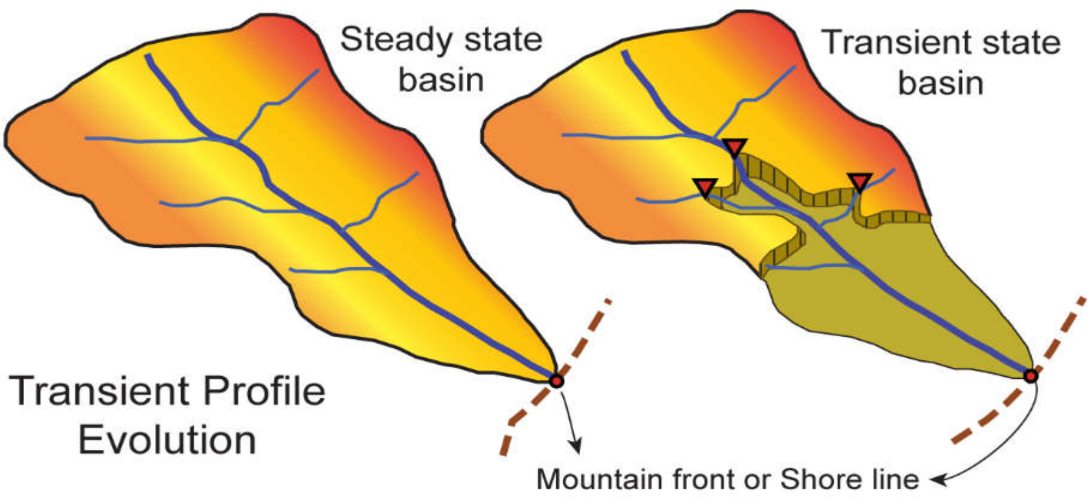
User Manual

Drainage Basin Analysis

- ✓ Drainage Basin Morphometry
- ✓ Geomorphic Indices
- ✓ Transient Profiler



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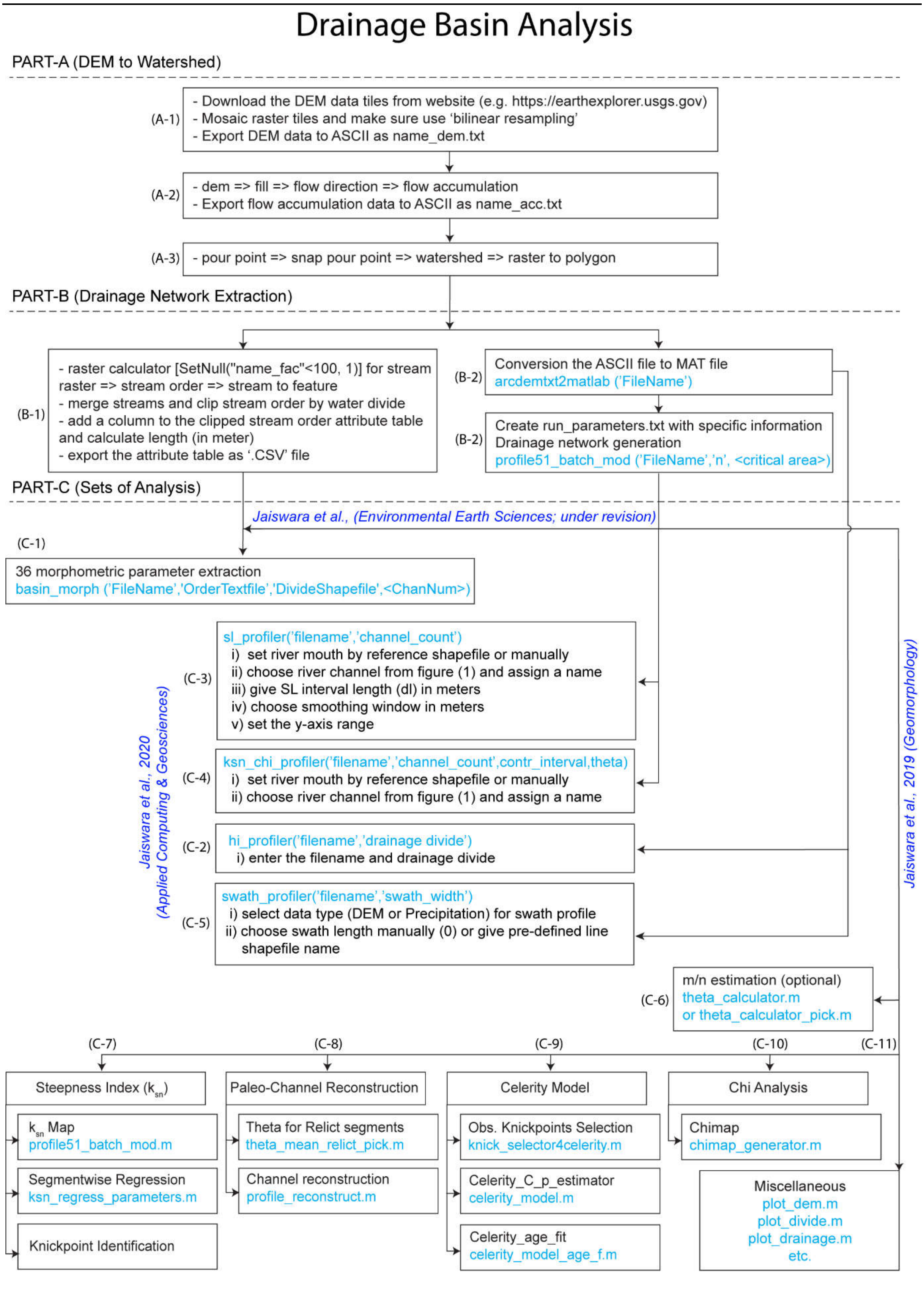
Workflow chart:



List of MATLAB functions

Sl.	**Scn.**	**OBJECTIVES**	**FUNCTIONS**
	A1	DEM to ASCII	ArcGIS (.txt)
	A2	FAC to ASCII	ArcGIS (.txt)
	A3	Drainage divide shapefile	ArcGIS (.shp)
	B1	Stream order to .CSV file	ArcGIS(.txt)
1	B2	Channel data generation	**(1) arcdemtxt2matlab_mod**
2			**(2) profile51_batch_mod**
3			(3) auto_chn_finder
4			(4) closeto
5			(5) movavg51
6			(6) auto_ks_calc
		Basin_Morph	
7	C1	basin morphometry from order.csv and chandata.mat	**(7) basin_morph**
8			(8) plot_reference
9			(9) plot_drainage
10			(10) plot_divide_zoom
11			(11) plot_drainage_mouth
12			(12) inpoly
13			(13) chan_clip_ref
14			(14) basin_length_width
15			(15)asymmetry_factor
		Geomorphic_Indices	
16	C2	Hypsometry integral and profile	**(7) hi_profiler**
17			(8) plot_reference
18	C3	SL-Index with river profile	**(9) sl_profiler**
19	C4	Ksn and Chi profile	**(10) ksn_chi_profiler**
20	C5	Swath profile	**(11) swath_profiler**
21			(12) inpoly
		Transient_Profiler	
22	C6	Reference theta estimator	**(7) theta_calculator**
23			(8) plot_reference
24			(9) plot_dem
25			(10) plot_drainage_ref
26			(11) plot_drainage
27			(12) chan_clip_ref
28			(13) chiplot_scatter_calculator
29			(14) theta_calculator_pick
30	C7	Ksn map ploting (from profile51_batch_mod)	**(15) ksnpoint2line_shp_map**
31		Ksn evaluation segmentwise	**(16) ksn_regress_analysis**
32			(17) plot_divide
33			(18) plot_divide_zoom
34			(19) sa_analysis
35			(20) sa_regress_relict
36			(21) answer_yn

37	C8	Paleo-channel reconstruction_relict theta	**(22) theta_mean_relict_pick**
38 39		Paleo-channel reconstruction_profile	(23) profile_reconstruct (24) sa_regress_reconstruct
40	C9	Celerity model-Knickpoint identification	**(25) knick_selector4celerity**
41 42		Celerity model- minimum missfit plot	**(26) celerity_model** (27) celerity_analysis
43		Celerity model- Fit plot at a given age	**(28) celerity_model_age**
44 45		Celerity model- GIF map	**(29) celerity_model_GIF_Map** (30) Estimate_KnickPoint
46 47	C10	Spatial Chimap	**(31) chimap_generator** (32) sa_analysis_chimap
Some plotting functions			
48 49 50 51	C11	DEM plotting reference .shp plotting drainage plotting drainage with respect to reference	plot_dem plot_reference plot_drainage plot_drainage_ref

PART-A (DEM to Watershed)

A-1. Data preparation

a) Download the required DEM data from the data distributor (we have used SRTM and ASTER data from https://earthexplorer.usgs.gov/)

b) If DEM data has multiple files, mosaic the file at GIS platform

c) The DEM should be projected into UTM projection system. (we have used UTM_Zone_46N). [note: often the projection of data involves resampling, make sure to select **'bilinear'** resampling technique and mentioning the cell size is optional]

d) For later use raw DEM grid need to be exported as ASCII files and named as <filename> followed by suffix 'dem'.

Note: A1, A2, A3 and B1 section can be perform using any GIS software (e.g. ArcGIS, QGIS). Here, we have used ArcGIS and the steps are explained in the following text.

A-2. Flow accumulation generation

Generate Flow accumulation file in any GIS platform (e.g. ArcGIS). Save DEM and Flow accumulation as ASCII files in the working directory by naming <filename> followed by suffix 'dem', 'acc' and/or '.prcpt' respectively.

(dem =>fil =>fdr =>fac)

a) Filling Sinks (fil) - This process will fill the sinks in a grid data and keep "Z limit (optional)" **unchecked**.
b) Flow Direction (fdr) - This process will compute flow direction using the eight direction pour point (D8) method. Keep the "force all edge cells to flow outward (optional)" **unchecked**.
c) Flow Accumulation (fac) - This process uses flow direction grid and generates a grid having cells that assigned by a number of connecting draining cells. Make sure that the output data type should be in **integer**.
d) For later use Flow accumulation grid need to be exported as ASCII files and named as <filename> followed by suffix 'acc'.

   Note: Make sure that the flow accumulation grid is generated from the same DEM which will be used to generate ASCII file for further processing.

A-3. Drainage divide extraction

a) Create a pour point shapefile to determining the drainage basin outlet
b) Snap pour point to rasterize the pour point.
c) Generate watershed raster for drainage divide boundary
d) Convert the extracted watershed raster to polygon shapefile and keep inside the shapefile folder.

Part-B (Drainage Network Extraction)

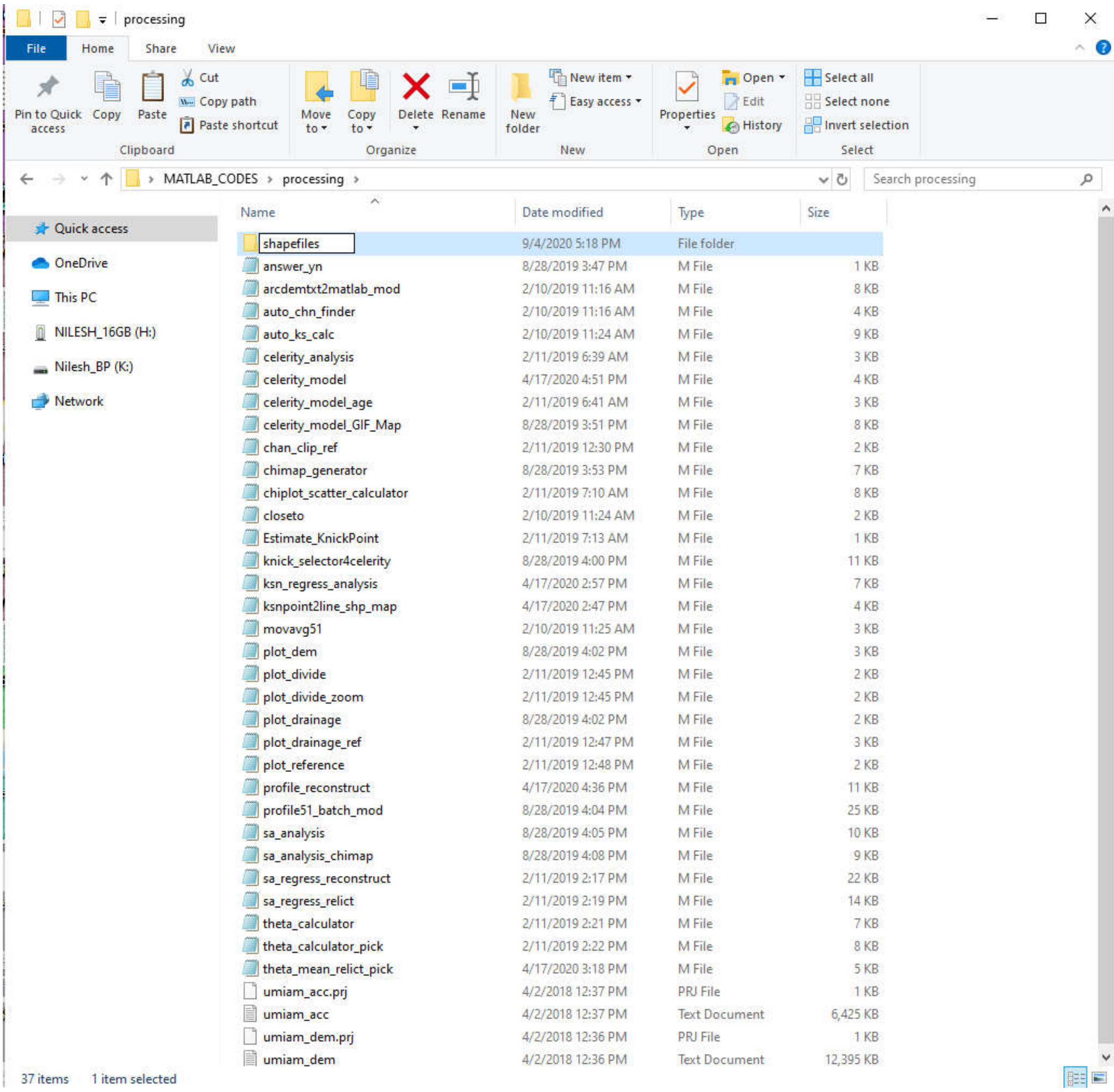
B-1. Drainage order extraction (only required for morphometric parameters)

a) Use 'raster calculator' to create stream raster and classify it using 'stream order'. Then convert ordered stream raster to shapefile using 'stream to feature' tool.
b) Merge the stream order features with respect to the order no. and then clip it by drainage divide boundary.
c) Add stream length column in the attribute table of clipped stream order and calculate the length in meters.
d) Export the attribute table as .CSV file

B-2. Drainage Network extraction (MATLAB)

Keep the ASCII files of DEM and Flow accumulation along with the extracted MATLAB scripts in a working directory/folder (make sure that the directory name and path should not contain any 'space', instead of 'space' use '_' while naming the directories). Make a new directory with the name of 'shapefiles' within the working directory, and keep shapefiles of drainage divide and other GIS files. The 'shapefiles' folder would contain all the input and output GIS files. Make sure the prefix of 'dem' and 'acc' ASCII files (.txt) is same (In present example 'umiam_' before 'dem' and 'acc').

The working directory would look something like this,



The drainage network extraction is being performed using the modified code adapted from (http://geomorphtools.geology.isu.edu/index.htm).

