

Esri Developer Summit

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Drawing Millions of Features in ArcGIS Advanced Techniques

Tanu Hoque

Philip Heede

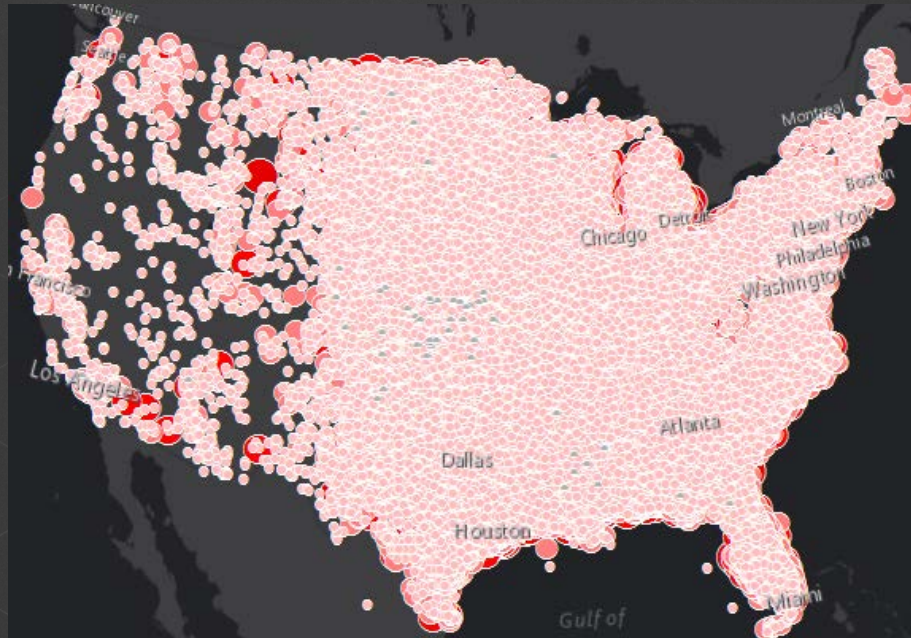
Agenda

- Topics
 - Spatial aggregation with artificial bins
 - Spatial aggregation with standardized geographies
 - Working efficiently with large time-series data

Spatial aggregation with artificial bins

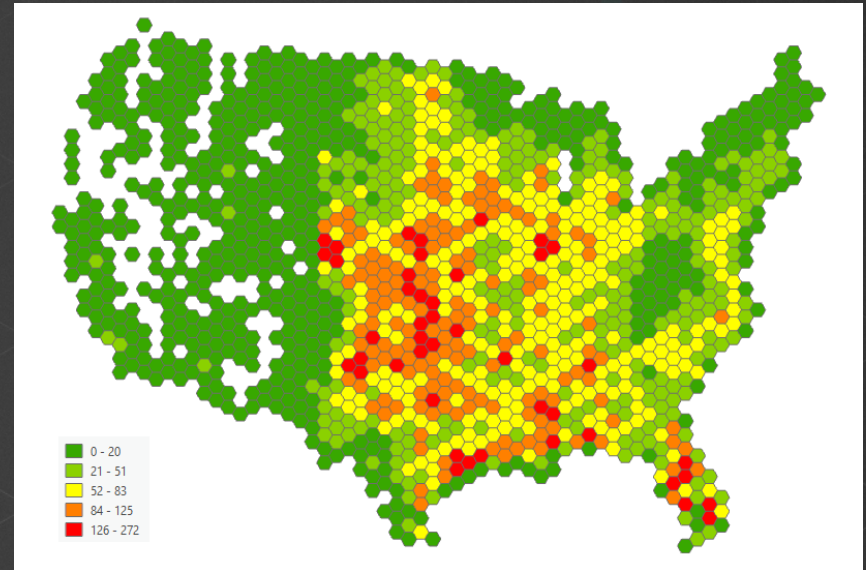
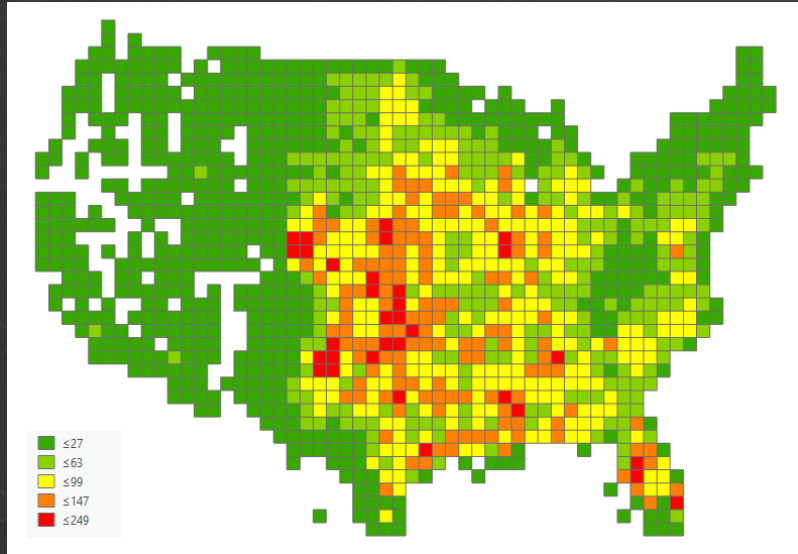
Why spatial aggregation?

