UNIT 5 DATA TYPES AND SOURCES

Structure

5.1 INTRODUCTION

In the previous unit, you have been introduced to data, information and also to geospatial data. As you know, geospatial data represents real world features (such as roads, land use, land cover, elevation, trees, waterways, etc.). Real world features can be divided into two abstractions, i.e. discrete features (e.g., a house) and continuous fields (such as rainfall amount, or elevations). The two kinds of abstractions are represented as raster and vector data, respectively. Though you have studied about the two types of spatial data in the previous unit, we will discuss in a little more detail about the two data types along with some examples in this unit. Geospatial data can now be obtained from a variety of sources. In this unit, we will also discuss about the sources from where you can obtain geospatial data.

Objectives

After studying this unit, you should be able to:

- describe the various types of spatial data;
- list out the sources of raster data;
- discuss about sources of vector data; and
- write about the sources of metadata.

5.2 TYPES OF SPATIAL DATA

As you have studied in the previous unit that spatial data records the relationship among and about geographically distinguishable features. In other terms, spatial data describes the spatial situation of objects concerning their

We will discuss about coordinate system in Unit 8 *Basics of Mapping* of MGY-001 *Overview of Geoinformatics*.

form and their relative situation in space and time. Usually, the spatial relation of individual points, lines or areas is made through a coordinate system, resulting in the relation to the real world coordinates. Here, we will discuss about the two data types i.e. raster and vector in some more detail with some representative examples.

5.2.1 Raster Data

As you know that in raster data type, real world features are represented as grids as shown in Fig. 5.1 a and b. In this data type, a fixed grid dimension is used and information about each grid is recorded. Raster data represents continuous numeric values, such as elevation, and continuous categories, such as vegetation types, water, etc.

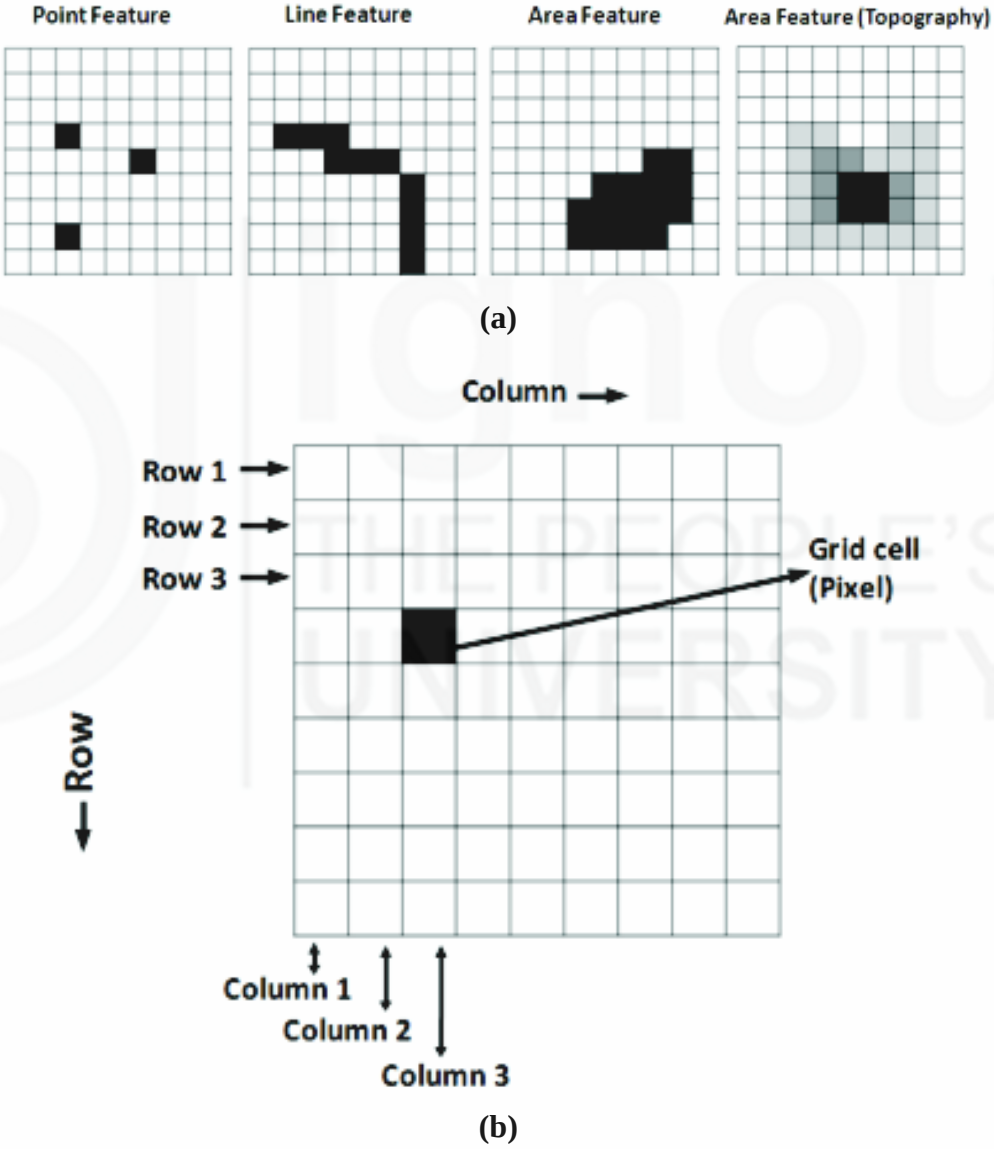


Fig. 5.1: a) Raster representation of real world features in the form of points, lines and area; b) grid structure of the raster data type representation

One of the most common examples of raster data is remote sensing image. All the digital remote sensing images is the example of primary raster data type irrespective of the fact whether it has been acquired through satellite remote sensing or aerial photography technique, as listed in Fig. 5.2. Scanned aerial photographs and satellite data are also the examples of raster data type.

As shown in Fig. 5.2, examples of raster data types are the following:

- digital satellite images, aerial photographs and space shuttle images
- scanned films, hard copy maps and images
- digital elevation models (DEMs).

We will now discuss about the three examples of raster data:

Satellite images, aerial photographs and space shuttle images can be used in remote sensing, GIS and mapping applications after some initial processing.

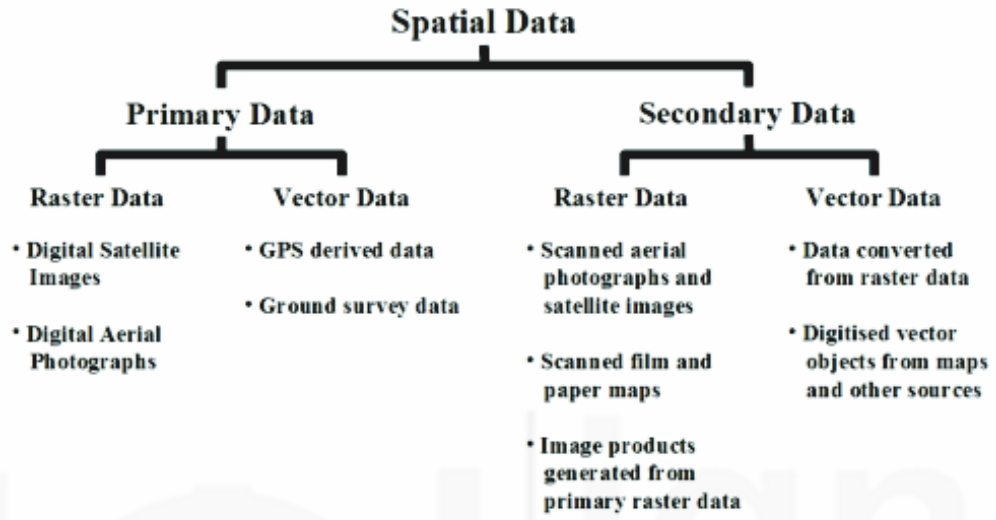


Fig. 5.2: Types of spatial data and the examples of raster and vector data types

a) Satellite Images, Aerial Photographs and Space Shuttle Images

Digital data from Earth-orbiting satellites provide a vast array of raster data which are used as input to GIS. Although there are several thousand manmade satellites around Earth, only a few series currently provide data suitable for GIS. These satellites are referred to as Earth-observation satellites, as they collect images (from a variety of sensors) of the Earth's surface and send these to receiving stations on the Earth. These remote sensing data are the most common example of raster data as shown in Fig. 5.3a.

