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Simulation of growing season length of a teak plantation in a dry tropical area using water budget

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The growing season length of trees can be predicted in temperate regions only with climate factors, such as temperature, while in dry tropical areas soil water availability must be examined to predict the length of the growing season during which trees can assimilate carbon. A multi-layer model was used to examine temporal changes in soil water availability in a dry tropical area for carbon gain assuming evergreen trees with a constant leaf area index (LAI). A numerical experiment with a constant LAI showed that the simulated value of canopy net photosynthesis (An) became negative in the dry season because of the assimilation limitations caused by stomatal conductance being reduced by severe soil drought, and because the simultaneous rise in leaf temperature increased dark respiration. Thus, the experiment emphasized the unfavorable carbon gain conditions in the dry season. The start of the longest duration of simulated positive An in a year approached the timing of leaf flushing of a teak plantation after the spring equinox, and the end appeared earlier than that of all canopy duration periods. Therefore, the model likely predicts the growing season length of the teak plantation in dry tropical areas. However, when leaf flushing occurred around the spring equinox, before the rainy season, other factors such as increasing day length may have been responsible, in addition to well-watered soil conditions; however, this hypothesis needs to be tested in future research. The numerical experiments with a constant LAI suggest that a smaller LAI and slower maximum rate of carboxylation likely extend the growing season length because soil water from the surface to the rooting depth is maintained at levels adequate for carbon gain longer by decreased canopy transpiration. These experiments also suggest that lower soil hydraulic conductivity and deeper rooting depth can extend the growing season by increasing soil water retention and soil

water capacity, respectively.