How Accurate is My Map?

Firstly - let's take a moment to appreciate the incredible capability of modern GPS. From 20,000km to 36,000km away, radio signals that are affected by gravitational, magnetic, ionospheric and atmospheric conditions are received from a hand-full of satellites and then analyzed by a tiny battery-powered, hand-held device. This device compares minute timing differences ("accurate to 100 nanoseconds") in these "carrier waves" and is able to pretty consistently tell you your position on the planet to within a few feet. Wow...
Now that we're suitably in awe, let's talk about accuracy.

What do you mean by "Accuracy"?

There are two ways to think about accuracy:

Relative (or Local) Accuracy
This is the accuracy of a point on the map relative to other points within the map/model. When asking questions like: "How long is this fence", "What's the area of this field" or "What is the volume of this stockpile", it doesn't really matter where the map/model is in the world, as long as the map/model is consistent with itself. *This is the important measure for length, area, and volume.*
For example, if we created a giant map of Antartica and wanted to measure the shortest distance from the South Pole to the Arctic Ocean we would need high relative accuracy in our map, meaning the size and shape of Antartica are correct so we find and measure the shortest distance. Say that distance is really 300 miles and we measured it as 300 miles and 20 feet, the relative accuracy of the shortest distance between the South Pole and the ocean would be within 20 feet.
Absolute (or Global) Accuracy
Absolute accuracy, on the other hand, is the degree to which the calculated position of a point on a map corresponds to its actual position in a fixed coordinate system in the real world. If a map has a high level of global

accuracy, the latitude and longitude of a point on that map will correspond fairly accurately with actual GPS coordinates.
This is important when you need a high degree of confidence that the lat/long and elevation measurements of each point on the map are correct when comparing with the real world, e.g. when comparing to geo-referenced design documents for a construction project or conducting property boundary surveys.
In our giant map of Antartica example, the absolute accuracy of the location of the South Pole is the difference between where it is on our map and where the real South Pole. If the map shows the South Pole 2 feet to the left of where it should be, then the absolute accuracy of that point is within 2 feet.

What Accuracy do you typically expect?

Note: your results may vary

These are examples to give you a rough idea, please don't quote these as expectations to support, there are many factors (see below).
As explained below, there are a number of factors which affect accuracy, however, as a rough rule of thumb, giving a typical Drone, modern GPS (able to receive signals from several constellations), and atmospheric conditions this is what you may expect. These numbers come from comparisons to DJI Phantom 3 data, flown with DroneDeploy at 250ft compared to Ground Control Points.

Relative Accuracy

The horizontal accuracy within a map largely depends on the Ground Sampling Distance (GSD, i.e. number of pixels per centimeter) of your data. You can expect the local error to be around 1 to 3 times the average GSD of the data.

Absolute Accuracy

As mentioned below, this largely depends on where you are on Earth, and what GPS receiver you have. Using a standard GPS on a DJI Phantom 3, you can typically expect to have around 1 meter (3 ft) horizontal accuracy. So if you draw a circle around you with a 1m radius, and give someone your GPS location, they're expected to be somewhere within this circle.

The rule of thumb is that absolute Vertical Accuracy will be around 3 times worse than the horizontal so we would expect around 3 meters.

GPS Corrections and Ground Control Points

You can radically improve your Absolute (or Global) GPS accuracy by using Ground Control Points (GCPs) or Differential GPS systems (RTK, PPK, etc.). More on this below, but these can increase your Absolute accuracy to maximum of around 2-5cm horizontally, and 4-8cm vertically.

Note: SenseFly eBee imagery with embedded RTK is also compatible with DroneDeploy on all Business, Premier, and Enterprise plans. This typically is within 1 to 3cm of horizontal accuracy. Read more about our compatibility with eBee RTK here.

What affects my Accuracy?

Drones can create highly accurate data, but the accuracy is dependent on a number of factors

- **Camera**: Better and bigger sensors have less noise, less blur, and less of a rolling shutter effect, which will produce better data
- **Lens**: Less lens distortion (barreling or fisheye) will produce better data
- **Drone**: Drones with gimbals keeping the camera pointing correctly will produce better data
- **Altitude**: The higher you fly, the less accurate things like elevation will be as it's harder to tell the relative difference between two distances the further you are away from it
- **Image resolution**: Higher resolution imagery will produce better data because there's more information to match against
- **Number of photos**: The more images, the more GPS locations we have to work with. This produces less error because of the Law of large numbers
- **Higher Overlap in imagery**: The higher the overlap in images, the more key-points we can detect, and the more GPS data we'll have for each pixel, increasing accuracy
- **Atmospheric Conditions**: GPS is affected by: Atmospheric Conditions (temperature, air density, pollution, clouds), Ionospheric conditions, Solar Flares

- **Buildings**: Tall structures block GPS signals, as well as reflect them (commonly called the "Urban Canyon") causing multi-path interference which causes inaccurate data
- **Location on Earth**: There are several GPS constellations (see below), and where you are on Earth limits the number of satellites you can
    - GPS in the US
    - GLONASS in Russia
    - GALILEO in Europe
    - BeiDou-2tf in China
    - NAVIC/IRNSS in India
    - Where GPS and GLONASS are the only Global systems, the others only have local visibility
- **GPS Receiver**: Different GPS receivers are able to listen to different constellations (listed above). Being able to accept more signals give more sats to use for positioning which improves accuracy.
- **Differential GPS**: RTK, PPK etc. has access to corrections of the GPS data which radically improves accuracy (meters -> cm).

