Chapter 16

Harnessing the Power of Geospatial Data:
The Convergence of SDI, Big Data, and Cloud Computing

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ABSTRACT

This chapter explored the transformative impact of cloud computing on geospatial data management, highlighting its scalability, cost-efficiency, and security features. This exploration adopted a qualitative method based on a literature review, systematically analyzing existing works to gain insights into the qualitative dimensions of the evolving intersection between cloud computing and geospatial data management. It detailed the integration of parallel processing, GIS platforms, machine learning, and data visualization within the digital landscape, fostering innovation. The narrative extended to include emerging technologies like edge computing, blockchain, AR/VR, and geospatial data marketplaces, giving rise to a groundbreaking geospatial data as a service (DaaS) model. Emphasizing the cloud's pivotal role in handling geospatial big data, the chapter outlined capabilities in parallel processing, GIS orchestration, machine learning integration, and disaster recovery.

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Emerging Trends in Cloud Computing Analytics, Scalability, and Service Models

INTRODUCTION

In the modern era, geospatial data has emerged as a cornerstone in addressing a multitude of complex challenges across diverse domains. The convergence of Spatial Data Infrastructure (SDI), Big Data, and Cloud Computing has redefined the way of harnessing and analyzing geospatial information. Big Data, characterized by its sheer volume, velocity, veracity, and variety, has inundated the data landscape. In response, cloud Computing has emerged as a powerful ally, offering utility-based computing services to tackle the complexities posed by big data (Yang et al., 2017). This convergence of technologies is revolutionizing the way of processing geospatial data across various scientific domains.

One of the most notable impacts is within the realm of climate studies, where geospatial data plays a pivotal role. Cloud computing can provide scalable and on-demand computing resources that enable efficient data management and analytics. In the context of geospatial data, this is particularly crucial. It can empower to process vast datasets relevant to climate studies, knowledge mining, land-use analysis, and even the forecasting of phenomena like dust storms (Yang et al., 2017). Data parallelism and automatic provisioning of virtual clusters have significantly enhanced the processing of big data (Yang et al., 2017). This, in turn, has accelerated the analysis and prediction of land use and land-cover changes. Notably, technologies like Google Earth Engine have harnessed cloud computing to process high-resolution global forest cover change maps, exemplifying the transformative potential of these tools. Furthermore, cloud computing is not confined to just processing power. It offers cloud storage and accessibility, which are instrumental in the storage and analysis of large land cover data. Complex algorithms for land cover change modeling can be parallelized and accelerated within Cloud Computing environments, enabling rapid change analysis (Yang et al., 2017).

In parallel, the significance of cloud, fog, and mist computing paradigms in handling geospatial big data is on the rise. Mist computing, in particular, leverages edge devices to enhance data throughput and reduce latency. MistGIS, a cutting-edge framework, has found practical applications in domains like tourism information infrastructure management and faculty information retrieval systems, simplifying data integration and retrieval. The validation of MistGIS underscored its potential to complement cloud and fog computing for geospatial big data analysis as noted by Barik, Misra, et al., (2019). Sustainable agriculture, a critical concern in a world facing a burgeoning population, presents a formidable challenge. The integration of geospatial data and technology is pivotal in mitigating ecological impacts and enhancing agricultural practices. Big data analytics, artificial intelligence, and machine learning have become imperative in optimizing agriculture by improving data accessibility and coherence. The influence of cloud computing, the Internet of Things, and data analytics has driven the agricultural industry toward digital agriculture, emphasizing precision conservation practices. The adoption of the “4 Rs” (right product, rate, time, and place) and the “7 Rs” framework significantly contribute to precision agriculture and conservation efforts. Connectivity and embracing edge computing have become paramount, especially in regions with limited bandwidth, enabling the effective harnessing of advanced agricultural technologies (Delgado et al., 2019).