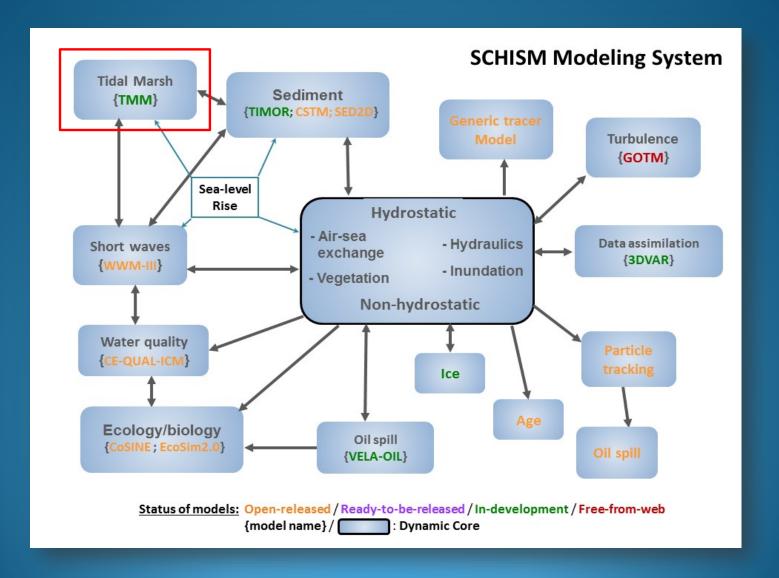
Tidal Marsh Model



Tidal Marsh Model



Tidal Marsh Model

Formulations & Parameterization	Formatting Spatial Data	Grid Generation	Run Model / Export Outputs to GIS Environment	Evaluation of Model Performance
System and boundaries Resolution Forcing & mechanistic functions State variables Governing equations	Spatial dataset for assisting grid generation Generation of DEMs	Unstructured Grid Combination of different cell shapes Connectivity list Iterative process	SCHISM framework Fortran and Matlab Scripts to Export SCHISM-TMM outputs	Calibration Skill Assessment Sensitivity Analysis

TMM code specifications -

Simulate **marsh migration** under the joint influence from tides, wind waves, sediment transport, precipitation, and SLR

TMM accounts for:

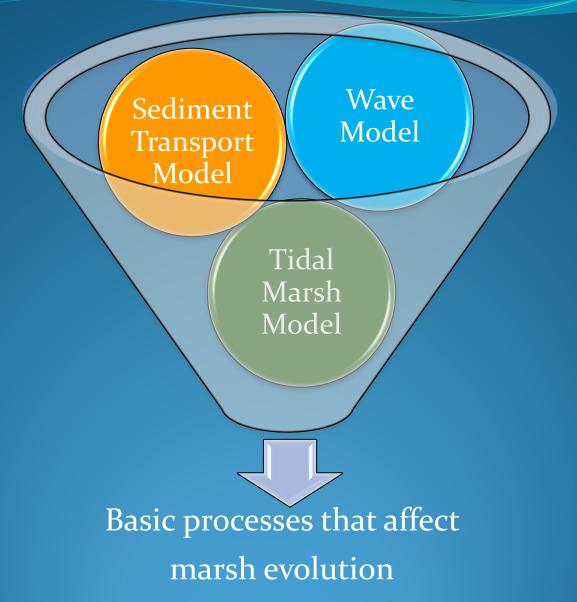
- shoreline bank erosion
- marsh accretion through mineral sediment deposition
- upland erosion inputs at the marsh edge
- marsh upland transgression under a changing sea level with constraints from physical barriers (e.g. ripraps, bulkheads, etc.)

TMM code specifies:

- Marsh presence/absence is marked on each unstructured-grid cell (roughness coefficient)
- Presence of marsh is determined by the surface elevation of the sediments: it can only support marsh presence if it falls in the appropriate intertidal range
- Constraints imposed for migration: 1) a cell can become 'marsh' at the new time step only if at least one adjacent cell was marsh at the previous time step,
 2) anthropogenic structures

Selected input datasets for TMM and supporting models:

Dataset	Source
Tidal Marshes (Scale: 1:1,000)	Tidal Marsh Inventory – CCRM, VIMS
Shoreline Structures	Shoreline Inventory Program – CCRM, VIMS
Riparian Land use (distance: 100	Shoreline Inventory Program – CCRM, VIMS
ft.)	
LIDAR data	United States Geological Survey (USGS)
Bathymetry	NOAA and CBNERR, VIMS
Bottom Type (grain sizes)	VIMS and Maryland Geological Survey (MGS)
River Input (average daily values)	United States Geological Survey (USGS)
Total Suspended Solids	Chesapeake Bay Program
Atmospheric Forcing	North American Regional Reanalysis (NARR)
Tides	US East Coast Tidal Database



(i.e. erosion, vertical accretion, landward migration)