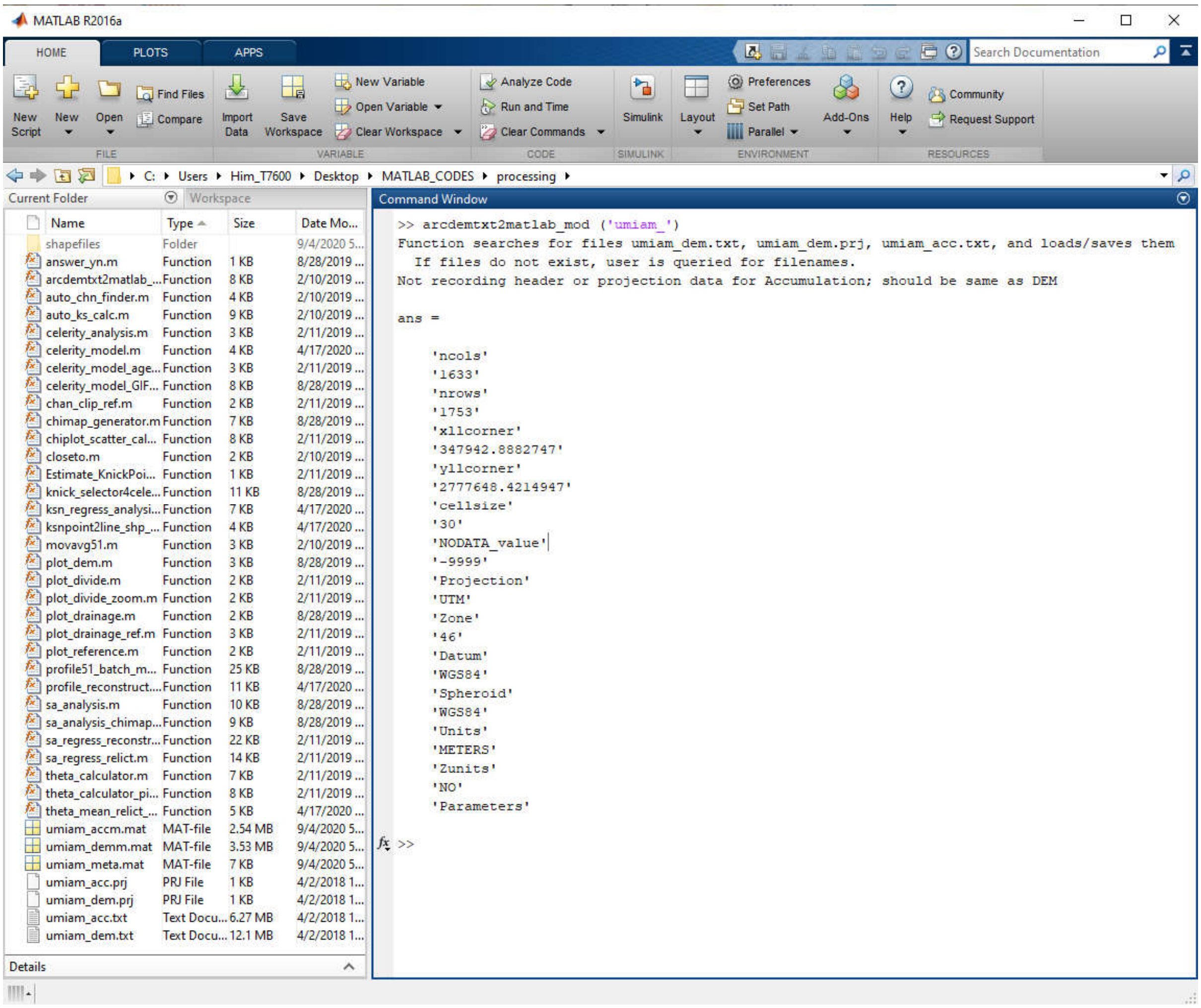
a) Conversion of ASCII file to MAT file

   arcdemtxt2matlab_mod ('filename')

   >>e.g.arcdemtxt2matlab_mod('umiam_')

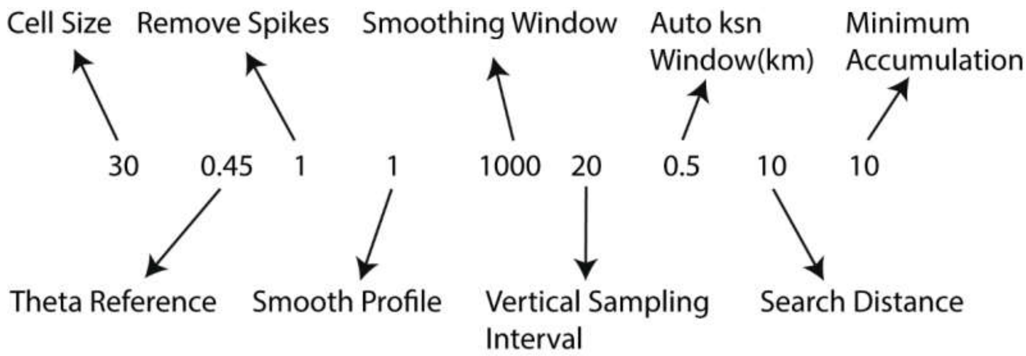
   [Note; write the initials without suffix (e.g. for file named as umiam_dem.txt and umiam_acc.txt, write as 'umiam_')]

   Output: MAT files of DEM, flow accumulation and metadata.



b) Create a text file with few predefined parameters

Create a text file named as "**run_parameters.txt**" file mentioning the input variables with space separated in following order;



(i) Cell Size: Pixel size of the raster grid

(ii) Theta Reference: generally, for bedrock river, default reference concavity is considered as 0.45. theta for more accuracy compute the theta reference for particular basin by using theta_calculator.m function (see section 4)

(iii) Remove Spikes (0/1): data spikes due to DEM artefact could be removed.

(iv)Smooth Profile (0/1): Whether to smooth elevation data or not

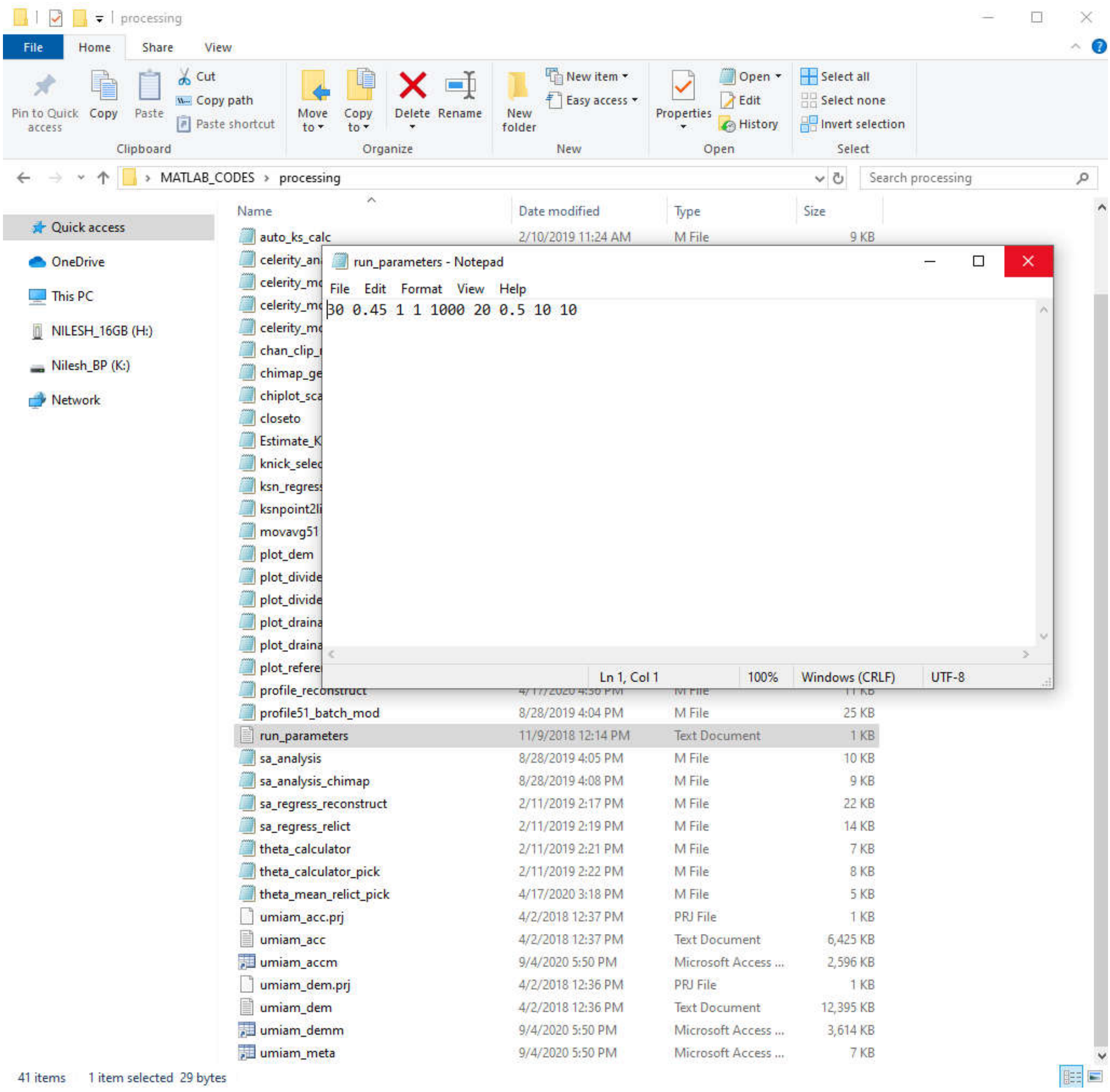
(v) Smoothing Window: Smoothing window in meter

(vi)Vertical Sampling Interval: Contour sampling interval (in meter) used for calculating the local slope.

(vii) Auto k_{sn}Window (km): Width of window (in meter) used in estimation of normalized steepness index

(viii) Search Distance: It is a distance for selecting the actual downstream river path from channel head.

(ix) Minimum Accumulation: Minimum area for determining the channel head.



c) Delineation of drainage network with channel steepness (k_{sn})

- The drainage network extraction has been performed using the modified code taken from (http://geomorphtools.geology.isu.edu/index.htm).

  Run the following script,

  profile51_batch_mod ('filename','n',<critical_area>)

  e.g. >>profile51_batch_mod('umiam_','n',1e7) [1e7=10000000]

  [Note; <critical_area> is a value in m^2 which is considered as the lowest accumulation area for automatically selecting the channels. Smaller the critical area, larger the number of identified channels.]

  Output: creates chandata.mat files containing various estimated variables.

%%

I-Basin Morphology

PART-C (Sets of analysis)

Table-1: List of Morphometric parameters

S.no.	Morphometric parameters	Formula	References
A	**Drainage network (Linear aspects)**		
1	Stream order (Su)	$Su = Su_1+Su_2+\ldots+Su_n$	Strahler (1964)
2	Stream length (Lu)	$Lu = L_1+L_2+\ldots+L_n$	Horton (1945)
3	Stream number (Nu)	Orderwise stream count	Horton (1945)
4	Stream length ratio (RL)	RL=Lu/(Lu-1)	Horton (1945)
5	Bifurcation ratio (Rb)	$Rb=U_n/U_{n+1}$	Schumm (1956)
6	Mean stream length (Lsm)	Lsm=Lu/Nu	Strahler (1964)
7	Rho Coefficient (Rhρ)	Rhρ = RL/Rb	Horton (1945)
B	**Basin geometry (Areal aspects)**		
8	Basin area (A) (km^2)	Calculated from Son basin boundary in GIS	Schumn (1956)
9	Basin perimeter (P) (km)	Calculated from Son basin boundary in GIS	Schumn (1956)
10	Basin length (Lb) (km)	Distance from outlet to farthest point on the basin boundary	Schumn (1956)
11	Basin width (Wb) (km)	Longest perpendicular distance to basin length across the basin	Schumn (1956)
12	Main Channel Length (Cl) (km)	Length longest water course from outlet to upstream	
13	Fitness ratio (Rf)	Rf = Cl/P	Melton (1957)
14	Form factor (Ff)	$Ff = A/Lb^2$	Horton (1945)
15	Relative perimeter (Pr)	Pr=A/P	Schumn (1956)
16	Length area relation (Lar)	Lar=1.4*A^0.6	Hack (1957)
17	Drainage density (Dd) (km/km^2)	Dd=Lu/A	Horton (1945)
18	Drainage texture (Dt)	Dt=Nu/P	Horton (1945)
19	Elongation ratio (Re)	Re = Dd/Lb = 1.128√A/Lb	Schumm (1956)
20	Circularity ratio (Rc)	$Rc = 4pi*A/P^2$	Strahler (1964)
21	Compactness coefficient (Cc)	$Cc = 0.2821*P/A^{0.5}$	Strahler (1964)
22	Stream frequency (Fs) (No/km^2)	Fs = Nu/A	Horton (1945)
23	Constant of channel maintenance (C)	C = 1/Dd	Schumn (1956)
24	Infiltration Number (If)	If = Fs*Dd	Faniran (1968)
25	Drainage Intensity (Di)	Di = F/Dd	Faniran (1968)
26	Length of overland flow (Lg)	Lg =1/2Dd	Horton (1945)
27	Wandering ratio (Rw)	Rw = Lc/Lb	Smart and Surkan (1967)
C	**Relief characteristics (Relief aspects)**		
28	Total basin relief (R)	R = H-h (height of the mouth)	Strahler (1952)
29	Relief ratio (Rr)	Rr = R/Lb	Schumm (1956)
30	Relative relief ratio (Rh)	Rh = (R/P)*100	Melton (1957)
31	Gradient ratio (Rg)	(Elevation of source- Elevation of	Horton (1932)

		mouth)/Lb	
32	Ruggedness Number (Rn)	Rn = Dd*(R/1000)	Patton and Baker (1976)
33	Melton Ruggedness Number (MRn)	MRn = R/A0.5	Melton (1957)
D	**Others**		
34	Sinuosity Index (Snt)	Snt=Actual length of trunk channel/ shortest distance from channel head to mouth	Stølum, H.H., (1996)
35	Asymmetry Factor (AF)	AF=(Area $_{Right}$/Area $_{Total}$)*100	Keller and Pinter(1996)

C-1. Morphometric parameter extraction

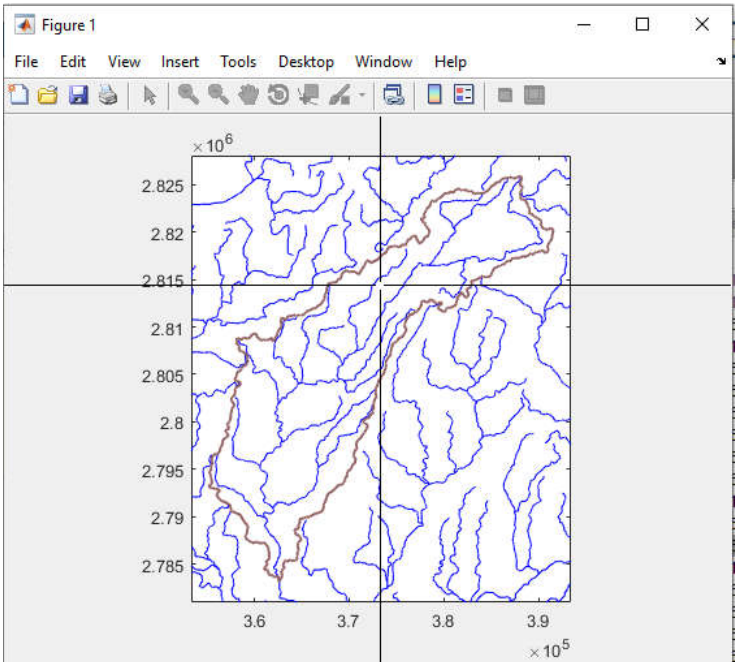
Run the following script for extracting the above mentioned parameters;

basin_morph(FileName, OrderText, DivideShapefile)

e.g. >>basin_morph('umiam_','order_aster_v2.csv','umiam_divide')

>>to determine the river mouth/exit point, select a random channel headconfined within the drainage boundary.