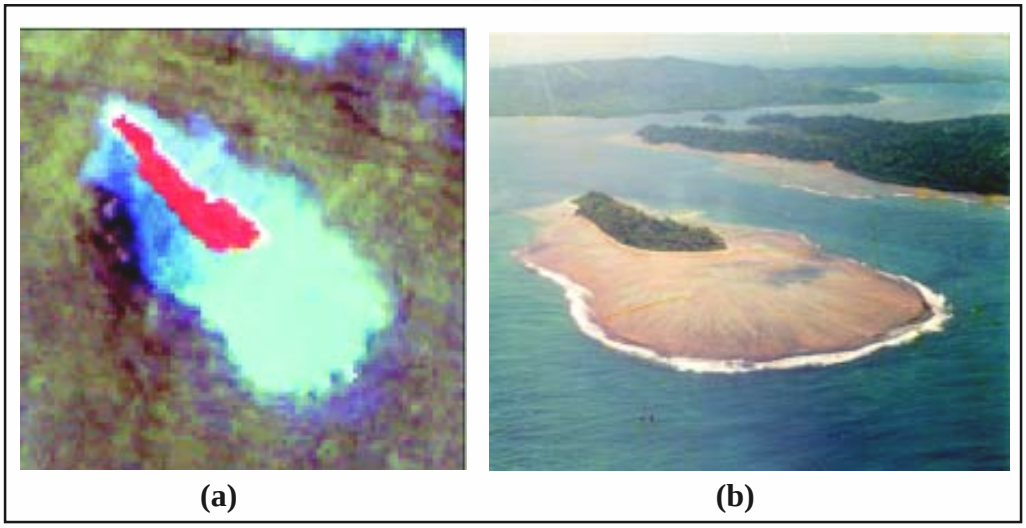


Fig. 5.3: (a) A satellite remote sensing image of the Jolly Buoy island at the Mahatma Gandhi Marine National Park at Wandoor located about 30 km from Port Blair in Andaman; (b) an aerial photograph of the same island

Orthophotographs combine the detail of photographs with the properties of a map.

Orthorectification converts image into map-accurate form by removing camera and terrain related distortions from the imagery through the use of sensor and terrain (elevation) information.

Digital aerial photographs are another common example of raster data (Fig. 5.3b). However, before using the aerial photographs directly in GIS, the distortion should be removed. The corrected, aerial photograph is called orthophotograph. This means that distances and areas can be measured on the orthophoto, bearings can be taken, and the data can be combined with other GIS data. Orthophotographs have been in existence since a long time, although earlier orthophotographs were primarily available only as analog products, such as a paper or film print. Data analysis tools/software have made it much easier to produce digital orthophotographs that are stored as a raster image file.

Photographs taken by astronauts during their space shuttle flights and also during their stay at the International Space Station (ISS) have also become a good source of raster data (Fig. 5.4). Characteristics of these space shuttle images are comparable to the satellite images in many aspects.

Fig. 5.4: Astronaut photograph of Adams Bridge connecting India and Sri Lanka through a chain of small islands. The bridge is popularly known as Ram Setu as it is believed to have been built by Lord Rama (source: http://eol.jsc.nasa.gov/ scripts/sseop/QuickView.pl?directory=ESC&ID=ISS006-E-43707)

b) Digital Elevation Models

Digital Elevation Models (DEMs) are one of the most versatile examples of raster data. These simple grid files contain locations (*x*, *y* coordinates) with the elevation (*z* value) at that location (Fig. 5.5). DEM can be used to support numerous topographical applications. The primary utility of these datasets comes from the fact that they represent topographical surface (such as height variations on the Earth) and show the relationship in 3D with physical landforms when all other features are placed upon them. Other datasets (both raster and vector) can be overlain on the DEM to provide a more realistic relationship between the data and the underlying topography. 3D GIS based applications essentially require DEM as one of the important layers. DEM can be generated from spot height data collected from ground surveys and from information in topographical maps. It can also be created from aerial photographs and remote sensing data.

c) Scanned Images and Paper Maps

In many instances, sources of raster data in geoinformatics data analysis tools begin as scanned photographs or maps (Fig. 5.6a). This generally refers to aerial photographs or any maps. Many scanned images, used in data analysis tools are both for illustrative and interpretive applications. For general imagery, where accuracy is not a major concern, a simple, scanned photograph may be acceptable. It may serve as a basic illustration or guide, but unless it is spatially accurate it has no real place in a data analysis tool.

