

Machine Learning Applications in Climate Science

This manuscript explores the diverse and growing applications of Machine Learning (ML) in climate science. With the rapid increase in environmental data from satellites, sensors, and climate models, traditional analytical methods often fall short in capturing complex, nonlinear relationships within climate systems. ML provides powerful tools to address these challenges by enabling efficient data analysis, pattern recognition, and predictive modeling. The paper discusses how ML techniques are enhancing climate modeling and prediction accuracy, improving early detection of extreme weather events, optimizing renewable energy forecasting, and facilitating environmental monitoring through remote sensing data. Additionally, it highlights the role of ML in tracking greenhouse gas emissions and supporting data-driven climate policy decisions. Overall, this work underscores how integrating ML into climate research accelerates scientific discovery, supports adaptation and mitigation strategies, and contributes to building a more sustainable and resilient planet.