Lab#2: Five Dimensions of GIS Data

In this lab, we will explore five basic "dimensions" of GIS data

- Location or position
- Length and Area
- Measures (M-dimension)
- Elevation (Z-dimension)
- Time or Temporal dimension

Download and unzip the file ***lab2.zip*** from the following website:

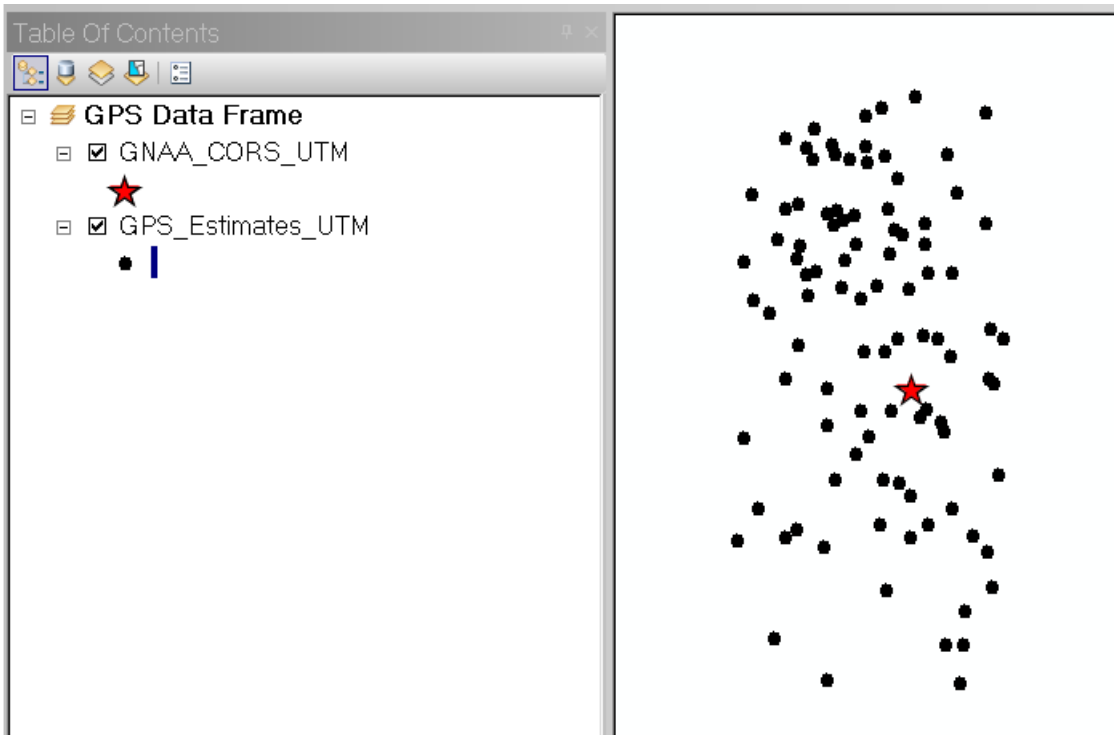
http://dverbyla.net/nrm338/data/

Extract the zipped file to your own personal folder by right mouse-clicking on the file in windows explorer.

Position or Point Location

You have GPS collars or GPS tags for locating animals or fish. You need to assess the precision of the GPS location estimates before attaching the collars to animals. You place the GPS collar at an accurately surveyed location…a Continuuously Operating Reference Station (CORS) site which you can access through the National Geodetic Survey web site.

There are 100 location estimates from the GPS collar and one true location from the CORS reference station. What is the mean distance between the 100 GPS collar estimates and the true location?



Use the ***Generate Near Table*** geoprocessing tool to create a table of distances.

GPS_Errors

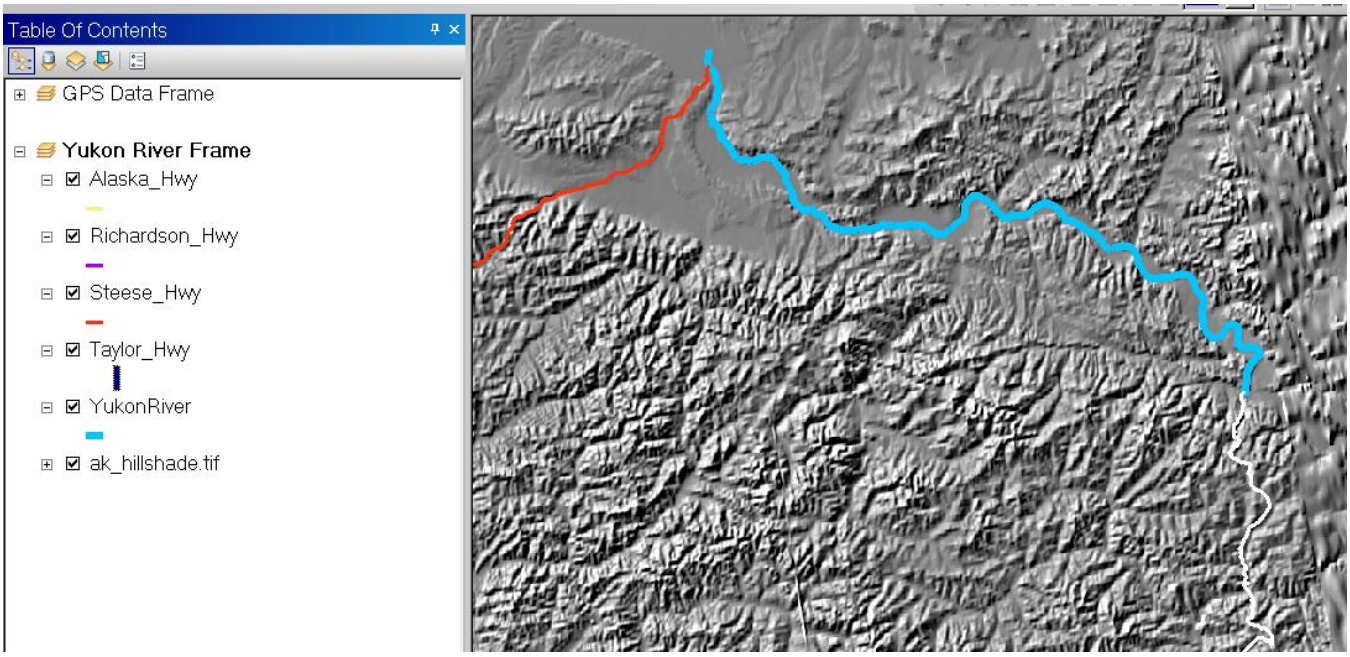
	INPUT_FID	NEAR_FID	DISTANCE
	0	0	2.736079
	0	1	4.477728
	0	2	1.980603
	0	3	2.129398

