# Hydrology Analysis

ISTANBUL**TECHNICAL**UNIVERSITY

## Sp. Anly. and Alg. in GIS
## Week 9

Res. Assist. Ömer AKIN

# Introduction & Aim of the Study

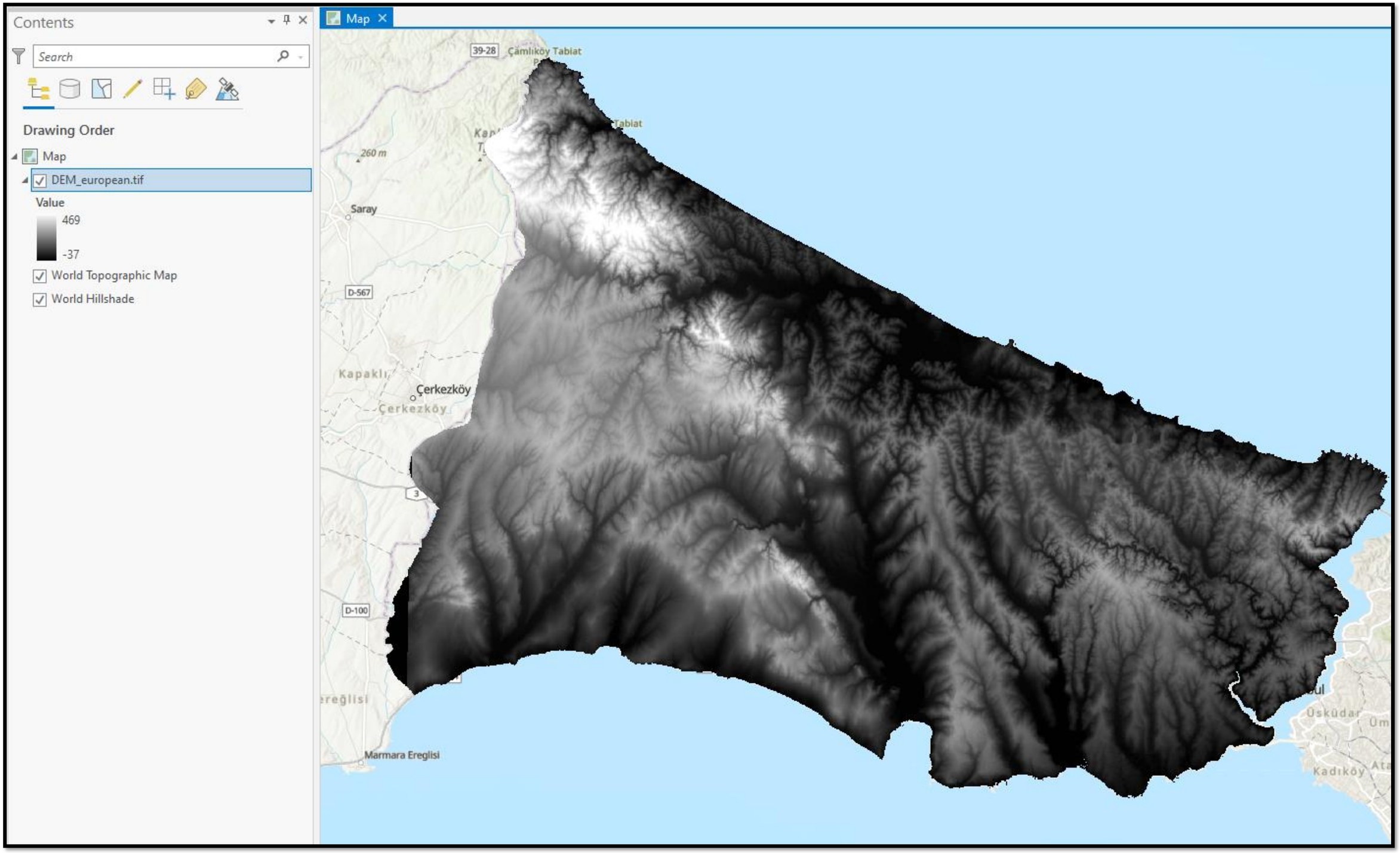
*Aim of the Study:*

- *Find watersheds and stream networks in the European Side of Istanbul*

*Input Data:*

- *Digital Elevation Model (Raster/GeoTIFF)*

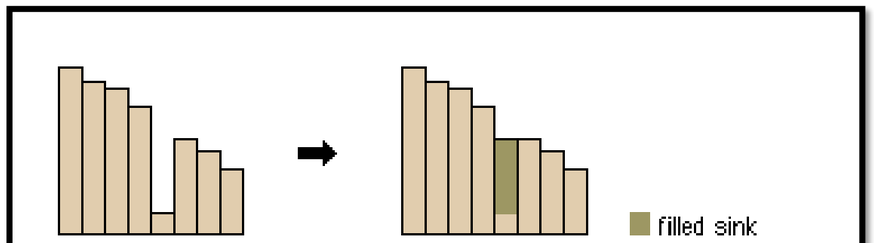
# Study Area & Data



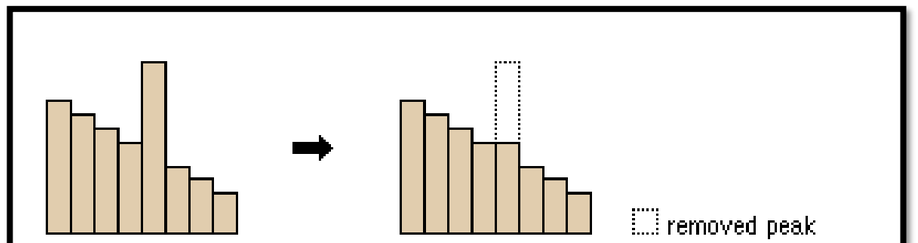
# Fill

Fills sinks in a surface raster to remove small imperfections in the data.

- Sinks (and peaks) are often errors due to the resolution of the data or rounding of elevations to the nearest integer value.
- Sinks should be filled first to ensure proper delineation of basins and streams. If the sinks are not filled, a derived drainage network may be discontinuous.

