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3-D Radar Sampling Methods for Ornithology and Wildlife Management

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3-D Radar Sampling Methods for Ornithology and Wildlife Management

Bird Strike North America 2011

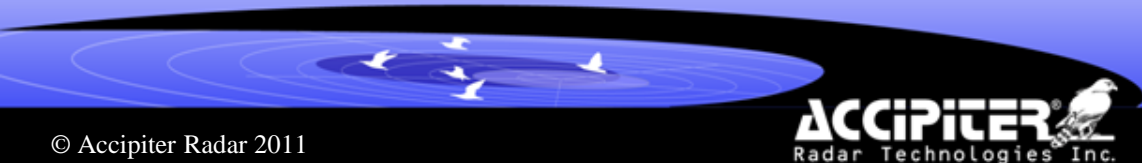
Niagara Falls, Canada, 12-15 September 2011

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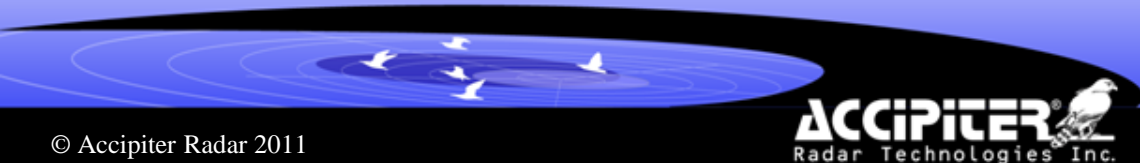
Avian Community Sampling

- Visual techniques
- Auditory techniques
- Migration monitoring



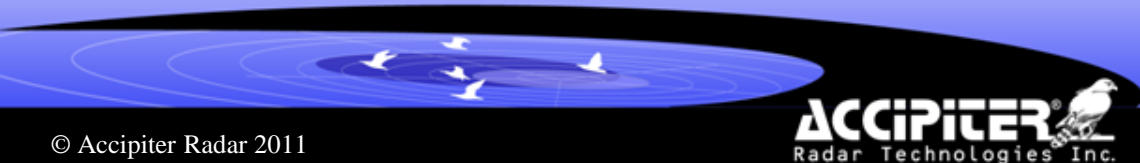
Visual Sampling Techniques

- Fixed radius, fixed time sampling
- Fixed radius, variable time sampling
- Unlimited radius, variable time sampling
- Incidental observations
- Trained observer can identify species



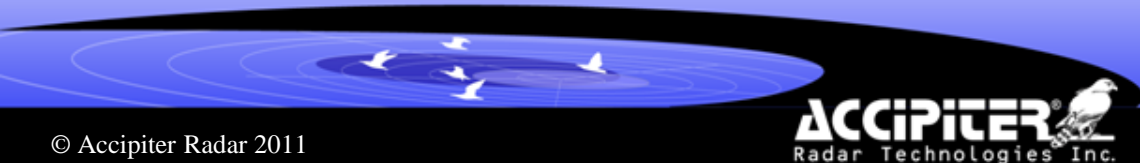
Auditory Sampling

- Supplement to visual sampling techniques
- Aid to species identification
- Used in conjunction with migration sampling for species identification



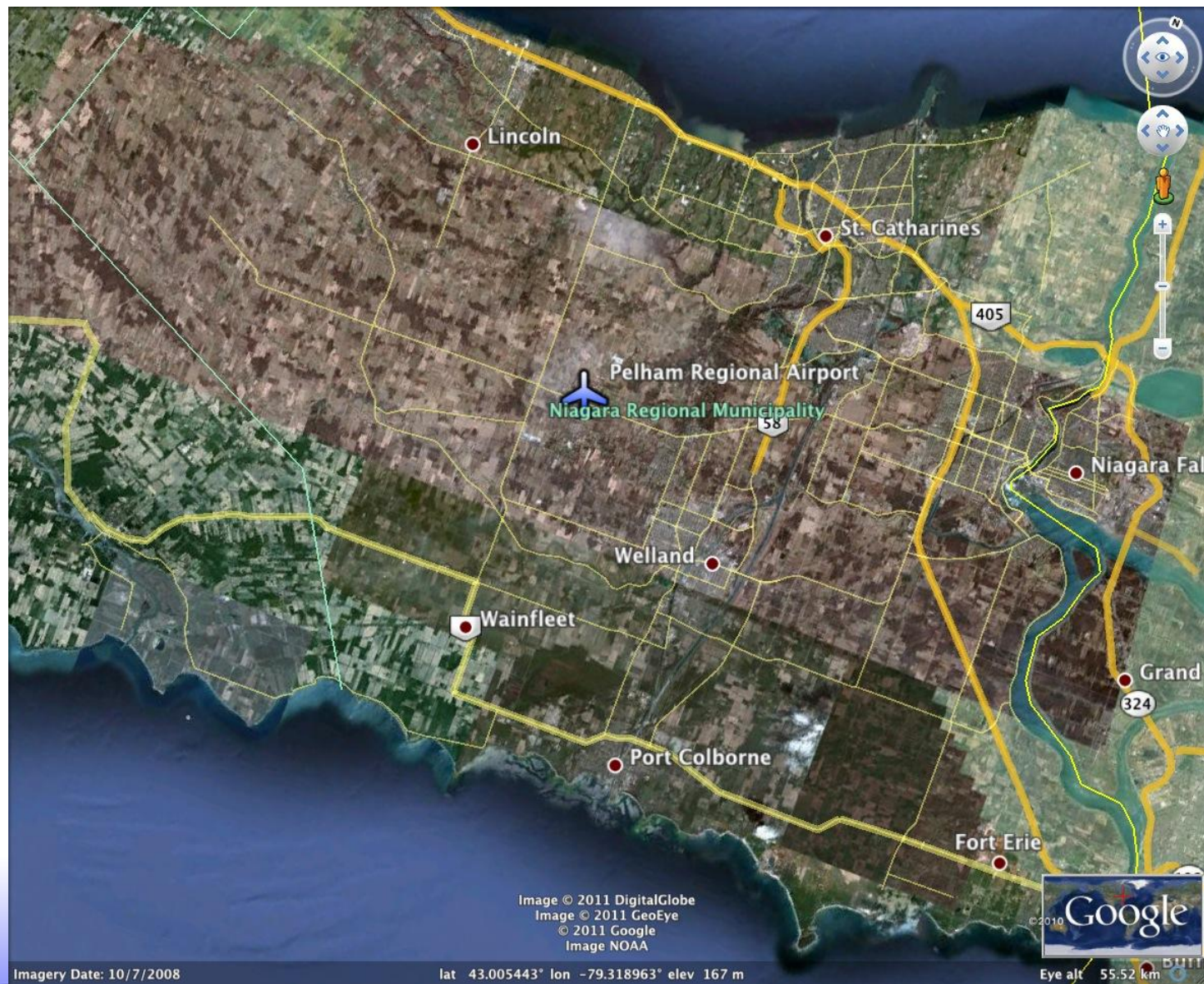
Migration Sampling Techniques

- Visual techniques
 - Moon watching
 - Ceilometer watching
- Auditory techniques
 - Record & review nocturnal calls
 - Automatic identification & logging
- Radar techniques
 - WSR-88D
 - Avian radars



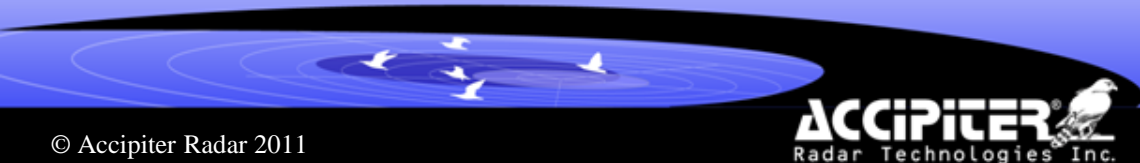


'Pelham Regional Airport' ©2010 Google

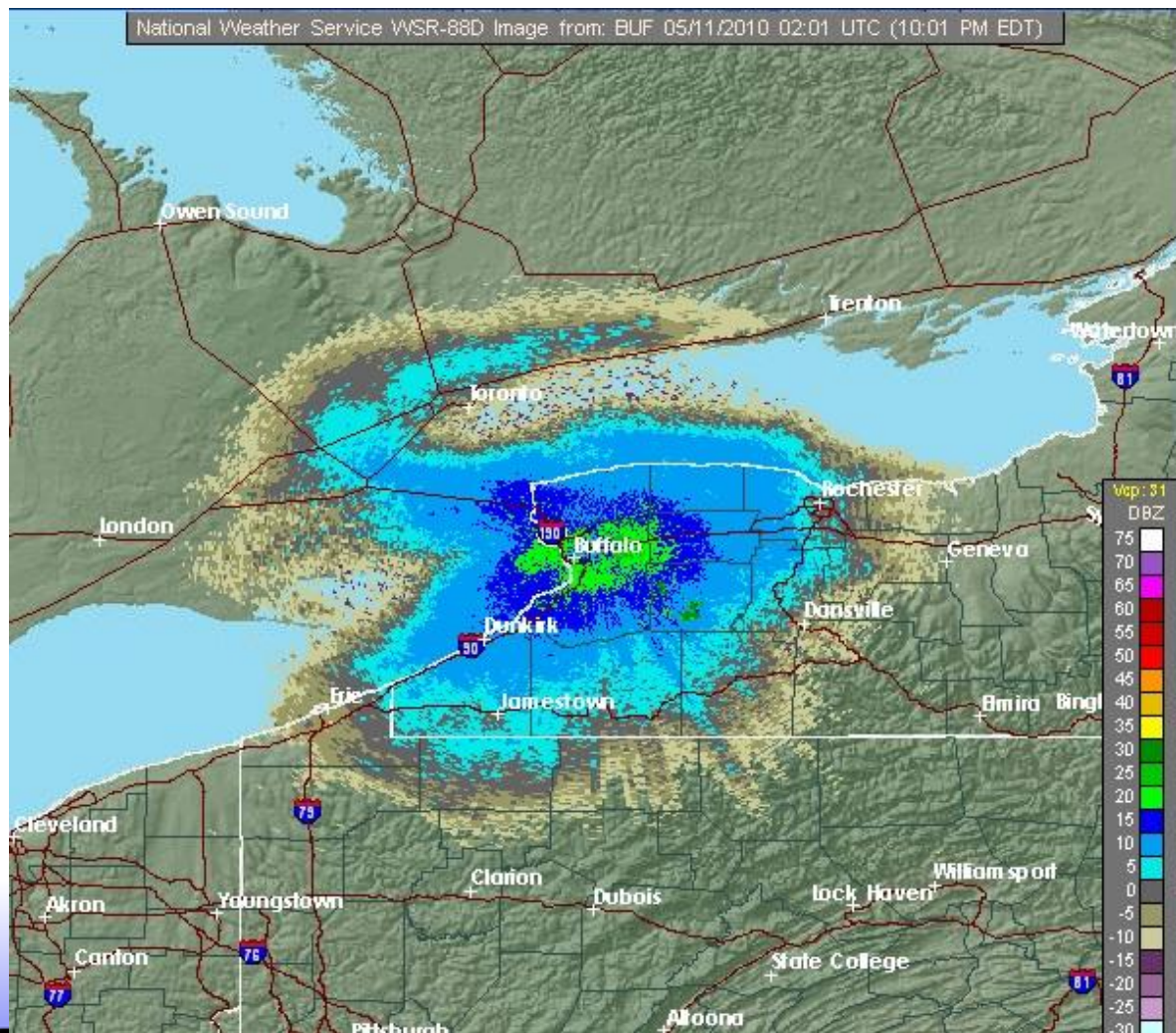


Wildlife Hazards

- White-tailed deer
- Coyote
- Canada goose
- Waterfowl
- Gulls
- Herons & egrets

