Permeability Block Modeling

1. Introduction

Building a rock model made of blocks (a so-called block model), each block being assigned the value of a property (porosity, permeability, etc), is a way to have a description of the rock that can help sub-plugging, or directly be used as an input for third party solvers.

A dedicated module might be integrated in a future PerGeos release. In the meantime, we present here a workflow responsible of splitting the data into blocks and assigning the permeability of each block as the value for the whole block.

The beginning of the workflow (consisting in splitting the volume into blocks) is similar to the porosity block modeling one.

As the permeability can't be obtained via the Label analysis module, getting the permeability value for each block will be done via a small TCL script invoking a recipe.

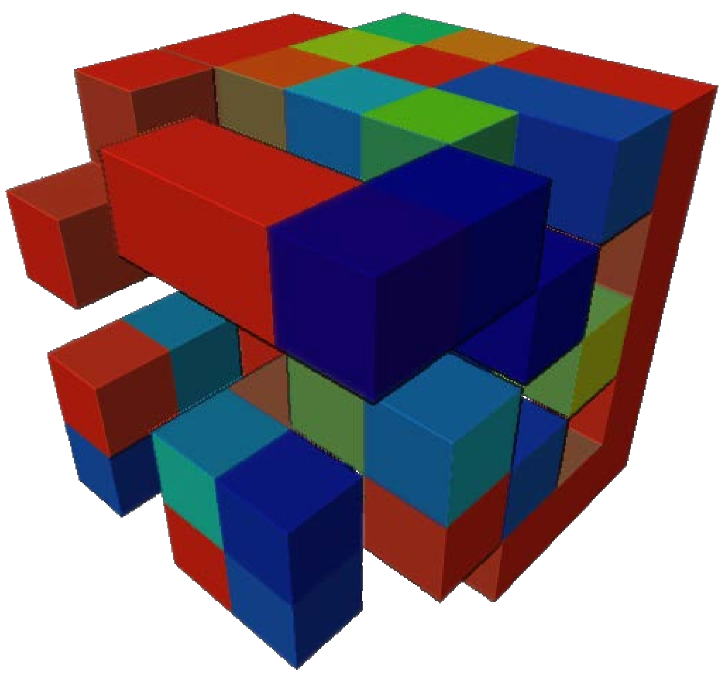


Figure 1 3D Block Model of the permeability

2. Building the recipe to split the volume into blocks

The process is similar to the one described in the Porosity block modeling tutorial available here:

https://fei.netexplorer.pro/dl/hJyH69O3Yi

1. Start with a binary volume of the pore space
   We will use the Berea sub-plug pore space from the tutorials directory.

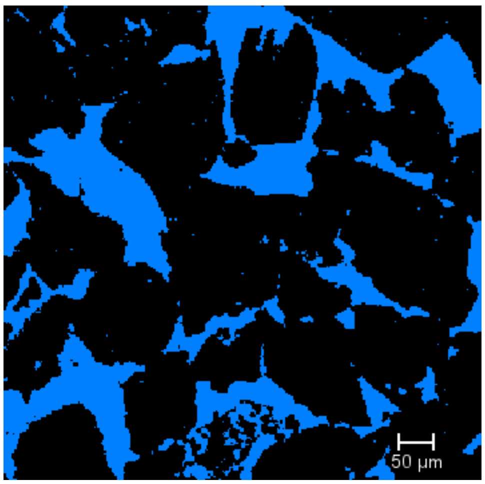
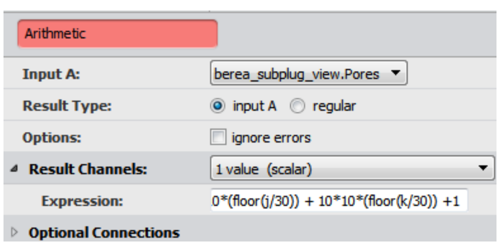
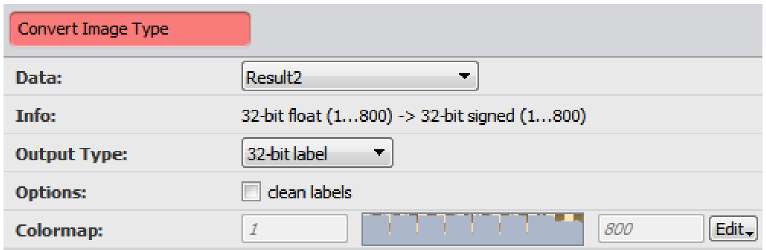


