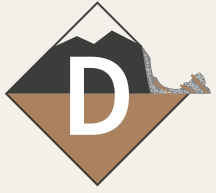




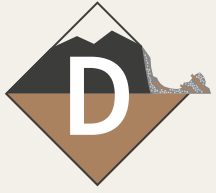
RAMMS::DEBRISFLOW Flexible Barriers

Marc Christen + Perry Bartelt



Idea

- Calculate possible retention volume of flexible barrier, according to document
«[Practical guide for debrisflow and hillslope protection nets](#)»
- Remove retention volume (and momentum) from the flow at location of flexible barriers.
- Flexible barriers must be defined as polygons, with widths of at least 2 x grid size.



Theory Retention Volume

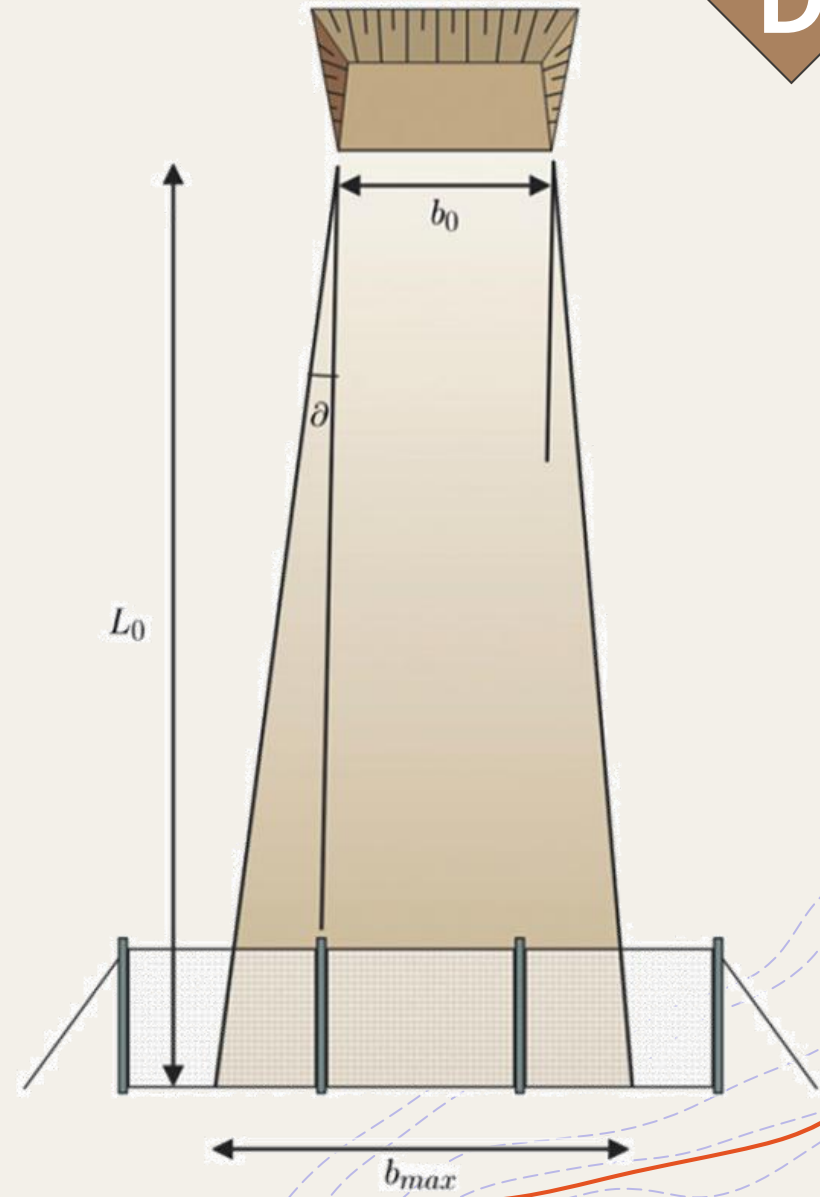
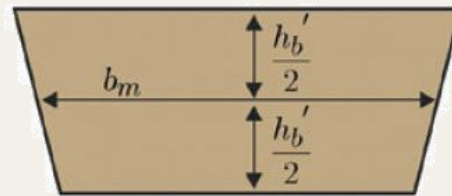
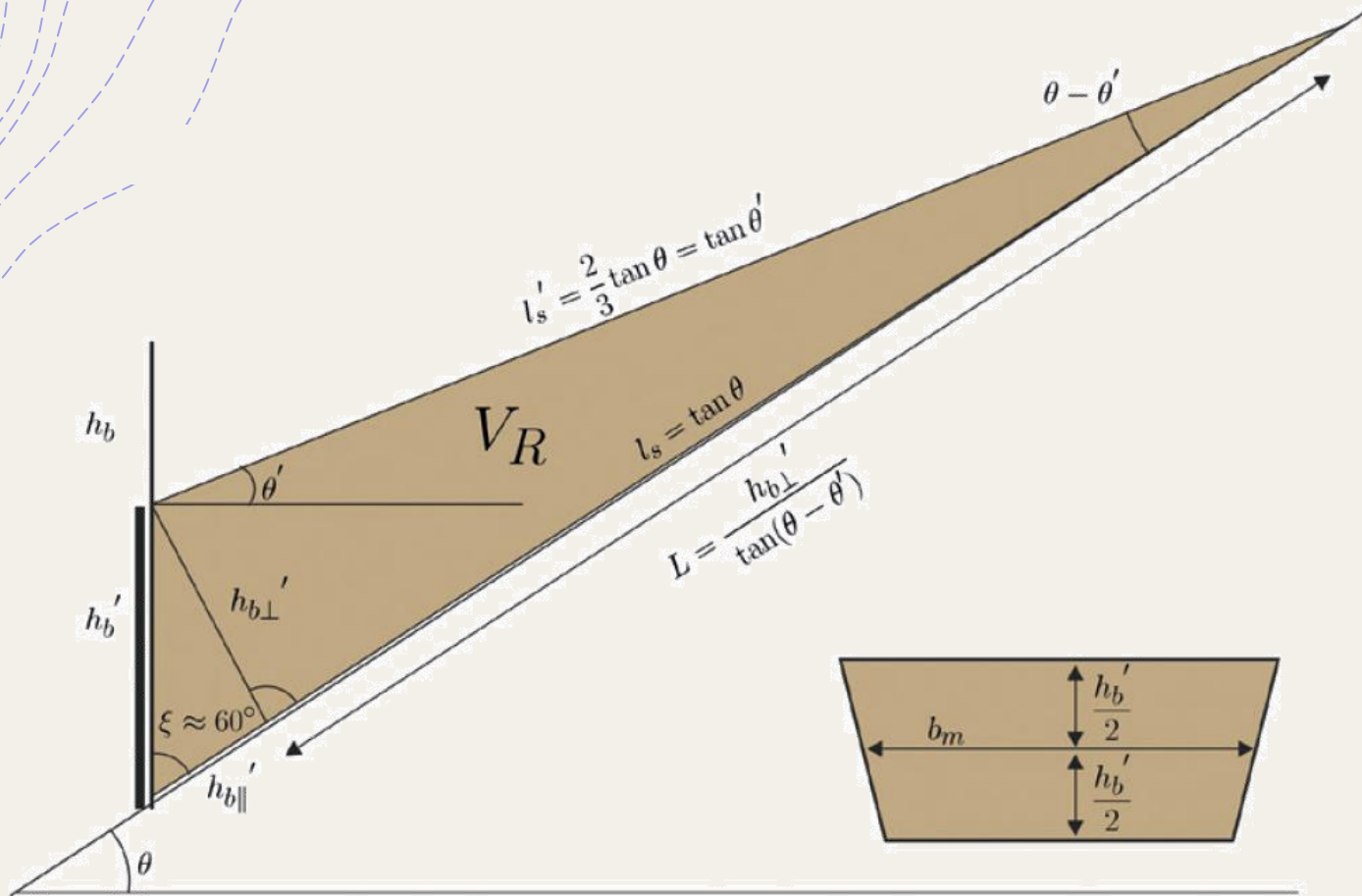
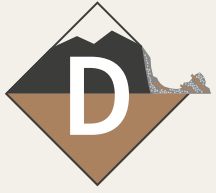
- Calculate possible retention volume according to:

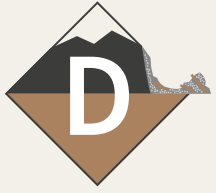
$$V_R = 0.5(h_b')^2 b_{max} \sin \xi \left(\frac{\sin \xi}{\tan(\theta - \theta')} + \cos \xi \right)$$

with

V_R	=	Retention volume of flexible barrier
h_b'	=	Barrier height
b_{max}	=	Width of barrier
ξ	=	Slope angle between barrier and terrain
θ	=	Slope angle of terrain
θ'	=	Slope angle of deposit

Theory

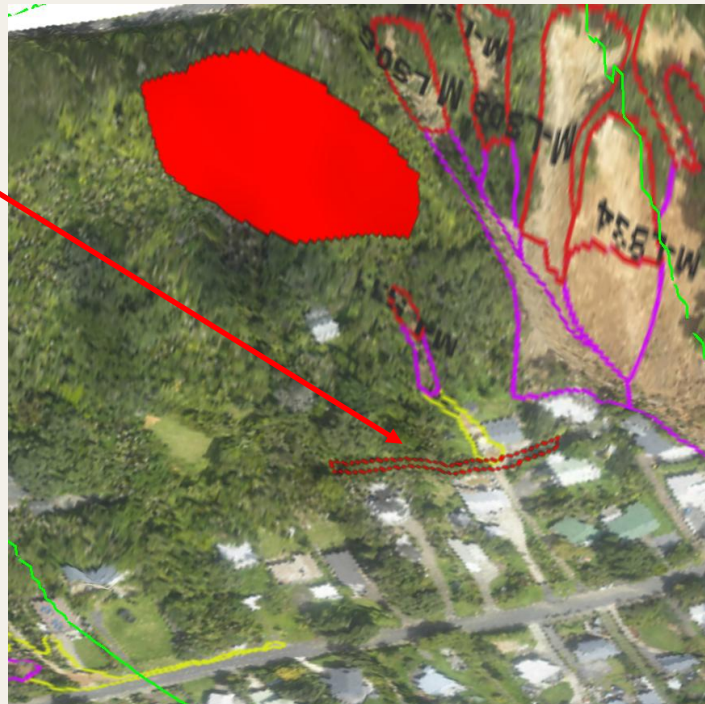




How to use new barrier tool

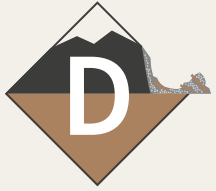
- Open an input file in RAMMS
- Then draw polygons at net/barrier locations
(you can have just one polygon in a shapefile, or even several polygons for several nets within one shapefile, see below)