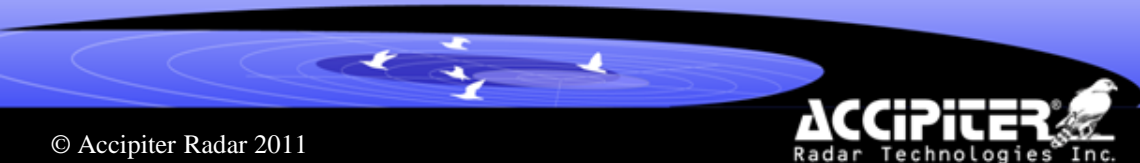


Buffalo Weather Radar



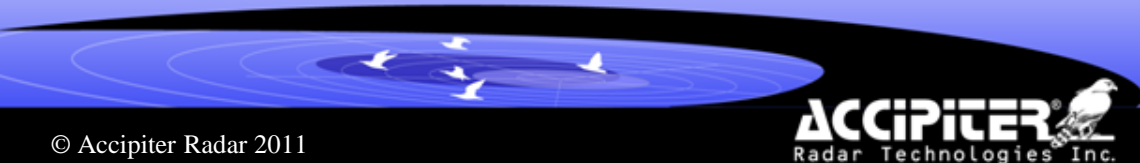
Avian Radar Complements Visual & Auditory Techniques

- Continuously samples avian community
- Detection at greater distances
- Detect and monitor nocturnal migration
- Automatically record avian behaviors

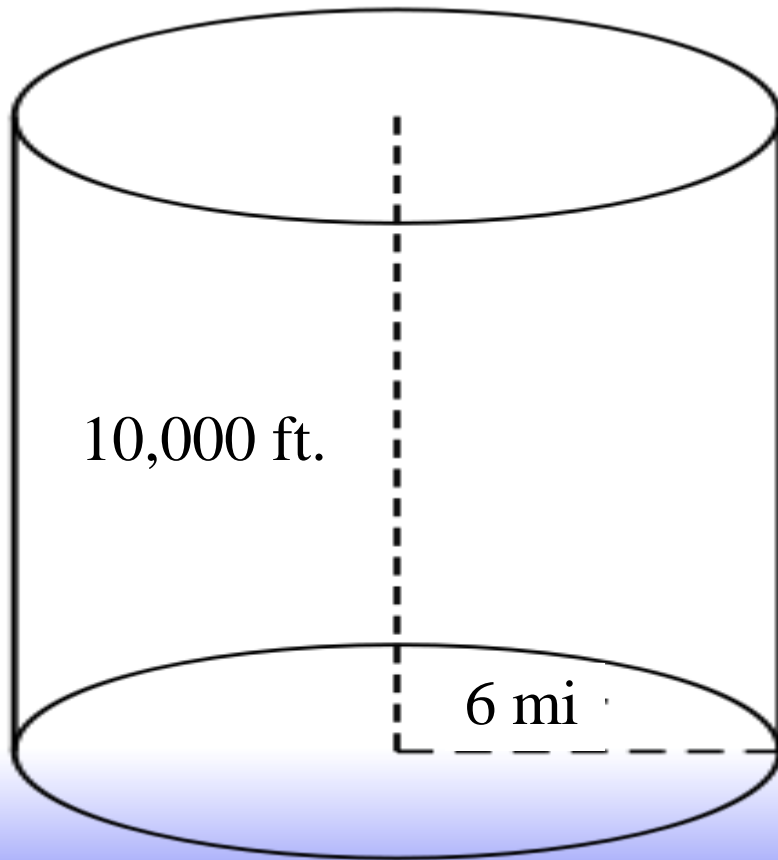


Visual & Auditory Techniques Complement Avian Radar

- Identification to species
- Monitor birds sitting on the ground or in vegetation
- Detect and monitor birds flying low to the ground

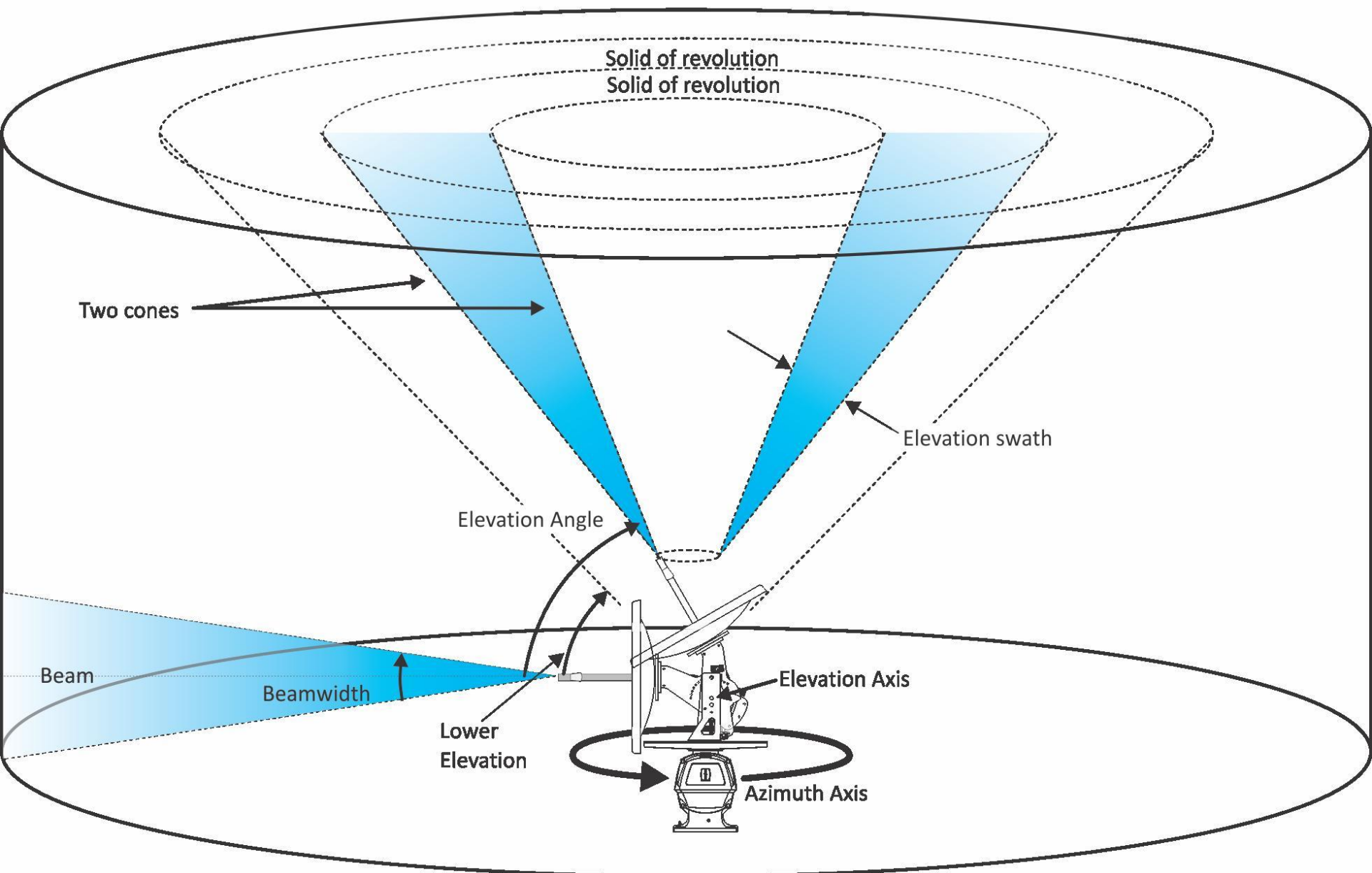


3D Sampling Radar



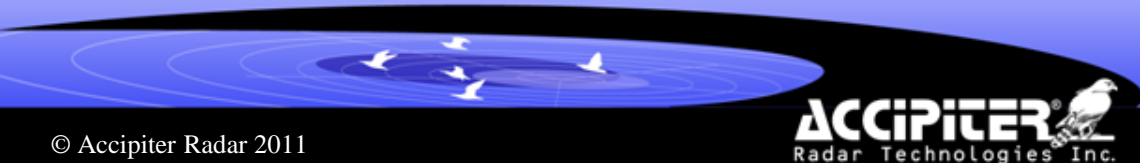
- Greater sample size
- Better data on altitudinal distribution
- More complete knowledge of sizes
- Cylindrical coverage
- Programmable scan patterns





3D Sampling Example

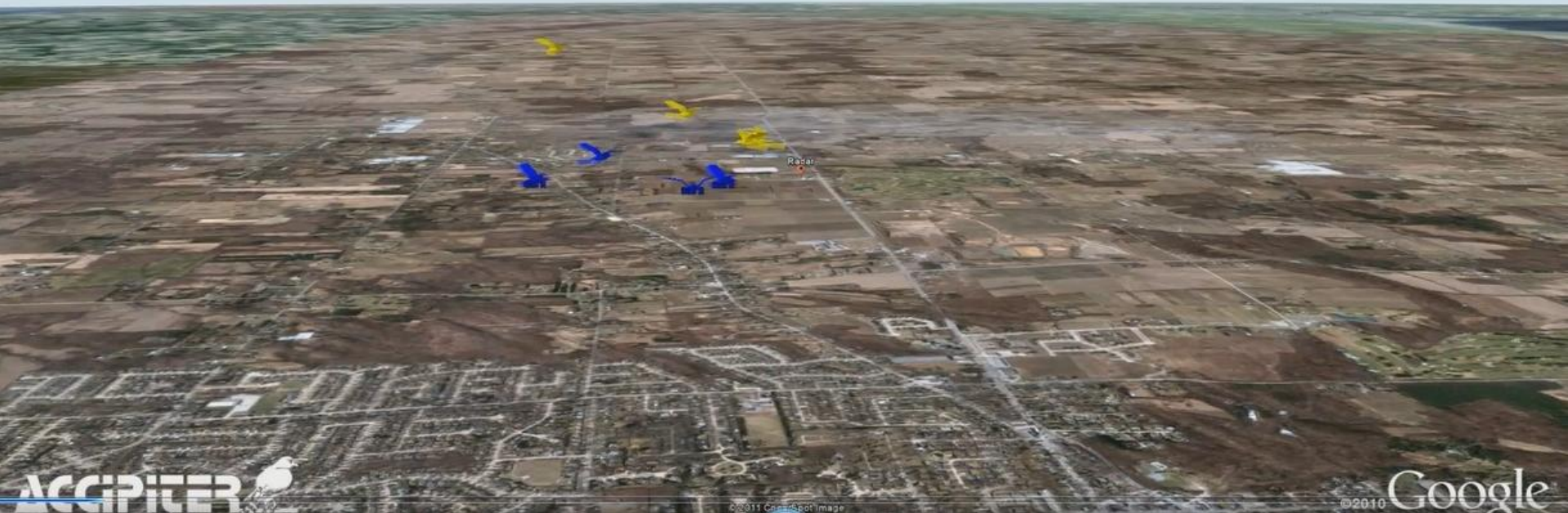
- Dual-axis scanning antenna
- 4° conical beam pattern
- 360° azimuth scanning
- Elevation scanning from 7° to 47° vertically
- 10 programmed elevation angles, 3 minute sampling at each elevation