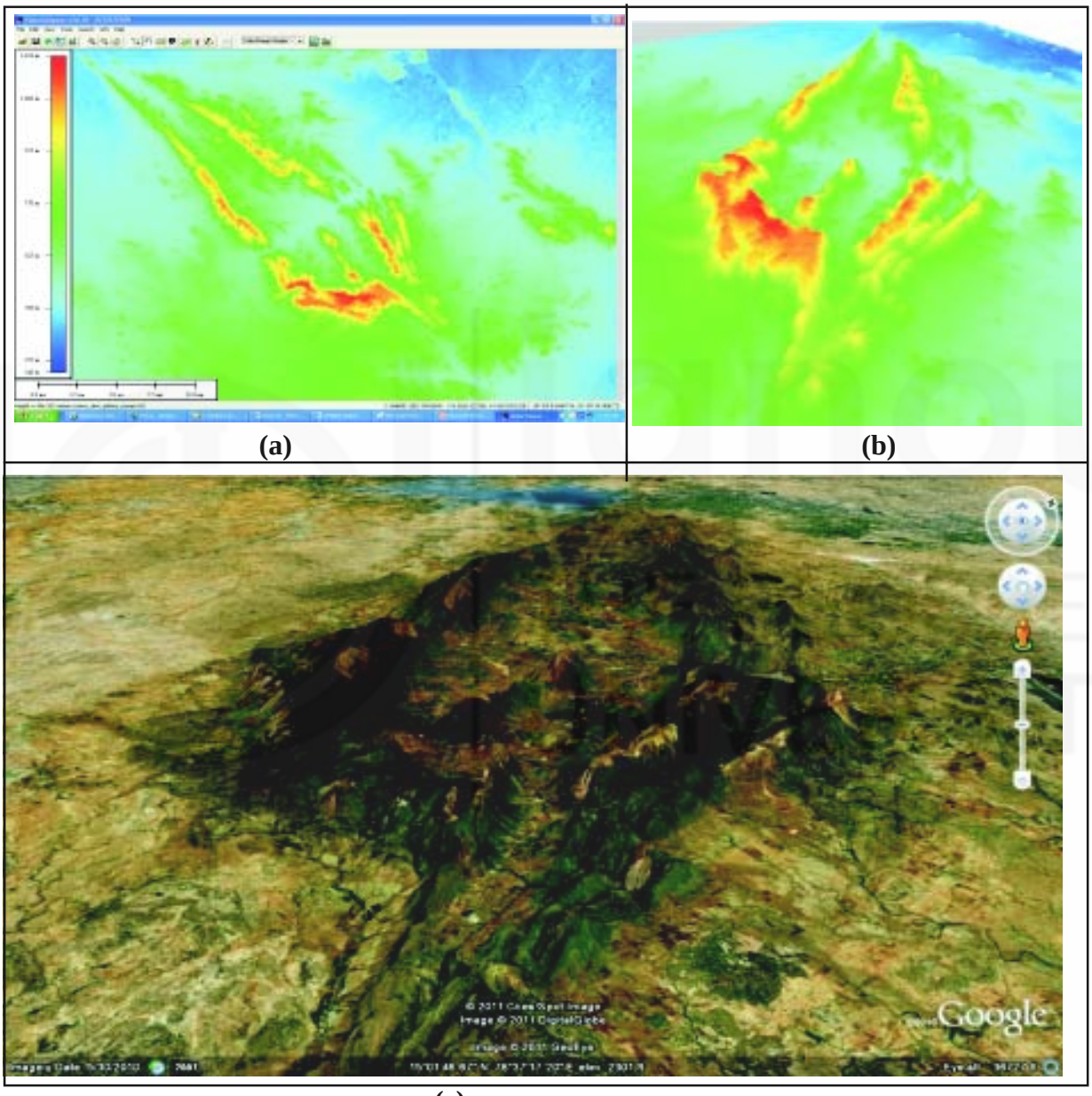


Fig. 5.5: a) A digital elevation model of a part of Karnataka, colour range from blue to red show increasing elevation; b) Three dimensional visualisation of the DEM; c) A satellite image draped over the DEM showing three dimensional view of the region (source: www.earth.google.com)

d) Derived Products

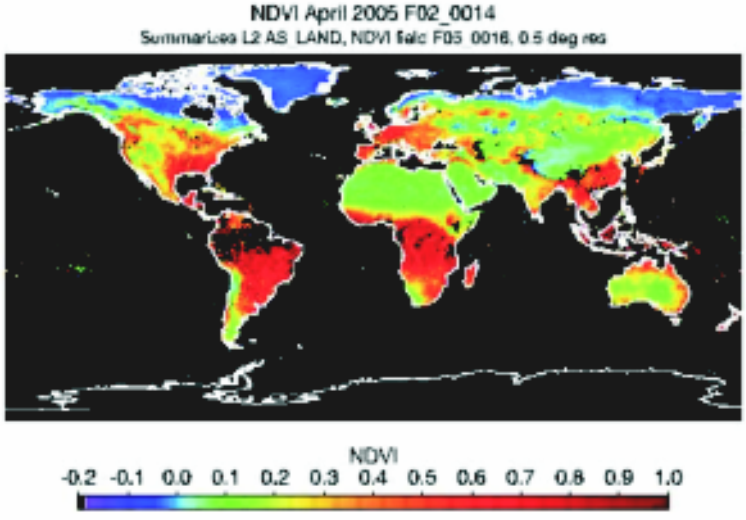
Digital data products generated from the primary raster data, such as satellite images, aerial photographs, etc., are also the examples of raster data. Some of the commonly generated products are land use/land cover maps, vegetation related products (Fig. 5.6b), ground water potential zone maps, etc.

5.2.2 Vector Data

Vector is the most popular form of representing features in GIS. The points, lines and areas of vector data can describe almost all spatial features on the Earth surface, we are interested in representing it in GIS and further analysing (Fig. 5.7). Road networks, schools districts, accident locations, addresses, rivers and streams-these features and many more are usually represented by vector data. Besides using existing vector data, most geoinformatics practitioners will end up making their own vector data. You can create vector data by digitising off the computer screen (referred to as 'heads-up' digitisation) or by digitising a printed map. This section provides a brief introduction to some of the more common vector datasets.

You will learn more about the devices used and process of digitisation in Unit 7 *Data Input of MGY-003 Global Navigation and Satellite System and Geographical Information System.*

(a)



(b)

Fig. 5.6: (a) Shows a paper map of a district boundary, which has been scanned and stored as a raster data; (b) Shows a derived product i.e. NDVI (Normalised Differential Vegetation Index) map of the world (source: http://rst.gsfc.nasa.gov/Sect3/Sect3_4.html)

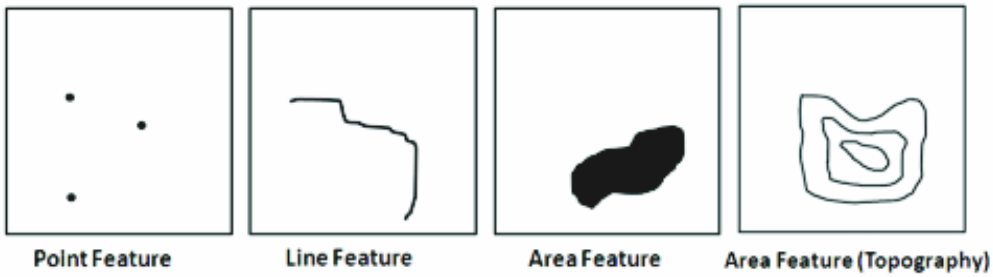


Fig. 5.7: Vector representation of real world features in the form of points, lines and area

a) GPS and Ground Survey Data

There is another important group of satellites that do not record imagery and rather provide locational reference information concerning one's location on the Earth. These locations are frequently used in data analysis tools to record locations of surface features and also to refer datasets as per the Earth's coordinates. The Global Positioning Systems (GPS) are the most common tool receiving signals from GPS satellites to provide locational information. Another source of vector data is the ground survey data, which are collected on the ground. You have learnt in the last unit that the vector data can be in form of point, line or area features (Fig.5.8).

b) Converted or Derived Products

Digital data products converted from the primary raster data or derived from the primary raster or vector data are also the examples of vector data. Some of the common products are land use/land cover maps, ground water potential zone maps, etc.

5.2.3 Comparison of Raster and Vector Data

As you have studied that the real world features can be represented in either raster or vector data types. However, there are some advantages and disadvantages of representing the real world features as raster or vector data. Fig. 5.8 depicts a comparison of how real world features are represented as vector and raster data.

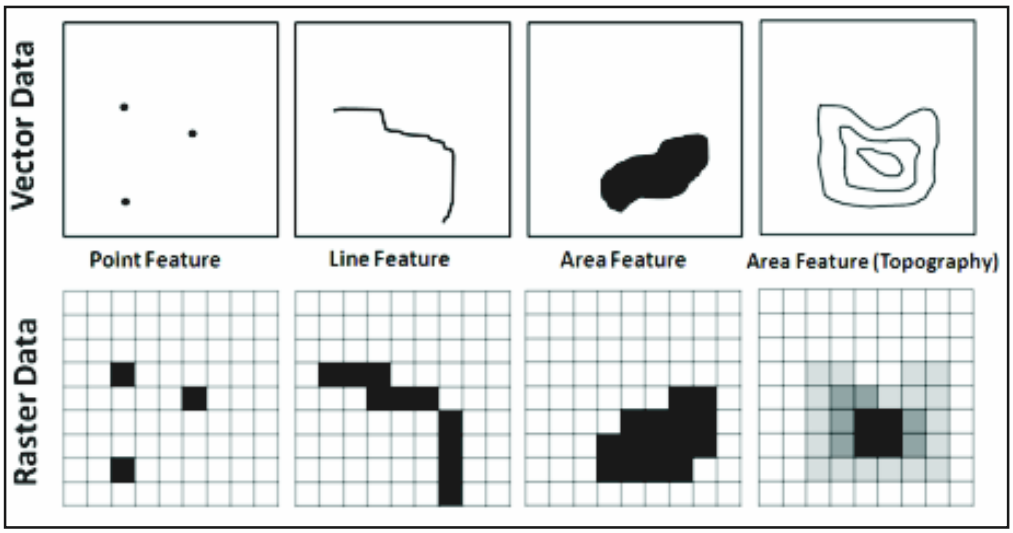


Fig. 5.8: Comparison of vector and raster representation of real world features in the form of points, lines and area

