Chapter 10
Satellite Imagery Used for Analysis of Soil Properties

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ABSTRACT

The integration of remote sensing technology in soil analysis represents a monumental leap in agricultural sciences. By harnessing the power of satellite imagery, scientists can now monitor and evaluate soil conditions across vast areas with unprecedented accuracy. This non-invasive technique allows for the continuous observation of soil health, aiding in the detection of changes over time due to natural or anthropogenic factors. The data collected from these observations are crucial for developing sustainable farming practices that not only increase crop yields but also protect the environment. Furthermore, the ability to analyze soil properties on such a scale is instrumental in managing land resources effectively, ensuring that the delicate balance between food production and ecological stewardship is maintained. As the global population continues to grow, the role of remote sensing in soil conservation and agricultural productivity becomes ever more essential, offering a beacon of hope for future generations.

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1. INTRODUCTION

The most valuable natural resource is soil, but it is limited and non-renewable. New knowledge and innovative technology are needed to protect environment while producing enough food and biomass to feed people. Knowledge of the morphological, chemical and physical properties, categorization, extent, geographical distribution and potential for various uses of soils is essential for achieving ecological crop production and preserving soil composition. Unless soil behaviour is understood, implementing scientific agriculture is extremely difficult (Ford & Quiring, 2019; Babaeian et al., 2019). Discipline and art of remote sensing consists of analysing data collected by a device that is not in close proximity to the object, place, or event being studied in order to learn more about it. The platform, the sensor and the data are the three basic components of remote sensing systems. Platforms are simply the boards on which the sensor is installed, and they can be classified as either airborne platforms (e.g., balloons, drones, and airplanes) or space-based platforms (spacecraft and satellites). The central component of a remote sensing structure, the sensor, can be passive or active and is responsible for data collection. Whereas passive sensors measure energy returned or released from ground (solar radiation), active sensors release energy and store data about reflected radiation (Pepe et al., 2018; Zhu et al., 2018). The smallest object that can be recognized serves as a portion of the spatial resolution, as example the spatial details of an image. Because the initial resolution of a picture can be converted to diverse pixel dimensions, this is frequently referred to as pixel dimension, although these words are not necessarily equivalent. The width and number of "spectral bands," also called "spectral resolution," denotes to a portion of electromagnetic spectrum that a sensor is capable to capture (Segarra et al., 2020). Besides, temporal resolution denotes to period between image captures and includes the time series of photos that are accessible for exploration (temporal handling) (Khanall et al., 2017). Aerial imaging systems typically have three main advantages: they can be positioned quickly to specific positions; they can capture high-resolution images; and can avoid unwanted atmospheric factors such as clouds. Aerial imagery is a useful substitute for ground data when determining the precision of other remote sensing data products. For purposes requiring broad geographic coverage and high spectral/temporal resolution, aerial systems are less suitable due to the significant compromises associated with these advantages. Processing, analyzing and storing data for aerial images also incurs significant financial and labour costs, therefore the images are typically costly (Shi et al., 2021).

Satellite remote sensing systems are separated in different types: coarse (for example multispectral through a spatial resolution superior than thirty metres), multispectral, hyperspatial and hyperspectral. The usefulness of each of these categories for remote sensing attributes depends on the resolution, availability and processing