BASEMENT

Topology and generation of a computational grid

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Outline

1. New topology
2. Generation of a computational mesh for BASEMENT version 3.0

Topology: example of a trapezoidal channel

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- Geometry

Table 1: Geometry of the trapezoidal channel

Length	500 [m]
Bed width	20 [m]
Bank height	4 [m]
Bank crest width	2 [m]
Bank slop	⅓ [-]
Bed slope	0.2 [%]

- Quality mesh

Table 2: Features of the quality mesh

Number of cells	8’871 [-]
Number of vertices	4’594 [-]
Min. triangle angle	28 [°]
Bed max. area	10 [m^2]
Bank max. area	15 [m^2]

Topology: computational mesh

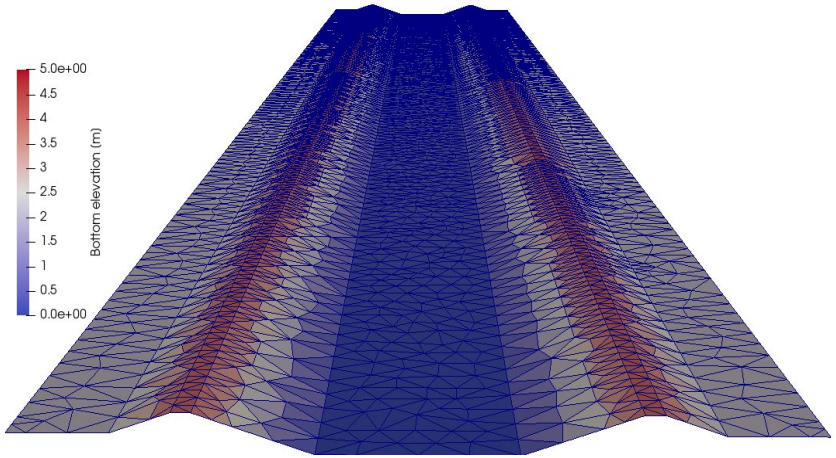


Figure 1: 3D view of the trapezoidal channel BASEMENT version 2.8

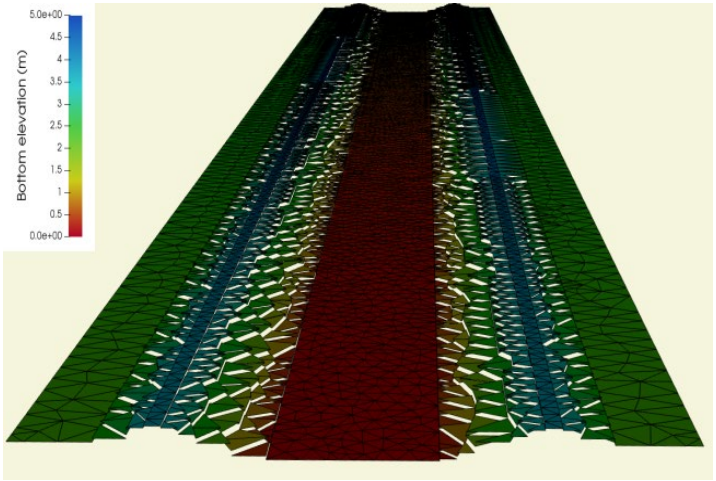
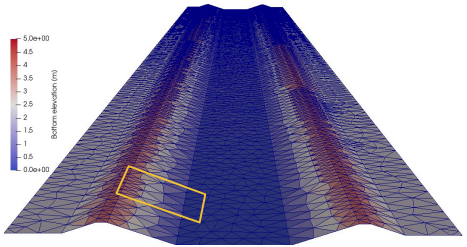


