Existing Landslide Software

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For Landslide workshop
NECTEC
June 1-2, 2017

Objectives

- To review the existing software packages that are available for us to use.
- To study the software packages in the following aspects
  - Required Input
  - Output

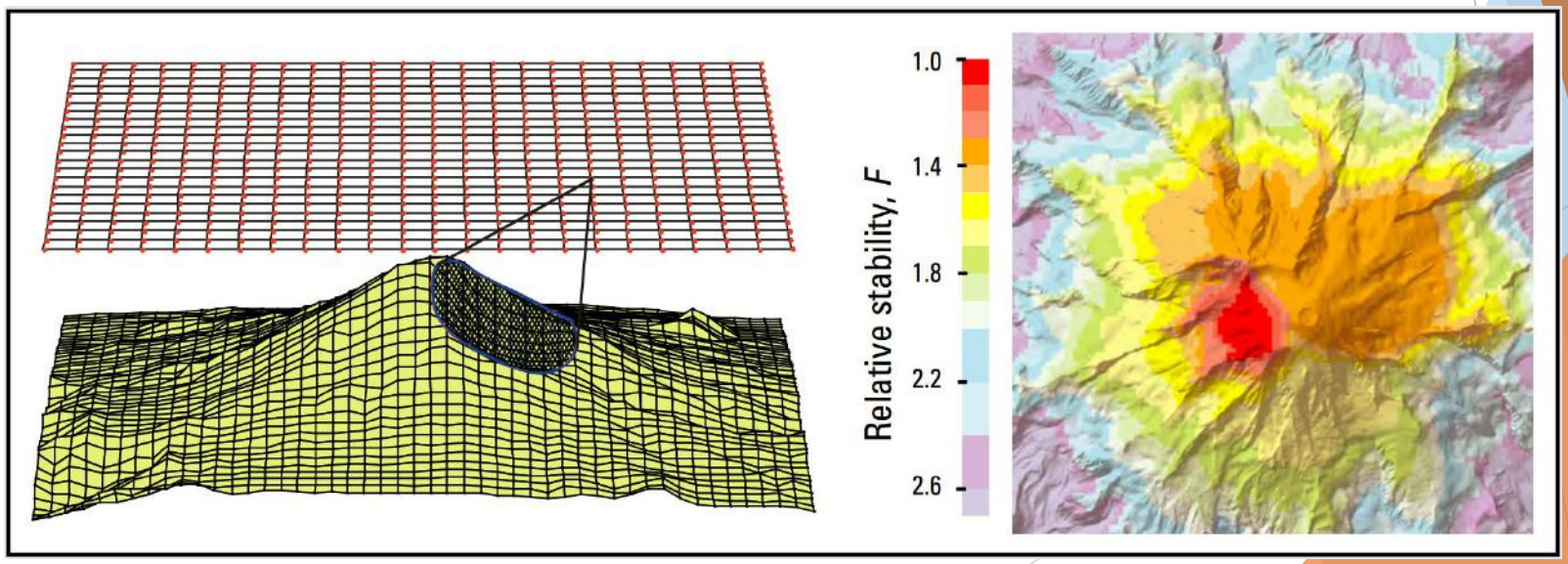
Software Packages to be reviewed

- Scoop3D
- Chasm
- Sim-Slope

Scoop3D

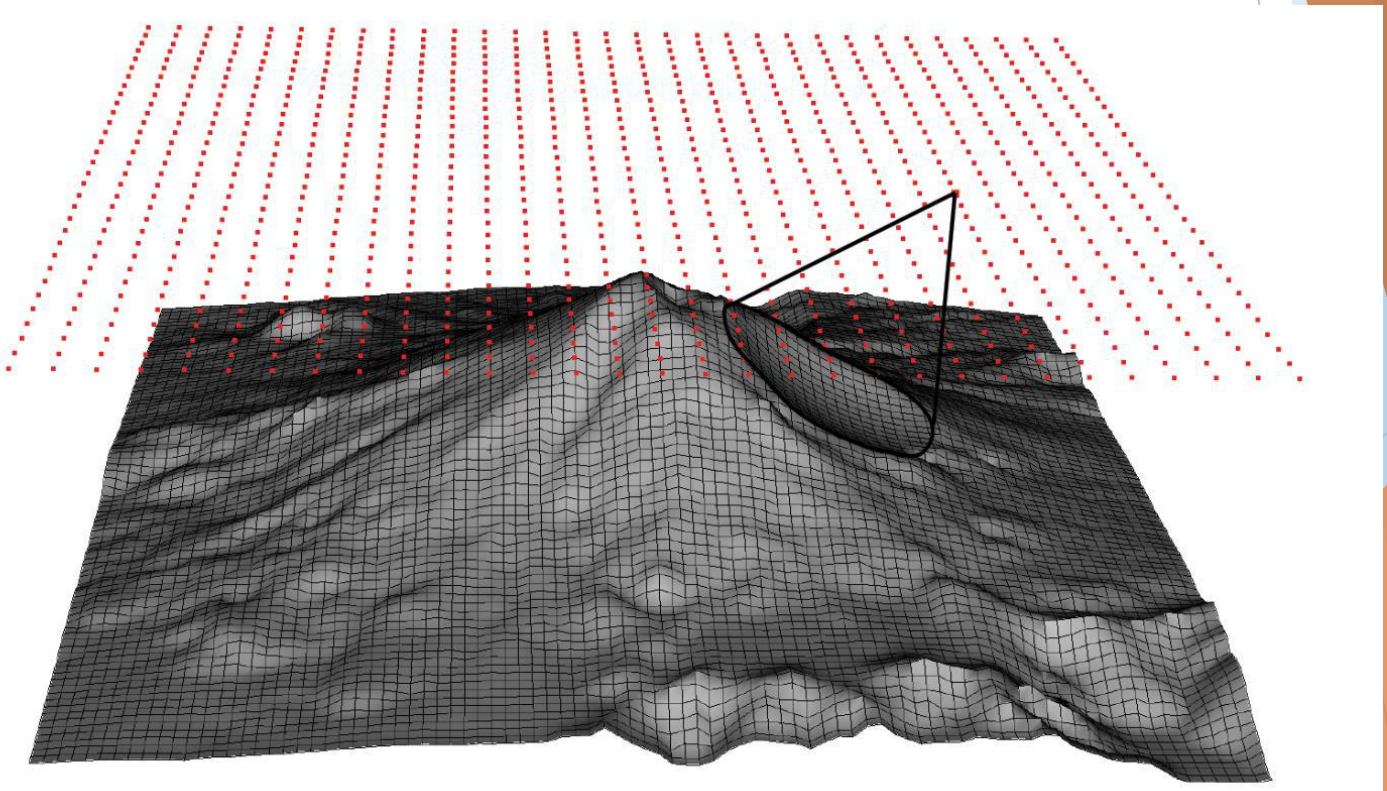
About Scoop3D

- It is developed by United States Geological Survey(USGS)
- It is software to analyze 3D slope stability.
- It systematically searches a digital landscape and compute the stability of 3D potential landslide.



Input: Digital Elevation Model (DEM)

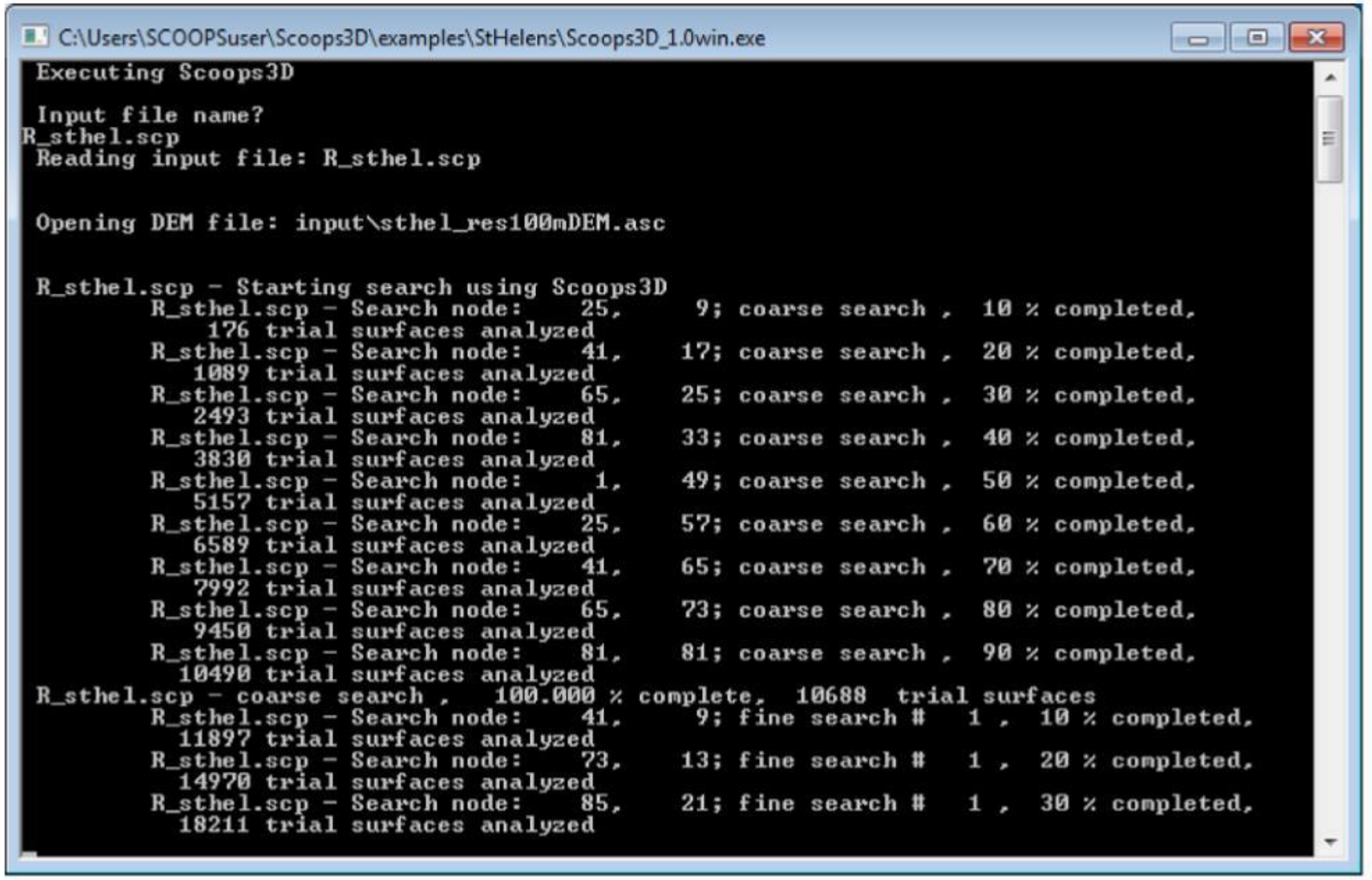
- DEM is a digital representation 3 dimensional information (X, Y, Z) of the earth surface.