(click on any channel head within the basin boundary to determine the basin outlet point which will be used as reference point for determining all the channels that falls inside the basin)



Following outputs will be displayed in the command window and a textile containing all the parameters will created in the working directory;

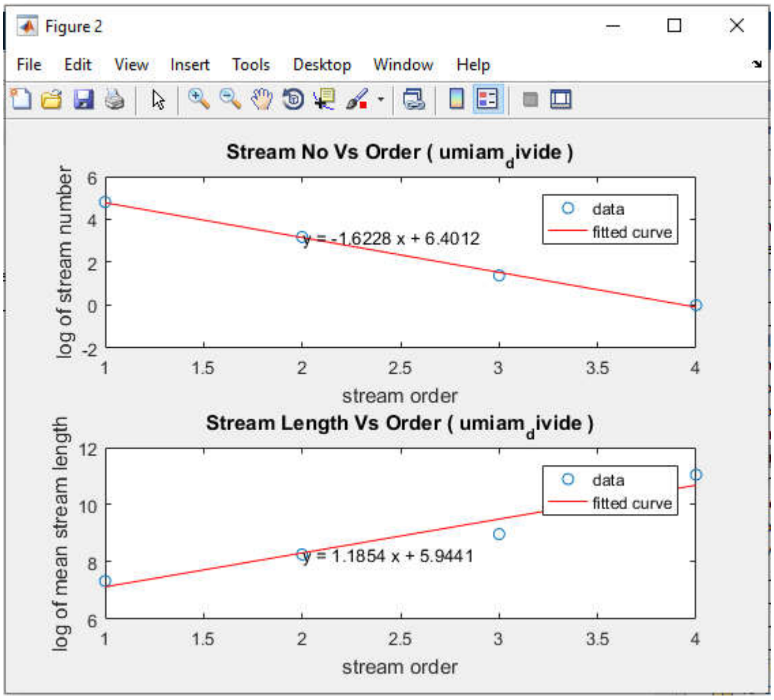
Command Window

```
53 chandata falls inside the basin
55 chandata falls inside the basin
57 chandata falls inside the basin
66 chandata falls inside the basin
-------------------ORDERWISW DRAINAGE PARAMETERS-------------------
                  Stream_number   Stream_length   Mean_stream_length   StreamLength_ratio   Bifurcation_ratio   Rho_Coefficient
                  _____________   _____________   __________________   __________________   _________________   _______________

    1                  123           189.09           1.5374                 NaN                 NaN                 NaN
    2                   24            93.21           3.8835               0.4929               5.125            0.096176
    3                    4            31.67           7.9168              0.33976                   6            0.056626
    4                    1            63.06           63.062               1.9914                   4             0.49785
    Order/Mean          38           94.258             19.1              0.94136              5.0417             0.21688

----------------LINEAR ASPECTS OF THE BASIN-----------------------
Stream order (u)                      = 4
Stream length sum (Lus) (km)          = 377.03
Stream number sum (Nus)               = 152
Mean stream length (RLs)(km           = 2.4805
Mean bifurcation ratio (Rbm)          = 5.0417
Mean stream length ratio (RLm)        = 0.94136
Mean Rho coefficient (Rhom)           = 0.21688
----------------AREAL ASPECTS OF THE BASIN------------------------
<< BASIN GEOMETRY >>
Area(A) (km^2)                        = 498.3062
Perimeter(P) (km)                     = 161.8305
Basin length(Lb) (km)                 = 49.8411
Basin width(Wb) (km)                  = 16.2788
Longest channel length(Cl) (km)       = 79.182
Fitness ratio (Rf)                    = 0.48929
Form Factor(Ff)                       = 0.2006
Shape factor ratio (Sf)               = 4.9852
Relative parameter (Pr) (km)          = 3.0792
Length area relation (Lar)            = 58.1602
Drainage density(Dd) (km/km^2)        = 0.75662
Drainage texture (Dt)                 = 0.93925
Elongation ratio (Re)                 = 0.50528
Circularity ratio (Rc)                = 0.2392
Compactness coefficient (Cc)          = 8.1786
Stream frequency(Fs) (No/km^2)        = 0.30503
Constant of channel maintenance(C)    = 1.3217
Infiltration number (If)              = 0.23079
Drainage intensity (Di)               = 0.40315
Length of overland flow (Lg)          = 0.66083
Wandering ratio (Rw)                  = 1.5887
----------------RELIEF ASPECTS OF THE BASIN-----------------------
Total basin relief(R)                 = 1.952
Relief ratio (Rr)                     = 0.039164
Gradient ratio(Rg)                    = 0.037618
Ruggedness number(Rn)                 = 1.4769
Melton ruggedness number (Mrn)        = 0.087444
Relative relief (Rh)                      = 1.2062
----------------OTHER PARAMETERS OF THE BASIN---------------------
Sinuosity (Snt)                       = 1.5937
Asymmetry factor (AF_m)             = 57.5916
Asymmetry factor (AF_b)             = 42.4084
>>
```

And following plots will be generated in various figure window;



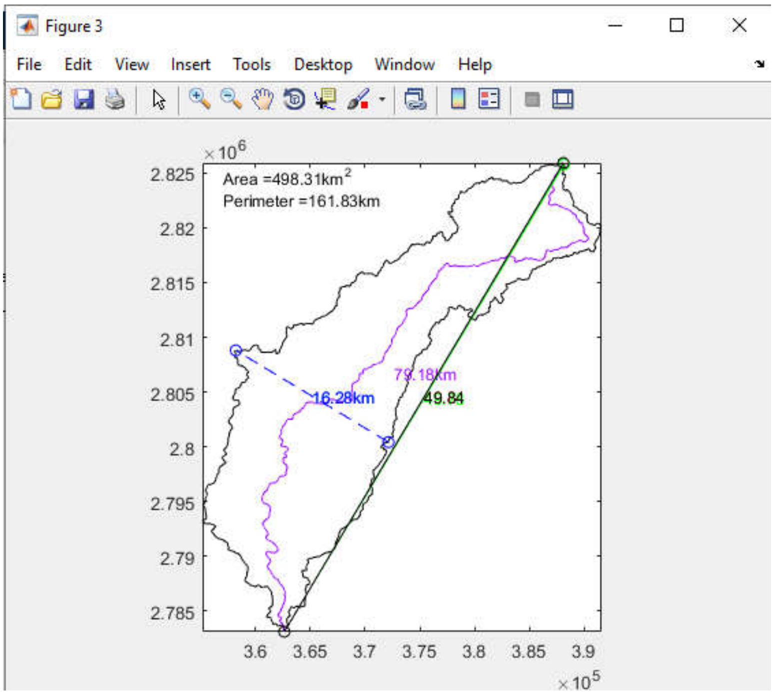


Figure 3
File Edit View Insert Tools Desktop Window Help
×10^6
Area =498.31km^2
Perimeter =161.83km
79.18km
16.28km
49.84
2.825
2.82
2.815
2.81
2.805
2.8
2.795
2.79
2.785
3.6 3.65 3.7 3.75 3.8 3.85 3.9
×10^5

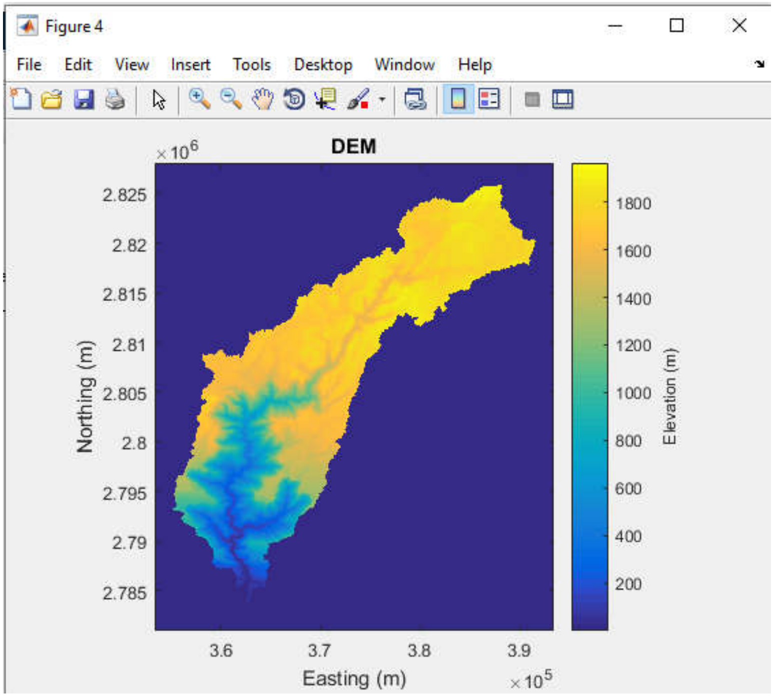
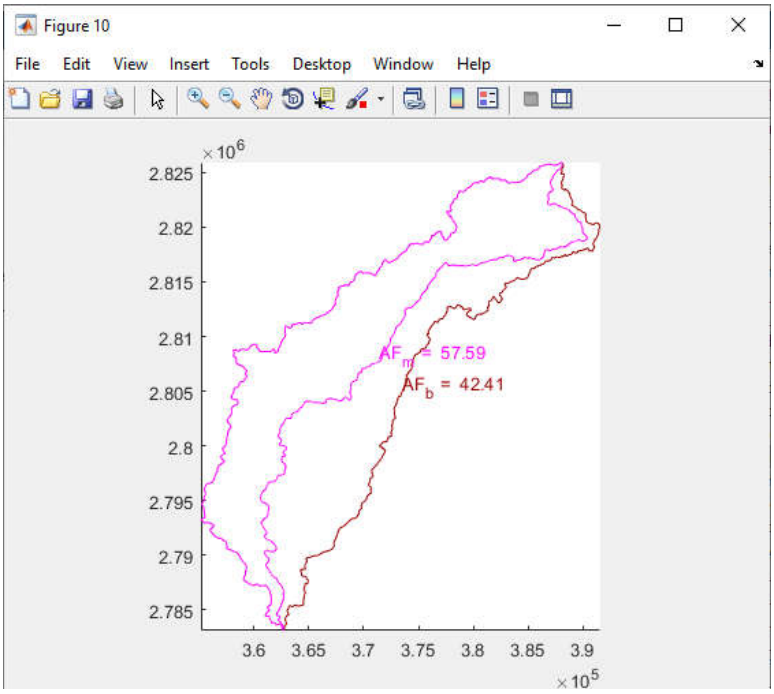


Figure 4
File Edit View Insert Tools Desktop Window Help
DEM
×10^6
Northing (m)
2.825
2.82
2.815
2.81
2.805
2.8
2.795
2.79
2.785
3.6 3.7 3.8 3.9
Easting (m)
×10^5
Elevation (m)
1800
1600
1400
1200
1000
800
600
400
200



%%

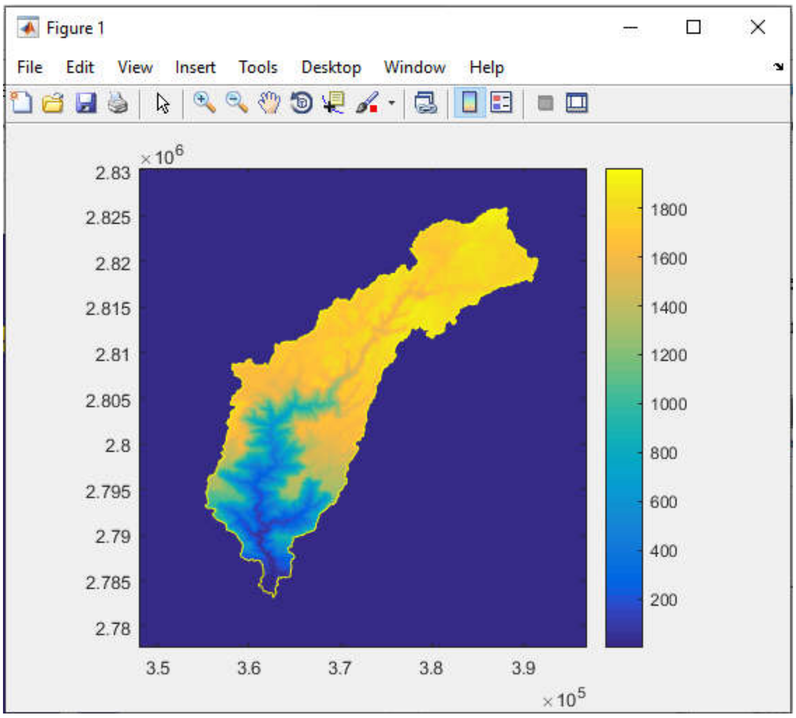
II-Geomorphic indices

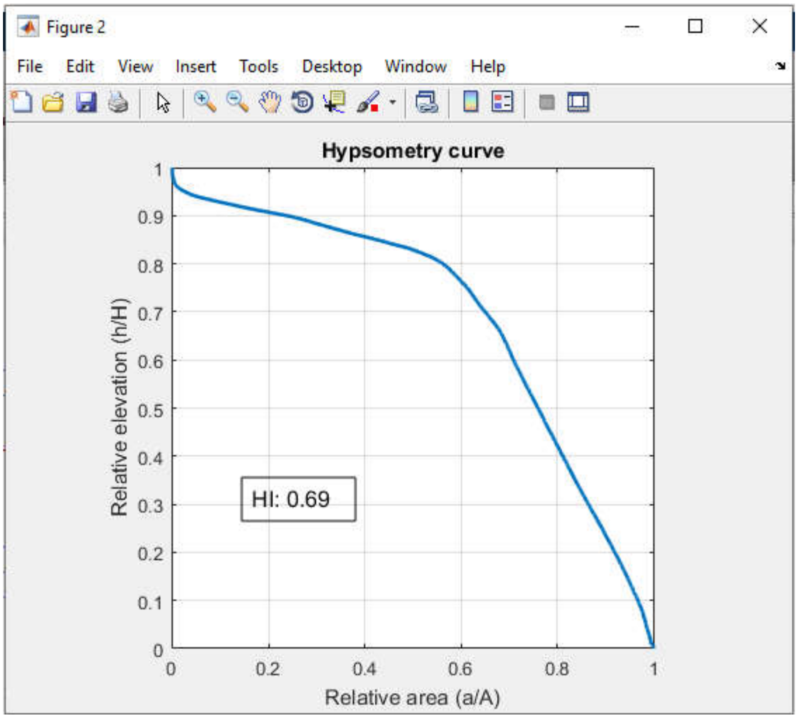
(C-2) Hypsometric Integral

hi_profiler('filename', 'drainage divide')

e.g. >>hi_profiler ('umiam_', umiam_divide')

- Input: ‘filename’ and ‘drainage divide’ [Note; drainage divide file keeps as a .shp file in a folder]
- Output figures (1) shows the drainage basin and figure (2) shows Hypsometry integral





(C-3) SL- Index

sl_profiler('filename')

e.g. >>sl_profiler('umiam_')

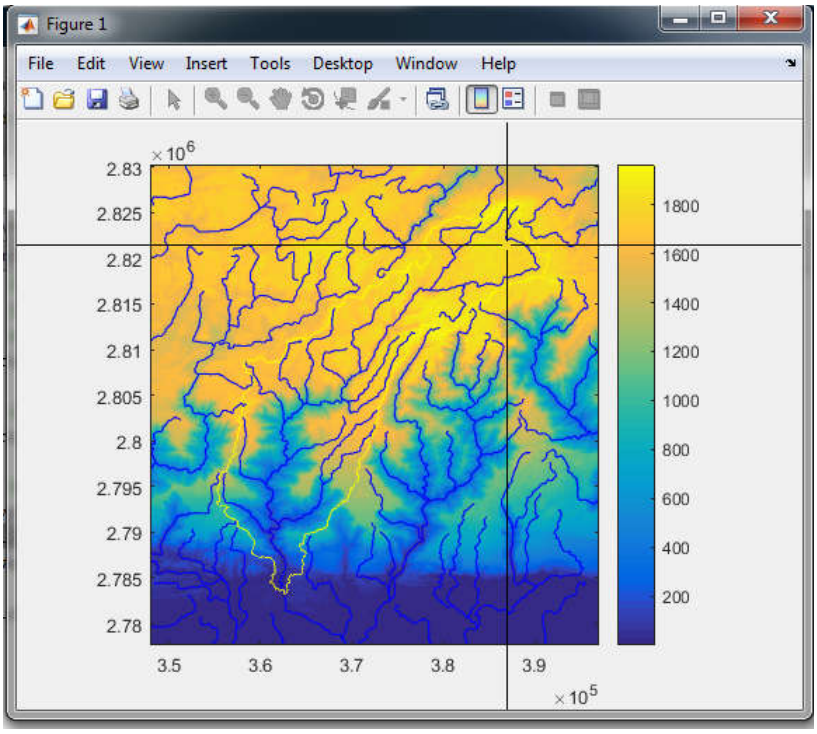
- Input: 'filename' and 'channel_count'