Figure 2: 3D view of the trapezoidal channel BASEMENT version 3.0

Topology: elevation interpolation



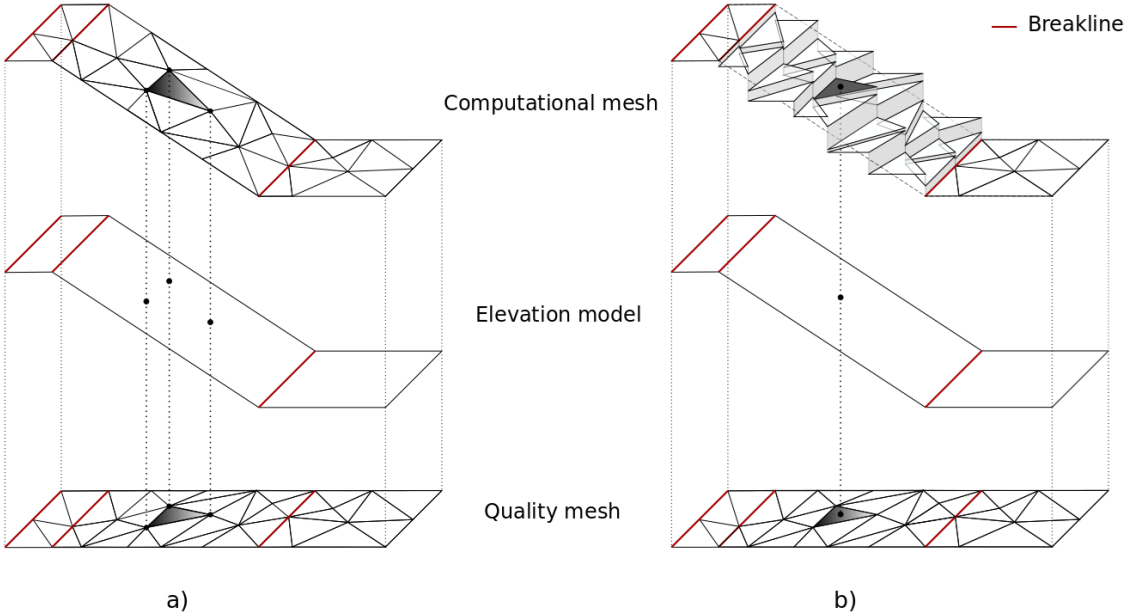
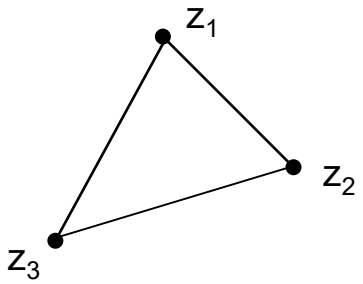


Figure 3: Schematic sketch of the elevation interpolation methods a) BASEMENT version 2.x b) BASEMENT version 3.x

Elevation interpolation methods

- Using computational mesh of v2.8 with v3.0
- Interpolation
  - Mean
  - Median
  - Minimum
  - Maximum
  - Weighted



