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Task Group 6

Global Navigation Satellite Systems

Progress report

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Task Group 6: Global Navigation Satellite Systems (GNSS)

TG6 which is the Global Navigation Satellite Systems (GNSS) focuses on enhancing geo-referenced field data collection through the use of GNSS and other related technologies. There is a wealth of geographical data collected through field surveys and assessments conducted by various UN agencies and their partners in the field. There is a need for a robust spatial database framework within which to catalogue and store the new data. There is currently no agreed standard on geographic feature attribution and classification for various 'base' data layers, nor has there been much drive towards a common understanding of the relationships between individual geographic features. In addition there is also a need for a data collection procedure that enables field assessments to be seamlessly integrated into this framework, thereby reducing data processing bottlenecks.

Main objectives

The overall aim of TG6 is to harmonize and facilitate field data collection activities undertaken by the different UN agencies where GNSS technology is used to improve field level data capture and geo-referencing. TG6 will also look at how advances in ICT including digital photography could be used in enhancing field level data collection.

This sub-working group of the UNGIWG aims to (1) minimize the laborious manual efforts often accompanied with GNSS data collection before data is useable; (2) improve the confidence, reliability, and usefulness level of the data collected during post acquisition phase; and (3) strengthen interoperability, and corporate accessibility, as well as reduce collection redundancy in support of a wider set of applications, not just for GIS, but for cross-thematic themes, and varying user requirements. Specific objectives of TG6 can be summarized as follows:

Insure consistency –consistencies in the approach, methodologies, and practices of using GPS given a particular situation or need.

Assure reliability – having the means and capabilities to measure the quality, reliability, accuracy and usefulness of data collected.

Develop Common Standards & Procedures – in support of the entire workflow involved when utilizing GPS technology; ranging from how data is measured, collected, corrected/processed, documented, stored, managed, integrated and exchanged. The issue of measuring units, projection, coordinate systems, format, handheld versus PDA/data loggers, etc…, becomes important.

Enhance Integration - greater integration of GPS technology into the assessment, monitoring and verification process (incl. questionnaires, survey forms, etc) as well as improved compliancy and interoperability amongst the various UN actors including existing corporate/field systems and various information management initiatives.

Documentation and metadata –support for data documentation or metadata that describes various aspects and processes involved in field data collection as well as the instrument itself and the settings and configurations applied.

Training and supportive material –Develop a set of common training modules and tools to support the overall objectives of GNSS

Task Group Membership

The Task Group Membership included:

Menghestab Haile (WFP) – Task Manager

Michal Smolka (WFP) –WFP Focal Point

Steve Ebener (WHO)

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Franck Albinet (WFP/UNHCR secondment to the secretariat of UNGIWG)

Due to staff mobility within the UN system some of the individual members may have moved away. It is important to develop a strategy that takes this into consideration and find a way to have continuity.

Activities undertaken

1. Background Research
As part of it work plan TG6 decided to undertake a review of current practices and usage of GPS technology by the various UN agencies. This included a review of GPS guidance material used by UN agencies. Various online resources and reference material was also included in the review.
The purpose of the review was to (1) gain a better understanding of what GPS guidance material is current existing; (2) recognise and acknowledge the areas of focus these materials where trying to address; and (3) identify gaps and weakness.

This would help ensure that any guidelines developed would build upon existing guidance material and strengthen gaps and weaknesses and areas not adequately or appropriately covered.

The following GPS guidelines material has been reviewed (listing UN only):

- GPS Field Guide [WHO, 2003, 26 pages]
- Geographic Information Data Collection Protocol [WHO, 2006, 6 pages]
- GPS Data Collection Protocol [WHO, 2003, 5 pages]
- How to use the GPS Training Material [WHO, 2003, 6 pages]
- Test and Use of the GPS in the Field [WHO, 2003, 15 pages]
- Guidelines for data collection in the field using Global Positioning System (GPS) Technology [WHO, 2003, 25 pages]
- Cleaning Protocol for the Geographic Component –Countries using GPS devices [WHO, 2005, 33 pages]
- Using GPS in the Field -"Manual & Reference" [UNHCR, 2004, 19 pages]
- Using GPS in the Field –"Saving/viewing GPS data on a computer (waypoint+ v1.7.07 user's guide)" [UNHCR, 2002, 22 pages]
- Basic GPS for Beginners [UNJLC, 2006, 17 pages]
- How to use a GPS Unit flyer [UNJLC, 2006, 2 pages]
- Downloading Data from a Garmin GPS flyer [UNJLC, 2006, 1 page]
- Integrating GPS & GIS with Census mapping [UN-DESA, 2004, 8 pages]
- Guidelines using GPS (HIC) [UN OCHA, 2004, 37 pages]

References to training material where found in some of the documents received. Reviewing training material would be a great value to the sub-working group and its efforts.

2. General Findings
A wealth of useful and 'ready to use' guidance material for the use of GPS in field data capture has been compiled by the various UN agencies. The fact that most of the guidelines often refer to the same or similar GPS devices currently being used by many of the field

offices makes adoption and their utility immediately applicable without too much difficulty and/or revision.

