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Editorial

Make Forests Better Play Their Role in Mitigating Climate Change

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Climate change caused by industrial carbon emissions and land use/land cover changes is a widely concerning issue around the world and is closely related to the global carbon cycle. Governments, organizations, and policymakers are paying more attention to climate change than ever before. Many developed and developing countries have made commitments to achieving carbon neutrality. Nevertheless, the first working group on the sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC) reports that climate change continues to intensify [1].

As a terrestrial ecosystem with the largest carbon stocks, forests play an important role in the active mitigation of atmospheric CO_2 through increased carbon stocks. However, how can we assess the magnitude of the contribution of forests and forest management to achieving the goals of carbon neutrality? How can we make forests more competent in mitigating climate change? Perhaps we could answer these questions from four perspectives: (a) forest carbon storage accounting, monitoring, and estimation; (b) the evaluation of the forest carbon storage, sequestration rate, and sequestration potential; (c) a forest management decision-support system aiming at carbon sequestration, and (d) forest carbon sequestration management practices.

In terms of forest carbon storage accounting, monitoring, and estimation, a large number of studies have been released, including on the methods recommended by the IPCC, and have promoted the construction of carbon sink methodologies [2,3], dynamic forest resources monitoring systems [4], and technical regulations for the observation and investigation for carbon sequestration in the forest ecosystem. High-frequency accurate monitoring and estimation of forest carbon storage are essential for developing approaches to improve the carbon sequestration rate. Currently, The recognized reliable methods are those based on field data, although it is costly and technically difficult to conduct high-frequency observations. Effective solutions for the issues related to high-temporal and -spatial resolution forest carbon storage monitoring and simulation are data fusion techniques based on satellite observations and field datasets, and model–data assimilation techniques based on dynamic global vegetation models and field datasets.

In terms of the evaluation of the forest carbon storage, sequestration rate, and sequestration potential, a unified viewpoint has not yet been reached due to the various status of study areas and the subjects of previous studies, which are determined by forest type, stand status, site conditions (including climatic variables, topographical variables, soil properties, etc.), and forest management activities. These factors affect the accumulation rate of forest carbon stocks by affecting the structure and function of the forest ecosystem. Therefore, a fundamental way to address this issue is to explain and simulate the relationship between forest carbon sequestration and these factors.

In terms of forest management decision-support systems, those aiming at carbon sequestration are more complicated compared to those related to timber harvesting. One

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of the reasons for this is the multiple subjects (or carbon pools) of carbon sequestration in forest ecosystems, including trees, shrubs, herbs, litter, soil, etc. Another reason might be the uncertainty of the impact of the environmental factors and stand status on carbon sequestration. The formation, consumption, and allocation of the net primary production of forest vegetation and turnover between carbon pools in the context of forest management and climate change are the significant issues that remain to be addressed. An effective solution is to integrate process-based models (including the dynamic global vegetation model, the gap model, etc.) and forest growth models with forest management decision-support systems.

Forest management practices aiming at carbon sequestration are applied to test theoretical methodology. We identify the methods, modules, and parameters that need to be improved through the planning and implementation of forest management practices.

The following are prominent questions that should be addressed:

(1) How can we develop high-accuracy technical regulations for forest carbon stock counting and monitoring?

(2) How can we estimate and simulate forest carbon storage with high accuracy, high frequency, and a high spatial resolution based on data fusion and model–data assimilation?

(3) What are the forest carbon sequestration rate and potential patterns globally and regionally?

(4) How does competition affect the forest carbon sequestration rate?

(5) What is the carbon sequestration potential of typical forests in the context of various site conditions and climate change?

(6) How can we improve forest management decision-support systems aiming at carbon sequestration based on their integration with process-based models and forest growth models?

(7) How can we make forest management planning aiming at forest carbon sequestration for different forest types at different sites?

(8) Which parameters, processes, and forest management activities are the most significant objectives that should be improved through forest management practices and demonstration?

The Special Issue is seeking articles from all over the world in the field of forest carbon storage monitoring and assessment. Additionally, it aims to provide an up-to-date compendium of recent research in this field from around the world. We hope that these contributions will help to answer the above questions as well as present research that has been completed and or that is ongoing to aid in clarifying these issues.

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