Elevation interpolation methods

- Trapezoidal channel

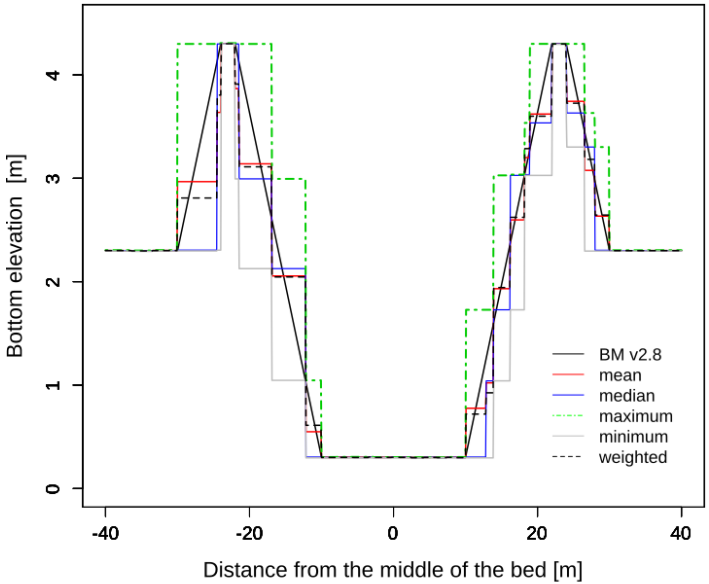


Figure 4 : Cross section of trapezoidal channel at x = 150 m from downstream

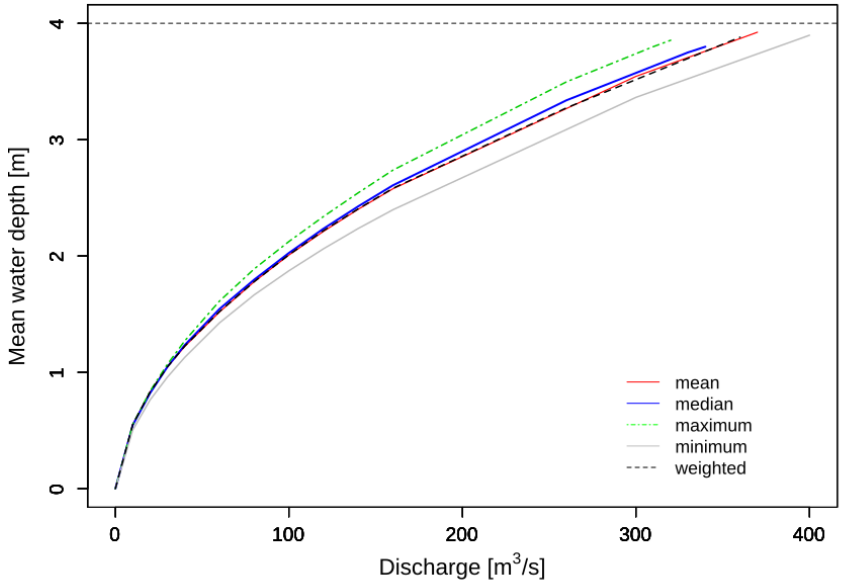


Figure 5 : Stage-discharge relationship of the trapezoidal channel at the cross section x = 150 m from downstream

Elevation interpolation methods

- Trapezoidal channel

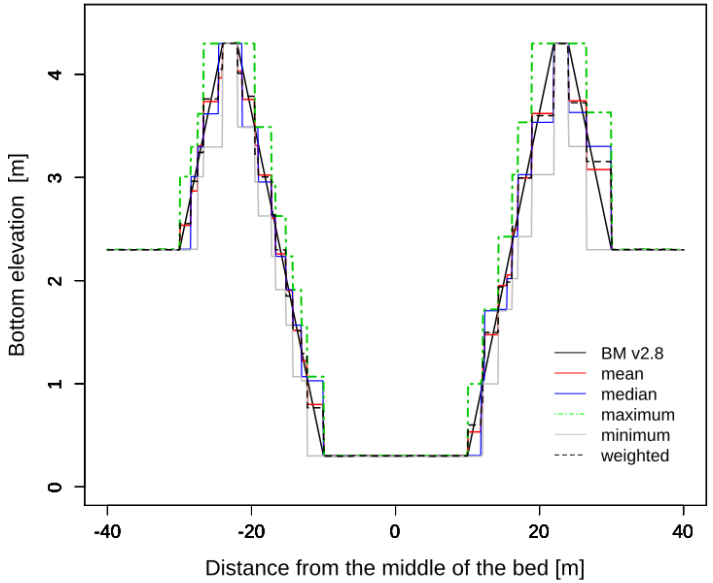


Figure 6 : Cross section of trapezoidal channel at x = 150 m for a finer mesh resolution

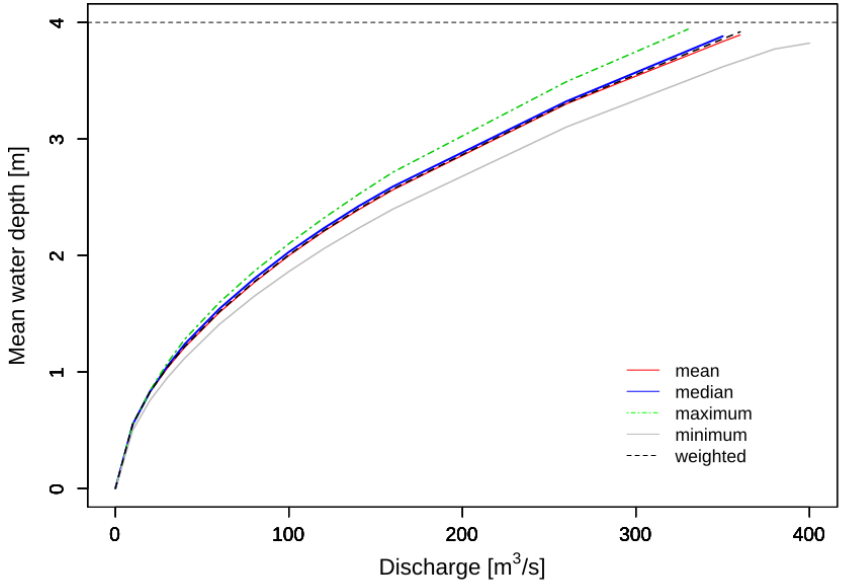


Figure 7 : Stage-discharge relationship of the trapezoidal channel at the cross section x = 150 m for a finer mesh resolution