Only 1 net location

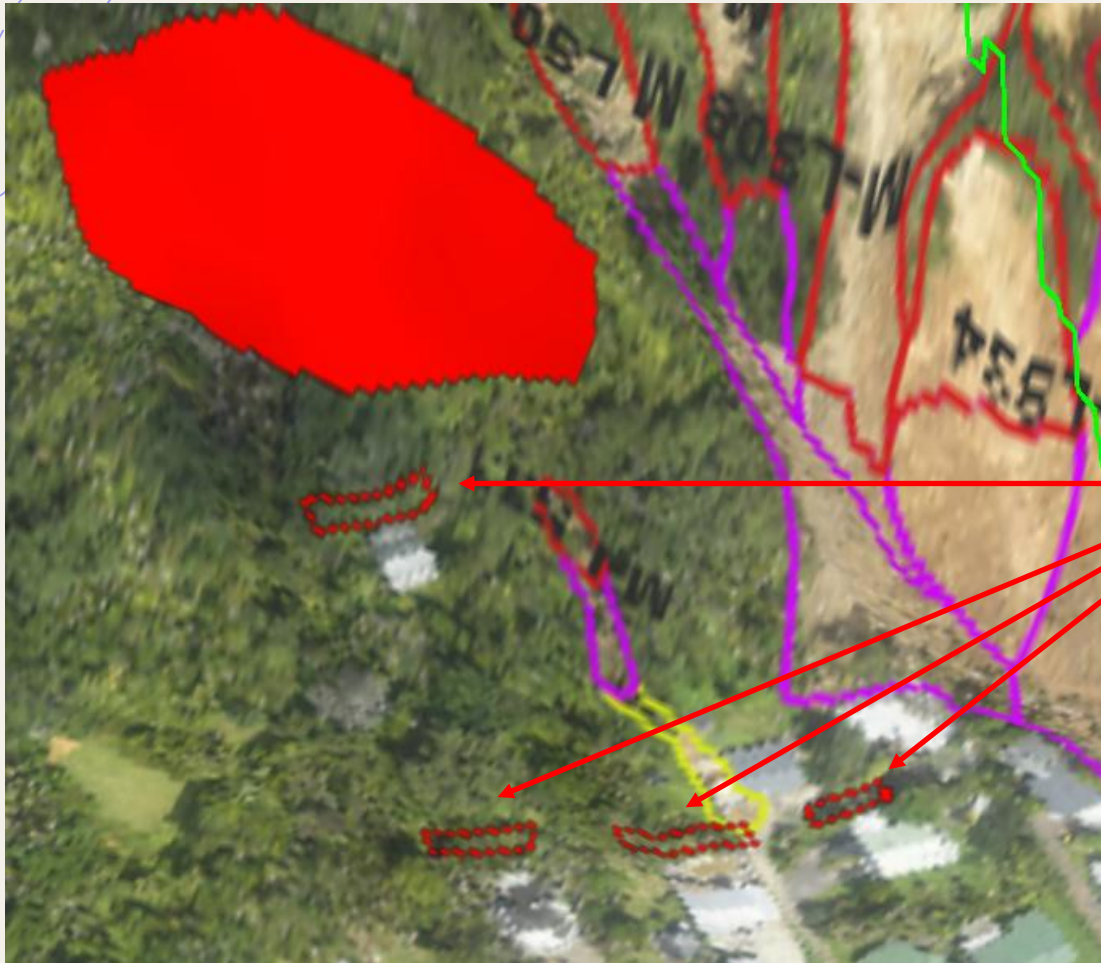


4 net locations





Set barrier parameters



MIN / MAX / COLORS

MAX 0.50

MIN 0.00

COLORS 50

TRANSPARENCY / CONTOURS

Transparency %

0 < >

Simulation Contour Lines

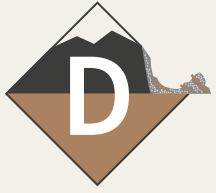
Various

Files General Volumes Region

Shapefiles, MuXi-Files and Domain-Files

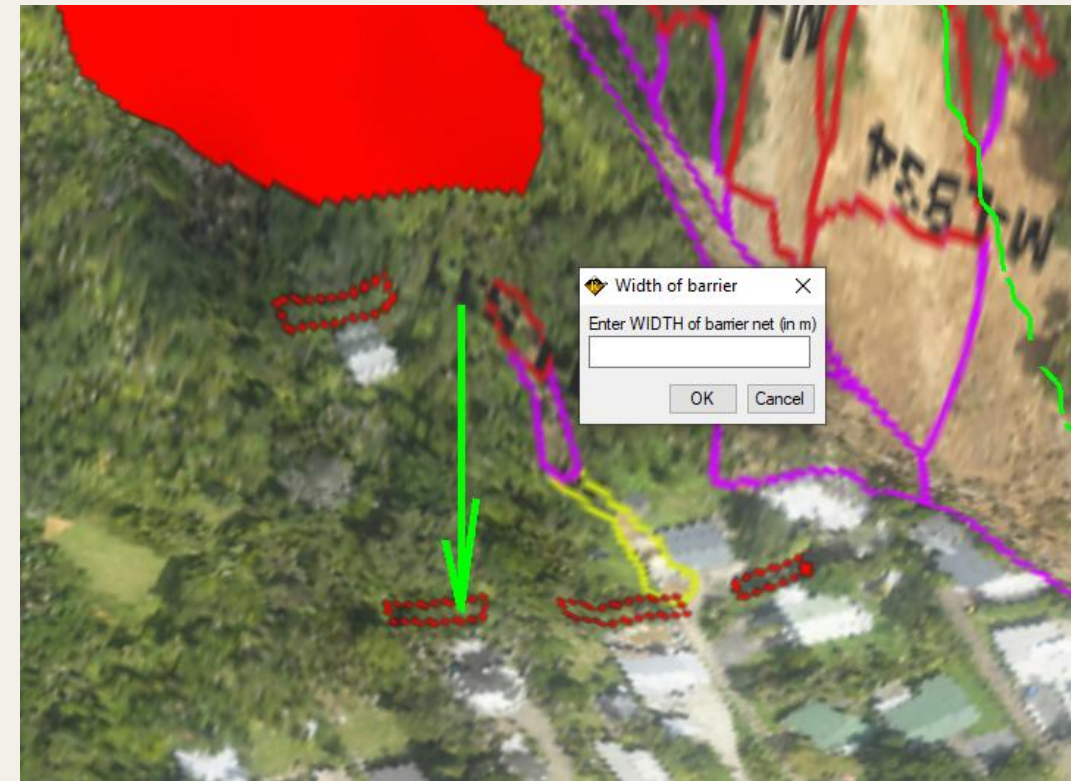
- Polygon
 - 00_Run_01.shp
 - 4bam**
 - A_Sh
 - barie
 - barie
 - barie
 - barie
 - Dom
 - dom
 - Erosic
 - house
 - house
