GPS Data Collection Methods

70 Freddy Blume February 25, 2010 [General Information](), [GNSS Campaigns]() 6421

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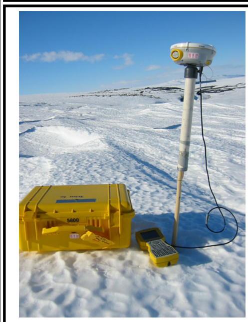
Various methods are used to collect high precision differential GPS data. The particular method used depends on several factors, including survey objectives, desired precision, available equipment, and field logistics. Higher precision typically requires a more rigorous field methodology and longer occupation times. The following table shows the features of the most common GPS survey methods:

	Survey style	Typical accuracy	Occupation time	Typical applications
	**Continuous**	< 0.5 cm	Months or more	Crustal deformation, geophysics, refe stations
	**Static**	0.5 cm – 2.5 cm	Hours to days	Crustal deformation, geodetic control baseline surveys, geophysics
	**Rapid Static**	1 cm – 3 cm	Minutes	Short baseline surveys, glaciology
	Kinematic (post-processing and real-time)	1 cm – 5 cm	Seconds	Short baselines, closely spaced points, positioning, feature surveys, GIS and

				
(not supported)	**Code Differential**	50 cm – 300 cm	Seconds	Coarse GIS, mapping, positioning
(not supported)	**Point positioning**	100 cm – 500 cm	Minutes to hours	Rough positioning

Continuous stations are continuously-operating long-term or permanent GNSS station installations involving immobile monumentation and sustainable power, and often involving data telemetry. The can be used as pre-existing base stations in campaign surveys (static, rapid static, and kinematic).

Static surveys are regional, sub-cm precision GNSS surveys with portable equipment and are the standard campaign data collection method for crustal deformation surveys. They typically involve occupying each point for several days to get the highest possible accuracy. Collect at least 6 hours of simultaneous data per day for processing and repeat benchmark occupations if possible.

Rapid static surveys are static surveys with just enough survey time at each point to be able to resolve the carrier phase integer ambiguity. A rule of thumb is to collect data for a minimum of 10 minutes per point, and add one minute of occupation time per kilometer of baseline length over 10 kilometers. For example, on an eight-kilometer baseline collect at least 10 minutes of data, and on a 28-kilometer baseline collect at least 28 minutes of data.

Kinematic surveys are local surveys (<10 km) using mobile GNSS equipment for the purpose of mapping features or of measuring point locations where several cm of precision is sufficient. At least two receiver set-ups are required: a base (stationary) unit and one or more rover (mobile) units. Kinematic surveys rely on continuous tracking to resolve the integer ambiguity; while the rover receiver/antenna may be moving during the surveys, continuous lock on the satellite signals must be maintained. Since the data processing software is able to both resolve the ambiguity and track the antenna motion, fixed-integer solutions are obtained nearly instantaneously.

> *Post-processing kinematic (PPK)* refers to surveys without communication between the base and rover receivers. Processing the data after data collection is required. There are no navigational capabilities in PPK surveys.
>
> *Real-time kinematic (RTK)* refers to surveys in which the base and rover receivers communicate corrections in real-time via a radio link. This requires additional hardware (base and rover radios) and additional power, and generally limits the survey to an area of several km, but eliminates the need for data processing and enables navigational capabilities.

Code differential surveys rely only on the code data to determine a differential solution. Simultaneous data collection between the base and rover receiver is still required, but there is no requirement to maintain continuous lock on the carrier phase since the phase data is not used. As a result, this method is extremely robust, but relatively coarse. For sub-meter accuracy, a rule of thumb is to collect data for five minutes per point, and add one minute of occupation time per five kilometers of baseline length over 10 kilometers. For example, on an eight-kilometer baseline collect at least five minutes of data, and on a 108-kilometer baseline collect at least 25 minutes of data.

Point positioning uses only data from a single receiver to determine its coordinates. The collected data are averaged, and longer occupations significantly increase the accuracy. This method is very coarse, but sometimes it is the only way to determine base station coordinates while in the field. Although these coordinates may be off by about a meter, it is close enough to allow the computation of precise baselines while at a remote field location. When better network accuracy is desired, the base coordinates must be re-computed when back from the field.

Online URL: https://kb.unavco.org/article/gps-data-collection-methods-70.html