- Sometimes drawing the raw data is overwhelming and doesn't provide any value



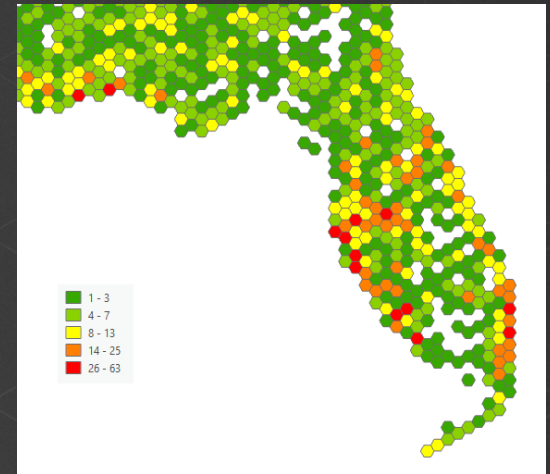
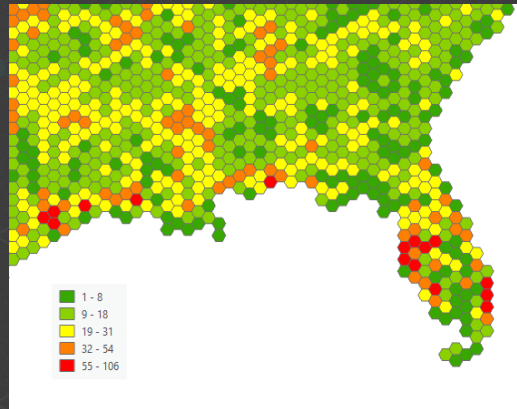
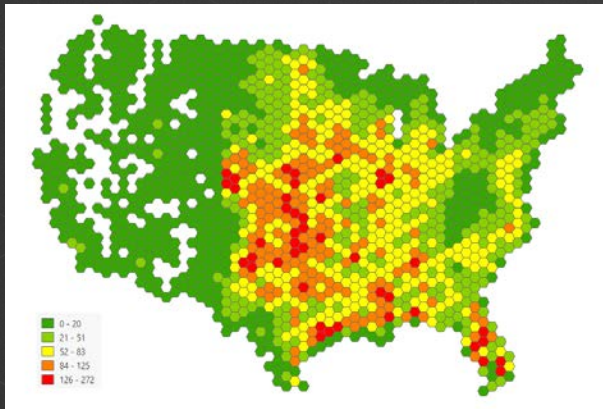
Artificial geography types