[Note: channel_count can be seen in the command window after run the program]

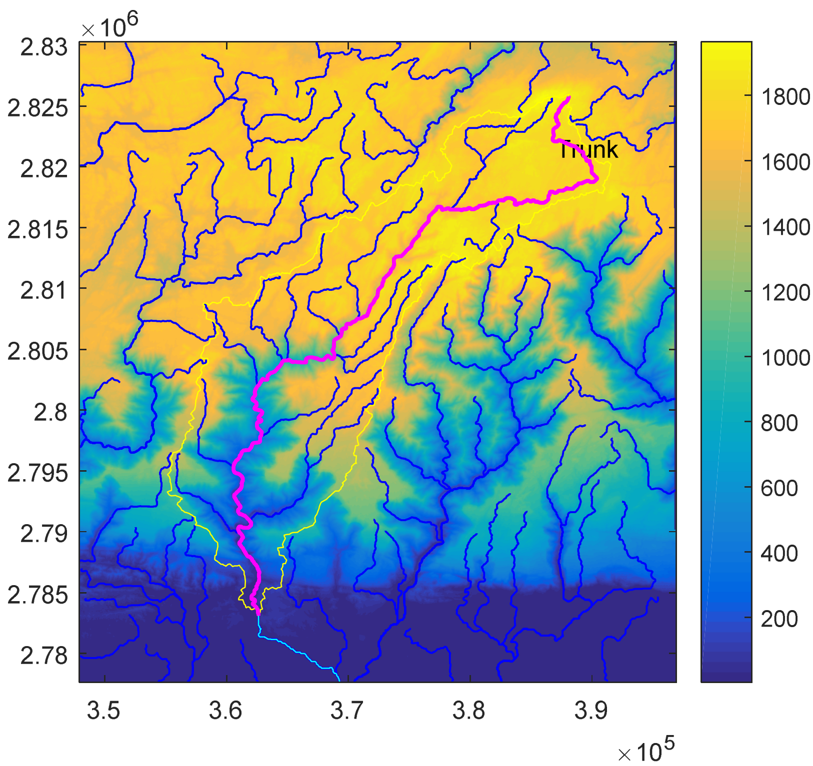
i) enter the mouth reference shapefile name or for choosing reference manually, enter <0>:

ii) select the reference point near the mouth of the drainage by clicking on figure (1)..

iii) select channel from the figure (1) by clicking near the river head and assign a name...



iv) enter the channel name :



v) Enter SL interval in meter else go for the default(5000m) interval by giving " 0 ":

vi) Enter smoothing interval OR to choose default interval(1000m) enter < 0 > :

vii) Do you want to change y-axis limits (1/0) :

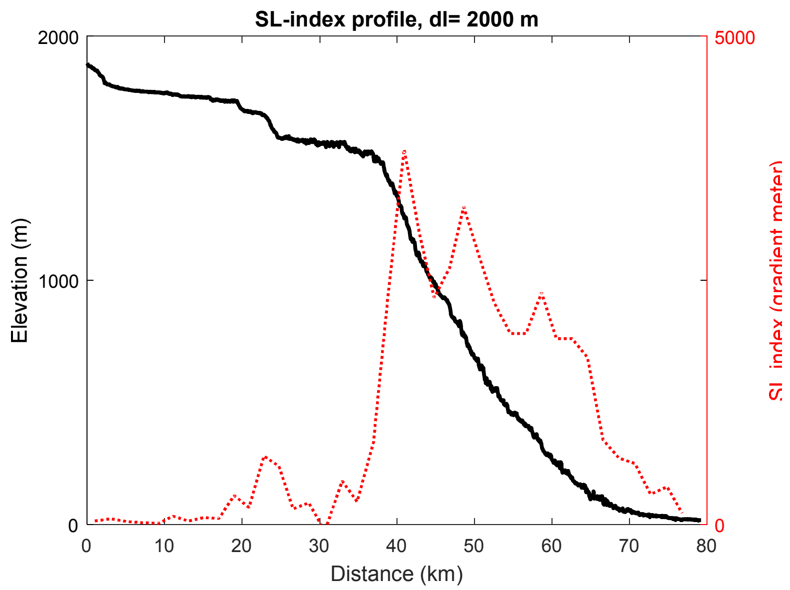
(1) Enter the Elevation y-axis minimum limit :

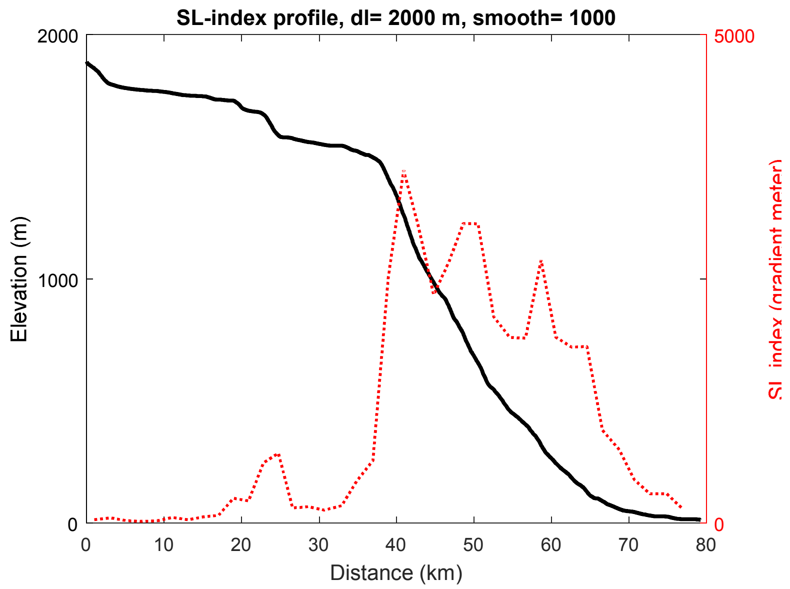
(2) Enter the Elevation y-axis maximum limit :

(3) Enter the SL y-axis minimum limit :

(4) Enter the SL y-axis maximum limit :

viii) Do you want select another channel (1/0) :





(C-4) Normalized steepness index (k_{sn})

The steepness indices are being automatically calculated for each channel while running the '**profile51_batch_mod**' code at the reference theta mentioned in the 'run_paraeters.txt' file. For visualization and plotting purposes, run the following code with the given soothing window.

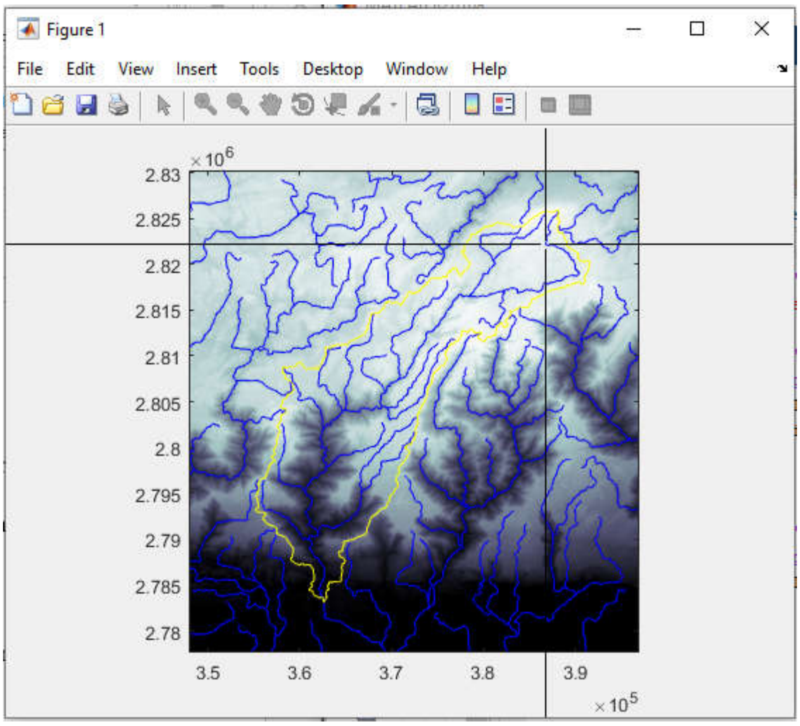
ksn_chi_profiler(file_name, ChanNum,Cont_Intv,theta)

e.g. >>ksn_chi_profiler('umiam_', 79,20,0.45)

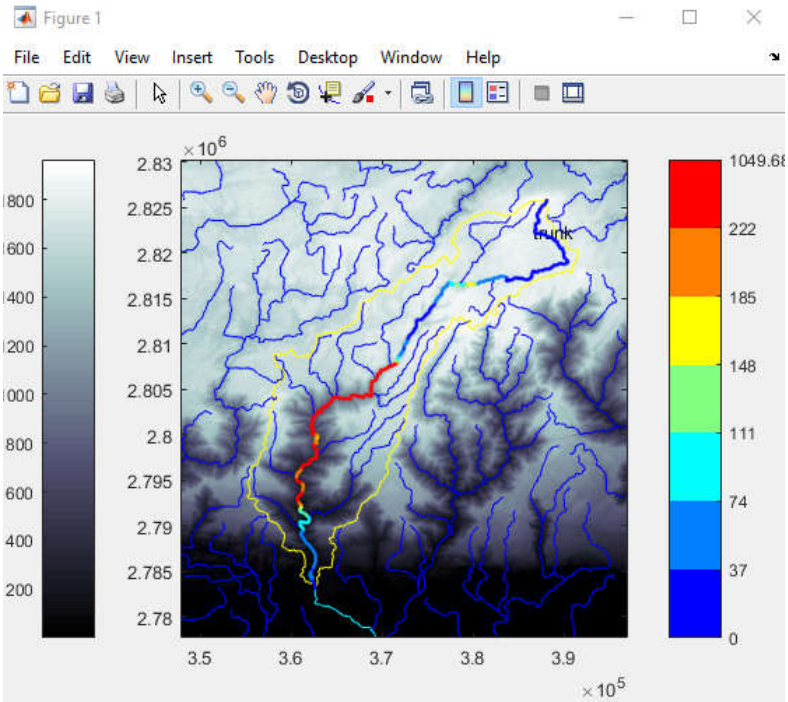
Input: drainage divide filename and

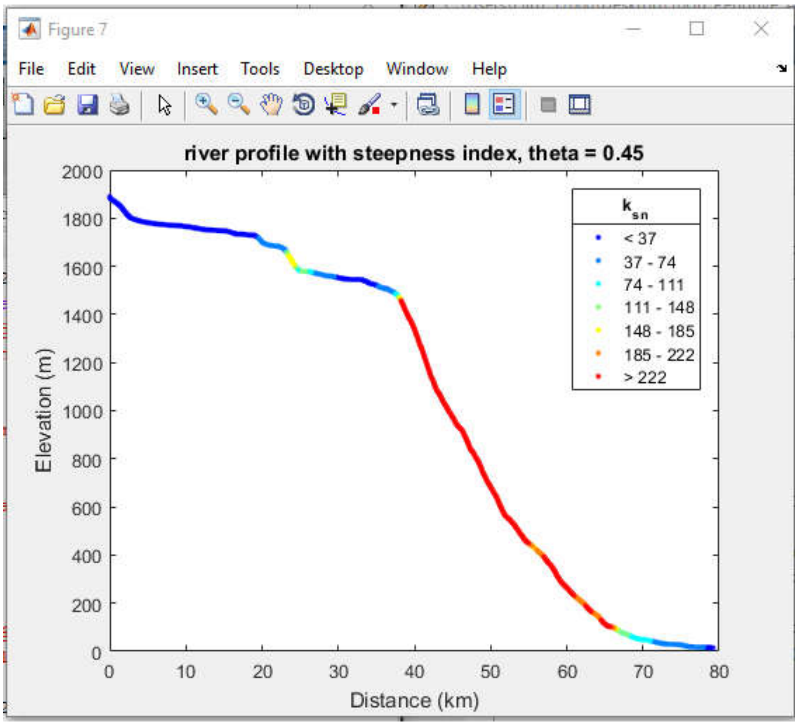
i) enter the reference shapefile name in single inverted comma Or choose manually by entering <0>:

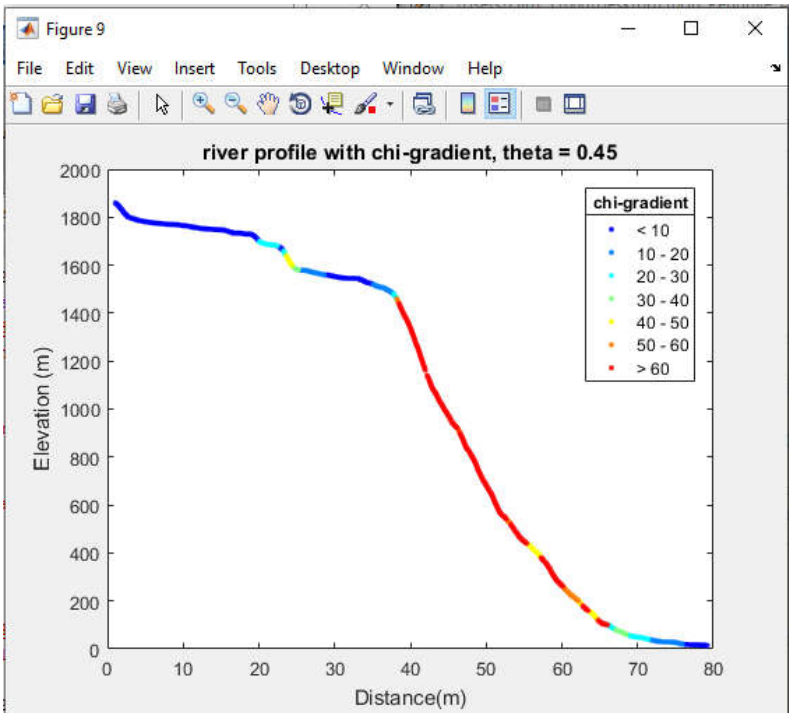
ii) select the channel by clicking near the river head and assign a name...

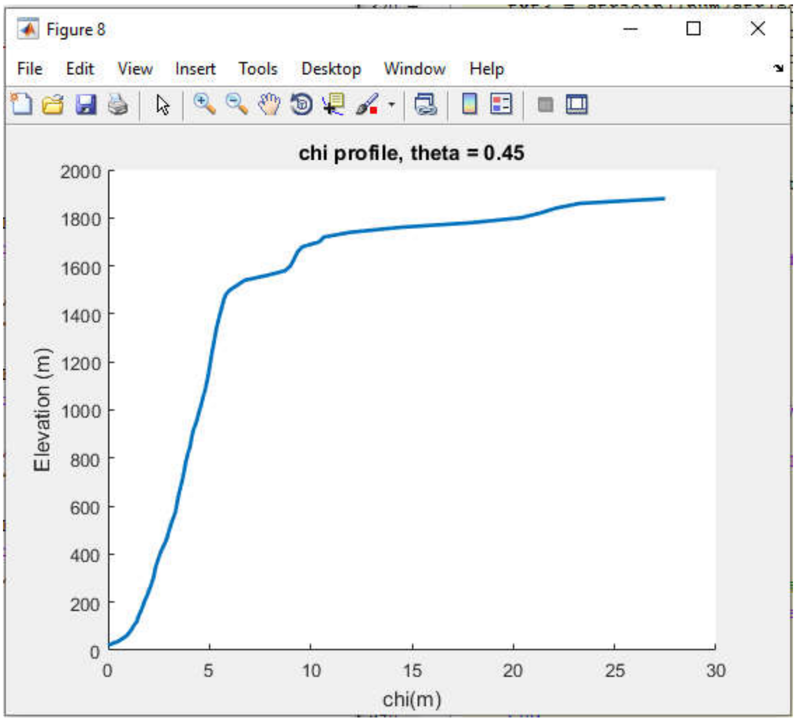


iii) enter the channel name in single inverted comma :









iv) do you want select another channel (1/0) :

Note: The k_{sn}values which falls within the desired basin boundaries are only reliable because they are being estimated for the respective accumulation area (which covers the entire basin area).