Sediment Transport Model

Inputs

- 1. elevation data-- Chesapeake Bay topobathy DEM raster
- 2. bathymetry data-- Chesapeake Bay topobathy DEM raster
- 3. bottom type--with grain sizes, Bay mainstem and VA tributaries points
- 4. shoreline erosion rates -- Hardaway data points
- 5. shoreline structures -- points (piers, etc) & linear features (riprap, bulkhead, etc)
- 6. river input--average daily values from Fall Line stations, USGS- tabular data

In addition for TMM:

7. Upland sediment input -- polygons of upland source area (10m buffer) and soil input value(s).

Tidal Marsh Model

Inputs

1. Marshes – (marsh type) Tidal Marsh Inventory, CCRM – points

Resolution (outer part – 15m): 1 m cross-shore

10-20 m along-shore

Resolution (inner part): 30 m

- 2. <u>Shoreline structures</u>— Shoreline Inventory, CCRM points (structures adjacent to marshes) ...do we want to incorporate all structures?
- 3. <u>Adjacent Upland</u> (transgression) 30m buffer points Resolution: 30 m
- 4. **Vegetation data** (stem diameter, height, and density)

Tidal Marsh Model

Processing of structures data for grid generation

York River structures (adjacent to marshes)

```
POINTID GRID_CODE
                                          POINT_X POINT_Y
                         Barriers
                         342610.61570000000
                                                   4155099.05038000000
                 yes
                         342611.61570000000
                                                   4155099.05038000000
                 yes
                 yes
                         342609.61570000000
                                                   4155098.05038000000
                         342610.61570000000
                                                   4155098.05038000000
                 yes
                 yes
                         342611.61570000000
                                                   4155098.05038000000
                                                   4155098.05038000000
                 yes
                         342612.61570000000
                 yes
                         342608.61570000000
                                                   4155097.05038000000
                 yes
                         342609.61570000000
                                                   4155097.05038000000
                 yes
                         342610.61570000000
                                                   4155097.05038000000
10
                 yes
                         342611.61570000000
                                                   4155097.05038000000
                         342612.61570000000
                                                   4155097.05038000000
                 yes
12
                         342613.61570000000
                                                   4155097.05038000000
                 yes
                         342608.61570000000
                                                   4155096.05038000000
                 yes
14
                 yes
                         342609.61570000000
                                                   4155096.05038000000
15
                         342610.61570000000
                                                   4155096.05038000000
                 yes
16
                 yes
                         342611.61570000000
                                                   4155096.05038000000
17
                 yes
                         342612.61570000000
                                                   4155096.05038000000
18
                 yes
                         342613.61570000000
                                                   4155096.05038000000
19
                 yes
                         342614.61570000000
                                                   4155096.05038000000
20
                         342609.61570000000
                                                   4155095.05038000000
                 yes
21
                         342610.61570000000
                                                   4155095.05038000000
                 yes
22
                yes
                         342611.61570000000
                                                   4155095.05038000000
23
                 yes
                         342612.61570000000
                                                   4155095.05038000000
24
                         342613.61570000000
                                                   4155095.05038000000
                 yes
```

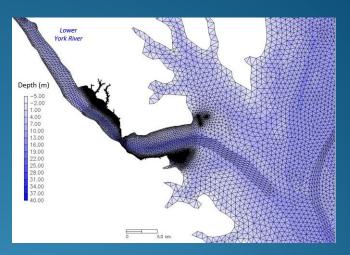
Grid Generation

One of the strengths of this model approach is that it uses an unstructured grid for the simulation

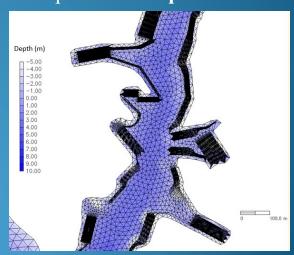


Grid generation software: SMS (Surface-water Modelling System) by Aquaveo.com

Marsh elements: increased bottom roughness parameter (Ye *et al.*, 2013)



This type of grid allows multiple resolutions over the domain and higher resolution where fine scales are important: **sharp transition**