Then use the ***Summary Statistics*** geoprocessing tool to compute the min, max, mean and standard deviation of GPS Errors.

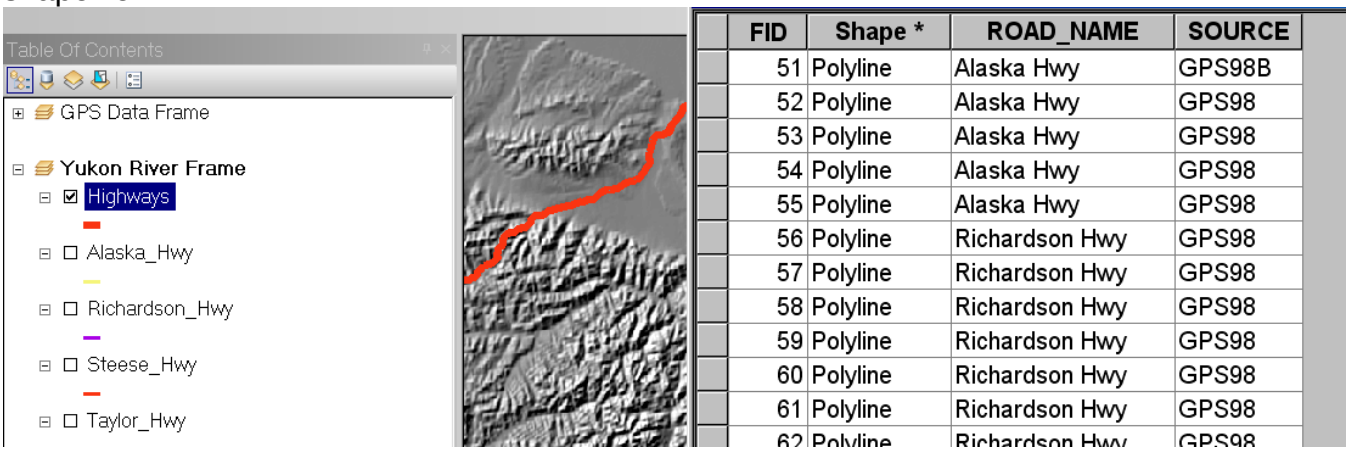
FREQUENCY	MIN_NEAR_DIST	MAX_NEAR_DIST	MEAN_NEAR_DIST	STD_NEAR_DIST
100	0.839981	10.067091	5.425527	2.407011

Length and Area

It is easy to compute length of lines and area of polygons as long as the GIS theme is in planar coordinates (meters or feet rather than degrees). Create a new data frame and name it Yukon River Frame. Add the following line shapefiles as layers in the frame, and the raster ak_hillshade.tif as the last layer:



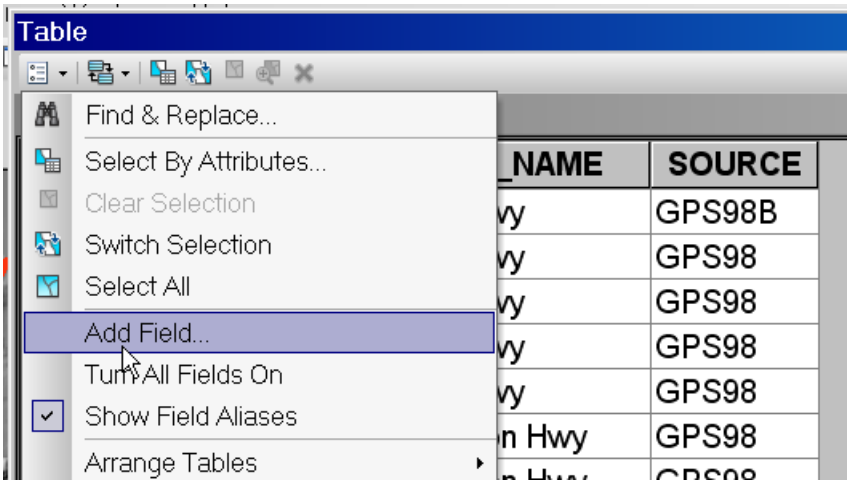
Use the ***Merge*** geoprocessing tool to merge together your Highway layers into one road shapefile.

