ENGINEERING SURVEY USING SATELLITE GEO-SPATIAL DATA DERIVED FROM HAND-HELD GPS.

Futuristic look at Trans National Highway connecting Lae in the Morobe Province to Port Moresby in National Capital District.

DEPARTMENT OF WORKS

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Consulting Engineers & Project Managers

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Global engineering at home in the South Pacific

NATIONAL CAPITAL DISTRICT COMMISSION

TSSP

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Overview

- Purpose of the Meeting
- Objectives of the Study
- Background
- Demonstration

1) Get into Google Map
2) Work Out Area
3)Do KML File
4)Import into GPS Visualizer Software
5)Convert Heights to Easting Knotting
6)Calibrate Heights for PNG 94

Why did we conduct the Research?

Department of Works Standard Survey Instruction

Objective of the Research

The objective of the study is to test;

- **Hypothesis 1:**

"The derived misclosures using survey data from Hand-Held GPSs may be too large to allow use in producing working drawings and/or use the results to derive BOQ estimates for C Conformed contract documents."

- **Hypothesis 2:**

"The coordinates derived by hand-held GPS can be "converted" and "calibrated" to PNG94 Datum to give a higher-level accuracy."

BACKGROUND

Review of Past Research.

Justification for the Research

Yinsong Wang et al “Google Earth elevation data extraction and accuracy assessment for transportation applications”.
https://doi.org/10.1371/journal.pone.0175756

Yinsong Wang's Conclusion?

- The **accuracy** of elevation data from GE is better along roadways compared to other elevation data sources in the conterminous USA, with MAE, RMSE, and GE roadway elevation error standard deviation of 1.32*m*,2.27*m* and 2.27*m* respectively;
- Google Earth elevation data is a **valuable resource** for transportation applications. The **precision of GE elevation data** along roadways is satisfactory, and there is no evidence showing the accuracy of GE roadway elevation varies significantly between states or route types; and
- The proposed extraction methods can locate the extracting route accurately, and can recognize multi-layered roadway section and segment the extracted route by grade automatically.

Justification for the Research

- NOAA “An Introduction to Lidar Technology, Data and Applications”. https://doi.org/10.1371/journal.pone.0175756
- Keil Schmid, NOAA Coastal Services Center *Keil.Schmid@noaa.gov*, (843) 202-2620