(C-5) Swath Profile

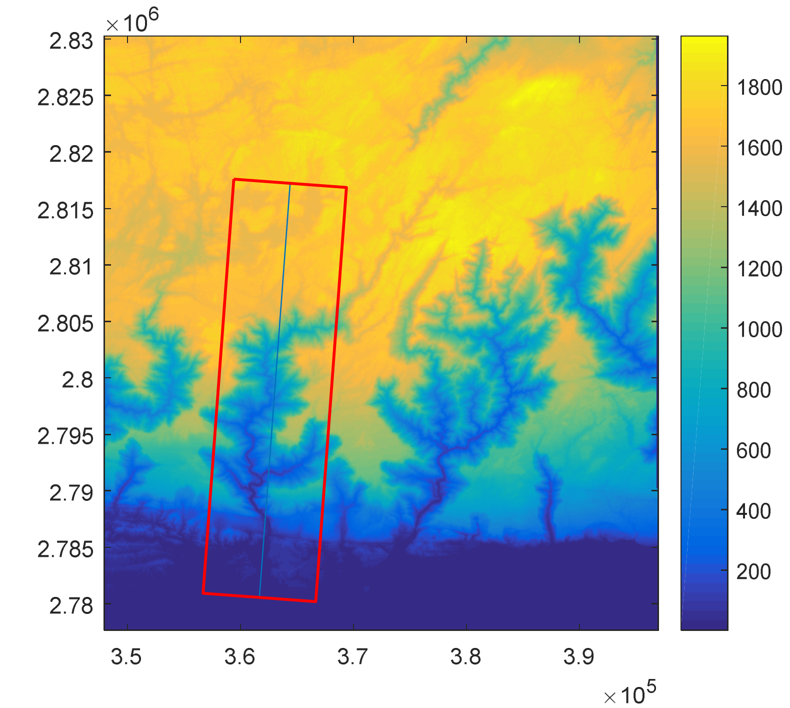
swath_profiler('filename', 10)

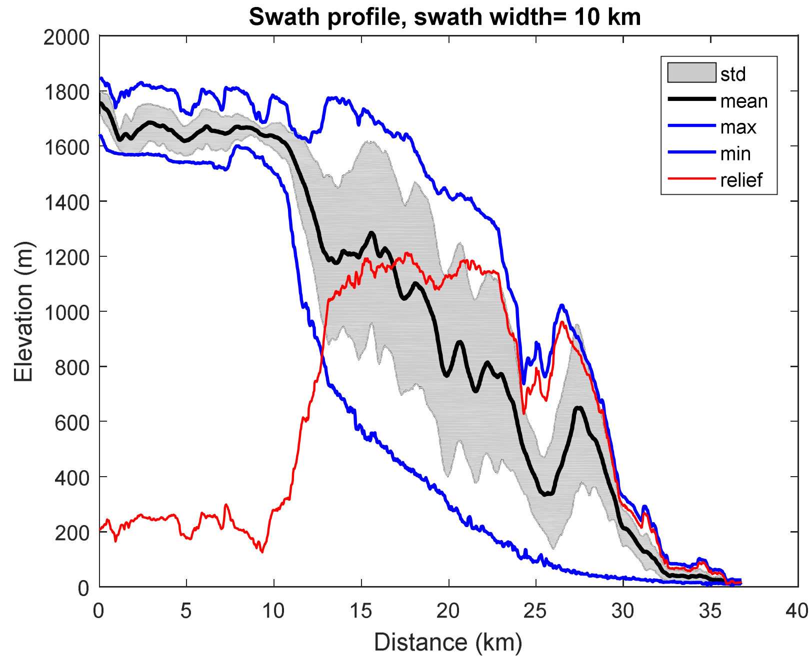
e.g. >>swath_profiler('umiam_', 10)

Input: ‘filename’ and ‘swath width’ in km

i) for swath profile from DEM, enter "1" OR for precipitation data enter "0" :**1**

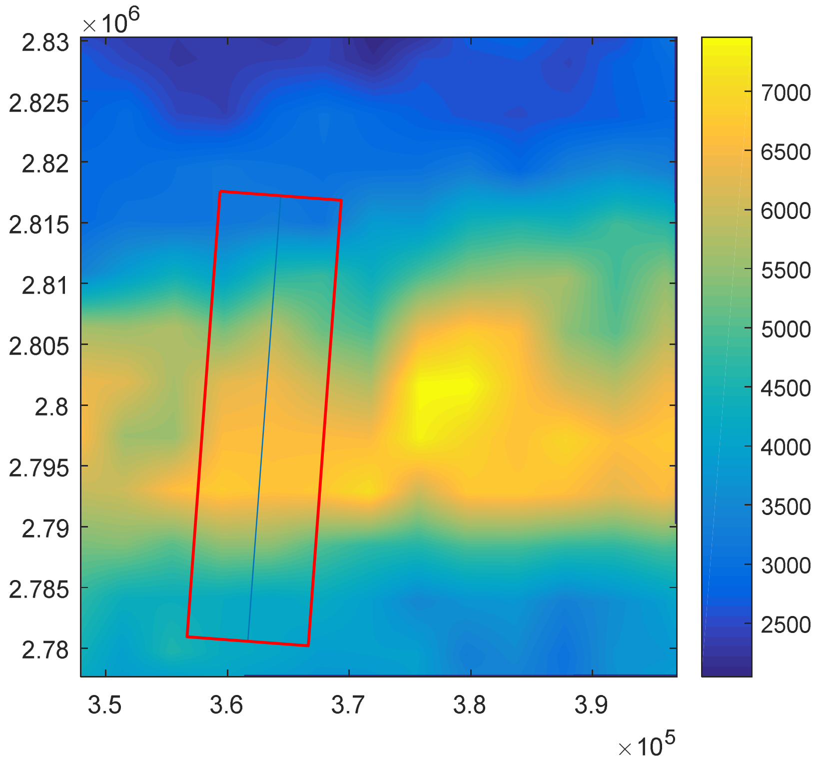
ii) for pre-defined swath line, enter "1" OR for manual input in figure(1), enter "0" : **'swath_umiam'**

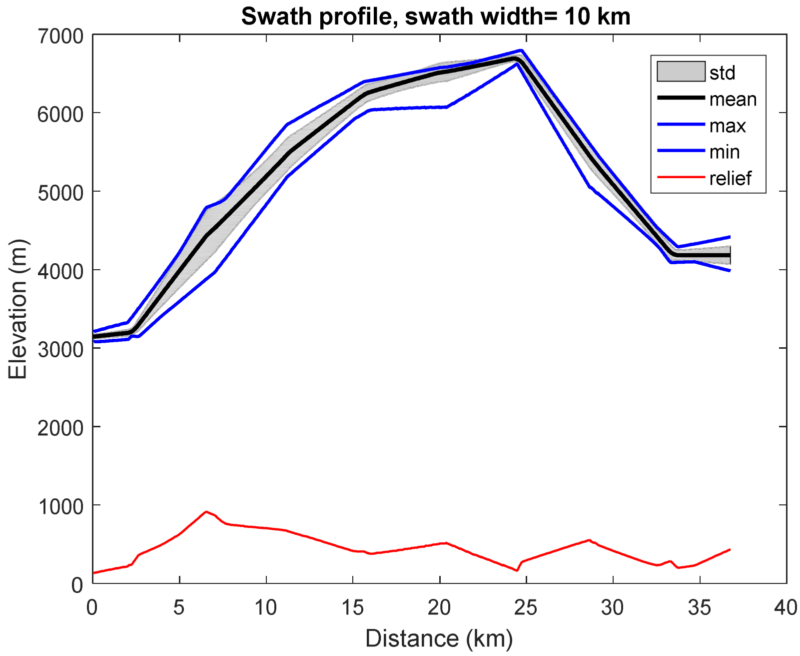




i) for swath profile from DEM, enter "1" OR for precipitation data enter "0" :**0**

ii) for pre-defined swath line, enter "1" OR for manual input in figure(1), enter "0" : **'swath_umiam'**





%%

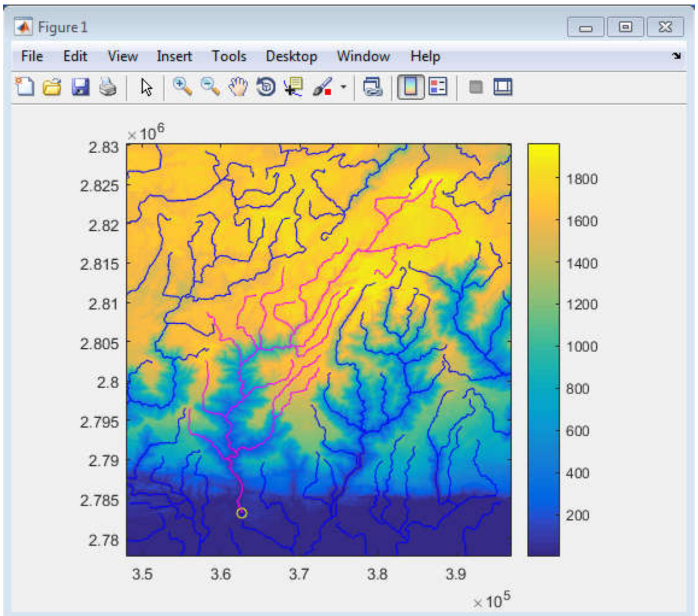
III-Transient profiler

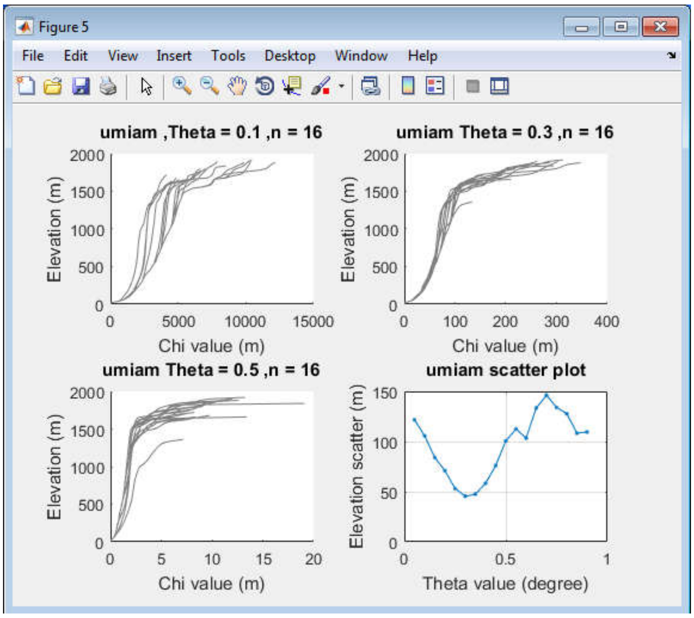
(C-6) Theta reference estimator (Optional)

Keep the reference .shp file in the shapefiles folder. You can give drainage divide (boundary) as reference file.

theta_calculator('filename', 'ref_filename')

e.g. >>theta_calculator('umiam_','umiam_pour_pt')



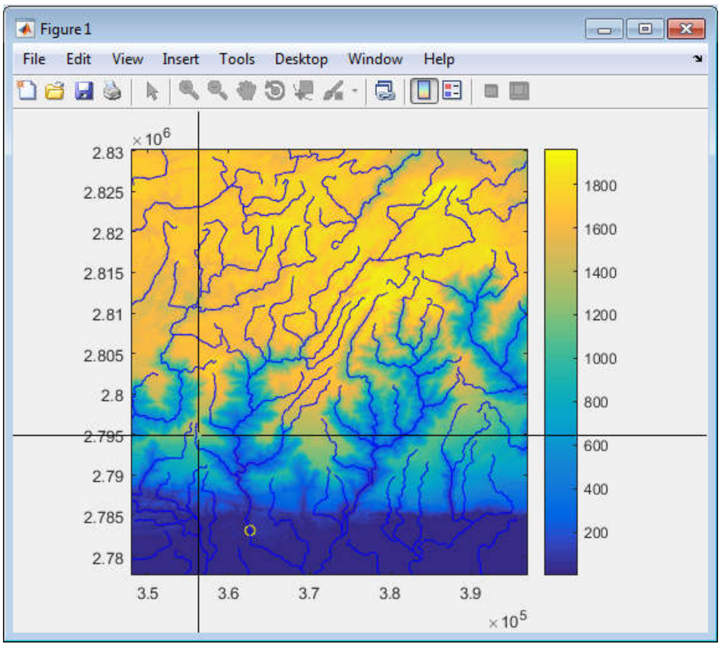


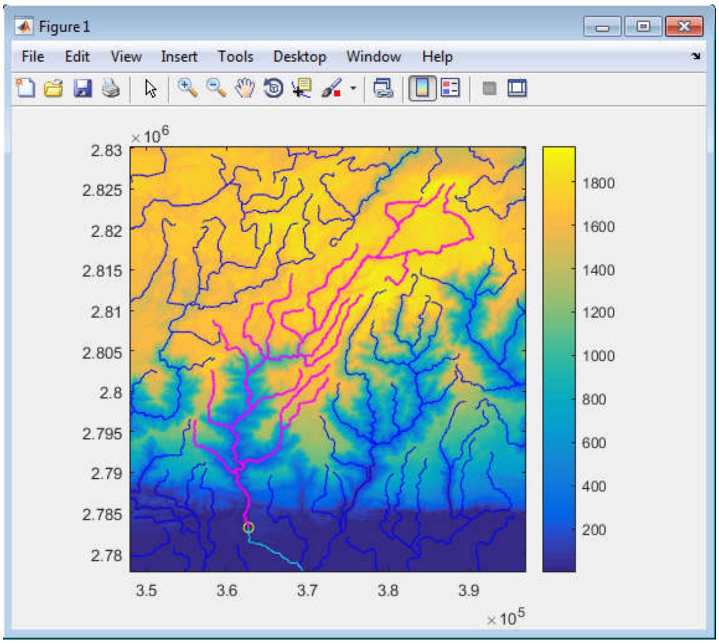
theta_calculator_pick('dem_filename','ref_filename')

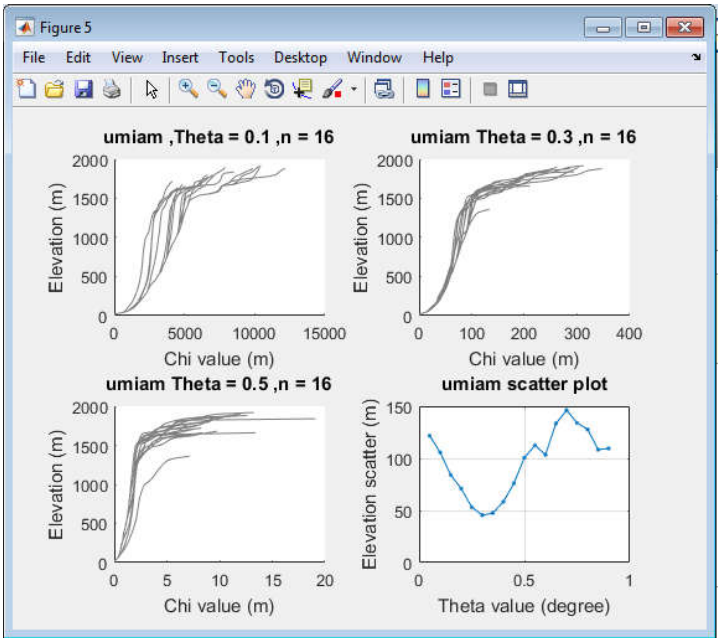
e.g. >>theta_calculator_pick('umiam_','umiam_pour_pt')

v) enter the number of channel that are being considered :**16**

vi) select channel from the figure (1) by clicking near the river head...







