Summary

Knowledge of forest growth and site productivity is essential for strategic decision-making in forest management. In forestry practice, site productivity and forest growth are predicted on the basis of models, so research aimed at developing models of site productivity and stand growth is also of great utilitarian importance. Forest growth models allow describing the dynamics of forest ecosystems, which is particularly important in the context of observed climate change. The aim of the dissertation was to develop innovative height growth modelling methods, taking into account the local specificity of site conditions and factors significantly modifying forest growth dynamics. Data from temporary sample plots, stem analysis and repeated airborne laser scanning (ALS) were used in the study. A method based on non-linear fixed effects (NFE) with the use of functions developed with the generalised algebraic difference approach (GADA) was applied in models development. Within the framework of the research, a new method for developing height growth models using data from temporal sample plots was developed, which allows for the construction of dynamic height growth and site index models characterised by polymorphism and variable asymptotes. The regional height growth models for Scots pine in Poland were also developed, and it was shown that including the natural forest region in the height growth modelling increases the model adequacy and height growth forecasting. It was also shown that including annual precipitation in the model allows better prediction of forest growth. It was also found that stand density significantly affects the dynamics of Scots pine height growth, and including stand density in the models increases the accuracy of height growth forecasting. The study showed that ALS data allow for the determination of height increment and the detection of short-term trends in height growth of trees caused by weather conditions and differences in stand density, which makes them suitable for use in stand growth modelling.

Keywords: site productivity, site index, LIDAR, climate conditions, stand density