- Rectangular bins
- Hexagons (hexbins)



Creating geographies

- Create multiple levels to support aggregation at smaller to larger scales
- Use an equal-area projection



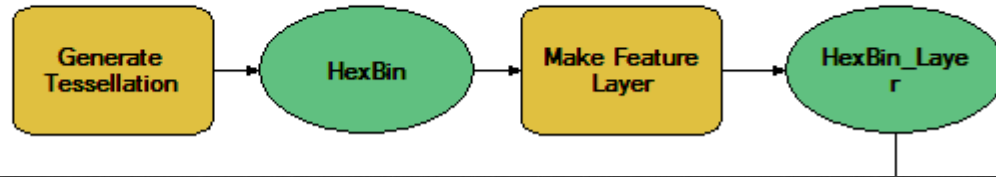
Aggregation approaches

- On-the-fly
 - Provides flexibility
 - Immediately shows updated data
 - Is appropriate for data that changes often
- Pre-calculated
 - Can have faster drawing speed
 - Requires upfront processing time from the author
 - Is appropriate for unchanging data

Pre-calculated aggregation options

- Geoprocessing tools

Step 1: Create hexagon tessellation

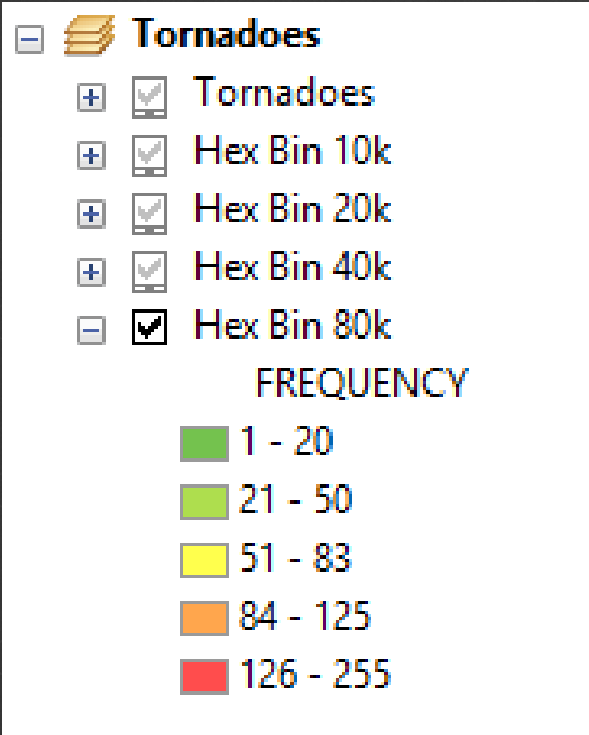


- Native RDBMS SQL

```
SELECT [...] INTO Tornado_Aggregate FROM Tornado t INNER  
JOIN Tornado_Bins bins ON bins.geom.STIntersects(t.geom)  
= 1 WHERE [...]
```

Authoring your map

- Set scale dependencies for each level of geography



The image shows a map interface with a legend for 'Tornadoes'. The legend is titled 'Tornadoes' and has a minus sign icon. It lists five items: 'Tornadoes', 'Hex Bin 10k', 'Hex Bin 20k', 'Hex Bin 40k', and 'Hex Bin 80k'. Each item has a plus sign icon and a checkbox. The 'Hex Bin 80k' item is checked. Below the list is a color scale legend titled 'FREQUENCY' with five color-coded ranges: 1 - 20 (green), 21 - 50 (light green), 51 - 83 (yellow), 84 - 125 (orange), and 126 - 255 (red).