Some of the advantages and disadvantages of representing the real world features as raster or vector data are given below:

- vector data can be displayed as vector graphics used on traditional maps, whereas raster data appear as an image that may have a blocky appearance for object boundaries as seen in Fig. 5.8
- raster data record a value for all points in the area covered which may require more storage space than the data in a vector format. Hence, sizes of vector files are usually smaller than raster data. Raster data can be tens, hundreds or more times larger than vector data
- it is easy to update and maintain vector data as a new feature (e.g. a road) can be added or removed from an existing vector data, whereas to update a raster data it needs to be completely reproduced
- vector data allows much more analysis capability, finding and creating networks, best route, airfields connected to two-lane highways, etc. Raster data does not have all the characteristics of the features it displays.

Spend 5 mins

Check Your Progress I

1) List the types of raster data.

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2) List the types of vector data.

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3) What does DEM stand for?

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5.3 SOURCES OF GEOSPATIAL DATA

In the previous section, we have discussed two data types namely; raster and vector. In this section, we will discuss about different sources of geospatial data which you can acquire either on cost or for free. We will also briefly discuss about how to find data and the kind of data available at different sources. First, we will discuss about different sources of raster data, followed by the vector data.

5.3.1 Sources of Raster Data

Though, raster data can be obtained in a number of ways; the most common ways are by means of aerial photography and satellite remote sensing.

In aerial photography, an aeroplane flies over an area, with a camera mounted underneath it. The photographs in digital format are imported into a computer and used. If the photographs are printed on hardcopy print then these are used either as such or converted into digital form (raster form) with the use of a high quality scanner. The digital data are then imported into a computer and used.

Satellite images are recorded when satellites orbiting the Earth capture signals from earth surface features of the area they are passing over. Once the image has been recorded, it is transmitted back to Earth receiving stations, electronically. You know that this process of capturing raster data from an aeroplane or satellite is called remote sensing. Here, we shall discuss about the sources of raster data which have already been acquired and archived by data providers, and are made available for users. Satellite data providers provide satellite images in several data formats with a variety of products created. We will discuss here the commonly used raster datasets viz. remote sensing satellite data, digital elevation model data and derived raster products.

a) Remote Sensing Satellite Data

In India, user can acquire remote sensing data from National Data Centre (NDC) of National Remote Sensing Centre (NRSC), of ISRO, which is located at Hyderabad. Remote sensing data from many satellites are available at the GLCF (Global Land Cover Facility) website at http://glcf.umiacs.umd.edu/data, as shown in Fig. 5.9. The GLCF is a center for land cover science with a focus on research using remotely sensed satellite data and products to assess land cover change from local to global scales. The archived Landsat orthorectified imagery for all the bands (ETM-PAN, TM and MSS data) is freely downloadable. These data are associated with locational accuracy of better than 50 meters. The data are useful for many of the natural resources mapping, monitoring, change detection studies, etc. Besides the Landsat data, some selected data from ASTER, IKONOS, Quickbird, Orbview, MODIS, SRTM, etc. are also available.

You will learn more about different kinds of satellite sensor data in Unit 6 *Major Space Programmes* of this Course.

Fig. 5.9: Webpage of the GLCF showing the kinds of data available therein

ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) data are available from the Terra satellite at http://asterweb.jpl.nasa.gov. There is more than one website which is offering fully or partially downloadable ASTER data for some parts of the Earth. Some of them are mentioned below:

- www.orthocoverage.com/download.
- http://edcdaac.usgs.gov/datapool/datapool.asp.
- www.cr.usgs.gov.
- https://lpdaac.usgs.gov.

The data broadly serve three categories of users based on size of the data and objective of the study namely, Local Observations, Regional Monitoring, and Global Mapping.

The remote sensing data could also be obtained from the Google Earth and ISRO Bhuvan about which we shall discuss in the following paragraphs.

i) Google Earth

You might be using Google Earth, which has a large number of images and other geographic information (Fig. 5.10). The free Google Earth basic program consists of thousands of satellite/aerial photographs that are updated periodically. The increasing popular program allows users to view their homes or any other area of interest around the world in a matter of seconds. According to the type of information it provides, we can put the Google Earth under category of hybrid database provider, because, in addition to image canvas, vector database comprising administrative/political boundaries, important place names, image scale, acquisition date, tourist places, and other information are available. Google Earth has QuickBird images to its browser covering important places, like cities, airports, industrial and others. Viewers

can browse their area of interest and fly through at variable angles, altitudes, scales and information. Geographic coordinates could be derived for any place. Navigation tools are provided for pan, zoom, visualise and fly through. By paying nominal price, the user can download QuickBird images from the server.

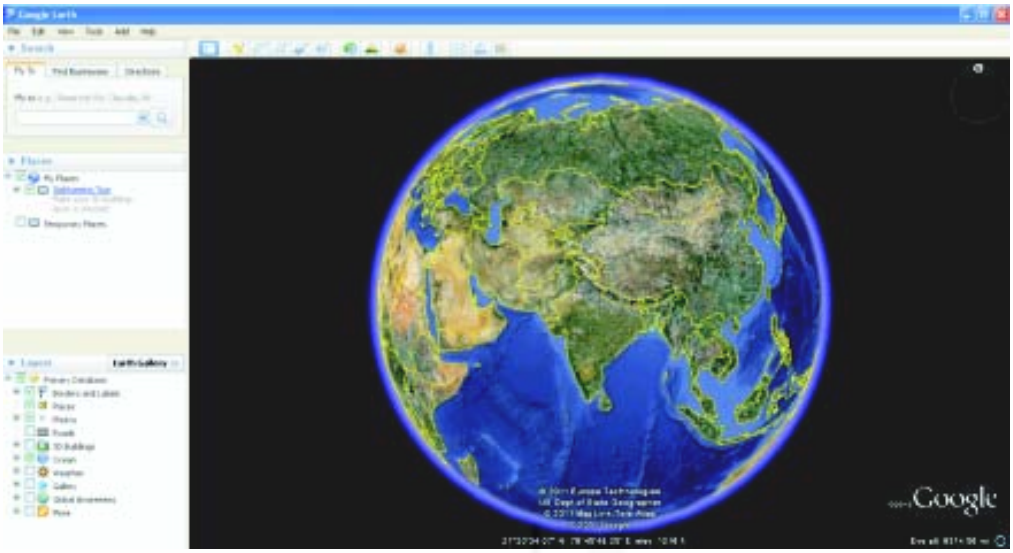


Fig. 5.10: A snapshot of the Google Earth

ii) Bhuvan

It is a geoportal of Indian Space Research Organisation (ISRO) showcasing Indian imaging capabilities in multi-sensor, multi-platform and multi-temporal domain (Fig. 5.11). This Earth browser gives a gateway to explore and discover virtual Earth in 3D space with specific emphasis on Indian regions. Bhuvan on its portal provides a range of services enabling isualization of various thematic data generated from different national missions and projects carried out by NRSC (National Remote Sensing Centre), Hyderabad. You will study the services provided by Bhuvan in the following paragraphs, which include land, weather, ocean and disaster services.