Figure 2 binary pore space

2. Split the volume into blocks with **Arithmetic**. We will use a block size of 30 voxels.
   The resolution of the Berea sub-plug is 273x271x222.
   There will be 273/30 = 10 blocks in X, 271/30 = 10 blocks in Y, and 222 / 30 = 8 blocks in Z.
   The regions are computed using the formula:
   (floor(i/30)) + 10*(floor(j/ 30)) + 10 * 10 *(floor(k/ 30)) +1



3. Convert it to a 32 bits label data with **Convert Image Type**



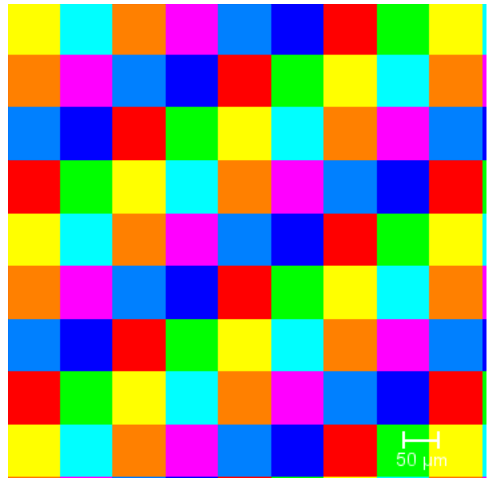
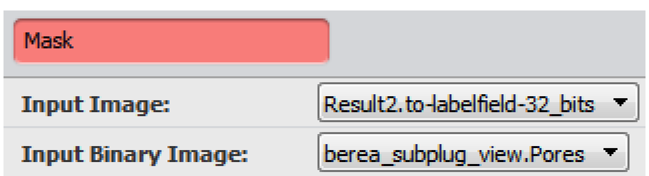


Figure 3 labelized blocks

4. Mask it with the pore space with **Mask**



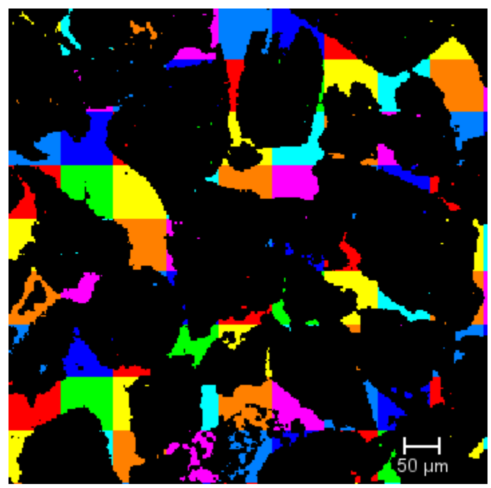


Figure 4 Masked Pore Space

The recipe can now be saved and applied to other data.

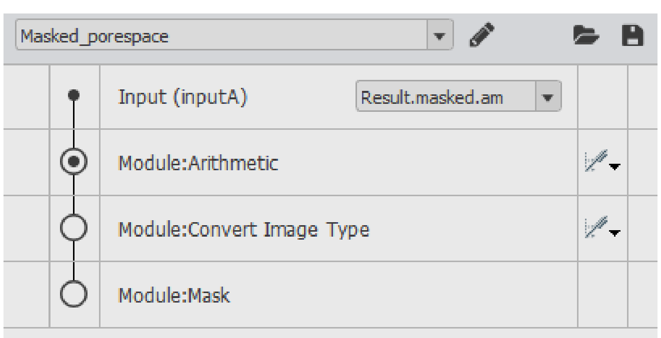


Figure 5 Masked pore space recipe

3. Compute the permeability per block

This step will involve:

- A TCL script responsible of applying a recipe to every block defined by the previous step

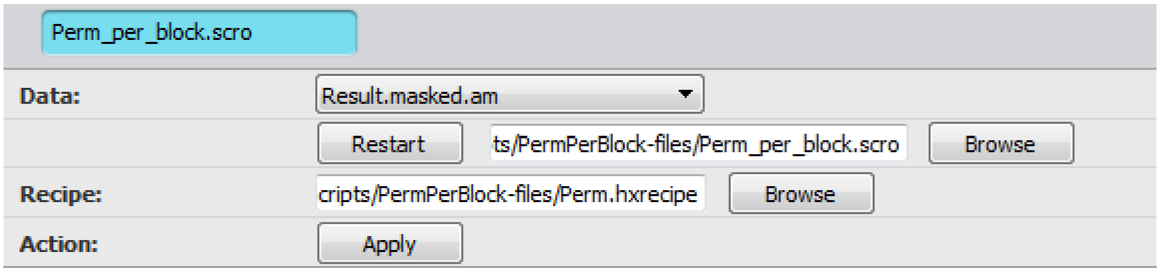


Figure 6 TCL script

The script is available here:
https://fei.netexplorer.pro/dl/_YWhLwG1ya

- A recipe containing the permeability simulation, so that it can be changed independently of the script

