GPS Workshop Notes, Terms & Jargon

March 2010

Using a hand held GPS receiver is really very simple
See the sky, Turn it on, Read location.
Pretty easy.

Introduction and Theory

This workshop will provide a basic understanding of GPS (Global Positioning System) and how it works. The primary focus will be the use and limits of hand held GPS receivers for recreational activities such as canoeing, hiking or geocaching.

GPS consists of a series of satellites that transmit data that allow receivers on Earth to determine their location with great accuracy. A complete complement of satellites for GPS is 24; there are usually a number of spare or extra satellites. There are a number of additional satellites that support enhanced or augmented services such as WAAS and DGPS. Also included in this system are ground stations that are used for detecting and updating errors. Generally most users of GPS only think about the receivers and call those a GPS or GPS unit. GPS will allow a users to accurately pinpoint their location anywhere on (or near) the surface of the earth through trilateration with the use of three or more GPS satellites.

The satellites orbit the earth at an altitude of roughly 20,000 km above the surface (25,000 from centre). The orbital paths of these satellites take them between roughly 60 degrees North and 60 degrees South latitudes. What this means is you can receive satellite signals anywhere in the world, at any time. As you move closer to the poles you will still pick up the GPS satellites they just won't be directly overhead anymore. This may affect the satellite geometry and accuracy but only slightly. The satellites are constantly moving, making two complete orbits around the Earth in just less than 24 hours; that's about 2.6 kilometers per second. At any one time there should be at least 6, and as many as 12, satellites available.

All hand held receivers with a good view of the sky will provide a position usually within 10-20m and some times less. There are several publicly available enhancements to GPS that allow a greater accuracy of 3 meters or less. Three of these enhancements are Wide Area Augmentation System (WAAS), Differential GPS (DGPS), and post processing corrections. With the exception of briefly mentioning these items they will not be covered in this workshop. WAAS uses a set of ground stations and geosynchronous satellites to provide atmospheric error corrections. Many new GPS receivers have WAAS capability built into the receiver already and it is freely available. DGPS requires at least a special receiver and in some cases a ground station transmitter. Post processing corrections are not much use to anyone in the field since it involves collecting a special format of GPS data stream onto a computer or memory device for processing at a later point in time. Much greater accuracy (cm or less) can be achieved using Carrier-phase tracking of GPS signals using what are known as L1 and/or L2 carrier signals. This type of tracking requires special receivers and equipment that are more expensive.

In most cases these enhancements provide little or no useful additional information for people that are using a GPS receiver for recreational purposes. Even individuals who are looking for geocaches will not generally benefit since the original co-ordinates were often taken without enhancement or the cache was located in a place where the enhancement was available.

Sky View

- You need to be able to ‘see’ at least three satellites. Buildings, mountains, a car roof (some windshields), even trees block the sky. You can receive GPS signals inside some buildings (e.g. wood construction houses, or through some windows) but generally there will be considerable degradation. Clouds don’t cause any problem

and if it is raining/snowing hard enough that the GPS signals are significantly degraded you have bigger problems to worry about.

Turn on

- All receivers run on some form of electrical power. Typically batteries but external power supplies are also available. Depending on the GPS receiver, how you use your unit, and the type of batteries the time you can expect ranges from 8 to 30 hours on two alkaline batteries.
- When you first start your GPS receiver after several months or have moved more than 300 (or so) km the time it takes to startup will be longer, often several minutes, since the location of the satellites is unknown. After this initial start-up subsequent initialization periods will be shorter, usually 30-60 seconds.
- Cold temperature will slow the display down on some GPS receivers. Alkaline batteries provide less power at lower temperatures; if you are using your GPS receiver below 0°C consider switching to lithium batteries. There is potential for damage to some LCD screens when using them below 0°C (some as low as -15°C).

Get Location

- The location that is displayed is particular to the co-ordinate system chosen and the underlying datum. If you are sharing locations with others or are working with a map (or GIS) these are very important concepts. You will need a basic understanding of datums and co-ordinate systems. The default for GPS is WGS84 datum and co-ordinates are usually indicated as latitude/longitude (e.g. Hddd° mm.mmm).
- GPS was created to pin point where you are on the surface of the earth. No direction or speed is known; these are added through software and knowing where you were a second (or less) ago or the next waypoint on your route. Some recreational GPS receivers have a built-in electronic compass and altimeters but those additions are not part of GPS.
- The location is <u>not</u> exact there is always some degree of error associated with any reading. Typically this is 10-20 meters and up to twice that in altitude. The documentation that comes with some GPS receivers claim the error is typically less than 7m (<3m with WAAS).

