

Climate sensitivity and drought legacy of tree growth in plantation forests in northeast China are species and age-dependent

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摘要: 【目的】在全球变暖的情况下, 干旱的发生率、频率和严重程度都在加快。了解人工林对气候变化的脆弱性, 尤其是对干旱事件的脆弱性, 对于揭示树木的恢复力、复原力和适应力的内在机制至关重要, 这对人工林的管理非常重要。目前尚不清楚林分年龄如何影响树木生长的气候敏感性, 以及中国东北地区人工林干旱遗留的方向、程度和持续时间。【方法】在本研究中, 我们利用 MODIS 导出 NDVI 时间序列和 2000 年至 2020 年的网格气候数据填补了这一知识空白。所选人工林以四种针叶树种为主, 包括红松 (*Pinus koraiensis*)、樟子松 (*Pinus sylvestris*)、日本落叶松 (*Larix kaempferi*) 和兴安落叶松 (*Larix gmelinii*)。【结果】结果表明, 不同树种和树龄组对树木生长的气候敏感性不同。红松和樟子松的生长主要取决于降水, 而日本落叶松和兴安落叶松的生长主要取决于温度。相对较老的日本落叶松 (21–40 年) 和兴安落叶松 (31–60 年) 比年轻的同种树 (分别为 10–20 年和 10–30 年) 对气候更敏感, 而较老的红松 (41–60 年) 和樟子松 (31–60 年) 则比年轻的同种树 (分别为 10–40 年和 10–30 年) 对气候不敏感。此外, 干旱对红松和日本落叶松的影响持续了一年, 对兴安落叶松的影响持续了两年, 对樟子松的影响持续了三年以上。老树受干旱的影响更为严重, 尤其是樟子松和兴安落叶松。研究结果有助于改善人工林管理, 更好地适应未来的气候变化。

关键词: 干旱遗留; NDVI; 人工林; 林龄; 树木生长-气候敏感性

Abstract

The occurrence, frequency, and severity of drought is accelerating under global warming. Understanding the vulnerability of plantation forests to climate change, particularly to drought events is critical to reveal the underlying mechanisms of tree resilience, recovery and acclimation which are important for plantation management. How stand age affects climate sensitivity of tree growth, as well as the direction, ma

gnitude and duration of drought legacy in plantation forests in northeast China is still unclear. In this study we used MODIS derived NDVI time series with gridded climate data from 2000 to 2020 to fill this knowledge gap. The selected plantation forests were dominated by four coniferous species including Korean pine (*Pinus koraiensis*), Scots pine (*Pinus sylvestris*), Japanese larch (*Larix kaempferi*), and Dahurian larch (*Larix gmelinii*). Results showed that the climate sensitivity of tree growth differed among species and age groups. Growth of Korean pine and Scots pine were mostly dependent upon precipitation, while growth of Japanese larch and Dahurian larch were determined primarily by temperature. Relatively old Japanese larch (21-40 years) and Dahurian larch trees (31-60 years) were more climate-sensitive than young conspecifics (10-20 years and 10-30 years respectively), while old Korean pine (41-60 years) and Scots pine trees (31-60 years) were less climate-sensitive than young conspecifics (10-40 years and 10-30 years respectively). Furthermore, the legacy of drought lasted one year for Korean pine and Japanese larch, two years for Dahurian larch and over three years for Scots pine. Old trees were more severely affected by drought, particularly Scots pine and Dahurian larch. The findings of the study can help improve plantation forest management for better adaptation to future climate change.

Keywords

Drought legacy; NDVI; Plantation forest; Stand age; Tree growth-climate sensitivity