Bayesian calibration of a process-based model for estimating the growth of Japanese cedar plantations

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In Japan, there is increasing concern about the effects of climate change on the growth or decline of old Japanese cedar (*Cryptomeria japonica*) plantations. Process-based simulation models can provide information on the short- and long-term responses of tree plantations to changing climate, which is useful for policy making and broad discussion among stakeholders. In many cases, however, it is difficult to obtain all of the model parameters from direct measurements. The recently developed Bayesian calibration scheme has the potential to provide a set of appropriate parameters for a model based on monitoring data archives. This study tested the applicability of Bayesian calibration to the parameterization of a process-based model for estimating the growth of Japanese cedar plantations. The process-based model Biome-BGC was used with the default parameters (evergreen needle leaf forest). The 20 eco-physiological trait parameters (*e.g.*, turnover rate, allocation, C:N ratio of tree organs, etc.) in Biome-BGC were calibrated simultaneously. For the Bayesian calibration, we used monitoring data for Japanese cedar plantations, including the monthly averaged data for the net ecosystem exchange (NEE) and soil respiration for 2001–2003 in the Kahoku Experimental Watershed in northern Kumamoto Prefecture, and growth and yield data for three experimental sites in Kyushu, Japan.
The simulations of NEE and soil respiration were improved after a small number of iterations (*i.e.*, <1000) in the Bayesian calibration, compared with the default values. A newly added parameter on the turnover rate of fine roots also improved the simulation of soil respiration. The variation in the biomass increment among the three experimental sites was smaller in the simulation than observations, even after the calibration. The next step is to improve the choice and combination of observation data (*e.g.*, gross primary production and respiration) and the calibration procedure (*i.e.*, hierarchal calibration).

Keywords: Cryptomeria japonica, Biome-BGC, Bayesian calibration