Chapter 14
Machine Learning–Integrated Air Quality and Environmental Monitoring Processes

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ABSTRACT

This chapter examines the collaboration between machine learning and remote sensing technology to improve air quality and environmental monitoring. It applies

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advanced techniques and extensive datasets to examine, forecast, and manage environmental elements in real time. The chapter explores the significance of monitoring air quality and the environment for public health and sustainable development. It explains the fundamentals of remote sensing and machine learning and how they can join forces. This research delves into how satellite imagery, sensor networks, and data fusion methods can provide a comprehensive view of the environment. It investigates their successful applications in various regions with diverse climates. The chapter highlights the challenges in this field such as obtaining quality data, addressing intensive computational requirements, and fostering interdisciplinary collaboration. It also outlines future directions and emerging opportunities, with a focus on promising technologies like deep learning and cloud computing.

INTRODUCTION

People have started to realize how important clean air and a healthy environment are in the past few years. This is because they have a big effect on our health, the changing climate, and how we can keep growing without hurting the planet. Breathing bad air can make you sick in many ways. It can hurt your lungs, your heart, and even make you die. Also, when we mess up nature, it can cost a lot of money, hurt plants and animals, and make climate change even worse. Because of all this, we need good ways to check on the air and environment. These help us spot problems and do something about them before they get too bad (Sokhi et al. 2021).

Remote sensing has become a useful way to keep an eye on the environment. It gives us a big picture view of Earth's surface and air. Satellites or planes with special sensors grab data about Earth in different light bands. This information helps us track things like how clean the air is, what people use land for, how healthy plants are, and how clean the water is. Remote sensing has some good points. It can cover huge areas we can't get to, look at the same place over and over, and give us solid, unbiased data. But there's a catch. We end up with so much complex data that old-school ways of looking at it just don't cut it anymore (Li et al. 2021).

This is where machine learning (ML) comes in. ML, a component of artificial intelligence, entails creating algorithms that can learn from data and make predictions based on it. ML can find patterns and connections in big datasets that normal statistics might miss. Combining ML with remote sensing data could boost how we keep an eye on the environment. ML algorithms can handle and study tons of remote sensing data, spot trends and weird stuff, and give quick insights that help make good choices (Rahimpour et al. 2021). By using large datasets, ML has an impact on uncovering patterns and relationships that might not be clear through regular statistical methods. The integration of ML with remote sensing data has the potential