Accuracy. Degree of conformity of a measure to a standard or true value. Hand held GPS receivers are generally capable of giving accuracy within 10-20m and often quite a bit better. Using augmentation (WAAS or DGPS) much better accuracy can be achieved. Users should note that one brand of recreational GPSr is basically as accurate as the next. Often when working with maps or provided co-ordinates some users claim that their GPS is quite inaccurate – confirm that you are using the correct datum and that you have good satellite coverage.

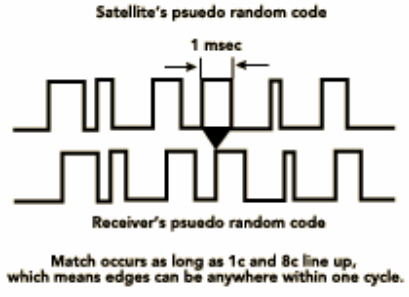
Almanac/Almanac Data. Every satellite in the GPS constellation transmits a detailed calendar about where it's going to be at any one time. It also transmits information about all of the other satellites. When your GPS receiver is in acquisition mode it is reviewing this information so it knows where to look for satellites that might not be in view at the moment. If you move more than ~500km or if your GPS has been turned off for a long period of time this information will be stale and it will take a longer time for your GPS to initialize (see Cold Start/Hot Start).

Bearing (BRG). The bearing is the straight line direction between one point and another – where you want to be going to reach a waypoint. This is not necessarily your track or course.

Benchmark. Generally a bench mark is a known or referenced location also known as a geodetic control point or monumented reference point. There are several sources for benchmark information; a good source for benchmark information is the Geodetic Survey of Canada (http://www.geod.nrcan.gc.ca/index_e/index_e.html) or geodetic network points found at Geobase (http://www.geobase.ca/geobase/en/data/geod1.html).

Channel. A channel of a GPS receiver is the necessary electronics to receive a signal from a single satellite. Most GPS receivers have many channels dedicated to receiving satellite signals which allows fast calculations and better accuracy. Some older GPS receivers had only one or a few channels and used multiplexing to jump from one signal to another on a single channel. See multi-channel receivers.

Code-Phase GPS vs. Carrier-Phase GPS. All GPS receivers that are used for recreational purposes use Code-Phase (also known as pseudorange) GPS methods to determine locations. The limit to this type of determination is in the range of 3-6 meters. A GPS receiver determines the travel time of a signal from a satellite by comparing the "pseudo random code" it's generating, with an identical code in the signal from the satellite. The receiver slides its code later and later in time until it syncs up with the satellite's code. The amount it has to slide the code is equal to the signal's travel time and thus the distance. The problem is that the bits (or cycles) of the pseudo random code are so wide that even if you do get synced up there's still plenty of slop.



To get higher accuracy (e.g. within cm or mm distances), after the GPSr has obtained an approximate location through the use of DGPS, the underlying carrier wave is used to determine the final position. See: http://www.novastars.com/gps/codevscarrier.htm

Cold Start. If a GPS receiver has been off for a long time, is new, or has traveled several hundred kilometers since it was last used it will take longer to initialize. This is called a cold start and can take several minutes to search for satellites because the almanac is 'stale'. In some cases this process can be shortened by telling the GPS where you are currently located.

Constellation. This term refers to the GPS satellites and their arrangement in space. GPS satellites are not fixed and constantly move, quite quickly actually. Different satellites will appear and disappear as they come in and out of range. Typically the number of GPS satellites in use is 24 with several spare satellites.

Coordinates. A set of numbers and occasionally letters that is used to identify the location on the surface of the earth using a particular coordinate system is called your coordinate.

Coordinate System. The coordinate system is the system or method used to identify a location using coordinates on the surface of the earth. Typically these are latitude and longitude but may also be in one of many grid projection units e.g. Universal Transverse Mercator (UTM). Each coordinate system has its own starting points, or points of reference, and often a specific datum.