Reviewing these guidelines, the focus and area covered can be generally grouped into the following main themes:

Background information (What is GPS; How does GPS work; Why use GPS; GPS accuracy; factors that effort GPS accuracy; general overview of technology, etc)
GPS Terminology (Glossary of GPS terms, acronyms, and descriptions, etc)
Device Comparisons (Listing of different and suggested GPS make/model devices from handheld, PDA, to high-end devices using ArcPAD software comparing capabilities, functionality, settings, and specifications)
General Guidance (user manual; how to use your GPS; how to collect waypoints, lines and areas; description of various settings; downloading to PC; etc)
Using GPS (Procedures, settings, guidelines, and protocols before and during acquisition)

The guidelines seem to support a specific situation, need, or particular make/model of GPS device. This is reflected by the fact that the guidelines are either tailored to support a pre-defined survey collection form; a summarized and improved version of the official GPS manufacture's User Guide/Manual; discussions and descriptions paper on various settings without clearly defining suggested upper or lower setting limits and their implications on data to be collected; or a combination of the above.

3. Gaps and Weaknesses (Priority areas of focus)
The guidelines reviewed cover a wide spectrum of useful and 'ready to use' material; however there are gaps and weaknesses, areas that are not necessarily adequately addressed or focused upon such as:

Defining minimum standards & specifications with respect to how GPS data is being 'packaged' or described in terms of accuracy considerations, quality control/assurance procedures, prescribed structured 'format', and predefined metadata elements;
Supportive guidelines to help specify how these standards can be met; and
Information management on how GPS data should be processed managed, maintained, stored, accessed, and shared with a wider audience in mind each with their own possible unique set of requirements.

Standards, supportive guidelines, and the role of *information management* will greatly facilitate improved interoperability, reliability, and consistency of the data being collected. This would also enable users to measure the confidence and usefulness level of the data being shared or collected in terms of their own requirements; helping minimise the data processing and work often required in making the data useable and useful.
The findings of the review outline the main objectives and focus of this sub-working group.

4. Need for Standards & Specifications

Coordinate Systems using a particular Datum (WGS84) and unit (decimal degrees) are often mentioned as a standard throughout many of the GPS guidance material developed throughout the UN. If the issue of standards are to be addressed seriously ensuring interoperability, reliability, and consistencies is achievable when capturing data using a GPS, then selective GPS settings alone cannot constitute a standard but rather seen as a requirement or recommendation of use.

Specifying and setting coordinate system alone do not guarantee consistency, reliability, or accuracy of data being collected. Other parameters of use and specification is required to be included and clearly identified to improve the confidence level of each and every location captured, to ensure its indeed within the expected relative accuracy tolerance (be it +/- 30m or +/- 100m) as well as in a form that can be readily useable.

Contrary to common belief, GPS technology is not foolproof, and does require some training before anyone simply picks up a GPS receive and hopes to start capturing good consistent, reliable, useful data.

The number of infinite possible permutations of XY (Long/Lat) and level of accuracies end-user of GPS data receive from the various field officers and partners vary dramatically – different order, different format, different precision level, different units, incorrect hemisphere, etc, etc, etc. In some cases even people's lives have been put at risk reporting 75.4518 (Decimal Degrees) as 75 45 18 (75 degrees, 45 Minutes, and 18 seconds) as was done in Pakistan.

So defining standards must go beyond merely specifying a standardized coordinate system setting but also include a host of other 'parameters of use' and specification which is independent of both device (type, make, model) and software being used. Some of these maybe implicate whiles others explicit but irrespective; they at least need to be declared and made known.

Much of these parameters and specification are already automatically collected by +90% of GPS devices either through user customisable settings, downloadable directly to PC, viewable on the GPS screen, or fixed and predefined by the manufacturer for those very low-end recreational GPS devices.

Defining and identifying which parameters and specification to use (including recommendation on settings), is something that the working group will need to address. For example, having date, time, device make/model, units/format (waypoint, time, date, etc), collection mode (3D), PDOP, to mention a few, ready available in addition to the coordinate system already provides a number of possibility. Please refer to Appendix A for examples.

This not only ensures accuracy consideration but also lends it's way to quality control assurance (development of appropriate procedures) making it relatively easy to flag or discard data that is unsuitable or unusable without going through the lengthy process of trying to map it (Surprise XY is 10km out!!!). It also helps to identify and focus training in the use of GPS based on data received.

Unless it's documented with a common agreed upon set of guiding values and principals that clearly define specifications, definitions of characteristics, conditions, and supportive guidelines/procedures allowing for the measurements of compliancy and attainability of a particular standard, it is then NOT a STANDARD.

5. Need for Guidelines

Guidelines need to be developed which do not encompass or duplicate existing available guidelines but focus more on their gaps and weakness. Additionally, Guidelines will also be required to help support and met any proposed *Standards* that may be developed.

