Airports Through Scale

Katie Meckler
25 June 2013
GNIS: No Hierarchy
Effectiveness of Hierarchy
GNIS points

- Good names, but no possibility for effective hierarchy
USGS TNM Polygon Layer

- Some information for hierarchy, but no names
- Codes for individual runway polygons – multiple per airport
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Data Choices

• GNIS database for preferred USGS name
• FAA “NFDC Facilities” database for hierarchy
  • FAA is federal agency, dataset suitable for national mapping
    – NFDC is National Flight Data Center

• Reasons for choice:
  – FAA database has detailed information
  – More flexibility with hierarchy
  – USGS polygon layer for largest scale only
Lat/Long Conversion to Decimal Degrees (in NFDC table)

- **Latitude**
- **Longitude**

- FAA’s “ARP” is Airport Reference Point latitude/longitude in seconds in NAD 83 (coordinates self reported by airport)
- An ARP is the average of the latitude-longitude of each runway’s center
Differences between GNIS and FAA Coords

FAA is the average of the latitude-longitude of each runway’s center (ARP)

GNIS is topo map location?
Spatial Join (Airports)

- Target Feature: GNIS layer
  - Of type Airport, name does not contain %Heli%
- Join Feature: FAA Layer
  - Of type AIRPORT
- Join Operation: JOIN_ONE_TO_ONE
- Keep only points that have a join
- Match option: Closest
- Search radius: 5km
Spatial Join (Heliports)

- Target Feature: GNIS layer
  - Of type Heliport, name contains %Heli%
- Join Feature: FAA Layer
  - Of type HELIPORT
- Join Operation: JOIN_ONE_TO_ONE
- Keep only points that have a join
- Match option: Closest
- Search radius: 5km
Retained GNIS points without FAA match

• Merged combination of the two spatial joins
• Used Symmetrical Difference tool with original set of GNIS points and merge
• Contains GNIS points without an FAA equivalent
Main Hierarchy

• Airports: Based on FAA code assignments
  – 3 letters = major public-use airports (JFK)
  – 1 letter/2 digits = minor public-use airports (C35, 4A6, 51R)
  – 2 letters/1 digit = special-use locations and some minor public-use airports (5BK, 7AK)
  – 2 letters/2 digits = Private-use airports (CA40)

• Heliports
Airport Hierarchy

• Our airport classes:
  A = 3 letter code airports (Major Public)
  B = 1 letter/2 digit and 2 letters/1 digit (Minor Public)
  C = 2 letters/2 digits (Private)

• Achieved classification through Python coding sequence:
def classifyAirport(fieldValue):
    if len(fieldValue) == 4:
        # If it's four digits, it's a private airport:
        return "C"
    else:
        # Must be three digits.
        chars = set("0123456789")
        if any((c in chars) for c in fieldValue):
            # If it contains a numerical digit, it's a minor public airport:
            return "B"
        else:
            # If there's no numerical digits, it's a major public airport:
            return "A"
More hierarchy

“Operatio_7”

• Added attribute column
• Totals all operations
  – 6 types of operations
    • Local, International, Commuter, Commercial, Air Taxi, Military (carriers)
  – Activity is self reported by airports
  – Use for hierarchy beyond FAA codes
## Final Attributes

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Small Scale Problem

• Major Airport Class
• No hierarchy

• Shortfalls:
  – Too dense
  – Needs further hierarchy

[“ArptClass” = ‘A’ ]
Solution Attempt: Thresholds

• Use operations total to remove labels/points within category at smaller scales
  – Create thresholds using operations total
    – Example: Only Major Airports with Operatio_7 \(\geq 100,000\) will be represented at a scale of 1M
Small Scale Problem

- Major Airport Class
- Threshold with total operations

- Shortfalls:
  - Very clustered
  - Poor representation of spread
  - No systematic way to decide threshold values

[\text{"ArptClass"} = 'A' \text{ AND } \text{"Operatio_7"} \geq 100,000]
Best Solution: Rectangular Point Selection Ladder

• Selects airports to keep based on highest total of operations within a rectangle
  – Maintains spread of airports, rural vs. urban
  – Systematic way to create further hierarchy
• (Application of Paulo’s summit thinning tool)
Tool Application

• Tool’s scale parameter and map scale not matched to produce varied rectangle sizes and therefore different point densities
• Multiple runs to decide best point densities
• Ran from 50K up to 5M, with various scale choices in between

– Example: input scale parameter of 1,270,000 equates to 4” rectangles at 250K map scale and 2.5” rectangles at 400K
## Through Scale

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24 K Polygon Layer
24 K Polygon Layer
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  - 620K
  - 400K
  - 250K
  - 150K
  - 100K
  - 60K
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  - ArpClass
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    - MinorPub
    - Priv
- Heliports
- 24K
- VmapTexas
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- Rectangular Point Select
- Basemap
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All minor airports with the highest total operations in 4" rectangles

250K
400K

**Public Major**
- All major airports with the highest total operations in 2'' rectangles

**Public Minor**
- All minor airports with the highest total operations in 2.5'' rectangles

**Private**
- [Private Name]

**Heliport**
- [Heliport Name]

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- 630K
- 400K
- Airports
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    - MinorPub
  - Priv
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- AirportsB_final_rect
- 250K
- 150K
- 100K
- 60K
- 40K
- 24K
- VmapTexas
- ALL
- Rectangular Point Select
- Basemap

**Map Details**
- West Houston Airport (HV S)
- William P. Hobby Airport (HOU)
- Ellington Field Airport (EFD)
- Sugar Land Regional Airport (SGR)
- Houston Southwest Airport (AXII)
- Pearland Regional Airport (LUV)
- Schueller International Airport (Galveston) (GLS)
All major airports with the highest total operations in 4" rectangles.

Table Of Contents:
- UTM 15N NAD83
  - 1MIL
  - 630K
    - Airports
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        - MajorPub
        - MinorPub
        - Priv
    - AirportsA_final_rect
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      - 250K
      - 150K
      - 100K
      - 60K
      - 40K
      - 24K
      - VmapTexas
      - ALL
      - Rectangular Point Select
      - Basemap

630K
All major airports with the highest total operations in 3.5" rectangles

only FAA Code for represented points
1M Comparison
Spatial Join Limitations

- Joining one-to-one based on distance allows inaccurate matches
- Combine name comparison with spatial join?
- Prevent multiple FAA Code assignments...
  ...but duplication is allowed by the FAA within airport boundaries

Or use FAA name
Recommendations

• Customizing Paulo’s tool from summits to airports
  – Average rectangle width used through scale: 3.2 inches (8.1 cm)
• Use accurate matching of GNIS name and coordinates with FAA Location ID and operations attributes
• Or use FAA name and coordinates instead
• Do not include GNIS points that are not in FAA tables
• Refine name/point decisions for each scale range with full map design