Tornadoes

- ☐ Tornadoes
- ☐ Hex Bin 10k
- ☐ Hex Bin 20k
- ☐ Hex Bin 40k
- ☒ Hex Bin 80k

FREQUENCY

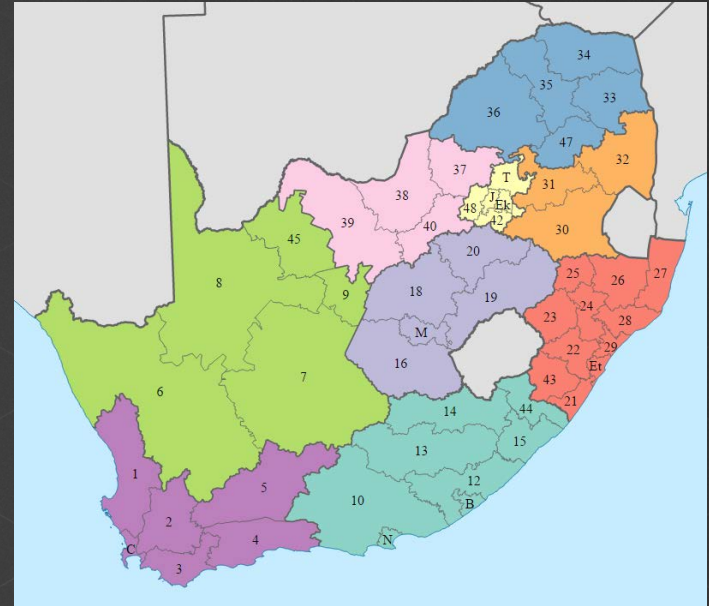
- 1 - 20
- 21 - 50
- 51 - 83
- 84 - 125
- 126 - 255