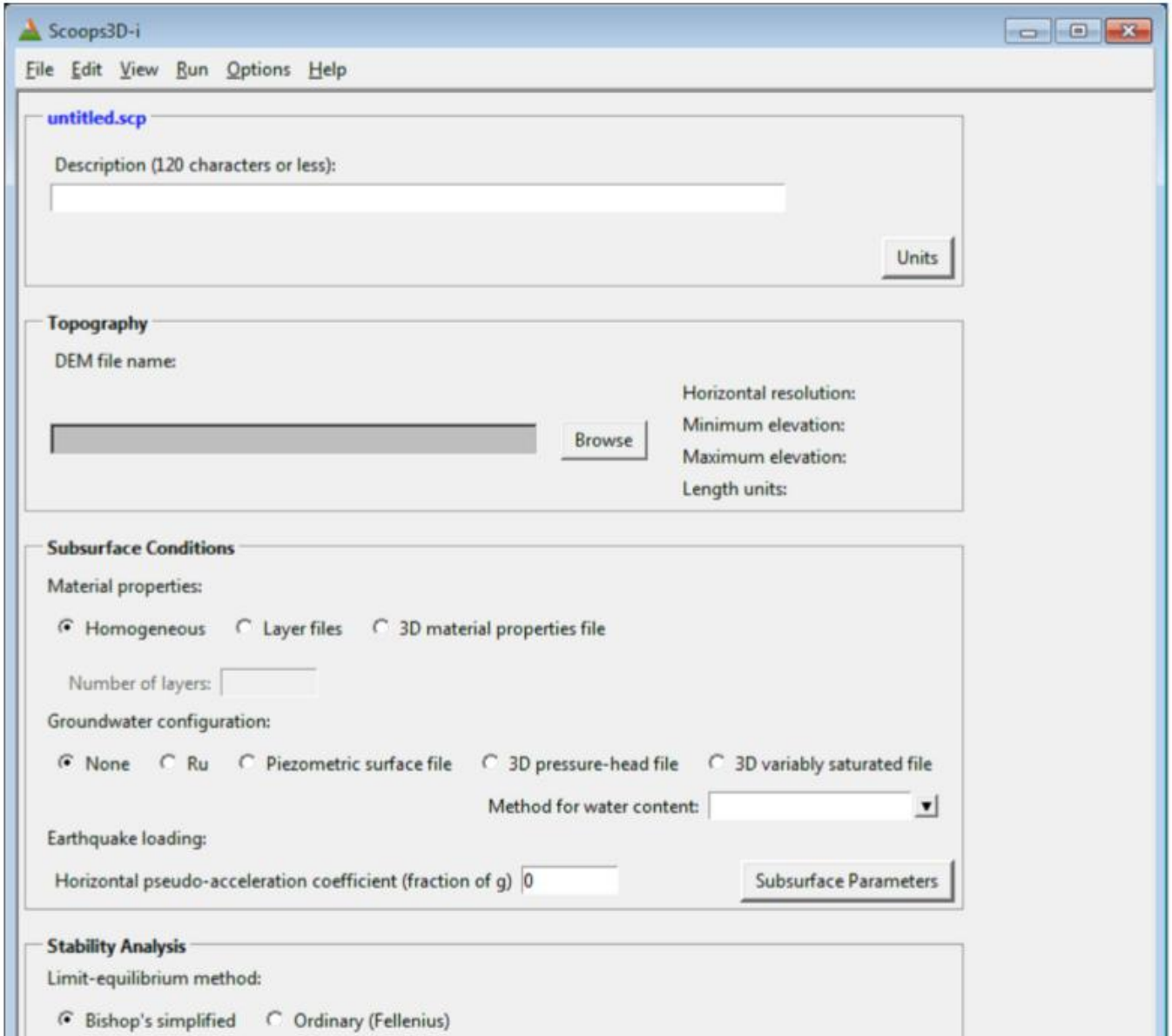
About the software

- The program can be downloaded over the Internet at http://pubs.usgs.gov/tm/14/a01
- It is free of charge.
- Available for both Windows (25 MB) and Mac OS (63 MB)
- It can be run from either a command line or user interface.