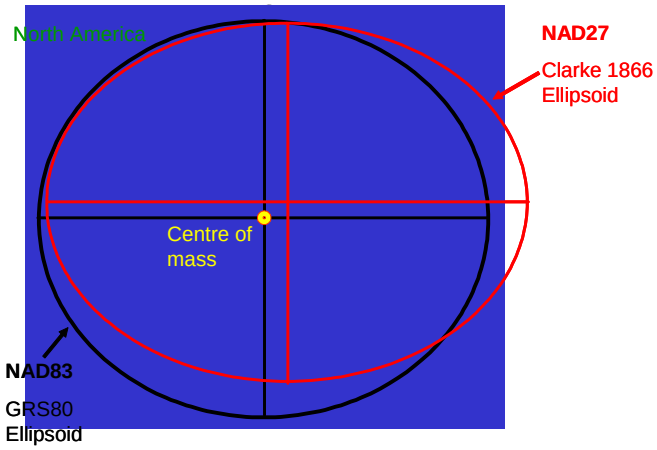
Datum. Geodetic datums define the size and shape of the earth and the origin and orientation of the coordinate systems used to map the earth. Hundreds of different datums have been used to frame position descriptions since the first estimates of the earth's size were made by Aristotle. Datums have evolved from those describing a spherical earth to ellipsoidal models derived from years of satellite measurements.

Modern geodetic datums range from flat-earth models used for plane surveying to complex models used for international applications which completely describe the size, shape, orientation, gravity field, and angular velocity of the earth. While cartography, surveying, navigation, and astronomy all make use of geodetic datums, the science of geodesy is the central discipline for the topic.

Referencing geodetic coordinates to the wrong datum can result in position errors of hundreds of meters. Different nations and agencies use different datums as the basis for coordinate systems used to identify positions in geographic information systems, precise positioning systems, and navigation systems. The diversity of datums in use today and the technological advancements that have made possible global positioning measurements with sub-meter accuracies requires careful datum selection and careful conversion between coordinates in different datums.

See: http://www.colorado.edu/geography/gcraft/notes/datum/datum_f.html

NAD27 vs. NAD83



Differential GPS (DGPS) Differential GPS involves the cooperation of two receivers, one that's stationary and another that's roving around making position measurements. The stationary receiver is the key - it ties all the satellite measurements into a solid local reference and transmits or collects corrections. DGPS generally requires a special receiver and base station transmitter. It is possible to collect data from a GPS unit and correct the locations using post-processing service. Usually signals for DGPS are limited and require direct line of sight. Recently, for Canada, CDGPS was launched which allows DGPS corrections across most of Canada (http://www.cdgps.com/e/cov.htm).

Dilution of Precision (DOP). This is a measure of error that some GPS units display. It is a description of how the satellite geometry affects accuracy; the lower the number the better. The usual maximum is 50 and a value of 6 or less is considered good. Most GPSr units are now using estimated position error which users find easier to interpret.

Easting. This is typically the first number in a UTM reference. The UTM easting coordinate (the X coordinate) for a feature is the distance in meters east or west from the central meridian of the UTM zone. The central meridian is assigned an easting value of 500,000 meters East. Since this 500,000m value is arbitrarily assigned, eastings are sometimes referred to as "false eastings". An easting of zero will never occur, since a 6° wide zone is never more than 674,000 meters wide. See Universal Transverse Mercator UTM.

Estimated Position Error (EPE) This is an estimate of the accuracy at any given moment based on satellite geometry, satellite position, clock offset, satellite signal quality. Each GPS receiver manufacturer apparently calculates this value slightly differently but in general the number you see on your GPSr provides a distance with 50% probability that the current location will fall within that distance.

Euro Geostationary Navigation Overlay Service (EGNOS), Europe. This is the European version of WAAS.

Galileo is Europe's contribution to a global navigation satellite infrastructure (GNSS). Galileo will be Europe's own global navigation satellite system, providing a highly accurate, guaranteed global positioning service under civilian control. It will be inter-operable with GPS and GLONASS, the two other global satellite navigation systems. This system is expected to be fully operational in 2014. see: http://ec.europa.eu/transport/galileo/index_en.htm

Geocaching. This is a sport that uses GPS and is accessible to all age groups and all abilities. Caches are hidden by people participating in the sport and the latitude and longitude of the location are posted on the internet. GPSr users can then use the coordinates to find the caches. When you find a cache, take something from the container, leave something you've brought, sign the logbook, and then return the

container to it's hiding spot for the next finder. A good source of information and cache locations is http://www.geocaching.com. There is a local Manitoba geocaching association as well that can be found at http://www.mbgeocaching.ca/. There is a whole language that goes with geocaching as well that can not be covered in this document. A good source for geocaching terms and jargon can be found at: http://www.geocaching.com/about/glossary.aspx, http://www.hobbycache.com/glossary.html, or http://geolex.locusprime.net/

Geographic Information System (GIS). A system that is capable of assembling, storing, and manipulating geographically referenced data. The first GIS system was developed in Canada in the 1960s.