 - profile
 - Rel_1
 - Rel_Tzo_toz_nar.shp
 - rel_198.shp (input)
 - Test.shp
- Domain
 - 00_Run_01.shp
 - Dom_128_132.shp

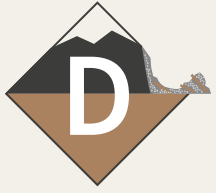
Right-click on filename and choose «Set as barrier (net)»



Set barrier parameters

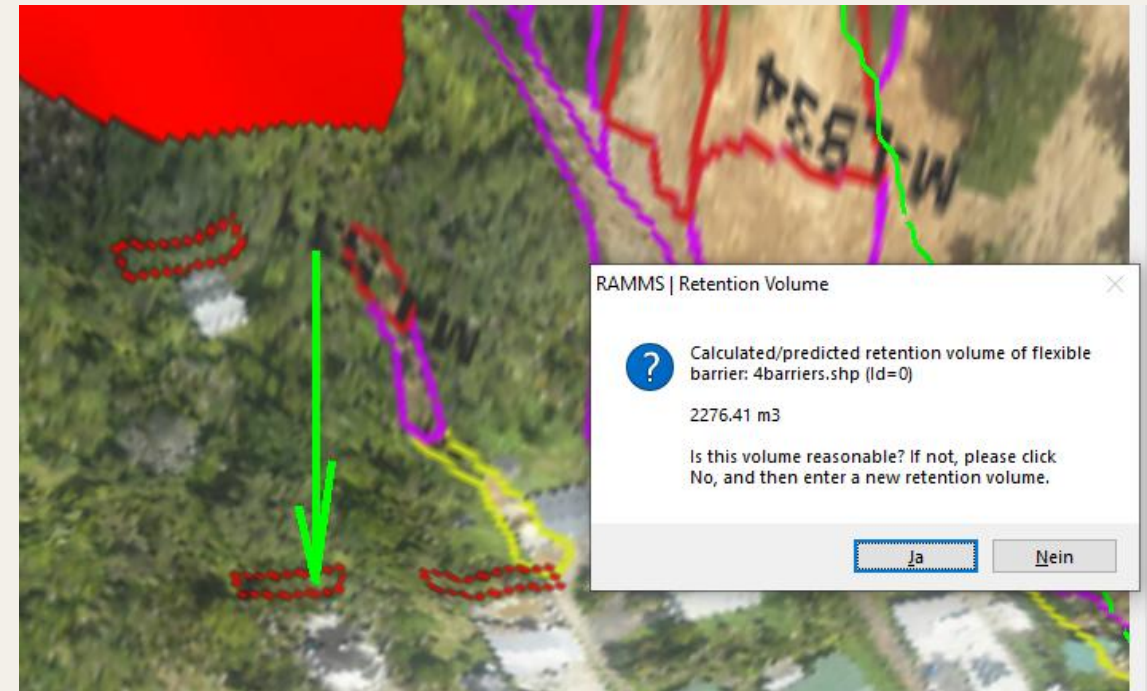
- Then set width and height for barrier (in m)
- The green arrow will tell you, for which polygon you are defining the parameters.
- If you click «Cancel», the polygon will be skipped, and no retention will take place at this polygon.