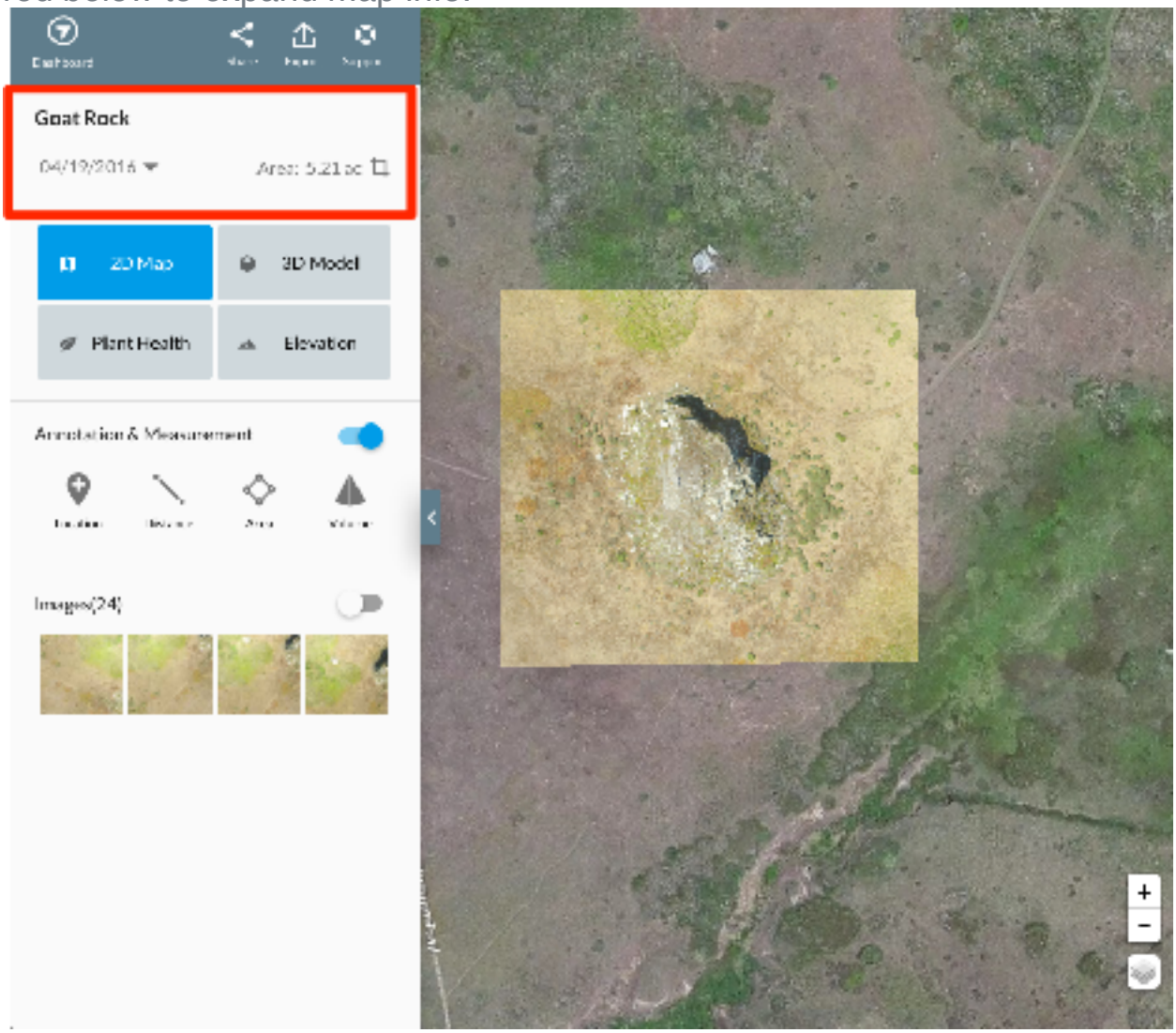
Below - we describe how to find out the **Global (or Absolute) Accuracy** of your map, and how to improve it (beyond the suggestions above).

Where can I find my accuracy information?