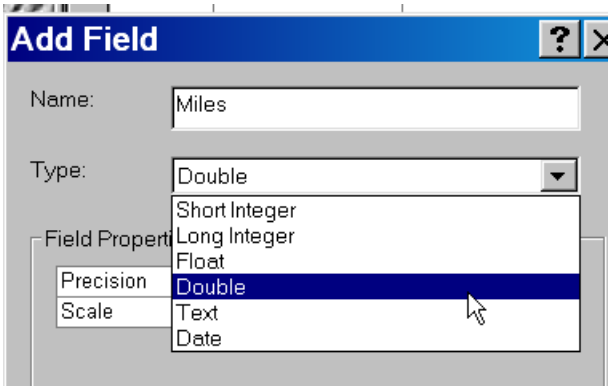


FID	Shape *	ROAD_NAME	SOURCE
51	Polyline	Alaska Hwy	GPS98B
52	Polyline	Alaska Hwy	GPS98
53	Polyline	Alaska Hwy	GPS98
54	Polyline	Alaska Hwy	GPS98
55	Polyline	Alaska Hwy	GPS98
56	Polyline	Richardson Hwy	GPS98
57	Polyline	Richardson Hwy	GPS98
58	Polyline	Richardson Hwy	GPS98
59	Polyline	Richardson Hwy	GPS98
60	Polyline	Richardson Hwy	GPS98
61	Polyline	Richardson Hwy	GPS98
62	Polyline	Richardson Hwy	GPS98

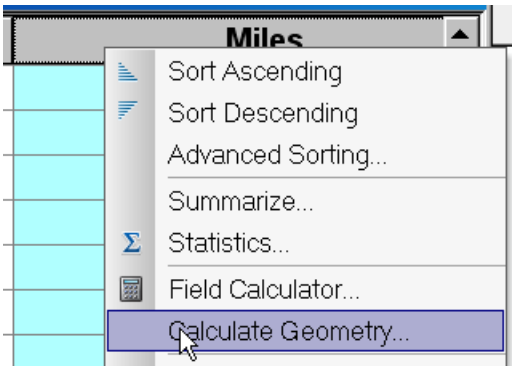
You want to float the Yukon from Eagle down to circle. A friend will drop you off at Eagle and drive your vehicle and leave it at Circle. How many miles would she have to drive from Eagle to Circle?

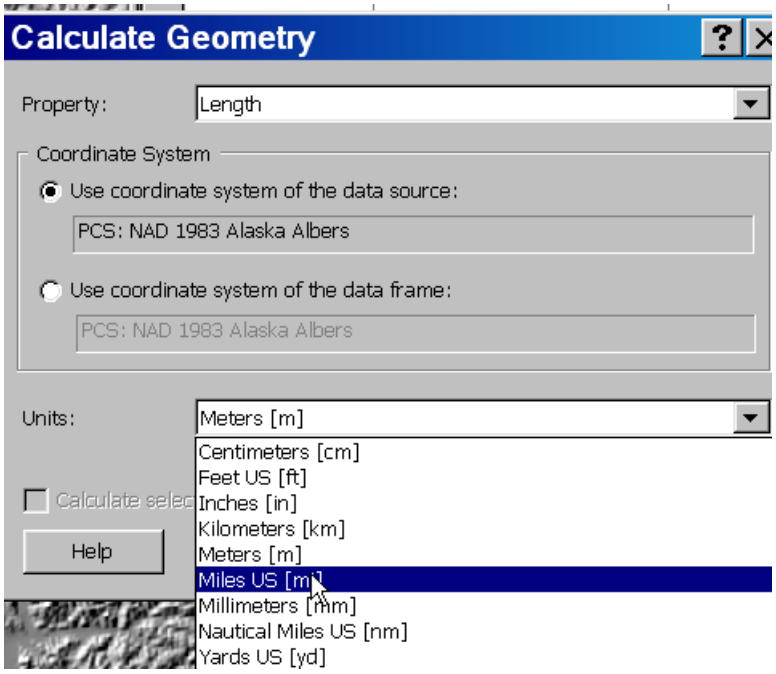
First add a double-precison field to contain the length of each line.



