

The role of forest age in the carbon cycle

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Forests are integral to the global carbon cycle, acting as both carbon sinks and sources. One of the key factors influencing this dynamic is forest age. In this lecture, we will explore how forest age affects carbon sequestration and release and its broader implications for climate change. We will begin by introducing the fundamental concepts of forest age and its relationship to the carbon cycle, offering insights relevant to forestry, ecology, and conservation. We will then focus on how advancements in remote sensing, national forest inventory data, and machine learning have enabled us to map forest age globally, highlighting the Global Age Mapping Integration (GAMI) v2.0 dataset.

GAMI provides high-resolution (100-m) global forest age data for 2010 and 2020, utilizing over 40,000 forest inventory plots, biomass and height data, satellite observations, and climate variables. Using machine learning models like XGBoost, GAMI addresses uncertainties through multiple model realizations and incorporates Landsat-based disturbance history, offering a way for analyzing forest age transitions. Finally, we will examine applications of this data, including how forest age transitions, particularly in older forests, contribute to changes in carbon sink strength. These insights are based on integrating GAMI data with satellite-derived aboveground carbon estimates and atmospheric inversion-derived CO₂ flux data.

Dept Life Science Systems
Winter semester 2024/25

Monday, 04.11.2024, 16:15–17:00

Online [https://tum-conf-zoom-x.de/j/69079483987?pwd=eIJ6bStBbXo0RHQ4aUJjVG1qRVpLdz09](https://tum-conf.zoom-x.de/j/69079483987?pwd=eIJ6bStBbXo0RHQ4aUJjVG1qRVpLdz09)

Meeting-ID: 690 7948 3987

Code: 021482

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