

GNSS correction services, ionospheric activity and Trimble RTX

How does ionospheric activity
impact your precision farming?



Table of contents

- 3** Taking precision to the next level
- 4** How it works
- 5** It's all connected
- 6** How to mitigate the impacts on your farming operation
- 7** Correction Services—RTK
- 8** Correction Services—Trimble RTX
- 9** At a glance: RTK vs. RTX
- 10** About Trimble Positioning Services

Taking precision to the next level

Protecting your farm's bottom line amid solar cycles, satellite disruptions and an erratic ionosphere.

Real estate isn't the only business that's all about location. Precision farming strategies that produce solid ROI rely on operators knowing their precise location—every centimeter counts. This is why many successful farmers turn to guidance and steering technology to ensure they have a clear understanding of the position of their equipment during all field tasks, even in difficult conditions.

The importance of location in farming spawned the correction services industry which, in the agriculture sector, takes location accuracy to the next level. By pairing a quality receiver with reliable correction services, farmers can 'correct' almost any errors due to satellite systems being delayed or disrupted by clock, orbit or atmospheric anomalies.

Farmers get corrected real time positions on the ground, leading to improved accuracy, higher productivity and a stronger bottom line.

For positioning in the field, the Global Navigation Satellite System (GNSS) signals are utilized. A minimum of four satellites is required to obtain a rough position ranging within several meters. However, each additional usable satellite contributes to the overall strength of the positioning performance. Speed and robustness of the positioning improves with every incremental satellite, usable by the GNSS receiver.



Here's how it works

- When the navigation satellite signals are sent to the GNSS receiver mounted on a vehicle, the receiver will begin calculating its position.
- Each GNSS has its own set of satellites that send location information to receivers.
- Dual constellation receivers (GPS and GLONASS) will receive signals from an average of 14 satellites per day.
- Multi-constellation receivers (GPS, GLONASS, Galileo and BeiDou) such as Trimble's NAV-900, will receive signals from an average of 27 satellites per day.
- The NAV-900 receives signals from 90% more satellites compared to a dual constellation receiver. The more satellites available, the more accurate and faster the receiver will be.

Reliable correction services are a key part of any precision farmer's arsenal, in a normal year. But as Solar Cycle 25 progresses, a high level of location accuracy becomes even more vital.



It's all connected: the ionosphere, solar cycles and farming

The ionosphere is a crucial layer of the Earth's atmosphere that interacts with solar radiation. It is influenced by solar activity, including the solar cycle, which refers to the 11-year period of increased and decreased sunspot activity. Solar Cycle 25, the current cycle, is expected to bring heightened solar activity.

During periods of increased solar activity, the ionosphere can undergo changes that impact agriculture, including radio communications, GPS systems and climate patterns. For farmers invested in—or considering investing in—precision ag technologies such as correction services, it's important to understand these potential impacts, and how to mitigate disruptions to maximize productivity and profitability.

When satellite signals are transmitted to Earth, they travel through layers of the atmosphere, including the ionosphere, known to have a significant influence on these signals. During events such as Solar Cycle 25, satellite positioning can be compromised, leading to degraded signal quality, distortions, reduced position accuracy or total signal loss. The irregularities cause fluctuations that a GNSS receiver can no longer model. As a result, the positioning performance is degraded. A highly charged ionosphere can also cause scintillation, visible as northern lights or auroras. While beautiful to observe, this can lead to compromised GNSS positioning performance, inaccurate corrections data and declining productivity for the farmer.



How to mitigate the impacts on your farming operation

First, assess your hardware and consider upgrading to newer GNSS receivers, such as the Trimble NAV-900, which supports multiple satellite constellations and signals. The more signals that are available to a high-quality GNSS receiver, the more equipped it will be to reduce ionospheric disturbances.

As a comparison, let's consider some key differences between Real-Time Kinematic (RTK) positioning and Trimble's RTX® correction service, used by over 100,000 farmers globally.



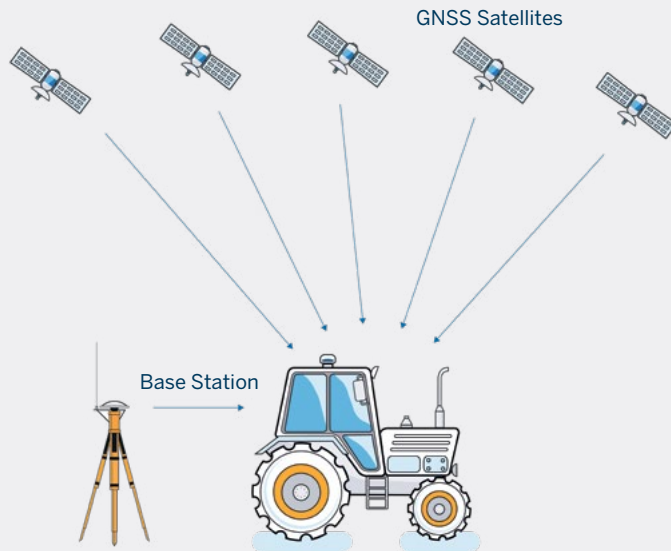
Correction services—RTK

RTK is reliant on a nearby base station and radio or network signals.