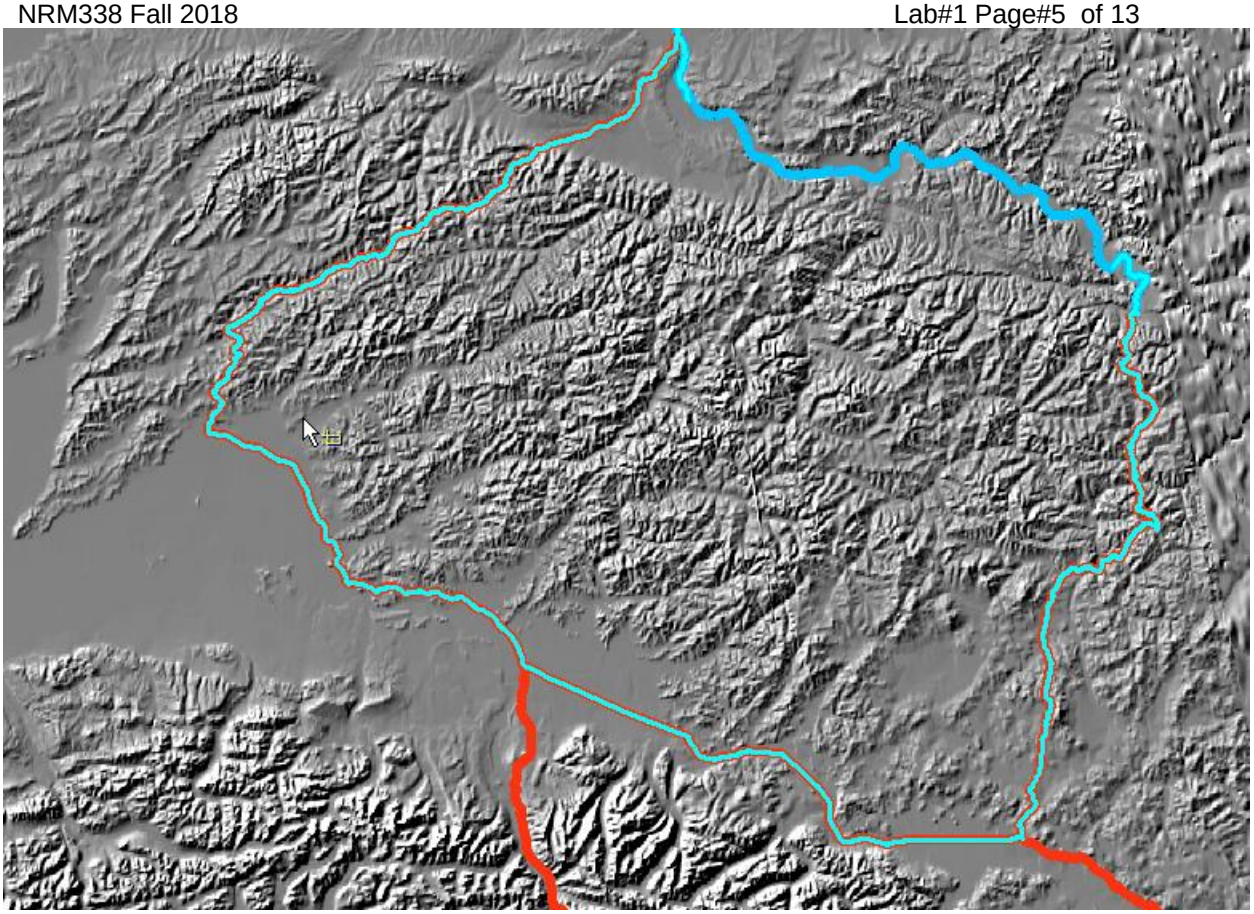


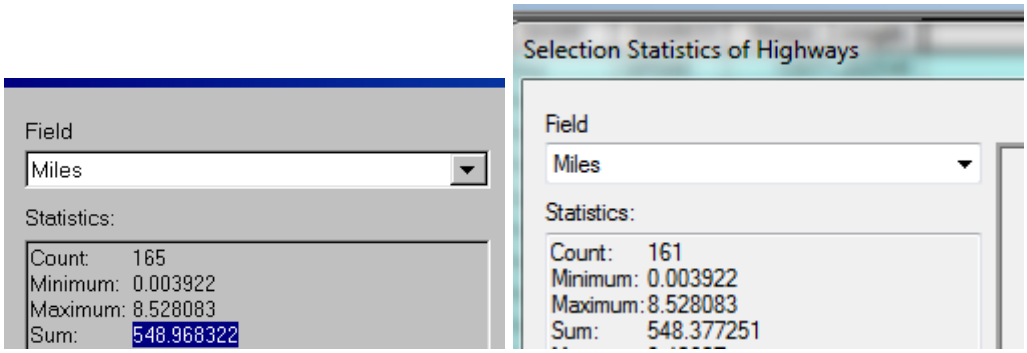
Then right mouse click on your numeric field and select





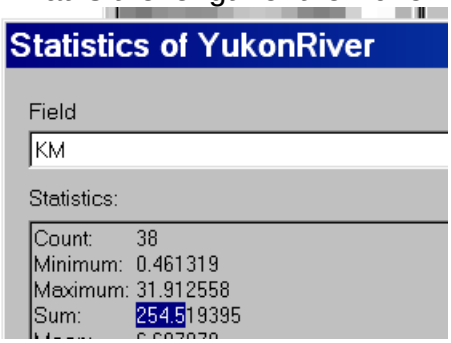
Then select the lines from Circle to Eagle along the highway system





So about 548-549 miles, depending on how many line segments you selected.

What is the length of the Yukon River float from Eagle to Circle in KM?



So about 255 kilometers

The Yukon River layer is composed of 38 lines.

YukonRiver

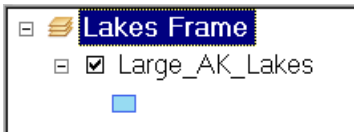
FID	Shape *	RiverName	KM
0	Polyline	Yukon River	8.445968
1	Polyline	Yukon River	8.402906
2	Polyline	Yukon River	3.076872
3	Polyline	Yukon River	13.377815
4	Polyline	Yukon River	8.317583
5	Polyline	Yukon River	3.156569

Use the ***Dissolve*** geoprocessing tool to dissolve these 38 lines into one line representing the river from Eagle to Circle.