(a)

(b)

Fig. 5.11: Two snapshots of ISRO's Bhuvan

Land Services: Through this service, Bhuvan lets users visualise thematic information which are critical for developmental activities. The 'Land services' link provides information on a variety of themes such as:

- groundwater potential zones and groundwater recharge areas
- land use/ land cover
- crop assessment and crop production forecasts
- watershed development
- national, state and district level wastelands information.

Weather Services: One of the key elements for improved weather forecast and services is observation. Augmentation of the current observation network is essential for providing weather and related information at local level. ISRO's programs on Disaster Management Support and Village Resource Centre (VRC) have weather information as a critical component. Several major user agencies in the country such as Indian Meteorological Department (IMD), Snow and Avalanche Study Establishment (SASE), Central Water Commission (CWC), State Agricultural Departments / Universities require automated systems for weather data collection from remote and inaccessible areas. Automatic Weather Station (AWS) transmits meteorological data every hour from remote stations installed in the foot print of INSAT / KALPANA satellite. On Bhuvan, this service gives information on latitude, longitude, temperature, pressure, wind, and humidity of the chosen location.

Ocean Services: The data showcased on Bhuvan about the Potential Fishing Zones (PFZ) contain information about distance, direction, and depth of the potential fishing zones.

Disaster Services: The Disaster Management Support (DMS) program of ISRO, commits to providing timely support and services from aero-space systems, both imaging and communications, for strengthening the resolves of disaster management in the country. These include creation of digital data base for facilitating hazard zonation, damage assessment, etc., monitoring of major

natural disasters using satellite and aerial data, development of appropriate techniques and tools for decision support, establishing satellite based reliable communication network, deployment of emergency communication equipments and research and development work towards early warning of disasters.

b) Space Shuttle Images

A good collection of digital astronaut photographs are available at the website of the Johnson Space Centre, USA (Fig. 5.12). The site hosts digital data of the entire world taken during different space missions, and hence provides data of different time scales. However, the digital astronaut images require some processing before these can actually be used by the users. The website provides links to different webpages wherein users can search data their interest.

Fig. 5.12: A good collection of space shuttle images is available at the website of Johnson Space Centre (source: http://images.jsc.nasa.gov/luceneweb/image_sites.jsp)

c) Digital Elevation Model Data

Following Digital Elevation Model data can be obtained by users for their work:

- Shuttle Radar Topographic Mission (SRTM) DEM Data
- ASTER DEM
- GTOPO30
- ETOPO5 5-minute gridded elevation data
- HYDRO1k

- ETOPO2 2-Minute Gridded Global Relief Data
- Land topography
- Gridded Global Topography
- Terraserver, etc.

i) **Shuttle Radar Topographic Mission (SRTM) DEM Data:** The SRTM is a joint project between the National Imagery and Mapping Agency (NIMA) and the National Aeronautics and Space Administration (NASA). The objective of this project is to produce digital topographic data for the Earth's surface (between 60ºN & 56°S latitudes), with data points located every 1-arc-second (approximately 30 m) on a latitude/ longitude grid. The absolute vertical accuracy of the elevation data is 16m. The data can be tailored to meet the needs of the military, civil, and scientific user communities. Other uses of the data include drainage modeling, realistic flight simulators, and site suitability for cell phone tower locations, navigation safety, improved mapping tasks, flood control, soil conservation, reforestation, volcano monitoring, earthquake research, and glacier movement monitoring. The data could be downloaded freely from http://srtm.usgs.gov.

ii) **ASTER DEM:** Land Processes Distributed Active Archive Centre (LPDAAC) offers ASTER image data DEM products (Fig. 5.13). The 30m DEM product is available in GeoTiff format via the FTP (File Transfer Protocal) mode from https://wist.echo.nasa.gov/wist-bin/api/ims.cgi?mode= MAINSRCH&JS=1 or www.gdem.aster.ersdac.or.jp/index.jsp.

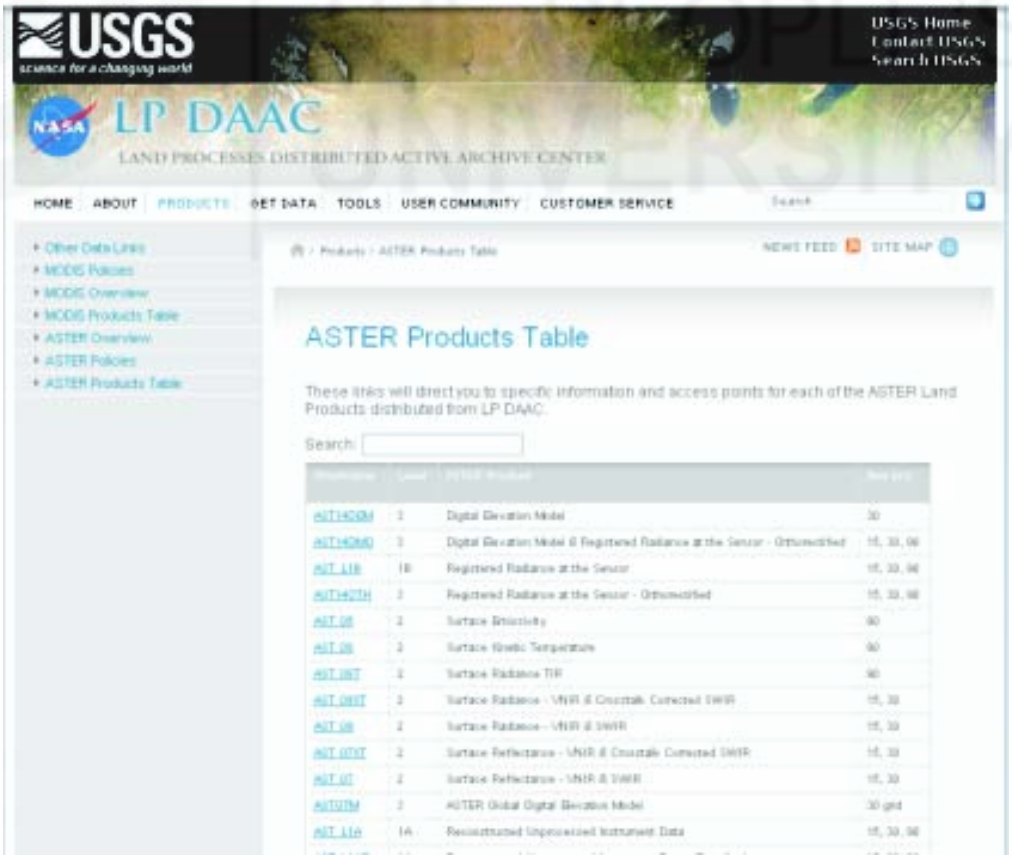


Fig. 5.13: A snapshot of LPDAAC website showing ASTER data products

iii) **GTOPO30:** It is a global DEM with horizontal grid spacing of 30-arc seconds (approx 1 km). GTOPO30 was derived from several raster and vector sources of topographic information. GTOPO30 project was completed in 1996 and developed over a 3-year period through a collaborative efforts led by staff at the USGS's Earth Resources Observation and Science (EROS) Centre. The DEM data is available for download from the website http://eros.usgs.gov/#/ Find_Data/ Products_and_Data_Available/gtopo30_info.

iv) **ETOPO5 5-minute Gridded Elevation Data:** It was generated from a digital database of land and sea floor elevations on a 5' latitude/ longitude grid. Data sources consist of ocean areas: US Naval Oceanographic Office, USA; West Europe, Japan/Korea: US Defense Mapping Agency; Australia: Bureau of Mineral Resources, Australia; New Zealand: Department of Industrial and Scientific Research, New Zealand; balance of world landmasses: US Navy Fleet Numerical Oceanographic Center. These various databases were originally assembled in 1988 into the worldwide 5-minute grid. The data can be downloaded from www.ngdc.noaa.gov/mgg/global/etopo5.HTML.

v) **HYDRO1k:** It is a geographic database developed to provide comprehensive and consistent global coverage of topographically derived data sets, including streams, drainage basins and ancillary layers derived from the USGS' 30 arc-second DEM of the world GTOPO30. HYDRO1k provides a suite of georeferenced data sets, both raster and vector, which will be of value for all users who need to organise, evaluate, or process hydrologic information on a continental scale. Its main goal is to provide to users, on a continent by continent basis, hydrologically corrected DEMs with ancillary data sets for use in continental and regional scale modeling and analyses. The data can be downloaded from http:// eros.usgs.gov/#/Find_Data/Products_and_Data_ Available/HYDRO1K. The major applications of GTOPO30 and HYDRO1K are:

- Terrain Visualisation
- Hydrologic Modeling
- Geological Applications
- Viewsheds Signal Propagation
- Remote Sensing Data Processing, etc.

vi) **ETOPO2 2-Minute Gridded Global Relief Data*:*** Newly created global elevation database gridded at 2-minute (lat-long) resolution is available at http://www.ngdc.noaa.gov/mgg/global/etopo2.html. The GEODAS data access system allows searching, extraction, display, and reformatting of the data. Color shaded relief images derived from the data displayed as 64, 512, and 1350-pixel squares representing 45° square areas.

vii) **Land Topography:** It is from the GLOBE project, an internationally designed, developed, and independently peer reviewed global digital DEM, at a latitude-longitude grid spacing of 30 arc-seconds. It is part of focus on the International Geosphere- Biosphere Programme and its data and information system.

viii) **Gridded Global Topography:** The Global Land One-kilometer Base Elevation (GLOBE) project is a 30-arc-second (1-km) gridded, quality-controlled global DEM. Global Relief: ETOPO2 supersedes TerrainBase and ETOPO5 were produced at an 8 km nominal grid (5' resolution). ETOPO2 contains more detailed 2' gridded data, which can be downloaded from www.ngdc.noaa.gov/mgg/topo/topo.html.

ix) **Terra Server:** TerraServer.com was founded with the purpose of finding a commercial market for satellite imagery and aerial images. The company procured a series of high-resolution satellite images for some specific areas. It became the first to release these images to the general public on April 17, 2000 and major internet provider (www.terraserver.com). User may view and buy images and many different stock image products available. Through partnerships with many leading imagery providers, it has assembled the largest variety of aerial and satellite imagery on the internet.

d) Derived Raster Products

Some of the commonly used derived raster products include the followings:

- land use/landcover maps
- normalised Difference Vegetation Index (NDVI) maps
- SPOT vegetation data
- biodiversity hotspot maps
- coral Reef hotspot maps.

The GLCF and NOAA websites also host several raster products, as shown in Figs. 5.14 and 5.15.

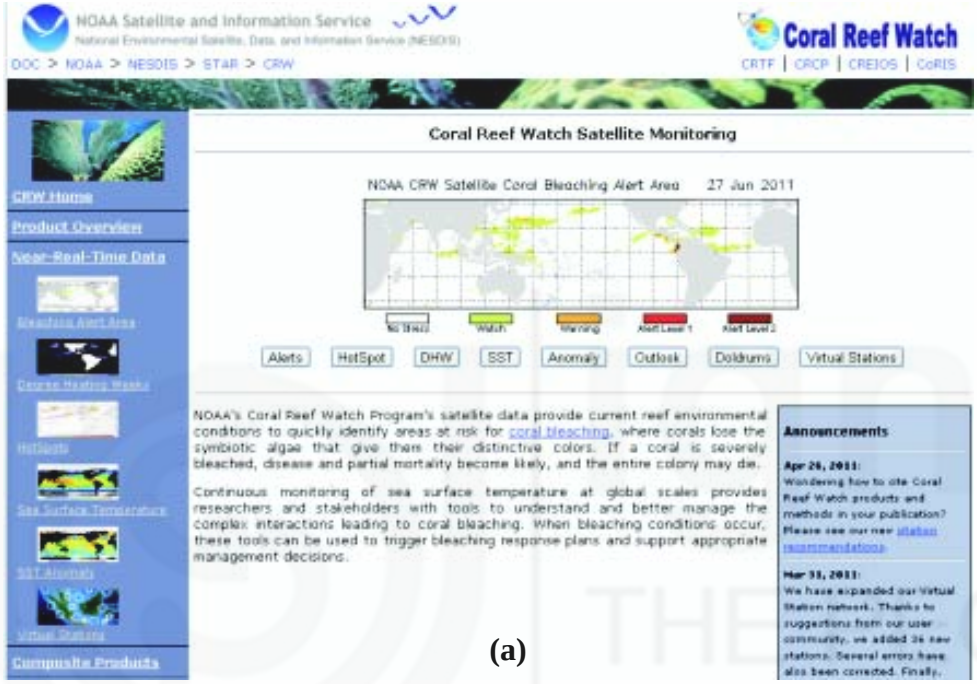
Fig. 5.14: A snapshot of the GLCF webpage hosting different raster data products

The following are some brief vector data sources from internet:

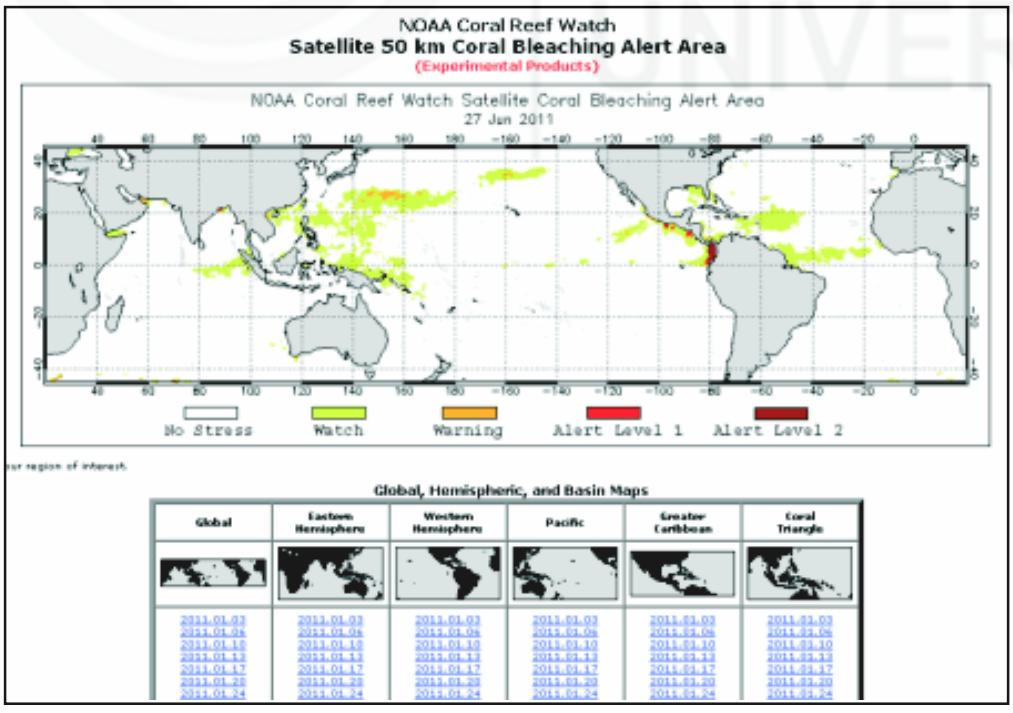
5.3.2 Sources of Vector Data

There are many sources of vector data from where we can obtain vector data either at some cost or freely. However, you need to be sure and careful while using these maps with regard to their appropriateness and accuracy.

