Seeing trees from drones: the role of leaf phenology transition in mapping species distribution in species-rich montane forests

<u>Supplementary Materials</u>

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Table S1. The separations among tree species, standing dead trees and canopy gaps based on all selected features. The higher the value, the higher the separability of the two species.

	Cryptomeria japonica	***Pseudolarix amabilis***	***Pinus taiwanensis***	***Ginkgo biloba***	***Liquidambar acalycina***	***Litsea auriculata***	**Standing dead trees**
Pseudolarix amabilis	1.08						
Pinus taiwanensis	0.35	1.50					
Ginkgo biloba	1.14	0.66	2.6425				
Liquidambar acalycina	1.1011	3.2257	0.9402	3.2257			
Litsea auriculata	0.8925	0.4533	1.3212	0.8470	1.1491		
Standing dead trees	3.5121	9.1545	6.2922	5.9192	4.6716	6.3402	
Canopy gaps	0.9931	2.7819	0.4419	5.3208	0.7716	2.8530	6.8819

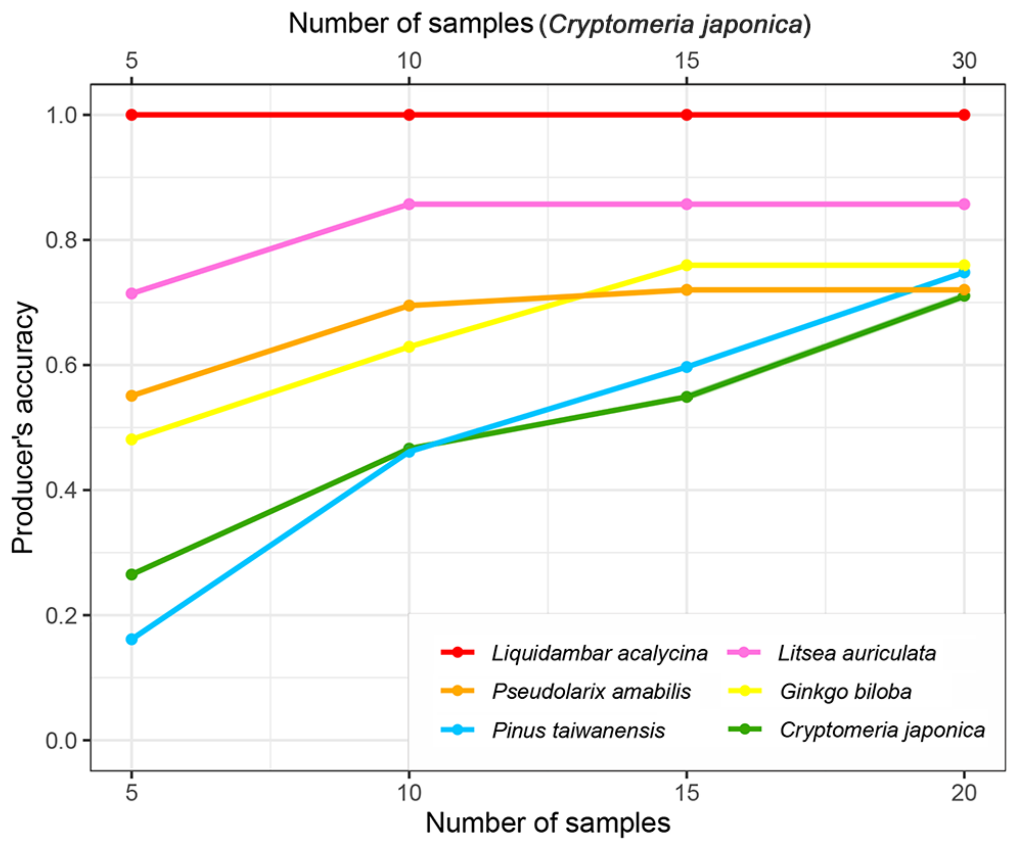

Figure S1. The producer's accuracy of the classification for six tree species with different sample sizes. The x-axis on the top is for *Cryptomeria japonica*, and the x-axis on the bottom is for the other five species.