YukonRiver_Dissolved

OBJECTID *	Shape *	RiverName	Total_KM
1	Polyline	Yukon River	254.519395

It is also easy to compute area of polygons as long as the GIS theme is in planar coordinates (meters or feet rather than degrees). Create a new data frame and add the shapefile Large_AK_Lakes to this new data frame.



Large_AK_Lakes

FID	Shape *	LakeName
0	Polygon	Selawik
1	Polygon	Teshekpuk
2	Polygon	Iliamna
3	Polygon	Becharof

What is the area of each lake polygon in KM^2? Add a double precision field and then use Calculate Geometry to compute the area of each polygon…what are the three largest lakes in Alaska?

Measures

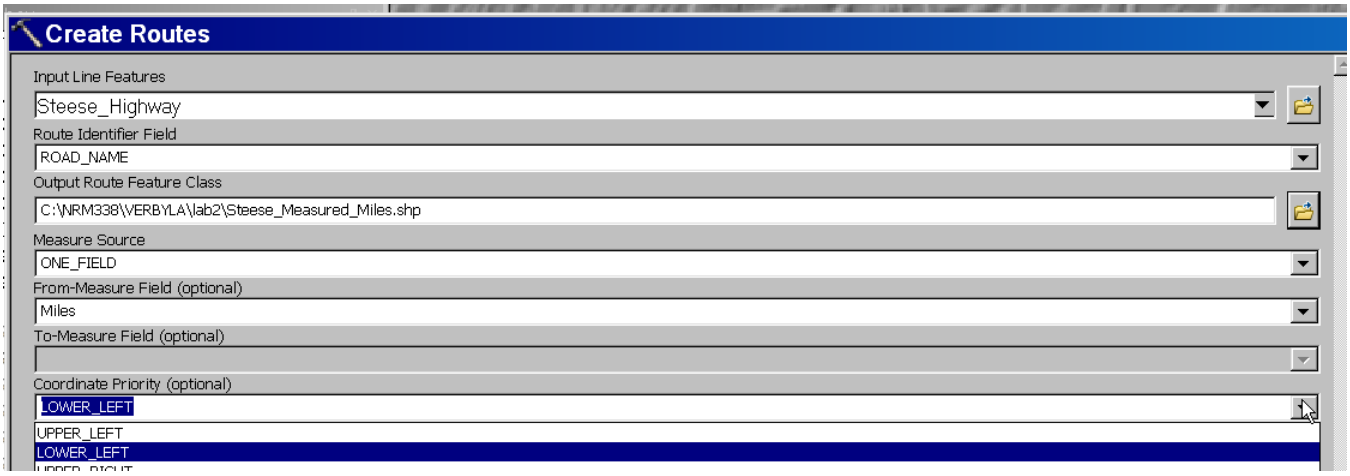
A measured line is called a route and it contains a linear measure such as miles along a highway, meters along a transect, KM along a river, steps along a trail, and so on.

Use the ***Dissolve*** geoprocessing tool to create one line representing the Steese Highway. Add a double precision field for Miles and compute the length of the line in miles.

Steese_Hwy_Dissolve

	Shape *	ROAD_NAME	Miles
	Polyline	Steese Hwy	157.101955

Next, create a measured line or route by using the **Create Routes tool**, with mile 0 starting at the lower left of the line.



Note that the shape is PolylineM where M stands for measured.

Steese_Measured_Miles

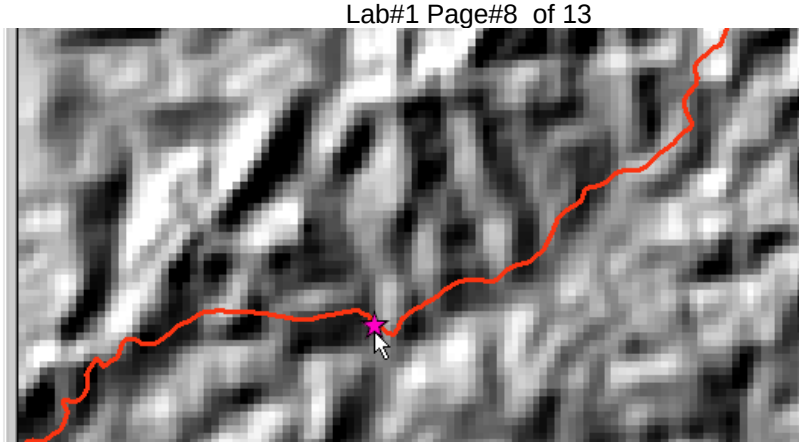
	FID	Shape *	ROAD_NAME *
▸	0	Polyline M	Steese Hwy

Add the dbf table Accident to your data frame.

Accident

	Highway	Mile
	Steese Hwy	89.5

Where is mile 89.5 located along the measured line? Use the **Make Route Event** tool make a point event layer at this location.

