Spatial Data Collection using GPS:

BEST PRACTICES - 2007

Best practices for GPS & Spatial Data Collection, Storage and Documentation

These Best Practices are designed to maximize positional accuracy and reliability for GPS-based survey. The overarching goal is for data to have the greatest value possible for both the initial project, and for the community at large as a legacy product. Central to this legacy value is the need for metadata to be mutually intelligible among Surveyors and GIS professionals. Special thanks to Michael Dennis for key contributions in development of Best Practices and Definitions.

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1.

i. Field Methods
    1) Survey style
        a. GPS uncorrected
        b. DGPS (single freq)
        c. Dual Freq (e.g. RTK, PPK, fast static, static)
        d. Total Station (or equivalent)
        e. Other
    2) Sampling interval and length of occupation
    3) Equipment used – Include Serial Number
        a. Receiver/controller/antenna (base & rover)
        b. Antenna height
        c. Leveling method (e.g. tri-brach, bubble-level)
    4) Target information
        a. Brief physical description
        b. Permanently marked or labelled?
    5) Name/contact of field technician

ii. Processing Methods
    1) Software used – specify software version and date of processing
    2) Base coordinate – include source, date, accuracy specs
    3) List each processing step

iii. Coordinate transformations & export to GIS or other format
    1) Datum transformations used
        a. include software/version
    2) Computed correction surfaces, "rubber sheeting"
    3) List any manual edits
    4) Record export parameters (when relevant), include software/version

iv. Responsibility
    1) Is the dataset vetted? By whom and for what purpose?
    2) Name/contact or website for 'official' version

b. Documentation should be complete enough that someone else can reproduce the product

c. For GIS data, accuracy and coordinate system information should be included as feature attributes (not just as separate, easy-to-lose and easy-to-ignore metadata files)

5. <u>Data Archival</u>

a. Retain all raw data – both rover & base files – for future reprocessing
    i. Base files (avoid uncommon, proprietary file formats)
    ii. Rover Files (avoid uncommon, proprietary file formats)
    iii. Metadata

Error Table. Calculations compliments of Michael Dennis for 2006 AKSMC presentation.(*cont*)

Positioning errors and examples for Alaska	**Error magnitudes**
Vertical datums and height systems	
Using NGVD 29 when NAVD 88 required	~1.7 to 2.1 meters too low in Anchorage vicinity (vertical)
Using ellipsoid heights for elevations	Varies from −6 meters to +21 meters (vertical)
Neglecting geoid slope when transferring elevations with GPS	Up to 0.25 meters vertical per km horizontal (up to 0.125 m/km in Anchorage area)
Using leveling without orthometric corrections to "correct" GPS-derived elevations	Can exceed 0.0125 meters vertical per km horizontal
Accuracy estimation and reporting	
Documenting geodetic datum as "WGS-84" when it is not	Perpetuates confusion about "equivalence" of WGS-84 and NAD 83
Listing grid coordinates (such as SPCS) as "NAD 83"	NAD 83 is a geodetic datum, not a grid coordinate system
Documenting geodetic datum as "GRS-80"	GRS-80 is a reference ellipsoid, not a datum
Documenting vertical datum as "Mean Sea Level" (MSL)	There is no MSL datum in the US (name changed to NGVD 29 in 1976)
Using precision as an accuracy estimate with data containing systematic errors (e.g., incorrect reference coordinates)	Accuracy estimate is

Abbreviations and definitions

Below is a list that includes abbreviations and terms used in this handout. In the interest of brevity, the definitions

Geoid. Surface of constant gravitational equipotential (a level surface) that best corresponds to global mean sea level. Often used as a reference surface for *vertical datums*.

Example of surveying documentation (*metadata*)

Basis of Bearings and Coordinates

Linear unit: U.S. Survey foot

Geodetic datum: North American Datum of 1983 (CORS96)

Vertical datum

Example of GPS Mapping documentation (*metadata*)

Basis of Bearings and Coordinates

Linear unit: Meters

Geodetic datum: North American Datum of 1983 (CORS96) Epoch 2003.0

Vertical datum: North American Vertical Datum of 1988 (see below)

Coordinate System:

Universal Transverse Mercator
Zone 6 North

This dataset was collected using single frequency code-phase GPS as part of the Chilkoot Trail Mapping Project <see X document>.

GPS and DataLogger hardware used: Trimble GeoXT (Serial # 243559); GPS Firmware 2.11;Mobile version 5 OS

Antenna: Trimble Hurricane antenna

GPS & Mapping Software: <Trimble TerraSync Professional version 2.61>. Pathfinder Office Software version 3.1 used for mission planning, data dictionary development, data transfer, differential post-processing and export. ArcGIS 9.1 (SP 2) was used to construct final GIS features.

Mapping Conditions: Varied terrain from open sky at sea level through alder understory and Spruce overstory. Portions of trail passed through steep ravines.

Survey Style: Trail features (trail centerline, bridges and signs) were mapped while walking with external antenna mounted at 7' above ground level (measured to base of antenna).

GPS Quality Settings:

HDOP - Optimal 4 (increased to 6 under thick canopy);

SNR - Optimal 39 (lowered to 28 under thick canopy);

Satellite Elevation Mask - Optimal 15.

Logging Rate: All trail segment positions collected at 5 second logging rate. All point features (bridges and signs) collected at 1 second logging rate.

GPS Data Processing: All data was post-processed against Kenai CORS (KEN1) - baseline ~ 110KM. Base station coordinates used were those provided by the Base provider (60°40'30.29149"N, 151°21'00.65464"W, 55.98 m (ITRF00-Epoch 1997.0). 100% of the file was corrected. Data was edited and then exported to ESRI shapefile format. Standard settings: Coordinate System: UTM Zone 6, NAD83. Datum: (Selected in PFO - NAD83 (CORS96) CONUS. ESRI shapefiles were then defined as UTM Zone 6, NAD83 in ArcToolbox.

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