Global Orbiting Navigation Satellite System (GLONASS). This is the Russian version of the GPS system.

Global Positioning System GPS is the acronym for Global Positioning System. GPS consists of a series of satellites (24+) that transmit data that allow receivers on Earth to determine their location with great accuracy. Also included in this system are ground stations that are used for detecting and updating errors. The whole system is officially known as NAVSTAR GPS (Navigation Signal Timing and Ranging Global Positioning System).

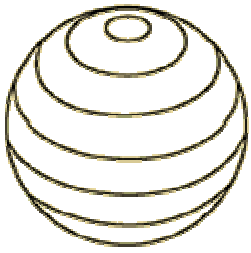
GPSr. The common reference used in the GeoCaching circles and forums to a GPS receiver.

Heading (HDG). This is the actual direction that you are pointed and moving. In the air and on water the heading may differ due to wind/currents from the actual Course Over Ground.

Hot/Warm Start. If you start up your GPSr while the almanac data is still current the acquisition time is quite short. This is because the location of the satellites is known and signals can be received quickly.

Initialization. The first time a GPS receiver finds the satellite array and orients itself to its current location (cold start). After initialization has occurred, the receiver will remember its location and acquires a position more quickly with a warm or hot start.

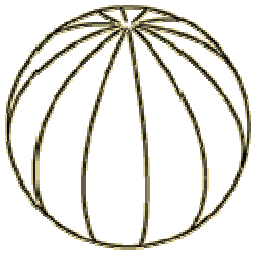
Latitude. A point north or south of the equator, perpendicular to the lines of longitude. Latitude is measured in degrees from 0 (equator) to 90 (pole). One minute of latitude equals one nautical mile. Think of lines of latitude as a series of hoops around the earth parallel to the equator.



Local Area Augmentation System (LAAS). This is a system like local DGPS around airports that provide precision aircraft landings in a local area of ~32km range. Personal or hand held receivers can not take advantage of LAAS.

Long Range Navigation (LORAN). This was one of the first radio navigation technologies used along the coasts. LORAN stations transmit a grid of radio waves that allows for accurate position plotting. LORAN is being phased out and is only mentioned here because some GPS receivers can provide approximate LORAN TDs (Time Delay) fixes. Unless you have or are using LORAN coordinates this additional feature will not be useful.

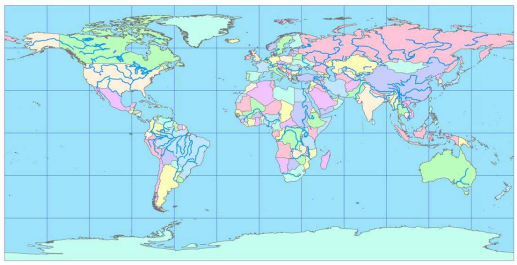
Longitude. This is the distance east or west of the prime meridian measured in degrees. Lines (meridians) create a geographic grid around the world that meet at the poles are furthest apart at the equator. The lines give the impression of a pumpkin.



Man Over Board (MOB). This is a special waypoint that is quick to create on most GPSr units. In most cases once it is created the GPSr automatically creates a track back route.

Map Projection. Map projections are a method to project the surface of a sphere (the earth) on a flat plane. There are many (hundreds) of projections that can be used. One of the most common projections used for topographic maps is Universal Transverse Mercator (UTM). See: http://www.colorado.edu/geography/gcraft/notes/mapproj/mapproj_f.html, http://en.wikipedia.org/wiki/Map_projection

Earth as a Globe



Cylindrical Projection or Plate Carrée

Mark (see Waypoint). Waypoints can be marked at any current location. A new way point can also be created for a different location.

Military Grid Reference System (MGRS). This is an extension of UTM that allows for abbreviated co-ordinate references. The MGRS coordinate for a position consists of a group of letters and numbers which include the following elements: a) The Grid Zone Designation, b) The 100,000-meter square letter identification, c) The grid coordinates. For example 14UPA338188 represents a 100m square designation using NAD83 near the corner of Chancellor Matheson and University Crescent, University of Manitoba.

Multi-Channel Receiver Multi-Channel or Parallel GPS receivers can simultaneously track more than one satellite. Most GPS receivers now have 12 channels, some have as many as 14-16. In most cases the additional channels are dedicated to specific satellite signals such as WAAS..