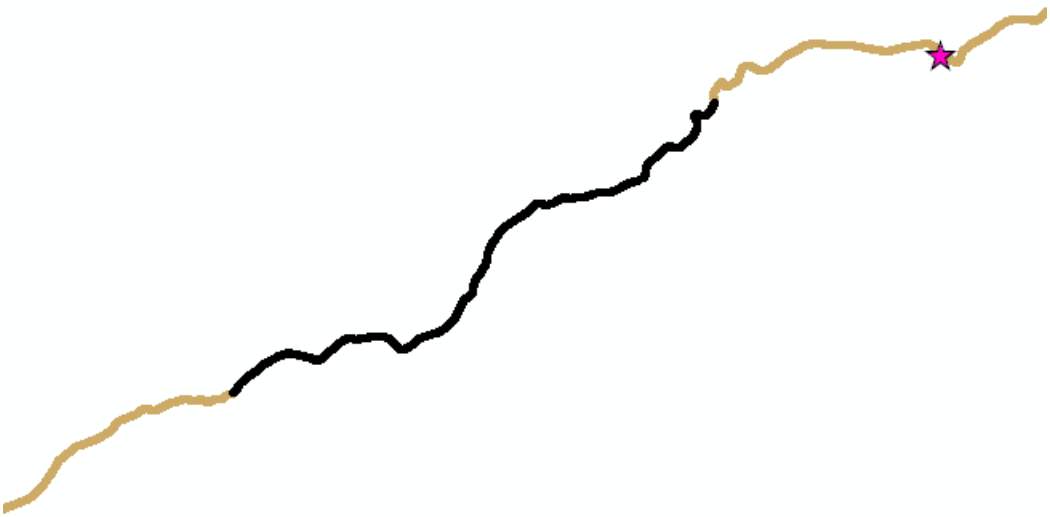


Next add the table Paving.dbf to your data frame.

Paving

	Highway	Start	End
	Steese Hwy	59.5	80.5

Use the **Make Route Event** tool to create a line event layer, showing paving from mile 59.5 to mile 80.5 along the measured line.



Z-Dimension

The Z dimension represents height or depth (X,Y, Z). Add the points Steese_Points_Z to your dataframe. The elevation or Z-dimension was estimated using GPS every 1 km along the Steese Highway. So the shape contains a Z value (elevation) and measure (KM) at each point location.

Steese_Points_Z

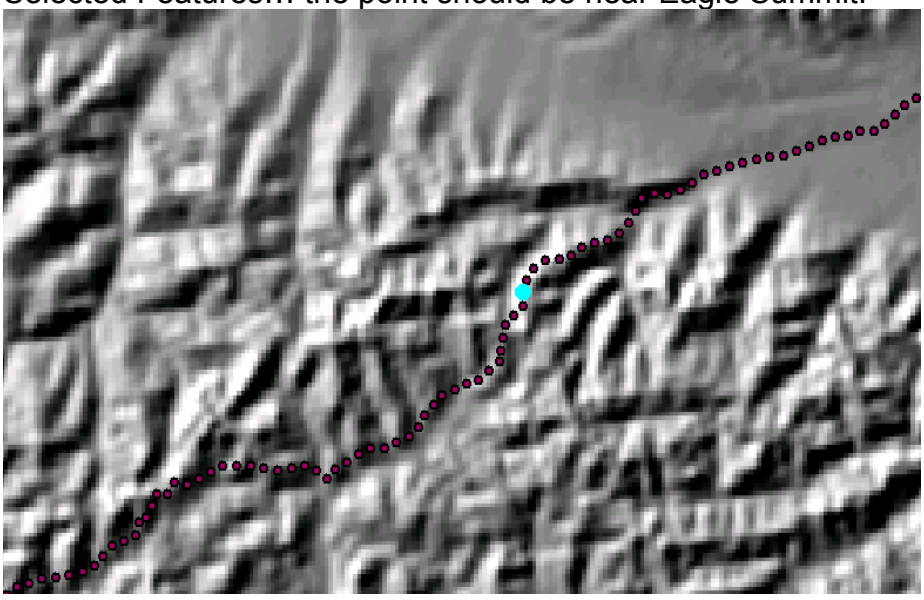
Shape *	Name
Point ZM	Steese Hwy
Point ZM	Steese Hwy
Point ZM	Steese Hwy
Point ZM	Steese Hwy
Point ZM	Steese Hwy
Point ZM	Steese Hwy
Point ZM	Steese Hwy
Point ZM	Steese Hwy

Use the Add XY tool to extract the X,Y, Z (in meters) and M (measure in KM) from each point to the point attribute table.

Steese_Points_Z

POINT_Z	POINT_M
130.04	1.00
137.00	2.00
137.00	3.00
146.22	4.00
161.39	5.00
184.61	6.00
216.97	7.00
230.84	8.00
239.42	9.00
282.84	10.00
330.36	11.00
283.48	12.00
228.50	13.00

Where is the highest elevation along this highway? Sort your Point_Z field descending and select the record with the highest elevation. Then from the Arcmap selection menu, Zoom to Selected Features… the point should be near Eagle Summit.