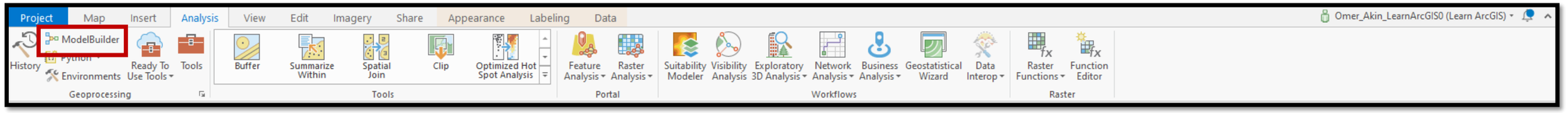


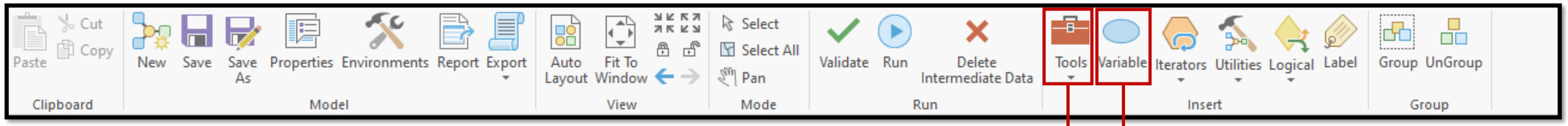

*Profile view of a sink before and after running Fill*



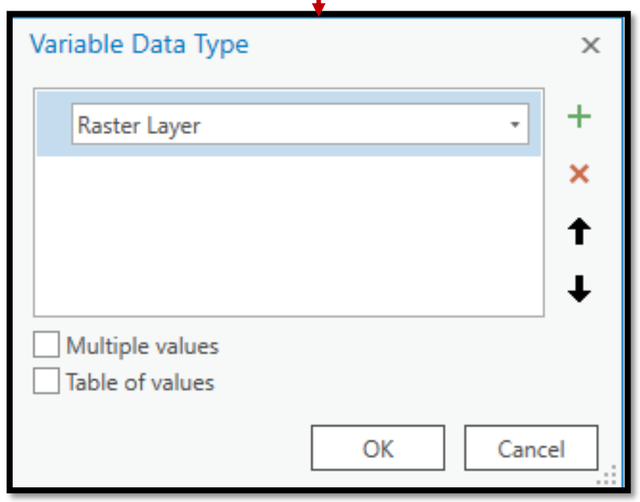

*Profile view of a peak before and after running Fill*

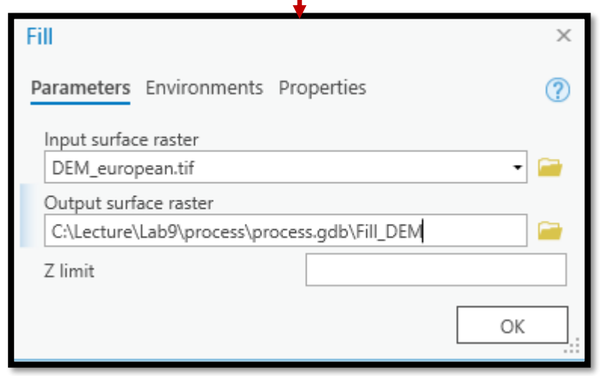
# Fill

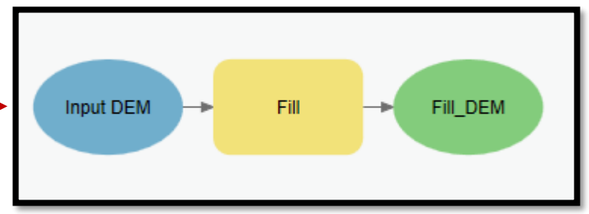


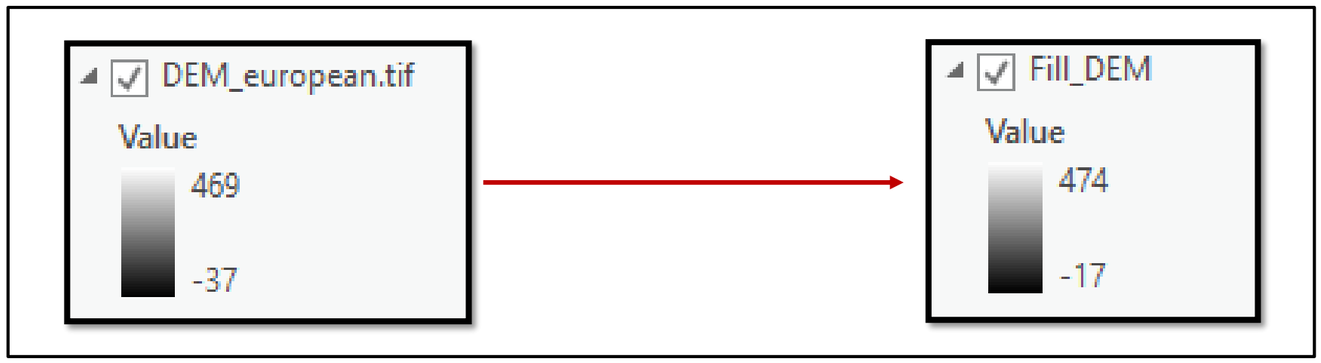




Create a raster input for DEM

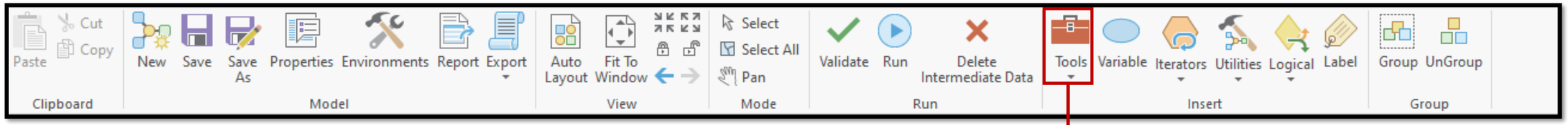


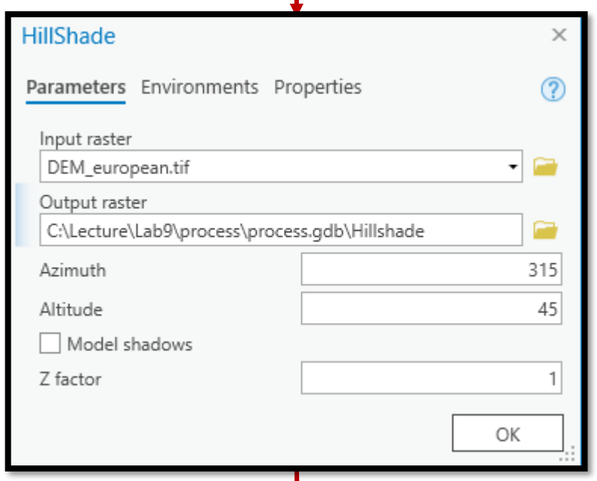



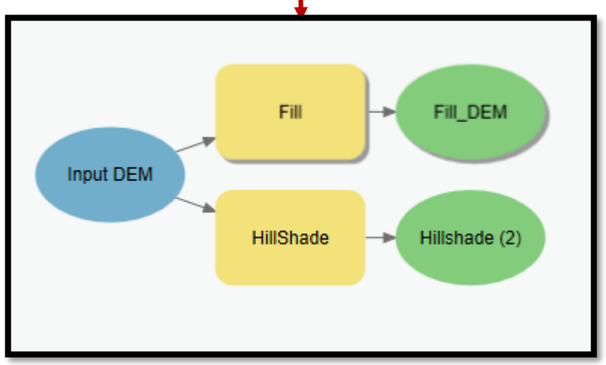



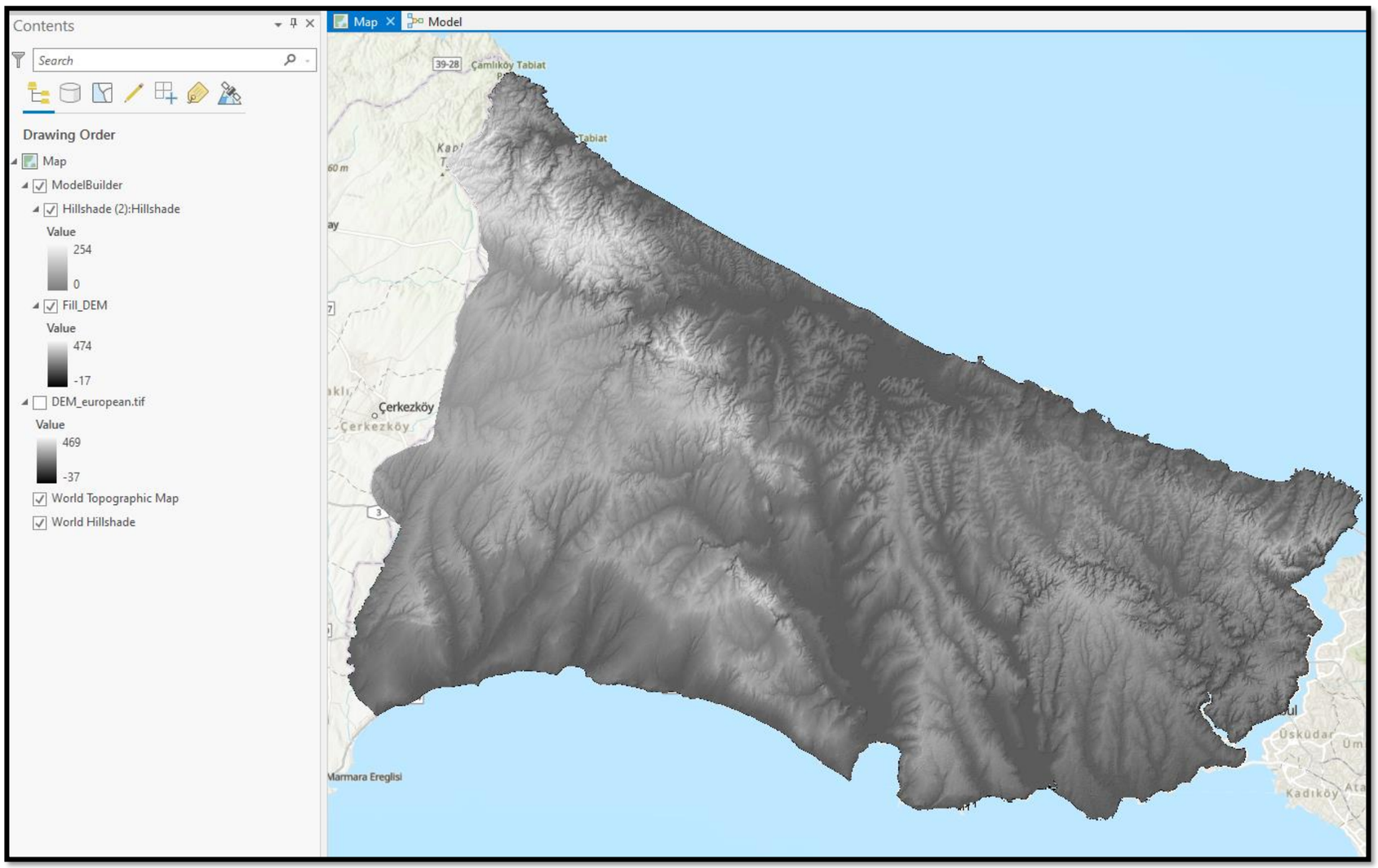



# Hillshade


Paste
Cut
Copy
Clipboard
New
Save
Save As
Properties
Environments
Report
Export
Model
Auto Layout
Fit To Window
View
Select
Select All
Pan
Mode
Validate
Run
Delete Intermediate Data
Run
Tools
Variable
Iterators
Utilities
Logical
Label
Insert
Group
UnGroup
Group

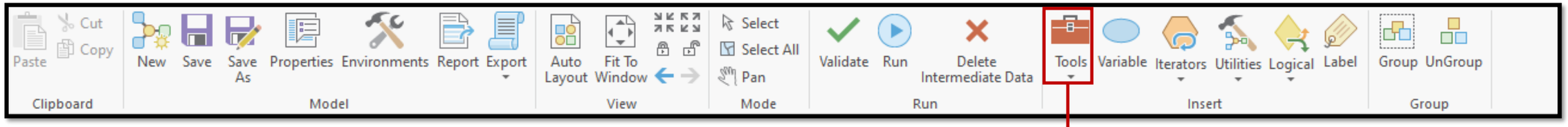

HillShade
Parameters
Environments
Properties
Input raster
DEM_european.tif
Output raster
C:\Lecture\Lab9\process\process.gdb\Hillshade
Azimuth
315
Altitude
45
Model shadows
Z factor
1
OK

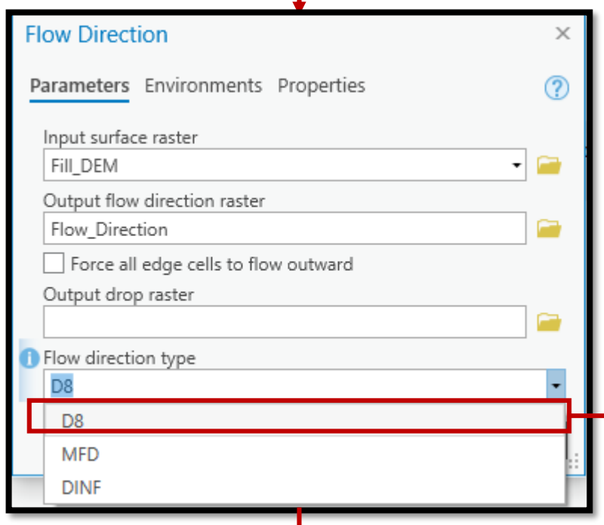

Input DEM
Fill
Fill_DEM
HillShade
Hillshade (2)


Contents
Search
Drawing Order
Map
ModelBuilder
Hillshade (2):Hillshade
Value
254
0
Fill_DEM
Value
474
-17
DEM_european.tif
Value
469
-37
World Topographic Map
World Hillshade
Map
Model
Çamlıköy Tabiat
Tabiat
Çerkezköy
Marmara Ereglisi
Üsküdar
Kadıköy

# Flow Direction

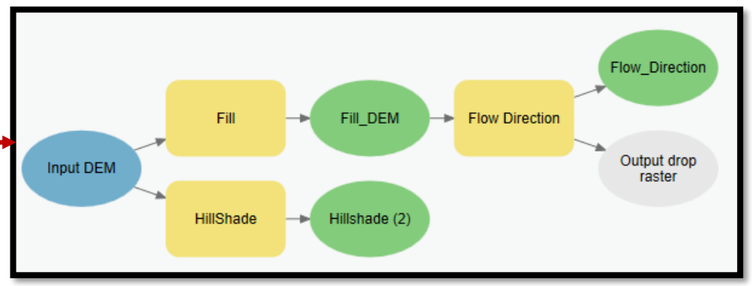
Creates a raster of flow direction from each cell to its downslope neighbor, or neighbors