Multi-Functional Satellite Augmentation System (MSAS), Japanese. This is Asia's version of WAAS. see: http://www.environmental-studies.de/Precision_Farming/EGNOS_WAAS__E/3E.html.

Multiplexing Receiver. Some older GPS receivers with only a few channels would track many satellites by jumping from one signal to the other and back again. These receivers, along with single channel receivers, take more time for acquisition and may work poorly under trees or poor sky view.

NAD27, NAD83 See North American Datum and/or Datum

North American Datum (NAD27, NAD83). See the discussion under Datum. NAD27 has a number of variations and is defined for the particular local ellipsoid used when noting positions on the surface of the earth. NAD83 was originally the same as WGS84 but the two have drifted slightly apart. The difference between NAD27 Canada and NAD83 in Manitoba is roughly 220meters north (i.e. subtract

220m from the NAD83 Northing to get NAD27). Newer Topographic maps that use NAD83 usually have the difference particular to that area noted on the map.

Northing. This is typically the second number (or set of numbers) in a UTM coordinate. The UTM northing coordinate (the Y coordinate) for a feature is the distance in meters north from the equator to the feature. To avoid negative numbers, locations south of the equator are made with the equator assigned a value of 10,000,000 meters North. Some UTM northing values are valid both north and south of the equator. In order to avoid confusion the full coordinate needs to specify if the location is north or south of the equator. Usually this is done by including the letter for the latitude band. See Universal Transverse Mercator (UTM).

National Marine Electronics Association (NMEA). This is a U.S. standards committee that defines how data is passed back and forth between shipboard electronic systems. All GPS receivers that can communicate with a PC are at least NMEA compliant. If you are buying software check the version of NMEA communication that is supported and the version your GPSr uses.

Navigation Satellite Timing and Ranging (NAVSTAR). NAVSTAR is the government acronym for the US based GPS satellite system.

Parallel-Channel Receiver. This is the same as a multi-channel receiver.

Patch Antenna. Well suited to picking up satellites overhead. These antennas have a small 'foot print' and are typically used in very small GPS receivers. Because they are better at picking up satellites overhead they may not be as suitable for working in areas with poor sky view. Hold the GPS receiver so the antenna is flat or facing the sky. Because of the antenna sensitivity these units will usually work better than others when held close to your body (e.g. in shirt pocket).

Power. Most GPS receivers will work off of 2 or 4 AA batteries and have a typical working time between 8 and 30 hours. Unless specifically noted in the manuals you should assume the manufacturers have provided the working hours in 'power save' mode. Expect to get fewer hours under normal use and even less if you actively use the GPSr. If you are using the unit for prolonged periods in a vehicle or in/near a building consider getting an external power supply. If you are working in conditions where the temperature is below 0°C consider using lithium batteries. When working below 0°C the LCD screen used on many GPSr units will become very slow or un-useable.

Precision. In this context it is an indication of the smallest unit of measurement given by a GPSr. In most cases the GPS accuracy will be much larger than the precision. For example most current GPSr units will measure UTM to the meter even though the accuracy is 10m. In the geocaching world degrees are measured to the 3rd decimal minute (1-2m in Wpg depending on lat or long) even though the accuracy is ~0.01.

Prime Meridian. Zero meridian used as a reference line from which all lines of longitude are measured. It passes near Greenwich, England.

Projected Waypoint. A way point that is created at a known distance and direction from the current position, or another known reference point, is called projected. This should not be confused with a projected grid system such as UTM.

Quadrifilar-Helix Antenna (Quad-helix or just Helix). Well suited to picking up satellite signals lower on the horizon and multiple directions. This makes them potentially better when working in wooded areas or areas with poor sky visibility (in vehicle). Orient the antenna if possible so it is upright. In some units this means you will need to hold the unit upright as well. The down side is the GPSr may use satellites for a fix that are in a poor constellation, have poor signal quality, or have multi-path errors.

Route. A group of waypoints linked to form a line with a leg between each point. Once a route is entered, or created, it can be followed either direction.

Selective Availability (SA). In the past the U.S. Department of Defense degraded the accuracy of the signals by as much as 91m. This was done to limit the use of the system by the enemies of the U.S. Thanks to Bill Clinton SA was discontinued in May 2000 allowing most hand held receivers to have an accuracy of ~15m or less – and geocaching was born.

Space Based Augmentation System (SBAS). Generic term for WAAS/EGNOS/MSAS.

