Digital Mapping of Resource Boundaries

Global Positioning System (GPS) Limitations and Solutions

Kristen Currens, Mason, Bruce & Girard, Inc.

GPS Accuracy

Accuracy is the twin brother of honesty; inaccuracy, of dishonesty. -Nathaniel Hawthorne

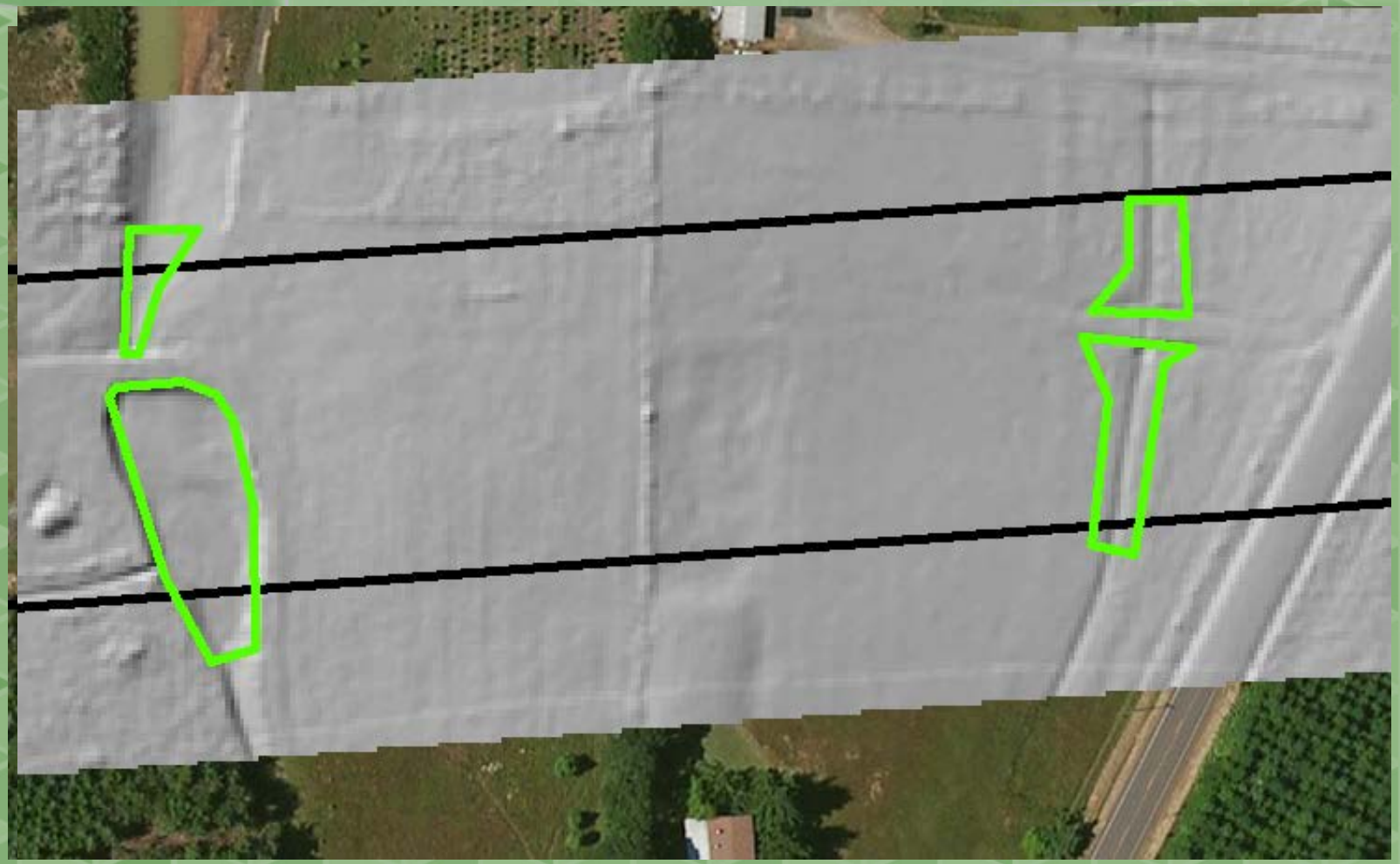
Universalis Cosmographia, Waldseemüller's 1507 world map