Processing of marsh data for grid generation





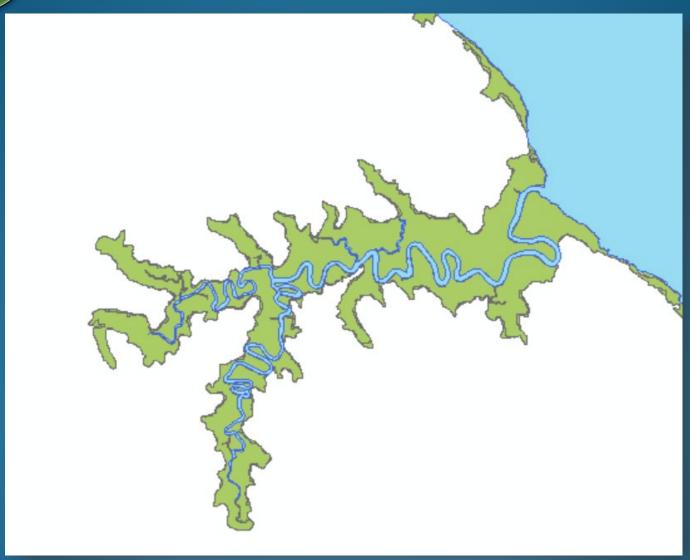
Geospatial Modelling Environment

- 1. Merge Old and New TMI into single file.
- 2. Convert merged TMI into line feature.
- 3. Buffer line feature by 15m, both sides
- 4. Erase the part of the buffer that overlaps the water using the water layer
- 5. Generate a 100m (or appropriate size) fishnet using the Create Fishnet tool in Data Management
- 6. Use the Command geom.splitpolysbylines in GME to split the buffer polygons where they intersect the lines.
- 7. Add a field called "Angle" to the split shapefile (Float)
- 8. Use the "Calculate Polygon Main Angle" tool in ArcMap to get the main angle
- 9. Add fields called "XDIST" and "YDIST" to the split shapefile. Use the field calculator to make the XDIST = 5, and the YDIST = 1. (these numbers are for the long-shore and cross-shore resolutions)
- 10. Erase the buffered area from the Merged TMI file. Repeat step 9 on the erased file, changing XDIST and YDIST value to 30 (this is the inner part of the marsh for non-fringing marshes).
- 11. Merge both files (outer and inner part of the marshes)
- 12. Use the genregular ptsinpolys command in GME to generate the grid points. Set the XDIST and YDIST fields accordingly. The optional [rot] argument should be your Angle field.
- 13. XY coordinates are added to the point shapefile
- 14. The attribute table of the point shapefile is exported as an ASCII file



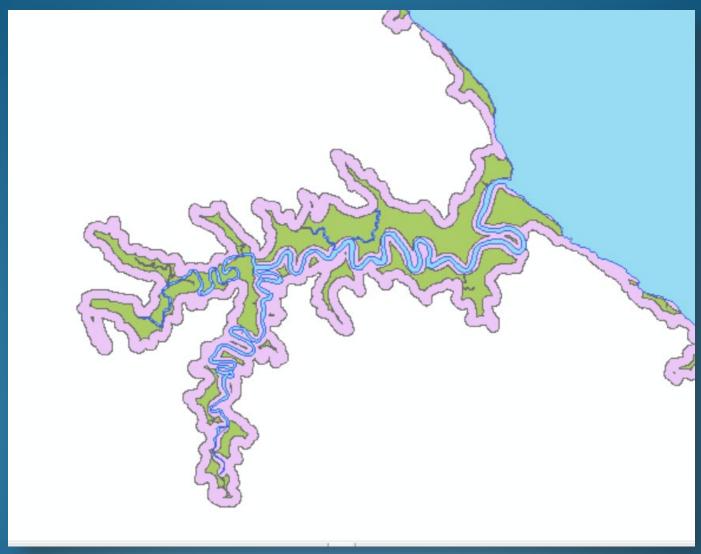


- 1. Merge Old and New TMI into single file.
- 2. Convert merged TMI into line feature.



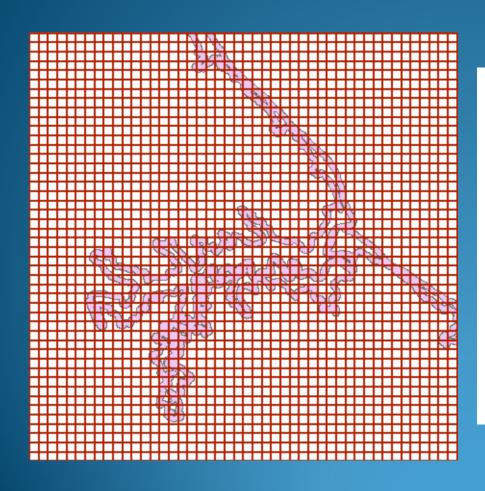


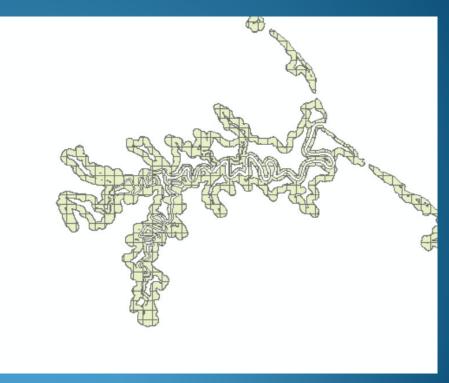
- 3. Buffer line feature by 15m, both sides
- 4. Erase the part of the buffer that overlaps the water using the water layer





- 5. Generate a 100m (or appropriate size) fishnet using the Create Fishnet tool in Data Management
- 6. Use the Command geom.splitpolysbylines in GME to split the buffer polygons where they intersect the lines.