Running Program via command line



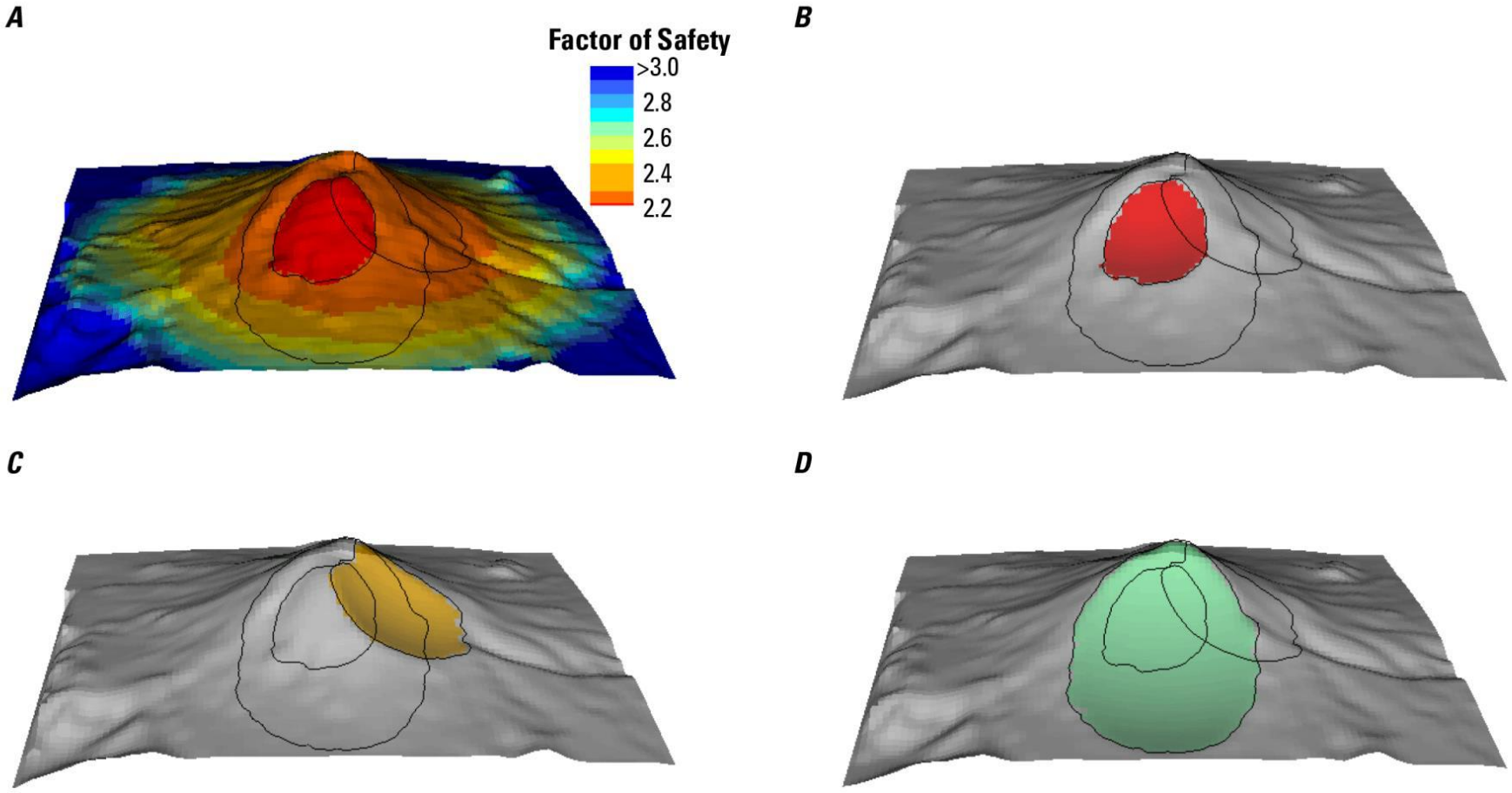
Running Program via user interface

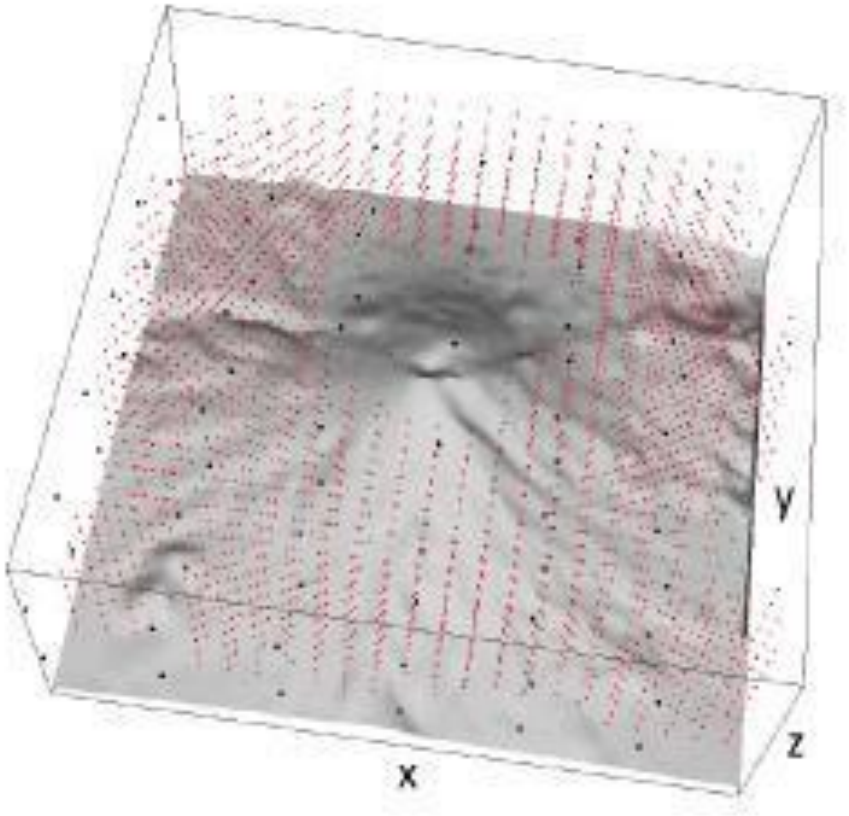


Input and Configuration Options

- **Input:** DEM
- **Surface Conditions:**
  - Material properties (Homogeneous or Layers)
  - Groundwater configuration
  - Earthquake loading
- **Stability analysis:** limit equilibrium method
  - Bishop Simplified
  - Ordinary method of slices
- **Searching methods**
  - Box Search
  - Single Trial Surface
  - File Search

Output: Stability Results




Y
Z
X

CHASM

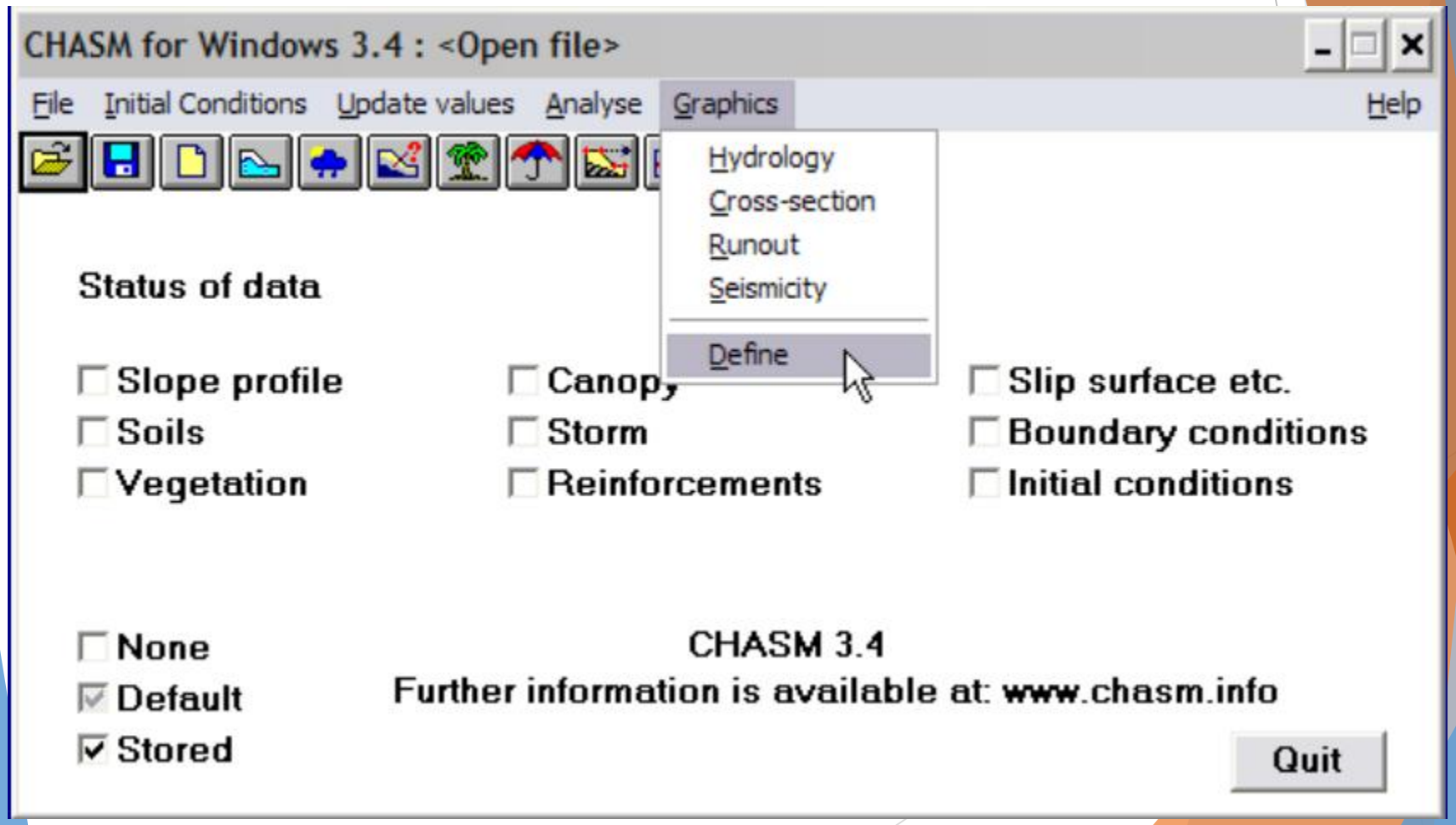
About CHASM

- CHASM is an integrated slope hydrology/slope stability software package.
- Support analysis and simulations
- The dynamics of slope hydrology are computed using a finite difference formulation that accommodates unsaturated and saturated soil water conditions.

Highlights

- Can create the slope geometry file for research purposes
- Edit all slope input files