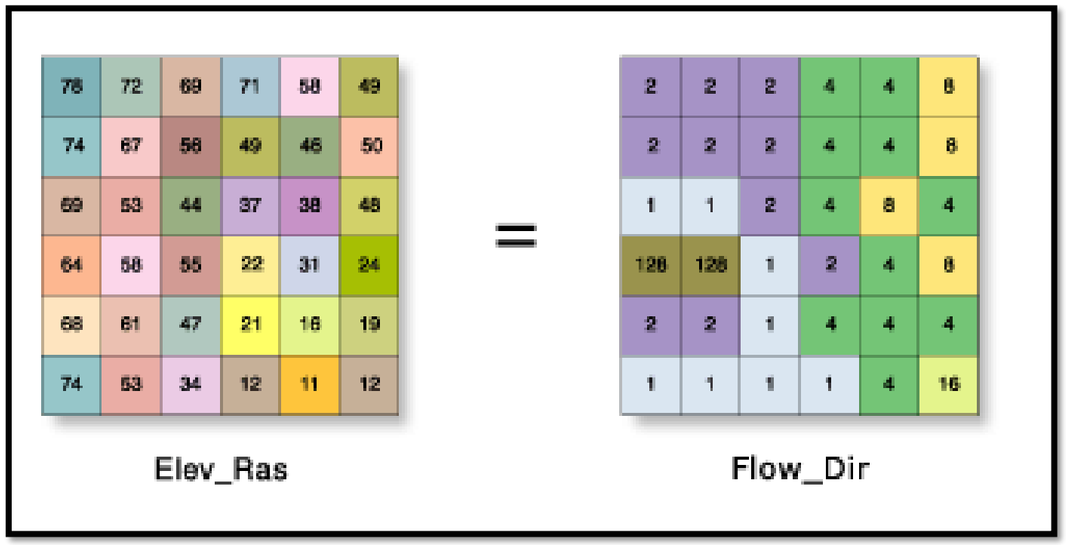




- The D8 flow method models flow direction from each cell to its steepest downslope neighbor.
- The output of the Flow Direction tool run with the D8 flow direction type is an integer raster whose values range from 1 to 255. The values for each direction from the center are:

| | | |
|---|---|---|
| 32 | 64 | 128 |
| 16 | | 1 |
| 8 | 4 | 2 |

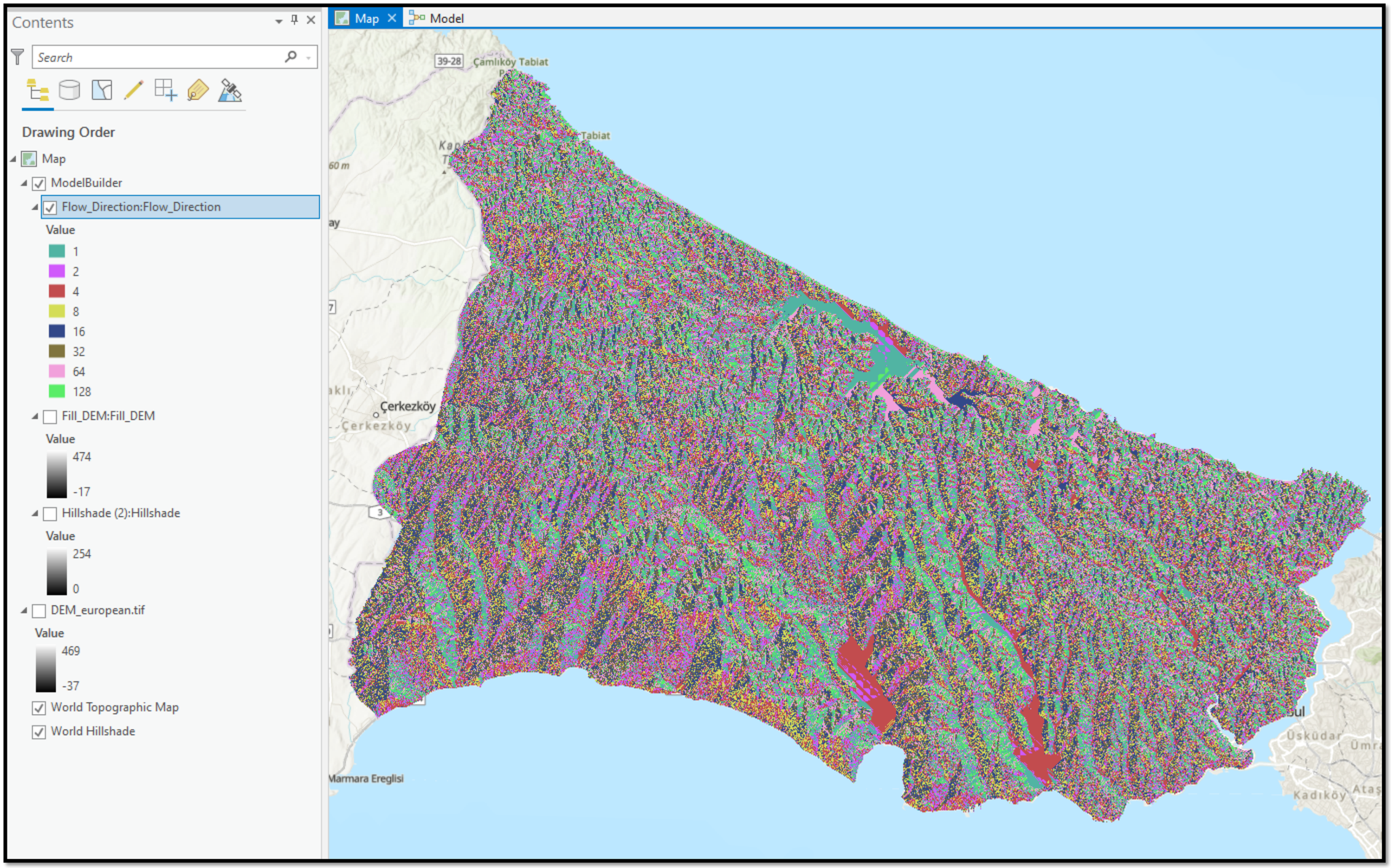



## Flow Direction Example



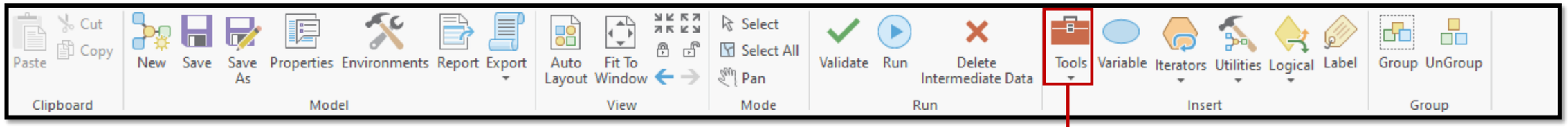

*To get more information about the other flow direction algorithms please visit:
https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-analyst/flow-direction.htm