Elevation interpolation methods

- Trapezoidal channel

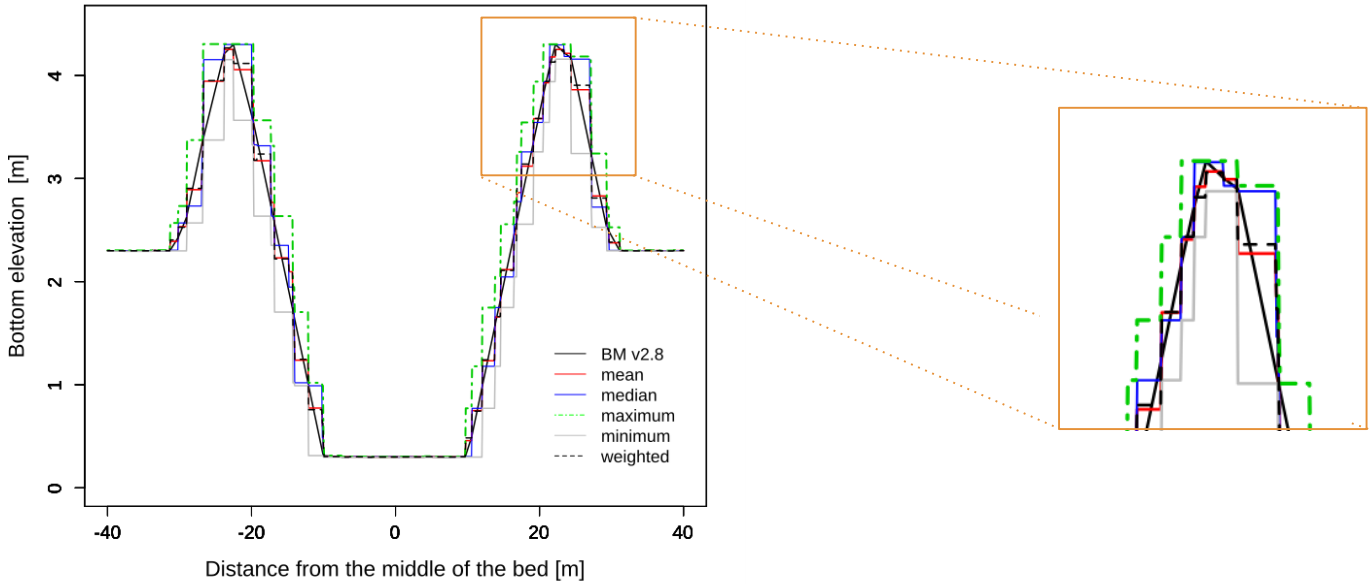


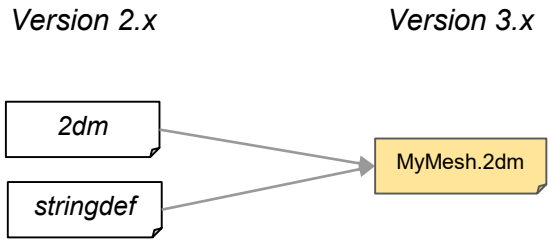
Figure 8 : Cross section of trapezoidal channel at x = 150 m with only one breakline defined at the bank crest

Topology: summary

vs

Table 3: Summary of features for the computational mesh in BASEMENT

Version 2.8	Version 3.0
Triangular and quadrilateral cells	Triangular cells
Dual mesh (cell vertex and cell centered)	Cell centered mesh
Variable bottom elevation over the cell	Constant bottom elevation over the cell
Computational mesh in 2dm format with material indices and stringdefs **defined separately** in *.bmc file	Computational mesh in 2dm format **including** material indices and stringdefs
Domain differentiation with elment_ids	Domain differentiation with regiondef



Topologie: conclusions

- New Topology
- Breaklines are considered differently
- Use of interpolated grid for v3.0 possible, but no common rule

➢ Create new model for v3.0 from scratch (grid generation and calibration)