3D Tracks

thAvianIcons

Typical Daytime Activity



ACCIPITER 

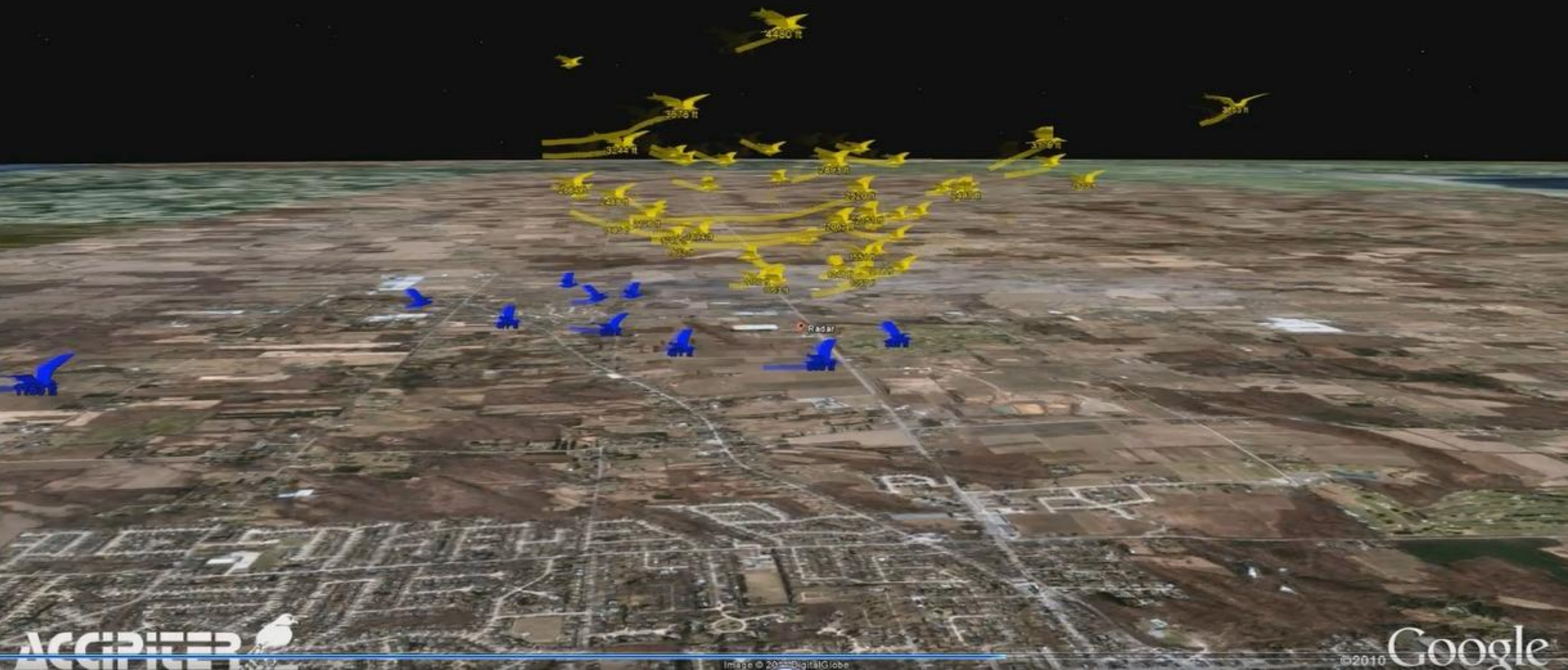
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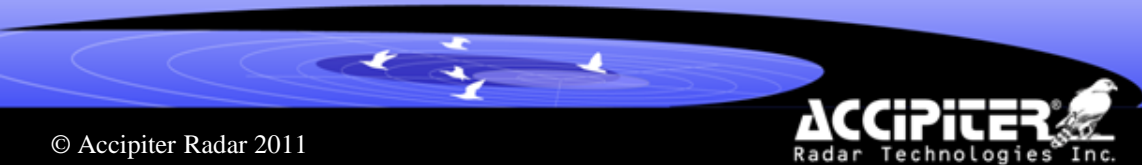
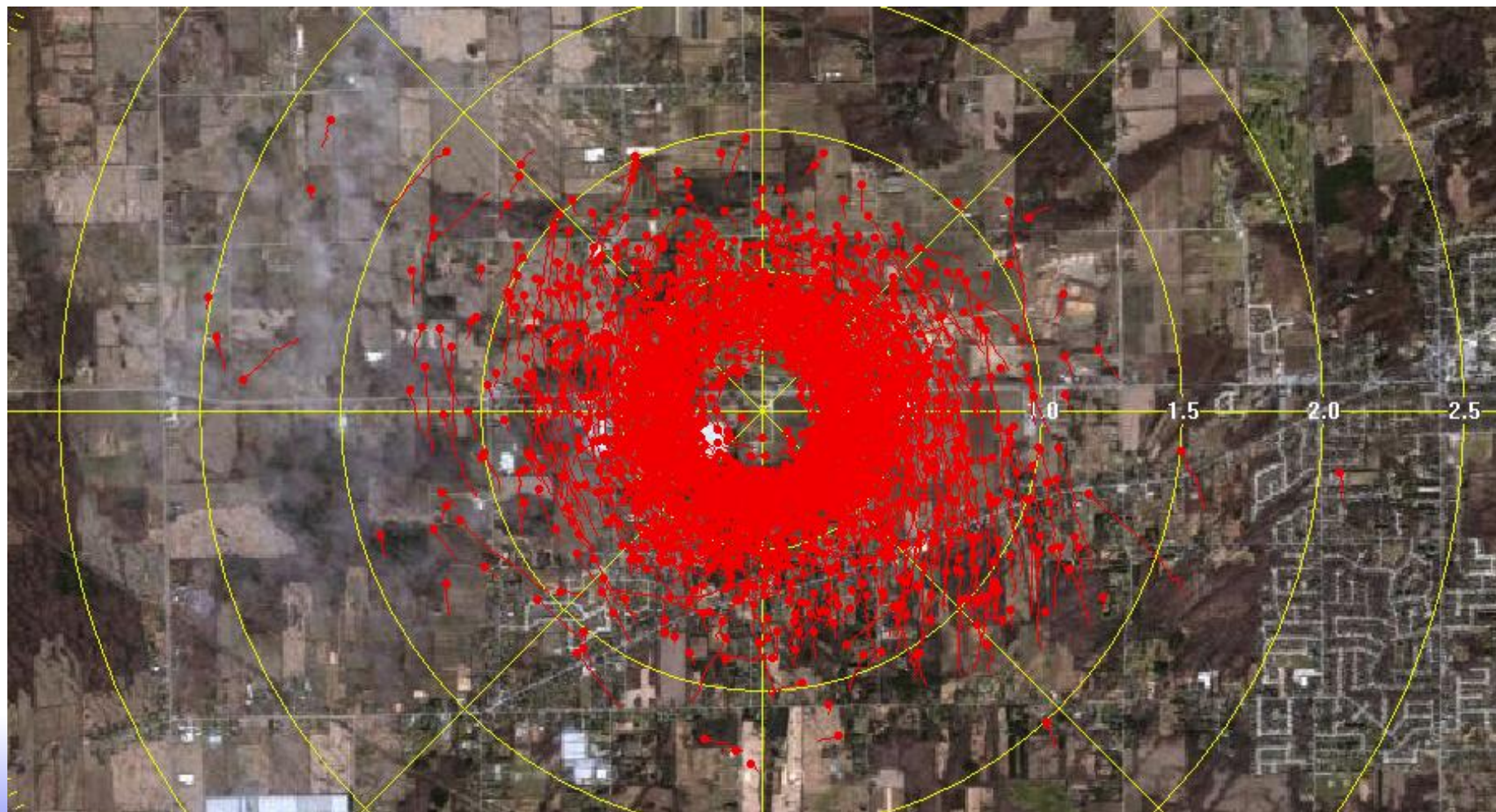
3D Tracks