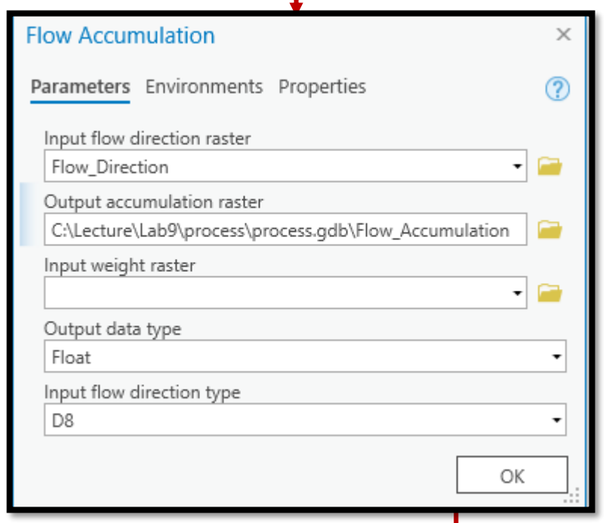
# Flow Direction Results

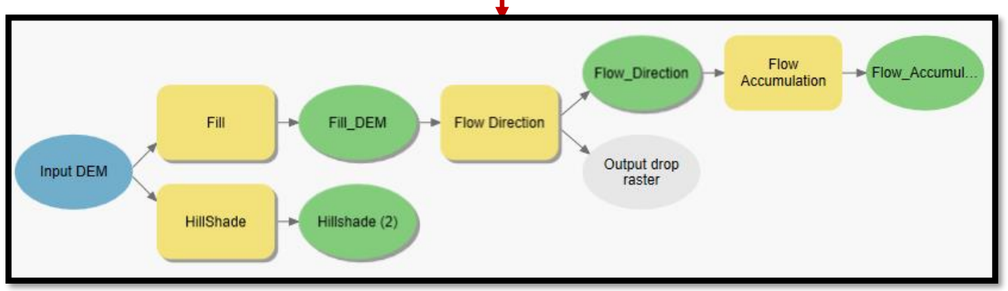


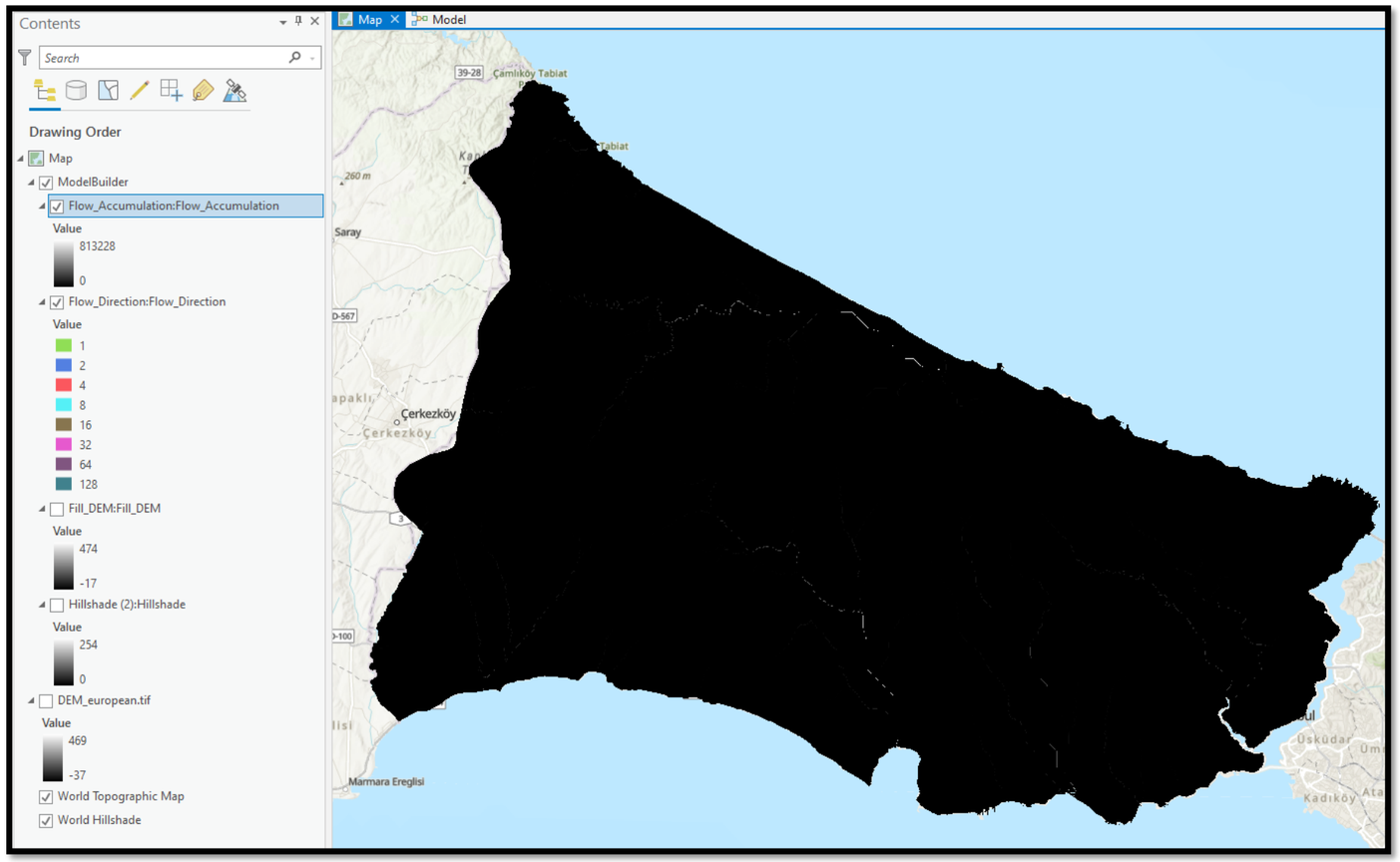
# Flow Accumulation

Creates a raster of accumulated flow into each cell.