Accuracy vs. Precision

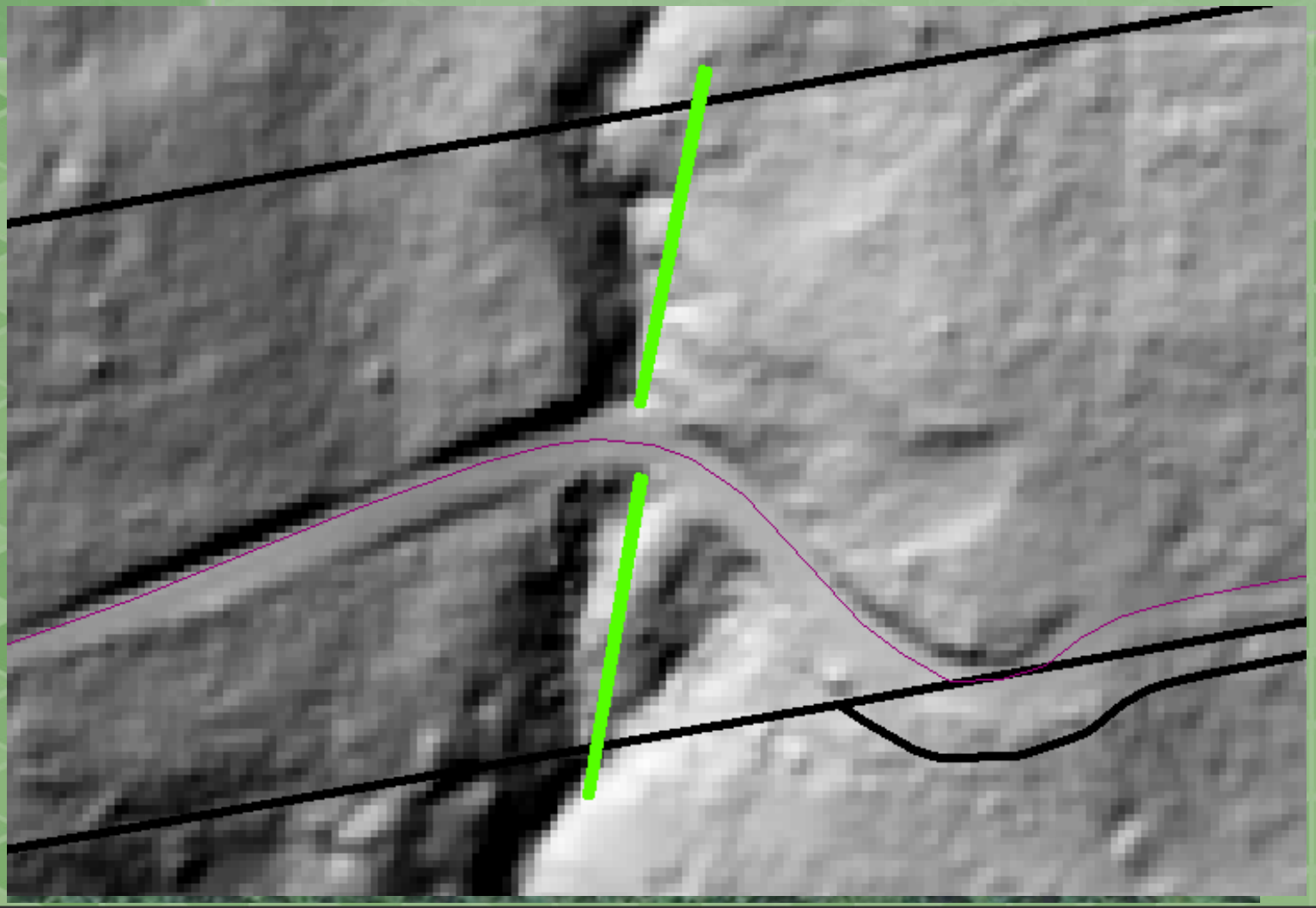
Precise but not accurate

Precise and accurate

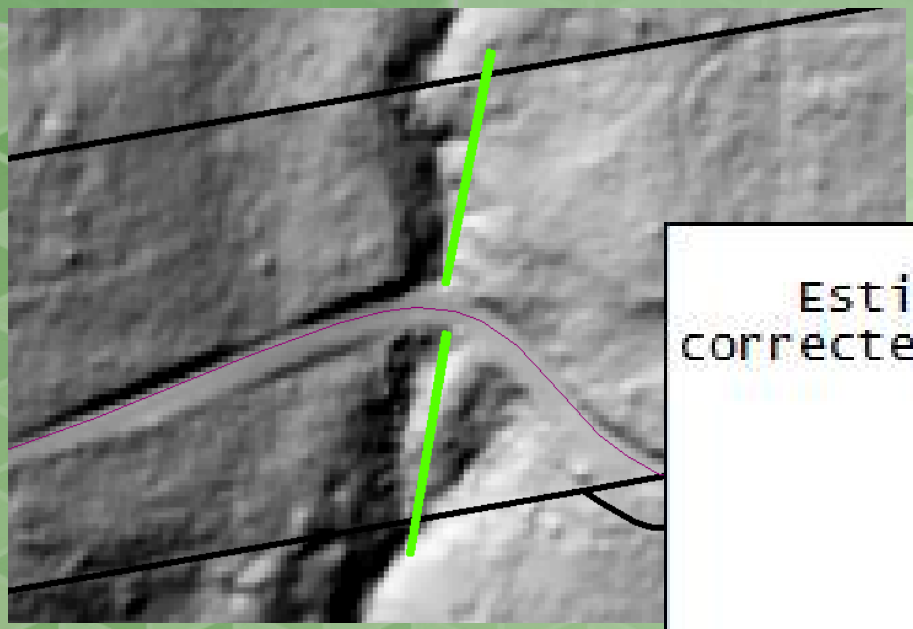
The Problem



The Problem



The Problem

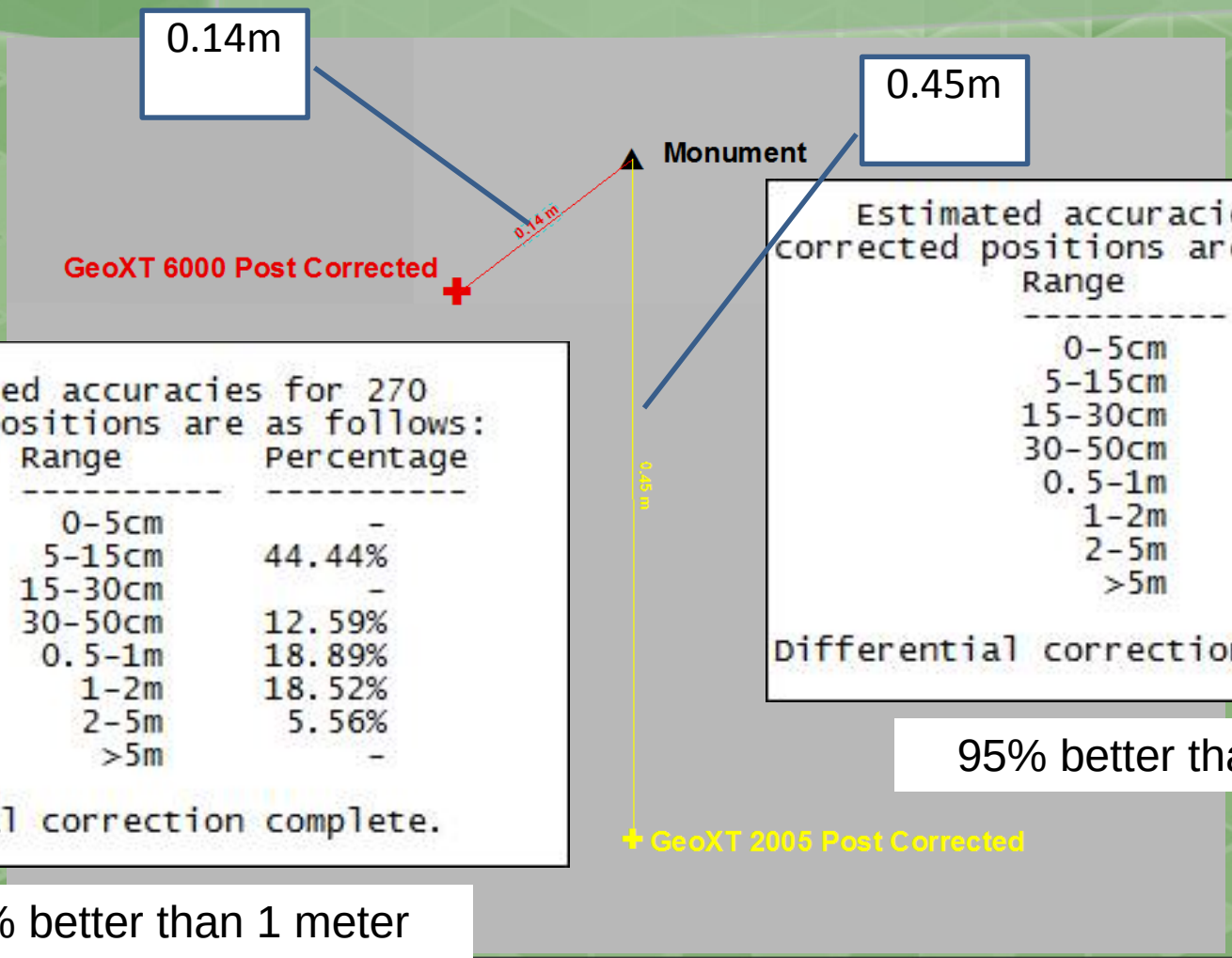


Estimated accuracies for 270 corrected positions are as follows:

Range	Percentage
0-5cm	-
5-15cm	44.44%
15-30cm	-
30-50cm	12.59%
0.5-1m	18.89%
1-2m	18.52%
2-5m	5.56%
>5m	-

Differential correction complete.

The Problem



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>5m	-

Differential correction complete.

75% better than 1 meter

Estimated accuracies for 210 corrected positions are as follows:

Range	Percentage
0-5cm	-
5-15cm	-
15-30cm	-
30-50cm	83.33%
0.5-1m	11.90%
1-2m	2.38%
2-5m	2.38%
>5m	-

Differential correction complete.