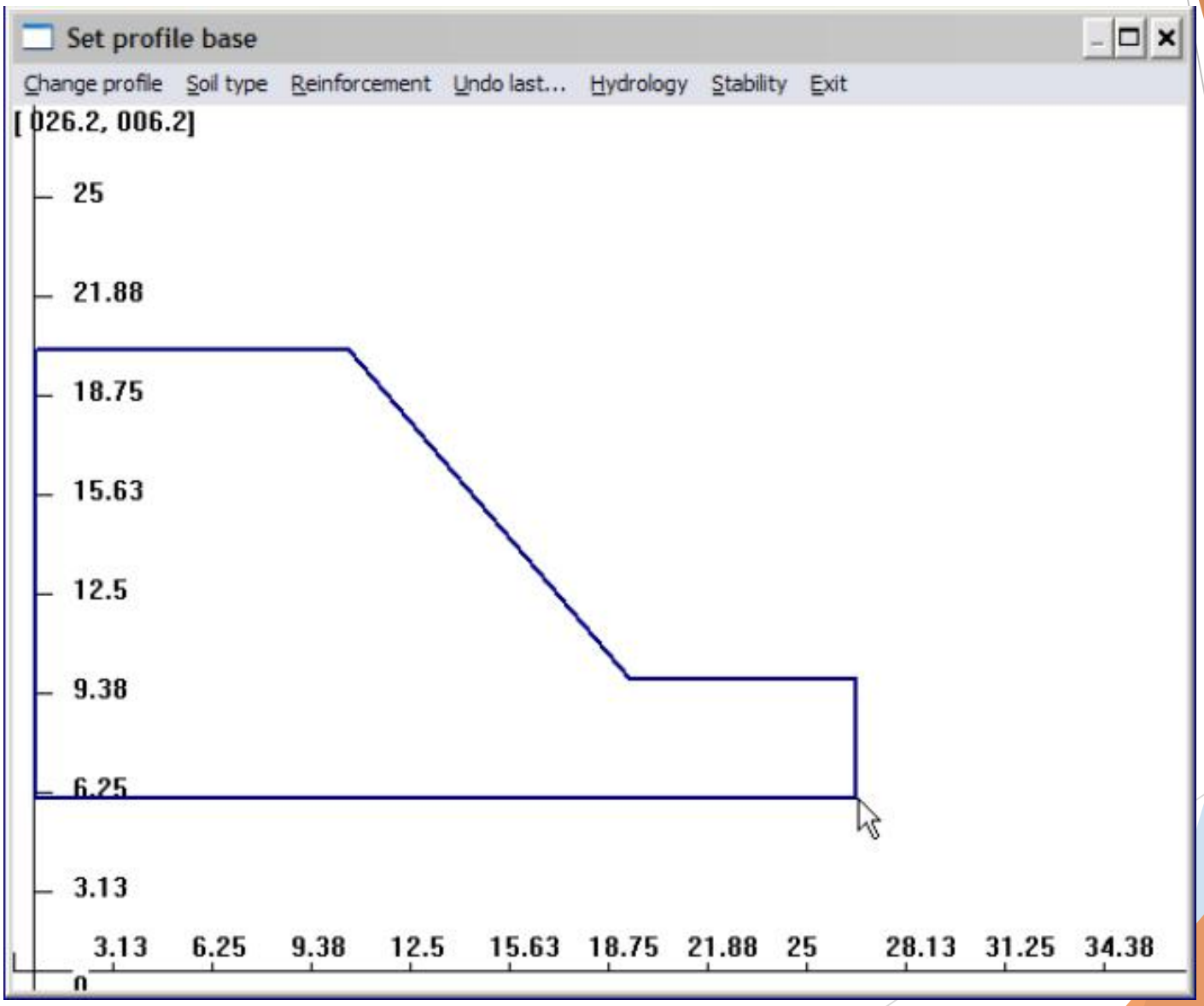
Define the Data

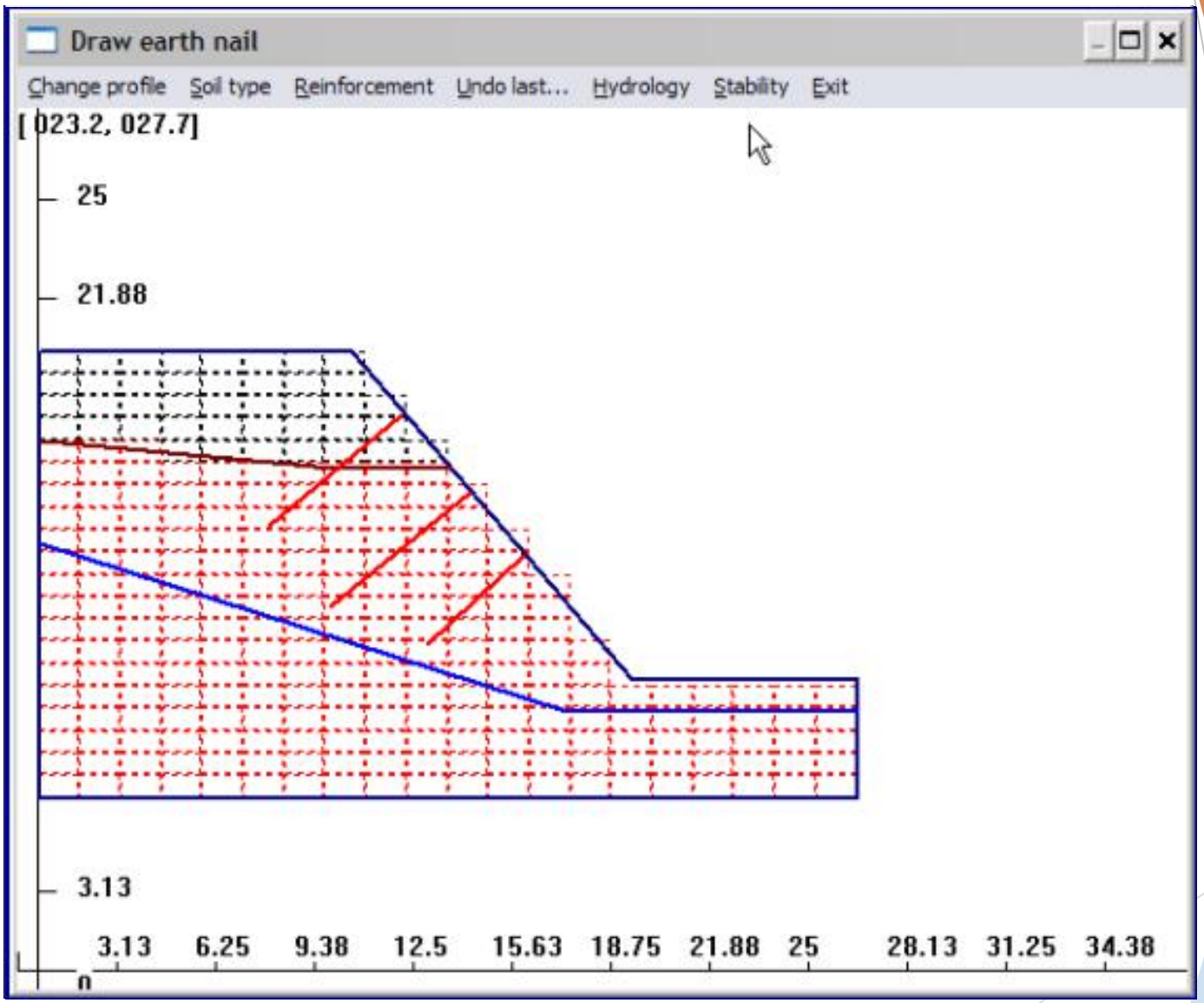


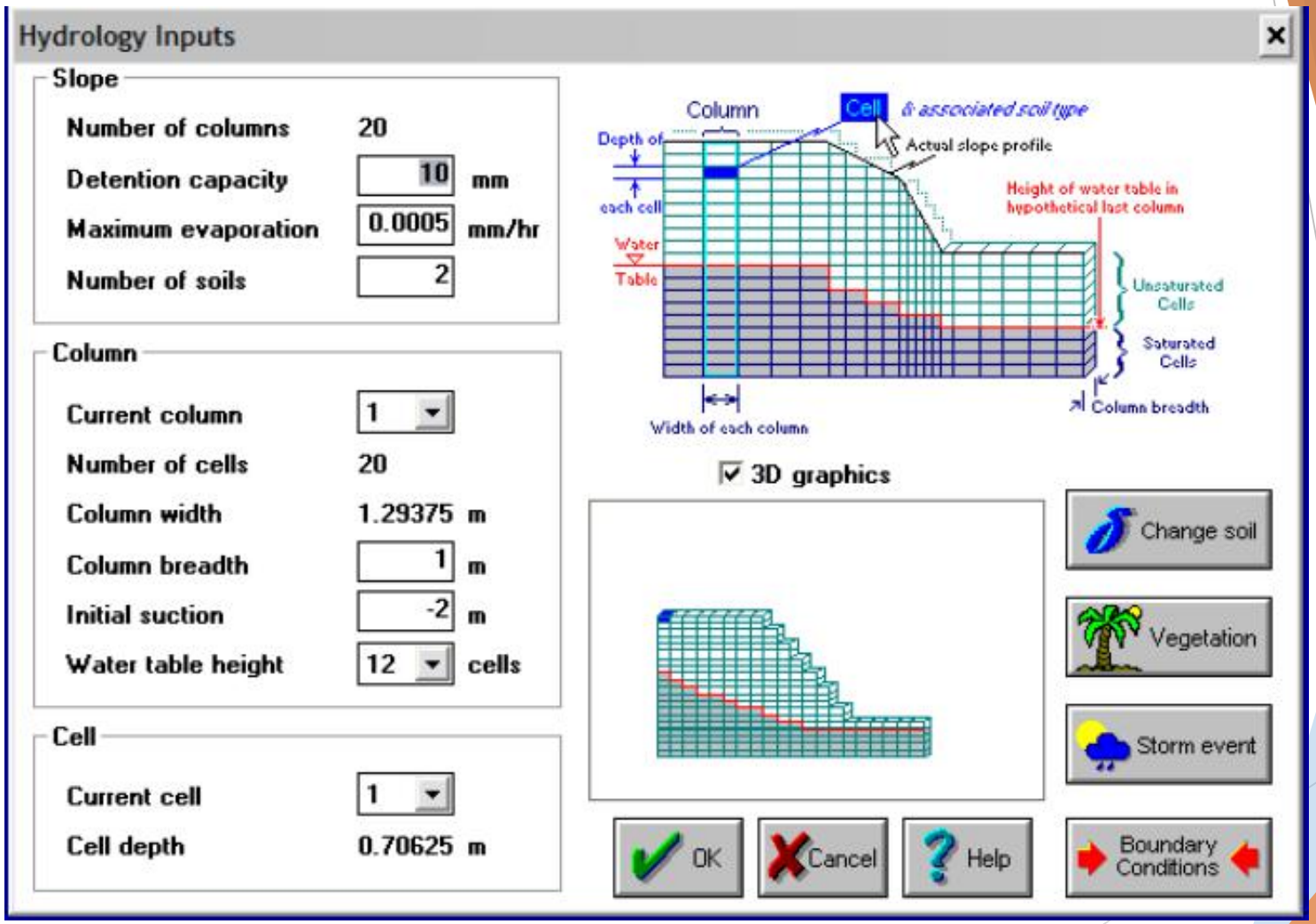
Stability analysis

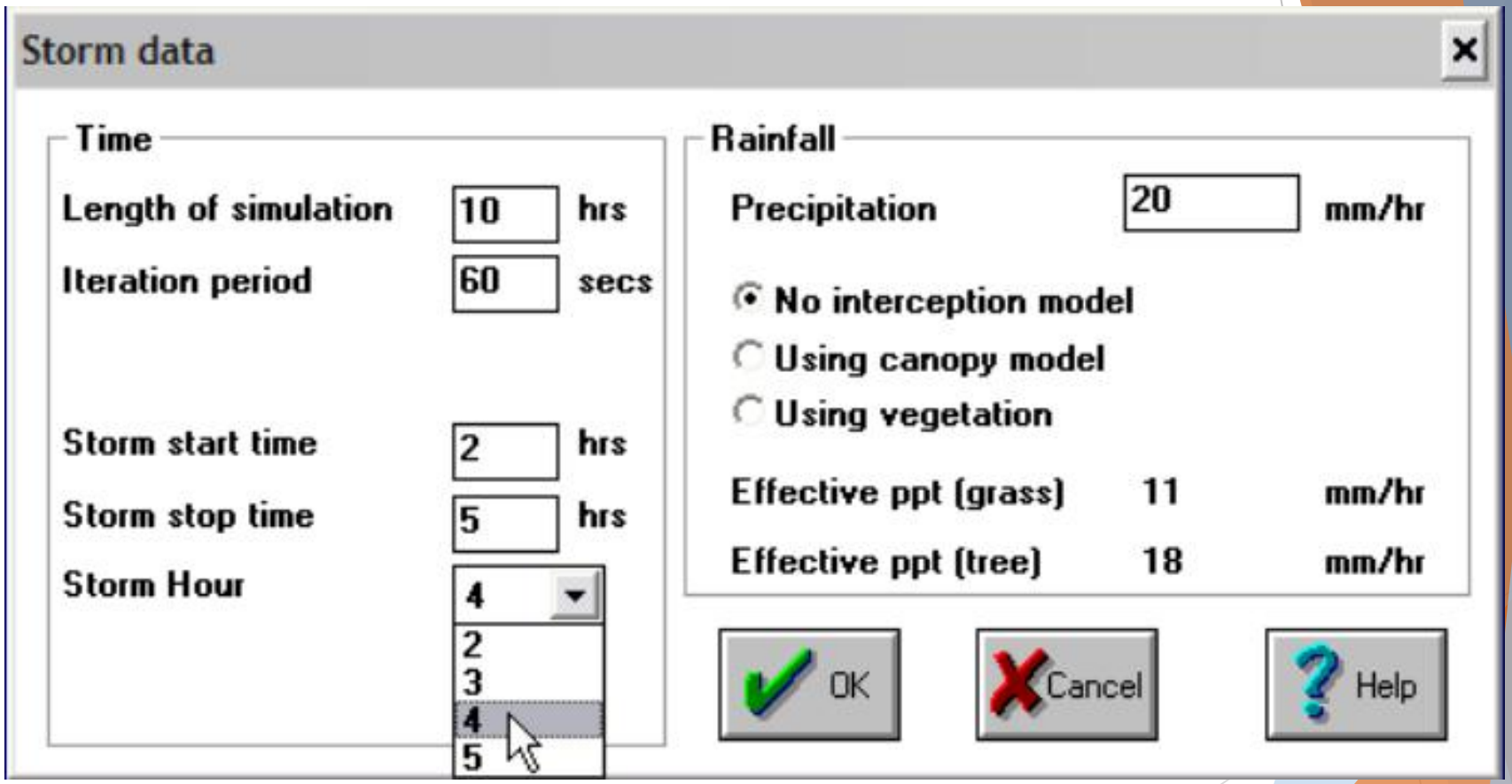
- CHASM uses the Bishop method of slices to perform slope stability analysis.
- Searching methods:

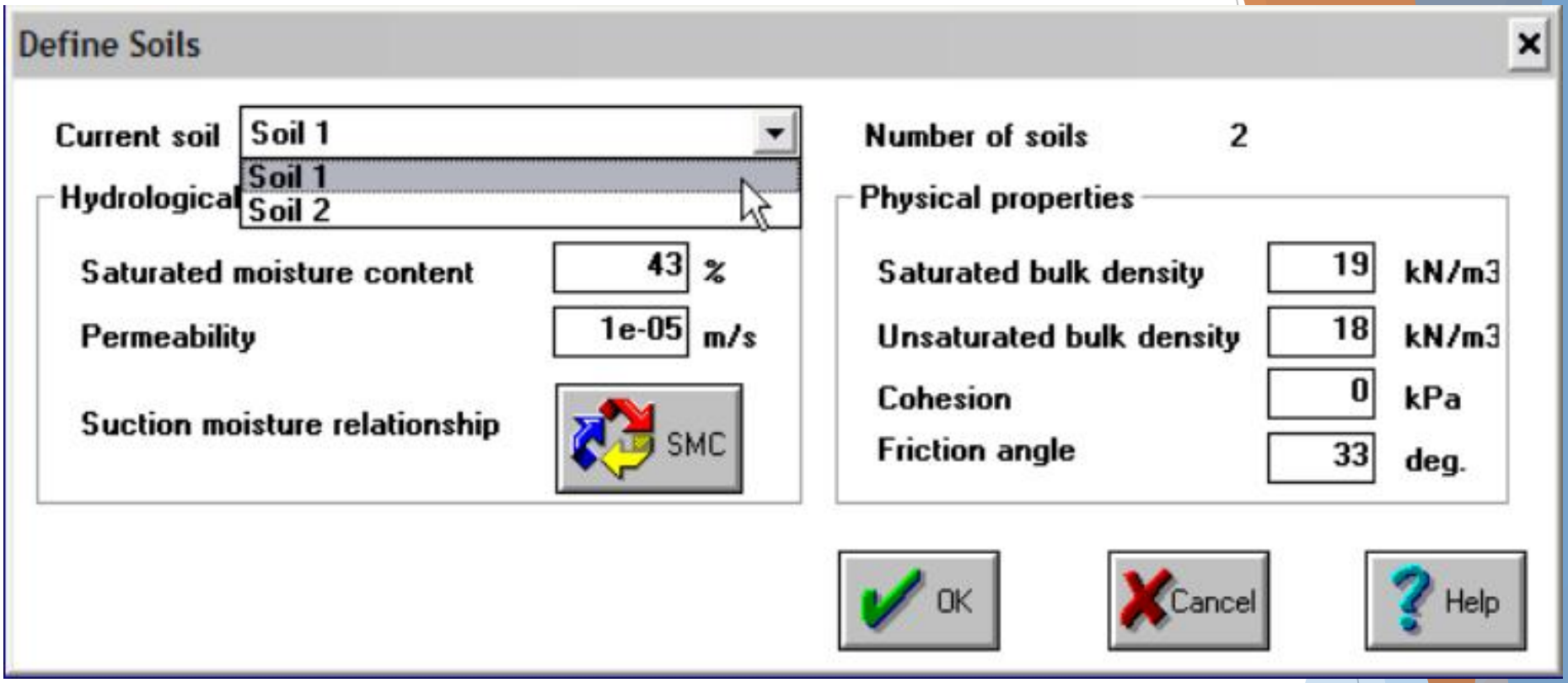
Making Geometry File

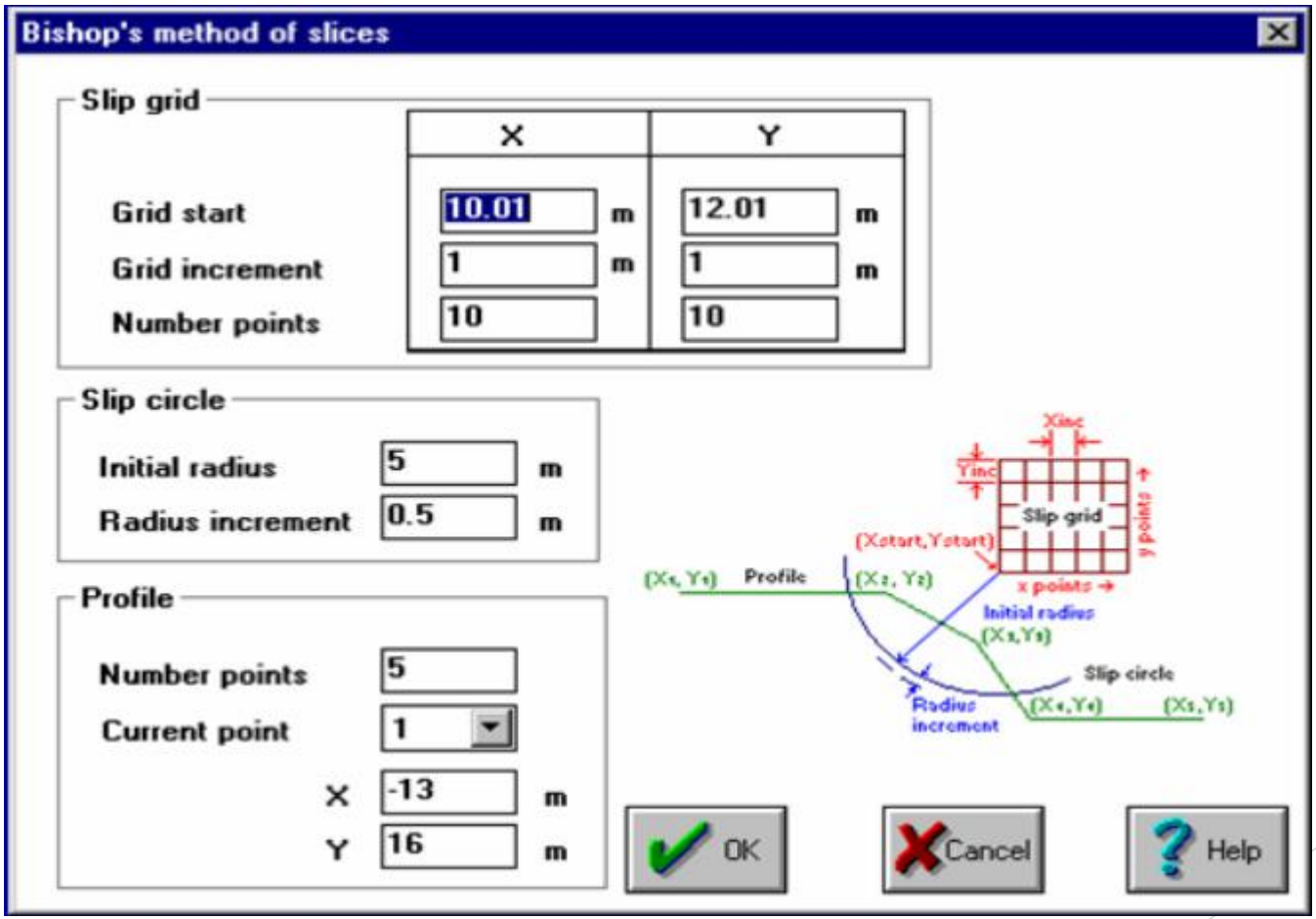


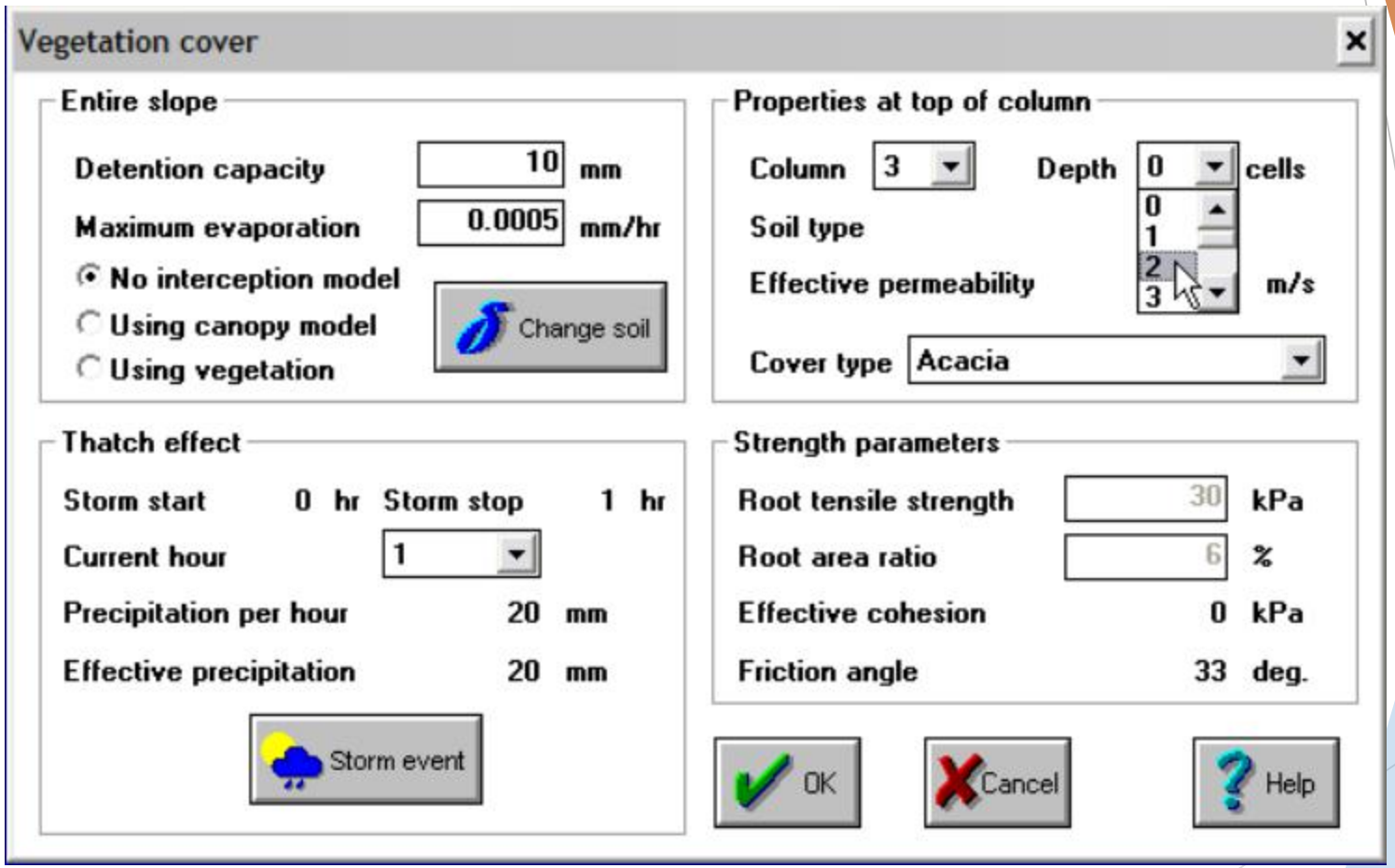

Draw earth nail
Change profile
Soil type
Reinforcement
Undo last...
Hydrology
Stability
Exit
[023.2, 027.7]
25
21.88
3.13
0
3.13
6.25
9.38
12.5
15.63
18.75
21.88
25
28.13
31.25
34.38

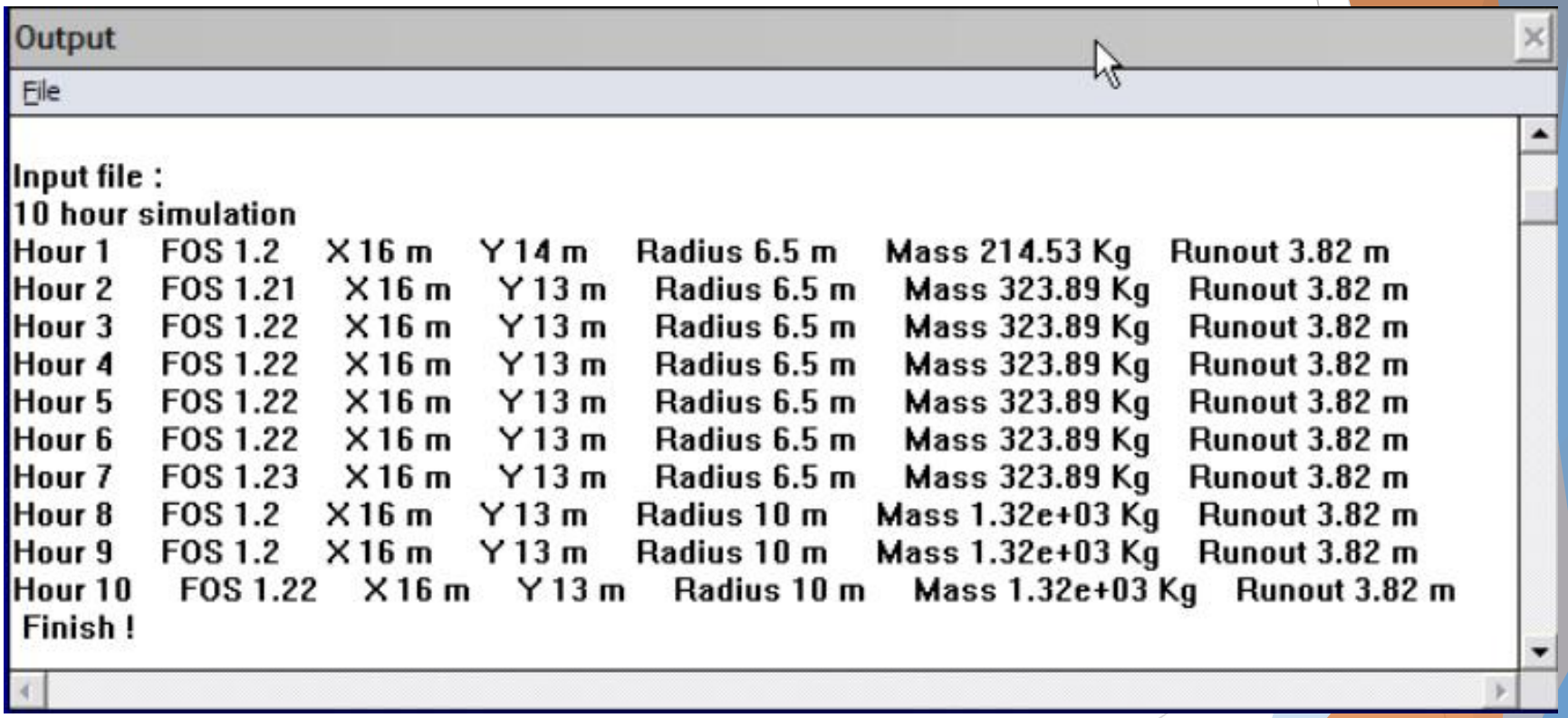

Hydrology Inputs
Slope
Number of columns 20
Detention capacity 10 mm
Maximum evaporation 0.0005 mm/hr
Number of soils 2
Column
Current column 1
Number of cells 20
Column width 1.29375 m
Column breadth 1 m
Initial suction -2 m
Water table height 12 cells
Cell
Current cell 1
Cell depth 0.70625 m
Column
Cell
& associated soil type
Depth of each cell
Actual slope profile
Height of water table in hypothetical last column
Water Table
Unsaturated Cells
Saturated Cells
Column breadth
Width of each column
3D graphics
Change soil
Vegetation
Storm event
OK
Cancel
Help
Boundary Conditions


Storm data
Time
Length of simulation
10
hrs
Iteration period
60
secs
Storm start time
2
hrs
Storm stop time
5
hrs
Storm Hour
4
2
3
4
5
Rainfall
Precipitation
20
mm/hr
No interception model
Using canopy model
Using vegetation
Effective ppt (grass)
11
mm/hr
Effective ppt (tree)
18
mm/hr
OK
Cancel
Help


Define Soils
Current soil
Soil 1
Soil 1
Soil 2
Number of soils
2
Hydrological
Saturated moisture content
43
%
Permeability
1e-05
m/s
Suction moisture relationship
SMC
Physical properties
Saturated bulk density
19
kN/m3
Unsaturated bulk density
18
kN/m3
Cohesion
0
kPa
Friction angle
33
deg.
OK
Cancel
Help


Bishop's method of slices
Slip grid
X
Y
Grid start
10.01
m
12.01
m
Grid increment
1
m
1
m
Number points
10
10
Slip circle
Initial radius
5
m
Radius increment
0.5
m
Profile
Number points
5
Current point
1
X
-13
m
Y
16
m
Xinc
Yinc
Slip grid
y points
x points
(Xstart,Ystart)
(X1, Y1)
Profile
(X2, Y2)
Initial radius
(Xs,Ys)
Slip circle
Radius increment
(Xe,Ye)
(Xs,Ys)
OK
Cancel
Help


Vegetation cover
Entire slope
Detention capacity
10
mm
Maximum evaporation
0.0005
mm/hr
No interception model
Using canopy model
Using vegetation
Change soil
Properties at top of column
Column
3
Depth
0
cells
Soil type
Effective permeability
m/s
0
1
2
3
Cover type
Acacia
Thatch effect
Storm start
0
hr
Storm stop
1
hr
Current hour
1
Precipitation per hour
20
mm
Effective precipitation
20
mm
Storm event
Strength parameters
Root tensile strength
30
kPa
Root area ratio
6
%
Effective cohesion
0
kPa
Friction angle
33
deg.
OK
Cancel
Help


Output
File
Input file :
10 hour simulation
Hour 1 FOS 1.2 X 16 m Y 14 m Radius 6.5 m Mass 214.53 Kg Runout 3.82 m
Hour 2 FOS 1.21 X 16 m Y 13 m Radius 6.5 m Mass 323.89 Kg Runout 3.82 m
Hour 3 FOS 1.22 X 16 m Y 13 m Radius 6.5 m Mass 323.89 Kg Runout 3.82 m
Hour 4 FOS 1.22 X 16 m Y 13 m Radius 6.5 m Mass 323.89 Kg Runout 3.82 m
Hour 5 FOS 1.22 X 16 m Y 13 m Radius 6.5 m Mass 323.89 Kg Runout 3.82 m
Hour 6 FOS 1.22 X 16 m Y 13 m Radius 6.5 m Mass 323.89 Kg Runout 3.82 m
Hour 7 FOS 1.23 X 16 m Y 13 m Radius 6.5 m Mass 323.89 Kg Runout 3.82 m
Hour 8 FOS 1.2 X 16 m Y 13 m Radius 10 m Mass 1.32e+03 Kg Runout 3.82 m
Hour 9 FOS 1.2 X 16 m Y 13 m Radius 10 m Mass 1.32e+03 Kg Runout 3.82 m
Hour 10 FOS 1.22 X 16 m Y 13 m Radius 10 m Mass 1.32e+03 Kg Runout 3.82 m
Finish !