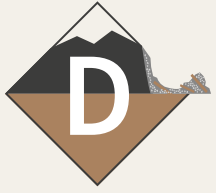




Set barrier parameters

- After you set width and height, RAMMS will show you the calculated possible retention volume for this barrier.
- If you are not satisfied, click «No» and enter a new retention volume (in m³)
- Then do the same for the other polygons in your shapefile.





Check barrier parameters

- After you set your barrier parameters, you can again right-click on the filename, and then RAMMS will show you this information:

RAMMS | Barriers

i Shapefile: 4barriers.shp

There is already a barrier specified for this element!
Please remove barrier before defining a new barrier setting!

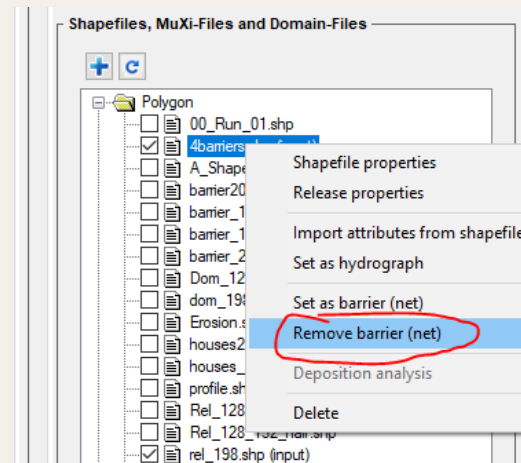
Barrier Information:

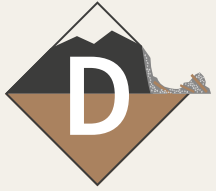
Id	H	W	S	Vr	Hr
0	4.00	25.00	14.44	2276.41	30.82

Legend:
Id: Id of polygon within shapefile
H: Barrier height (m)
W: Width of barrier (m)
S: Mean slope angle within barrier polygon (°)
Vr: Estimated retention volume of flexible barrier (m3)
Hr: Max retained height within barrier polygon cells (m, fictional)

OK

- If you want to set new parameters, remove the barrier first from the shapefile (right-click):





Check barrier parameters

You can also check your barrier parameters in the «Run Simulation» window:

RAMMS | Run Simulation

General Params Mu/Xi Release Erosion **Barriers**

BARRIER INFORMATION ?

Barrier Shapefiles and Values

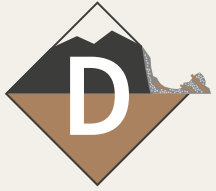
Id	H	W	S	Vr	Hr	Name + Path
0	4.00	25.00	14.44	2276.41	30.82	4barriers.shp

Legend:

- Id: Id of polygon within shapefile
- H: Barrier height (m)
- W: Width of barrier (m)
- S: Mean slope angle within barrier polygon (°)
- Vr: Estimated retention volume of flexible barrier (m3)
- Hr: Max retained height within barrier polygon cells (m, fictional)