Demo: Aggregating to artificial bins

Spatial aggregation with standardized geographies

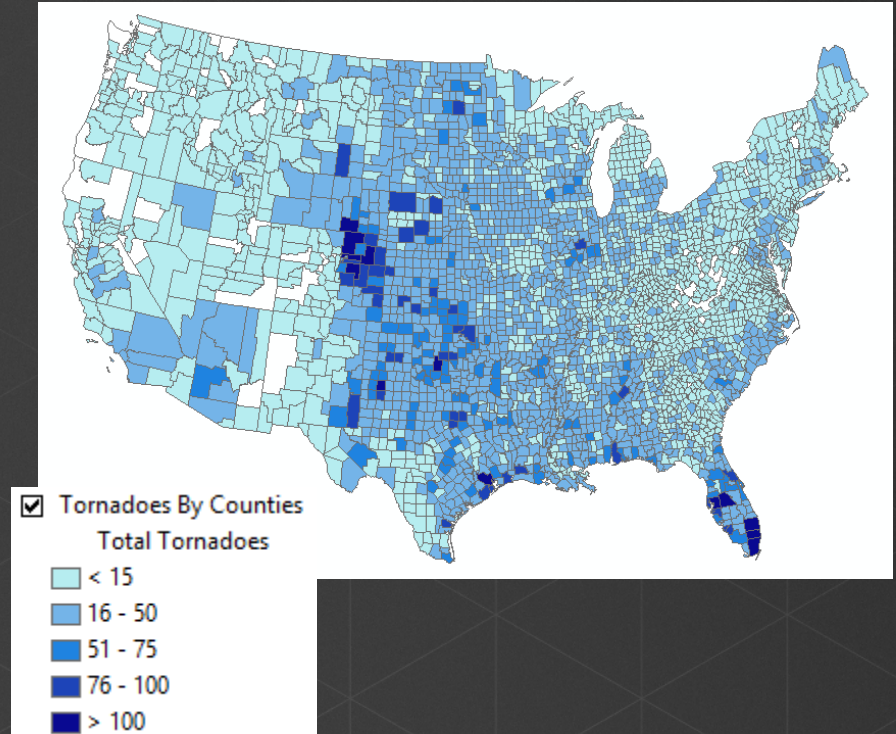
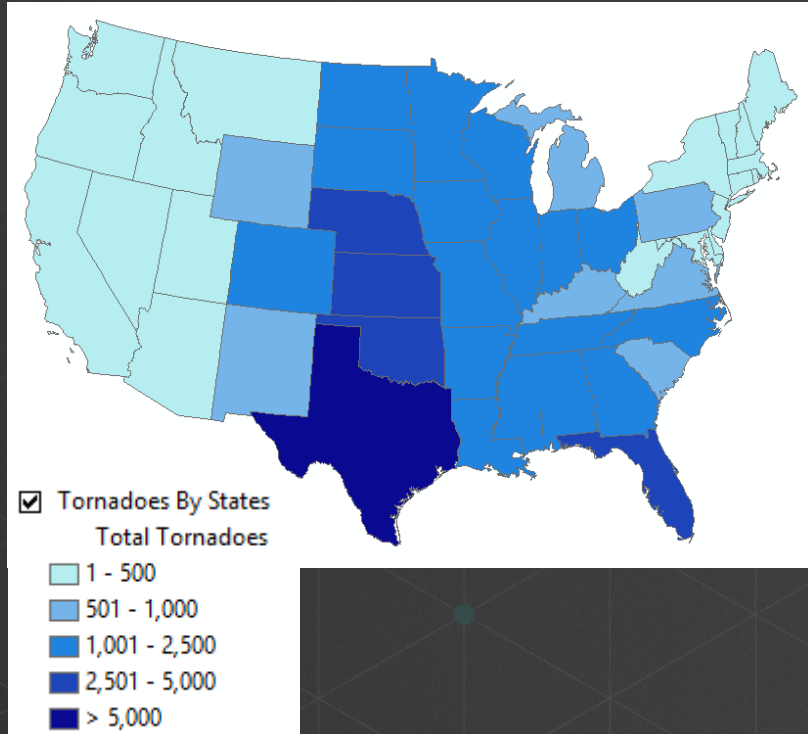
Using standardized geographies

