Pollution abatement

Role of Geographic Information System (GIS) and Remote Sensing (RS) in air pollution management

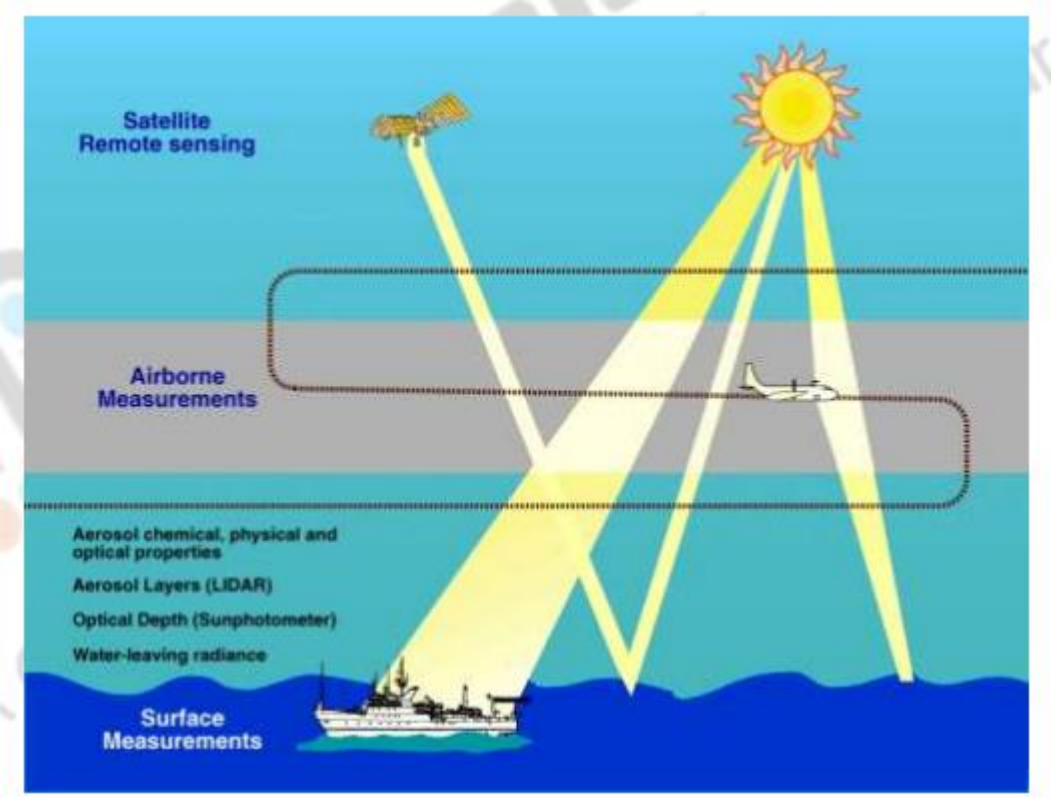
The ultimate goal of any air quality management plan is to ensure minimal impact of pollutants on human health. Therefore, the exposure to pollutants and health assessment becomes the major component of a management plan; and to get information about these two parameters, continuous monitoring is very important (Gulia et al., 2015). Also, air quality model plays a very crucial role in formulating air pollution control and management strategies by providing information about better and more efficient air quality planning (Patania et al., 2009). Monitoring of air pollutants in most of the developing countries is done manually using air sampling instruments. This monitoring is usually done by regulatory monitoring authorities such as Environmental Protection Agency (EPA), Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs). The association of these air pollutants and the human health has relied on the ground measurements which are done by the CPCB or SPCBs. Although ground-based measurement is considered to be the most accurate, but this approach has certain weakness. The ground monitors cover sparsely and unevenly distributed area. Besides, in developing countries, the ground-based monitoring is mainly focused in the urban and some suburban areas. To overcome these issues and to get continuous data, use of GIS and Remote Sensing data has increased in recent past. Although the use of satellite remote sensing data has been used to track particle air pollution events since 1970s; the quantitative studies of atmospheric particles began after the launch of NASA's Terra satellite in December 1999. Nowadays, many countries are using satellite data to monitor and manage air quality.

4.1 Management and monitoring of air pollutant using GIS

One of the effective tools in air quality management is Geographic Information Systems (GIS) because of its ability to capture, manipulate, analyse and map geographically referenced data. Map making ability of GIS by integrating database operations such as query and statistical analysis with the visualization and geographic analysis makes it a powerful tool to explain events, predicting possible outcomes and planning abatement strategies. The air automatic systems contribute to identify changes in the environmental quality continuously over time and space; helping to determine in a quick manner and detect early problems of environmental quality data serving for environmental management and protection. Among the basic parameter to know about the air quality, the required parameters measured in the field include wind direction, wind speed, temperature, relative humidity and pressure etc.; the other parameter includes SO2, NO2, CO, O3, PM etc. GIS can be integrated with different types of dispersion models such as AERMOD, CALINE-4, OSPM, CALPUFF, CALGRID, EDAMS, ADMS etc, which provide information about different pollutant and dispersion patterns of pollutants. For example, Elbir et al. (2004) developed a decision support system for air quality management in big Turkish cities. The GIS system was based on CALPUFF dispersion model and associated database to calculate emission from various sources. From the obtained data, the manager can give out timely warning and propose the appropriate measure to manage, control and protect the environment as well as identify the responsibilities of production facilities/ industrial zones and of cities.

4.2 Determination and management of air pollution using Remote Sensing Technique

In air pollution monitoring and management application, remote sensing is considered as an important tool. Its application is really important in the context of estimation of Aerosol Optical Thickness/Aerosol Optical Depth (AOT/AOD) using Moderate Resolution Imaging Spectro Radiometer (MODIS), the Multiangle Imaging Spectro Radiometer (MISR), or the Visible Infrared Imaging Radiometer Suite (VIIRS). Aerosol Optical Thickness/Aerosol Optical Depth (AOT/AOD) is defined as the integral of aerosol extinction coefficient along the entire vertical atmospheric column, it is considered as one of the Essential Climate Variable (ECV) that influences climate, visibility and quality of the air. Satellite derived AOD represent the amount of the particulate present vertically in the atmosphere of the earth and it can be considered as overall indicator of pollution in any urban area (Lim et al., 2009). Aerosol concentration can be measured directly by the ground-based sun photometer or estimated by sensors on the satellite



The ground-based measurements have high accuracy and temporal frequency but they represent a limited spatial range around the station. Conversely, data of the satellite provides information about the aerosols at larger scale with moderate quality and lower frequency (Nguyen et al., 2014).

The satellite data also provides data for other pollutants apart from PM; there are satellites that provide information near the surface on ozone's chemical precursors and VOCs (Duncan et al., 2014).There are several instruments that measure infrared (IR) wavelength of light to infer the CO concentration. Instruments that observe thermal infrared (TIR) wavelength can measure CO in the free troposphere, although the vertical resolution is poor; data from these instruments are shown to be useful in tracking long range transport of pollutant. The management process requires information about the pollutant and after getting requisite information about the pollutant, it becomes easy to manage. The satellite remote sensing has an extensive application in identifying the aerosol columnar properties, especially in terms of optical depth, their composition, morphology and vertical distribution. This eventually provides the evidences which are used in establishing the source-transport-receptor relations of aerosols over a synoptic scale (Mhawish et al., 2018). Moreover, satellite data of atmospheric composition are often used to identify the pollution emission, transboundary movement of the pollutants, forecasting the air quality, and also relating the air quality with the human health.