COLLECTING GPS DATA WITH MOBILE DEVICES: TROUBLESHOOTING TIPS AND OPTIMISATION

Is your smartphone or tablet not operating smoothly during mobile data collection events (i.e. with apps such as ODK or Kobo collect)? You will find in this document some tips and suggestions to optimize GPS data collection!

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Table of Contents

I. Introduction

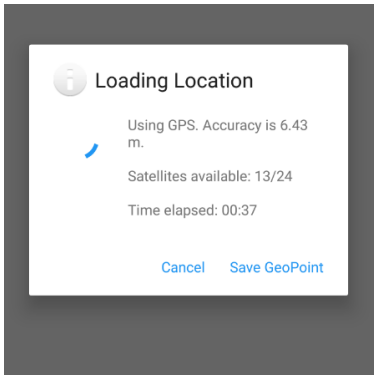
Effortless collection of GPS coordinates is what researchers in the field are looking for but barely encounter: either it is taking a very long time to get the GPS coordinates, the displayed accuracy is very low, or sometimes coordinate collection fails altogether!

Proper GPS data collection takes time, and it is often advisable to wait a few minutes to obtain accurate coordinates. However, no official threshold exists for GPS data collection times. This leaves field researchers wondering where the line is between an "appropriate" time interval to collect the points and an interval which would be considered "too long".

As a general rule, if the time to collect coordinates exceeds five minutes between points, or if point accuracy is below 25 m, there may be an issue with the GPS device used.

Reminder:
In a mobile data collection form, GPS questions should always remain optional in order to not block the enumerator if the device has an issue to collect GPS coordinates.

II. Some general considerations



- Measuring the accuracy and precision of GPS data collection is a complex topic. We will forego a detailed description here, but it is important to keep in mind that there are numerous ways to measure precision and accuracy (for example, you might have heard about HDOP, PDOP, etc.). For a bit more information, refer to the document on "Assessment of GPS accuracy of mobile devices".

- Applications such as ODK and KoBo Collect (at least the latest versions of those apps) display a "GPS accuracy measurement" (see illustration). This measurement (automatically calculated by Android[1] and different from the HDOP) provides a general indication of accuracy, though its reliability is disputed and should not be considered a precise measurement.

- CartONG set out to test the GPS accuracy of some devices. For more information, see document "Assessment of GPS accuracy of mobile devices". While it's not possible to derive overall conclusions from this study, due to the nature of its design, it nonetheless indicates that the majority of commonly handheld GPS devices remain accurate under 10m, a level which is sufficient for most humanitarian contexts (survey of health infrastructures, water points, etc.). Specific activities such as surveying an urban or camp area with a high density of buildings, plot surveys of agricultural land, etc. may nevertheless demand higher accuracy – depending on the expected analysis – and therefore paying particular attention to GPS quality.

Reminder: GPS collection should not be taken lightly

Coordinates collected at the household level are personal data, and subject to the data protection rules (if unsure, please consult your organization). Data collected on community infrastructures can likewise be harmful. Prior to collecting such data – and certainly prior to publishing it – make sure that it is indeed imperative to the project at hand and that it complies with your organization's data collection standards.

[1] https://forum.opendatakit.org/t/odk-community-how-is-gps-accuracy-calculated-in-odk/2208

III. Basic tips

The following tips can help you obtain GPS coordinate data, quickly, easily, and more accurately.

III.1. GPS collection depends on your environment

When collecting GPS coordinates, do your best to avoid overhead obstruction. Ensure that you are not inside a building, below a tree or under heavy clouds. You need to be **outside** and if possible **far from anything that can block the satellite signal** (be it a tree, building, etc.). Naturally in some contexts, you might have no choice (monsoon season, in a narrow valley, inside a forest or within a city with small footpaths between buildings), but keep in mind that those factors affect the quality of your GPS data collection.

Always hold the device at least 4 cm away from the body, with the antenna upwards (usually vertically) to better pick up the satellite signal.

III.2. A new device or a device newly imported in a different country or region may require time to pick up its initial satellite signals

A new device can take up to 20 or 25 minutes to lock its first coordinates. To speed up the initial process, it is advised to connect it to the local GSM network with a SIM card and/or local Wi-Fi, if possible.

Going forward, you can then remove the SIM card, turn off the Wi-Fi, and continue collecting.

III.3. Getting the first GPS coordinates of the day may take more time than subsequent points

Similar to the newly-imported devices, the first coordinates of the day often require the most time, and can take up to 15 minutes in some regions for the devices to detect sufficient satellite signals.

It is therefore advisable to turn on the "location feature" only once at the beginning of the data collection and not switch it off until the end of the data collection effort. Bear in mind, however, that this could result in a reduced battery life.

