Summary of GPS Location Data for Piñon Flat II Seismic Array - T.J. Owens

I have reduced the GPS data collected January 12 - 15, 1991 at the Piñon II array sites. In general, the results look very good and, with a few qualifiers outlined below, I would judge the effort successful.

The data at most sites consisted of recordings of location determined by Eagle GPS receivers operating simultaneously at both the array center and at the remote site. Data was logged to a PC at 10 second intervals for variable lengths of time. Data reduction consisted of the following steps:

1. Determine a time interval where the base station and the site observations overlap. In establishing this interval, I sometimes had to make a judgement as to the quality of the data at each site. This was largly based on the variability of the observations and the degree to which these variations tracked each other at the two observation sites. The length of the overlaping time intervals varied from 140 to 720 seconds for the 23 sites analyzed.

2. For the data in this time interval, I calculated several parameters and their standard deviations:

   - Latitude and Longitude at the center site.
   - Relative Latitude and Longitude of the remote site.
   - Relative Elevation of the remote site.
   - Relative location of the remote site in meters.

3. Estimation of the absolute coordinates of the center site based on the average coordinates obtained in the 4 days of recording.

In estimating the relative position of the sites in meters, I discovered that the values obtained by simple differencing of the relative locations in meters output by the GPS software did not always agree with the values obtained by converting the relative latitude and longitude values to meters using standard formula. In the final analysis, I assumed that the relative latitude and longitude were the more accurate parameters and these were converted to meters to generate the final relative location values.

Relative Elevation estimates are the most serious flaw in the data set. Through blatant inexperience, we failed to output the satellite lock information to the log file and are thus unable to know when the GPS receivers were in "ALTITUDE HOLD" mode and when they were able to determine legitimate information regarding elevations. I may be able to cast more light on this issue with further line-by-line analysis of the log files, but for now I would say we have no reliable information of the site elevations. Topo sheets or an altimeter will be needed to establish this information.

Location errors were usually less than ± 2.00 meters in each direction and often less than ± 1.00 meters. Exceptions to this statement include sites C7, B3, and B4. The worst errors were at site B3, where rapid variations in readings during the log file resulted in longitundal uncertainties of ± 6.61 meters in this location. The variabilities at each site with large error could be attributed to similar variations.

Due to human error, the second log file at site E1, collected due to poor initial readins, was lost and we therefore do not have a GPS location for this site.

Due to time constraints, sites A1, A2, and A3 were located using a Trimble GPS receiver. In this method, a reading at the remote sites was taken in between two readins at the center site to allow for drift corrections. It was found that drift was minimal and that the locations predicted by the Trimble were almost exactly as those obtained using conventional brunton and tape measure methods. Thus, I believe the locations obtained for these sites are quite good although specific error bounds could not be calculated.

If time permits and equipment is available, I would suggest re-occupying sites E1, B3, and B4 to try to get less variable estimates of the relative positions of these sites. Errors at sites C5 and B5 could probably be reduced by reoccupation as well.

Based on the results of this survey, I pronounce the absolute location of site A0 to be:

33° 36’ 23.280" N, 116° 27’ 11.303" W