GPS Equipment and Accuracy

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Overview

• How Does GPS Work
• Correction Types/Services
• Accuracy vs. Repeatability?
• Reliability?
• Correction costs
• Purchase Considerations
Understanding GPS Classes

Levels of Correction
- Sub-meter
- Decimeter
- Centimeter (RTK)

Number Required
- GPS: 4 satellites
- RTK: 5 satellites

Image courtesy of University of Kentucky
## Sources of GPS Correction

<table>
<thead>
<tr>
<th>Type</th>
<th>Broadcast Method</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAAS</td>
<td>Satellite</td>
<td>---</td>
</tr>
<tr>
<td>Single Frequency</td>
<td>Satellite</td>
<td>John Deere SF1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OmniStar XP</td>
</tr>
<tr>
<td>Dual Frequency</td>
<td>Satellite</td>
<td>John Deere SF2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OmniStar XP</td>
</tr>
<tr>
<td>RTK</td>
<td>Radio or Cellular</td>
<td>Several</td>
</tr>
<tr>
<td>Correction Service</td>
<td>Pass-to-Pass Accuracy</td>
<td>Potential Range of Drift</td>
</tr>
<tr>
<td>--------------------</td>
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<td>--------------------------</td>
</tr>
<tr>
<td>WAAS</td>
<td>± 6 to 13 inches</td>
<td>± 4.7 ft</td>
</tr>
<tr>
<td>Sub-meter</td>
<td>± 6 to 13 inches</td>
<td>± 2.3 ft</td>
</tr>
<tr>
<td>Decimeter</td>
<td>± 2 to 4 inches</td>
<td>± 1.7 ft</td>
</tr>
<tr>
<td>RTK</td>
<td>± 1 inch</td>
<td>± 1 inch</td>
</tr>
</tbody>
</table>

Selection of GPS Accuracy

Pass-to-Pass vs. Long-Term
GPS Selection vs. Operation

- **Sub-meter**
  - Scouting
  - Yield mapping
  - Soil sampling
  - Variable-rate

- **Decimeter* and RTK**
  - Planting
  - Strip-tillage
  - Auto-swath
  - Controlled traffic
Accuracy vs. Reliability

• **Accuracy (relative)**: measured in distance and has long been the standard metric for analyzing the performance of GPS systems.

• **Reliability** measures the up-time of a GPS system. Combination of:
  – Satellite availability
  – Correction service availability.
5 Operating Satellites, 2 Blocked by Trees
9 Operating Satellites, 2 Blocked by Trees
More Satellites = More Operational Time
GPS Solution

- Best Case: 8 - 9 Satellites
- Near Trees: 5 - 6 Satellites
- May lose correction or ability of receiver provide a position (down-time)

GNSS Solution (GPS+GLONASS)

- Best Case: 14 - 15 Satellites
- Near Trees: 8 - 10 Satellites
- Improved reliability (continues to work!)
Example GNSS Receivers

“GPS + GLONASS”

- John Deere SF3000
- AgLeader GPS 2500
- Trimble AgGPS 442
- Raven Phoenix 300
- Topcon AGI-3

Comments:
- Must have GNSS correction!
- Increased options in the future.
GPS Correction Costs (non-RTK)

• **WAAS:** Free

• **Single Frequency:**
  – OmniStar XP - $800/yr
  – OmniStar G2 - $800/yr (GNSS)
  – John Deere SF1 - Free

• **Dual Frequency:**
  – John Deere SF2 - $800/yr
  – OmniStar HP - $1500/yr
Example RTK Correction Costs

RTK fees:

– Trimble VRS: $1500/yr
– CORS in TN: $300/yr
– Earl Dudley: $1000/yr
– John Deere: $2000/yr

*May require cellular data plan + modem
GPS Purchase Considerations

• **Required accuracy** for your operation
  – Sub-meter vs. RTK
  – Pass-to-pass vs. long-term
  – Purchase vs. free correction service

• **Source of GPS correction**

• Suggest **GNSS receivers** on future purchases

• Is the receiver **easily upgradeable** as new firmware versions are released?
Thank-You

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