April 24, 2020. Testing the addition of GALILEO Satellites to enhance RTK availability.

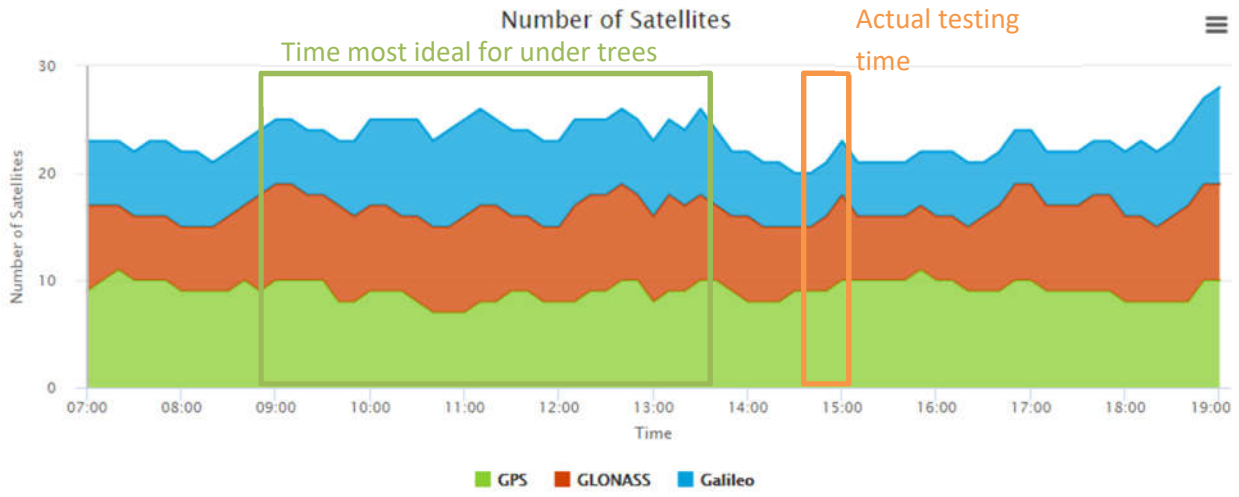
For over 10 years, the standard for RTK availability has been to use both GPS and GLONASS satellite constellations to utilize an average of 12-18 satellites at one time. Recently, Europe's GALILEO satellites have been made available for use, to add 4-8 satellites at a time. This may also increase when more are made available.

A test was performed by collecting some data of a simultaneous comparison. The comparison is between a NovAtel FlexPak6 rover tracking GPS+GLONASS, and a PwrPak7 rover tracking GPS+GLONASS+GALILEO. The FlexPak6 is out of production, and was available for purchase between April 2011 and November 2018. This represents a model many of our users currently have. The PwrPak7 is the latest production model that has replaced Flex6. To reduce as many other variables as possible, both receivers are receiving the satellite signals from a single GNSS antenna model GNSS-502, split with a signal splitter. Also, both receivers are receiving correction from the same base station, through the same 900MHz data radio which was split with a "Y" cable. Timestamped position messages were recorded to a text file to map. Five (5) points per second were logged, which created a lot of points, but the extra will give more of a "real time" comparison.

The NovAtel receivers have an option to report their estimated Vertical Standard Deviation. This is a way they measure the predicted quality of the computed position. The lower the deviation, the more precise. As a "control" for the experiment, in open sky, both show nearly the same deviation (+/- 0.002).

Also note on the overhead images shown they are from summer time of a year past. There was actually less leaf cover on the trees in late April during my testing. All data recorded was less than 1 mile from the base station, because it is known that accuracy will slowly decrease with greater baseline.

Looking back at the GNSS Mission Planning in hindsight, the time the data was recorded in the afternoon there were 5 or 6 Galileo Satellites in view, and if testing would have been done in the morning there was a time there was 9 available. However, this test shows results that can be obtained in an "unplanned" approach, rather than "best case scenario".



On figure 1.1 and 1.2 below, the receiver's reported deviation is shown in text. The dots are also colored as follows: Green= 0.02 or less, Yellow= 0.02 to 0.25, Red = Greater than 0.025. This example has heavy tree cover on the North side, and intermittent trees on the South.