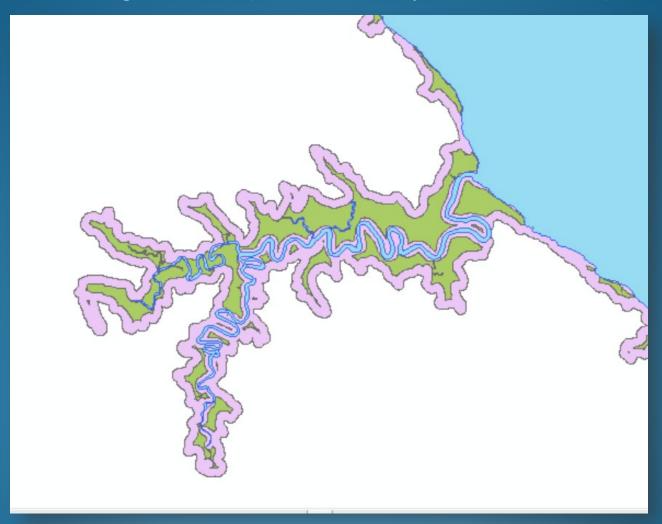
- 7. Add a field called "Angle" to the split shapefile
- 8. Use the "Calculate Polygon Main Angle" tool in ArcMap to get the main angle
- 9. Add fields called "XDIST" and "YDIST" to the split shapefile. Use the field calculator to make the XDIST = 5, and the YDIST = 1. (these numbers are for the long-shore and cross-shore resolutions)

NewTMI_line_buf15_EraseWater_Split										
	FID	Shape	ld	Refld	Angle	XDIST	YDIST			
F	0	Polygon	0	0	90	5	1			
	1	Polygon	0	0	-90	5	1			
	2	Polygon	0	0	0	5	1			
	3	Polygon	0	0	90	5	1			
	4	Polygon	0	0	0	5	1			
	5	Polygon	0	0	0	5	1			
	6	Polygon	0	0	90	5	1			
	7	Polygon	0	0	-90	5	1			
	8	Polygon	0	0	0	5	1			
	9	Polygon	0	0	90	5	1			
	10	Polygon	0	0	0	5	1			
	11	Polygon	0	0	0	5	1			
	12	Polygon	0	0	90	5	1			
	13	Polygon	0	0	-90	5	1			
	14	Polygon	0	0	0	5	1			
	15	Polygon	0	0	0	5	1			
	16	Polygon	0	0	0	5	1			
	17	Polygon	0	0	0	5	1			
	18	Polygon	0	0	0	5	1			
	19	Polygon	0	0	0	5	1			
	20	Polygon	0	0	-90	5	1			
	21	Polygon	0	0	90	5	1			
	22	Polygon	0	0	90	5	1			
	23	Polygon	0	0	-90	5	1			
	24	Polygon	0	0	0	5	1			



10. Erase the buffered area from the Merged TMI file. Repeat step 9 on the erased file, changing XDIST and YDIST value to 30 (this is the inner part of the marsh – for non-fringing marshes).

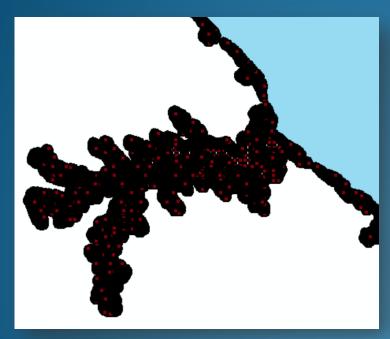
11. Merge both files (outer and inner part of the marshes)

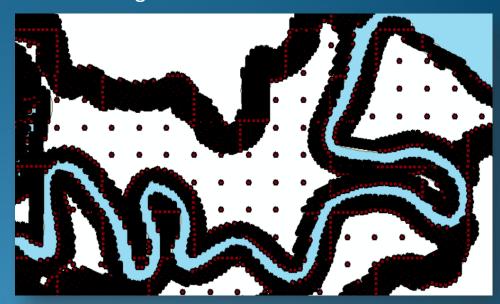


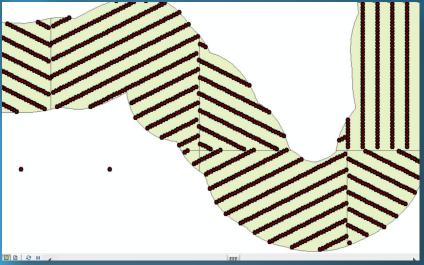


12. Use the genregularptsinpolys command in GME to generate the grid points. Set the XDIST and YDIST fields accordingly.

The optional [rot] argument is the "Angle" field.









