

Mt. Mitchell, NC

Stream profiles with ArcMap 10.1 and R

JESSE S. HILL 2013 UNC-CH

- This tutorial shows how to extract longitudinal profiles using ArcMap 10.1 and how to plot them with R, an open-source software.
- R is freely available at: cran.us.r-project.org/
- If you want the R script used and a copy of this tutorial please email Jesse Hill at: hilljs@live.unc.edu



Add your DEM. I added hillshade and colors. Make sure your data frame and the DEM are in the same projection. Use (Data management \rightarrow projections and transformations \rightarrow raster \rightarrow project raster) if needed.



This is Yancey county, NC, home to Mt. Mitchell, the highest point east of Black Hills, SD.



Some of the next few steps will seem to take *forever*, depending on your computer. Prepare to do something else during the processing.



Fill the DEM to remove any pits, etc. Use (spatial analyst \rightarrow hydrology \rightarrow fill). 424771.786 3991136.901 Meters



Select your DEM as the surface raster.



Now use (spatial analyst \rightarrow hydrology \rightarrow flow direction). Input the filled DEM and the name you want for the flow direction raster.



Now use (spatial analyst \rightarrow hydrology \rightarrow flow accumulation). Input the flow direction and the name you want for the flow accumulation raster. Set type to (integer).



Now use (spatial analyst \rightarrow hydrology \rightarrow flow length). Input the flow direction and the name you want for the flow length raster.



I've added a water layer from a small-scale base map. This is optional, but it will help name files according to real stream names.



Add a new shapefile. Make it a point.



424771.786 3975992.284 Meters

Make sure you name the file and assign the same projection as the DEM.



Assign the top of the streams with the editor tool. You can find this by right-clicking the recently added shapefile and choosing (edit features \rightarrow start editing).



Click (continue).



Click (organize templates).



Click (new template).



Choose the new shapefile and click (close).



Click (point).



Number of features selected: 1

378310.503 3966893.039 Meters

Click on the locations of all the headwaters. I have turned on my water layer to help find streams. Click all the points you want included as profiles for each basin.



I selected all the streams that feed into the Cane river.

393540.039 3966862.641 Meters



Stops the edit session

390044.237 3974006.235 Meters

Once all headwaters have been selected, click (editor \rightarrow stop editing).



Click (yes) to save your edits.



Calculates the least-cost path from a source to a destination.

397947.789 3971300.789 Meters

Use (spatial analysis \rightarrow distance \rightarrow cost path) to find the downstream paths.



376881.784 3972790.304 Meters

Input raster = shapefile of selected points Cost distance = flow accumulation raster Backlink raster = flow direction raster Output raster = name you want for the cost path raster file



Creates a table showing cell values for a raster or set of rasters.

389953.042 3961634.137 Meters

Use (spatial analysis \rightarrow extraction \rightarrow sample) to extract the x,y,z, flow length, and flow accumulation into a *.dbf file (database file).

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397978.187 3972121.542 Meters

Input the filled DEM, the flow length, and flow accumulation. Do it in this order to be able to input into the R script that will be used later.

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	1 C C 1	•								P

397978.187 3972121.542 Meters

Choose the costpath as the (input location raster or point features). Assign the filepath where the *.dbf file will go. Note this filepath, as you will need it in the following steps. Make sure to end the filepath with '.dbf' and that there are no spaces. Choose (BILINEAR) as the resampling technique.



Adds a new map layer based on XY events from a table

364935.262 3974006.235 Meters

This is optional, but you can see if it worked by using (file \rightarrow add data \rightarrow add xy data). Add the *.dbf file that was just created.



387156.401 3968048.173 Meters

These are points representing all the precise downstream paths. If the paths only go a short distance, you likely forgot to fill the DEM in the earlier step.



389092.895 3977165.347 Meters

Zoom out to see where the stream exits the DEM.



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R Console

R version 2.15.2 (2012-10-26) -- "Trick or Treat" Copyright (C) 2012 The R Foundation for Statistical Computing ISBN 3-900051-07-0 Platform: x86 64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY. You are welcome to redistribute it under certain conditions. Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

R is a collaborative project with many contributors. Type 'contributors()' for more information and 'citation()' on how to cite R or R packages in publications.