Temperature Range. Most GPS units will function fine between -15°C and +60°C but check since some only work above 0°C. The temperature range is a little misleading since most units have a LCD screen which might become slow (or non-functioning) below 0°C.

Topographic Maps (Topo Maps). These maps depict, in detail, ground relief, drainage, forest cover, administrative areas, populated areas, and transportation routes. In Canada they are available in two standard scales, 1/50 000 and 1/250 000. The maps show a geographic grid (longitude and latitude) and a projected Universal Transverse Mercator (UTM) grid.

Topographic maps produced by Natural Resources Canada conform to the National Topographic System (NTS) of Canada. The National Topographic System provides general-purpose topographic map coverage of the entire Canadian landmass.
See: http://maps.nrcan.gc.ca/topo101/index_e.php

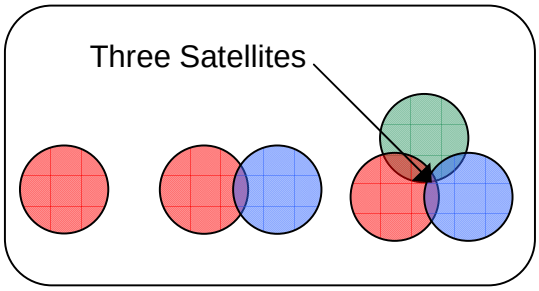
In the United States topographic maps are produced by the U.S. Geological Survey. Maps are available as 1:24,000-scale maps (1 inch = 2,000 feet) for most areas with complete topographic coverage of the United States at scales of 1:100,000 and 1:250,000. Maps are also available at various other scales. See: http://erg.usgs.gov/isb/pubs/booklets/topo/topo.html.

Track (TRK). Your track is the current direction of travel relative to a ground position (also called Course Over Ground).

Track Log (TRK). A track is a set of 'bread crumbs' that most GPS receivers drop while they are on and have a satellite fix. This track can usually be saved like a route and followed back to an origin. On some GPSr units tracks are averaged when they are saved – not every point is saved but multiple points that are in a line are compressed to save space. In some cases when a satellite fix is lost the GPSr will interpolate a line for some period of time track based on the last known speed and direction.

Triangulation. A trigonometric operation for finding a location based on bearings (or angles) from two fixed points a known distance apart. This is often used as a description of the method that GPS uses to calculate a location. For the hair splitters in the crowd the following note comes from Trimble: *We're using the word "triangulation" very loosely here because it's a word most people can understand, but purists would not call what GPS does "triangulation" because no angles are involved. It's really "trilateration."*

Trilateration. The method used to find a specific location of an object using the geometry of triangles. This is similar to triangulation but uses only measured distances between known locations. To accurately determine a location at least three reference points are needed. This is the method that GPS receivers use to locate an unknown point. GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map. A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude).



Universal Polar Stereographic (UPS). This a grid system based on the polar stereographic projection, applied to the Earth's polar regions north of 84 degrees north and south of 80 degrees south. Basically a polar version of UTM.

Universal Time Coordinated (UTC). UTC is the international atomic time scale that serves as the basis for timekeeping for most of the world. Introduced in 1972 this universal measurement replaced Greenwich Mean Time (GMT) as the world standard for time in 1986. UTC is a 24-hour timekeeping system. The hours, minutes, and seconds expressed by UTC represent the time-of-day at the Earth's prime meridian (0° longitude) located near Greenwich, England. The time used by your GPSr is a special GPS internal time that is transmitted as part of the satellite message. In addition the satellite transmits information in the form of leap seconds adjustments to permit your unit to adjust the clock display to agree with standard UTC time. GPS time was zero at 0h 6-Jan-1980 and since it is not perturbed by leap seconds GPS is now ahead of UTC by about 14 seconds.

Universal Transverse Mercator (UTM) Universal Transverse Mercator projection and grid system was adopted by the U.S. Army in 1947 for designating rectangular coordinates on large scale military maps. UTM is currently used by the United States and NATO armed forces. With the advent of inexpensive GPS receivers, many other map users are adopting the UTM grid system for coordinates that are simpler to use than latitude and longitude.