Figure 1.1 Standard deviation on FlexPak6, GPS+GLONASS

Figure 1.2 Standard Deviation on PwrPak7, GPS+GLONASS+GALILEO

On figure 2.1 and 2.2 (next page), the receiver's reported deviation is shown in text. The dots are also colored as follows: Green= 0.02 or less, Yellow= 0.02 to 0.25, Red = 0.025 to 0.08, White=0.08 and greater. This example has mild to heavy cover on the East side. There are two sets of dots in this area, the right side driving Northbound, and the left while driving Southbound.

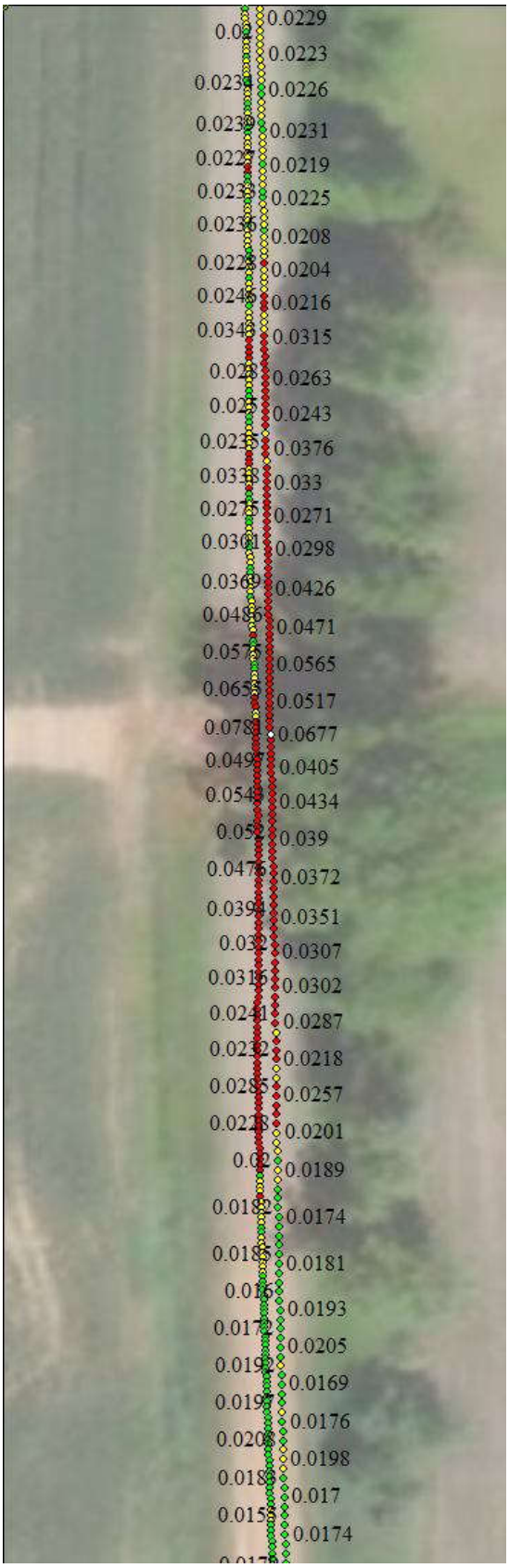


Figure 2.1 Standard deviation on FlexPak6, GPS+GLONASS

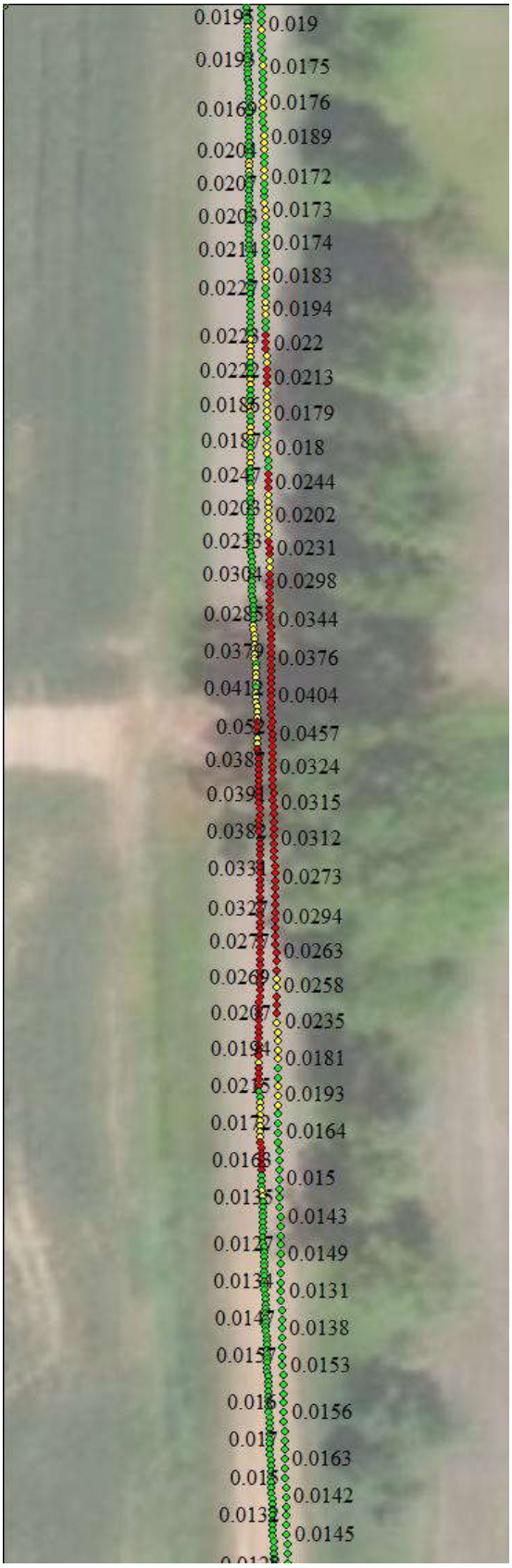


Figure 2.2 Standard Deviation on PwrPak7,GPS+GLONASS+GALILEO

On figure 3.1 and 3.2 below, the receiver's reported deviation is shown in text. The dots are also colored as follows: Green= 0.02 or less, Yellow= 0.02 to 0.25, Red = 0.025 to 0.08, White=0.08 and greater. There are two sets of dots in this area, the right side driving Northbound, and the left while driving Southbound. This is an extreme example with complete obstruction to the West and heavy to the East. It is not expected for either receiver to perform well with this much overhead view obstructed.