 $\label{eq:type} $$ Type 'demo()' for some demos, 'help()' for on-line help, or 'help.start()' for an HTML browser interface to help. $$ Type 'q()' to quit R. $$$

[Previously saved workspace restored]

Start the program R. The default screen should look something like this, except the colors may vary.

- - X



In order to read *.dbf files into R, it is necessary to download a package called "foreign." Select (Packages \rightarrow Install package(s)).

File Edit View Misc Packages Windows Help

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R R Console

R version 2.15.2 (2012-10-26) -- "Trick or Treat" Copyright (C) 2012 The R Foundation for Statistical Computing ISBN 3-900051-07-0 Platform: x86_64-w64-mingw32/x64 (64-bit)

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[Previously saved workspace restored]

> utils:::menuInstallPkgs()

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CRAN mirror	
Poland	
Portugal	
Russia	
Singapore	
Slovakia	
South Africa (Cape Town)	
South Africa (Johannesburg)	
Spain (Madrid)	make a function that makes png images of stream profiles
Sweden	dbf files with columns containing: x,y,z,length,accumulation
Switzerland	mits of elevation are converted from ft to m in this example.
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Taiwan (Taipei)	iser must first scan in the *.dbf file then decide a plot title, head
Thailand	upstream/downstream directions of the basin which must be entered
Turkey	acter strings in quotation marks.
UK (Bristol)	
UK (London)	
UK (St Andrews)	<pre>% =function (combofile.title.header.upstream.downstream.Xlim.Ylim)</pre>
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Select a place near you. It is not critical exactly where you chose.

File Edit View Misc Packages Windows Help

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Scroll down and select "foreign" then click (OK).



File	e Edit View Misc Packages Windows Help						
	Source R code New script						
	Open script						
	Display file(a)						
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_	Exit	cite R or R packages in publications.					
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Click (File \rightarrow Open script). Navigate to the wherever the R scripts are located and open them. For this example we will use "dbfprofileR.R"





On the left is the R console, where codes will be executed. On the right is the script. To execute any code, simply copy and paste into the console, or highlight the line(s) and press (ctrl + r). Commands can also be typed directly into the console.

File Edit Packages Windows Help





Highlight the lines from "dbfprofileR = function..." down to "graphics.off()}

File Edit Packages Windows Help



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R Console		R C:\UNC\Lineaments\R\dbfprofileR.R - R Editor	- • ×
+ ## put in order of down stream distance	*	<pre>## put in order of down stream distance</pre>	A
+ cc = cc[order(cc[,5],decreasing=TRUE),]		<pre>cc = cc[order(cc[,5],decreasing=TRUE),]</pre>	
+ X = cc[,2]		X = cc[,2]	
+ Y = cc[, 3]		Y = cc[,3]	=
+ Z = cc[, 4]		Z = cc[, 4]	
+ L = cc[, 5]		L = cc[,5]	
+ A = cc[f 6]		A = cc[, 6]	
+ ### ft to m. remove this if necessary		<pre>### ft to m. remove this if necessary</pre>	
+ Z = Z * 0.3048		Z = Z*0.3048	
+ ## this opens the plotting window in R		<pre>## this opens the plotting window in R</pre>	
+ dev.new()		dev.new()	
+ ## this adds ".png" to the end of the title and defines the file nam	le l	## this adds ".png" to the end of the title and defines the file na	ame
+ out1=paste(title,".png",sep="")		<pre>outl=paste(title,".png",sep="")</pre>	
+ ## this defines the dimension of the .png file in pixels		<pre>## this defines the dimension of the .png file in pixels</pre>	
+ png(file=out1,width=2400,height=600)		png(file=out1,width=2400,height=600)	
+ ### this defines the margins		### this defines the margins	
+ par(mai=c(1,1.5,.7,1))		par(mai=c(1,1.5,.7,1))	
+ ### plot the downstream distance vs. elevation		<pre>### plot the downstream distance vs. elevation</pre>	
+ plot (-(L/1000),Z,main = header,		plot (-(L/1000),Z,main = header,	
+ xlab= 'downstream distance (km)', ylab = 'elevation (m)', cex=.2, pch=.	02,col='g\$	<pre>xlab= 'downstream distance (km)', ylab = 'elevation (m)', cex=.2, pch=</pre>	=.02,col='gr
+ xlim= Xlim,ylim = Ylim ,cex.main=3.5,cex.axis=1.8,cex.lab=2)		<pre>xlim= Xlim,ylim = Ylim ,cex.main=3.5,cex.axis=1.8,cex.lab=2)</pre>	
<pre>+ #axis(4, labels=TRUE,cex.axis=1.8)</pre>		<pre>#axis(4, labels=TRUE,cex.axis=1.8)</pre>	
+ ### this plots text for the directions		### this plots text for the directions	
+ text (Xlim[1],.9*Ylim[2],upstream,cex=4)		text (X11m[1],.9*Y11m[2],upstream,cex=4)	
<pre>+ text (Xlim[2],.9*Ylim[2],downstream,cex=4)</pre>		<pre>text (X11m[2],.9*Y11m[2],downstream,cex=4)</pre>	
+ ### this counts the pixels in an inch		### this counts the pixels in an inch	
<pre>+ pin = par("pin")</pre>		pin = par("pin")	
+ ### This is the map scale	=	### Inis is the map scale	
+ MS = (abs (Xlim[1]-Xlim[2])*1000) / pin[1]		MS = (abs (XIIm[I]-XIIm[2])*1000) / pin[I]	
+ ### This is the profile scale		### Inis is the profile scale	
+ PS = (abs (Ylim[1]-Ylim[2])) / pin[2]		PS = (abs (riim[i]-riim[2])) / pin[2]	
+ ### vertical exxageration = map scale / profile scale		*** vertical exxageration - map scale / profile scale	
+ VE = MS/PS		VE - MS/PS	
+ ### this plots the V.E.		<pre>### this plots the V.E. tout (08*Visual Visual Visual Anna Visual Visual</pre>	2)
+ text(.98*Xlim[1],Ylim[1]*1.1,paste("VE =",format(VE,digits=1),"X"),ce	x=3)	graphics off())	Jer-S)
+ graphics.off() }			
>	*		
< III	►	<pre> // // // // // // // // // // // // //</pre>	
			•

