SEIB-DGVM: A new Dynamic Global Vegetation Model using a spatially explicit individual-based approach

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We report the development of a new Spatially Explicit Individual-Based Dynamic Global Vegetation Model (SEIB-DGVM), the first DGVM that can simulate the local interactions among individual trees within a spatially explicit virtual forest (Fig 1, Ref 1). In the model, a sample plot is placed at each grid box, and then the growth, competition, and decay of each individual tree within each plot is calculated by considering the environmental conditions for that tree as it relates to the trees that surround it (Fig 2).

Based on these parameters only, the model simulated time lags between climate change and vegetation change. The model also successfully reconstructed the -3/2 power law in dense forest, suggesting that the spatially explicit individual-based representation is appropriate. Moreover, on a local scale, the model reproduced climate zone-specific patterns of succession, carbon dynamics (Fig 3), and water flux, although on a global scale, simulations were not always in agreement with observations.

SEIB is also being incorporated into the Kyousei2 Integrated Synergetic System Model of the Earth (KISSME), which is being used to analyze complex interactions among various processes in the earth's troposphere. Finally, because the SEIB-DGVM was formulated to the scale at which field biologists work, the measurements of relevant parameters and data comparisons are relatively straightforward, and the model should enable more robust modelling of terrestrial ecosystems.

[Ref 1] H. Sato, A. Itoh, and T. Kohyama, Ecological modelling, submitted.

[Ref 2] M. Kawamiya et al., Journal of Earth Simurator, in press.

[Fig 1] Input, output, and basic composition of the SEIB-DGVM.

[Fig 2] Representation of individual trees, and a snapshot of the simulated forest stand of the SEIB-DGVM (30m∗30m of temperate mixed-forest).

[Fig 3] Changes in LAI and terrestrial carbon pool during 200 years simulation after fire in three climatic zone.

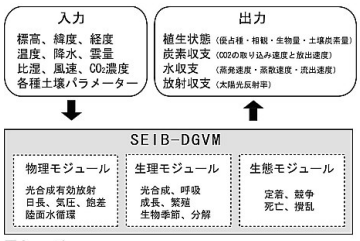

Fig 1

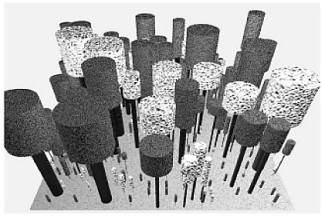

Fig 2

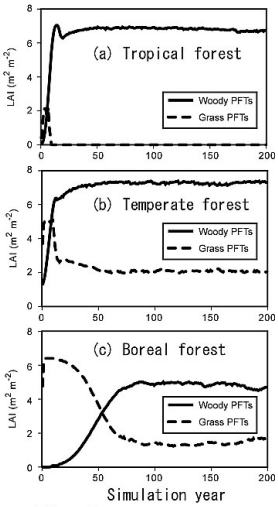

Fig 3