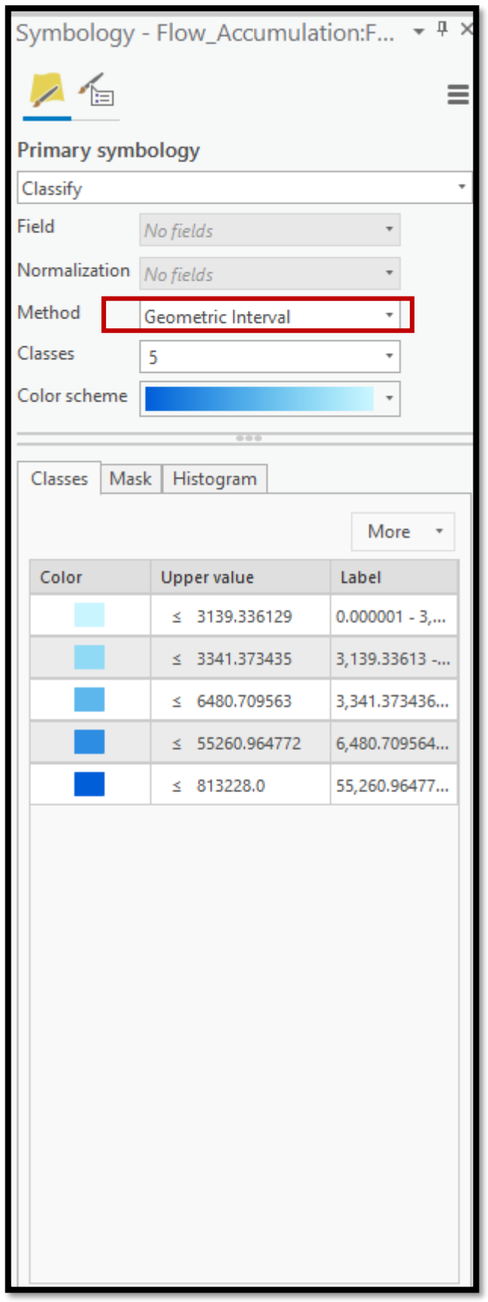


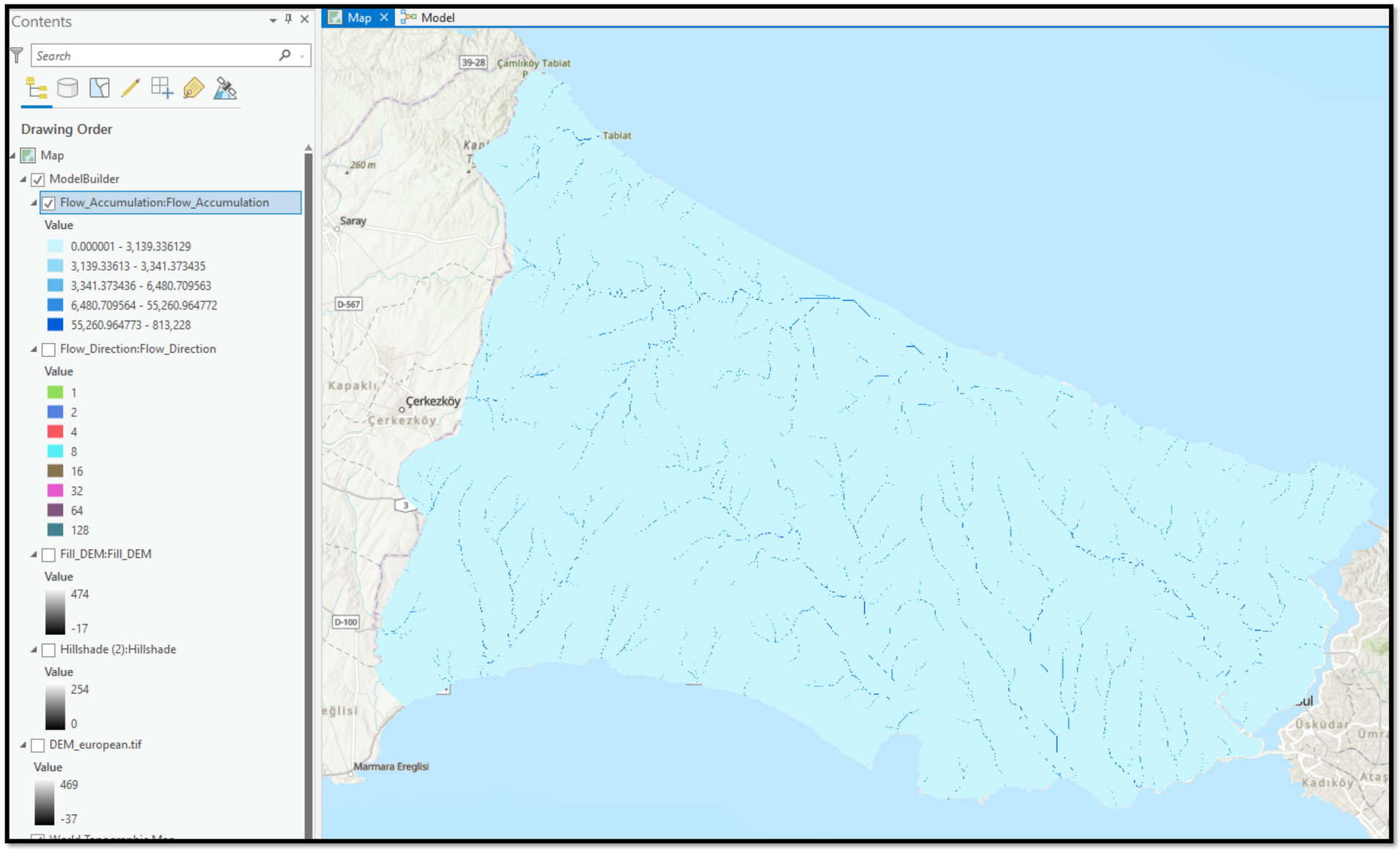



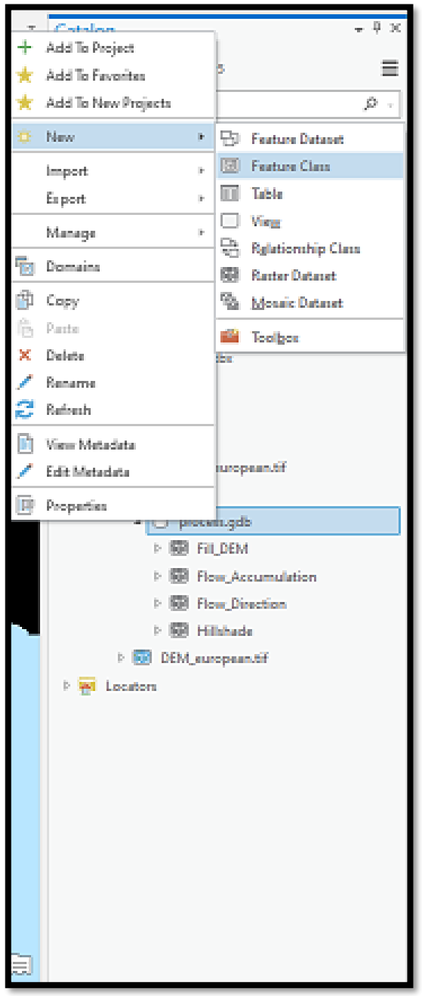
# Flow Accumulation Results

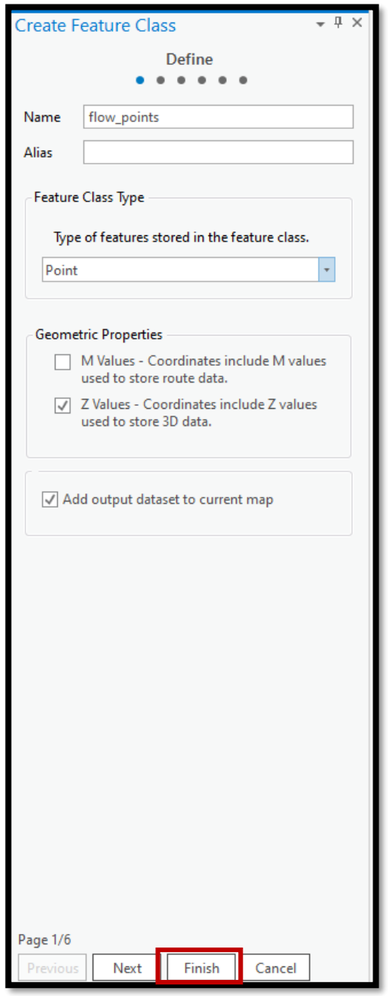


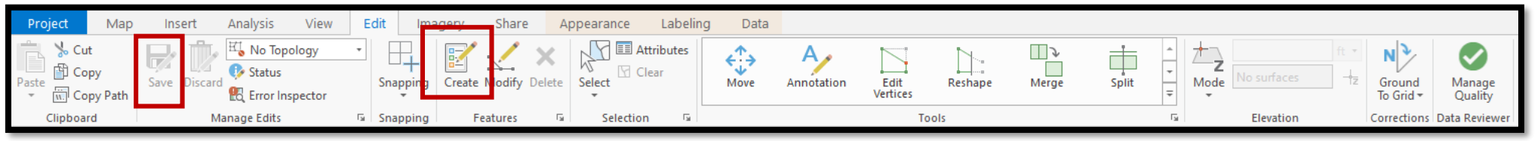



# Watersheds

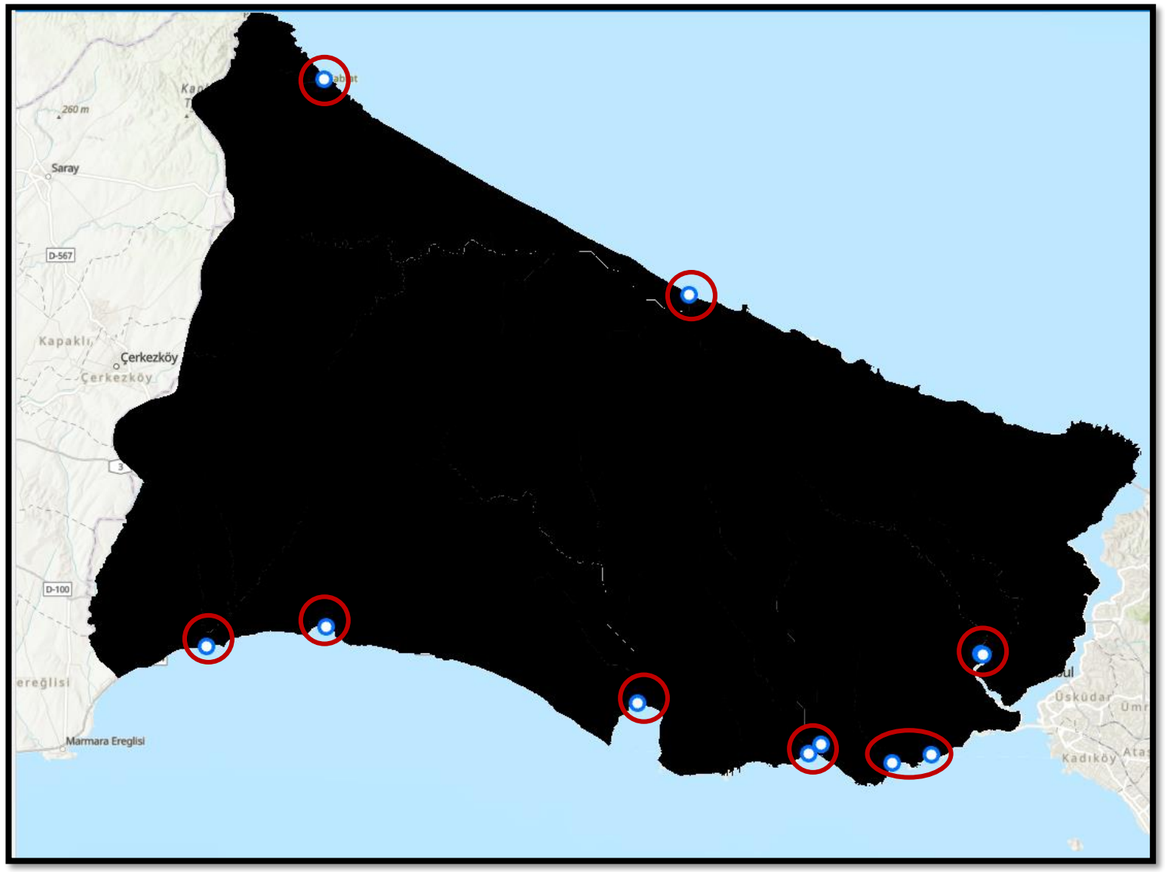
Create an empty point feature class to specify the start of streams.



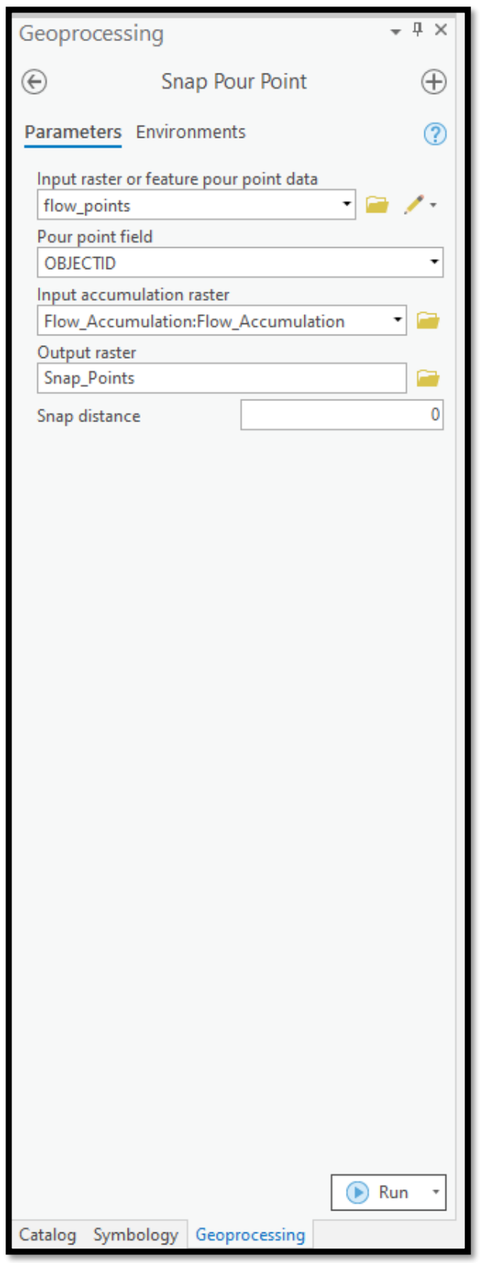



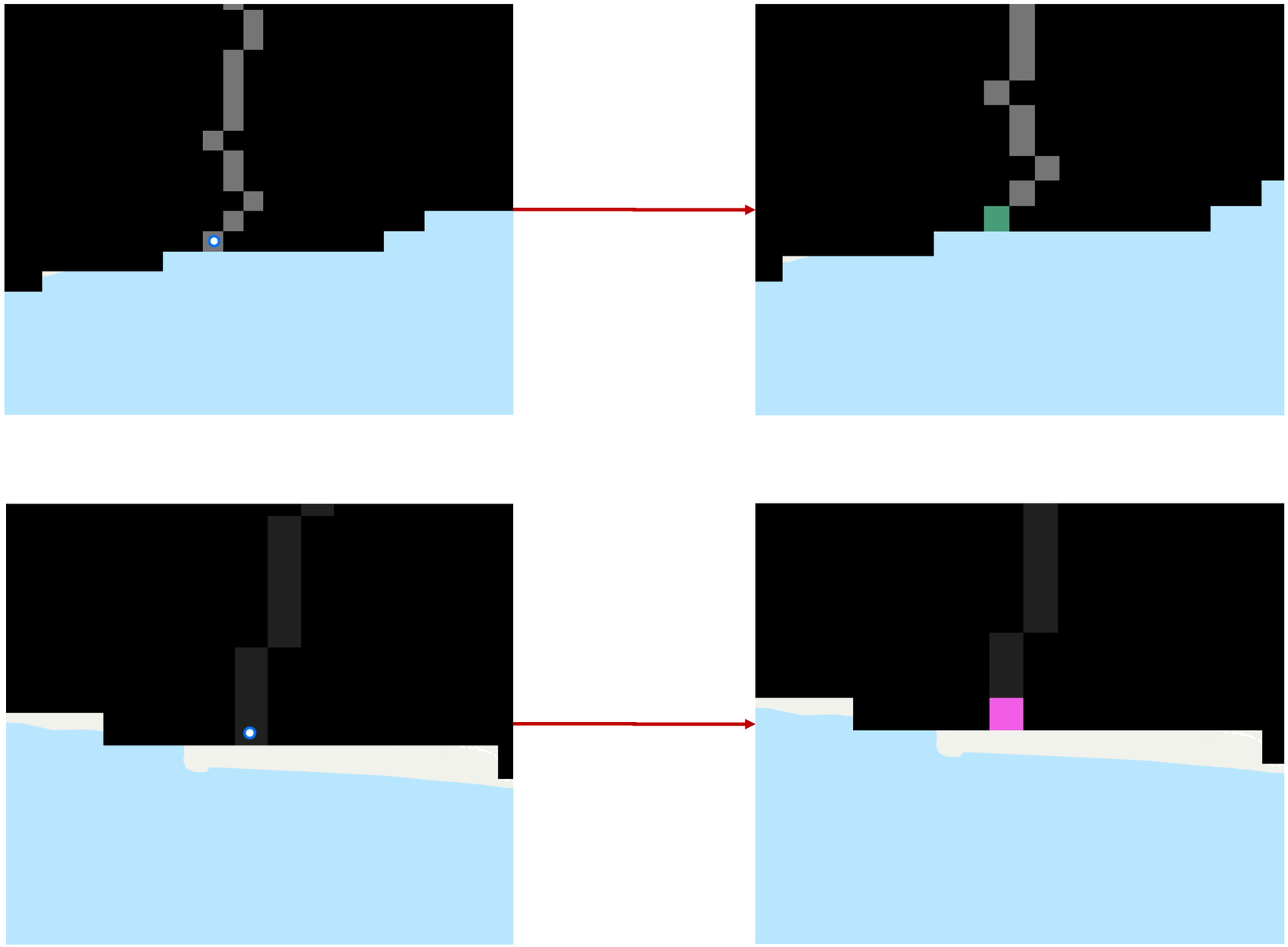

Manually add start of the streams as a point feature to create watersheds. To detect the start points we should zoom-in to accumulation raster