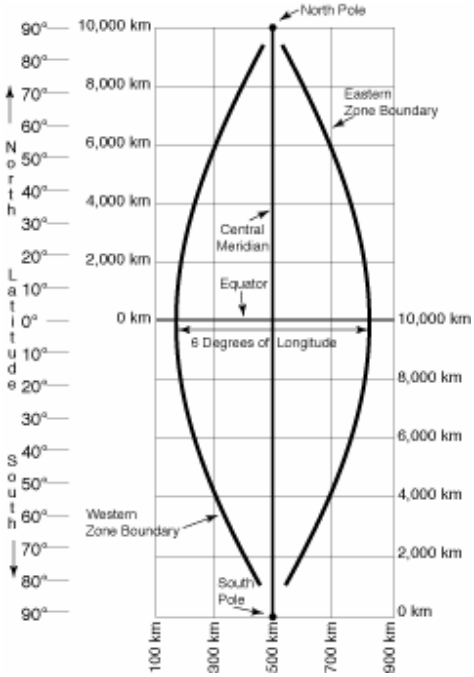
The UTM system divides the earth into 60 zones each 6 degrees of longitude wide. These zones define the reference point for UTM grid coordinates within the zone. UTM zones extend from latitude of 80° S to 84° N. In the polar regions the Universal Polar Stereographic (UPS) grid system is used.

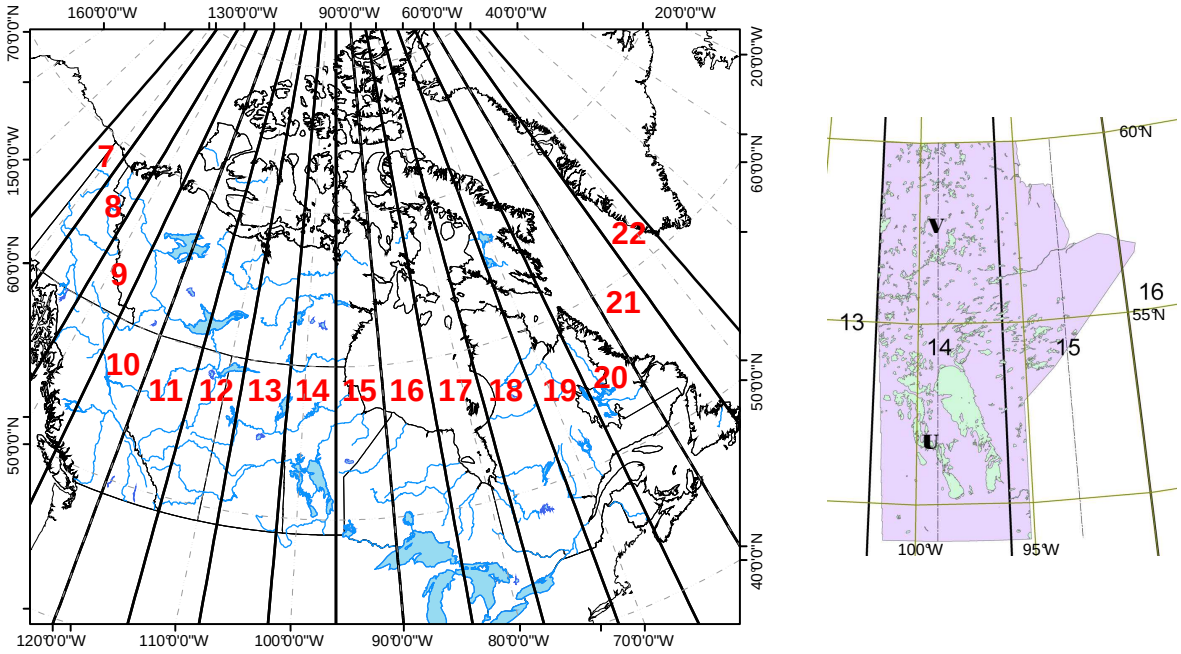
UTM zones are numbered 1 through 60, starting at the International Date Line, longitude 180°, and proceeding east. Zone 1 extends from 180° W to 174° W and is centered on 177° W. Manitoba is located mostly in zone 14 but extends in the north into zones 15 and 16.

Each zone is divided into horizontal bands spanning 8 degrees of latitude. These bands are lettered, south to north, beginning at 80° S with the letter C and ending with the letter X at 84° N. The letters I and O are skipped to avoid confusion with the numbers one and zero. The X band spans 12° of latitude.

A square grid is superimposed on each zone. It's aligned so that vertical grid lines are parallel to the center of the zone, called the central meridian.

UTM grid coordinates are expressed as a distance in meters to the east, referred to as the "easting", and a distance in meters to the north, referred to as the "northing". UTM zones are setup so there is minimal measurement error across the whole zone with the biggest difference being 0.9996 of the true scale. True scale occurs about 180km on each side of the central meridian of each zone.