If you want to ensure that your GPS remains on, you can install a GPS app such as Connected GPS. It's a simple app and does the trick.

https://play.google.com/store/apps/details?id=org.bruxo.gpsconnected&hl=en_US

It helps the device to be connected to the GSM network or Wi-Fi network to get its initial satellite connection of the day.

Generally speaking, to optimize accuracy, it is always advisable to wait at least 10 minutes at the beginning of collection to initialize the mobile device's GPS receiver.

III.4. Additional applications can assist your device in coordinate collection

Install an app such as GPS Test and use it to load Ephemerides, which is another option to speed up the coordinate collection process. Wait to get a full signal with adequate accuracy and then let the app remain open during data collection (together with your standard data collection apps such as KoBo / ODK).

https://play.google.com/store/apps/details?id=com.chartcross.gpstest

Such apps also show an image of the sky with signal strength for each satellite; it helps to see if your body or any other element may be hiding part of the sky. It also helps to clear your GPS data and to start connecting to satellites from scratch which is useful when you are switching regions.

Similar apps to GPS Test may provide the same service, such as GPS Status https://play.google.com/store/apps/details?id=com.eclipsim.gpsstatus2. The purpose of this document is not to provide a benchmark of GPS apps, but to give some options..

III.5. Disable any battery saver settings or airplane mode

Devices with power-saving features often disable GPS location services to save battery life. Therefore, be sure to turn off any power-saving settings on the device (configuration varies considerably between devices).

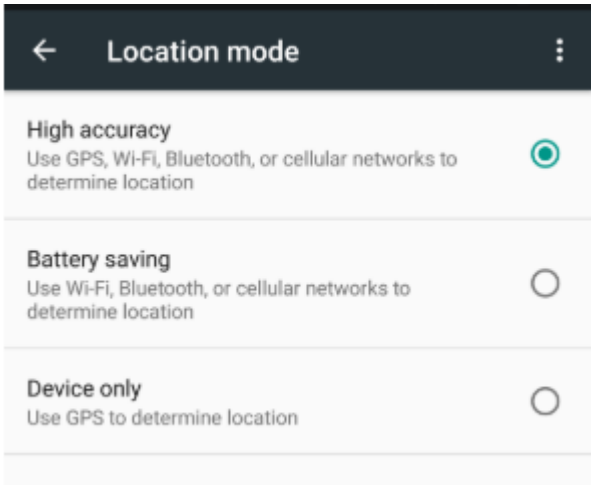
Although the airplane mode is great to reduce battery consumption (and is fully compatible with GPS location) it can also impact the time it takes to acquire a GPS location. Perform a test without airplane mode activated to see if it affects data collection.

IV. More advanced tips

The following tips can help with quicker, easier, and more accurate data collection, but can vary tremendously based on the mobile device used. It is important to perform tests on your hardware before depending on them for data collection in the field.

IV.1. High accuracy settings

Under location settings of the devices being used, you can confirm the "location accuracy" by selecting "High Accuracy" (in settings / location / mode) which helps finding the device's location faster and recording it more accurately.



If the said option is activated, battery consumption may be well above normal.

Conversely, you can try the opposite setting: in your settings, tap the GPS icon (usually top) to see GPS modes. Try setting it to "use GPS only" rather than high accuracy mode and see if this helps.

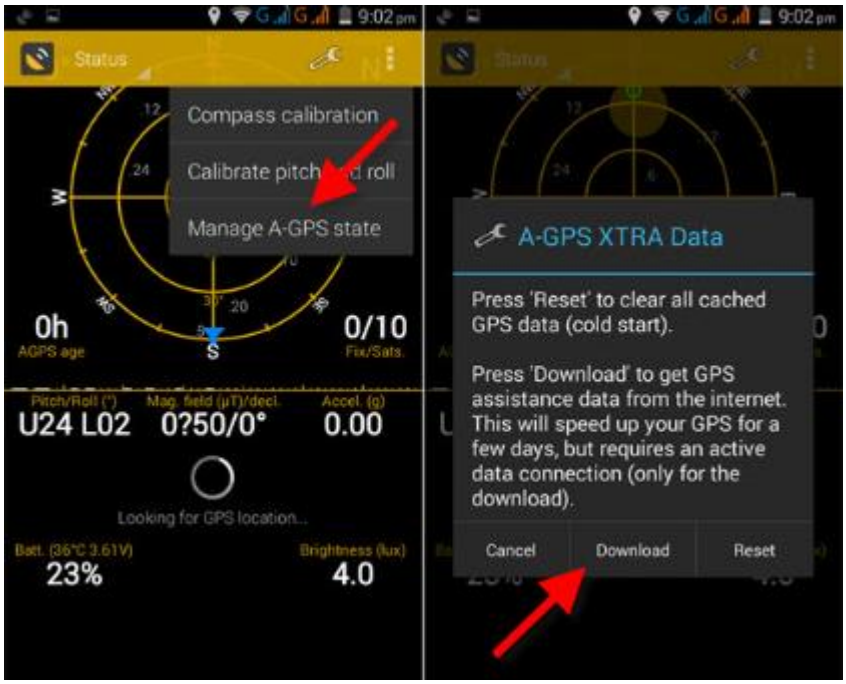
IV.2. Corrupted aGPS

The GPS may not work because the aGPS (assisted GPS[2]) data may have become corrupted. To fix this, you can use an app like GPS Status & Toolbox to clear your GPS data and start connecting to satellites from scratch.

https://play.google.com/store/apps/details?id=com.eclipsim.gpsstatus2

In the app, tap anywhere on the screen, then tap the menu icon (wrench) and hit "Manage A-GPS state". Click on "Reset," then once done, go back to the "Manage A-GPS state" menu and tap "Download" (you must have internet connection for this step). Wait a few minutes, and your GPS data should now be refreshed.

[2] https://en.wikipedia.org/wiki/Assisted_GPS



IV.3. Restrict the wanted GPS accuracy

Use an application such as GPS Logger (https://play.google.com/store/apps/details?id=com.mendhak.gpslogger&hl=fr) or OSMAnd that allows you to limit the recording of GPS points according to a determined estimated accuracy (usually the HDOP): you can choose for example to record points only if the estimated accuracy is less than 5 m.

However, please consider: inaccurate points are always better than no points at all! And ensure that this option is not enabled for recording tracks when travelling by car, for example, as under these settings there is a risk that no points will be recorded at all.

If you need to measure some points with a higher accuracy (less than 3 m), you could use the GPS Averaging application, which calculates an average of the recorded positions (https://play.google.com/store/apps/details?id=org.destil.gpsaveraging). You will need to export the calculated average point by point in gpx or kml format.

V. Hardware issues

Not all GPS device sensors are created equal: some smartphones or tablets (especially when purchased locally) can be faulty. At times, the GPS may not work at all if unassisted by a GSM network for some regional versions of a smartphone!

To be sure that your devices work properly, be sure to test them in different environments (and try to test them under ideal conditions: clean sky, without shade, etc.)

V.1. Check on the internet

On your internet browser type in the "name of your model + GPS issue" as keyword to know if your model is known to have experienced GPS issues (e.g. such as the LG G2 https://www.google.com/search?client=firefox-b-ab&q=LG+G2+GPS+issues).

V.2. Find out if your GPS issues are hardware- or software-related

With the GPS Test application (see above) you can diagnose whether a poor GPS signal is the result of a hardware or software issue. In GPS Test you can watch your devices connect to satellites around the earth. Ideally the device needs to receive signals from at least 5 satellites to lock a good position.

If no satellites appear, this could be due to interference from metallic objects around you, your device case, or your GPS hardware not working properly. Try to remove the case, as well as any metallic object around you and change your location.

If satellites do appear, but your GPS is still not working properly, then you likely have a software issue (you can try to reset the aGPS, as seen above, or reset the factory settings).

Connect to a Wi-Fi and/or GSM network to see if it changes anything for your device. If this is the case (after obtaining the initial set of coordinates), it could mean that your GPS feature is only working when GSM or Wi-Fi is activated which can happen with some lower budget devices.

V.3. Test different devices in the same location

If possible, test multiple devices (different brands and/or models) in the same location and evaluate the difference of time and accuracy of GPS coordinates. If there is a significant variability, it is likely due to a hardware issue.

VI. Other options to consider

VI.1. Get an external GPS receiver

In some contexts (as with complicating environmental factors, such as forest cover or topography), an external GPS receiver may help device accuracy. CartONG has not yet tested it, but GLO from Garmin https://buy.garmin.com/fr-FR/FR/p/109827 (that can be coupled with the smartphone via Bluetooth and recharged with the same charger) has received positive feedback from user groups.

VI.2. Check the compatibility of your devices with satellite constellations other than GPS

For more information see: https://en.wikipedia.org/wiki/Satellite_navigation

Check the compatibility of sensors of the purchased device with the satellite constellations: GPS, GLONASS, Beidou and (soon to be) Galileo. Opt for devices that are compatible with Galileo, as it is intended to improve the quality of positioning.

VI.3. Try a dual frequency GNSS chip

The dual-frequency chip comes with a new reception frequency for devices, as well as an improved algorithm for position calculations. These chips are new to the mobile market and much is expected of them. However, as this is recent technology, their accuracy remains unverified, and therefore caution must be exercised regarding their effectiveness.

https://medium.com/@sjbarbeau/dual-frequency-gnss-on-android-devices-152b8826e1c

https://www.gsa.europa.eu/newsroom/news/world-s-first-dual-frequency-gnss-smartphone-hits-market