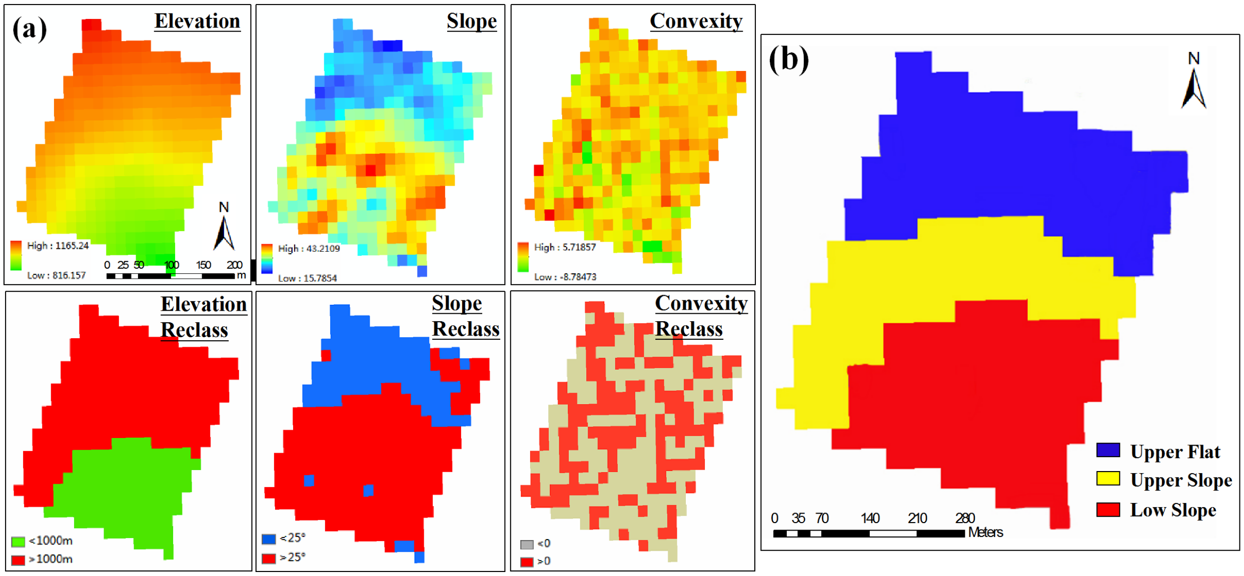

Figure S2. (a) The maps of three topographical variables (elevation, slope, and convexity) that taken into consideration for habitat classification. Each variable was reclassified into two levels. The grid size is 30 m × 30 m. **(b)** The map of three habitat types produced based on the elevation and slope.

Table S2. The number of samples (including ground-based and visual interpretation-based) for six target tree species, canopy gaps and standing dead trees in the (a) upper flat, (b) upper slope, and (c) low slope.

Target objects	Upper flat	Upper slope	Low slope
Liquidambar acalycina	9	8	31
Ginkgo biloba	21	21	21
Cryptomeria japonica	51	38	31
Litsea auriculata	9	14	6
Pseudolarix amabilis	11	11	11
Pinus taiwanensis	20	20	20
Standing dead trees	32	14	3
Canopy gaps	25	14	13

Table S3. Classification accuracy of three habitat types with spectral and spatial geometric features using the KNN algorithm (without additional reference data).

Target objects	Upper Flat		Upper Slope		Low Slope	
	PA (%)	**UA (%)**	**PA (%)**	**UA (%)**	**PA (%)**	**UA (%)**
Cryptomeria japonica	48	49.3	90.7	100	95.4	100
Pseudolarix amabilis	30.4	20	85.9	90.2	77.3	62.5
Pinus taiwanensis	20.4	17.6	81.1	83.3	0	0
Ginkgo biloba	41.3	57.1	84	73.7	85.9	91.3
Liquidambar acalycina	0	0	100	66.7	94	100
Litsea auriculata	78.3	44.4	77.3	54.5	100	64.3
Standing dead trees	90.2	65.2	100	94.4	100	100
Canopy gap	40.1	51.4	100	91.7	100	97.9
Overall accuracy (OA, %)	50.9		89		94.4	
Cohen's Kappa coefficient (K)	0.338		0.845		0.907	