Press (ctrl + r) and you should see the code copied into the R console on the left. The function 'dbfprofileR' is now defined and can be used to plot profiles.

File Edit Packages Windows Help



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R Console	C:\UNC\Lineaments\R\dbfprofileR.R - R Editor
<pre>+ ## put in order of down stream distance + cc = cc[order(cc[,5],decreasing=TRUE),]</pre>	## try it out! ***
+ $X = cc[,2]$ + $Y = cc[,3]$ + $Z = cc[,4]$	<pre># The dbf file has six columns: index(useless) ,x,y,z,flowlength, and flow acc # The flow accumulation is not used in this code but I keep it in the dbf # ownert process suppry for simplicity</pre>
<pre>+ L = cc[,5] + A = cc[,6] + #### ft to m. remove this if necessary</pre>	<pre># export process anyway for simplicity ## this is an example of how to execute the code E</pre>
<pre>+ Z = Z*0.3048 + ## this opens the plotting window in R + dev.new()</pre>	<pre>## this assigns the name of the working directory</pre>
<pre>+ ## this adds ".png" to the end of the title and defines the file name + out1=paste(title,".png",sep="")</pre>	<pre>setwd('C:/UNC/Lineaments/R/profile_figs/test') i vou need to call the package "foreign"</pre>
<pre>+ ## this defines the dimension of the .png file in pixels + png(file=out1,width=2400,height=600) + #### this defines the margins</pre>	library (foreign)
<pre>+ par(mai=c(1,1.5,.7,1)) + ### plot the downstream distance vs. elevation + plot (-(L/1000),Z,main = header,</pre>	<pre>## Cane River ## this reads in the dbf file. Call it what ever you want without spaces caneriver = read.dbf("C:/UNC/Lineaments/streams/cane/cane_export.dbf")</pre>
<pre>+ xlab= 'downstream distance (km)', ylab = 'elevation (m)',cex=.2,pch=.02,col='g\$ + xlim= Xlim,ylim = Ylim ,cex.main=3.5,cex.axis=1.8,cex.lab=2) + favis(4 _ labels=TUUE cev avis=1.8)</pre>	<pre>## Run the function 'dbfprofileR'</pre>
<pre>+ #ais(+, fabels-rob, cex.axis-ito) + #### this plots text for the directions + text (Xlim[1],.9*Ylim[2],upstream, cex=4)</pre>	<pre>dbprofileR(caneriver,"cane","Cane River", "S","N", Xlim = c(-75,-25),Ylim = c(750,1550))</pre>
<pre>+ text (X1m[2],.9*Y1m[2],downstream,cex=4) + ### this counts the pixels in an inch + pin = par("pin")</pre>	<pre>## You should see a plotting window pop up then disappear. You can find your ## in the working directory</pre>
<pre>+ ### This is the map scale + MS = (abs (Xlim[1]-Xlim[2])*1000) / pin[1] + ### This is the profile scale</pre>	
<pre>+ PS = (abs (Ylim[1]-Ylim[2])) / pin[2] + ### vertical exxageration = map scale / profile scale + VE = MS/PS</pre>	
<pre>+ ### this plots the V.E. + text(.98*Xlim[1],Ylim[1]*1.1,paste("VE =",format(VE,digits=1),"X"),cex=3) + graphics.off() }</pre>	