- Select the appropriate level of geography
 - South Africa example:
 - Nation
 - Province
 - District
- Do not necessarily use the most detailed geographies



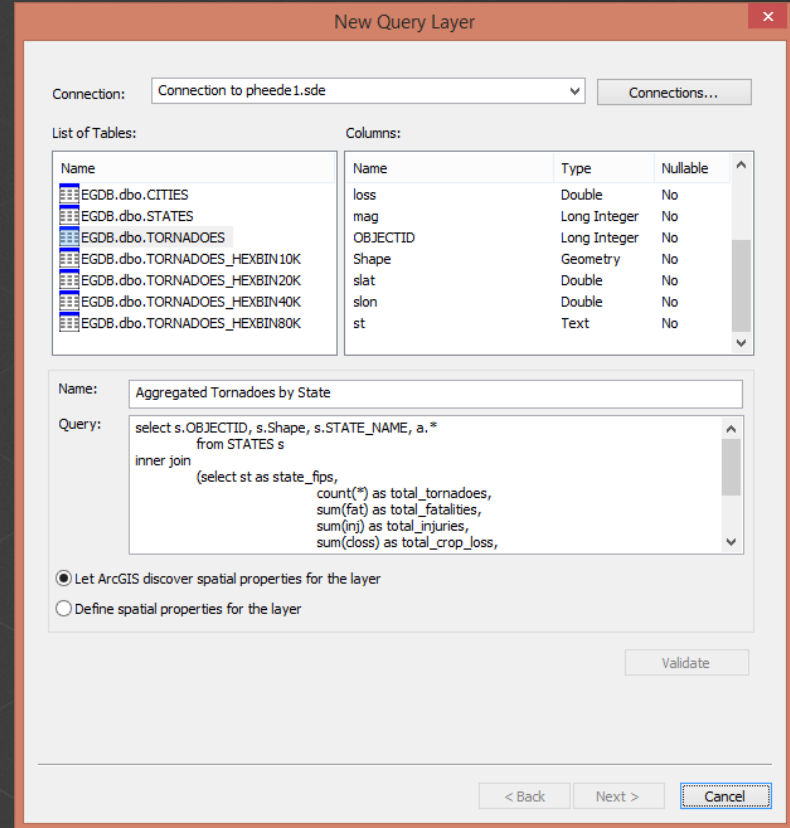
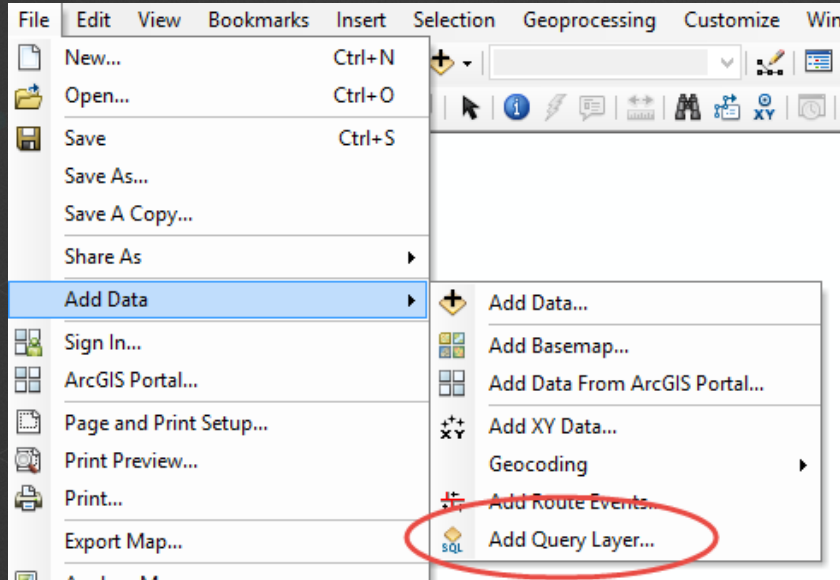
South African provinces and districts

Tornado example



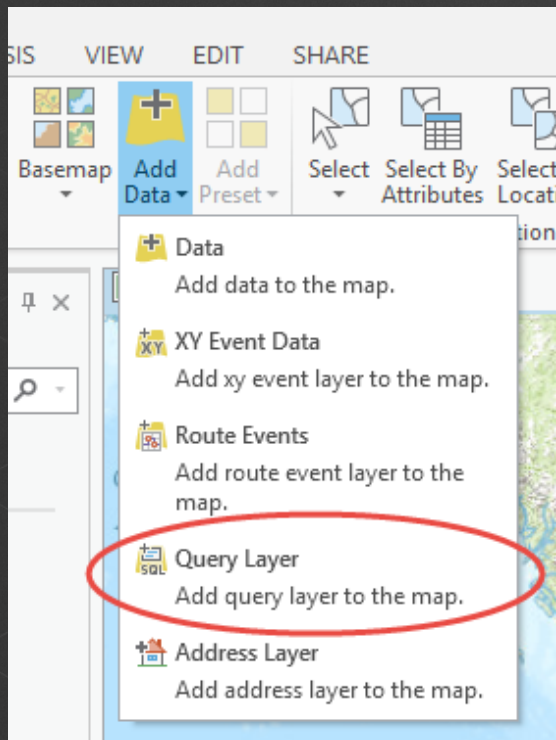
On-the-fly aggregation in ArcMap

- Query layer with custom SQL



On-the-fly aggregation in ArcGIS Pro

- Query layer with custom SQL



New Query Layer

Connect to a database and define the query.