- 13. XY coordinates are added to the point shapefile
- 14. The attribute table of the point shapefile is exported as an ASCII file

Gric	Grid_Points									
	FID	Shape	ld	REFFID	PNTID	Old_Marsh	New_Marsh	Upland	POINT_X	POINT_Y
 	0	Point	0	0	1	1	1	0	346610.710197	4144257.78386
	1	Point	0	0	2	1	1	0	346640.710197	4144227.78386
П	2	Point	0	1	1	1	1	0	347472.374802	4143433.307
	3	Point	0	1	2	1	1	0	347502.374802	4143403.307
П	4	Point	0	1	3	1	1	0	347502.374802	4143373.307
	5	Point	0	3	1	1	1	0	348098.117439	4142803.20297
	6	Point	0	3	2	1	1	0	348128.117439	4142773.20297
П	7	Point	0	5	1	1	1	0	346945.945846	4142283.50151
	8	Point	0	5	2	1	1	0	346975.945846	4142253.50151
П	9	Point	0	5	3	1	1	0	347005.945846	4142223.50151
	10	Point	0	5	4	1	1	0	347185.945846	4142133.50151
П	11	Point	0	5	5	1	1	0	346915.945846	4142073.50151
	12	Point	0	5	6	1	1	0	346945.945846	4142073.50151
П	13	Point	0	5	7	1	1	0	347005.945846	4142073.50151
	14	Point	0	5	8	1	1	0	347005.945846	4142043.50151
П	15	Point	0	5	9	1	1	0	347095.945846	4142043.50151
П	16	Point	0	5	10	0	1	0	347005.945846	4142013.50151
	17	Point	0	5	11	1	1	0	347035.945846	4142013.50151
	18	Point	0	5	12	1	1	0	347035.945846	4141983.50151
	19	Point	0	5	13	1	1	0	347065.945846	4141983.50151
	20	Point	0	6	1	1	1	0	347376.165526	4142186.58026
	21	Point	0	6	2	1	1	0	347406.165526	4142156.58026
	22	Point	0	6	3	1	1	0	347406.165526	4142126.58026
	23	Point	0	6	4	1	1	0	347406.165526	4142096.58026
	24	Point	0	6	5	1	1	0	347376.165526	4142036.58026