(C-7) Steepness index (ksn) analysis

(C-7.1) ksn map generation (regional map)

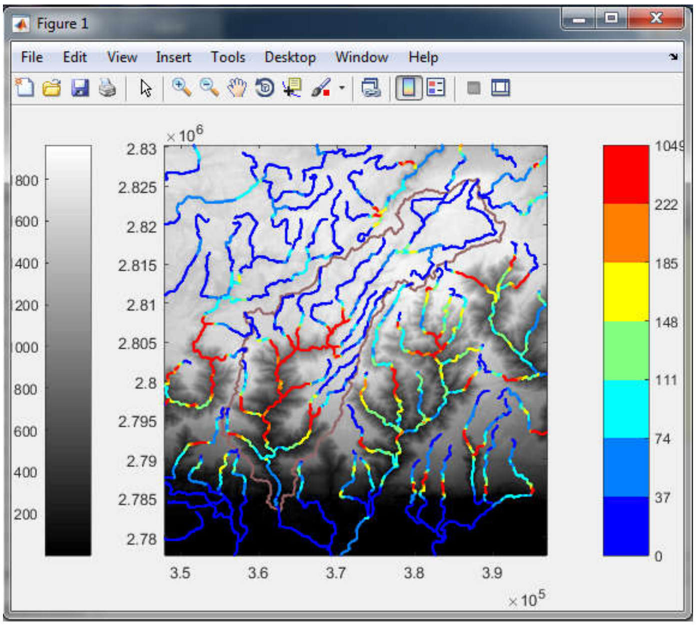
The steepness indices are being automatically calculated for each channel while running the ‘**profile51_batch_mod**’ code at the reference theta mentioned in the ‘run_paraeters.txt’ file. For visualization and plotting purposes, run the following code with the given soothing window;

ksnpoint2line_shp_map('dem_name','ref_name',smooth_wind)

e.g. >> ksnpoint2line_shp_map('umiam_','umiam_divide',10)

Note: The k_{sn}values which falls within the basin boundaries are only reliable because they are being estimated for the respective accumulation area (which covers the entire basin area).

For recalculating the theta k_{sn}at different reference theta, first modify the ‘**run_parameters.txt**’ and run the ‘**profile51_batch_mod**’code again.



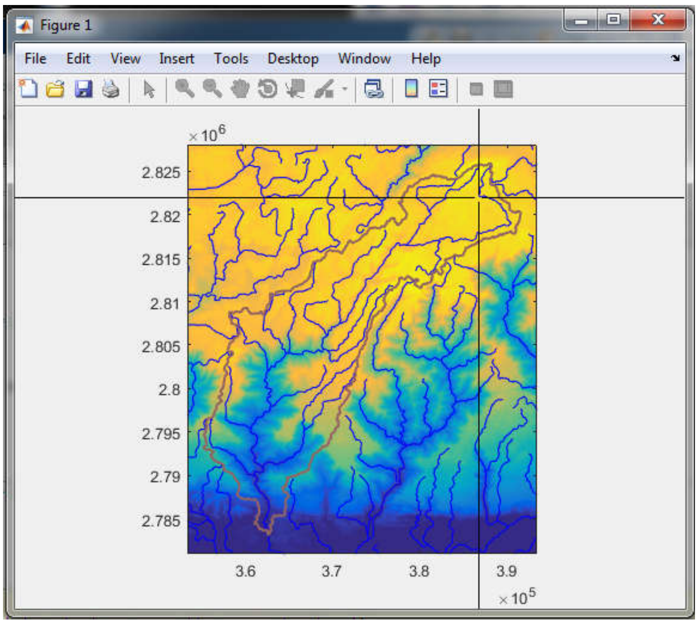
Output files: ‘ksn_shapefile’ would be created inside the ‘shapefile’ directory which can be used in a GIS platform.

(C-7.2) ksn regression parameters

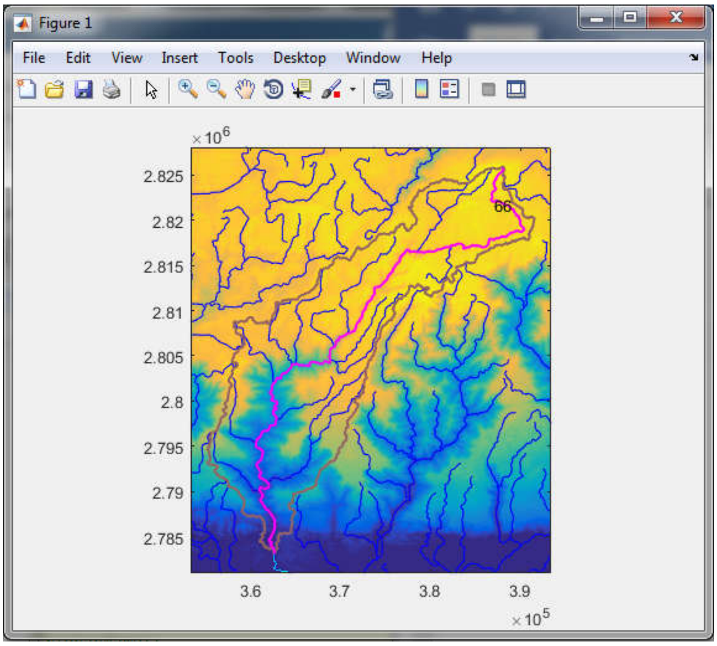
Steepness index for the segment of channel via regression

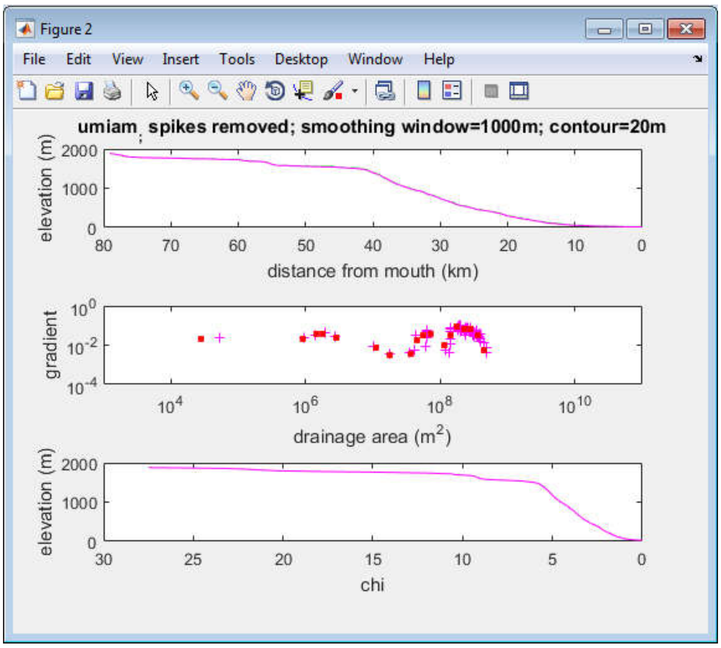
ksn_regress_analysis('dem_name','divide_name','ref_name',Theta_ref)

e.g. >>ksn_regress_analysis('umiam_','umiam_divide','dauki_fault',0.45)



vii) select channel from the figure (1) by clicking near the river head…



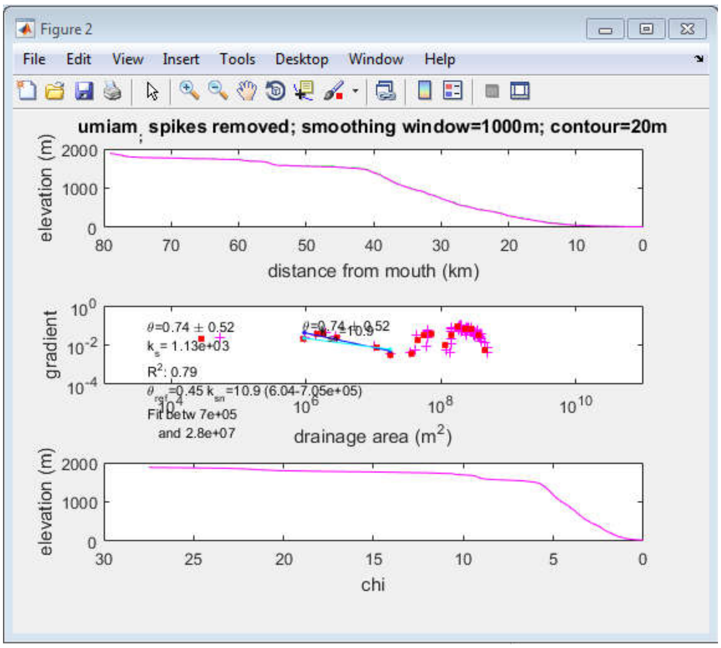


viii) From which plot would you like to pick regression limits? (or enter "d" for manual input)

a) logS-logA (fig2 plot3); b) long profile (fig2 plot1); c) Chi(distance) : **b**

ix) Include Click on LEFT (max dfm) then RIGHT (min dfm) bounds for regression from STREAM PROFILE (fig2, plot 1)

Regress bounds must include at least 3 data points -- crosses on LOG(S)-LOG(A) PLOT…



x) **do you want to keep the regress value (y) or reselect regression range (n) : (y/n).... y**

If ‘**n**’, it will go to step (iii) and start freshly.

xi) do you want another S-A regression : (y/n).... **n**

If ‘**y**’, it will go to step (iii) and ask the for another regression range

xii) Click the upper left corner to locate temporary parameter text.

xiii) do you want to go for another channel : (y/n).... **n**

If ‘**y**’, return to figure (1) and repeat the steps from (i) to (vii) for another channel selection.

Output files: S-A regression plots, S-A regress mat files and figure with selected channel

(C-8) Paleo-channel reconstruction

The paleo-base level of any transient state river can be reconstructed based on the scaling parameters (steepness and concavity index) of relict reach which assumed as representative of previous uplift-erosion setting. The geomorphic and hydrological variation at a smaller drainage area can lead to the great variation in steepness index (k_{sn}) (Clark et al., 2005; Wobus et al., 2006; Gallen et. al., 2013). To avoid such complication, channel steepness indices (k_{sn}) were normalized using the mean concavity (θ_{ref}) of all the identified relict reaches. The function mention below can be used to analyse the channels having relict reaches and estimate the θ_{ref}. The selected regression segment should be within the relict reach and contain significant number of data points.

(C-8.1) Mean theta estimation

theta_mean_relict_pick('dem_name', 'divide_name','ref_name',Theta_ref)

e.g. >>theta_mean_relict_pick('umiam_','umiam_divide', 'umiam_divide',0.45)

(The steps are similar with the steps involve in '5.1. ksn regression parameters')

i) select channel from the figure (1) by clicking near the river head

ii) From which plot would you like to pick regression limits? (or enter "d" for manual input)

a) logS-logA (fig2 plot3); b) long profile (fig2 plot1); c) Chi(distance) : **a**

Click on minimum THEN maximum bounds for drainage area from LOG(S)-LOG(A) PLOT (fig2, plot 3)

Include at least 3 data points -- crosses on LOG(S)-LOG(A) PLOT

iii) do you want to keep the regress value (y) or reselect regression range (n) : (y/n)....

iv) do you want to go for another channel : **(y/n)....**

[Repeat step (i) to (v) until all the relict reaches are covered]

Output file: mat files containing SA regress parameters of relict reaches will be produced and the estimated mean theta will be shown in the command window. The mean theta will be latter used as theta_ref for the reconstruction of paleo-base level.

(C-8.2) Paleo-base level reconstruction

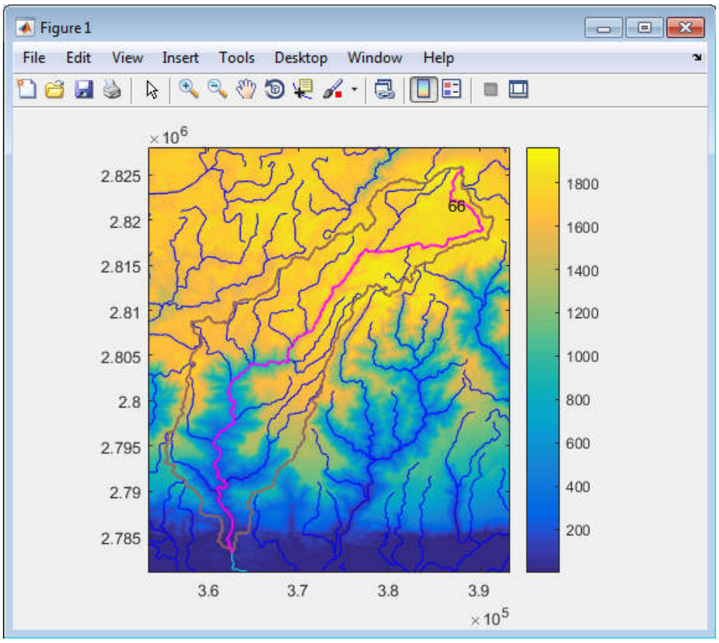
Once the mean theta has calculated, the paleo-base level can be reconstructed using the following matlab function,

profile_reconstruct('dem_name','divide_name','ref_name',Theta_ref)

e.g. >>profile_reconstruct('umiam_','umiam_divide', 'umiam_divide',0.3)

(The steps are similar with the steps involve in '5.1. ksn regression parameters')

i) select channel from the figure (1) by clicking near the river head



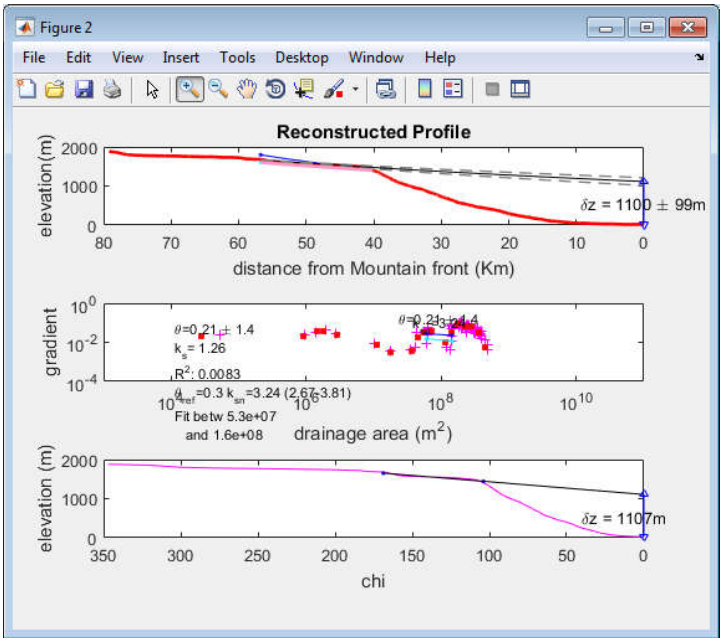
i) a) logS-logA (fig2 plot3); b) long profile (fig2 plot1); c) Chi(distance); (fig3 plot2): **a**

ii) Click on minimum THEN maximum bounds for drainage area from LOG(S)-LOG(A) PLOT (fig2, plot 3)

Include at least 3 data points -- crosses on LOG(S)-LOG(A) PLOT

Click the upper left corner to locate temporary parameter text.