The Digital Chart of the World (DCW) is an Environmental Systems Research Institute Inc. (ESRI) product, originally developed for the US Defense Mapping Agency (DMA). It is a vector cartographic dataset based at 1:1,000,000-scale Operational Navigation Chart (ONC) series, which is the largest scale basemap source with global coverage.



(a)



(b)

Fig. 5.15: (a) Snapshot of the NOAA webpage hosting various raster data products related to coral reefs; (b) shows a product indicating coral reef bleaching alert areas (source: http://coralreefwatch.noaa.gov/satellite)

The stock of Omni resources comprising international topographic maps at all scales is one of the largest of any map dealer worldwide. All worldwide topographic maps at 1:250,000 are available. It also stocks most of the topographic maps available worldwide at 1:50,000 scale, especially Europe, Central America & South America. Topographic maps at 1:25,000 scale for selected countries, like U.K, France, Switzerland, Belgium, U.S and other parts of the world are also available. Besides, topographic maps at 1:25,000 scale for many major cities worldwide are available.

In India, there are several data centres from where one can procure data. List of the geospatial data centers across India is given in Table 5.1 along with their addresses.

Table 5.1: Geospatial data centers across India

Sl No	Name of the Geospatial Data Centre	Mailing Address
1	Andhra Pradesh Geospatial Data Centre, Hyderabad	Director, Andhra Pradesh Geospatial Data Centre, Survey of India, Uppal, Hyderabad-500039 Ph.: 040-27200359; Fax: 040-27202059 E-mail: dirgdc-ap@nic.in, directorapgdc@yahoo.com
2	Assam and Nagaland Geospatial Data Centre, Guwahati	Director, Assam & Nagaland Geospatial Data centre, Survey of India, Ganeshguri Chariali Dispur, Guwahati - 781006 Ph.: 0361/ 2234370, Fax No. 0361/ 2261725 E-mail: angdcguw-asm@nic.in
3	Bihar Geospatial Data Centre, Patna	Director, Bihar Geospatial Data Centre, 164 A/B, Sheikhpura House (Near JD Women's College), PO- B.V. College, Patna-800014 (Bihar). Ph.:0612-2280756 (EPABX), 2280261, 2280265 Fax: 0612-2280265 Email: bihargdc@yahoo.co.in, gdc-bih@nic.in
4	Chhattisgarh Geospatial Data Centre, Raipur	Director, Chhattisgarh Geospatial Data Centre, Survey of India, Reena Apartment, 3rd Floor, Pachpedi Naka, Dhamtari Road, Raipur-492001, Fax: 0771-2411135 E-mail: cggdc@sancharnet.in
5	Gujarat, Daman & Diu Geospatial Data Centre, Gandhinagar	Director, Gujarat, Daman & Diu Geospatial Data Centre, Survey of India, Sir Creek Bhavan, Sector 10-A, Gandhinagar-382010, P.O. Box No. 1, Ph.: 079-23238469 Fax: 079-23237518,079-23240451,079-2324052 E-mail: dirgddgdc@yahoo.com & dir-gddgdc@nic.in
6	Punjab, Haryana & Chandigarh Geospatial Data Centre, Chandigarh	Director, Punjab, Haryana & Chandigarh Geospatial Data Centre, Survey of India, Survey Complex, Dakshin Marg, Sector 32 A, Chandigarh - 160030, Ph.: 0172-2600031, 2602607 Fax: 0172-2604671, E-mail: gdc-soi-chd@nic.in
7	Himachal Pradesh Geospatial Data Centre, Chandigarh	Director, Himachal Pradesh Geospatial Data Centre, Survey of India, SOI Complex, Dakshin Marg, Sector 32 A, Chandigarh - 160030 Fax: 0172-2613398, E-mail: hpgdcsoi@yahoo.com
8	Jammu & Kashmir Geospatial Data Centre, Jammu	Director, Jammu & Kashmir Geospatial Data Centre, H No.65, Zorwar Stadium,Channi Himmat, Jammu-180015 (J&K) Ph.: 0191-2466556, Fax: 0191-2450185 E-mail:jkgdcjammu@yahoo.co.in
9	Jharkhand Geospatial Data Centre, Ranchi	Director, Jharkhand Geospatial Data Centre, Survey of India, Near Magistrate Colony, Doranda, Ranchi-834002, Jharkhand Ph.: 0651-2482789, 2481386, Fax: 0651-2482789 E-mail: gdc-soi-jhr@nic.in, soi_ranchi@yahoo.com

10	Karnataka Geospatial Data Centre, Bangalore	Director, Karnataka Geospatial Data Centre, Survey of India, Sarjapur Road, Koramangala, 2nd Block, Bangalore – 560034 Fax: 080-25533595, E-mail: soikargdc@yahoo.com
11	Kerala and Lakshadweep Geospatial Data Centre, Thiruvananthapuram	Director, Kerala and Lakshadweep Geospatial Data Centre, Survey of India, CGO Complex, Poonkulam, Vellayani PO, Thiruvananthapuram - 695522, Fax: 0471-2481852, E-mail:surveykerala@asianetindia.com
12	Madhya Pradesh Geospatial Data Centre, Jabalpur	Additional Surveyor General, Madhya Pradesh Geospatial Data Centre, Survey of India, Survey Colony, Vijay Nagar, Jabalpur-482002, Fax: 0761-2643182, E-mail: dccsvy@sancharnet.in
13	Maharashtra and Goa Geospatial Data Centre, Pune	Additional Surveyor General, Maharashtra and Goa Geospatial Data Centre, Survey of India, Phulenagar, Alandi Road, Pune – 411006 Fax: 020-26614665, E-mail: mgdcsoipune@vsnl.net.in
14	Meghalaya and Arunanchal Pradesh Geospatial Data Centre, Shillong	Director, Meghalaya and Arunachal Pradesh Geospatial Data centre, Survey of India, Post Box No.89, MALKI, Shillong - 793001 (Meghalaya) Fax: 0364-2224937, E-mail: gdcsoi-ar-meg@nic.in
15	Orissa Geospatial Data Centre, Bhubaneshwar	Director, Orissa Geospatial Data Centre, Survey of India, Survey Bhawan, PO - RR Laboratory, Bhubaneshwar - 751013 Ph.: 0674-2300355, Fax: 0674-2301418, E-mail: ogdco5@sancharnet.in
16	Rajasthan Geospatial Data Centre, Jaipur	Director, Rajasthan Geospatial Data Centre, Survey of India, Great Arc Bhawan, Sector-10, Vidyadhar Nagar, Jaipur- 302023 Ph.: 0141-2236840, Fax: 0141-2236891 E-mail:surwest@datainfosys.net
17	Survey (Air) and Delhi Geospatial Data Centre, New Delhi	Director, Delhi Geospatial Data Centre, Survey of India, West Block No.4, R.K. Puram, New Delhi - 110066 Fax: 011-26196301, 26107035 E-mail:dsa@nda.vsnl.net.in
18	Tamilnadu, Pondicherry and Andaman & Nicobar Island Geospatial Data Centre, Chennai	Director, Tamilnadu, Pondicherry and Andaman & Nicobar Island Geospatial Data Centre Survey of India Block-III, Electronics Complex, Thiru-Vi-Ka Industrial Estate, Guindy, Chennai-600032 Fax: 044-22328145, E-mail: soitnpani@dataone.in
19	Tripura, Manipur and Mizoram Geospatial Data Centre, Silchar	Director, Tripura, Manipur and Mizoram Geospatial Data Centre, Survey of India, P.O. Rangir Khari, N.S. Avenue, Haila Kandi Road, Silchar - 788005, Fax: 03842-240555
20	East Uttar Pradesh Geospatial Data Centre, Lucknow	The Director, East Uttar Pradesh Geospatial Data Centre (N.Z.), Survey of India, B-2, 2nd Floor, Pickup Bhavan, Vibhuti Khand, Gomati Nagar, Lucknow (U.P.) - 226 010, Ph.: (0522) 2720740, 4102260, 2306185, 4102259(Official), 2733671(Resi), 2720634(Fax), 9415330053(Mob.); EPBAX No.: 0522-2720638; E-mail: upgdc-lko@up.nic.in
21	Uttarakhand & West Uttar Pradesh Geospatial Data Centre, Dehradun	Director, Uttarakhand & West Uttar Pradesh Geospatial Data Centre, Survey of India, 17 E.C. Road, Dehradun-248001 Fax: 0135-2656402, E-mail: surveynco@sancharnet.in
22	West Bengal & Sikkim Geospatial Data Centre, Kolkata	Additional Surveyor General, West Bengal & Sikkim Geospatial Data Centre, Survey of India, No.13, Wood Street, Kolkata – 700016, Ph.: 033-2287-2155/5732/5733/5734, Fax: 033-22879038, E-mail: soigdc-wb@nic.in