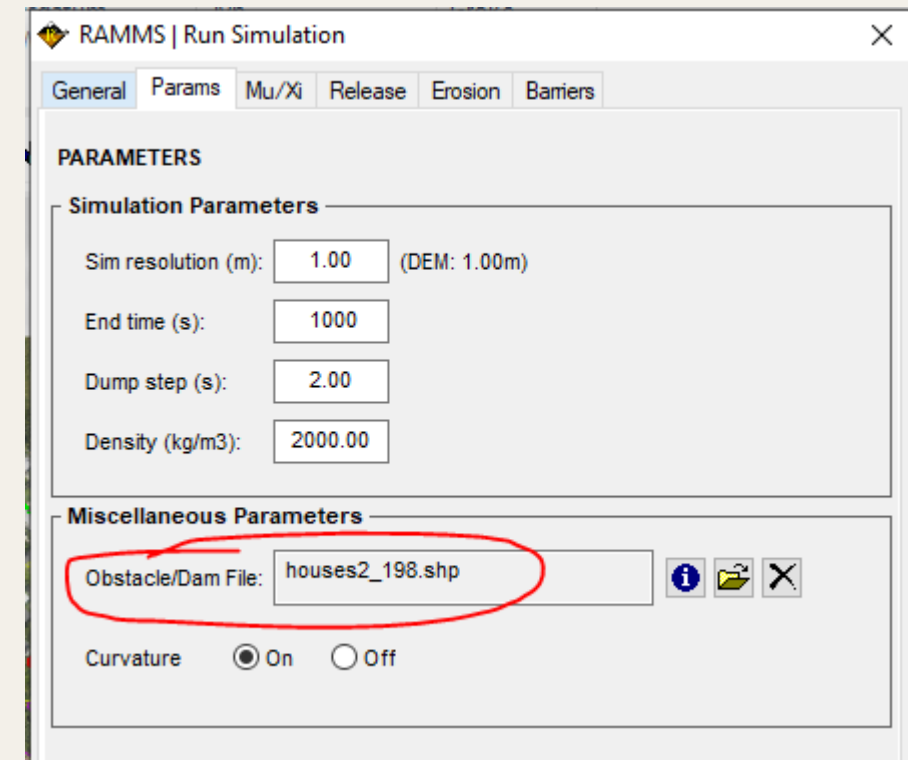
Additional Information:

- It is not suggested to use the Center-Of-Mass stopping criteria with barrier
- Use lower values for the momentum stopping criteria than usual.



Add obstacles

- Add obstacles (e.g. houses) that the flow cannot flow through by drawing a shapefile (with one or several polygons inside) and then adding the shapefile here:



Start a simulation

- Next, start a simulation with your barriers.
- In the black DOS-window, you can see, how much volume is retained.
- With barriers, set stop criteria to 1%:
(do not use Center-of-Mass stop criteria with barriers)

```
Auswählen cmd.exe /c E:\RAMMS\DEBRISFLOW\Beispiele\StuMason_Matt\RAMMS_OUTPUT\Run198_Mc_4Barriers.out.bat

Time 20.0
Step 309 dt 0.0693123 Cfl 0.449139
Hmax 1.37 m Vmax 4.79 m/s

MOVING MOMENTUM: 44.4 percent ( 2332.2 / 5250.8 )

FLOW VOLUME: 1246.82 m3

BLOCK VOLUME: 1816.64 m3
BARRIER RETENTION VOLUME: 569.80 m3
NUMERICAL VOLUME LOSS: 0.01 m3

VOLUME CHECK: 1.0
.....

Time 22.0
Step 337 dt 0.072659 Cfl 0.449054
Hmax 1.43 m Vmax 4.47 m/s

MOVING MOMENTUM: 40.2 percent ( 2109.3 / 5250.8 )

FLOW VOLUME: 1232.08 m3

BLOCK VOLUME: 1816.64 m3
BARRIER RETENTION VOLUME: 584.54 m3
NUMERICAL VOLUME LOSS: 0.02 m3

VOLUME CHECK: 1.0
.....
```

Digital elevation info:

Stop Criteria

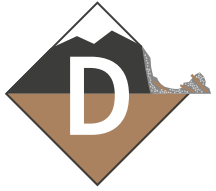
Percentage of total momentum (%): ?

Center-of-Mass vel threshold (m/s): ?