Current failure surface

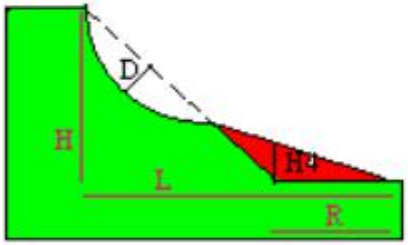
Current failure surface

Hour 5

FOS = 1.26

Run out (R) :

Mean =	2.72	m
Upper 95% confidence =	6.61	m
Lower 95% confidence =	-0.44	m



For interpretation of the result shown here, please refer to the documentation at :
www.chasm.info

Quit

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Input Data

Options of data

- Slope profile
- Soils
- Vegetation
- Canopy
- Storm
- Reinforcements
- Slip surface
- Boundary condition
- Initial conditions

Simplified Slope stability (SimSlope)

About SimSlope

- Invented by GeoLogismiki, a Greec software company that develops software programs for geotechnical engineering tasks.
- It can be used mainly for preliminary analysis of slopes.
- It is designed for performing a quick stability check on a given slope and to get a quick estimate regarding stability and potential failure surface.

Cost

- Free Trail for 30 days
- License:

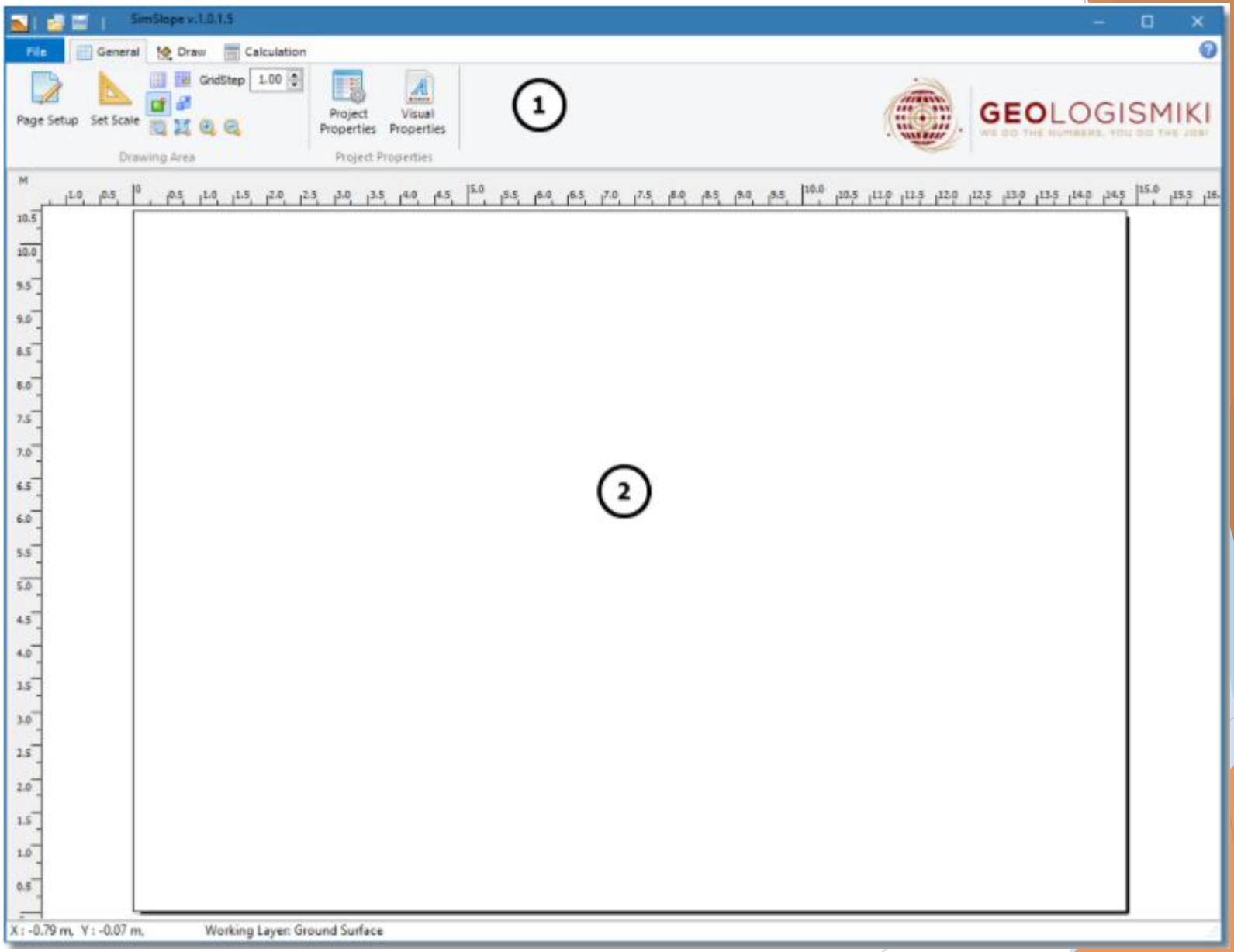
1	249 Euro
2-5	224 Euro/license
6-10	200 Euro/license

Requirements

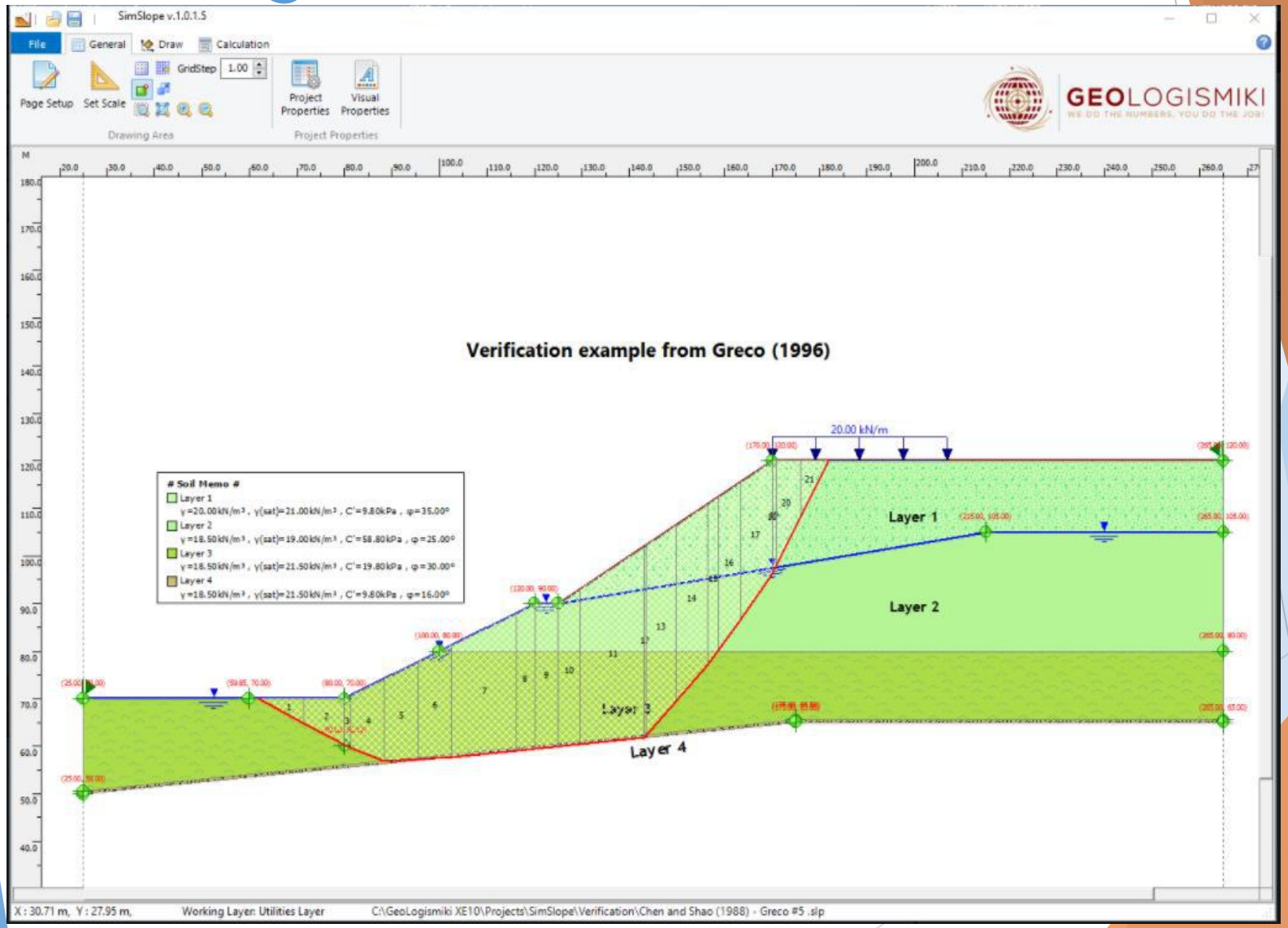
- SimSlope has been tested on IBM compatible machines using Windows® 7, 8, 8.1 and 10 operating system