thAvianIcons

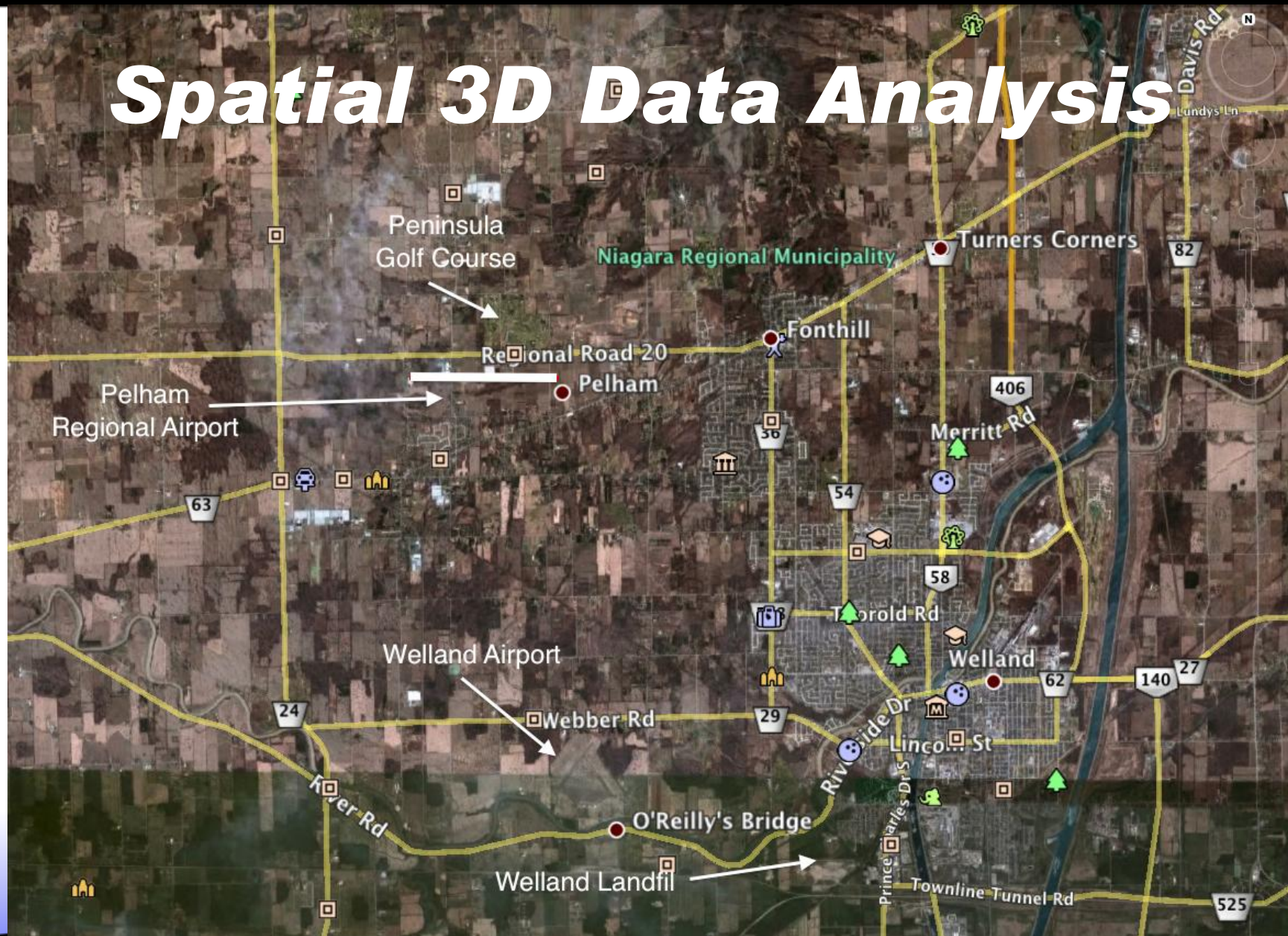
Nighttime Migration



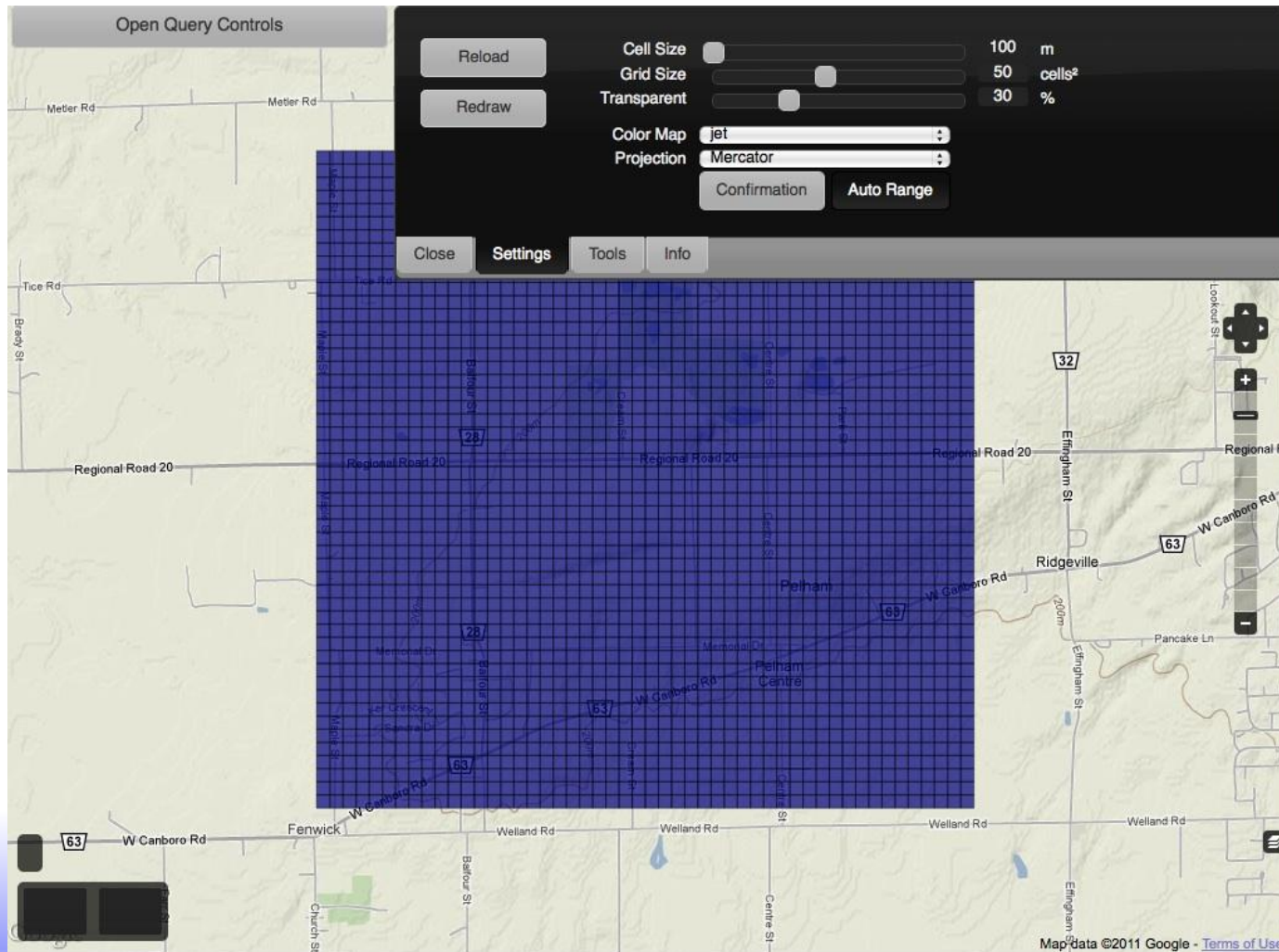
Histories



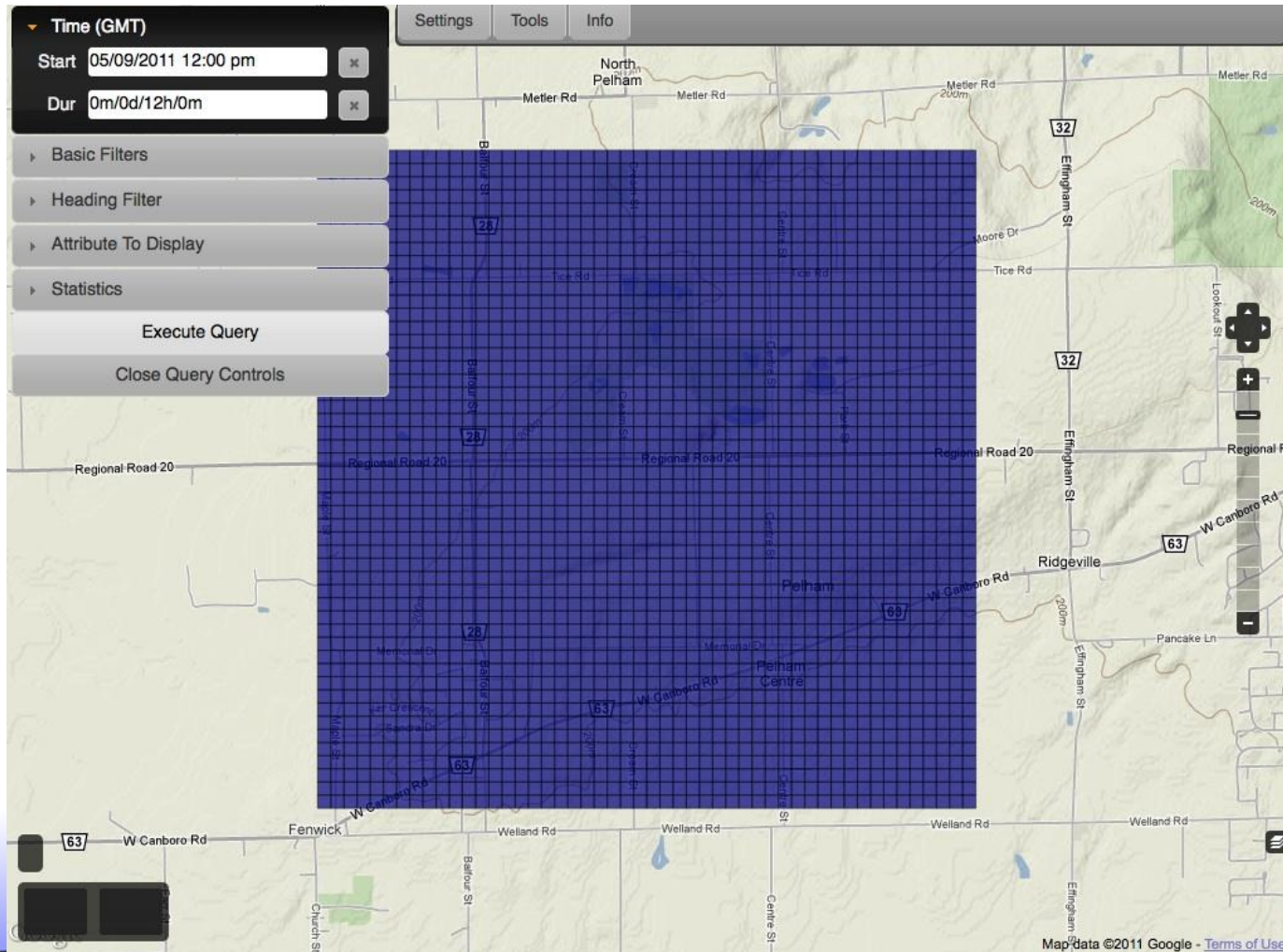
Spatial 3D Data Analysis



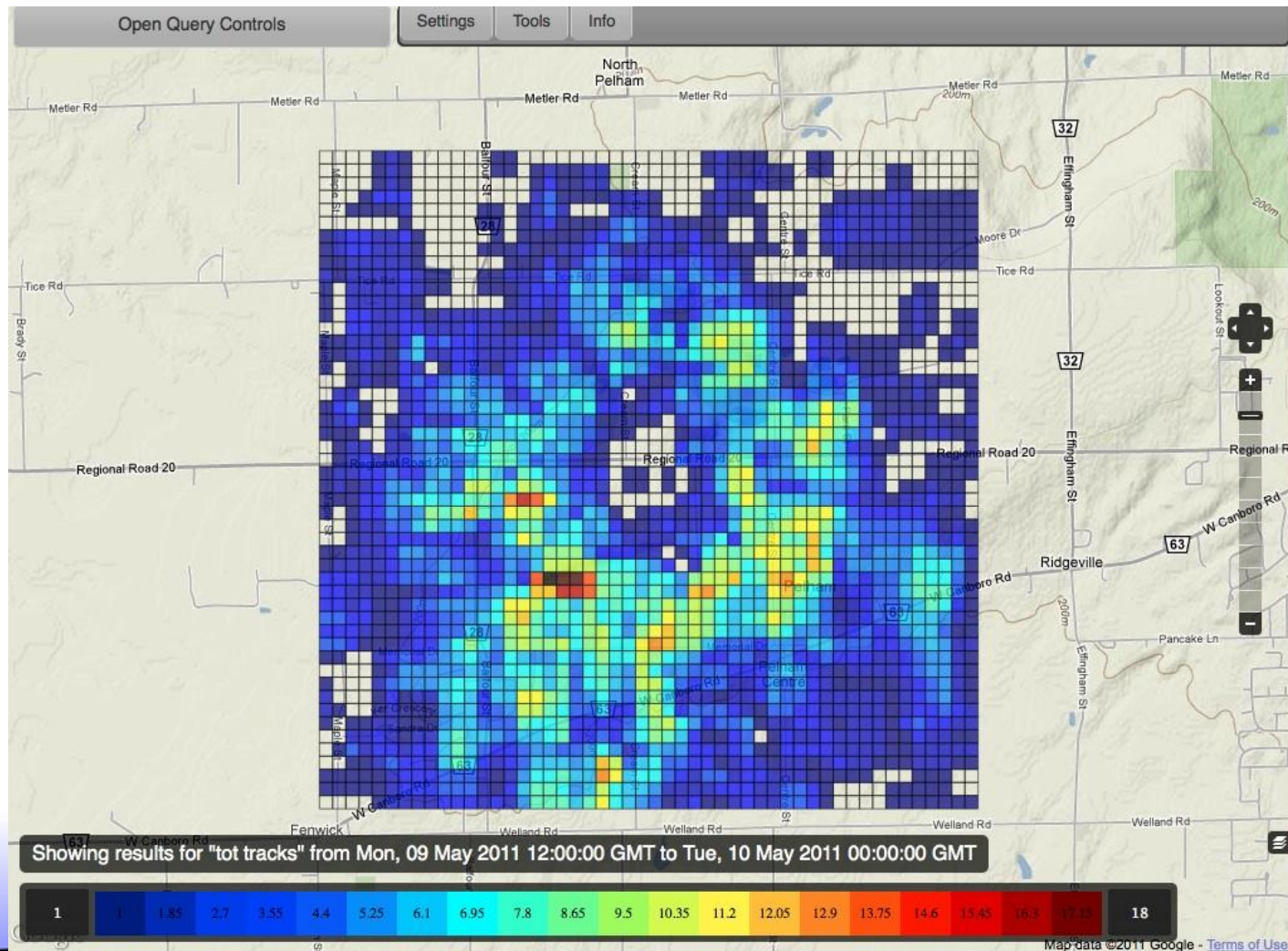
Select Resolution



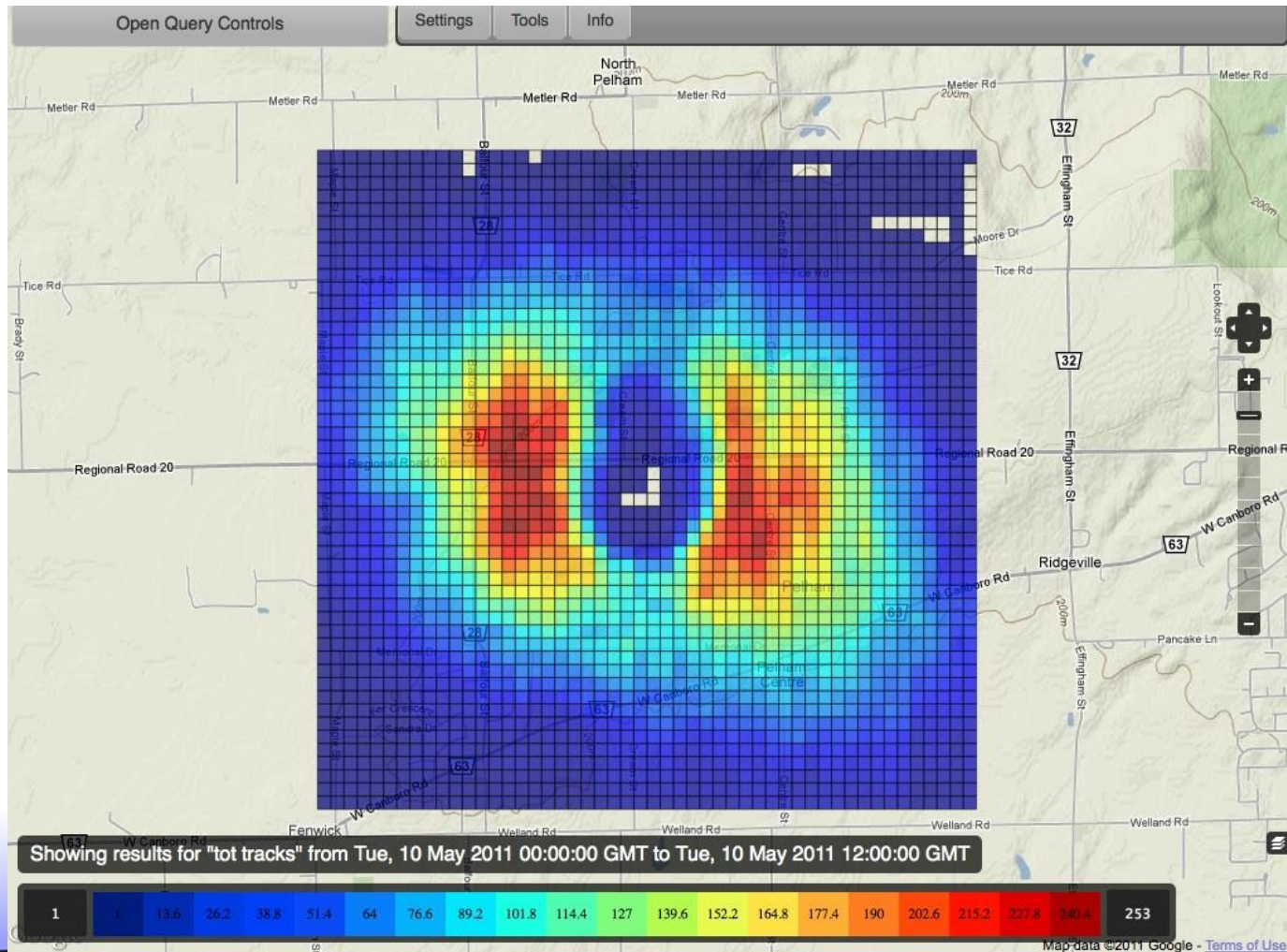
Spatial Analysis



Number of Diurnal Bird Tracks



Number of Nocturnal Bird Tracks

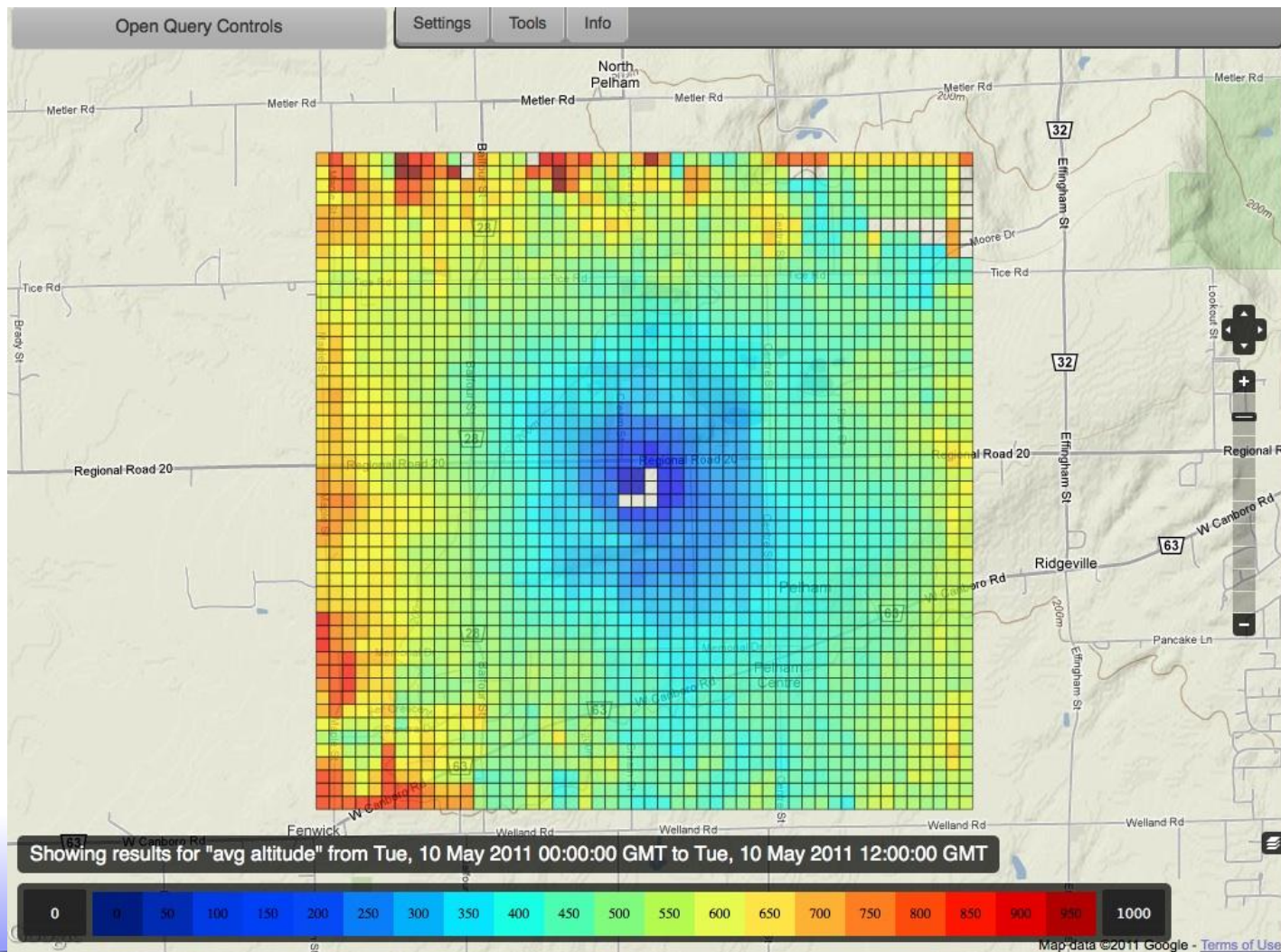


Count Data Exported in Excel Format

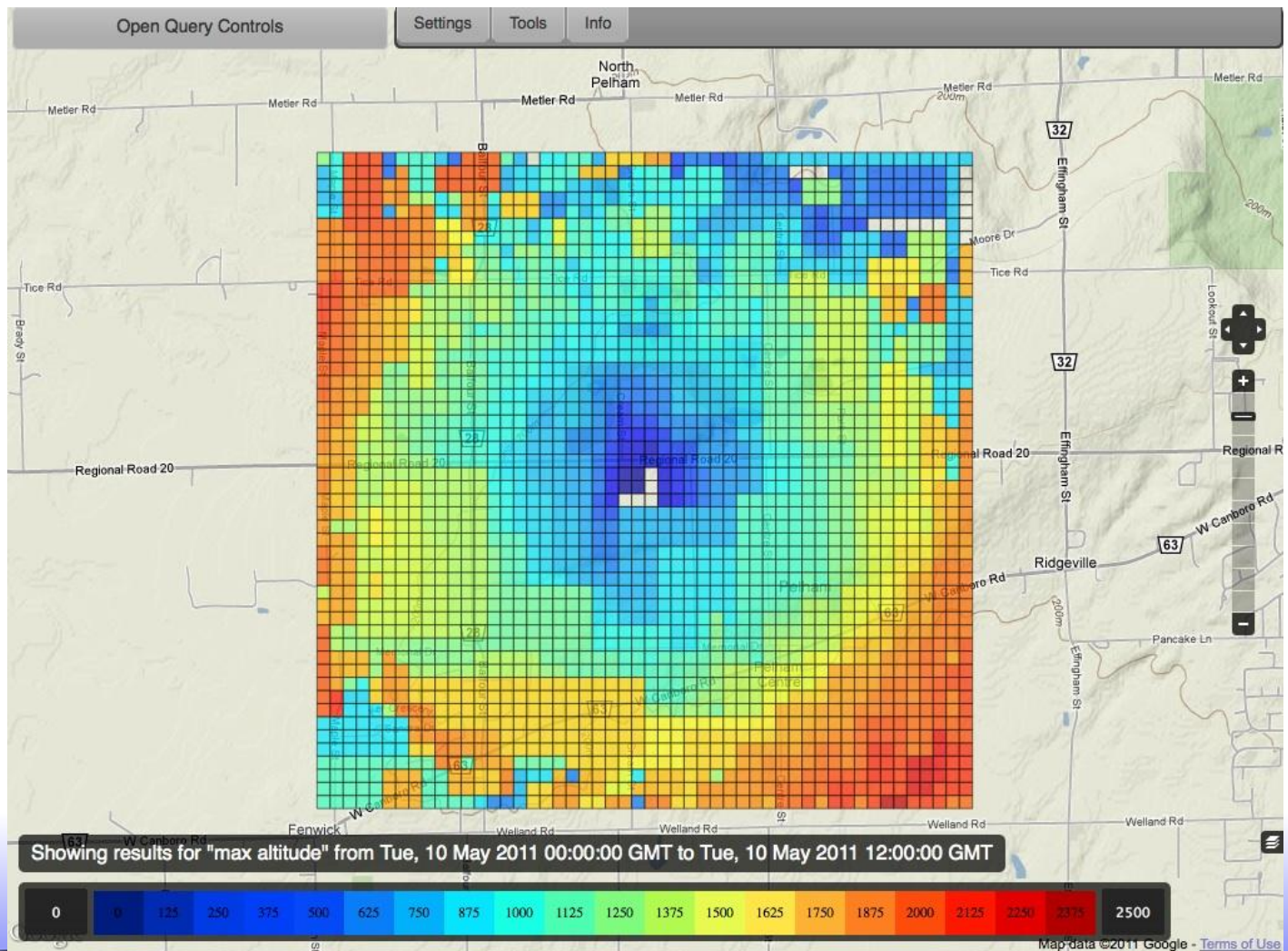
Km West (-) to East of Radar

| Km North (-) to South of Radar | | -2.5 | -2 | -1.5 | -1 | -0.5 | 0.5 | 1 | 1.5 | 2 | 2.5 |
|--------------------------------|------|------|-----|------|------|------|------|------|------|-----|------|
| | -2.5 | 66 | 115 | 29 | 129 | 83 | 18 | 48 | 16 | 126 | 4 |
| | -2 | 53 | 33 | 441 | 6 | 240 | 196 | 426 | 105 | 14 | 395 |
| | -1.5 | 40 | 831 | 920 | 718 | 688 | 253 | 1283 | 5 | 75 | 253 |
| | -1 | 19 | 3 | 14 | 5 | 24 | 7 | 18 | 6 | 12 | 9 |
| | -0.5 | 1111 | 265 | 776 | 1749 | 550 | 167 | 1128 | 78 | 37 | 834 |
| | 0.5 | 683 | 129 | 306 | 1187 | 858 | 729 | 25 | 1590 | 550 | 85 |
| | 1 | 281 | 63 | 9 | 445 | 235 | 488 | 451 | 107 | 555 | 29 |
| | 1.5 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 4 | |
| | 2 | 3 | 45 | 5 | 7 | 48 | 3 | 13 | 19 | 22 | 40 |
| | 2.5 | 18 | 789 | 96 | 768 | 73 | 1073 | 283 | 1332 | 315 | 1169 |