Developing and defining the *Standards* are seen as a prerequisite to developing comprehensive set of Guidelines to help facilitate the standardization of data collection procedures and quality control.

6. Need for Information Management

The role and importance of Information Management needs to be strengthen by which a field office efficiently plans, collects, processes, organises, stores, uses, manages, and disseminates GPS data, ensuring its value and use is exploited to the fullest extent.

This involves developing and identifying appropriate procedures (i.e. SOPs, data management), tools, and roles of responsibilities (i.e. staff) in order to address the various aspects of IM.

Conclusions:
Briefly, the following outlines the broad next steps for the sub-working group:

- Review findings and progress made thus far and agree upon scope, objectives, deliverables and role of the working group. How this links into other initiatives being addressed by other UNGIWG task groups.
- Continue background research; collating and reviewing GPS-related guidelines/training material from various partners and users, etc…
- Undertake a brief inventory survey of the GPS devices (make, model, type, organisation, etc) commonly used in the field.
- Defining and identifying which 'parameters of use' and specification to consider and include within a commonly accepted set of minimum Standards will need to be determined. This will involve an initiative process amongst the working group and those dealing with GPS in the field as well as other expert groups.
- Draft and define Standards, as well as begin sketching Supportive Guidelines to help meet these Standards including strengthening areas of gaps and weakness of existing guidance material.
- Circulate draft Standards and Supportive Guidelines for comments and suggestions to a wider audience including expertise and practitioners of GPS field data capture within the humanitarian and development community.
- Define and strengthen the role of Information Management (IM) has on field data capture using GPS technology, -developing appropriate procedures, SOPs, etc.
- Field test the Standards, Guidelines, IM procedures in order to determine how best to implement and apply them practically in the field (i.e. case study and lesson learnt).
- Finalise Standards, Supportive Guidelines and IM procedure and begin adoption and implementation at the field level (A strategy and plan to undertake this will be needed).

Appendix A:

Below is a list of suggested elements (GPS settings, specifications, criteria, parameters, guidance, metadata, etc) for potential consideration and possible inclusion as ingredients into a common set of minimum Standards and supportive Guidelines.

Each of these elements will need to be carefully examined and reviewed in terms of their importance, relevance, usefulness, feasibility, and implications of final consideration and inclusion; taking into consideration the nature of work being carried out, the practical user constraints and limitation (i.e. equipment, staff, skill sets, etc), as well as the trying to overcome the issues of interoperability and other problems and findings highlight in this document.

Note: the elements listed below are not necessarily in any particular order. There may be some settings or criteria missing.

Elements/Settings	**Comments/ Options**
Almanac	The almanac is used by a GPS receiver to determine satellite visibility and as an aid during acquisition of GPS satellite signals
Initialisation	Time to orient GPS device when using device in a new location (or whenever it has been moved +500 miles from last use).
Device used	**Model**, **Make**, **Type**, etc
Source of data	**Organisation**
Time	**Units** (UTC Time, 24-hour, 12-hour, time zone), **Precision**, **Format** (hh:mm:ss, hhmmss, hhmm, hhmm am/pm)
Date	**Units, Precision**, **Format** (DD/MM/YYYY, MM/DD/YYYY, DD-MMM-YYYY)
Logging Interval	**Units**, **Format** –time between "positions"
Feature Settings	**Value** (Waypoint / Line / Area / other)
Projection System	**Coordinate System** (Geographic) **Datum** (WGS 1984) **Coordinate Units** (Latitude / longitude, Decimal Degrees, etc) **Coordinate Order** (XY, YX, Long/Lat, Lat/Long) **Precision** (decimal places) **Hemisphere** (north / south + / -) **Format** (Degrees:Minutes:Seconds; DD.xxxx, etc)
Language	**Value (**English, French, etc**)**
Altitude	**Altitude Reference / Geiod Mode (**HAE, MSL, other, etc) **Units (**feet, meters, etc**), Precision**, **Format**
Distance	**Units (**feet, meters, etc**), Precision**, **Format**
Minimum positions	Minimum number of positions required to log point feature
Minimum time	Time required to "Lock on" to satellites before capturing data and ensuring acquisition of carrier phase information.
Position Mode	**Value** (2D/3D) 3D required a minim of 4 satellite which helps improve XY accuracy
Elevation Mask/Angle	Angle below which Satellites should not be tracked (Normally set to 15 degrees) to limit & prevent propagation and multipath errors
Signal-to-noise ratio (SNR) mask	Measure of signal strength -prevents device recording waypoints with low quality.
PDOP	(Position Dilution of Precision) -lower the more accurate XY prevents receiver from logging inaccurate positions due to poor satellite

	geometry
Attribution	Data Dictionaries, attributes, unique codes, etc
Number of visible satellites	Minimum number of Satellites required before recording can begin.
Logging Settings & file naming conventions	File naming convention for RAW GPS data, log files, etc
Magnetic Declination	Angle between the magnetic and geographic meridians at any place. Different for different places in the world.
Exchange & storage format	**Format** (XML, SHAPE, Text, excel, etc)
Metadata	Metadata to include?