

Understory biomass measurement based on SfM data by a manual low-flying drone under the canopy

*Yupan Zhang¹, Yuichi Onda¹, Xinchao Sun², Takashi Gomi³

1. Center for Research on Isotopes and Environmental Dynamics, University of Tsukuba, Ibaraki, Japan, 2. Institute of Surface-Earth System Science, Tianjin University, Tianjin, PR China, 3. Department of International Environmental and Agricultural Science, Tokyo University of Agriculture and Technology, Tokyo, Japan

Understory vegetation has the important effect that cannot be ignored on Evapotranspiration. In this study, Structure from Motion (SfM) was used to reconstruct understory vegetation structure by a manual low-flying drone under the canopy with radial paths in a line thinning plantation and a spot thinning plantation made by Japanese cedar and cypress. By generating Orthomosaic image and dense point cloud data, we then extracted Excess Green Index (ExG) and Canopy Height Model (CHM), combining with understory biomass data from field harvesting to establish a quantitative relationship between the CHM and biomass, which was then used to map biomass and vegetation coverage in the study area. The results indicated that (1) a flight height of 7-10 meters is more conducive to understory vegetation reconstruction, with a photo quality greater than 0.8 and a point cloud density of more than 20 points/cm². (2) a regression cubic model based on the CHM has acceptable accuracy and biomass estimate capability ($P < 0.01$), with a coefficient of determination of 0.75. (3) compared with the spot thinning, the understory biomass under the line thinning scenario was higher (average biomass 3.03 kg/m²). (4) vegetation coverage based on the ExG index of visible light analysis was affected by ambient light (strong sunlight on a sunny day), and it cannot reflect the seasonal changes of understory vegetation biomass. These results disclosed the potential of the dense point cloud from drone SfM for estimating understory biomass. With this method, we will measure more than 5000 m² of headwater catchment in the future.

Keywords: Drone, Understory biomass, Evapotranspiration, Structure-from-Motion Multi-View Stereo Photogrammetry