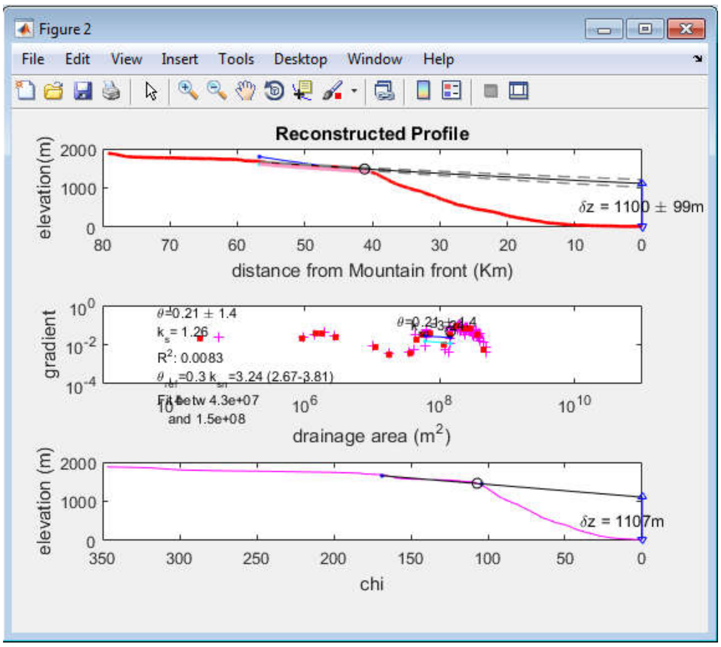
iii) do you want to perform the reconstruction (y) or go for reselect the relict segment (n) : (y/n)....**y**



iv) do you want another S-A regression : (y/n)....**n**

v) Mark points on long profile? (y/n)....

vi) a) logS-logA (fig2 plot 3); b) long profile (fig2 plot1); c) logS-dfm (fig3 plot 2):**b**



vii) Classify this point? (y/n) ....

viii) Major Knick; 2) Minor Knick; 3) Start of Steep Sect.; 4) End of Steep Sect.; 5) Other? **1**

ix) Mark another point? (y/n)....**n**

x) select another channel selection : (y/n).... **n**

(C-9) Knickpoint retreat model (Celerity model)

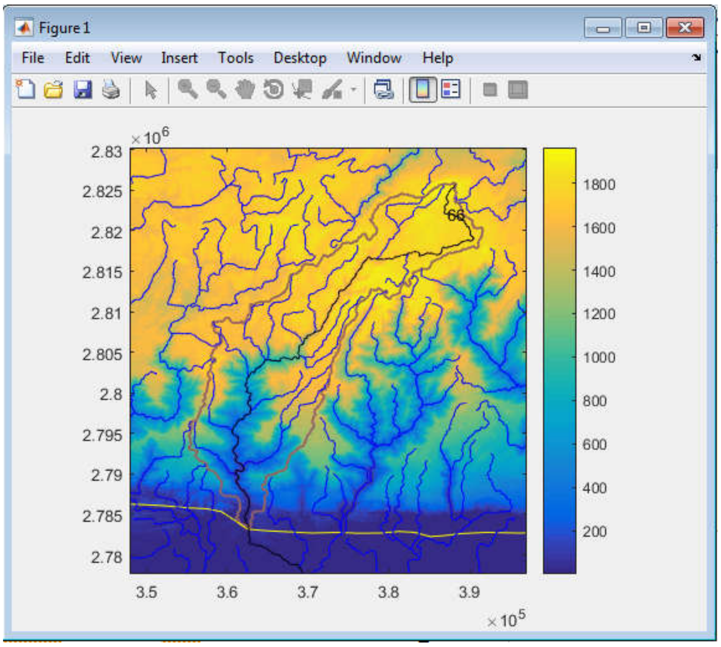
(C-9.1) Knickpoint identification

% listing the observed knickpoints

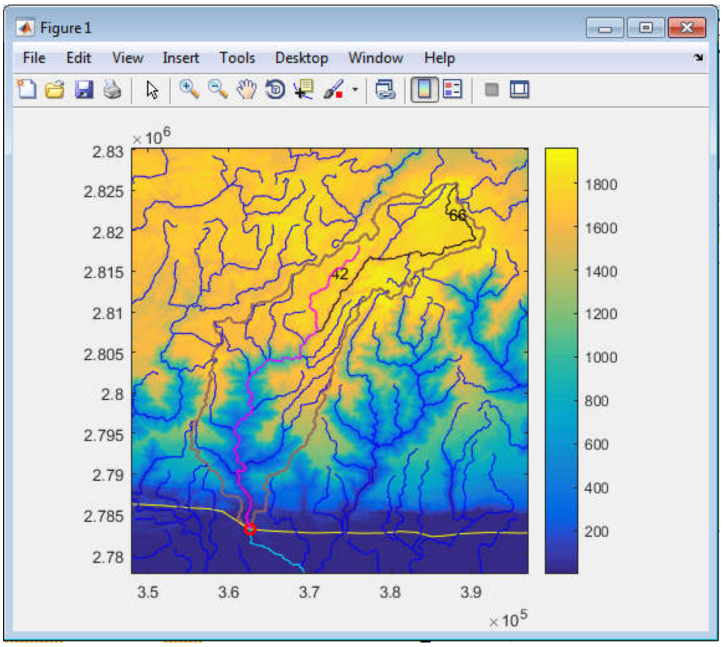
knick_selector4celerity ('dem_filename','divide_filename', 'ref_filename')

>>knick_selector4celerity ('umiam_','umiam_divide', 'dauki_fault')

ii) select Trunk channel for reference from the figure (1) by clicking near to the channel head...



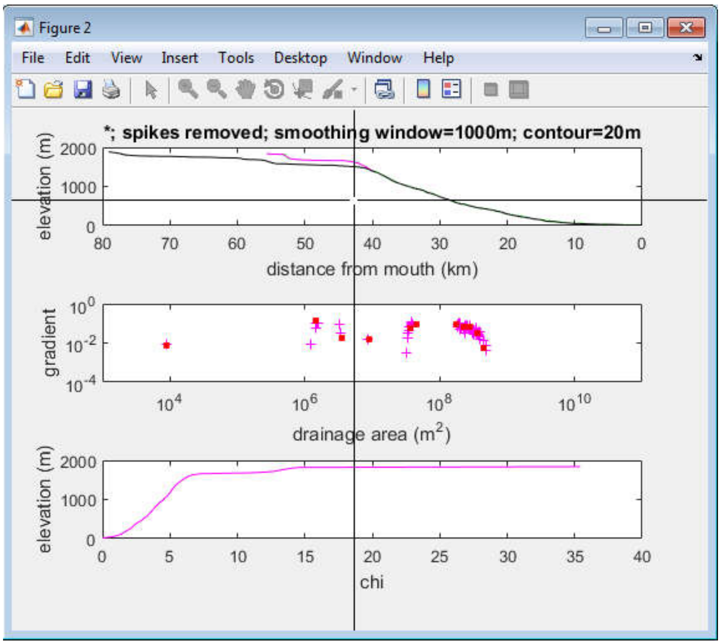
iii) select channel from the figure (1) by clicking near the river head…



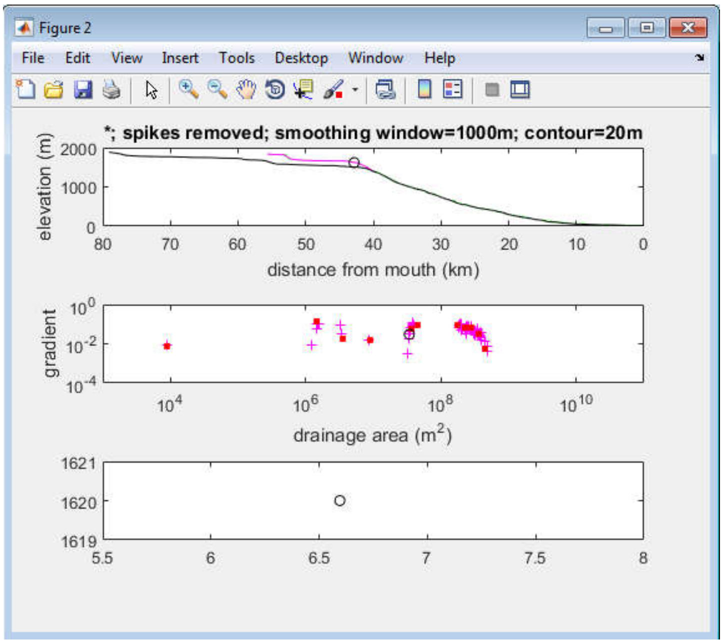
iv) Mark points on long profile? (y/n)....

v) From which plot would you like to mark points?

a) logS-logA (fig2 plot 3); b) long profile (fig2 plot1); c) logS-dfm (fig3 plot 2):**b**



vi) Classify this point? (y/n)....



vii) How do you want to classify it?

1) Major Knick; 2) Minor Knick; 3) Start of Steep Sect.; 4) End of Steep Sect.; 5) Other?**1**

viii) Mark another point? (y/n)....**n**

ix) select another channel selection : (y/n)....**n**

select another channel : (y/n).... n

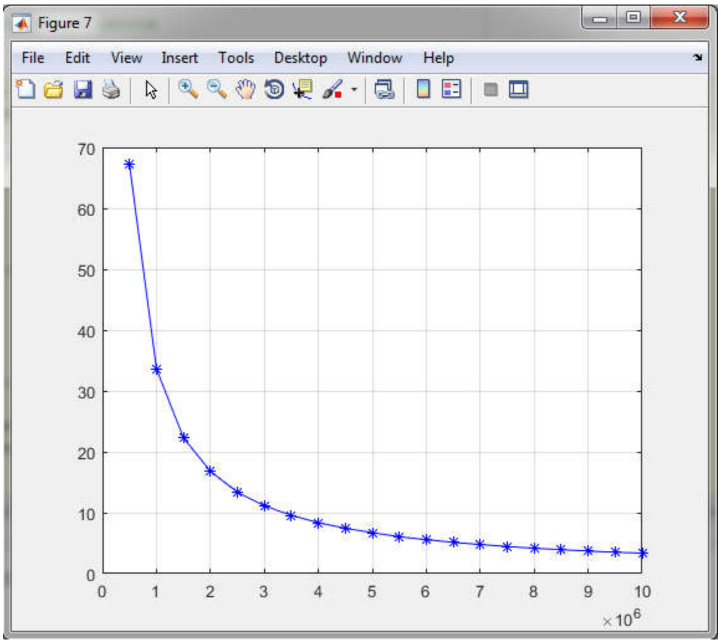
(C-9.2) Celerity parameters estimator (Celerity Model)

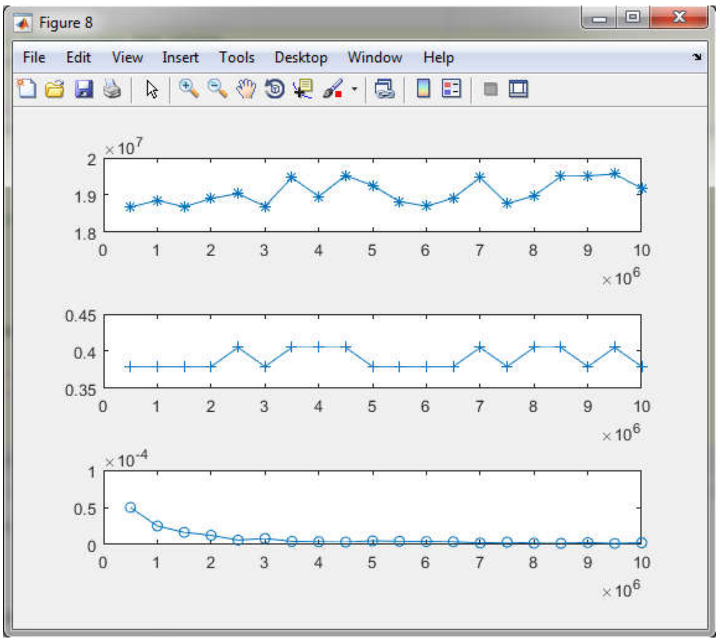
% modify the input parameters and run directly

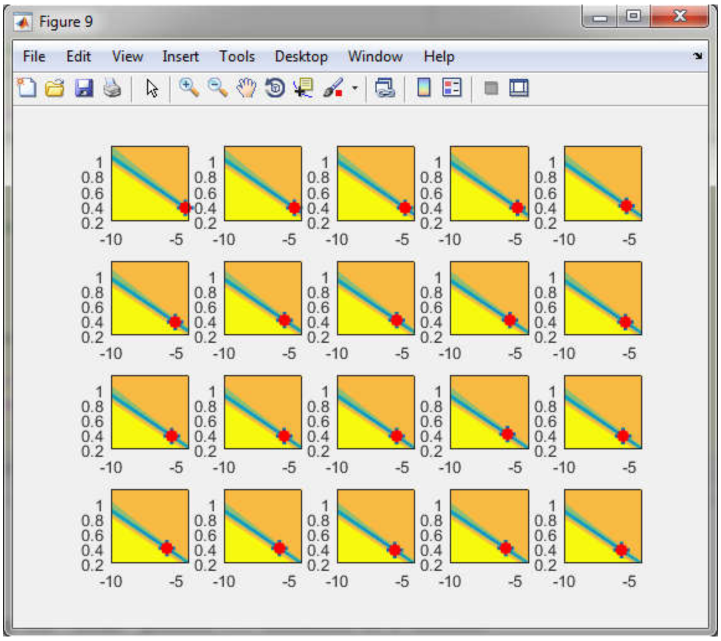
celerity_model('dem_name_',ref_name')

e.g. >>celerity_model('umiam_','dauki_fault')

i) enter the age range for celerity run = **(0.5:0.5:10)*10^6**







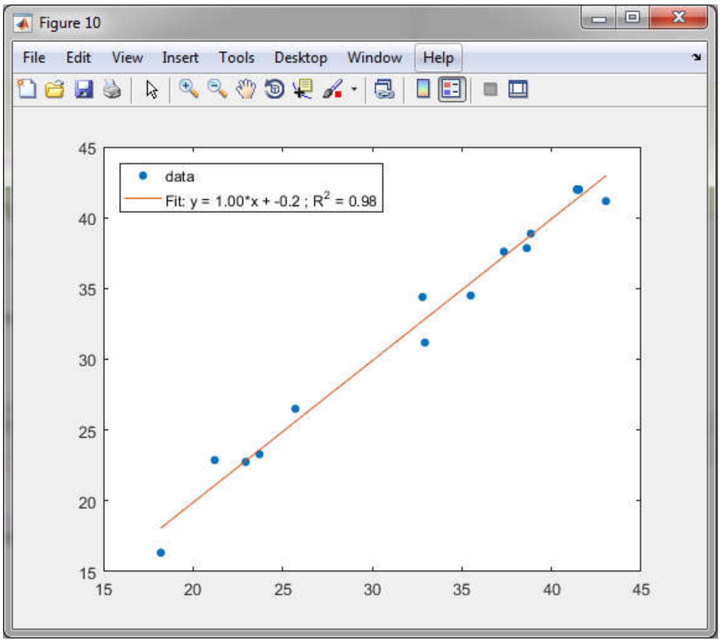
Output files: knickpoint retreat rate plot, misfit plot and m vs K parameters plot