Scroll down to the line starting with 'setwd("....")' .This is where you will set the working directory (folder) where the plots will go. Choose any existing filepath as long as there are no spaces. Highlight this line and press (ctrl + r).



R Console		R C:\UNC\Lineaments\R\dbfprofileR.R - R Editor
+ X = cc[,2]	^	<pre>### vertical exxageration = map scale / profile scale ^</pre>
+ Y = cc[, 3]		VE = MS/PS
+ Z = cc[, 4]		THE THIS PLOTS THE V.E.
+ L = cc[, 5]		<pre>text(.98*x11m[1],Y11m[1]*1.1,paste("vL =",format(vL,dig1ts=1),"x"),Cex=3)</pre>
+ A = cc[, 6]		graphics.off() }
+ ### ft to m. remove this if necessary		=
+ Z = Z * 0.3048		ff try it out!
+ ## this opens the plotting window in R		
+ dev.new()		
+ ## this adds ".png" to the end of the title and defines the file nam	ne	# The dbf file has six columns: index(useless) .x.v.z.flowlength, and flow acc
+ out1=paste(title,".png",sep="")		# The flow accumulation is not used in this code but I keep it in the dbf
+ ## this defines the dimension of the .png file in pixels		# export process anyway for simplicity
+ png(file=out1,width=2400,height=600)		
+ ### this defines the margins		## this is an example of how to execute the code
+ par(mai=c(1,1.5,./,1))		
+ ### plot the downstream distance vs. elevation		## this assigns the name of the working directory
+ plot (-(L/1000), 2, Main - neader,	$02 = a 0 1 = 1 a^{2}$	
+ Xiab = downstream distance (Xm) , yiab = elevation (m) , cex2, pon	02,COI- g¢	<pre>setwd('C:/UNC/Lineaments/R/profile_figs/test')</pre>
+ favis(4 labels=TRUE cev avis=1 8)		
+ ### this plots text for the directions		<pre>## you need to call the package "foreign"</pre>
+ text (Xlim[1]9*Ylim[2].upstream.cex=4)		library(foreign)
+ text (Xlim[2],.9*Ylim[2],downstream.cex=4)		
+ ### this counts the pixels in an inch		## Cane River
+ pin = par("pin")		<pre>## this reads in the dbf file. Call it what ever you want without spaces</pre>
+ ### This is the map scale		<pre>caneriver = read.dbf("C:/UNC/Lineaments/streams/cane_export.dbf")</pre>
+ MS = (abs (Xlim[1]-Xlim[2])*1000) / pin[1]	=	
+ ### This is the profile scale		## Run the function 'dbfprofilek'
+ $PS = (abs (Ylim[1]-Ylim[2])) / pin[2]$		
+ ### vertical exxageration = map scale / profile scale		approfiles (Caneriver, "Caner, "Cane River", "S", "N",
+ VE = MS/PS		XIIM = C(-75, -25), IIIM = C(750, 1550))
+ ### this plots the V.E.		## You should see a plotting window non up then disappear. You can find your
+ text(.98*Xlim[1],Ylim[1]*1.1,paste("VE =",format(VE,digits=1),"X"),ce	ex=3)	** Tou should see a protoing window pop up then disappear. Tou can find your
+ graphics.off() }		
>		
	~	+ I
III	► a	

Call the package 'foreign.' Highlight the line 'library(foreign)' and press (ctrl + r).