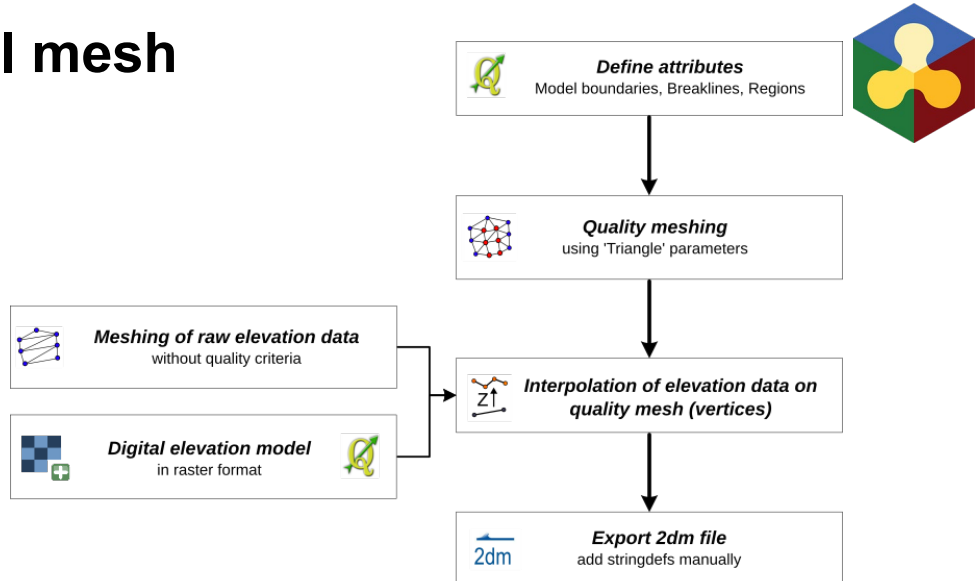
Generation of a computational mesh for BASEMENT v3.x

- **QGIS** version 2.18 (not yet 3.x)
- **BASEmesh** plugin: new version 1.44 (release with BASEMENT v3.0)
- Two procedures:
  - A Common procedure for **small** meshes (< 50’000 - 100’000)
  - B New procedure for **large** meshes

Generation of a computational mesh

A Small meshes

1. Same procedure to generate .2dm file (BASEmesh)
2. Modify the .2dm



Generation of a computational mesh

A Small meshes

1. Same procedure to generate .2dm file (BASEmesh)
2. Modify the .2dm

2dm

```
MESH2D   #created automatically via meshModel tool
E3T       1    1155     861    1154       2
E3T       2     137    3166    2145       3
  …       …       …       …       …       …
  …       …       …       …       …       …
  …       …       …       …       …       …

ND    3510 401.701104  0.719666  0.803402
ND    3511 292.228530 35.734722  2.584457
```

Figure 9 : 2dm file resulting from the meshing process with BASEmesh

Add manually!

```
MESH2D   #created automatically via meshModel tool
NUM_MATERIALS_PER_ELEM 1
E3T       1    1155     861    1154       2
E3T       2     137    3166    2145       3
  …       …       …       …       …       …
  …       …       …       …       …       …
  …       …       …       …       …       …

ND    3510 401.701104  0.719666  0.803402
ND    3511 292.228530 35.734722  2.584457
NS 3 6 34 65 123 654 -7 Stringdef_name
```

