**3.3** **Primary GIS Data Collection methods**

**Reading material**

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| Primary GIS Data Collection methods  In this session you will learn more about primary data collection.  Primary data or raw data is a type of information that is obtained directly from the first-hand source through experiments, surveys, or observations. A typical example of primary data are household surveys. In this form of data collection, researchers can personally ensure that primary data meets the standards of quality, availability, statistical information and sampling required for a particular research question. |
| You will now go through five data collection methods:   1. Remote Sensing 2. Surveying 3. LiDAR – vector data capture 4. Global Navigation Satellite System (GNSS) 5. Mobile Sensor system |
| 1. **Remote Sensing**   Remote sensing is used to determine the chemical, physical, and biological properties of an area without physical contact – making it one of the most popular methods for gathering raster data. This type of GIS data collection is primarily carried out by satellites and aircraft sensors, which can assess the characteristics of a location by measuring the electromagnetic radiation objects on the surface emit.  Remote sensing is advantageous to GIS professionals for several reasons. To start, remote sensing can cover massive areas, including spots that would be difficult to get to physically (such as the middle of an ocean). In addition, this GIS data collection technique allows for continuous information gathering, which can be helpful when monitoring local temperatures, assessing water levels, measuring air quality, etc. |
| One form of remote sensing used for GIS data collection, typically conducted by high-quality analogue optical cameras, is photography. GIS photography can come in many different forms, including satellite images, aerial photographs, thermal images, and digital elevation models (DEMs).  While extremely useful, digital elevation models are more challenging to create than traditional photos are. To create one, you’ll have to use stereo imagery, which means you’ll need two satellites to take a picture of the same location from different angles.  In contrast, aerial photography is one of the earliest, simplest remote GIS data collection methods – and today, it’s one of the cheapest. Aerial photography tends to capture small areas from a much lower height than satellite imagery. While the two can find similar types of information, aerial photography is typically reserved for smaller-scale applications such as agricultural management, land use, and marketing properties. |
| Aerial surveys (a) and satellite remote sensing (b) are employed to map relatively large areas at comparably large scales, as illustrated in the images below:    *Shuttle Radar Topography Mission, U.S. Geological Survey Department of the Interior/USGS and NASA, JPL.* <https://ltb.itc.utwente.nl/509/learningoutcome/show/76976> |
| 1. **Surveying**   Surveying is the science of accurate measurement of natural and human made features on the earth. Data collected by surveyors are then used to create highly precise maps. Surveyors calculate the precise position of points, distances and angles through geometry. This includes most of the time the use of instruments such as total stations, EDM etc, ...  Though not the most efficient or cost-effective methodology, ground surveys are the most accurate form of vector-based GIS data collection. For this reason, surveys tend to be the method of choice when it comes to measuring buildings, property lines, and other features where precision is a top priority. The basic principle in play here is that location can be determined by assessing the direction and distance from other known locations. Accordingly, surveys are an excellent way to determine a reference point for other forms of GIS data collection.  BIM 101: Total Station Measurement Methods - BIM Learning Center  Source:<https://ltb.itc.utwente.nl/509/learningoutcome/show/76976> |
| More on how land surveying works, you can find in the next video.  <https://www.youtube.com/watch?v=SPCewaAfqPA> (time duration 6:25) |
| 1. **LiDAR – vector data capture**   LiDAR which stands for Light Detection and Ranging, is a relatively new technology used for GIS data collection. If topographic surveys weren’t exciting enough already, these surveys are created with lasers. LiDAR is rather complex, but the main components are low flying aircraft and GPS technology. The instruments gather in-depth information on the Earth’s shape by scanning an area with flashing lights, resulting in an accurate, almost instant topographic survey.  LIDAR  Source: <https://www.aidash.com/remote-sensing-the-art-behind-geospatial-data-collection-for-non-experts/> |
| Find out how LiDAR data is collected in this video:  <https://www.youtube.com/watch?v=H2-Yp30TGk4> (time duration 4:09) |
| 1. **Global Navigation Satellite System (GNSS)**   Global Navigation Satellite System (GNSS) refers to a constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers. The receivers then use this data to determine location. Earth-orbiting satellites broadcast their locations in space and time, of networks of ground control stations, and of receivers that calculate ground positions by trilateration.  satellite imagery  Source : <https://www.gps.gov/> |
| The performance of GNSS is assessed using four criteria:   1. Accuracy: the difference between a receiver’s measured and real position, speed or time; 2. Integrity: a system’s capacity to provide a threshold of confidence and, in the event of an anomaly in the positioning data, an alarm; 3. Continuity: a system’s ability to function without interruption. 4. Availability: the percentage of time a signal fulfils the above accuracy, integrity and continuity criteria. |
| At present GNSS include two fully operational global systems: the United States' Global Positioning System (GPS) and the Russian Federation's GLObal NAvigation Satellite System (GLONASS), as well as the developing global and regional systems, namely Europe's European Satellite Navigation System (GALILEO) and China's COMPASS/Bei-Dou, India's Regional Navigation Satellite System (IRNSS) and Japan's Quasi-Zenith Satellite System (QZSS). Once all these global and regional systems become fully operational, the user will have access to positioning, navigation, and timing signals from more than 100 satellites. |
| 1. **Mobile sensor system**   With a mobile Sensors system and the support of a satellite receiver, we can take GIS into the field with us on powerful, compact mobile computers and view, capture and update information, and then synchronize changes between the field and office. **Mobile GIS provides the integration of mapping, GIS and positioning to field users via hand-held and mobile devices.**    Source: <https://ltb.itc.utwente.nl/509/learningoutcome/show/76976> |

**Exercise materials and tasks**

**Quiz questions**

Please perform the following sorting exercise to check if you have understood the different methods and their features:

Please link the features on the right with their corresponding method:

Town expansion, car navigation, tree height, water pipeline, crop observation, plot border, boat location, traffic sign, digital elevation model, garbage can, flood, civil engineering, forest

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| --- | --- |
| Remote sensing |  |
| Surveying |  |
| LiDAR |  |
| GNSS |  |
| Mobile GIS/GPS |  |

Answer:

Remote Sensing - town expansion, flood, forest, crop observation

Surveying - plot border, civil engineering, water pipeline

LiDAR - tree height, digital elevation model

GNSS - boat location, car navigation

Mobile GIS/GPS - traffic sign, garbage can