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Geomorphological Mapping using Real Time Kinematic (RTK) GPS

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In present day, LiDar, RTK-GPS, and Total Station are the most convenient instruments to map various topography in high precision. In RTK-PGS survey a pair of dual-frequency GPS receivers for a reference and a rover is used. The reference receiver may be replaced by public virtual reference service through a cell phone. The accuracy of RTK-GPS is less than 20 mm and ideal for geomorphological studies for the easiness and swiftness of the measurements. However, application for scientific survey is not widely done yet while it is quite common in construction sites. This paper aims to introduce the technique, example of studies, and problems.
The precision of RTK-GPS and Total Station is respective < 20 mm and 1 mm. Both are enough for general topographic survey but the speed of the measurement is very much different. While RTK-GPS measures 1800--7200 points/hour by moving measurement and hundreds points/hour by stop-and-go measurement, Total Station measures less than 1000 points/day without frequent setup changes. Air-borne LiDar commonly has 100 to 150 mm 1 sigma error and is not accurate enough for detailed study of topography. Ground-base LiDar on the other hand attains mm order accuracy and almost as accurate as Total Station. LiDar's great advantage is remote measurements. GPS antenna and Total Station Prism should be carried to the point to measure, but LiDar can shoot all points visible from the equipment remotely. The difficulties of LiDar survey arise from shadows owing to low shooting angles, to select ground reflection and to porcess tremendous amount of data. Long time and good resources are required.
Relative positions are quite easily acquired by RTK-GPS if the measurements are carried out in one setting and continuously. The relative accuracy is confirmed to compare the RTK-GPS results with Total Station results. However measurements in different settings or in another day may significantly sift. In order to avoid the errors by the shift, set-up of several reference points is necessary. Relative positioning with regard to these reference points are usually reliable. For the accuracy of altitude, repeated measurements of reliable reference points such as benchmarks are indispensable as well as conversion from ellipsoid height to geoid height. When absolute positioning is required, public monuments and their position data should be used. When a rover is receiving calibration data from reference receiver or from public service, a measurement and analyses for high-precision positioning are carried out simultaneously. In case a rover collects data by itself without calibration data, analyses are to be done with the data from a reference receiver after the survey. This method is called Post-Processing RTK measurement.
Following are examples of RTK-GPS survey. The altitudes of marine terraces and their former shorelines are mostly based on map reading of 1/25000 topo sheets or on barometric survey. Those old and inaccurate estimates of the altitudes often differ from RTK-GPS results. A lot of coastal geomorphic information should be revised using RTK-GPS.

Keywords: geomorphology, geodetic survey, GPS, RTK-GPS, marine terrace, LiDar