What is LiDAR Survey

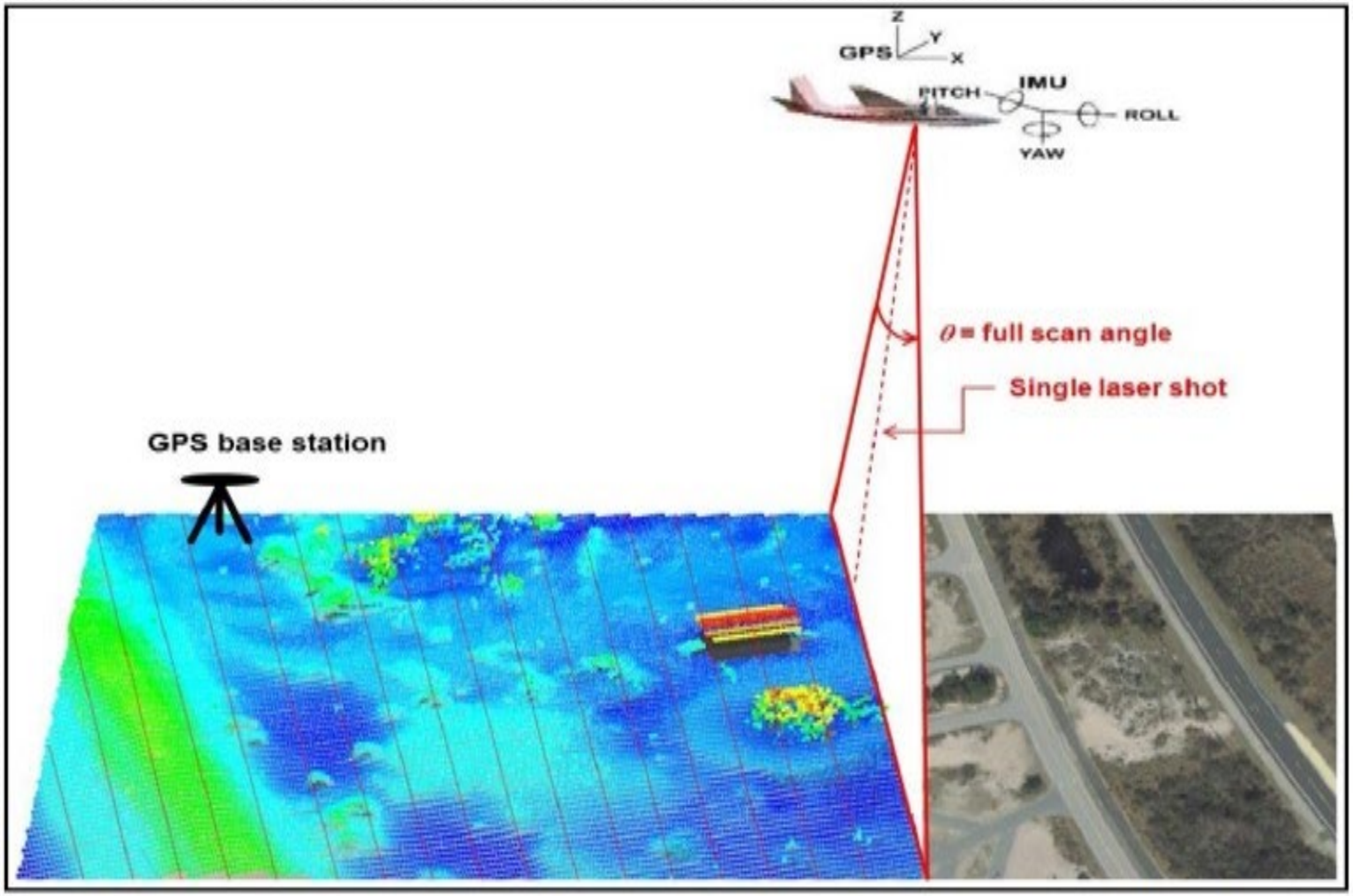


Figure 2-1. Schematic diagram of airborne lidar performing line scanning resulting in parallel lines of measured points (other scan patterns exist, but this one is fairly common)

NOAA Overview

Lidar instruments can rapidly measure the Earth's surface, at sampling rates greater than 150 kilohertz (i.e., 150,000 pulses per second). The resulting product is a densely spaced network of highly accurate georeferenced elevation points (Figure 2-2)—often called a point cloud—that can be used to generate three-dimensional representations of the Earth's surface and its features. Many lidar systems operate in the near-infrared region of the electromagnetic spectrum, although some sensors also operate in the green band to penetrate water and detect bottom features. These bathymetric lidar systems can be used in areas with relatively clear water to measure seafloor elevations. Typically, lidar-derived elevations have absolute accuracies of about 6 to 12 inches (15 to 30 centimeters) for older data and 4 to 8 inches (10 to 20 centimeters) for more recent data; relative accuracies (e.g., heights of roofs, hills, banks, and dunes) are even better. The description of accuracy is an important aspect of lidar and will be covered in detail in the following sections.

USGS - Lidar

USGS
science for a changing world

SCIENCE PRODUCTS NEWS CONNECT AB

FREQUENTLY ASKED QUESTIONS | MAPPING, REMOTE SENSING, AND GEOSPATIAL DATA

What is Lidar data and where can I download it?

Light Detection and Ranging (lidar) is a technology used to create high-resolution models of ground elevation with a vertical accuracy of 10 centimeters (4 inches). Lidar equipment, which includes a laser scanner, a Global Positioning System (GPS), and an Inerti Navigation System (INS), is typically mounted on a small aircraft. The laser scanner transmits brief pulses of light to the ground surface. Those pulses are reflected or scattered back and their travel time is used to calculate the distance between the laser scanner and the grou

Lidar data is initially collected as a "point cloud" of individual points reflected from everything on the surface, including structures and vegetation. To produce a "bare earth" Digital Elevation Model (DEM), structures and vegetation are stripped away.

The USGS hopes to complete collection of lidar data for all of the U.S. and its territories by 2022 (status map). Due to high cloud cover an remote locations, Interferometric Synthetic Aperture Radar (IfSAR)—rather than lidar—is being used in Alaska,