Connection: pheed1

List of Tables:

Name
EGDB.dbo.CITIES
EGDB.dbo.STATES
EGDB.dbo.TORNADOES
EGDB.dbo.TORNADOES_HEXBIN10K
EGDB.dbo.TORNADOES_HEXBIN20K
EGDB.dbo.TORNADOES_HEXBIN40K
EGDB.dbo.TORNADOES_HEXBIN80K

Columns:

Name	Type	Nullable
OBJECTID	Long	False
date	Text	True
st	Text	True
mag	Long	True
inj	Long	True
fat	Long	True
loss	Double	True
clloss	Double	True

Name: agg by state

Query:

```
select s.OBJECTID, s.Shape, s.STATE_NAME, a.*
from states s
inner join
(select st as state_fips,
count(*) as total_tornadoes,
sum(fat) as total_fatalities,
sum(inj) as total_injuries,
sum(clloss) as total_crop_loss,
sum(loss) as total_loss
from TORNADOES a
group by st) a
on s.STATE_NAME = a.state_fips
```

☒ Let ArcGIS Pro discover spatial properties for the layer
☐ Define spatial properties for the layer

Validate

< Back Next > Cancel

Demo: Aggregating to standardized geographies

Working efficiently with large time-series data

Large time-series data—Example 1

- Rainfall data
 - Static geography: Point
 - Attribute data changing over time: Measurement
 - A thousand weather stations reporting once per day for 10 years would create more than 3.5 million records

Large time-series data—Example 2

- Stream data
 - Static geography: Polyline
 - Attribute data changing over time: Prediction
 - About 67,000 stream polyline segments predicted at four-hour intervals over a 10-day period creates more than 4 million records

Table

FLOW_MAP

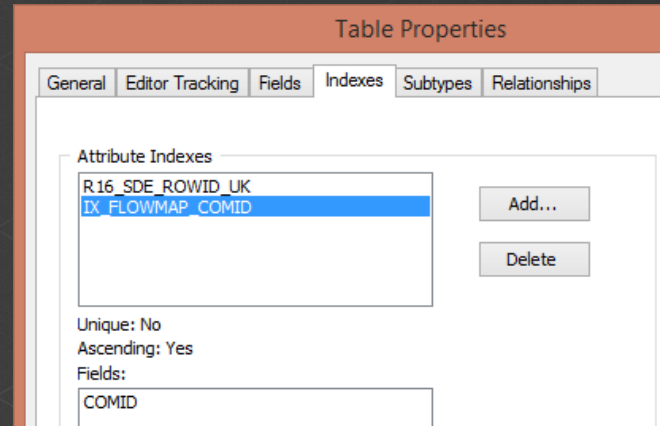
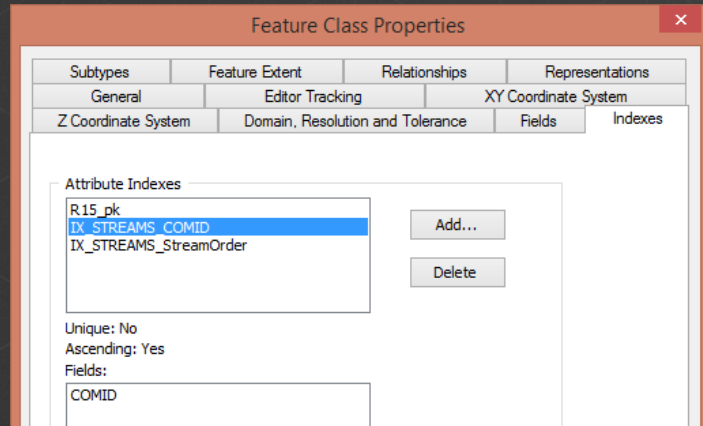
	OBJECTID *	Time	COMID *	Qout	TimeValue
	4037159	60	1109679	0.1213	2/10/2015 18:00:0
	4037160	60	1078897	0.0908	2/10/2015 18:00:0
	4037161	60	1078881	0	2/10/2015 18:00:0
	4037162	60	1109689	0	2/10/2015 18:00:0
	4037163	60	1109687	0	2/10/2015 18:00:0
	4037164	60	1109681	0.1302	2/10/2015 18:00:0
	4037165	60	1109677	0	2/10/2015 18:00:0
	4037166	60	1109683	0	2/10/2015 18:00:0
	4037167	60	1109755	0	2/10/2015 18:00:0
	4037168	60	1109643	0	2/10/2015 18:00:0
	4037169	60	1109675	0.1358	2/10/2015 18:00:0
	4037170	60	1109669	0.1407	2/10/2015 18:00:0
	4037171	60	1109667	0	2/10/2015 18:00:0
	4037172	60	1109697	0	2/10/2015 18:00:0
	4037173	60	1109657	0.3253	2/10/2015 18:00:0
	4037174	60	1109641	0	2/10/2015 18:00:0
	4037175	60	1109695	0	2/10/2015 18:00:0
	4037176	60	1109653	0.2505	2/10/2015 18:00:0
	4037177	60	1109753	0	2/10/2015 18:00:0
	4037178	60	1109635	0.3094	2/10/2015 18:00:0
	4037179	60	1109691	0	2/10/2015 18:00:0
	4037180	60	1109665	0.1633	2/10/2015 18:00:0