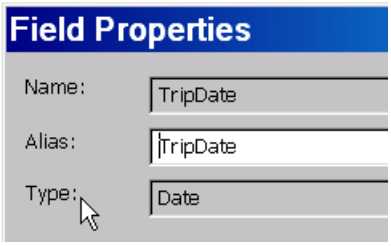


Temporal Dimension

The date type is a special field type that contains time information (day,month,year in shapefiles, day,month,year,hour,min, seconds in geodatabases). You have points recorded using a GPS along the Yukon River

CanoeTrip

FID	Shape *	TripDate
0	Point	8/30/2011
1	Point	8/31/2011
2	Point	9/3/2011
3	Point	9/5/2011
4	Point	9/8/2011
5	Point	9/9/2011
6	Point	9/10/2011

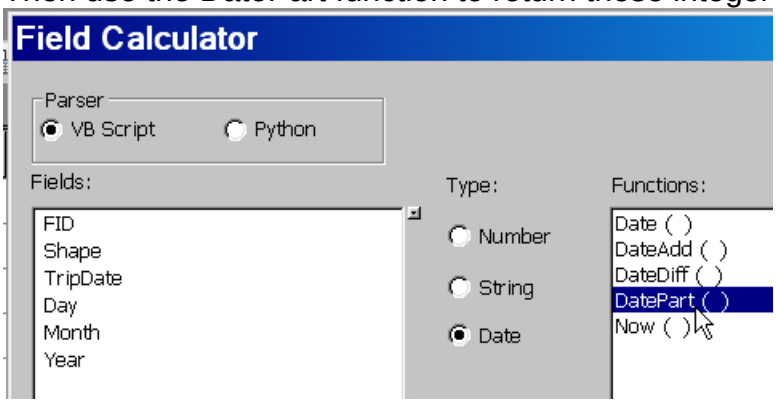


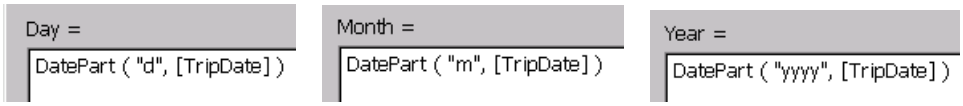
Notice that the TripDate field type is date…

There are special functions that you can use with a date field.
Add three short integer fields for Day,Month, Year

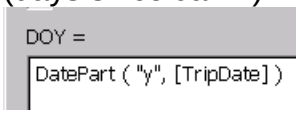
TripDate	Day	Month	Year
8/30/2011	0	0	0
8/31/2011	0	0	0
9/3/2011	0	0	0
9/5/2011	0	0	0
9/8/2011	0	0	0
9/9/2011	0	0	0
9/10/2011	0	0	0

Then use the DatePart function to return these integer values from your TripDate field.





Add a short integer field DOY for day of year, and then compute day of year (days since Jan 1)



Add a short integer field Days, and then compute days since the start of the trip.

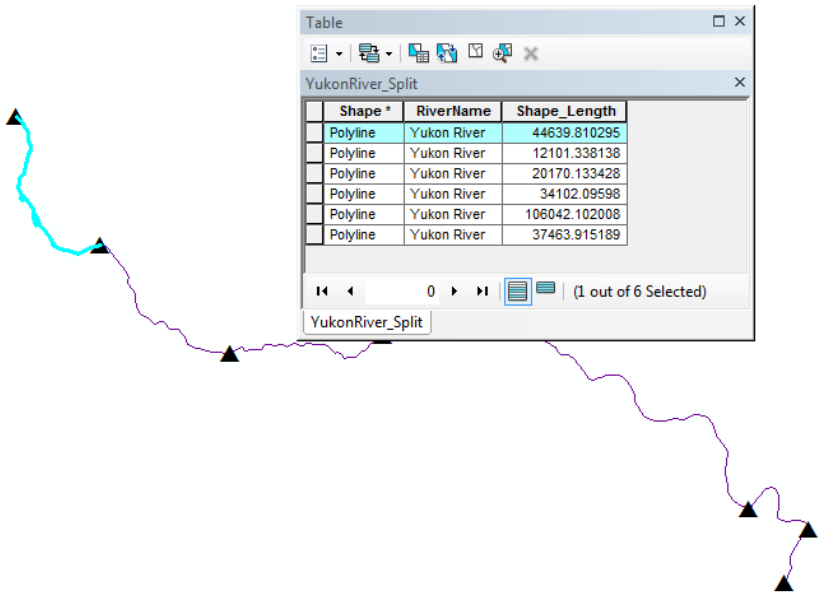
TripDate	Day	Month	Year	DOY	Days
8/30/2011	30	8	2011	242	0
8/31/2011	31	8	2011	243	1
9/3/2011	3	9	2011	246	4
9/5/2011	5	9	2011	248	6
9/8/2011	8	9	2011	251	9
9/9/2011	9	9	2011	252	10
9/10/2011	10	9	2011	253	11

What is the distance between the points along the Yukon River?
First use the ***Dissolve*** geoprocessing tool to create a single line representing the river…