0 1 1 1 1 0 346610.71019700000 4144257.783860000000 1 1 1 1 1 0 347472.37480200000 41444257.783860000000 1 1 1 1 1 1 0 347472.37480200000 4143433.307000000000 1 2 1 1 1 0 347502.37480200000 4143433.30700000000 1 3 1 1 1 0 347502.37480200000 4143433.30700000000 3 1 1 1 0 348098.11743900000 414383.30700000000 3 1 1 1 0 348098.11743900000 4142833.20297000000 3 1 1 1 0 348098.11743900000 4142283.50151000000 5 1 1 1 0 346945.94584600000 4142283.50151000000 5 1 1 1 0 346945.94584600000 4142233.50151000000 5 2 1 1 0 346945.94584600000 4142233.50151000000 5 3 1 1 0 347005.94584600000 4142233.50151000000 5 3 1 1 0 347005.94584600000 4142233.50151000000 5 3 1 1 0 347005.94584600000 4142233.50151000000 5 3 1 1 0 346945.94584600000 4142233.50151000000 5 6 1 1 0 346945.94584600000 4142073.50151000000 5 7 1 1 0 346945.94584600000 4142073.50151000000 5 6 1 1 0 346945.94584600000 4142073.50151000000 5 7 1 1 0 347005.94584600000 4142073.50151000000 5 7 1 1 0 347005.94584600000 4142073.50151000000 5 7 1 1 0 347005.94584600000 4142073.50151000000 5 1 1 0 347005.94584600000 4142073.50151000000 5 1 1 0 347005.94584600000 4142073.50151000000 5 1 1 0 347005.94584600000 4142073.50151000000 5 1 1 0 347005.94584600000 4142073.50151000000 5 1 1 0 347005.94584600000 4142073.50151000000 5 1 1 1 1 0 347055.94584600000 4142073.50151000000 5 1 1 1 1 0 347055.94584600000 4142073.50151000000 5 1 1 1 1 0 347055.94584600000 4142073.50151000000 6 1 1 1 0 347065.94584600000 4142073.50151000000 6 1 1 1 0 347065.94586000000 4142073.50151000000 6 1 1 1 0 347065.94586000000 4142073.50151000000 6 1 1 1 0 347065.94586000000 4142073.50151000000 6 1 1 1 0 347065.94586000000 4142073.50151000000 6 1 1 1 0 347065.94586000000 4142073.50151000000 6 1 1 1 0 347066.165526000000 4142073.58026000000 6 1 1 1 0 347266.16552600000 4142073.58026000000 6 1 1 1 0 347266.16552600000 4141796.58026000000 6 1 1 1 0 347266.16552600000 4141796.58026000000 6 1 1 1 1 0 347266.16552600000 4141796.58026000000 7 1 1 1 1 0 347366.85994800000 4141976.58026000000 7 1 1 1 1 0 347366.85	REFFID	PNTID	01d_Mar	sh	New_Mars	sh	Upland	POINT_X	POINT Y
0									
1 1 1 0 347472.37480200000 4143433.307000000000 1 2 1 1 0 347502.37480200000 4143403.307000000000 3 1 1 0 347502.37480200000 4143373.307000000000 3 1 1 0 348028.11743900000 4142783.20297000000 5 1 1 0 346945.94584600000 4142283.50151000000 5 1 1 0 346945.94584600000 4142283.50151000000 5 2 1 1 0 347005.94584600000 4142233.50151000000 5 3 1 1 0 347905.94584600000 4142233.50151000000 5 4 1 1 0 346945.94584600000 4142073.50151000000 5 5 1 1 0 346945.94584600000 4142073.50151000000 5 7 1 1 0 347005.94584600000 4142043.50151000000 5 7 1 1									
1 2 1 1 0 347502.3748020000 4143403.3070000000000000000000000000000000									
1		2							
3 1 1 1 0 348098.11743900000 4142803.20297000000 5 1 1 0 348128.11743900000 4142773.20297000000 5 1 1 0 346945.94584600000 4142283.50151000000 5 2 1 1 0 346945.94584600000 4142223.50151000000 5 3 1 1 0 347085.94584600000 4142233.50151000000 5 4 1 1 0 346945.94584600000 4142073.50151000000 5 5 1 1 0 346945.94584600000 4142073.50151000000 5 6 1 1 0 347005.94584600000 4142073.50151000000 5 7 1 1 0 347005.94584600000 4142043.50151000000 5 8 1 1 0 347005.94584600000 4142043.50151000000 5 9 1 1 0 347005.94584600000 4142043.50151000000 5 <td></td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		3							
3 2 1 1 0 348128.11743900000 4142273.20297000000 5 1 1 1 0 346945.94584600000 4142283.50151000000 5 2 1 1 0 346945.94584600000 4142223.50151000000 5 3 1 1 0 347005.94584600000 4142233.50151000000 5 1 1 0 346915.94584600000 4142073.50151000000 5 6 1 1 0 346945.94584600000 4142073.50151000000 5 6 1 1 0 347005.94584600000 4142073.50151000000 5 8 1 1 0 347005.94584600000 4142043.50151000000 5 9 1 1 0 347005.94584600000 4142043.50151000000 5 9 1 1 0 347005.94584600000 4142043.50151000000 5 10 0 1 0 347005.94584600000 4142013.50151000000 <									
5 1 1 0 346945.94584600000 4142283.50151000000 5 2 1 1 0 346975.94584600000 4142253.50151000000 5 3 1 1 0 347055.94584600000 4142233.50151000000 5 4 1 1 0 347185.94584600000 4142073.50151000000 5 5 1 1 0 346945.94584600000 4142073.50151000000 5 6 1 1 0 347005.94584600000 4142073.50151000000 5 7 1 1 0 347005.94584600000 4142073.50151000000 5 9 1 1 0 347005.94584600000 4142043.50151000000 5 9 1 1 0 347005.94584600000 4142043.50151000000 5 10 0 1 0 347035.94584600000 4142013.50151000000 5 12 1 1 0 347035.94584600000 4142013.50151000000				1					
\$\begin{array}{cccccccccccccccccccccccccccccccccccc		1		1					