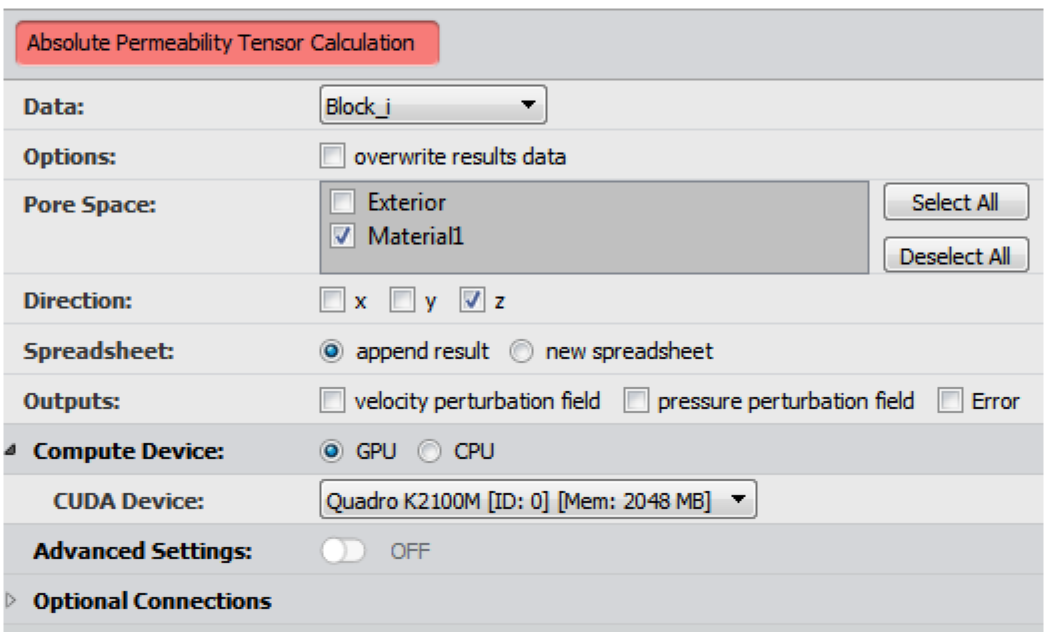


Figure 7 Permeability simulation module

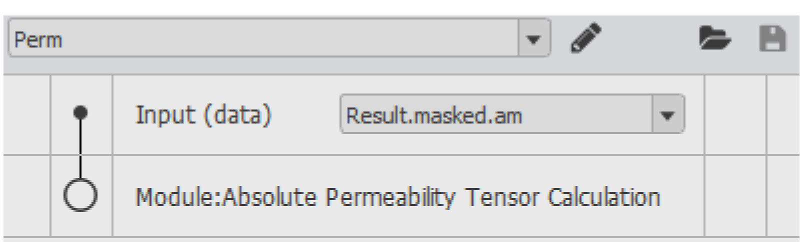


Figure 8 Permeability recipe

The permeability recipe is available here:

https://fei.netexplorer.pro/dl/93CfiDlQfq

When the script finishes, a data named *Result* will store the permeability per block.

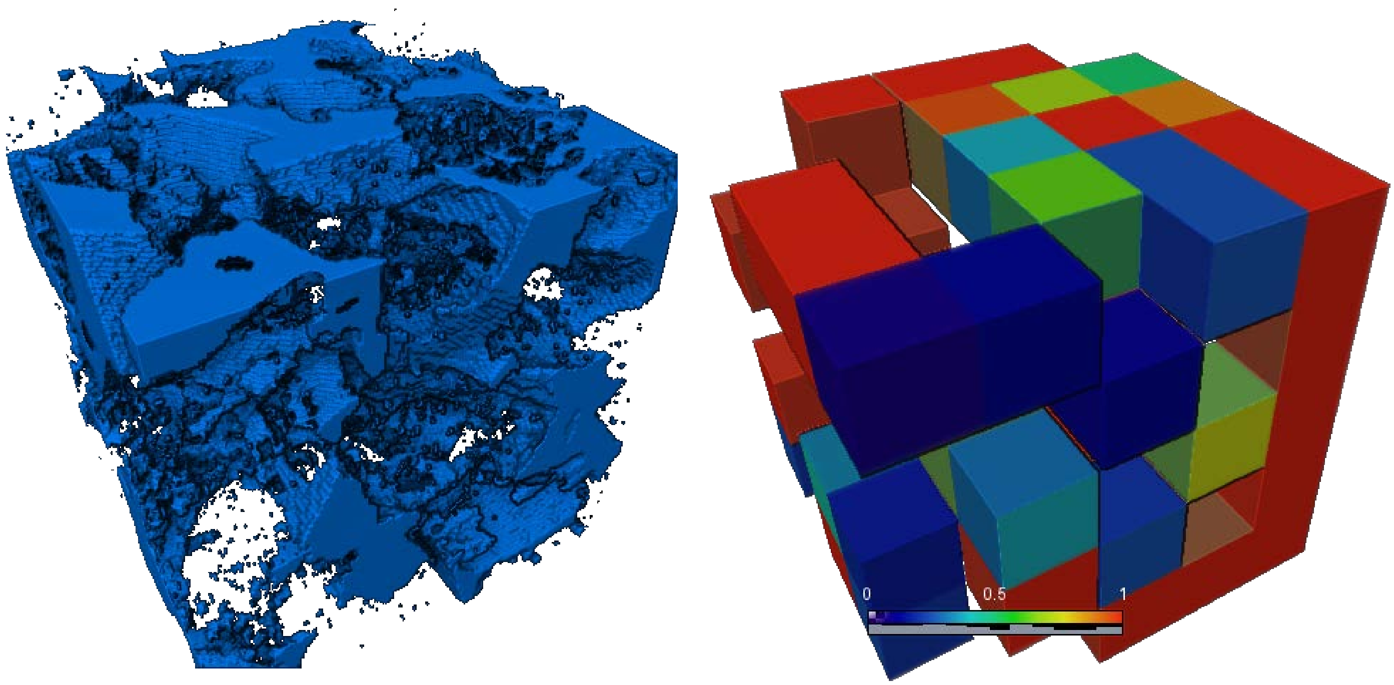


Figure 9 Pore Space and associated permeability per block