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森林の放射計算にはどの程度詳細な植生構造のモデル化が必要か？
How much complexity of plant canopy structure is good enough for the light environment simulation?

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Most land surface models assume that a plant canopy can be abstracted as a turbid medium to compute mass, energy, and carbon exchange. The canopy is horizontally homogeneous as leaves are randomly distributed in space. Consequently, radiation only changes in a vertical direction. Lambert-Beer type light penetration scheme is widely adapted for transmission and absorption simulation of a plant canopy. In this scheme, the incoming light exponentially decreases with an increase in leaf area. Leaf inclination angle and light incident angle is considered in the model. This model is only valid when the leaves are randomly distributed in space. To consider the spatial anisotropy of leaf distribution, Nilson (1971) introduced clumping modeling. By putting the clumping index into the Lambert-Beer equation, this scheme extends the light environmental computation for non-random distribution of leaves within a plant canopy. The clumping modeling is simple. Yet, there are some issues. For example, the clumping index is not a constant value. The clumping index changes with the light incidence angle and vertical levels. Also, we cannot directly measure the clumping index. The 3-dimensional modeling of forest light environment needs a lot of ecosystem structural data sets along with a vast computation time. The recent progress of measurement techniques (e.g. LiDAR) enables to run and evaluate the realistic light environment. In this presentation, I show some of the comparison results to see how the different complexities of light penetration modeling affect the light environment.

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