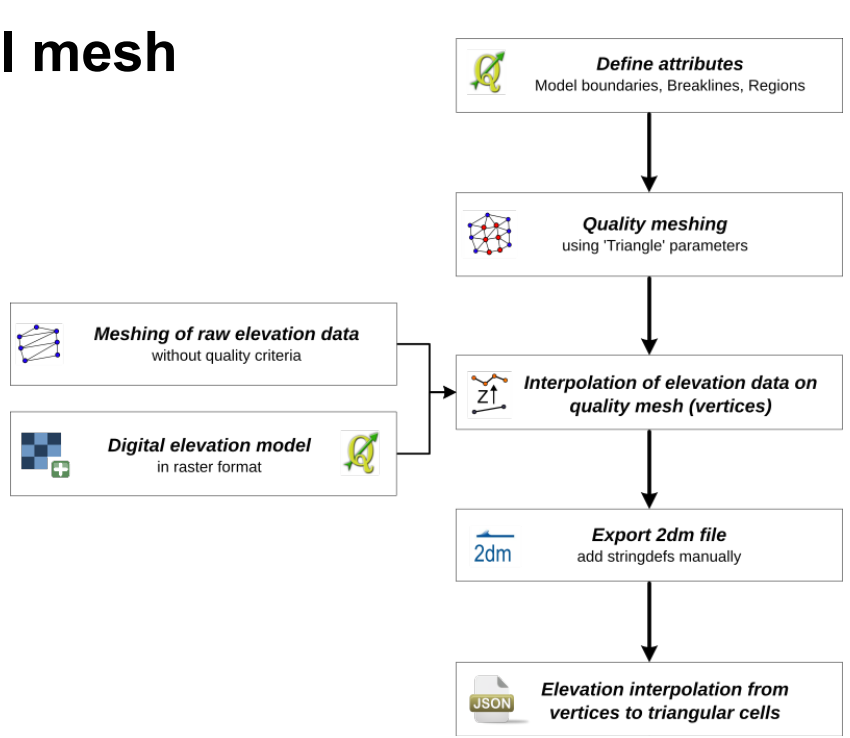
Figure 10 : modified 2dm file for simulation with BASEMENT v 3.0

Generation of a computational mesh

Ⓐ Small meshes

1. Same procedure to generate .2dm file (BASEmesh)
2. Modify the .2dm
3. Elevation interpolation methods
   - Mean
   - Median
   - Minimum
   - Maximum
   - Weighted

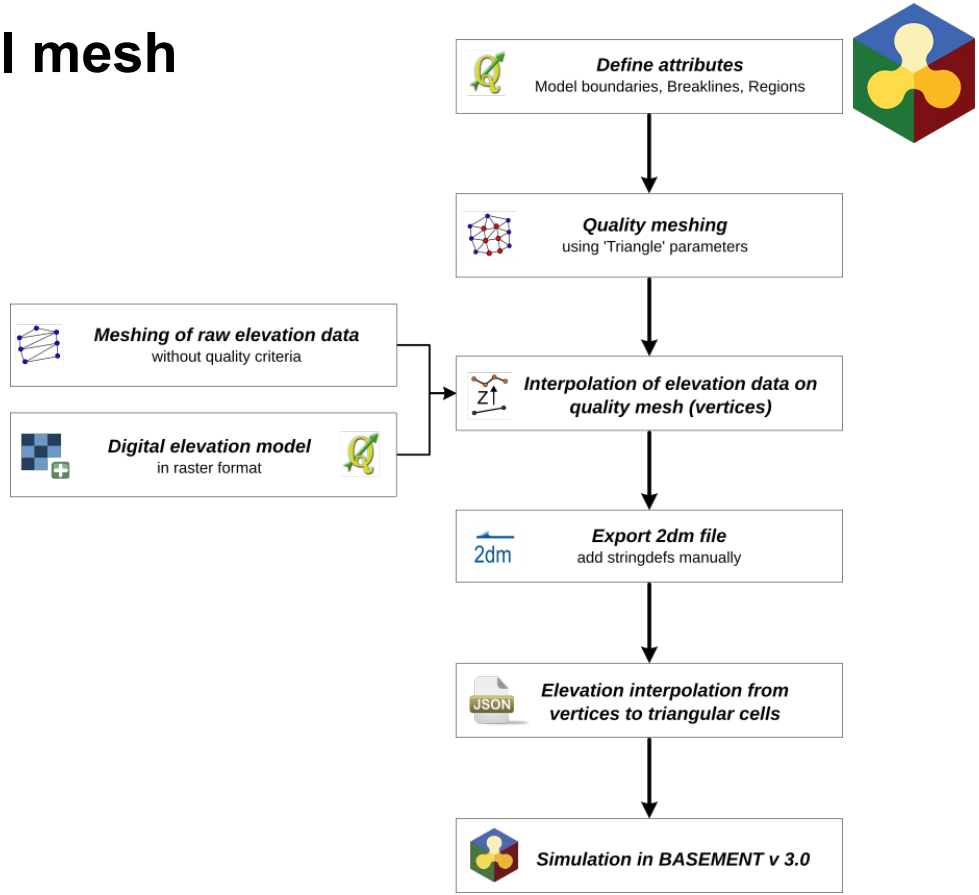
model.json



Generation of a computational mesh

Ⓐ Small meshes

1. Same procedure to generate .2dm file (BASEmesh)
2. Modify the .2dm
3. Elevation interpolation methods
4. Simulation in BASEMENT v3.0