\$\begin{array}{cccccccccccccccccccccccccccccccccccc		2							
5 4 1 0 347185.94584600000 4142133.50151000000 5 5 1 1 0 346915.94584600000 4142073.50151000000 5 6 1 1 0 346945.94584600000 4142073.50151000000 5 7 1 1 0 347005.94584600000 4142073.50151000000 5 8 1 1 0 347095.94584600000 4142043.50151000000 5 9 1 1 0 347095.94584600000 4142013.50151000000 5 10 0 1 0 347095.94584600000 4142013.50151000000 5 12 1 1 0 347035.94584600000 4142013.50151000000 5 12 1 1 0 347055.94584600000 4142013.50151000000 5 12 1 1 0 347065.94584600000 4141983.50151000000 6 1 1 1 0 347376.16552600000 4142186.580260000000		3							
5 1 1 0 346915.94584600000 4142073.50151000000 5 6 1 1 0 346945.94584600000 4142073.50151000000 5 7 1 1 0 347005.94584600000 4142073.50151000000 5 8 1 1 0 347005.94584600000 4142043.50151000000 5 9 1 1 0 347005.94584600000 4142013.50151000000 5 11 1 1 0 347035.94584600000 4142013.50151000000 5 12 1 0 347035.94584600000 4142013.50151000000 5 13 1 1 0 347035.94584600000 4141983.50151000000 6 1 1 0 347065.94584600000 4141983.50151000000 6 1 1 0 34736.16552600000 4142186.58026000000 6 1 1 0 347406.16552600000 4142156.58026000000 6 3 1 1<		1							
5 7 1 1 0 347005.94584600000 4142073.50151000000 5 8 1 1 0 347005.94584600000 4142043.50151000000 5 9 1 1 0 347095.94584600000 4142043.50151000000 5 10 0 1 0 347035.94584600000 4142013.50151000000 5 12 1 1 0 347035.94584600000 4142983.50151000000 5 13 1 1 0 347035.94584600000 4141983.50151000000 6 1 1 1 0 347376.16552600000 4142186.58026000000 6 1 1 1 0 347376.16552600000 4142186.58026000000 6 3 1 1 0 347406.16552600000 4142136.58026000000 6 3 1 1 0 347406.16552600000 4142036.58026000000 6 5 1 1 0 347376.16552600000 4142036.58026000000	5	7	1						
5 7 1 1 0 347005.94584600000 4142073.50151000000 5 8 1 1 0 347005.94584600000 4142043.50151000000 5 9 1 1 0 347095.94584600000 4142043.50151000000 5 10 0 1 0 347035.94584600000 4142013.50151000000 5 12 1 1 0 347035.94584600000 4142983.50151000000 5 13 1 1 0 347035.94584600000 4141983.50151000000 6 1 1 1 0 347376.16552600000 4142186.58026000000 6 1 1 1 0 347376.16552600000 4142186.58026000000 6 3 1 1 0 347406.16552600000 4142136.58026000000 6 3 1 1 0 347406.16552600000 4142036.58026000000 6 5 1 1 0 347376.16552600000 4142036.58026000000	5	6	1	1					
5 8 1 1 0 347005.94584600000 4142043.50151000000 5 9 1 1 0 347095.94584600000 4142043.50151000000 5 10 0 1 0 347095.94584600000 4142013.50151000000 5 11 1 1 0 347035.94584600000 4142013.50151000000 5 12 1 1 0 347035.94584600000 4141983.50151000000 6 1 1 0 347365.94584600000 4142186.58026000000 6 1 1 0 347366.16552600000 4142186.58026000000 6 1 1 0 347406.16552600000 4142186.58026000000 6 3 1 1 0 347406.16552600000 414216.58026000000 6 4 1 1 0 347406.16552600000 4142036.58026000000 6 5 1 0 347376.16552600000 4142036.58026000000 6 6 1<	5	7		1					
5 9 1 1 0 347095.94584600000 4142013.50151000000 5 10 0 1 0 347035.94584600000 4142013.50151000000 5 11 1 0 347035.94584600000 4142013.50151000000 5 12 1 1 0 347035.94584600000 4141983.50151000000 6 1 1 0 347376.16552600000 4142186.58026000000 6 2 1 1 0 347406.16552600000 4142186.58026000000 6 3 1 1 0 347406.16552600000 4142166.58026000000 6 4 1 1 0 347406.16552600000 4142096.58026000000 6 5 1 1 0 347376.16552600000 4142036.58026000000 6 7 1 0 347376.16552600000 4142036.58026000000 6 7 1 0 3473406.16552600000 4142036.58026000000 6 7	5								
5 10 0 1 0 347005.94584600000 4142013.50151000000 5 11 1 0 347035.94584600000 4142013.50151000000 5 12 1 1 0 347035.94584600000 4141983.50151000000 5 13 1 1 0 347065.94584600000 4141983.50151000000 6 1 1 1 0 347376.16552600000 4142186.58026000000 6 2 1 1 0 347406.16552600000 414216.58026000000 6 3 1 1 0 347406.16552600000 4142036.58026000000 6 4 1 1 0 347376.16552600000 4142036.58026000000 6 6 1 1 0 347406.16552600000 4142036.58026000000 6 7 1 1 0 347406.16552600000 4142036.58026000000 6 8 1 1 0 347286.16552600000 4141206.58026000000									
5 11 1 1 0 347035.94584600000 4142013.50151000000 5 12 1 1 0 347035.94584600000 4141983.50151000000 6 1 1 1 0 347065.94584600000 4141983.50151000000 6 1 1 1 0 34736.16552600000 4142186.58026000000 6 2 1 1 0 347406.16552600000 4142166.58026000000 6 4 1 1 0 347406.16552600000 4142036.58026000000 6 5 1 1 0 347406.16552600000 4142036.58026000000 6 6 1 1 0 347406.16552600000 4142036.58026000000 6 7 1 1 0 347406.16552600000 4142036.58026000000 6 8 1 1 0 347286.16552600000 4141906.58026000000 6 9 1 1 0 347286.16552600000 4141766.58026000000 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
