Human-Caused Fires: An Exploratory Pattern Analysis

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Human Caused Fires: Exploratory Pattern Analysis

- Introduction
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- Applications
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http://www.forwolves.org/ralph/wpages/the-great-burn-roadless.htm

Introduction

- Why we chose this project

Introduction

Clearwater National Forest

1.8 million acres

612,400 visitors annually

~11% of fires are human-caused

Average cost of large (>10 ac.) human-caused fires:

$760,136

lightining-caused fires:

$241,077

Introduction

- Database Design Objectives
  - Integrate existing databases and shape files
  - Derive additional useful feature classes
  - Normalize database for efficiency and standardization of present and future data
  - Create domains to limit future data entry options
  - Define relationships that allow for exploration of fire occurrence patterns and predictions
  - Establish topologies that enforce data integrity and ensure valid analyses

Datasets

- Fire Data
  - Points: Ignition Locations for All Fires
  - Polygons: Extents for Fires >10 acres
- Human Features Data
  - Points: Campgrounds, Boating Sites, Picnic Areas, etc…
  - Polylines: Roads and Trails
- Landscape Data
  - Rasters: Anderson's Fire Behavior Fuel Model

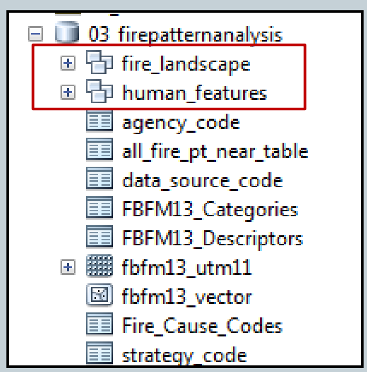
Methods

- Data Organization
- Data Normalization
- Data Integrity Enforcement:
  - Domain Establishment
  - Relationship Class Creation
  - Topology Creation and Validation

http://alexen.dk/blog/?tag=data-analysis

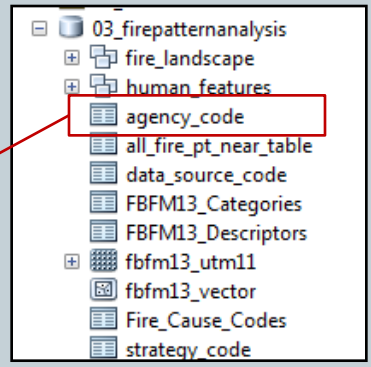
Methods : Data Organization

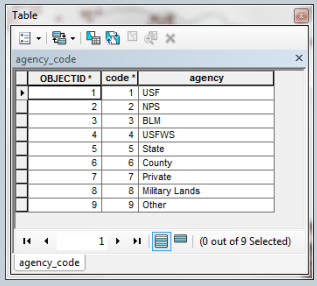
- Created two feature datasets to hold spatial layers
- Raster and Tablular data located in geodatabase root



Methods : Normalization

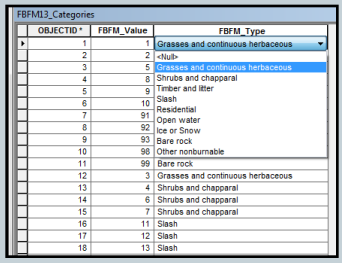
- Created tables and reclassed spatial data fields to reduce redundancy

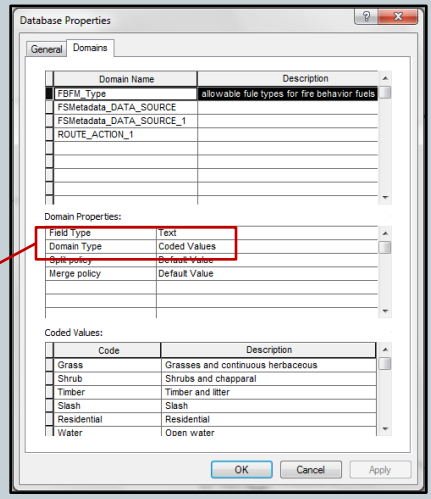




Methods : Domains

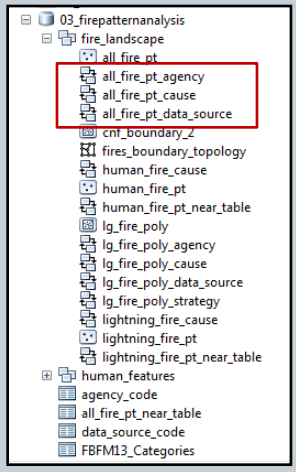
- Created domains to codify values, ensuring data integrity of current and future data