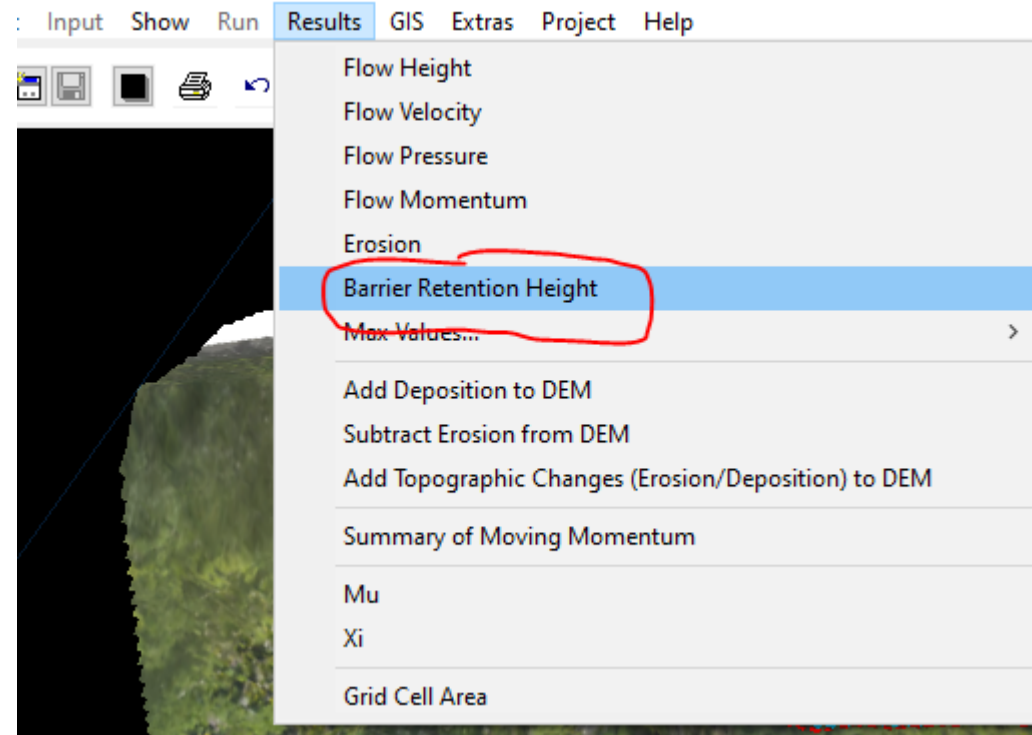
Remarks

- use "Escape" to close/cancel this window
- use "Ctrl+r" to start a simulation

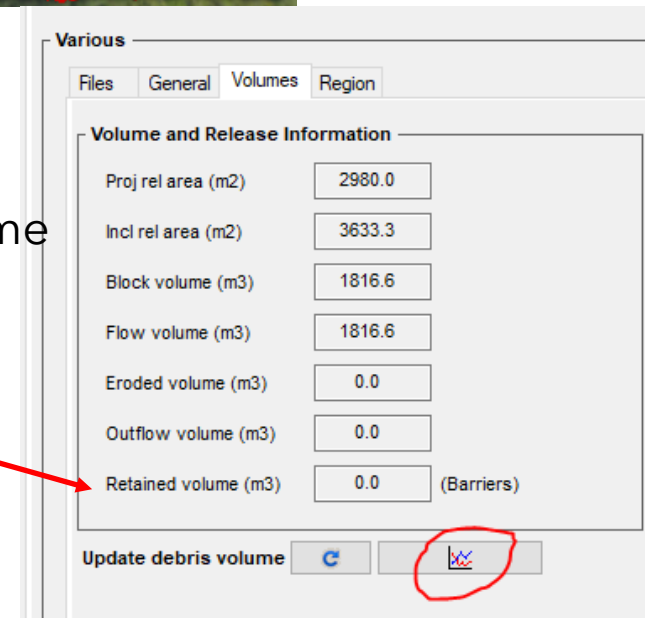


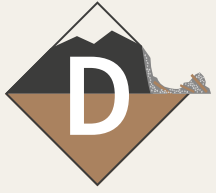


- + When looking at results, you can check the retained volume like this:
- + Choose «Barrier Retention Height» and then animate the flow!
- + Look at Volume-Plot by clicking here:



You can also see the retained volume Here:





Results and Log

- The barrier information is also added to the output-log-file!