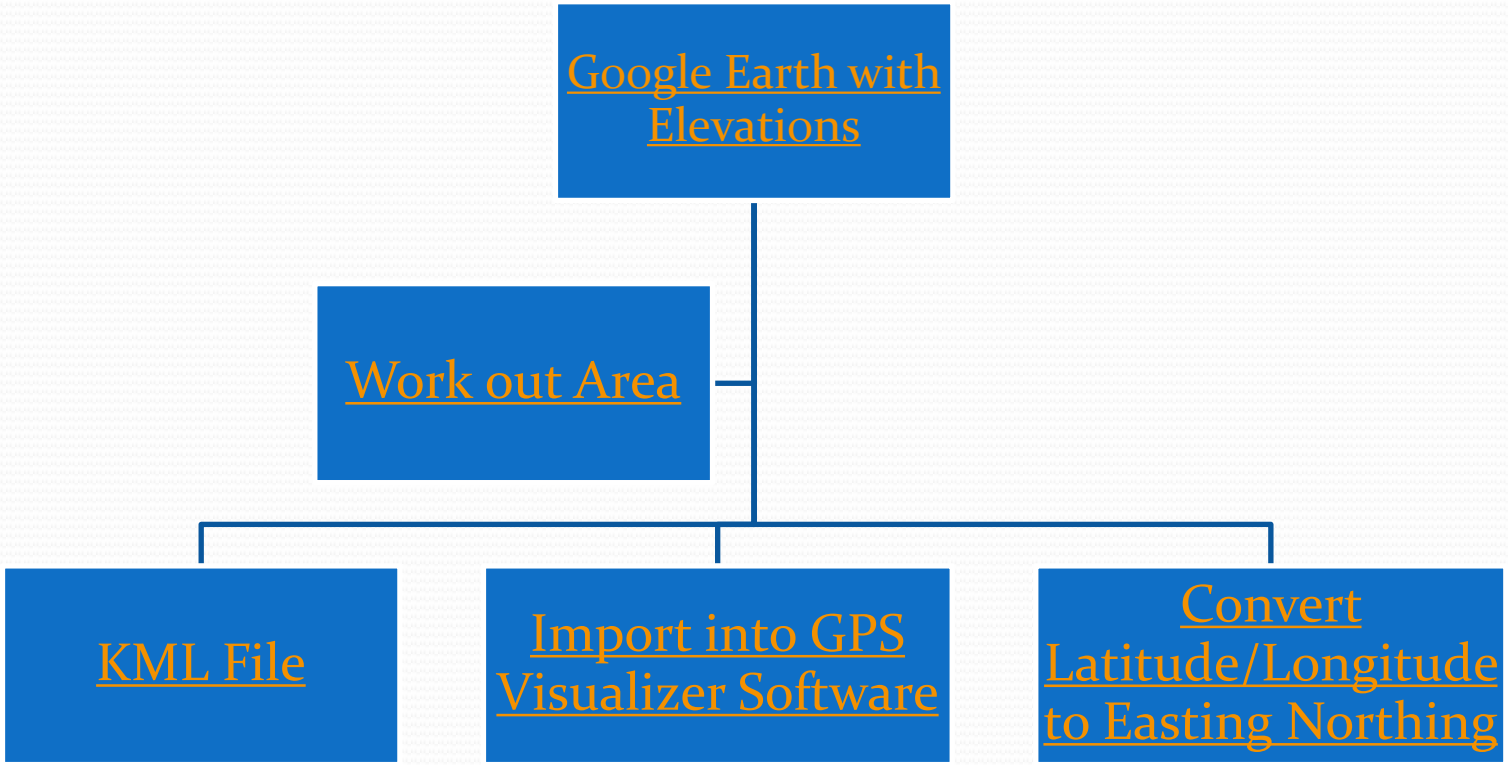
Now to Show this Method.

- Sen Hugo and Colleen Jackson “Engineering Survey Using Satellite Geo-Spatial Data Derived From Hand-Held GPS”. July 2022

Conclusion

- 7 **FINDINGS**
- 7.1 As shown in the study, the use of a hand-held GPS without connection to any PNG94 (ITRF92 at epoch1994.0) 1st Order Control marks to allow conversion to the GRS 80 ellipsoid and the calibration to the EGM2008 Geoid gives a **large uncertainty** in the positions relative to other adjacent points to which they are directly connected.

- 7.2 This study also shows that by tying the GPS survey to the PNG94 Datum 1st Order Control marks for Madang (GS1495) and at Wewak (PSM 15497), the requirement for network accuracy also known as **absolute accuracy is satisfied**. A position's accuracy must be specified with respect to an appropriate truth set such as a national geodetic datum which in PNG is the PNG94 Datum. The engineer who intends to use hand-held GPS is assured that the radio waves transmitted by GPS satellites enable extremely precise earth measurements across continents and oceans and that we are able to estimate the ellipsoid with such precision because of the global set of measurements provided by GPS.



Calibrate Heights for PNG 94

Import into Civil CAD, Civil 3D & 12D for Design

Appendices.

- Local MSL=ITRF Ellipsoid Height (h) – EGM 2008 N Value + Offset.
- Table 1: PNG94 (ITRF92 at epoch 1994.0) - 1st order control - Adjustment 7th June 2008 - Updated 1st December 2011.
- Coordinate Conversion Theory.
- Table 2: Conversion to PNG94 Datum Grid and Geodetic Coordinates by using the SGS Prime COGO Application and Survey Pocket Tools Apps.

THE END

Thank you very much for your time and you have a pleasant day.