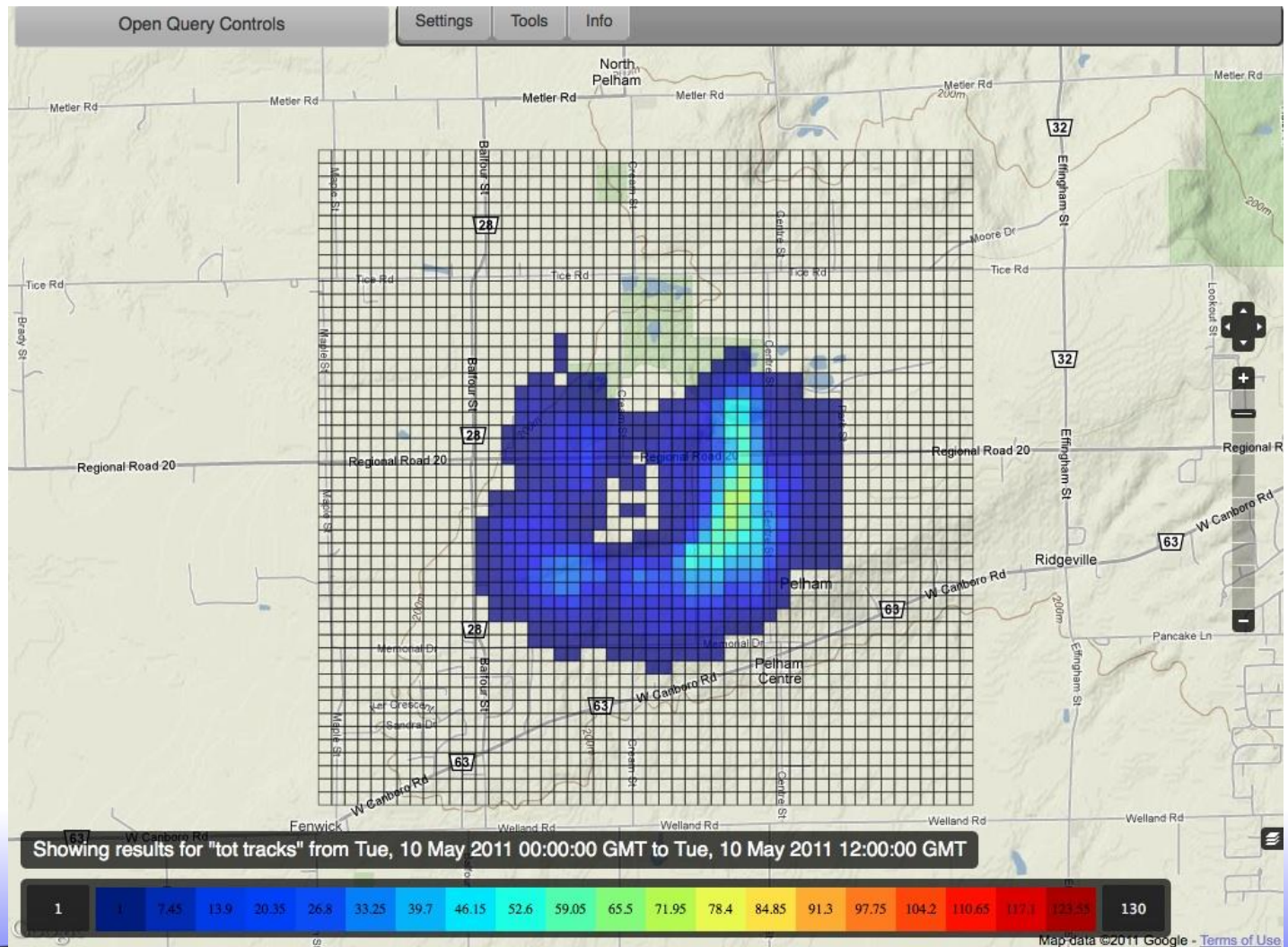
Mean Nocturnal Altitude



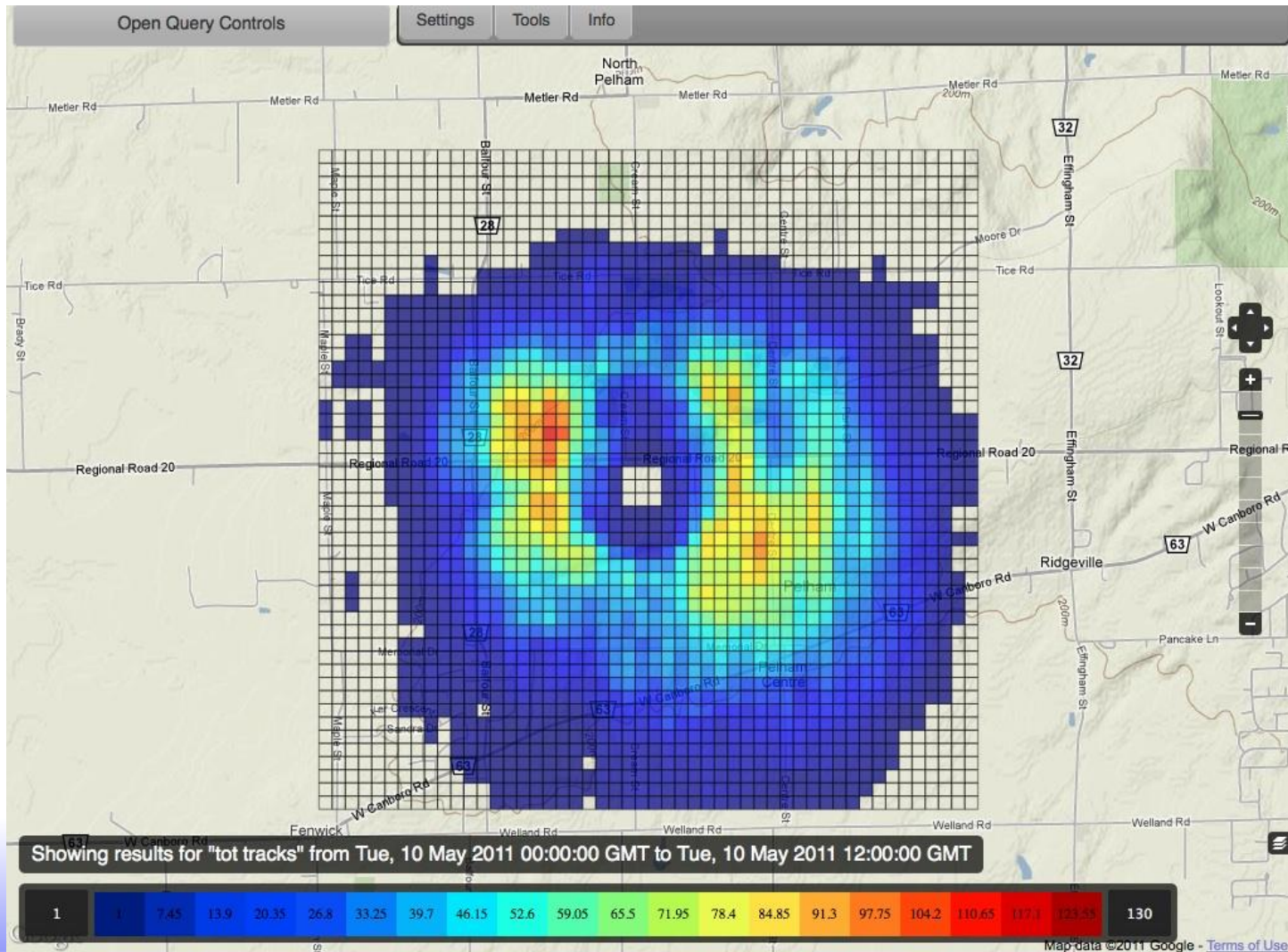
Maximum Nocturnal Altitudes



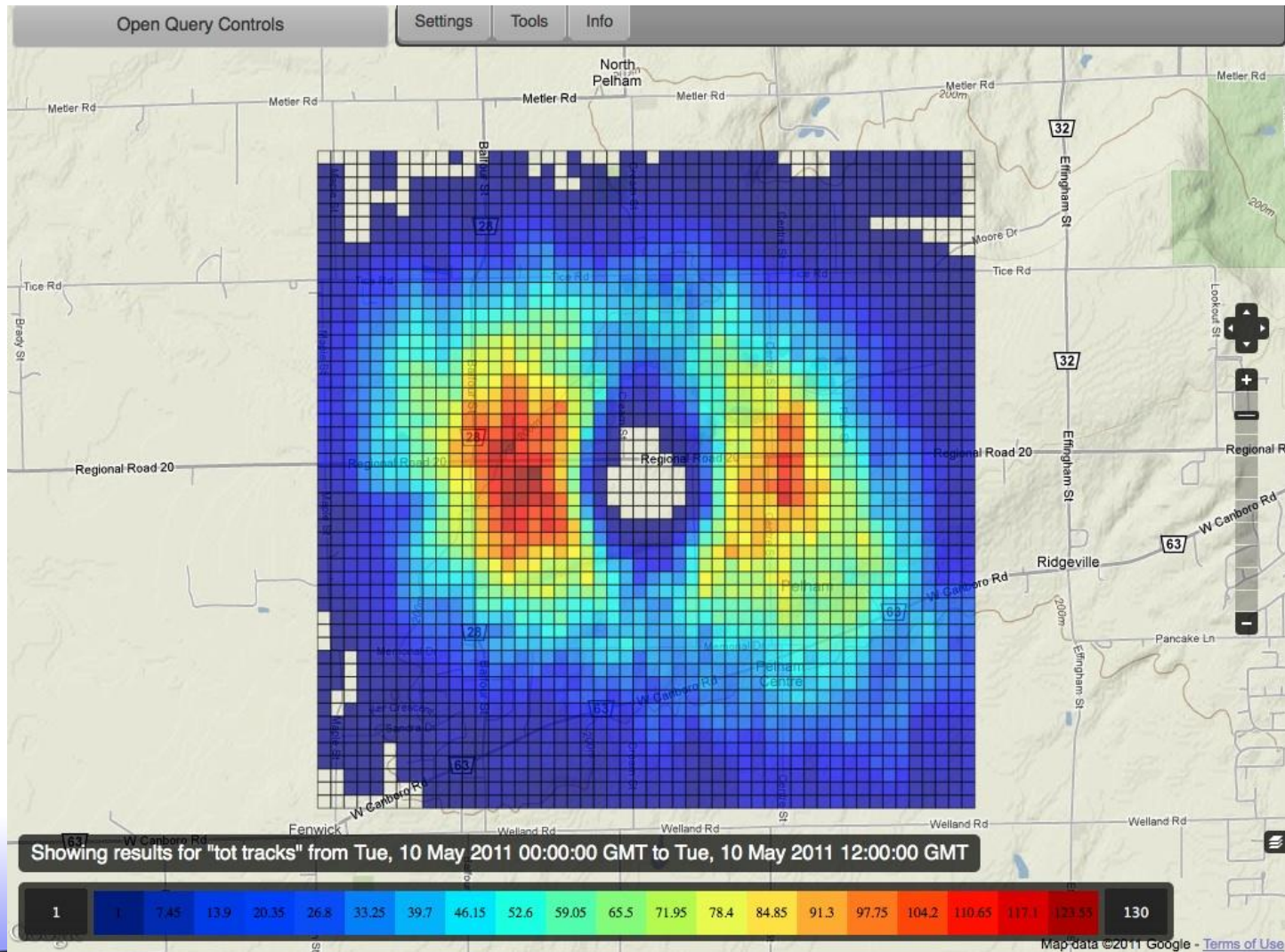
0 – 500 ft



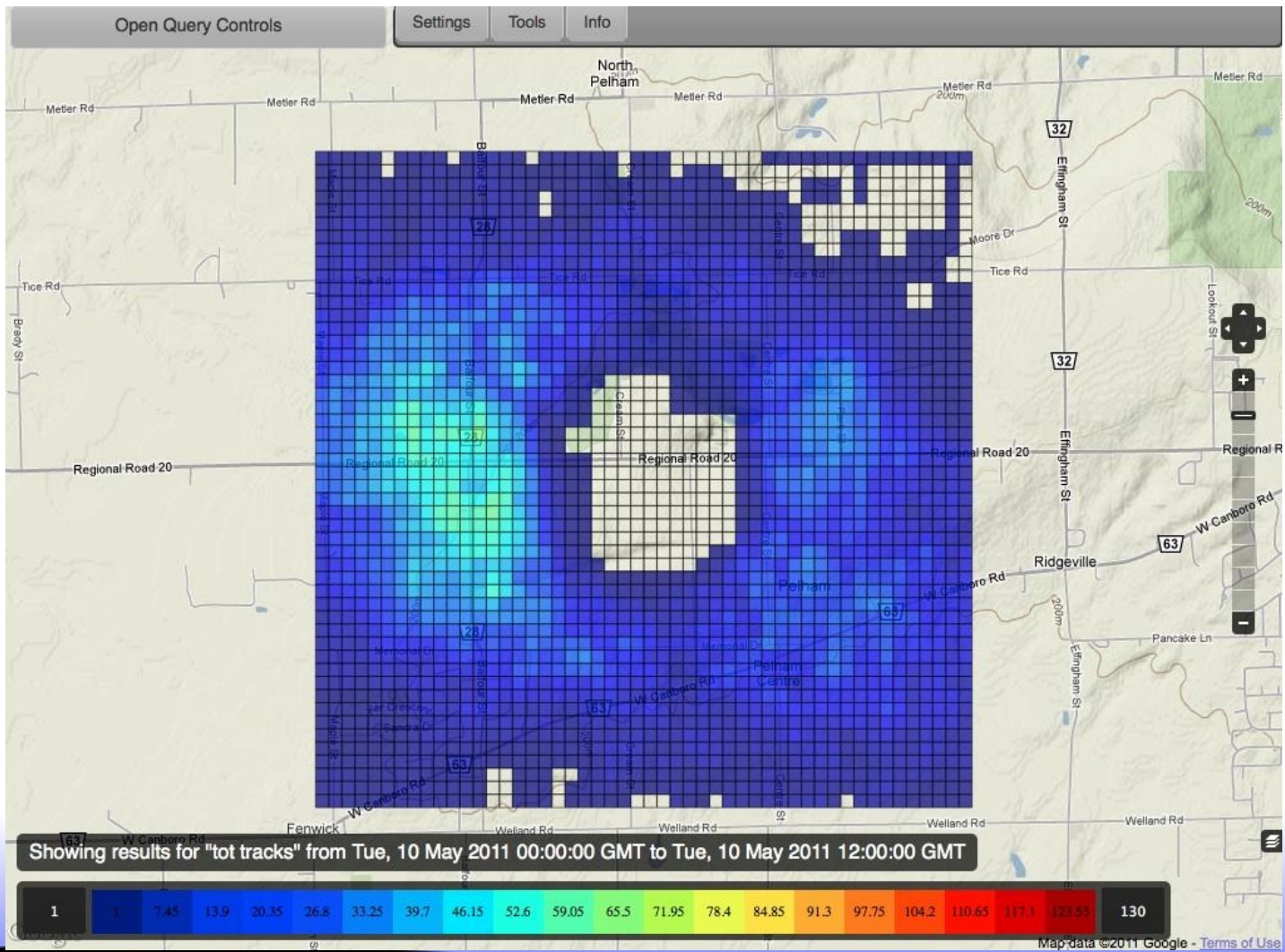
500 – 1000 ft



1000 – 2000 ft



2000 – 5000 ft



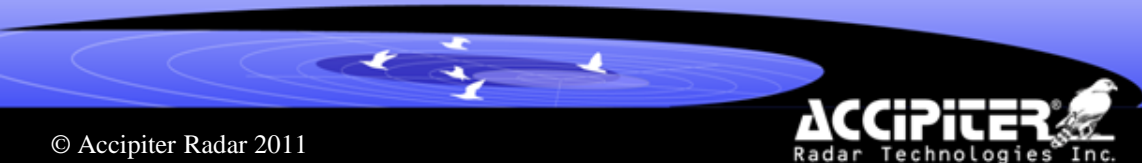
Examine by Cell

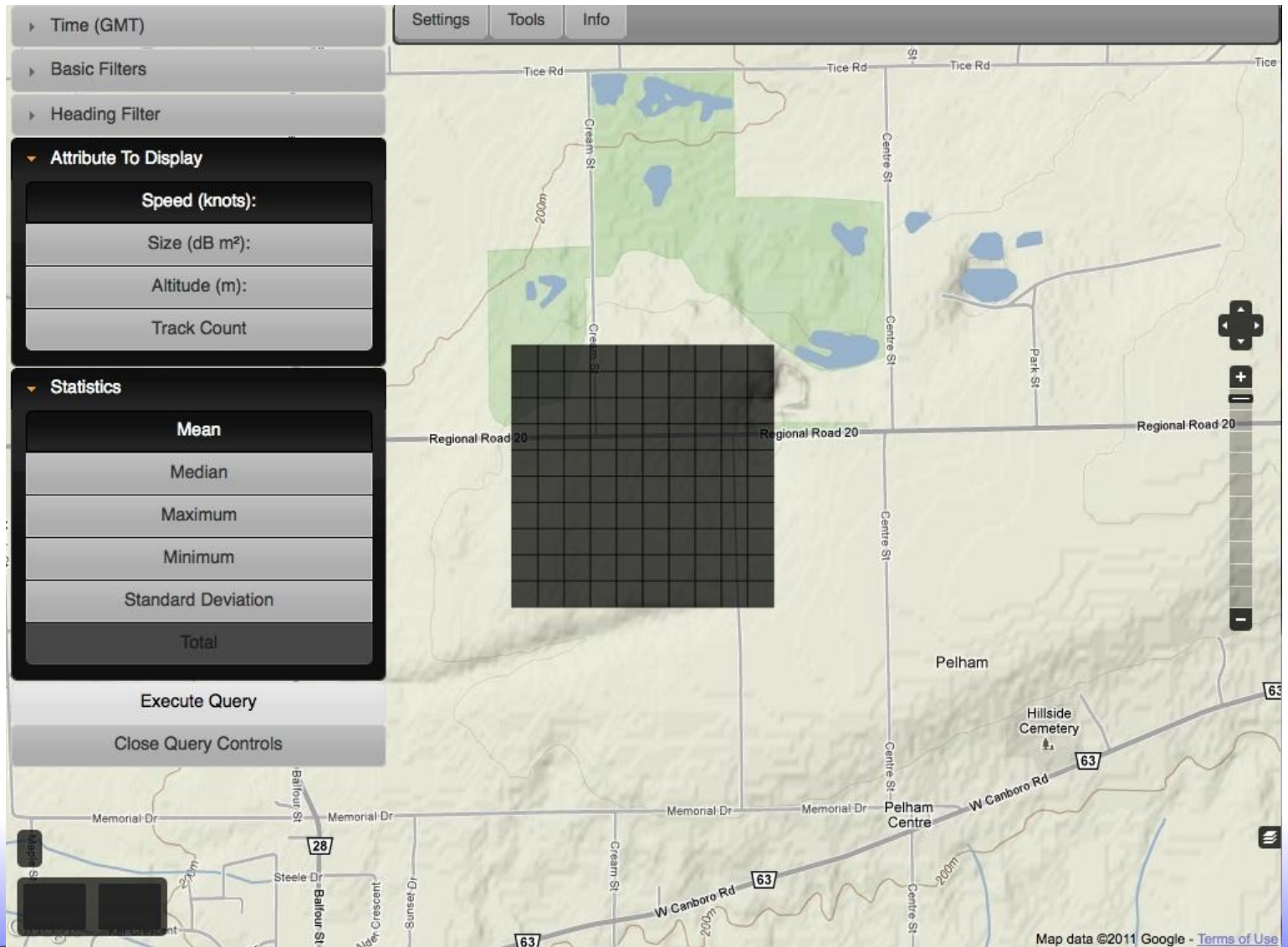
Attributes

- Track count
- Altitude
- Heading
- Speed
- Size

Statistics

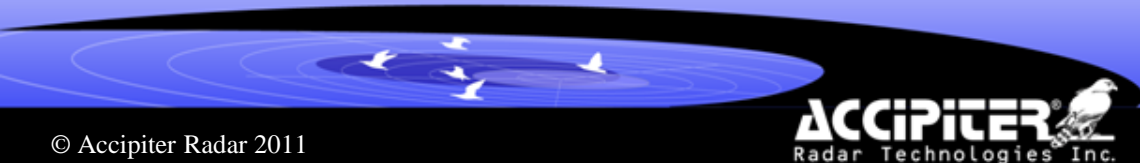
- ← Total
- Mean
- Median
- Standard Deviation
- Maximum
- Minimum



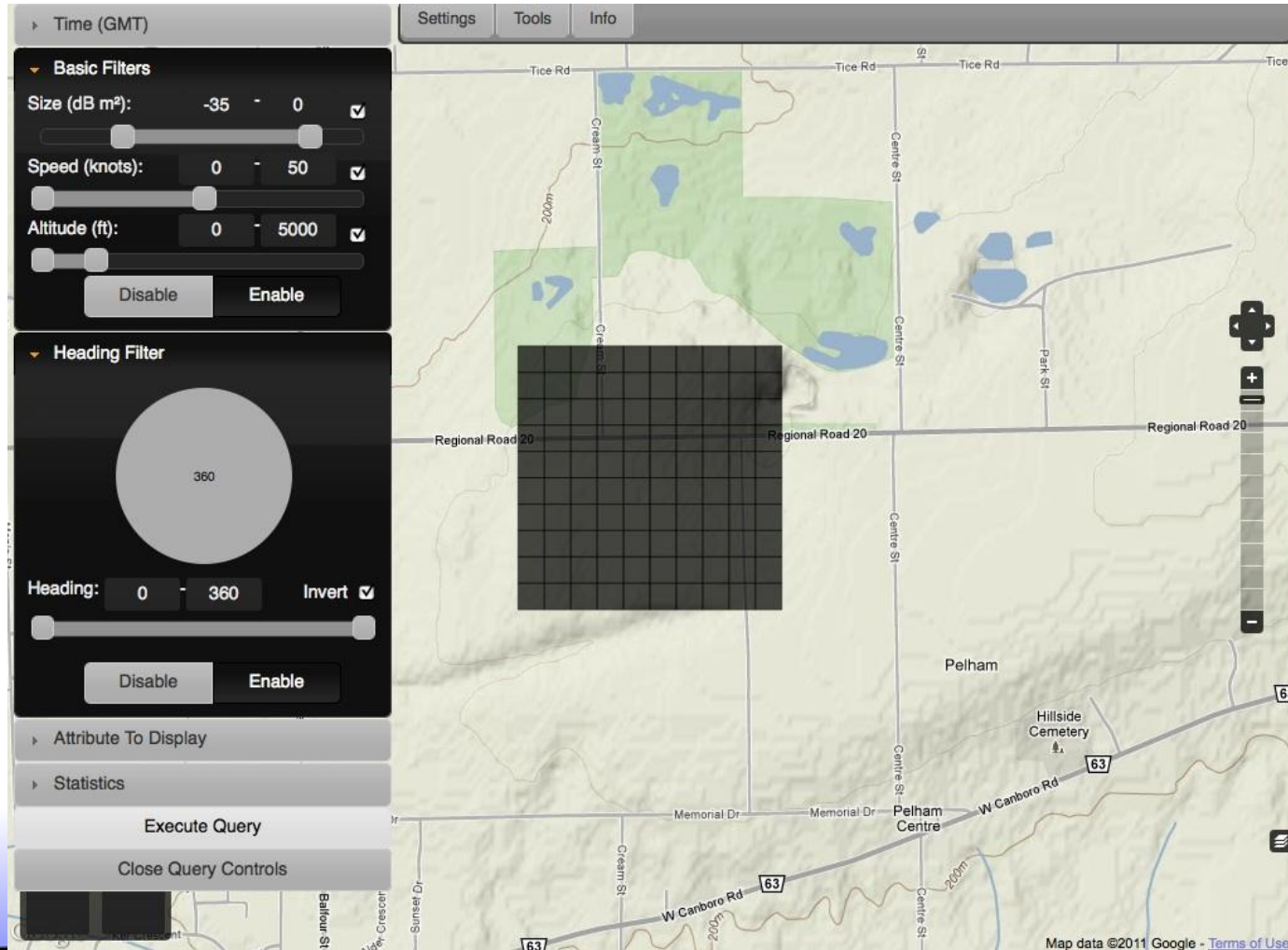


Filter on Attributes

- Altitude
- Speed
- Heading
- Size
- Combinations of the above

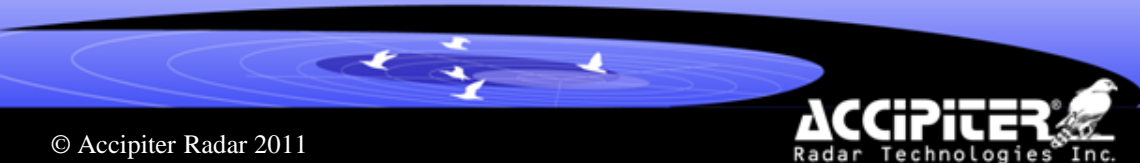


Example of Filters



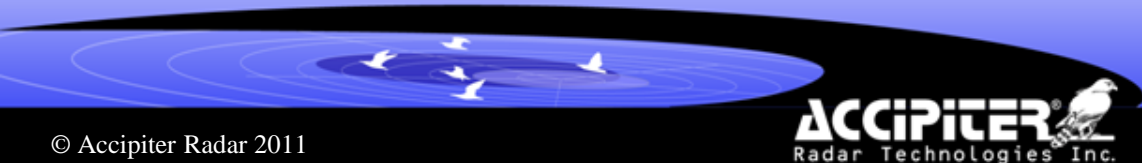
Periodic Reports

- Generated Hourly, Daily, Weekly, Monthly
 - Locations of activity
 - Directions and speed of movement in each cell
- Specific queries
 - Investigate trouble spots