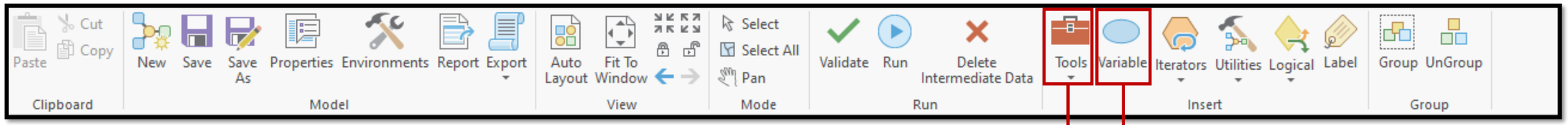
# Watersheds

## Add created points into accumulation raster as raster cells

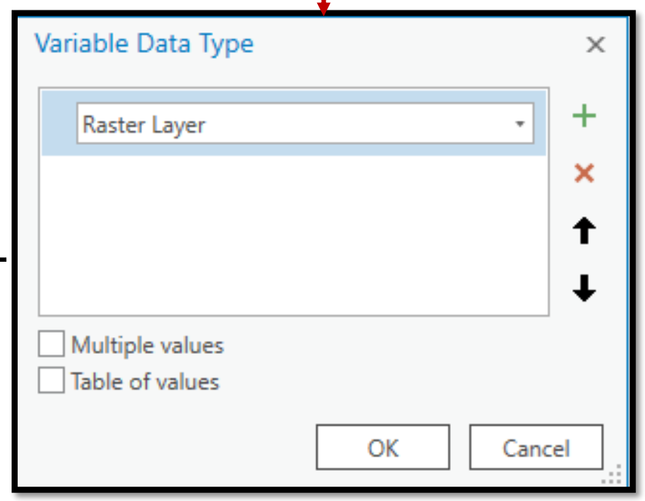


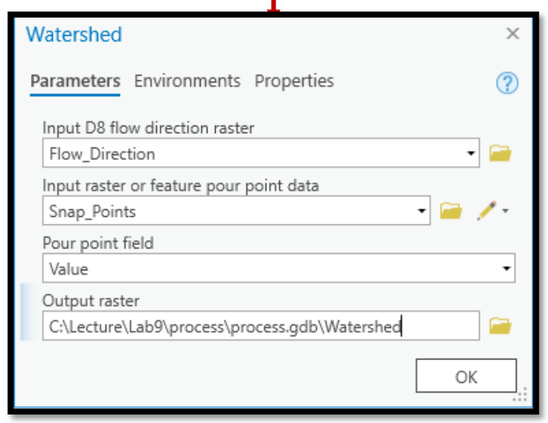



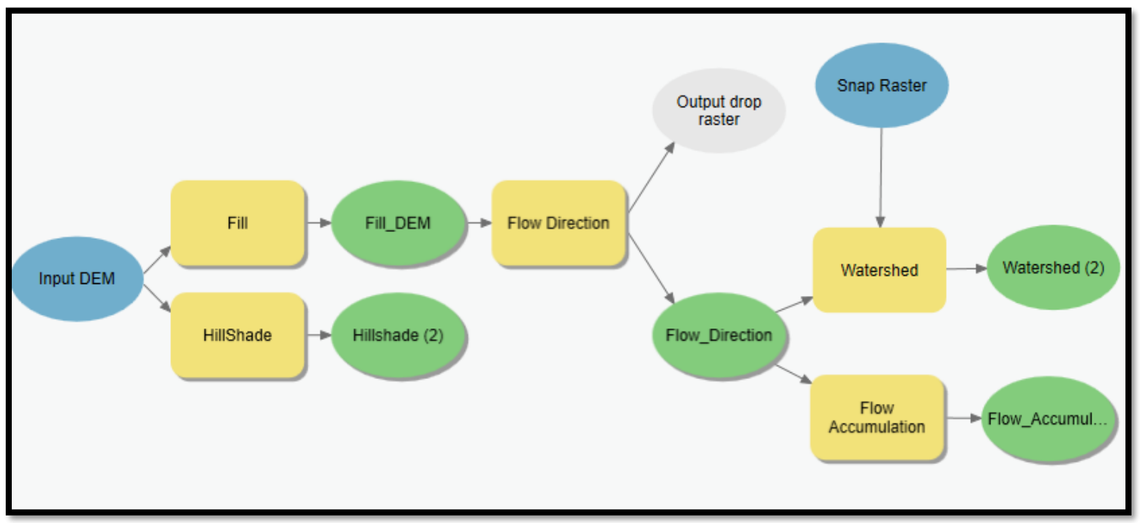
# Watersheds



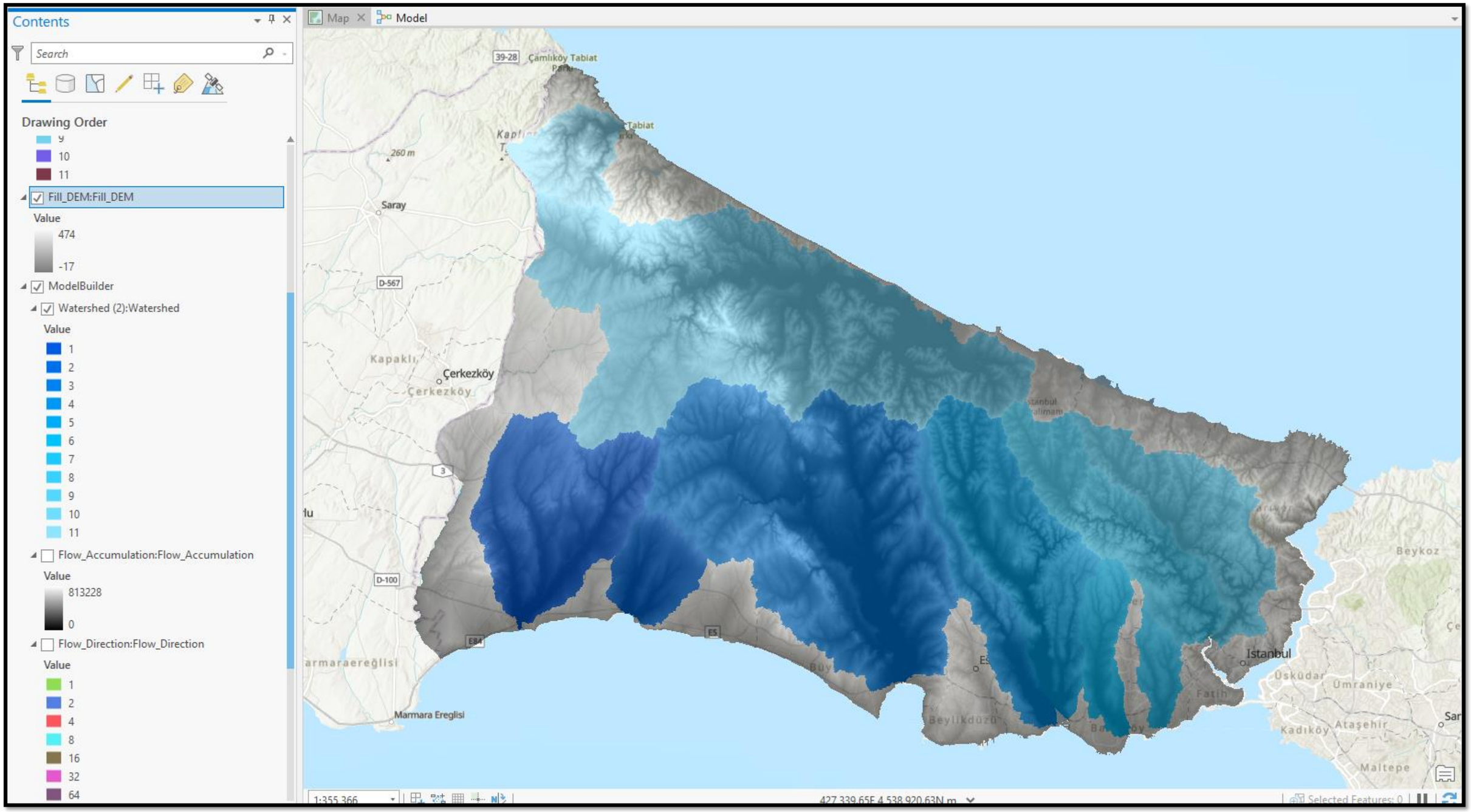

Create a raster input for Snap Raster



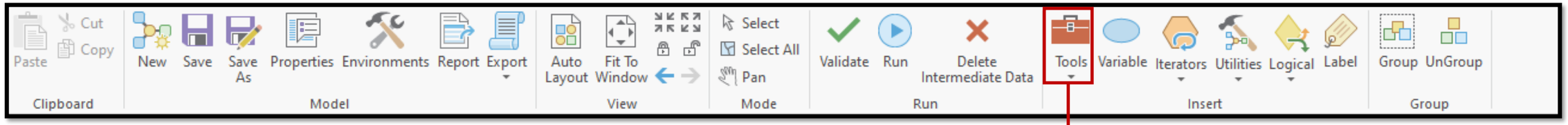



# Watershed Results



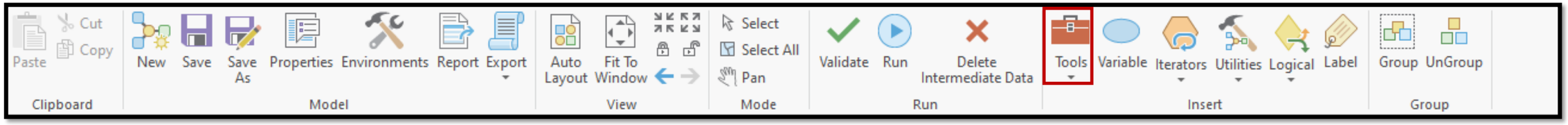
# Export Watersheds



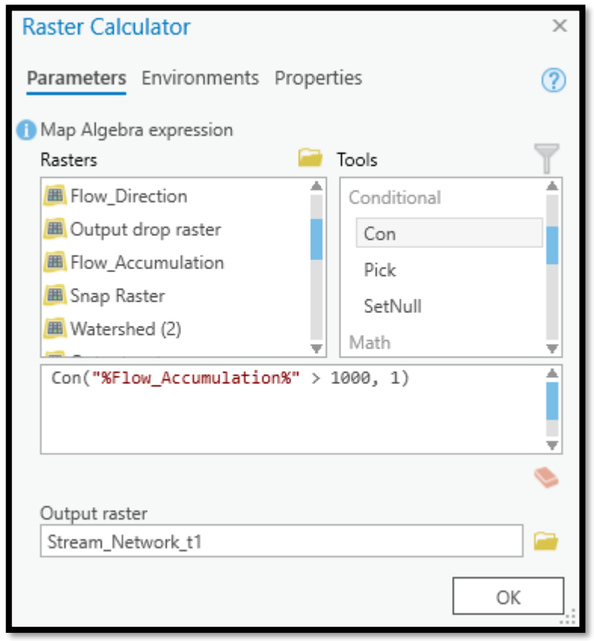
# Stream Networks

Apply a threshold value to generate stream networks from flow accumulation raster.