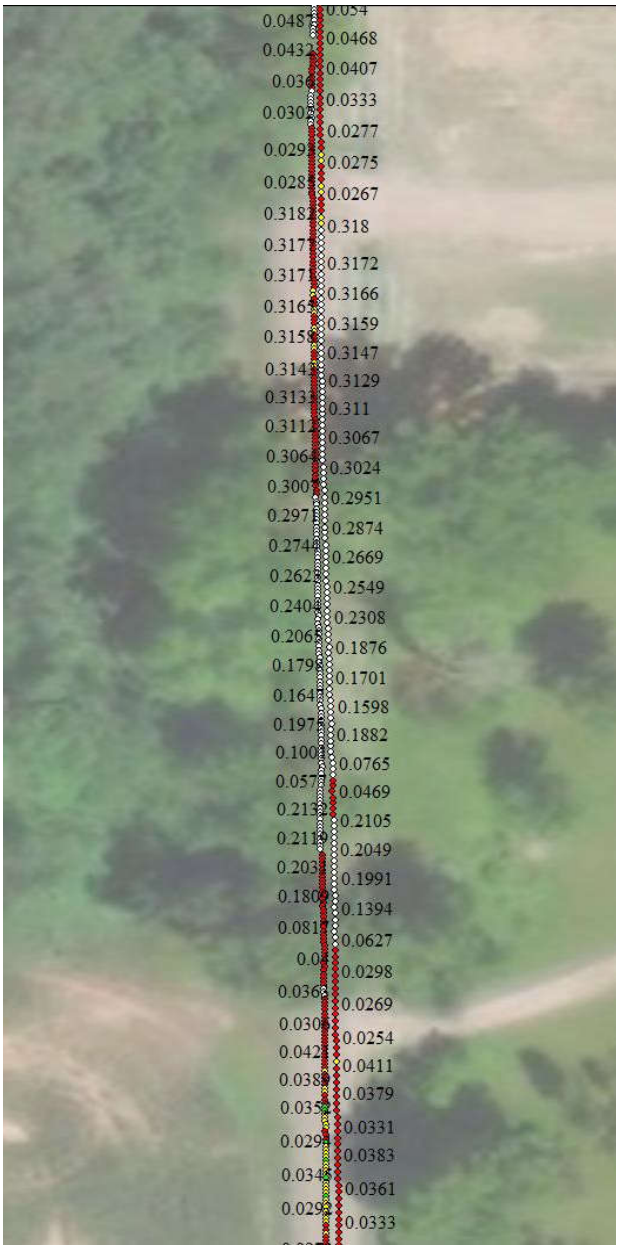


Figure 3.1 Standard deviation on FlexPak6, GPS+GLONASS

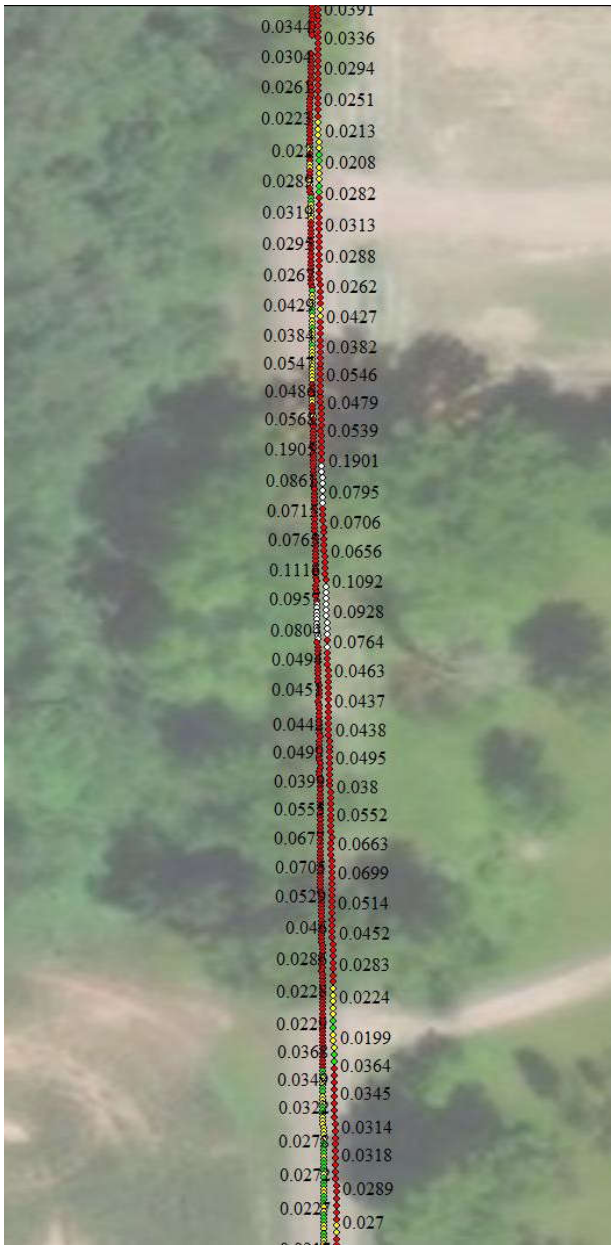


Figure 3.2 Standard Deviation on PwrPak7,GPS+GLONASS+GALILEO

Conclusion:

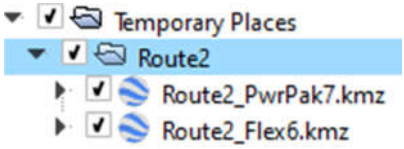
Although heavy tree cover will still make it harder for any GNSS receiver to calculate a position as accurately, it shows from my testing that adding Galileo satellites to the existing GPS+GLONASS does improve the position accuracy. As noted earlier, perhaps if Mission Planning would have been done to plan for a time of day when the most satellites were available, the satellite counts would be higher and likely deviations lower.

Complete Data Set:

All of the recorded data is available in a format you can download to view/study in Google Earth. There are 2 separate files because recording was paused in between.

Route 1
https://drive.google.com/open?id=1TQUm5PN14Gtk1WAnxAZDU7qTDXDGBTXF

Route 2
https://drive.google.com/open?id=1sazUJwaGOLYPi224tcJqDSsBnjzB6EmG



Some additional notes on this data:
*If you look to the left “Places” area in Google Earth you will be able to hide and show the results from each receiver, so that you only view one at a time.
*For the labels on these, the text shows additional satellite information. An example of the label text “0.013,23,23” denotes 0.013 Vertical Standard Deviation, 23 satellites tracked, 23 satellites with multi-frequency signals used in solution. You will notice that not all tracked are able to be used in obstructed situations.
*In Route 2 there was enough distance to the base and trees to block the radio signal. Data points were removed if they had 6.0 or more seconds of differential lag, because RTK begins to lose accuracy the longer it goes without correction. With a shared radio, both receivers report the same differential lag.

Contact for more information:
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