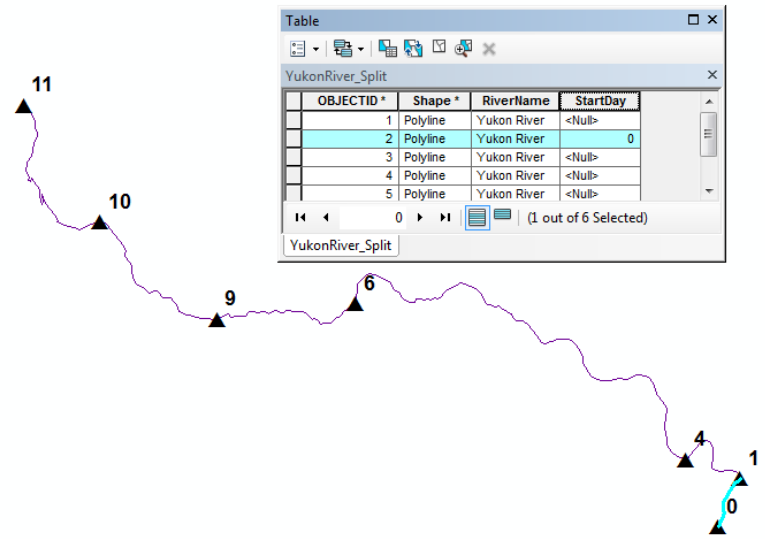
YukonRiver_Dissolved

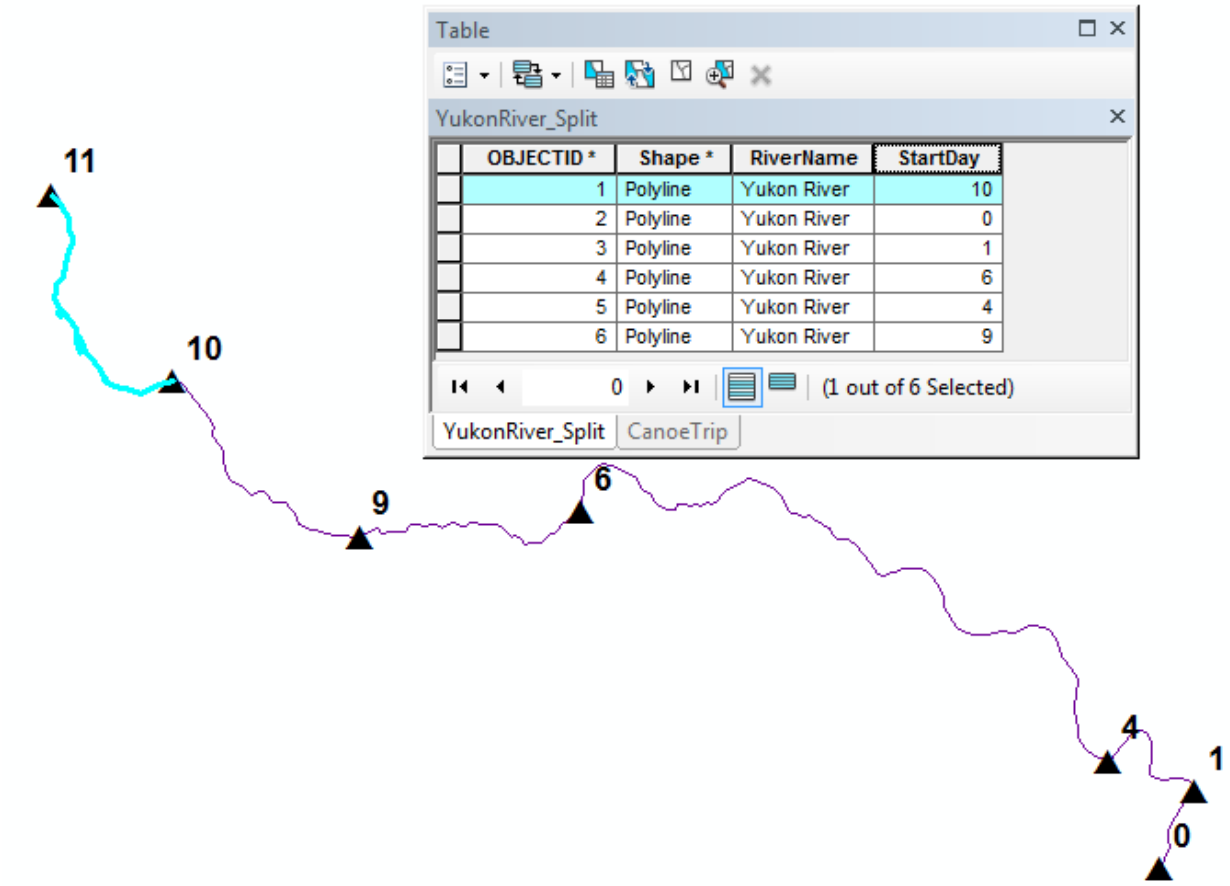
	OBJECTID *	Shape *	RiverName
	1	Polyline	Yukon River

Then use the ***Split Line at Point*** geoprocessing tool with a search radius of 5 meters to split the dissolved Yukon River line into lines representing each river segment floated. The output lines will not be in the correct downstream order….



Add a short integer field representing the start day for each section. Label your points using your Days field. Select the upstream line and use the field calculator to assign it to day 0, then select the next line and assign it to day 1, etc.





Use the ***Sort*** geoprocessing tool to sort your records permanently by StartDay.

Shape *	RiverName	StartDay
Polyline	Yukon River	0
Polyline	Yukon River	1
Polyline	Yukon River	4
Polyline	Yukon River	6
Polyline	Yukon River	9
Polyline	Yukon River	10

Add double precision fields and compute Miles and KM floated for each river line (right mouse-click on the field, select Calculate Geometry).

RiverName	StartDay	Miles	KM
Yukon River	0	7.5	12.1
Yukon River	1	12.5	20.2
Yukon River	4	65.9	106.0
Yukon River	6	21.2	34.1
Yukon River	9	23.3	37.5
Yukon River	10	27.7	44.6