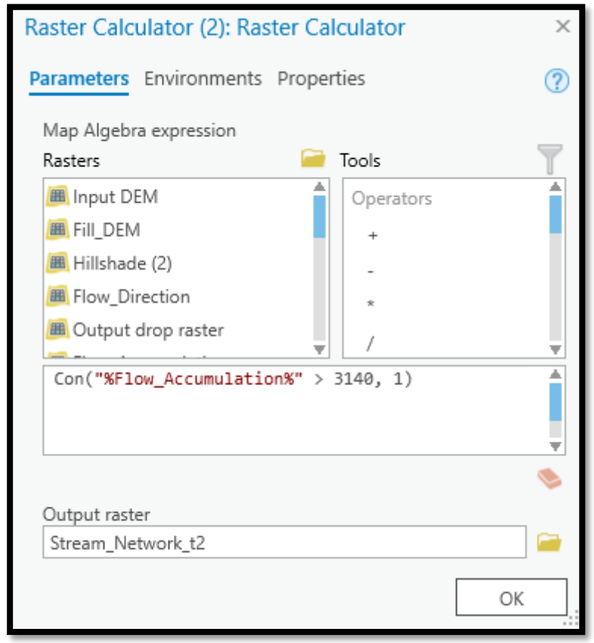
- Geometric intervals could be used to find appropriate threshold value
- Also determined by the scale and scope of the project



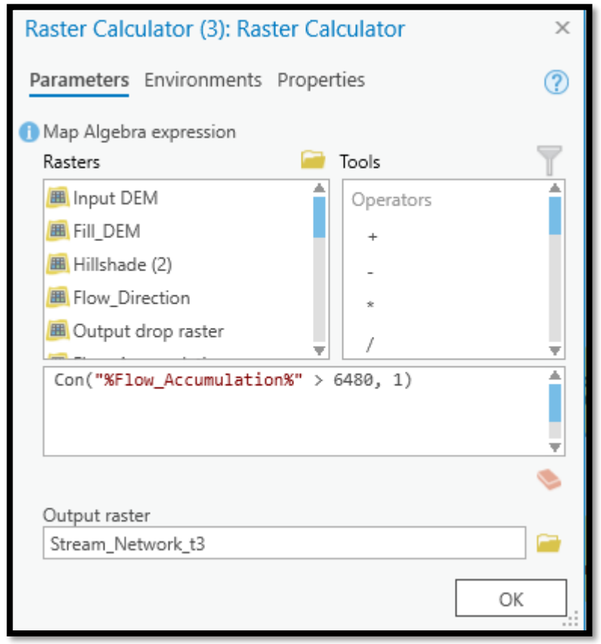

*Threshold 1: 1000*




*Threshold 2: 3140*

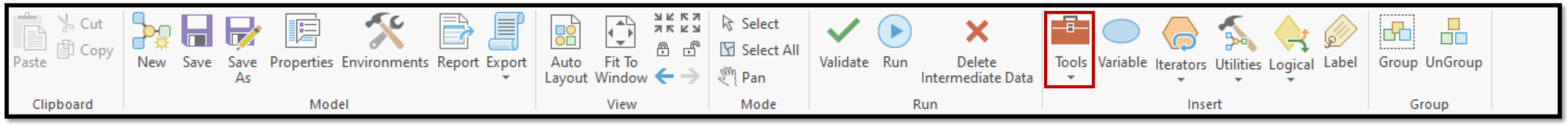



*Threshold 3: 6480*

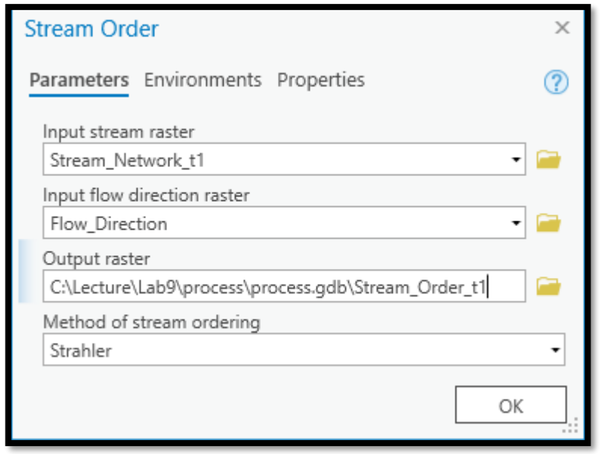


# Stream Order

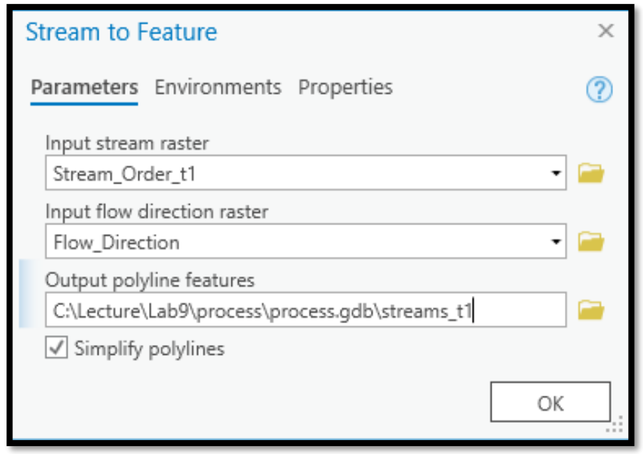
By using stream networks and flow direction, order of the streams will be generated for each threshold value. Then, we'll convert stream order rasters to polyline to better interpret the results.