95% better than 1 meter

Accuracy Outputs

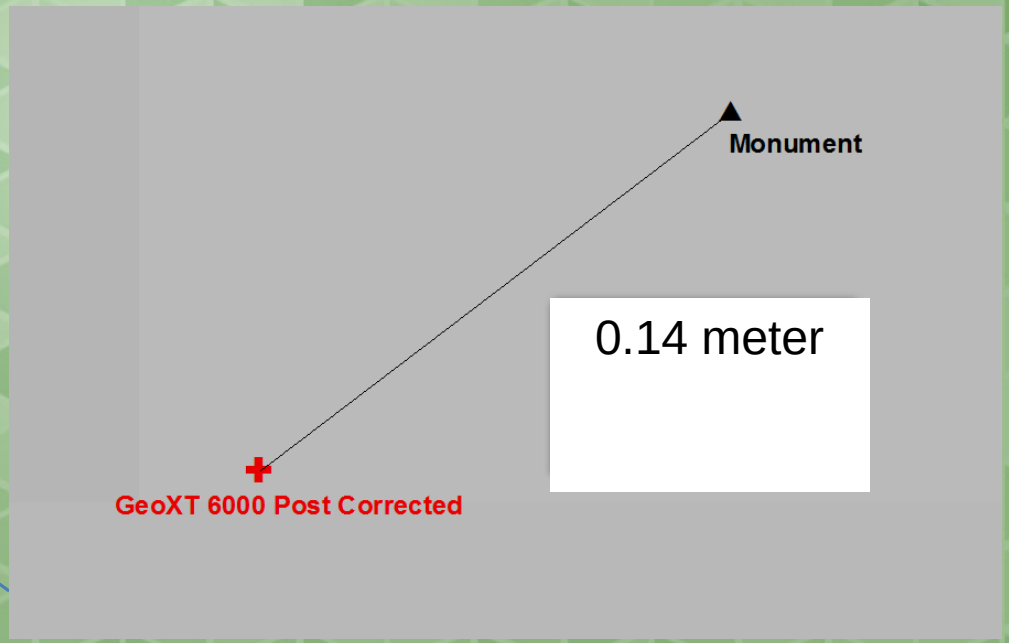
= Precision

Estimated accuracies for 270 corrected positions are as follows:

Range	Percentage
0-5cm	-
5-15cm	44.44%
15-30cm	-
30-50cm	12.59%
0.5-1m	18.89%
1-2m	18.52%
2-5m	5.56%
>5m	-

Differential correction complete.

Measured Accuracy



GPS Accuracy

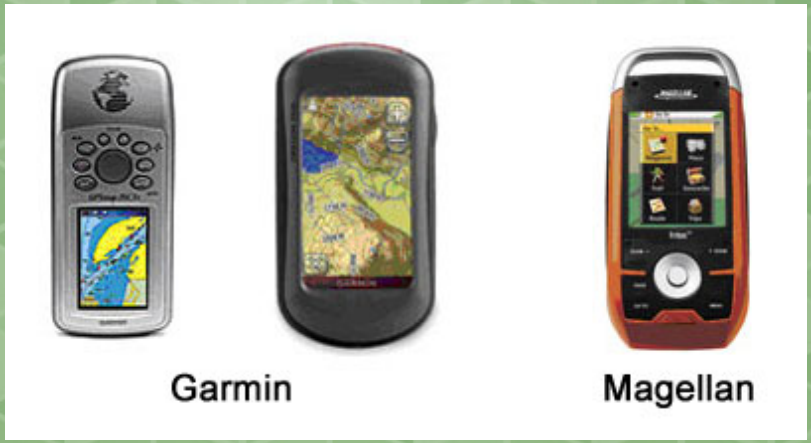
Accuracy is limited by:

- Equipment
- Site and satellite constraints
- Pre-field, field, and post-processing methods

GPS Accuracy Equipment

3 grades:

- Consumer >3 meters
- Mapping 1-3 meters



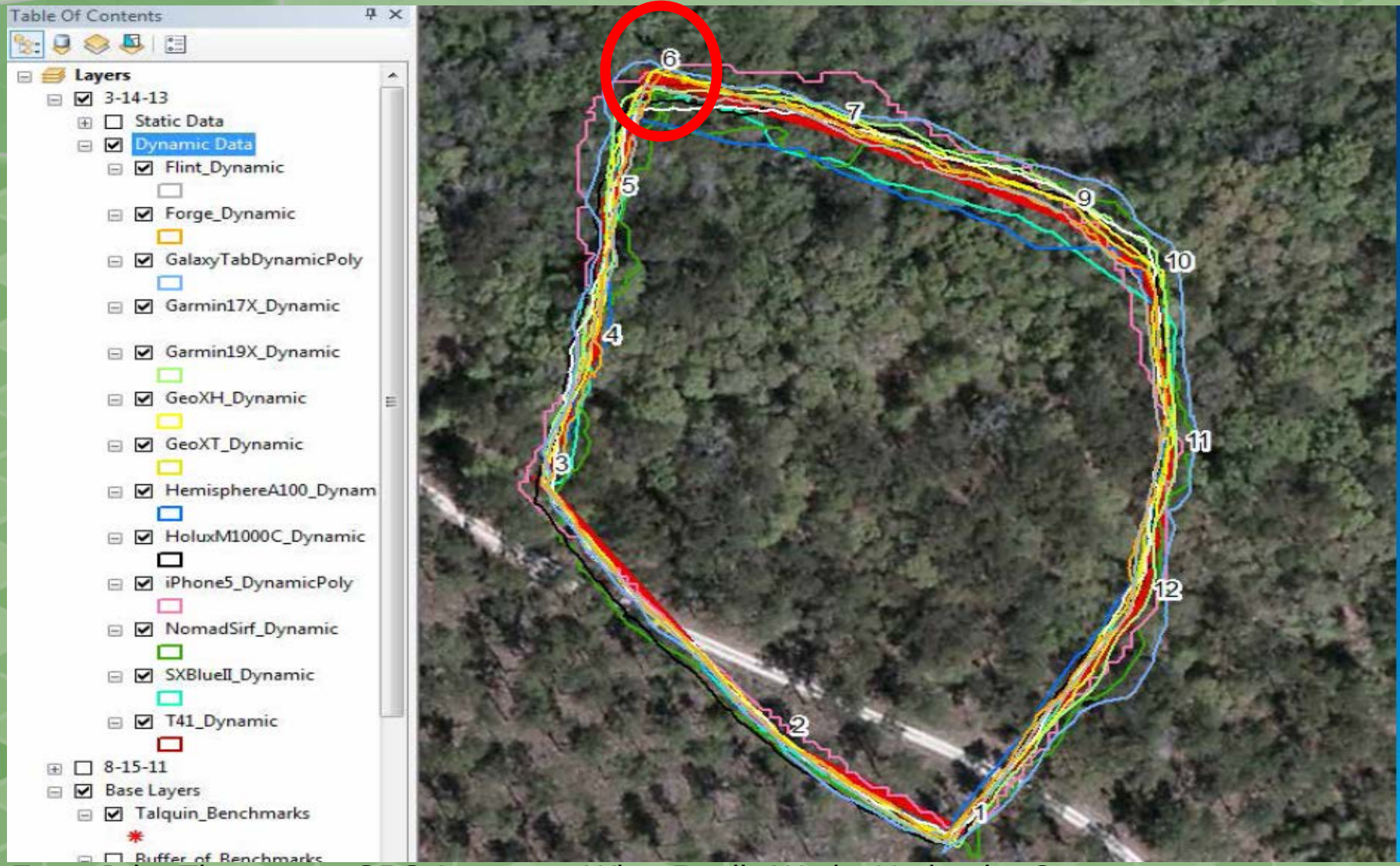
GPS Accuracy Equipment

3 grades:

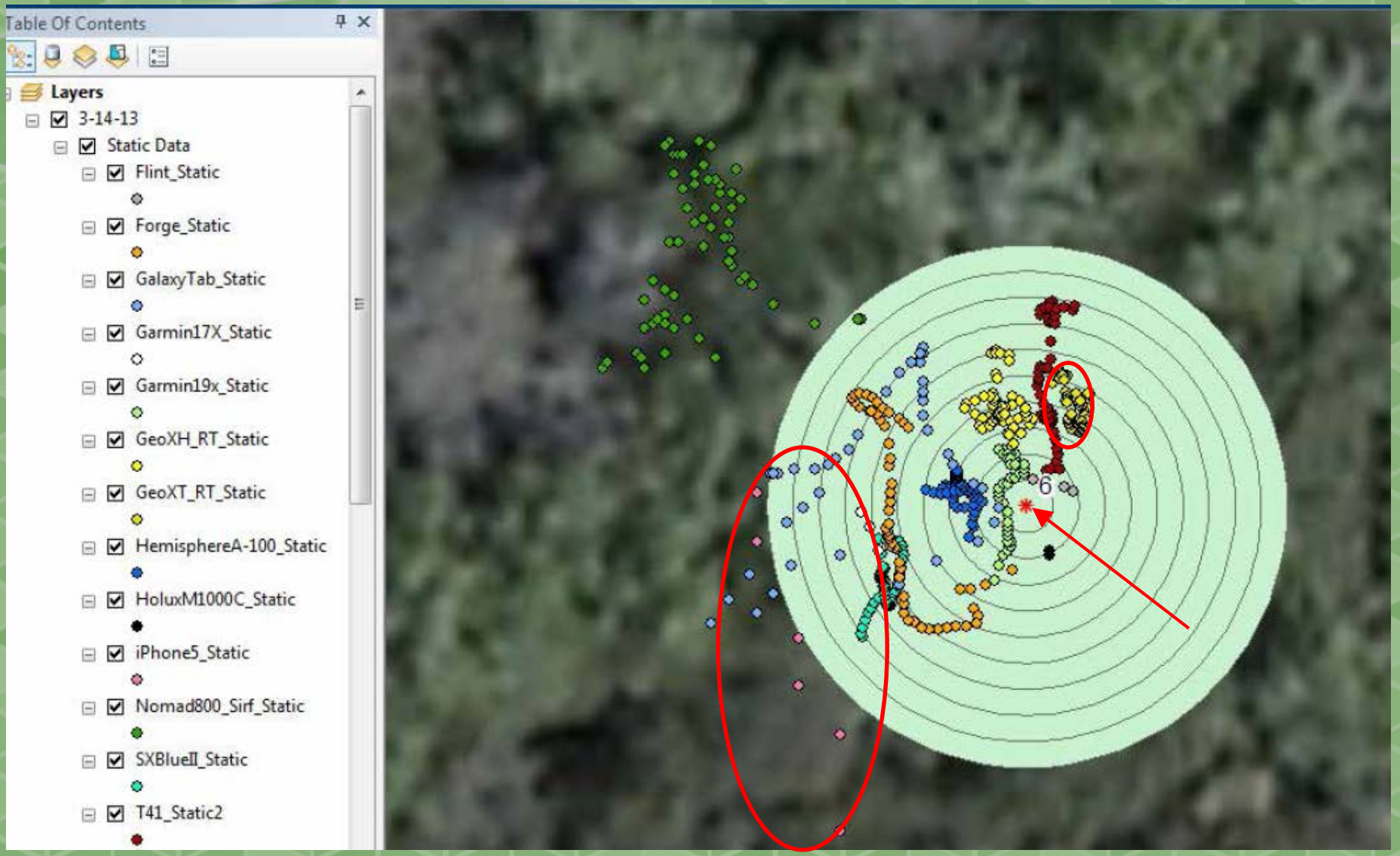
- Professional (sub-meter) < 1 meter

GPS Accuracy
Site and Satellite Constraints

- Site Constraints:
  - Steep topography
  - Buildings
  - Dense vegetation cover
- Satellite Constraints:
  - Satellite geometry
  - Multipath



From John Thompson, GPS Accuracy: What Really Works Under the Canopy 2013



From John Thompson, GPS Accuracy: What Really Works Under the Canopy 2013

GPS	Avg Error (m)	Rank
Post Processed GeoXH 6000 GLONASS	0.75	1
Garmin_19X	1.63	2
Flint_Internal	1.85	3
Post Processed GeoXT 6000 WAAS	1.87	4
Holux_M1000C	1.99	5
Hemisphere_A100	2.66	6
GeoXH 6000 GLONASS	3.97	7
Trimble T41	4.02	8
GeoXT 6000 WAAS	4.36	9
Forge_Internal	5.73	10
SX_Blue II	6.18	11
iPhone5	10.57	12
GalaxyTab	15.60	13
Nomad_800_Internal	16.08	14