5 12 1 1 0 347035.94584600000 4141983.50151000000 6 1 1 0 347065.94584600000 4142186.58026000000 6 1 1 0 347376.16552600000 4142186.58026000000 6 2 1 1 0 347406.16552600000 4142126.58026000000 6 3 1 1 0 347406.16552600000 4142096.58026000000 6 4 1 1 0 347406.16552600000 4142036.58026000000 6 5 1 1 0 347406.16552600000 4142036.58026000000 6 6 1 1 0 347406.16552600000 4142036.58026000000 6 7 1 1 0 347406.16552600000 4142036.58026000000 6 8 1 1 0 347286.16552600000 4141796.58026000000 6 9 1 1 0 347226.16552600000 4141766.58026000000 6 </td <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td>				1					
5 13 1 1 0 347065.94584600000 4141983.50151000000 6 1 1 1 0 347376.16552600000 4142186.58026000000 6 2 1 1 0 347406.16552600000 4142126.58026000000 6 3 1 1 0 347406.16552600000 414206.58026000000 6 4 1 1 0 347376.16552600000 4142036.58026000000 6 6 1 1 0 347406.16552600000 4142036.58026000000 6 7 1 1 0 347406.16552600000 4142036.58026000000 6 8 1 1 0 347266.16552600000 4141206.58026000000 6 9 1 1 0 347286.16552600000 4141766.58026000000 6 10 1 1 0 347226.16552600000 4141766.58026000000 6 10 1 1 0 347226.16552600000 4141766.58026000000<				1					
6 1 1 1 0 347376.16552600000 4142186.58026000000 6 2 1 1 0 347406.16552600000 4142156.58026000000 6 3 1 1 0 347406.16552600000 4142196.58026000000 6 4 1 1 0 347406.16552600000 4142036.58026000000 6 5 1 1 0 347406.16552600000 4142036.58026000000 6 6 1 1 0 347406.16552600000 4142036.58026000000 6 7 1 1 0 347286.16552600000 4142036.58026000000 6 8 1 1 0 347286.16552600000 4141796.58026000000 6 10 1 1 0 347226.16552600000 4141766.58026000000 6 12 1 1 0 347226.16552600000 4141766.58026000000 6 12 1 1 0 347226.16552600000 4141766.58026000000									
6 2 1 1 0 347406.16552600000 4142126.58026000000 6 3 1 1 0 347406.16552600000 4142126.580260000000 6 4 1 1 0 347406.16552600000 4142036.58026000000 6 5 1 1 0 347376.16552600000 4142036.58026000000 6 6 1 1 0 347406.16552600000 4142036.58026000000 6 7 1 1 0 347286.16552600000 414126.58026000000 6 8 1 1 0 347286.16552600000 4141796.58026000000 6 9 1 1 0 347226.16552600000 4141766.58026000000 6 10 1 1 0 347226.16552600000 4141766.58026000000 6 12 1 1 0 347226.16552600000 4141766.58026000000 6 12 1 1 0 347236.16552600000 4141566.58026000000									
6									
6		2							
6 5 1 1 0 347376.16552600000 4142036.58026000000 6 6 1 1 0 347406.16552600000 4142036.58026000000 6 7 1 1 0 347406.16552600000 4142036.58026000000 6 8 1 1 0 347286.16552600000 4141826.58026000000 6 9 1 1 0 347286.16552600000 4141766.58026000000 6 10 1 1 0 347256.16552600000 4141766.58026000000 6 12 1 1 0 347286.16552600000 4141566.58026000000 7 1 1 0 347356.83594800000 4141567.16468000000 7 2 1 1 0 347326.83594800000 4141587.16468000000 7 3 1 1 0 347326.83594800000 4141587.16468000000 10 1 1 0 347326.83594800000 4141987.783350000000		2		1					
6 6 1 1 0 347406.16552600000 4142036.58026000000 6 7 1 1 0 347406.16552600000 4142006.58026000000 6 8 1 1 0 347286.16552600000 4141826.58026000000 6 9 1 1 0 347286.16552600000 4141766.58026000000 6 10 1 1 0 347256.16552600000 4141766.58026000000 6 12 1 1 0 347286.16552600000 4141676.58026000000 7 1 1 0 347386.3859480000 4141677.16468000000 7 2 1 1 0 347326.8359480000 4141647.16468000000 7 3 1 0 347317.52090200000 4141917.78335000000 10 1 1 0 347317.520902000000 4141917.78335000000		4							
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		5							
$\begin{array}{cccccccccccccccccccccccccccccccccccc$									
$\begin{array}{cccccccccccccccccccccccccccccccccccc$									
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				1					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				1					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$									
7 1 1 1 0 347356.8359480000 4141677.16468000000 7 2 1 1 0 347326.8359480000 4141647.16468000000 7 3 1 1 0 347326.8359480000 4141587.16468000000 10 1 1 0 347317.52990200000 4141917.78335000000									
7 2 1 1 0 347326.83594800000 4141647.16468000000 7 3 1 1 0 347326.83594800000 4141587.16468000000 10 1 1 0 347317.52090200000 4141917.78335000000									
7 3 1 1 0 347326.83594800000 4141587.16468000000 10 1 1 0 347317.52090200000 4141917.78335000000		1							
10 1 1 1 0 347317.52090200000 4141917.78335000000		2							
12 1 1 1 0 347602.65020100000 4142222.51711000000									
	12	1	1	1	Ü	347602.	65020100	000	4142222.51711000000



DEM

Topobathy DEM (in .tif format) is resampled from 1m cells to 3m cells.

Then, it is divided the data layer into more manageable blocks and converted to .asc format.

Both .tif and .asc are raster formats.