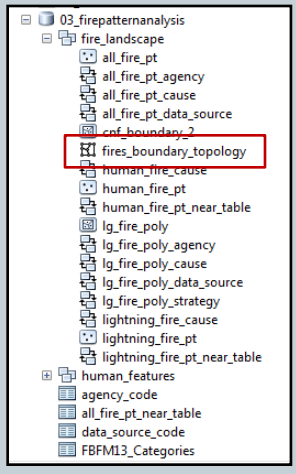
Methods : Relationship Classes

- Linked tabular and spatial data
- In Arc10, can be located either with origin or destination data



Methods : Topology

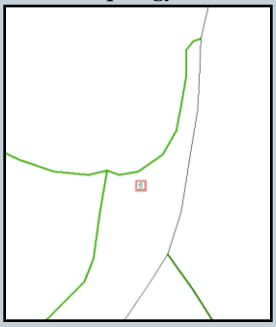
- Defined rules to limit and/or require certain relationships between feature classes
- Before doing a spatial analysis, features have to be in the correct location



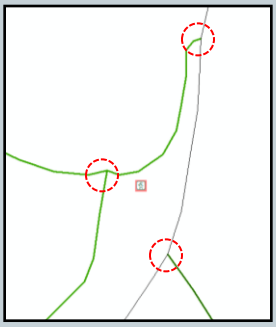
Methods : Topology Example

Rule : Trailheads must be covered by endpoints of Trails

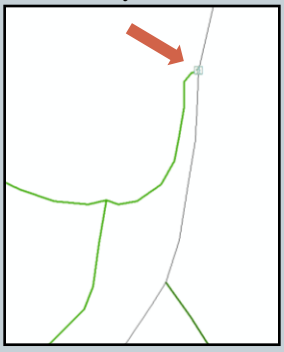
Failed Topology



Where to Move?



Successfully Validated



Applications : Intended

- Identify “problem areas” of visitor behavior
- Identify best allocation of education and prevention resources
- Highlight high-priority areas for fuel treatments/ mitigation/reduction
- Inform fire management and enforcement decisions (e.g. campground fire bans, fire patrols, etc…)

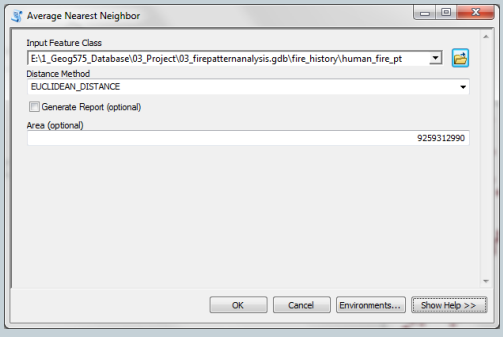
Applications : Demonstration

- Clustering analysis of human-caused fires

1. Is there clustering?
2. If so, where is the clustering?
3. Is the clustering related to the presence of a human-made feature, the available fuels or a combination of both?