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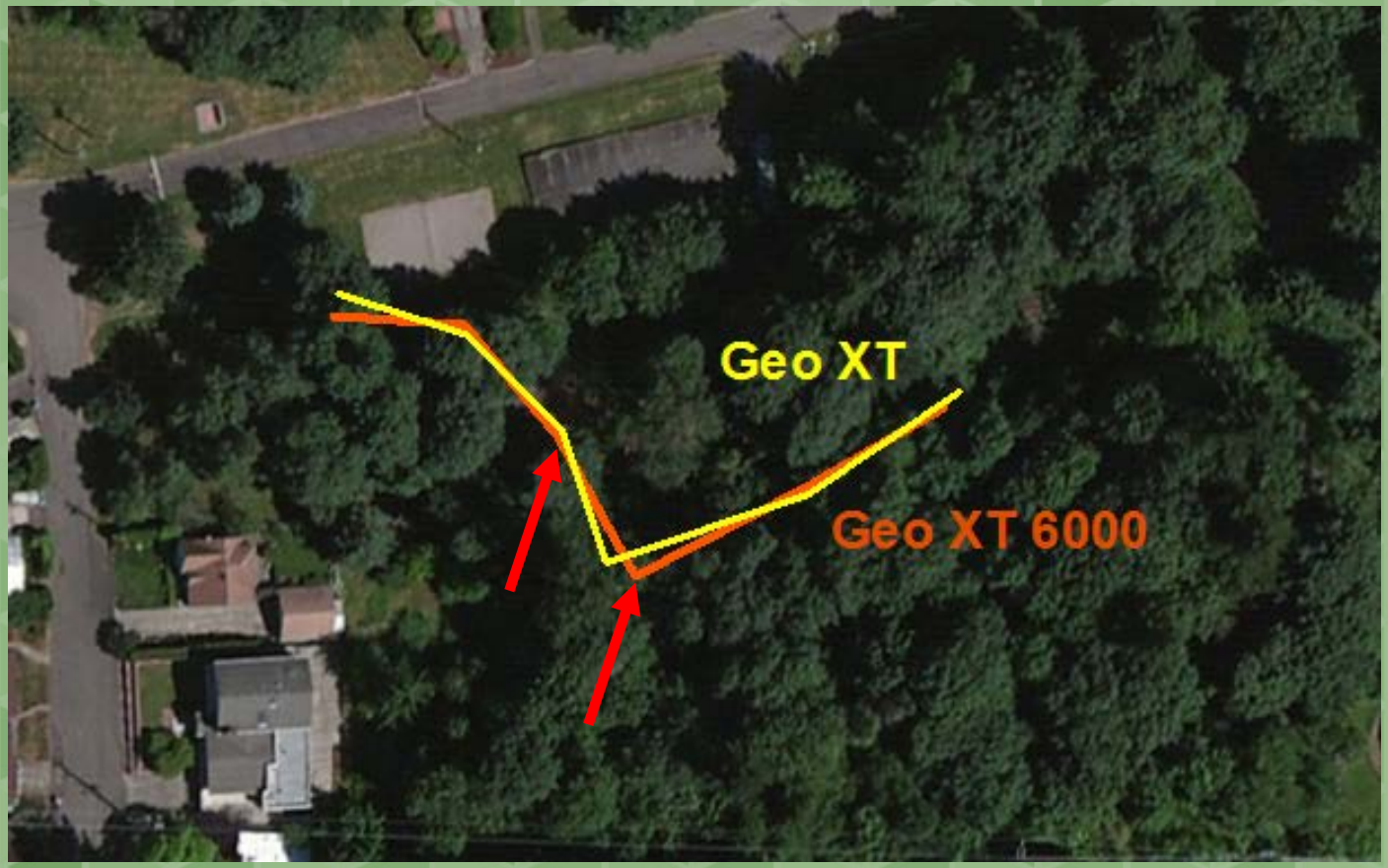
GPS Accuracy Equipment

Differences between two professional-grade units



GPS Accuracy Methodology

Pre-field Methodology

- GPS settings (“Smart Settings”)
- Pathfinder trip planning

GPS Accuracy Methodology

Field Methodology

- Back to the north
- Hold unit with receiver pointing directly up
- Hold still with unit at the same vertical and horizontal position
- Collect at least one surveyed monument/day

GPS Accuracy Methodology

Post-processing Methodology

- Office processing ensures best results
- Compares monument locations to select the best base-station

Project Management Implications

Fast is fine, but accuracy is everything.
-Wyatt Earp

Quality of other project data collected by:

- Other entities
- Different equipment
- High standards and protocols necessary

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