The Survey of India (SOI), Dehradun supplies topographic products (on both hardcopy and digital form) to its users at 1:25,000; 1:50,000 and 1:250,000 scales. The various types of maps published and distributed by SOI are given on http://www.surveyofindia.gov.in/maps.html.

National Atlas and Thematic Mapping Organisation (NATMO) is a premier national thematic maps and atlas-making organisation, under the Union Ministry of Science & Technology, which publishes several maps and atlases at small scales (http://natmo.gov.in/).

Geological Survey of India (GSI) is one of the oldest survey organisations in the world and a premier organisation of Earth science studies. It is custodian of geoscientific database developed over 150 years. The main products of GSI constitute different memoirs, records, journals, bulletins, different thematic maps and atlases, and geological mapping on 1:50,000 scale for entire India. Reconnaitary survey covers 97% of Exclusive Economic Zone (2.02 million sq.km) (www.gsi.gov.in/page2.htm). Airborne geophysical survey covers 2.07 million sq.km in geologically critical areas at 1: 25,000 scale mapping (www.gsi.gov.in/page2.htm)**.**

National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), a national soil survey organisation with its headquarters at the Indian Agricultural Research Institute (IARI) and four Regional Centres at Bangalore, Delhi, Kolkata and Nagpur has published maps on salt-affected soils of India; soil and land use maps for districts/village level and research bulletins on geomorphology, soils and land use (http://nbsslup.nic.in/home1.htm).

5.3.3 Sources of Metadata

Metadata sources include dataset from Landscan and Census India.

The LandScan dataset comprises of a worldwide population database compiled on a 30" × 30" lat/long grid. Census counts (sub-national level) were apportioned to each grid cell based on likelihood coefficients, which are based on proximity to roads, slope, land cover, nighttime lights and other information. LandScan has been developed as part of the Oak Ridge National Laboratory (ORNL) Global Population Project for estimating ambient population at risk. The LandScan dataset files are available via the internet in ESRI grid/raster binary formats by continents and world (www.ornl.gov/sci/landscan/index.html).

The Indian census is the largest single source of statistics on the people of India. With a history of more than 125 years, this reliable, time tested exercise has been bringing out a veritable wealth of statistics every 10 years beginning from 1872 when the first census was conducted in India, non- synchronously in different parts. For scholars/researchers in demography, economics, anthropology, sociology, statistics and many other disciplines, the Indian census is a fascinating data source. The rich diversity of the people of India is truly reflected through the decennial census, which is one of the basic tools to understand and study India. It provides information on demography, socio-economics, population, sex, literacy, fertility/death rates, workers, non-workers, etc., at state and district levels. Some of the information is available at www.censusindia.net.

Check Your Progress II

Spend 5 mins

1) Name some internet sources from where you can obtain raster and vector data.

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2) List the sources of metadata.

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3) What are the services provided by Indian Portal Bhuvan?

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5.4 SUMMARY

You have learnt the following in this unit:

- There are basically two types of geospatial data, i.e. raster and vector.
- Examples of raster data type include satellite imagery, scanned photographs/maps, orthophoto and Digital Elevation Model (DEM), whereas example of vector data type include digital line graphs.
- Sources of raster, vector and metadata include various mapping agencies, internet resources and other sources from where you can either just visualise or download data and derived products with or without any cost.

5.5 UNIT END QUESTIONS

Spend 30 mins

1) What are the advantages and disadvantages of vector and raster data?
2) Discuss in brief about raster data sources.
3) Mention a few advantages of the Google Earth.
4) Give some names of Indian agencies providing vector data?

5.6 REFERENCES

- Liu, J.G. and Mason, P. (2009), *Essential Image Processing and GIS for Remote Sensing*. 1st Ed. John Wiley & Sons, 460p.
- http://coralreefwatch.noaa.gov/satellite.
- http://eol.jsc.nasa.gov/scripts/sseop/QuickView.pl?directory=ESC&ID=ISS006-E-43707.
- http://rst.gsfc.nasa. gov/Sect3/Sect3_4.html.
- http://images.jsc.nasa.gov/luceneweb/image_sites.jsp.
- www.earth.google.com.

Data from above mentioned websites were retrieved between 25th June to 20th July 2011.

5.7 FURTHER/SUGGESTED READING

- Lo, C.P. and Yeung, A.K.W. (2007), Concepts and Techniques of Geographic Information System, 2nd Ed. Phi Learning Private Ltd. New Delhi.

5.8 ANSWER

Check Your Progress I

1) Raster data - Satellite imagery, Orthophotos, DEM (Digital Elevation Model), Scanned photo.
2) Vector Data - Digital Line Graph (DLG).
3) DEM (Digital Elevation Model).

Check Your Progress II

1) http://glcf.umiacs.umd.edu/data,ftp://ftp.glcf.umiacs.umd.edu, http://srtm.usgs.gov, and edcweb@usgs.gov.
2) Landscan, census data.
3) Bhuvan provides land, weather, ocean and disaster services

Unit End Questions

1) Refer to section 5.2.3
2) Refer to section 5.3.1
3) Refer to section 5.3.1
4) Refer to Table 5.1 and summarise it.

Box 1

USGS Web site at http://www.usgs.gov is the starting point for online information about the USGS, its programs, data products, and educational resources. It also contains an extensive list of pointers to Internet geographic information resources not managed specifically by the USGS. Many other U.S. federal agencies have set up publicly accessible information resources on the Internet. Some of these are:

- NASA Earth Observation System (EOS)
  http://eospso.gsfc.nasa.gov
- National Geospatial-Intelligence Agency (NGA)
  www.nima.mail
- National Oceanic and Atmospheric Administration (NOAA), Environmental Satellite, Data and Information Service (ESDIS) www.nesdis.noaa.gov
- U.S. Bureau of Land Management
  www.blm.gov/nsdi.html
- U.S. Environmental Protection Agency, National GIS Program www.epa.gov
- U.S. Fish and Wildlife Service
  www.fws.gov

Information pertaining to geographic information activities in other countries may be found at the Websites of the following organizations:

- Australia Surveying and Land Information Group
  www.auslig.gov.au
- European Umbrella Organization for Geographic Information (EUROGI)
  www.eurogi.org
- Geomatic Canada
  http://ess.nrcan.gc.ca/geocon/product_e.php
- Ordnance Survey, U.K.
  www.ordsvy.gov.uk
- United Nations Environment Program
  www.grida.no

(Source: Liu and Mason, 2009)