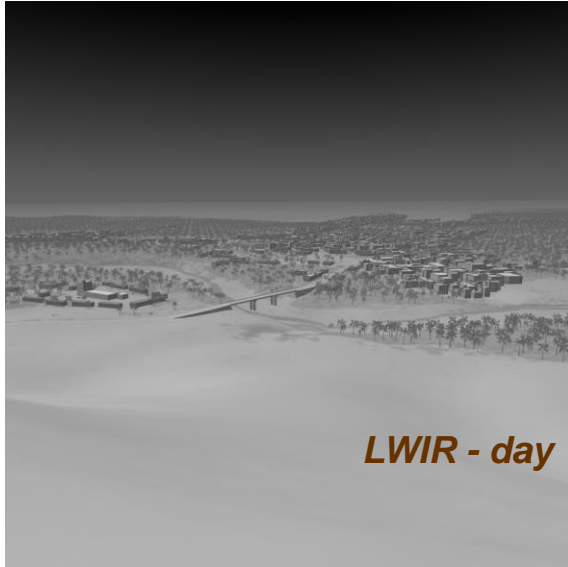
Using PATCHES: operational example

This generic area has been duplicated on the whole database urban areas, providing rich and regular urban zones:



Using PATCHES: advantage

- No geometrical error in the whole scene provided the patch has been checked
- No radiometric error in the whole scene provided the patch classification is OK



- The only risk is repetition
- Solution = Wang Tiling generalization to 3D

Wang Tiling 3D

- The Wang-Tiling method enables to perform a quasi-infinite variety of physical materials
- Very useful for large 3D scenes with many details
- WT Increases the **entropy** of the synthetic images

A variant is Wang Tiling 3D. The idea is to combine 2D WT and introduction of features such as punctual, surfaces and instances of 3D objects.

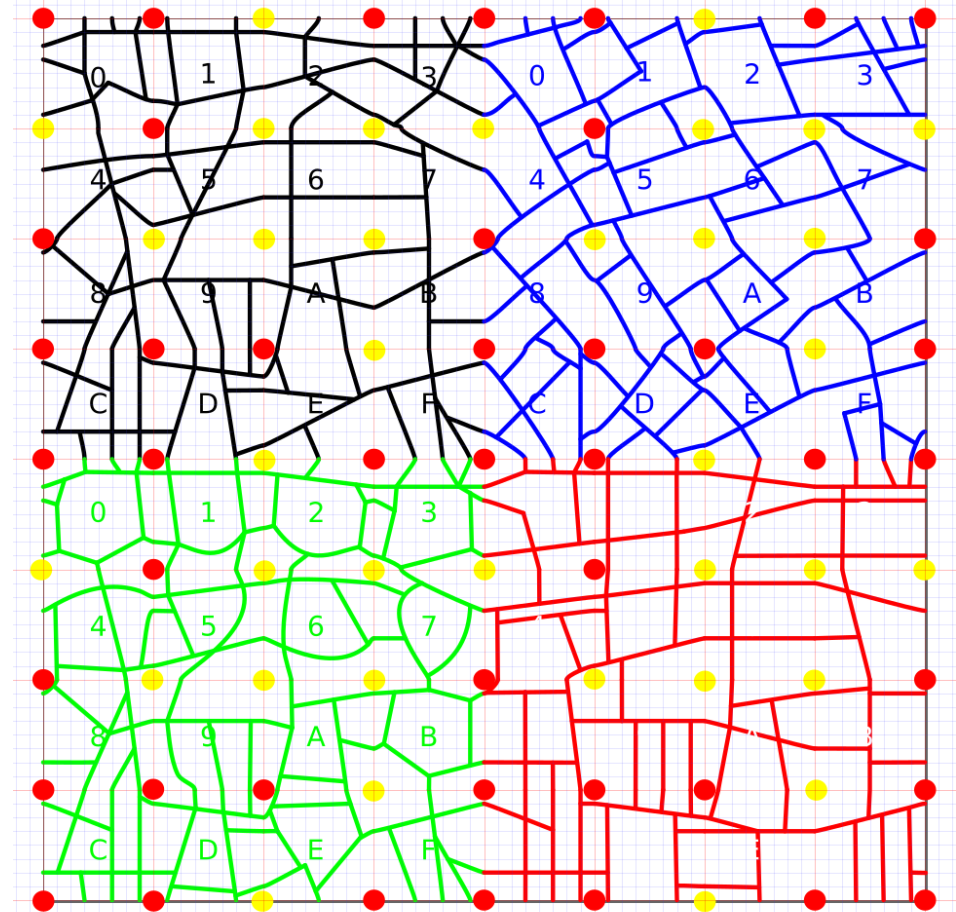
The first step is to tile using Wang approach a fictitious planimetry