With close proximity to the base station, the overall performance is highly reliable, especially when it comes to height accuracy. However, an increase in ionospheric activity will harm the overall performance and during scintillation, the positioning performance can become unusable for precision agriculture.

Key points to know:

- Immediate start
- Exceptionally accurate when located near the base station
- Repeatable on an annual basis
- Dependent on radio or network data connection
- Additional hardware and knowledge is required
- Highly affected by scintillation



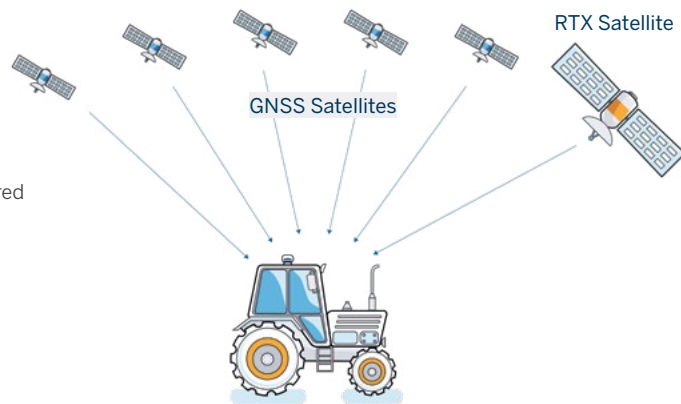
Correction services—Trimble RTX

Trimble RTX is built for global scale.

The Trimble RTX correction service is built on a global network of base stations constantly feeding data into state-of-the-art processing centers. The resulting correction data is then broadcast through geostationary satellites in space and used to provide highly accurate positioning performance for precision agriculture. While the ionospheric increase will impact the overall performance, Trimble RTX, with its global network of base stations, can withstand scintillation better than other correction services, resulting in higher productivity for farmers.

Key points to know:

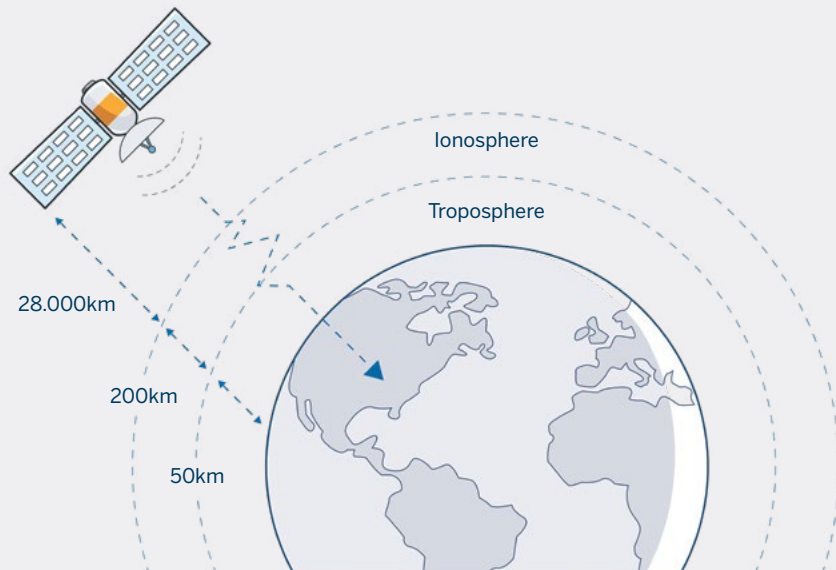
- Quick convergence times
- Centimeter-level accuracy worldwide
- Repeatable on an annual basis
- No additional investment in hardware, knowledge or maintenance required
- Access to professional support 24/7
- More resilient to scintillation
- Multi-constellation support



At a glance: RTK vs. RTX

To maintain productivity through the coming solar peak in 2025, consider the following points:

- All GNSS signals need to pass through the ionospheric layer and will experience disruptions while traveling to Earth.
- The number of satellites usable by the GNSS receiver is key to mitigating the impact of ionospheric effects.
- RTK corrections rely on the capability of the base station, offer immediate start-up and high accuracy near the base station. However, this system is highly susceptible to ionospheric effects like scintillation.
- Trimble RTX provides multi-constellation corrections for over 100 navigation satellites, centimeter-level accuracy worldwide and shows a superior performance in case of scintillation.
- Trimble RTX and the NAV-900 provide the easiest and most valuable solution for precision agriculture.



About Trimble Positioning Services

Across applications and industries, Trimble Positioning Services delivers reliability and peak performance to solve today's biggest location-based challenges.

positioningservices.trimble.com



To learn more about solar cycles,
scan the QR code below:



