



The Role of GPS in Earth Science Applications

Commercial availability of high-resolution GPS and DGPS systems is changing the way in which earth scientists perform data acquisition tasks in a variety of fields. This change is being driven by the benefits of obtaining GPS time and positioning information. These include precise:

- Acquisition of time-series data in stationary surveys (i.e. observatory or earthquake hazard applications)
- Synchronization of stationary and rover units for post-processing and correction of spatial data in mobile surveys (i.e. mineral exploration, UXO, and archeology applications)
- Real-time guidance of rover units to conform with survey specifications in mobile surveys (i.e. UXO and other high-productivity ground surveys)
- Location of measurement stations for determining follow-up activities and making effective decisions in mobile surveys (i.e. mineral exploration drilling, UXO detection and high-resolution archeology mapping)

In these contexts, the importance of GPS / DGPS will continue to rise as additional services are added (for example, EGNOS in Europe) and as the benefits of data acquisition instrumentation equipped with GPS become more broadly known and accepted.





GPS and GEM Magnetometers

GEM Systems, Inc. delivers a range of GPS and DGPS systems that enable customers to perform magnetic surveys with a variety of positioning accuracies, according to their application needs and budgets.

GEM is the only commercial magnetometer manufacturer to offer built-in GPS / DGPS. The advantages of this approach include a truly seamless and integrated positioning solution that minimizes weight and simplifies survey procedures.

Note: Categories B, C and D below include time, lat / long, and navigation option (UTM conversion, coordinate rotation, waypoint programming and lane guidance).

A. v5.0 and v6.0 Options

- I. No GPS
- II. Time only, built-in GPS (** for base and stationary surveys).

B. Stand-alone GPS (v6.0)

- III. <5m resolution, built-in GPS.

C. Stand-alone DGPS (v6.0)

- IV. **NEW** <1.5m resolution, built-in DGPS with SBUS support (WAAS / EGNOS / MSAS, OmniSTAR, etc.). If these satellite systems not available, resolution is <5m.
- V. <1m resolution, external DGPS with WAAS / EGNOS or international subscriber services - OmniSTAR or Thales (Racal).

D. DGPS Systems (v6.0)

- VI. 0.1 to 1m resolution, internal DGPS system with post-processing. Requires base and rover GPS / Mag.
- VII. 1 cm resolution, external high-end DGPS system. Requires radio modems.



Technical Approaches

GEM's primary approach is to select low-cost, small-size and superior quality GPS receivers for its integrated magnetometer applications. The company's current generation of integrated boards represent the latest technologies designed for low-cost, high-reliability positioning performance with lower power requirements.

Selection of GPS technology manufacturers is also a key consideration -- with GEM carefully choosing technologies that will continue to advance. Current board generations, for example, will enable EGNOS DGPS as the EGNOS system adds more capabilities in future.

Other GPS features include high reliability, outstanding performance under severe conditions (foliage, urban canyons) and ease of integration. Performance is maximized through the use of an active GPS receiver that amplifies signals for detection under adverse conditions, such as foliage.

Where precise synchronization is required, GEM's systems also take advantage of integrated timing options that provide an accurate 1PPS timing pulse aligned with UTC. This level of timing accuracy has specific benefits for base station and observatory network / earthquake hazard monitoring applications.

All GPS boards are carefully screened for magnetic components. Although this is a time-consuming process, it is one of the reasons that GEM's magnetometers are able to obtain consistently high-quality data – i.e. by minimizing system noise, we ensure that the data obtained truly represents the geologic, engineering and scientific phenomena of interest.

International Subscriber Services

GEM has one exception in terms of its GPS solutions – an external GPS is available for customers who 1) want <1m accuracy without post-processing, or 2) who are not operating in areas supported by WAAS or EGNOS. In the latter case, users have the option of purchasing an OmniSTAR or Thales (Raycal) subscription.

GEM does not provide subscription purchase services; however, we can direct our customers to an appropriate re-seller agency. These services can be activated in most parts of the world within a half-hour to an hour.