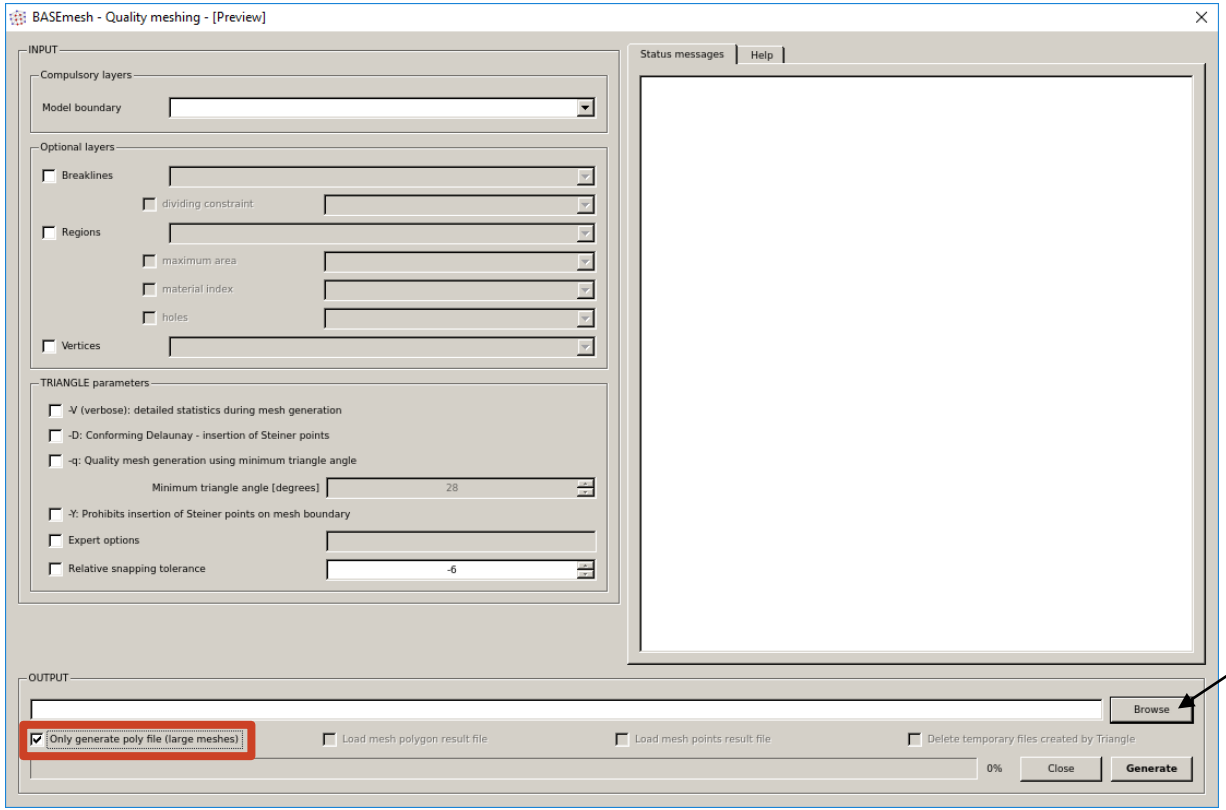


Generation of a computational mesh

B Large meshes

1. Define attributes
2. Quality mesh with BASEmesh 1.44

Generation of a computational mesh



Select the output directory

Figure 11 : Quality meshing for large meshes, screenshot of BASEmesh GUI

Generation of a computational mesh

Large meshes

1. Define attributes
2. Quality mesh with BASEmesh 1.44
3. Open a command window inside the output directory
4. Execute the BASEmesh python script BASEmesh.py to generate the 2dm

python /…/BASEmesh.py

Generation of a computational mesh

Large meshes

1. Define attributes
2. Quality mesh with BASEmesh 1.44
3. Open a command window inside the output directory
4. Execute the BASEmesh python script
   BASEmesh.py to generate the 2dm
5. Simulation in BASEMENT v3.0

Thank you

Questions?