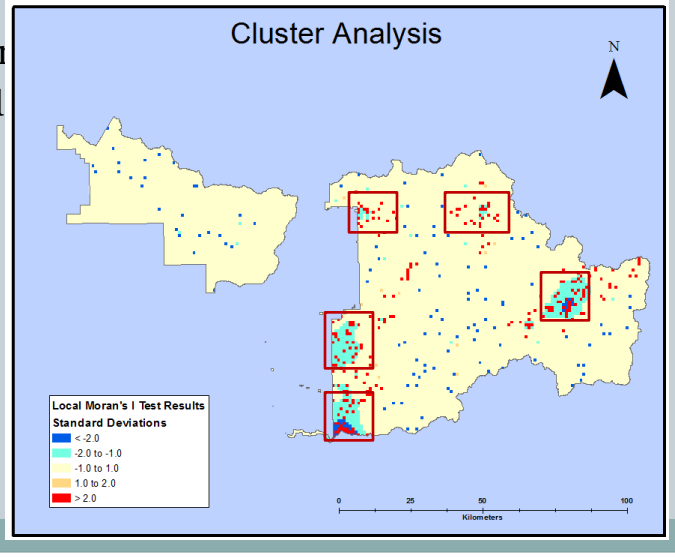
Applications : Patterns

- Is there any clustering?
- Used Average Nearest Neighbor tool
- Result: 0.78



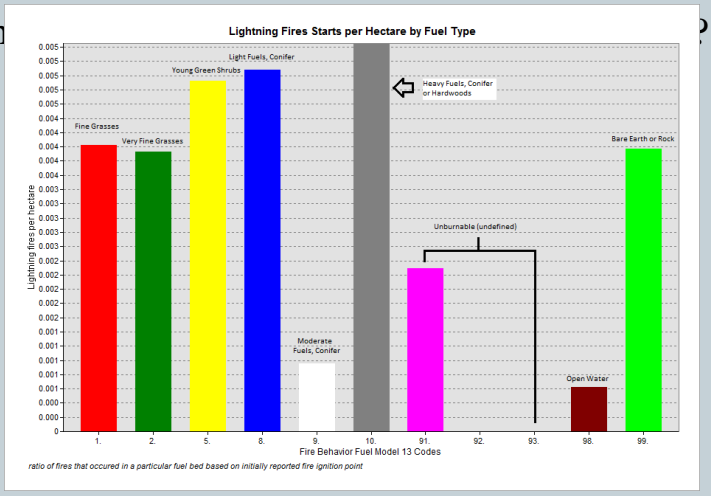
Applications : Patterns

- Wher
- Used

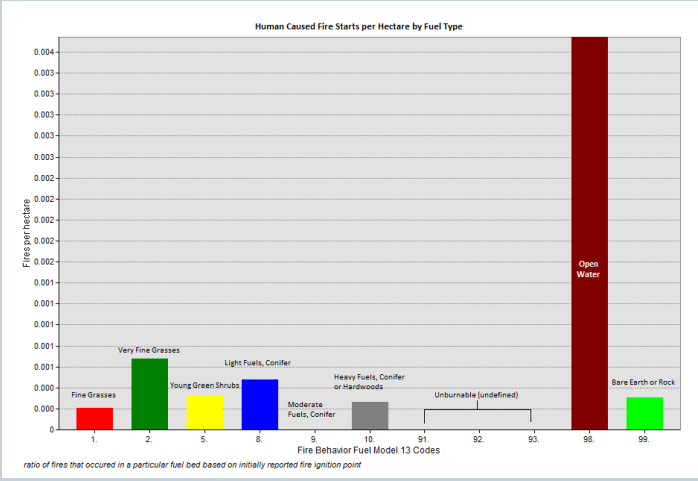


Applications : Patterns

- Is th

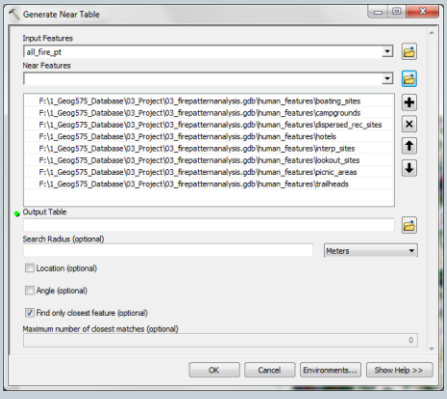


Applications : Patterns



Applications : Patterns

- Is there an association with human-made features?
- Near Analysis of all fires in relation to developed recreation sites



Applications : Patterns

- Average distance to developed recreation feature
  - human-caused fires: 3.5km
  - lightning-caused fires: 3.8km
- Closest Feature Type:

	All fires		Fires <1km from features	
	Human	Lightning	Human	Lightning
Picnic Area	24.6%	3.6%	6.3%	0.5%
Campground	13.4%	23.0%	12.5%	6.0%
Trailhead	7.5%	10.6%	0.0%	4.7%
Dispersed Rec Site	47.0%	52.2%	78.1%	81.9%
Lookout Tower	5.2%	9.3%	3.1%	6.5%
Boating Site	2.2%	0.6%	0.0%	0.5%
Interpretation Site	0.0%	0.7%	0.0%	0.0%

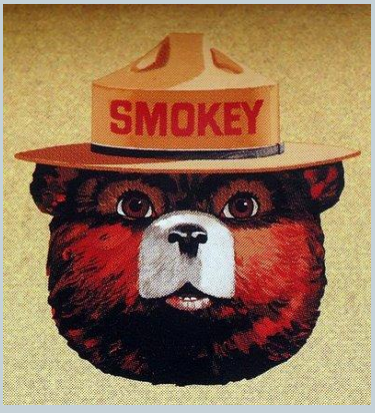
Conclusions

- Validation of initial assumption – human-caused fires are clustered
- Anselin local Moran's I conclusion – there are hotspots and spatial outliers throughout the study area, further investigation of those locations might be warranted
- Fuel model association – human caused fires have a different concentration than naturally occurring wildfires
- Recreation association - more closely tied to front-country recreation areas

Limitations

- Updating requires revisiting multiple sources
- Does not consider/include weather data
- Coarse spatial resolution of fuel model may lead to seemingly erroneous results
- Ignition points are often "best estimate" with a lower than optimal accuracy and precision
- Human actions are more complex than captured in this database

Questions?



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