UTM Zones in Canada and Manitoba

Warm/Hot Start (See Hot Start).

Waterproof. Unfortunately waterproof can mean many things to different individuals and manufacturers. When looking for something that is waterproof look for a standard measurement reference (e.g. IEC 529 IPX-7) that indicates it can withstand immersion in 1m of water for 30minutes. Most GPS receivers will work fine in the rain or splash as long as they are stowed dry. I have unfortunately discovered that the seals on some GPSr units are quite sensitive. Dropping the GPSr or knocking it about may make the unit no longer water proof. In some cases the designation only refers to the GPSr internal electronics and not the battery case. Lastly Waterproof does not mean the GPSr will float – most don't.

Waypoint or Mark. A waypoint is the common term to indicate a specific electronic address or location stored in your GPS receiver. Many GPS receivers have a 'Mark' button that will allow you to set or create a waypoint.

WGS84 (Word Geodetic System). This is the base datum that is used by GPS. WGS 84 is an earth fixed global reference frame, including an earth model. It is defined by a set of primary and secondary parameters: i. the primary parameters define the shape of an earth ellipsoid, its angular velocity, and the earth mass which is included in the ellipsoid reference, ii. the secondary parameters define a detailed gravity model of the earth. Other datums (e.g. NAD27) are based on a local reference or ellipsoid that is suitable only for the defined area for the datum (e.g. NAD27 Canada is configured for use with Canada). WGS84 and NAD83 were originally the same and for most purposes are interchangeable.

Wide Area Augmentation System (WAAS). This is system transmits corrections for North America for typical atmospheric errors in the GPS system often reducing the estimated error to within 3 meters. Initiated and funded by the FAA to improve aircraft navigation over all 50 states in the USA and Puerto Rico, WAAS became fully operational and available in July 2003. This system uses geosynchronous satellites and thus you may have problems getting a fix (or any improvement) further north where the satellites will be close to the horizon. On some GPS receivers WAAS reception can be turned off since the antenna must be powered continually and can draw batteries down more quickly. Even though the WAAS satellites can be seen in South America the use of WAAS outside of calibrated areas may give poorer readings and larger errors than using 'normal' GPS settings (this included much most of Manitoba even if you can pick up a WAAS satellite). In 2006 a WAAS correction station came online at the Winnipeg airport, this along with the move of one of the satellites further west and the addition of new satellites, should provide better corrections for Manitoba and WAAS satellite lock by the end of the summer. See http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/waas/, http://gpsinformation.net/exe/waas.html

It is important to note that even when WAAS is turned on it may not be in use by your receiver. If you are using a Garmin GPSr look for 'D' over the status bars in the satellite view, a Magellan (eXporist at least) GPSr will have WAAS beside the accuracy and/or a black W satellite bar in the satellite view. Unless you see the WAAS indicator don't expect improved accuracy. When trying to get WAAS correction the whole data stream is quite long and it takes a while to download the information – in other words you will have to wait for a while after the initial position acquisition for WAAS correction.

World Geodetic System 84 (WGS84). See WGS84 and/or Datum

Some WWW Based Information

General Information

GPS Information http://gpsinformation.net/
Dale DePriest's Navigation and GPS Articles
http://www.gpsinformation.org/dale/
A Practical Guide to GPS http://www.dbartlett.com/
GPS: The New Navigation http://www.pbs.org/wgbh/nova/longitude/gps.html
Canada Map Sales http://www.canadamapsales.com/
Canadian Topographic Maps Maps 101 http://maps.nrcan.gc.ca/maps101/index.html
Burchill's GPS Workshop: http://home.cc.umanitoba.ca/~burchil/mantario/gps.html

GeoCaching

The Official Global GPS Cache Hunt Site http://www.geocaching.com/
MANITOBA GEOCACHING ASSOCIATION http://www.mbgeocaching.ca/

Utilities and GIS Source.

GPS Utility http://www.gpsu.co.uk/
GSAK (Geocaching Swiss Army Knife) http://www.gsak.net/
Easy GPS http://www.easygps.com/
Manitoba Land Initiative http://web2.gov.mb.ca/mli/

GPS Manufacturers

Garmin: http://www.garmin.com/
Magellan: http://www.magellangps.com/en/
Lowrance Electronics http://www.lowrance.com/

Support

Mountain Equipment Co-op http://www.mec.ca