4038780 (0 out of 4038780 selected)

FLOW_MAP

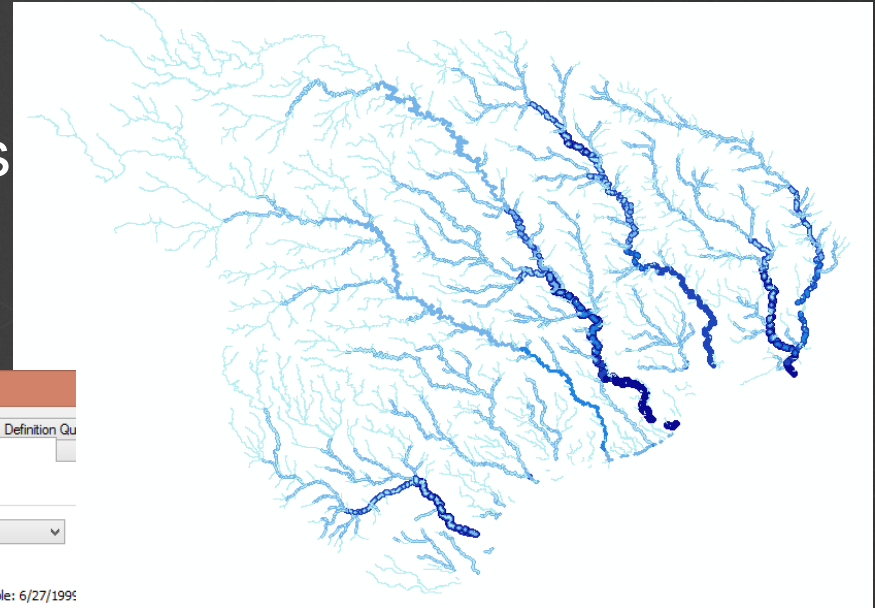
Setting up the data

- One-to-many (1:M) join between the spatial data and the temporal records
 - All data should come from the same database
 - Database indices are required for the attributes you join against



Visualizing the data

- Set up time-aware properties on the layer
- Set scale dependencies
- Create definition expressions



Layer Properties

Hatches		Joins & Relates		Time		HT
General	Source	Selection	Display	Symbology	Fields	Definition Query

Definition Query:
StreamOrde >=5 and Qout > 0.0]

Layer Properties

General	Source	Selection	Display	Symbology	Fields	Definition Query
<input checked="" type="checkbox"/> Enable time on this layer						
Time properties						
Layer Time: Each feature has a single time field						
Time Field: FDATE Sample: 6/27/1995						
Field Format: <Date/ Time>						
Time Step Interval: 6.00 Hours						
Layer Time Extent: 1/27/2015 00:00:00 To: 2/10/2015 18:00:00						

Software demonstration: Working with time-series data