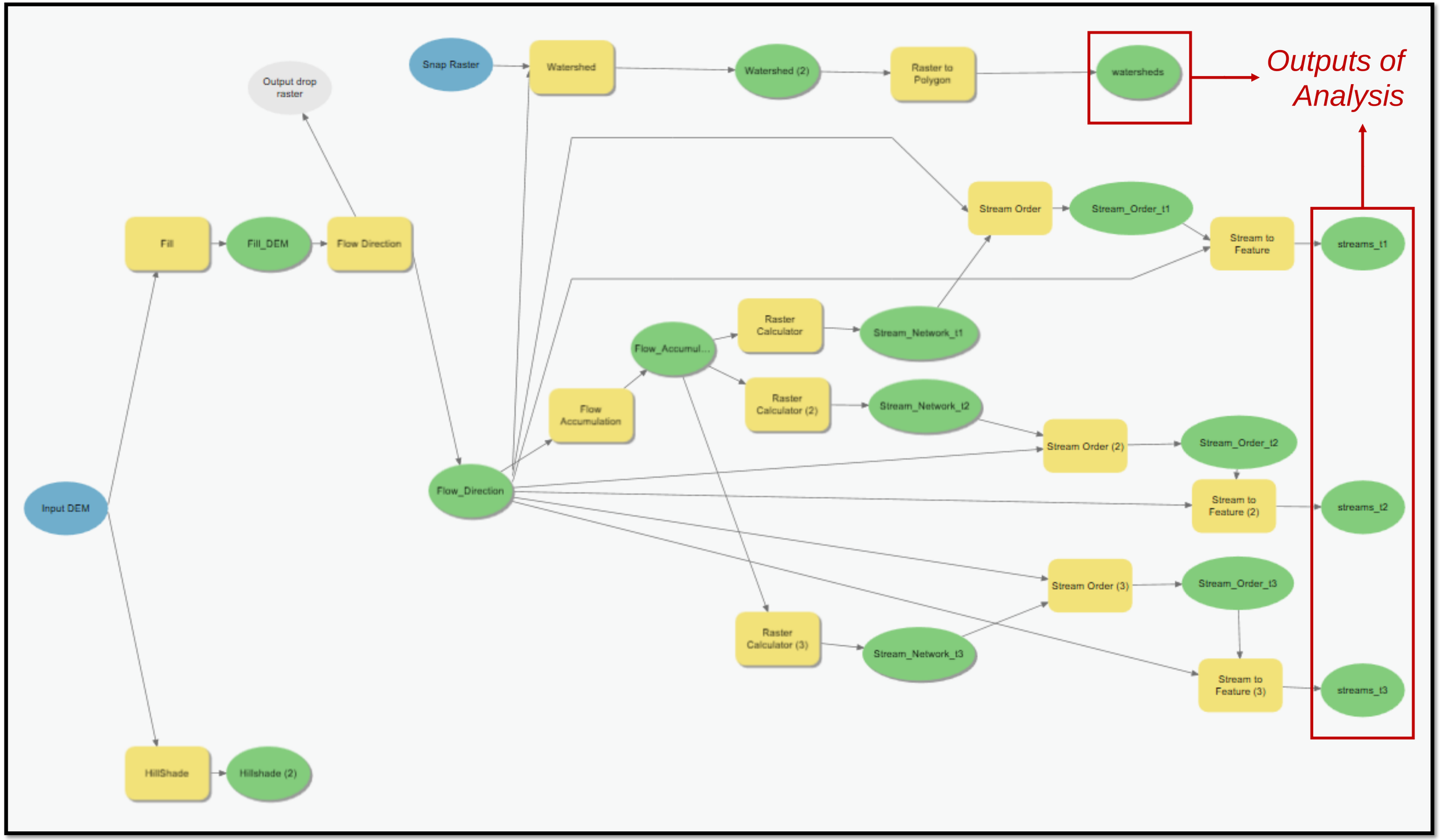

*Use Stream order for each threshold*



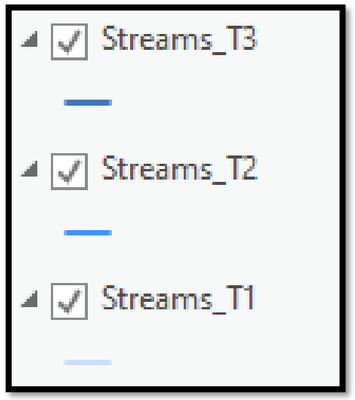

*Use Stream to Feature for each threshold*

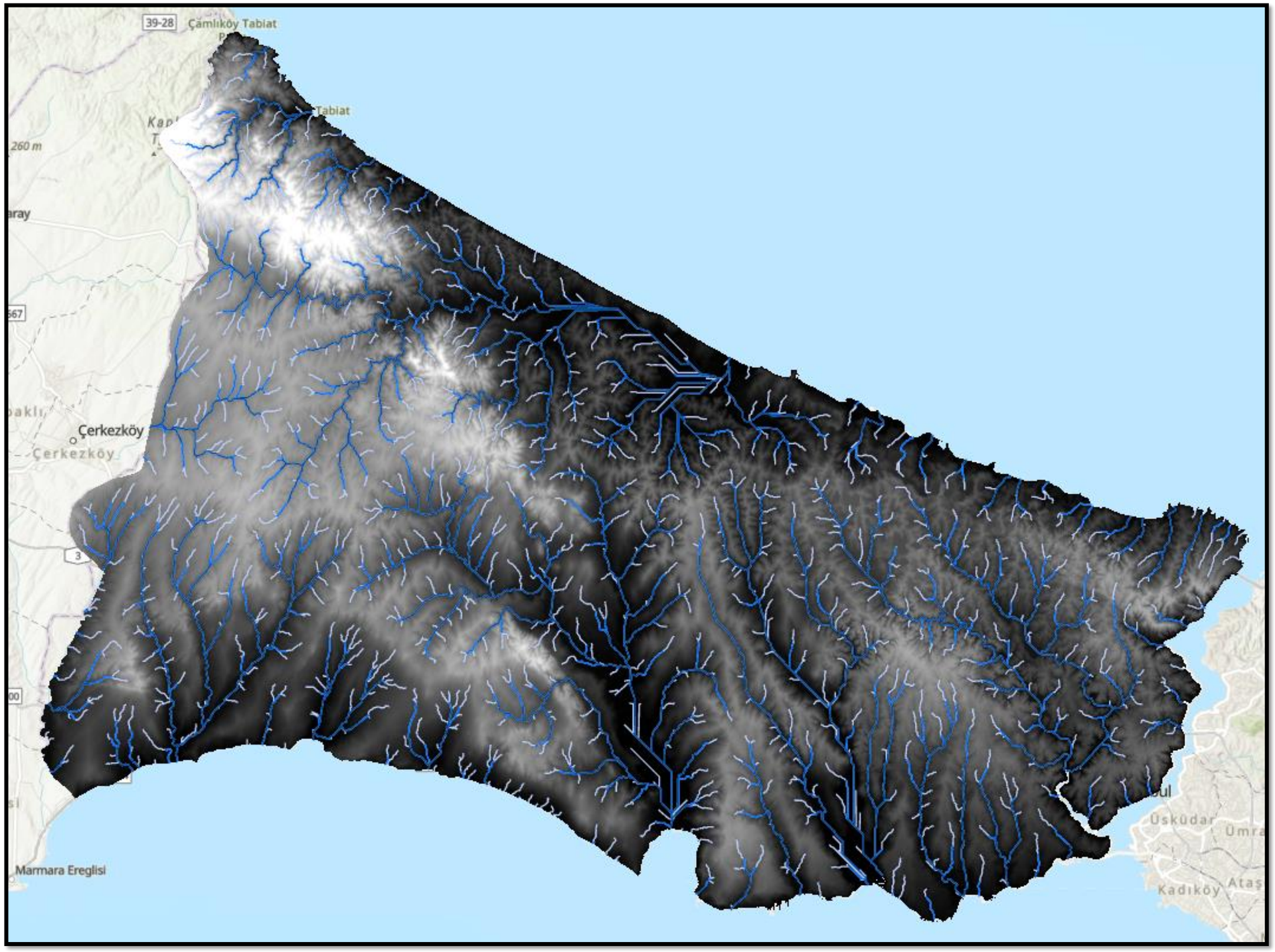


# Hydrology Model

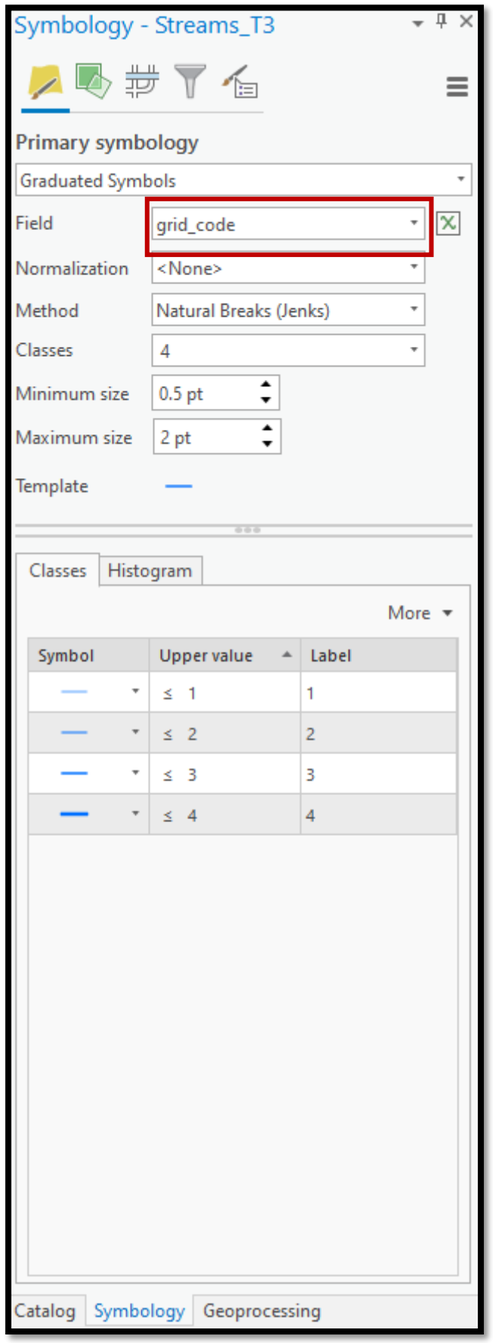


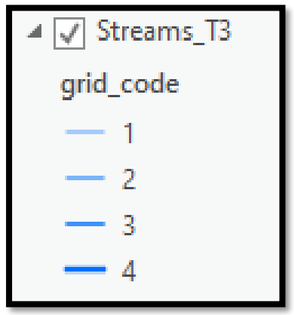
# Results of Analysis

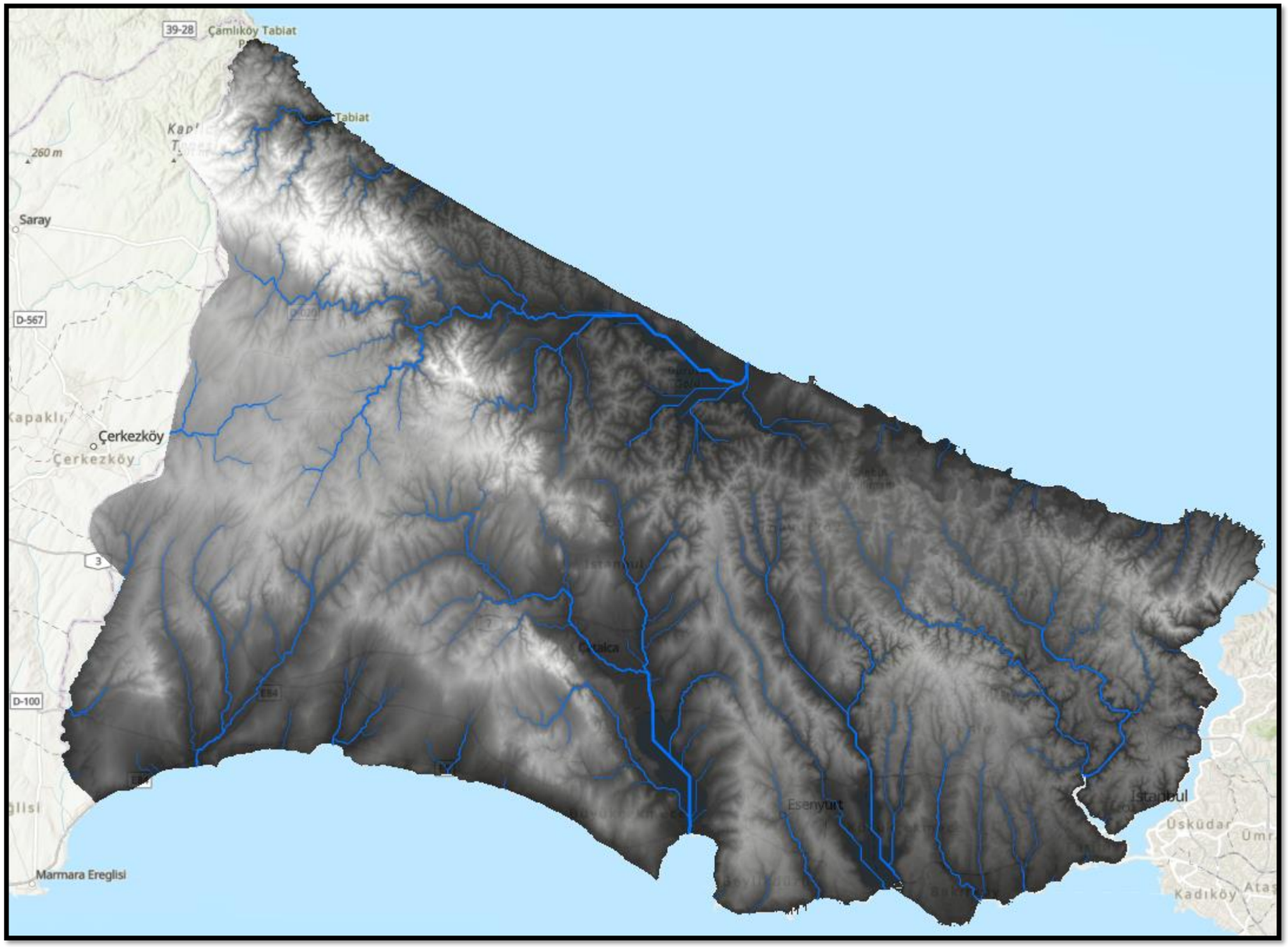


# Classify Stream Order



# Results & Take Home

*Aim of the Study:*

- *Find watersheds and stream networks in the European Side of Istanbul*

*Output Data:*

- *Watersheds (Vector-Polygon)*
- *Stream Networks for 3 different threshold value (Raster)*
- *Stream Orders for 3 different threshold value (Vector-Polyline)*

## *Contact:*

akinom@itu.edu.tr