(C-9.3) Celerity model for an age fit

celerity_model_age('umiam_','dauki_fault')

e.g. >>celerity_model_age('umiam_','dauki_fault')

i) enter the age to theexamine the observed vs modeledknickpoits =**4*10^6**

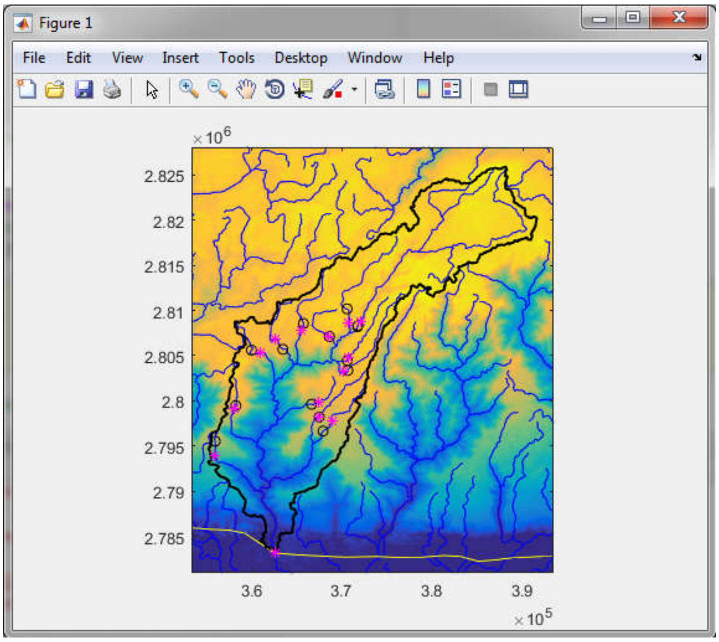


(C-9.4) GIF animation for Celerity Model for given age

celerity_model_GIF_Map('dem_name',’divide_name', 'ref_name')

e.g. >>celerity_model_GIF_Map('umiam_','umiam_divide', 'dauki_fault')

i) enter the age to the examine the observed vs modeledknickpoits =**1.5*10^6**

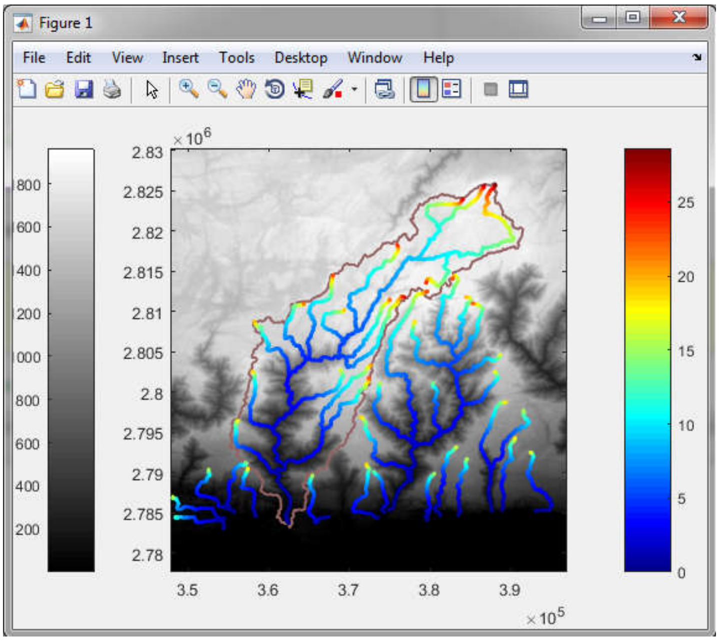


(C-10) Spatial chimap generation

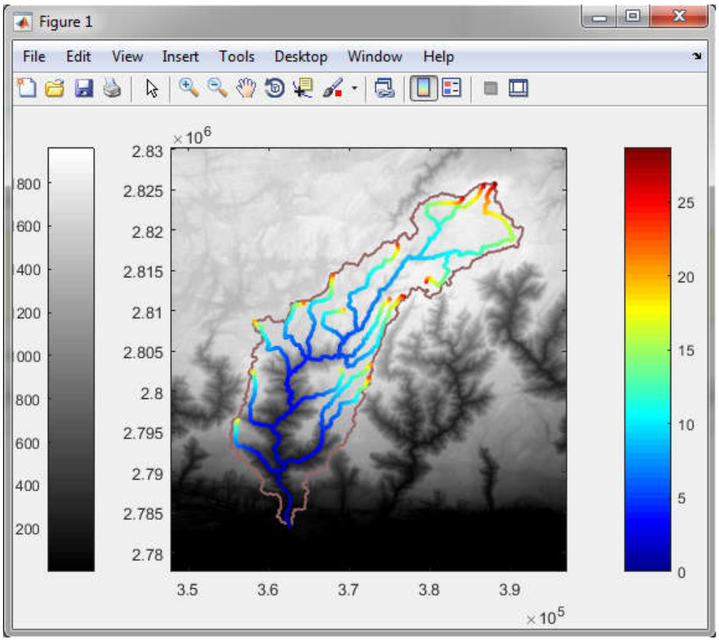
chimap_generator('dem_name', ‘divide_name', ‘ref_name')

e.g. >>chimap_generator('umiam_', 'umiam_divide', 'contour_20')

x) Enter contour value OR enter "0" for confluence reference :**20**



e.g. >>chimap_generator('umiam_', 'umiam_divide', 'umiam_pour_pt')

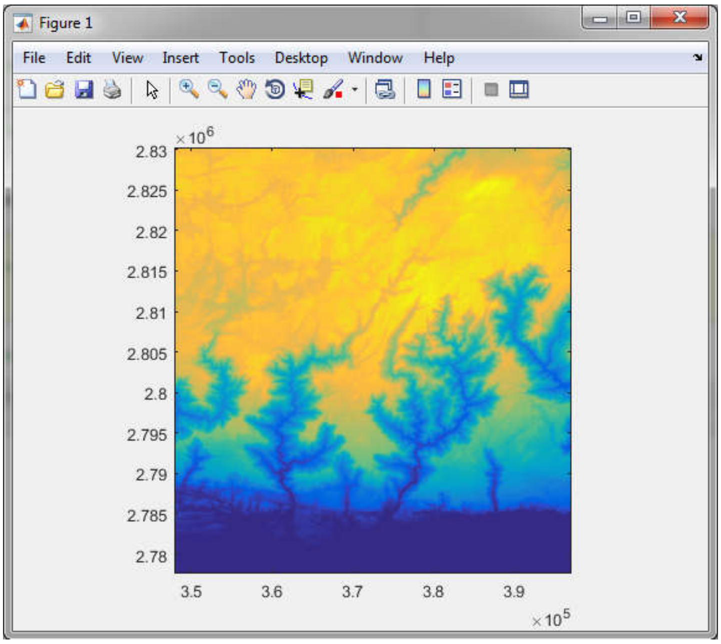


(C-11) Miscellaneous functions

% data visualization

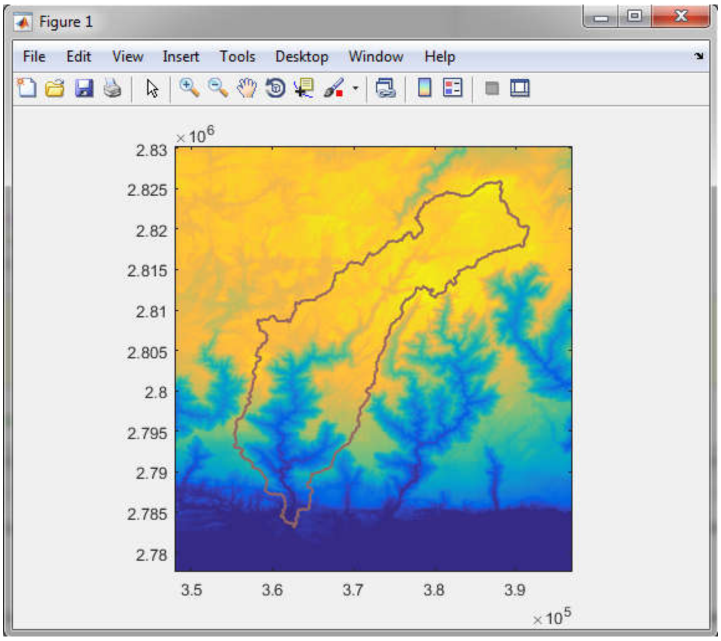
plot_dem('dem_name')

e.g. >>plot_dem('umiam_')



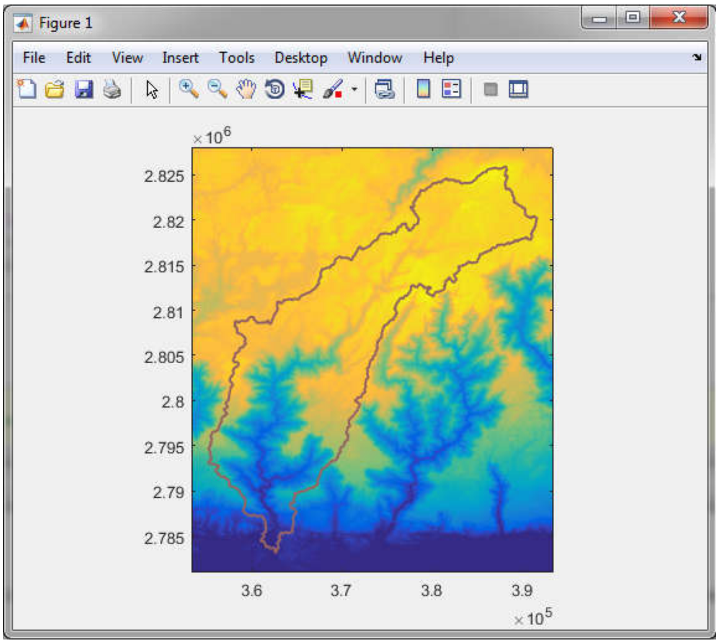
plot_divide('divide_name')

e.g. >>plot_divide('umiam_divide')



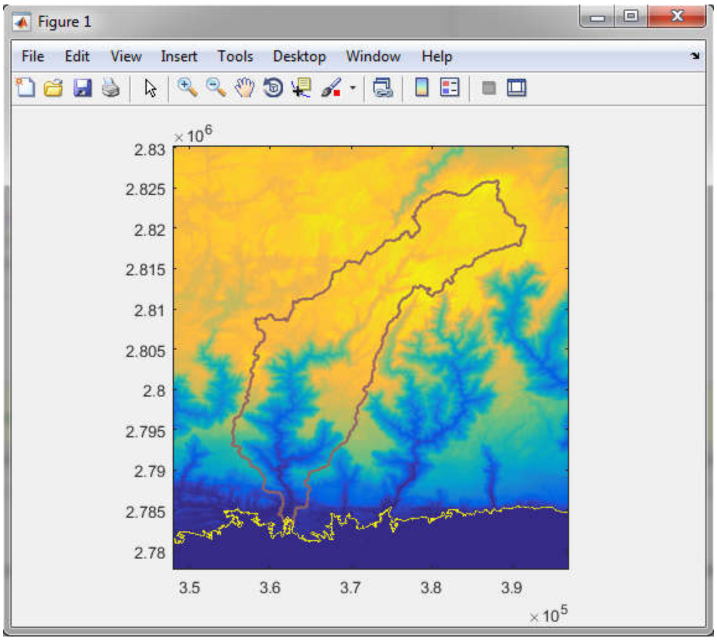
plot_divide_zoom('divide_name')

e.g. >>plot_divide_zoom('umiam_divide')



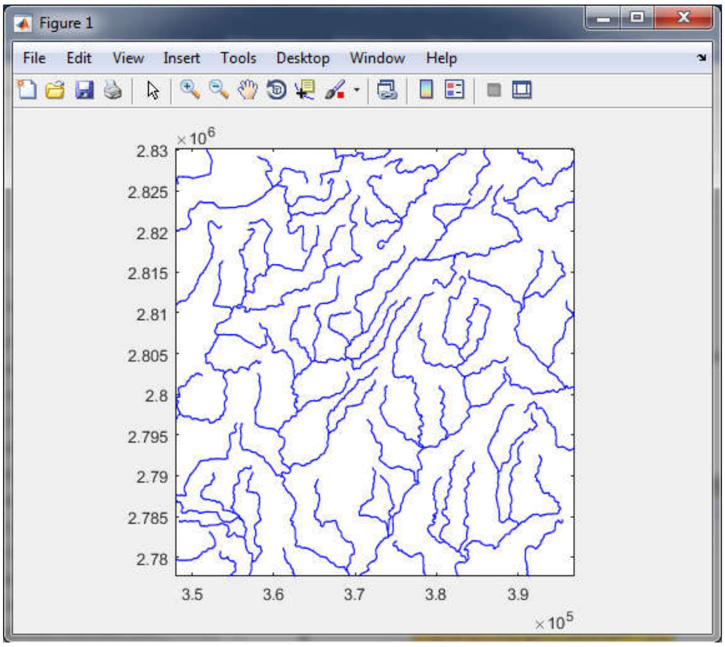
plot_reference('ref_name')

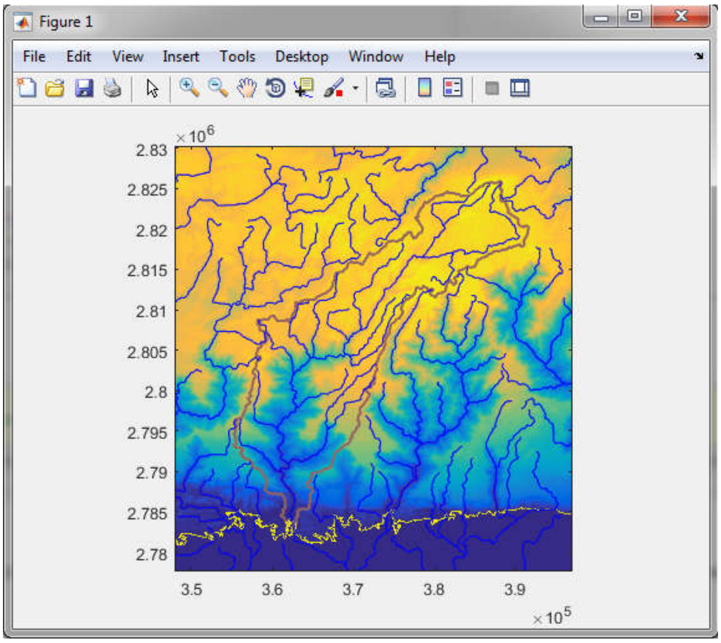
e.g. >>plot_reference('contour_20')



plot_drainage()

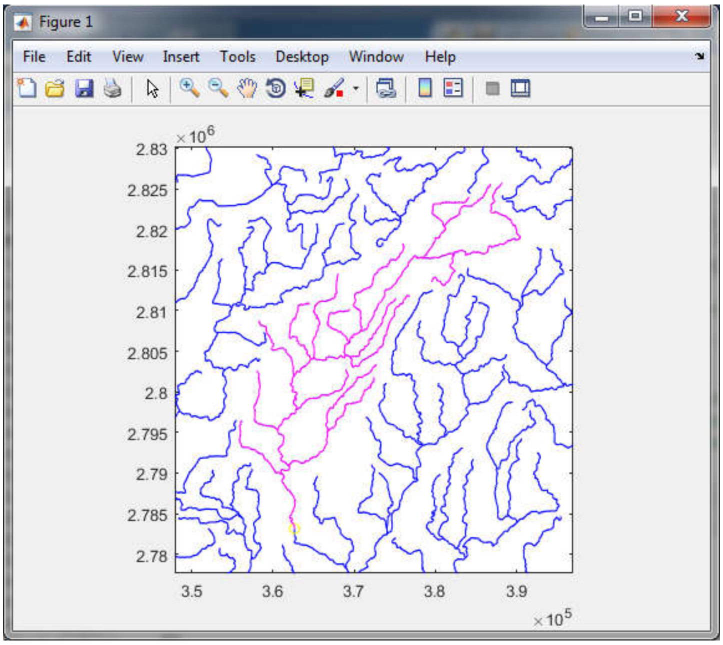
e.g. >>plot_drainage()





plot_drainage_ref('ref_name')

e.g. >>plot_drainage_ref('umiam_pour_pt')



Point data to shapefile converter

For chimap:

chipoint2line_shp('chimap_pointdata.txt',smooth_wind)

e.g. >>chipoint2line_shp('chimap_pointdata.txt',10)

For steepness map:

ksnpoint2line_shp('ks_pointdata.txt',smooth_wind)

e.g. >>ksnpoint2line_shp('umiam_ks_data.txt',10)