Turning point in forest productivity revealed from 40 years of national forest inventory data

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Résumé

Global changes, such as changing climate or disruption in biogeochemical cycles, are affecting forest productivity worldwide. In Europe, increasing forest productivity has been reported over the 20th century, but continuing increase in temperature and shifts in precipitation patterns is expected to result in trend inversion in productivity trends. Trends in productivity are depending on the focal spatial scale and on the considered time window, stable trends at large spatial scale can mask divergence at smaller scale while short time windows limit the capacity to reveal non-linear trends such as turning points. Capitalizing on 40 years of French national forest inventory data we explored trends in forest productivity at the regional level using a hierarchical modelling approach. We fitted two classes of models, a first one explicitly estimating temporal trends and a second one including no temporal components but climatic variables reflecting changing temperature and water availability. We find a decrease in productivity in 95% of the regions and a high contrast in trend shapes between regions over the period studied: lowland regions with average temperature above 11.9∘C showed linear negative trends in productivity while lowland regions in colder climatic zones showed hump-shaped trends with turning points between 1985 and 2005 and recent declines in productivity. In mountainous regions, average climate did not appear to be a strong mediator of trend shapes. The temporal trends were reconstituted with high fidelity from the model including only climatic variables implying that changes in temperature and water availability are likely drivers of the reported trends. These results imply that continuing and exacerbating climate change in the 21st century will put further pressure on forest productivity impacting forest carbon sink potential and reducing sustainable rate of timber extraction.

Mots-Clés: temporal trends, growth rate, forest demography, forest policy, monitoring

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