Let us take the example of a city:



The city map is made of 4 sub-maps

Each sub-map is a simple 2 “colours” WT that defines roads



Wang Tiling 3D

*We add to each tile a background texture
That is also a WT texture*

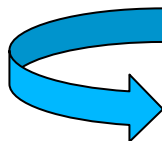


Then we can enrich the planimetry with many details:

- *Parking areas*
- *Marks on the road*
- *Grass*
- *...*

Then we can instancy many 3D details:

- *Buildings*
- *Streetlights*
- *Pylons*
- *Bus stop*
- *...*



Wang Tiling 3D: Korean style

New features and standardization



Wang Tiling 3D: French style

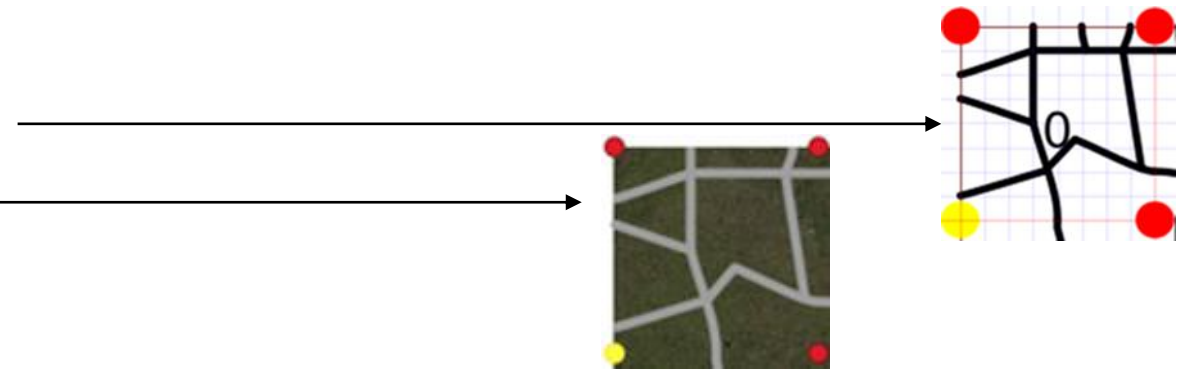
New features and standardization



Wang Tiling texture and interoperability

Short term approach:

- ➔ Storing the WT map of planimetry
- ➔ Storing WT background texture
- ➔ Storing the WT combination
- ➔ Storing the planimetry enrichment
- ➔ Storing the 3D instances



Long term approach:

- + ➔ Store the templates (rules) for 3D automatic extrusion



CONCLUSION

OKTAL-SE has a strong experience in the field of new SE data structures.

As shown in this presentation on a specific example based on WT approach we observe that SEDRIS/RIEDP is not really compliant but not so far.

Many other new features should be discussed this way such as:

- Dynamic sea modelling
- Advanced animations
- Clouds modelling and voxels
- Material roughness
- Advanced lighting
- Advanced sensors (EO + RF) (passive + active)
- ...

My feeling is that for all that cases SEDRIS/RIEDP is not really compliant but not so far.

But one big issue remains the **dynamic procedural modelling** of the SEs at rendering level both for terrain and objects and both for geometry and materials. That is a big challenge.

More and more IGs meet this approach (to spare disk space typically) and propose solutions SE-GLOBE-VIEWER, VBS BLUE, Unreal4 ...

My feeling is that nor SEDRIS/RIEDP nor CDB are compliant to this approach. But it is a good opportunity for interoperability and normalization.

A new building/conference room available in Vigoulet

New features and standardization



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