 - Monitor start & end of migration, density of migrants in the airspace



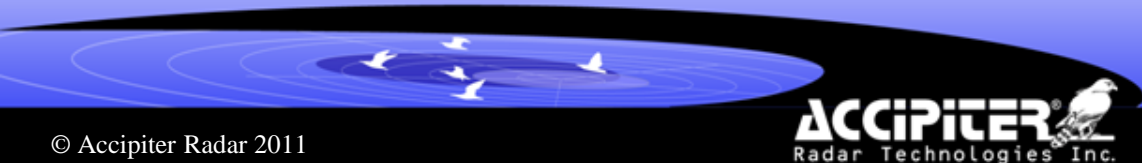
Data Integration

- Visual & auditory sampling
 - Periodic sampling
 - Species ID
 - Details of behavior
- Radar sampling
 - Continuous sampling
 - Quantification of flying birds
 - Altitude
 - Automatic data logging



CONCLUSIONS

- Visual and radar sampling provide complementary data on avian hazards to aviation
- New analytical tools can quantify attributes of avian activity to aid biologists in determining threat levels and monitoring hazard trends
- Automatic report generation allows biologists to spend more time in the field



Acknowledgments

We thank our colleagues at Accipiter Radar for their assistance in the development of the analytical software and preparation of illustrations for this presentation, and the numerous wildlife biologists for their ideas on the types of information they needed to help them do their jobs.

Thank You & Questions



Niagara, Ontario



Niagara, NY