Main Features

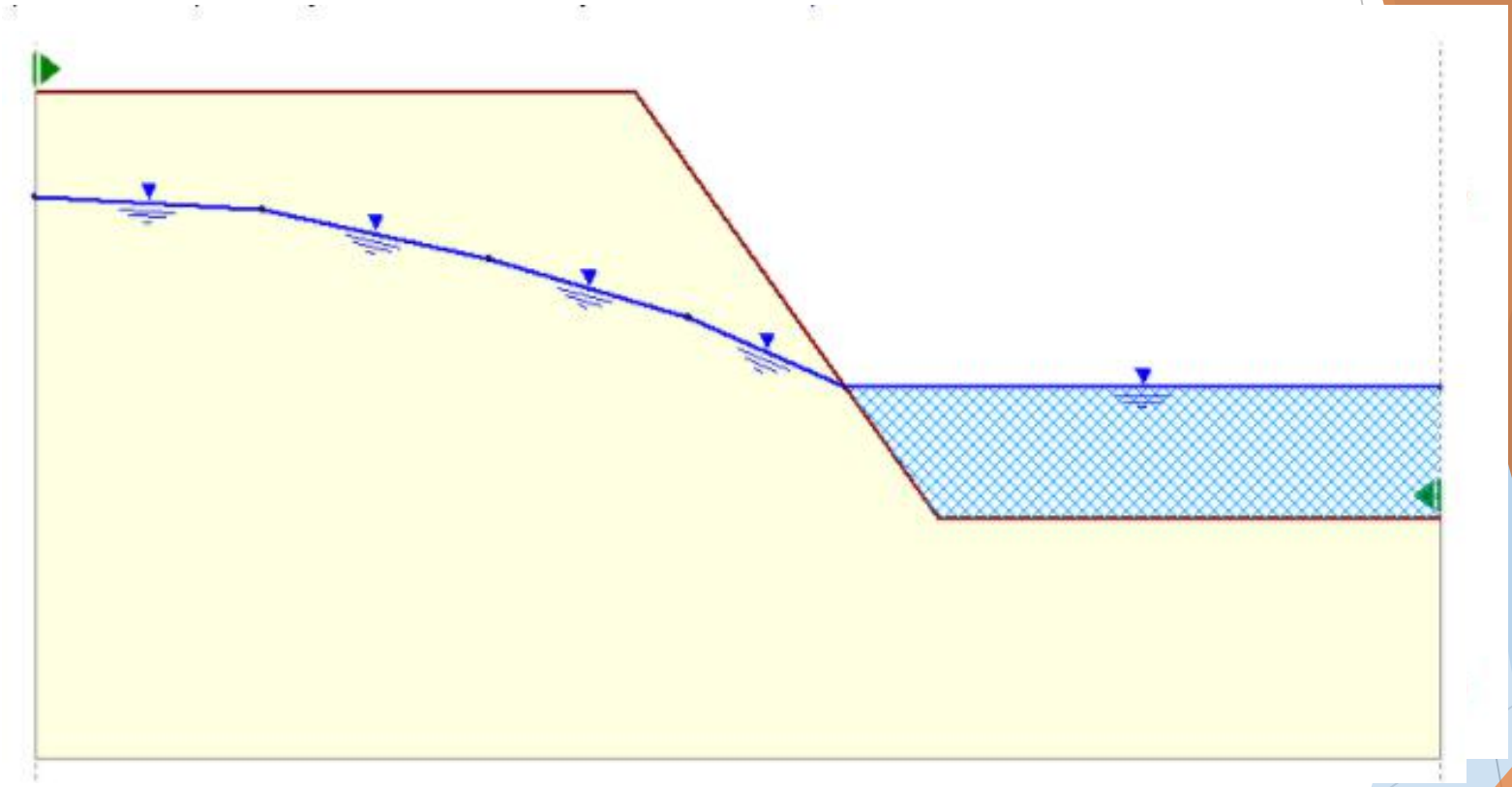
- Simple to use Computer Aided Designed (CAD) interface
- Drafting tools to quickly define slope geometry
- Support for linear external loads and water line
- Fine tuning parameters for locating critical failure shape


SimSlope v.1.0.1.5
File
General
Draw
Calculation
GridStep
1.00
Page Setup
Set Scale
Drawing Area
Project Properties
Visual Properties
Project Properties
1
GEOLOGISMIKI
2
X : -0.79 m, Y : -0.07 m,
Working Layer: Ground Surface

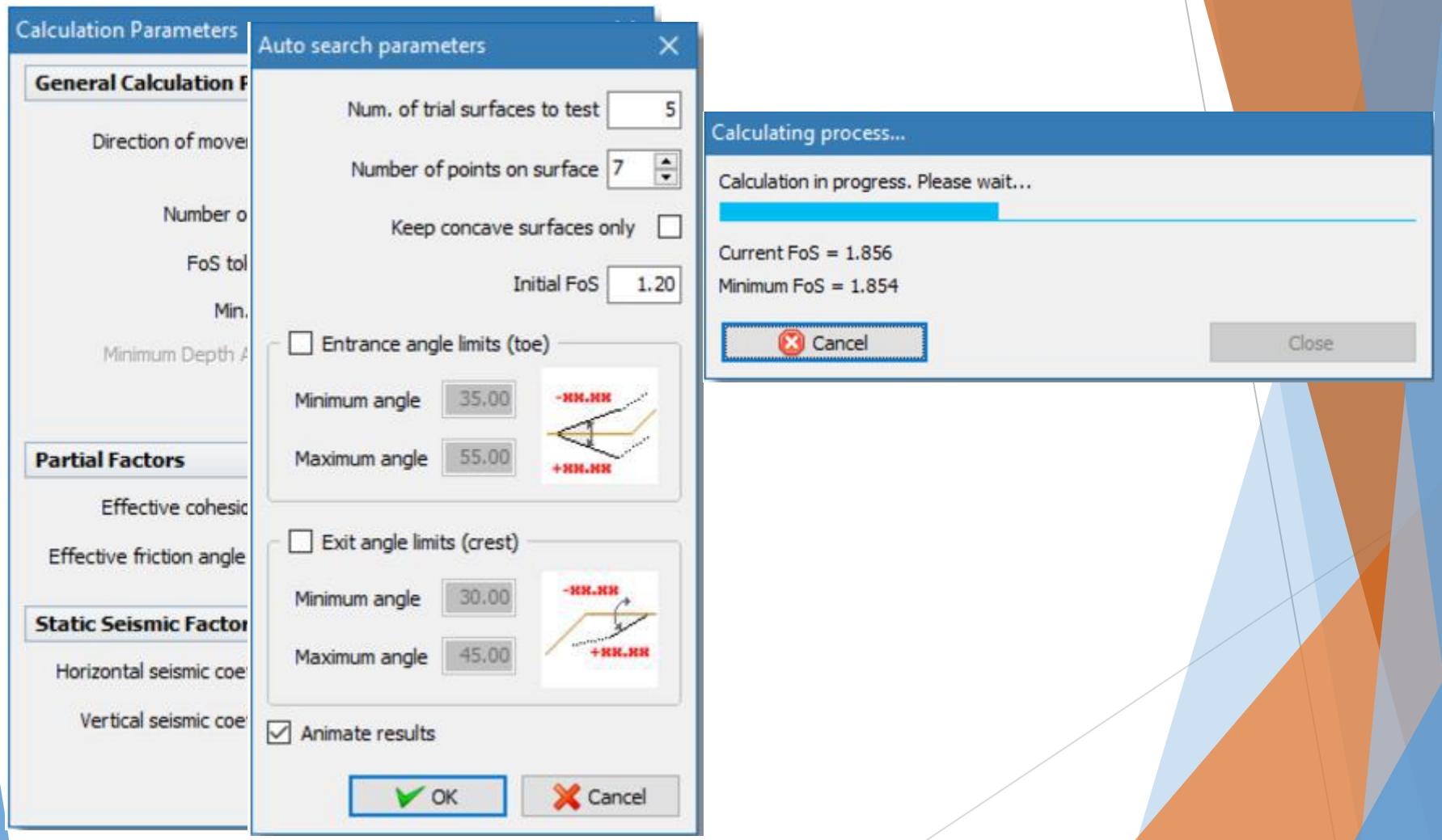
Setting Menu



Draw Toolbar



Calculation Tool Bar



THE END

DEM, DTM, DSM

- DEM: include only bare terrain
- DSM: including terrain and terrain features like natural features and man made features
- DTM- including terrain, geological, climatic, geomorphology, climatology, meteorology, and oceanology factors

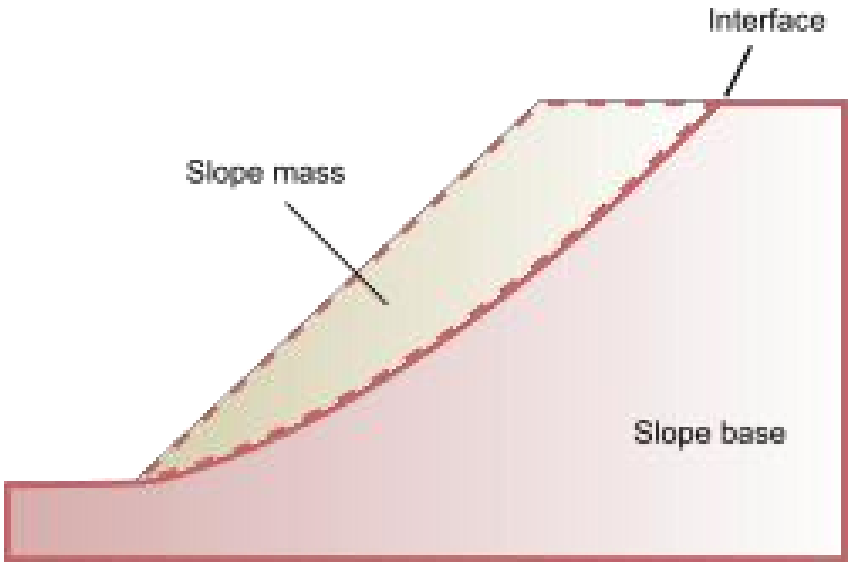
Limit equilibrium methods

- Analysis output: a factor of safety (Fs)
- Fs= $\frac{\text{resisting force}}{\text{driving force}} = \frac{s}{\tau} = \frac{c' + \sigma' tan\, \phi'}{\tau}$

  c=cohesion, σ'= normal stress, τ sheering strength, ϕ' angle of internal friction
- Fs < 1 → unstable

Stability Analysis:

- Methods used: **limit equilibrium methods**
- Limit equilibrium methods investigate the equilibrium of a soil mass tending to slide down under the influence of gravity



A typical cross-section of a slope used in two-dimensional analyses.