	<u> </u>	~
R R Console		R C:\UNC\Lineaments\R\dbfprofileR.R - R Editor
+ X = cc[.2]	· · · · ·	<pre>### vertical exxageration = map scale / profile scale</pre>
+ Y = cc[.3]		VE = MS/PS
+ Z = cc[,4]		### this plots the V.E.
+ L = cc[,5]		<pre>text(.98*Xlim[1],Ylim[1]*1.1,paste("VE =",format(VE,digits=1),"X"),cex=3)</pre>
+ A = cc[, 6]		graphics.off() }
+ ### ft to m. remove this if necessary		
+ Z = Z * 0.3048		
+ ## this opens the plotting window in R		## try it out!
+ dev.new()		
+ ## this adds ".png" to the end of the title and defines the file n	ame	
+ out1=paste(title,".png",sep="")		Fine dof file has six columns: index(useless), x, y, z, flowlength, and flow acc index (useless), x, y, z, flowlength, and flow acc
+ ## this defines the dimension of the .png file in pixels		Fine flow accumulation is not used in this code but I keep it in the dbf
+ png(file=out1,width=2400,height=600)		<pre># export process anyway for simplicity</pre>
+ ### this defines the margins		
+ par(mai=c(1,1.5,.7,1))		++ this is an example of now to execute the code
+ ### plot the downstream distance vs. elevation		the this assigns the name of the warking directory
+ plot (-(L/1000),Z,main = header,		** this assigns the name of the working directory
+ xlab= 'downstream distance (km)', ylab = 'elevation (m)', cex=.2, pch	=.02,col='g\$	setvd/IC//INC/Lineaments/P/profile_figs/test/)
<pre>+ xlim= Xlim,ylim = Ylim ,cex.main=3.5,cex.axis=1.8,cex.lab=2)</pre>		Setwid C., one, himeaments, k/pionie_rigs, test ;
+ #axis(4, labels=TRUE,cex.axis=1.8)		## you need to call the package "foreign"
+ ### this plots text for the directions		The you need to call the package foreign
<pre>+ text (Xlim[1],.9*Ylim[2],upstream,cex=4)</pre>		libidiy(loldign)
<pre>+ text (Xlim[2],.9*Ylim[2],downstream,cex=4)</pre>		## Cape River
+ ### this counts the pixels in an inch		## this reads in the dbf file. Call it what ever you want without spaces
+ pin = par("pin")		caperiver = read.dbf("C:/IIIC/Lineaments/streams/cape/cape.export.dbf")
+ ### This is the map scale		
+ MS = (abs (Xlim[1]-Xlim[2])*1000) / pin[1]		## Run the function 'dbfprofileR'
+ ### This is the profile scale		
+ PS = (abs (Yiim[1]-Yiim[2])) / pin[2]		dbprofileR(caneriver,"cane","Cane River", "S","N",
+ ### vertical exxageration = map scale / profile scale		Xlim = c(-75, -25), Ylim = c(750, 1550))
+ VE = MS/PS		
+ ### this plots the v.E.	201721	## You should see a plotting window pop up then disappear. You can find your
+ text(.98*Aiim[i], iiim[i]*i.i, paste("VE =", format(VE, digits=i), "A"),	cex-s)	## in the working directory
<pre>+ graphics.oll() ; > setwd(!C:/UNC/Tiperments/P/profile_figs/test!)</pre>		
> library(foreign)		
> IIDIGLY(IDICIGN)		
	~	
< III	► 14	

Next you need to read in the *.dbf file that was exported from ArcMap in the earlier steps. Name this whatever you want with no spaces, then define the path to the *.dbf file. Highlight the line and press (ctrl + r) to execute.

File Edit Packages Windows Help



For the last step, run the function dbfprofileR. Add the name defined in the previous step, the name you want the profile *.png file to have, the header on the plot, the upstream and downstream directions, and the horizontal (in km) and vertical (in meters) limits. Highlight and press (ctrl + r).











- This process offers less expensive methods of stream profile extraction because it uses R (free) instead of other programs often used (not free) for plotting the profiles.
- R is freely available at: cran.us.r-project.org/
- If you want the R script used and a copy of this tutorial please email Jesse Hill at: hilljs@live.unc.edu