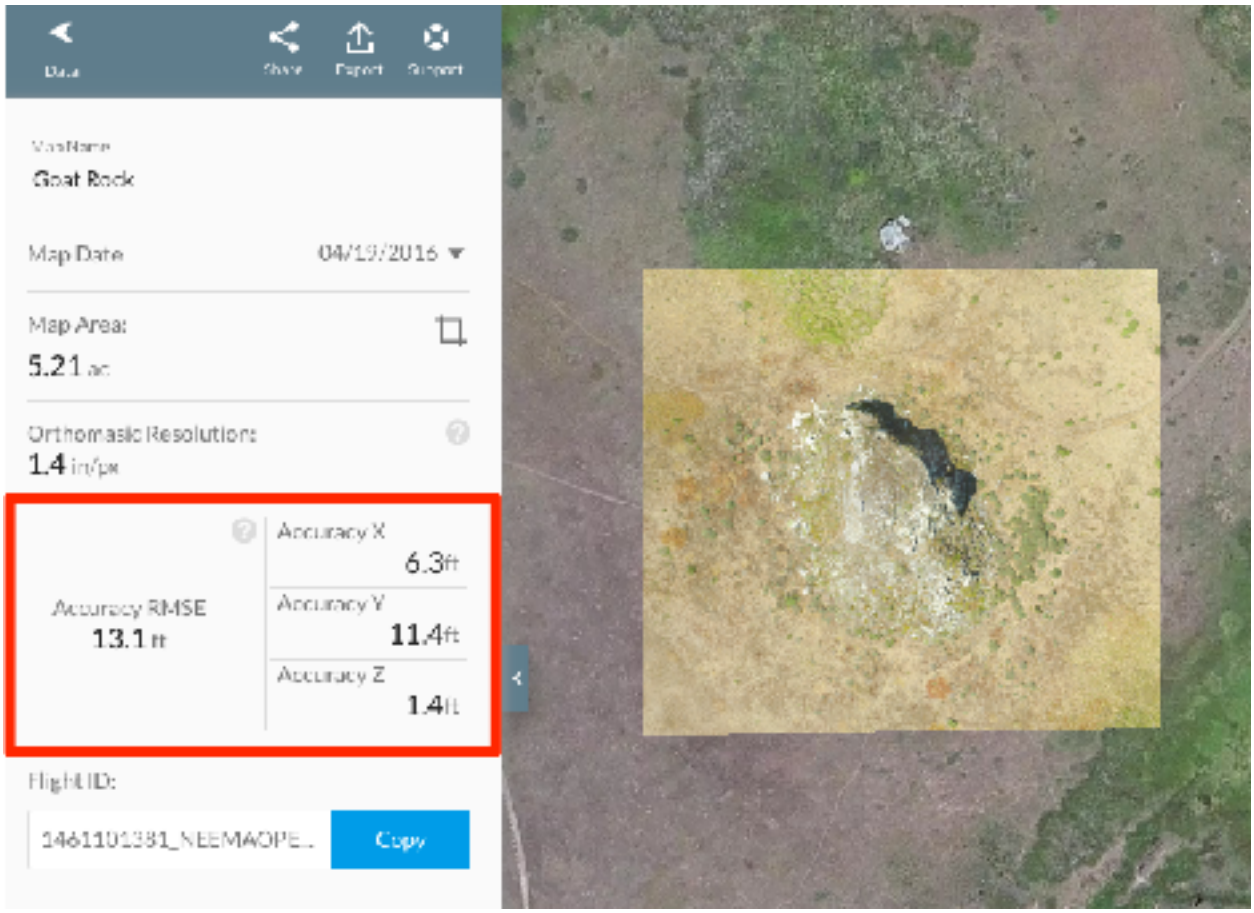
Note: This isn't the ACTUAL Absolute Accuracy, but a proxy to this.

Below, we show you where to view the accuracy on DroneDeploy. This isn't the actual accuracy, but a proxy to the Absolute Accuracy of your data. Without Ground Control Points, it's impossible to know the precise Absolute Accuracy, but we work out an expectation on the accuracy by comparing the difference of where the drone thought it was (using it's GPS), and where it needed to be in order to make the images overlap and stitch appropriately.

Choose a map from your dashboard, then click the portion highlighted in red below to expand map info.



The Map Info panel brings up details about the map. Here, you'll see the total area of the map, resolution , and the accuracy of the map.



RMSE?
RMSE is the Root Mean Squared Error - this gives you the accuracy across all the X, Y, Z dimensions.
Reminder: Accuracy shows the average error between where the GPS said the camera was, and where DroneDeploy calculated the camera needed to be in order to make the overlapping images stitch. Where the expected camera locations are off by a large number, we expect lower data accuracy.

How can I increase accuracy?

Each of the items listed above in What affects my Accuracy as an area to improve.

The biggest improvements can be made by:

Using a Differential GPS

Differential GPS systems like RTK and PPK will radically increase your accuracy. We currently support the SenseFly eBee imagery with embedded RTK on Business, Premier, and Enterprise plans. Read more about our compatibility with eBee RTK here.

We're also working towards supporting the DJI A3 with the D-RTK GNSS module.

RTK typically produces an absolute horizontal accuracy of within 1 to 3cm.

Using Ground Control Points

Ground control points add another layer of location data to the map, rather than relying solely on the GPS of the drone. With added Ground Control points, we expect 1-5 centimeters of accuracy. This is dependent on your Ground Sampling Distance, i.e. the number of pixels/cm. Read our full overview on Ground Control Points here
DroneDeploy can incorporate Ground Control Points for Business or Enterprise customers- please contact support@dronedeploy.com for more information. We recommend a minimum of 4 GCPs, and as many as 10 for larger maps.