GPS/GNSS for Agriculture

Global Navigation Satellite Systems (GNSS), commonly known as Global Positioning Systems (GPS) involve a variety of components and are most commonly used in agriculture for navigation.

GPS is the term for the US NAVSTAR satellite system. Other systems are being developed by other countries such as Russia's GLONASS and the EU's Galileo.

In a GNSS, satellites orbit the earth and send signals to receivers that can give highly accurate information about their location on the earth's surface.

Currently the US's NAVSTAR GPS and GLONASS are the only satellite systems that are fully operational. Availability of multiple satellite systems can help improve the availability of signals, but only if the equipment you purchase has the ability to receive signals from each system.

Different levels of positioning accuracy are available depending on what you are trying to accomplish. As you would expect, higher accuracy comes with a higher price tag. Table 1 gives an overview of some of the options.

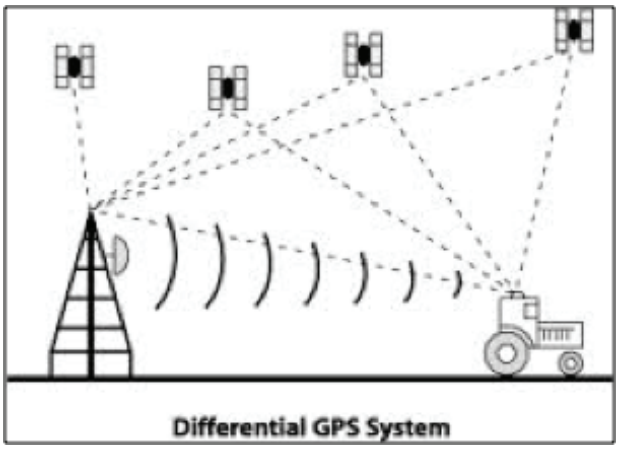
Right (top image): This shows a GPS receiver and antennae that receive differential signals.

Right (bottom image): This shows a tractor operator using the in-cab display to use GPS guidance in the field.

Table 1: GPS options.

Type of GPS	Accuracy	Average Cost	Agricultural Uses
Stand-alone receiver: usually a handheld unit that receives satellite signals	~4–10 m	AU$100-1000	• Recording location of on-farm activities such as soil and tissue tests • Strategic trials
Differential receiver: receiver plus additional fixed, ground-based reference stations to correct errors in original signal. May require a subscription.	~0.1–1 m	Up to AU$10 000	Everything above plus: • Guidance • Yield Mapping • Variable-Rate Control
Real-Time Kinematic (RTK) differential receivers: type of differential receiver where correction signal comes from a local base station in real-time.	2–10 cm	AU$10 000 –40 000	Everything above plus: • Autosteer • Elevation mapping • Land levelling and forming

The most common type of GPS used in precision agriculture is RTK. The accuracy of different RTK systems varies slightly so make sure you understand the terminology dealers are using before you make a decision about what to purchase.



(http://www2.ca.uky.edu/agc/pubs/pa/pa5/pa5.htm)

Above: A differential GPS system uses a ground-based reference station to increase the accuracy of the location information. RTK receivers get their correction signal from a local base station in real-time.

Satellite navigation definitions

Sometimes these terms are used interchangeably, but they actually mean different things.

- **Guidance:** GPS guides machinery but control remains with the operator. The guidance system uses a signalling device to prompt the driver to maintain a predetermined path. Requires sub-metre accuracy of GPS signal.
- **Autosteer:** Removes operator from the majority of steering operations. For safety, autosteer systems have an automatic override system as soon as the operator takes control of the steering wheel. These systems also monitor the quality of the satellite signal. Requires centimetre accuracy of GPS signal.
- **Controlled Traffic:** The use of guidance or autosteer to confine all machinery loads to the least possible area of permanent traffic lanes.

Benefits of satellite navigation

Most of the benefits of satellite navigation result in improved efficiency of farming operations that help farmers save time and money. Some of these benefits are listed below.

- reduced skip and overlap of inputs
- reduced driver fatigue
- reduced compaction
- improved soil water management
- increased yield
- inter-row cultivation, spraying, and planting.

Agricultural uses of GPS

As listed in Table 1, there are a variety of agricultural uses of GPS besides navigation. A common thread amongst all of these activities is the use of spatial data. When you have access to specific information about **where** different things are happening on the farm, this can help you better understand your land and give you more confidence in making management decisions.

In addition to the spatial information provided by GPS, agricultural GPS equipment and accompanying software can be used for automated record keeping and inter-vehicle communications, among other things. Understanding your equipment and all of its capabilities can help you streamline your farming operation to become more efficient and productive.

References

Whelan, B. and J. Taylor. 2013. *Precision Agriculture for Grain Production Systems.* CSIRO Publishing. 199pp.